

UNITED STATES ARMY IN WORLD WAR II

The Technical Services

THE CORPS OF ENGINEERS: THE WAR AGAINST JAPAN

by

Karl C. Dod



CENTER OF MILITARY HISTORY

UNITED STATES ARMY

WASHINGTON, D.C., 1987

Library of Congress Catalog Card Number: 66-60004

First Printed 1966—CMH Pub 10-6

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C., 20402

UNITED STATES ARMY IN WORLD WAR II

Stetson Conn, General Editor

Advisory Committee

(As of 15 June 1965)

Fred C. Cole
Washington and Lee University

James A. Field, Jr.
Swarthmore College

Ernest R. May
Harvard University

Earl Pomeroy
University of Oregon

Charles P. Roland
Tulane University

Lt. Gen. August Schomburg
Industrial College of the Armed Forces

Maj. Gen. David W. Gray
U.S. Continental Army Command

Brig. Gen. Jaroslav T. Folda
U.S. Army War College

Brig. Gen. Elias C. Townsend
U.S. Army Command and General Staff College

Lt. Col. Thomas E. Griess
United States Military Academy

Theodore Ropp
Duke University

Office of the Chief of Military History

Brig. Gen. Hal C. Pattison, Chief of Military History

Chief Historian	Stetson Conn
Chief, Histories Division	Col. Paul P. Hinkley
Chief, Editorial and Graphics Division	Col. Joseph S. Coulter
Editor in Chief	Joseph R. Friedman

. . . to Those Who Served

Foreword

Contributions of the Corps of Engineers to victory in war, and to our country's peacetime history, are well known and appreciated. The skill and versatility of this talented body of soldiers met a supreme test in operations against the Japanese, many of which were conducted in the most primitive and undeveloped regions of the world. Engineers built the Alaska Highway, Canol, and the Ledo Road in Burma. They cleared the jungles to build airfields for heavy bombers and supervised the work of Filipinos, Chinese, and Melanesians as they built runways by hand. They built ports, roads, and docks where none had existed. Indeed, one of the most familiar recollections of the U.S. veteran of the war against Japan is the ubiquitous engineer operating a bulldozer.

Dr. Dod's subject is vast and varied, and he has worked hard and capably to fit it into the confines of a single volume. He has made an original contribution to knowledge in the highly technical areas of Engineer problems, organization, equipment, supply, administration, and operations.

Washington, D.C.
18 June 1965

HAL C. PATTISON
Brigadier General, USA
Chief of Military History

The Author

Karl C. Dod received a Ph.D. in history from the University of Illinois and has taught history at Morningside College and at Montana State College. During World War II he worked with the U.S. Civil Service Commission and as historian with the Historical Division in the Office of the Chief of Engineers, and subsequently served in the U.S. Army with the Field Artillery. After the war he joined the Office of the Chief Engineer, Army Forces, Pacific, as a civilian historian. In 1950 he rejoined the Engineer Historical Division and has been a staff member ever since. He is coauthor of Volume I, *Engineers in Theater Operations,* and author of Volume II, *Organizations, Troops, and Training,* in the series "Engineers of the Southwest Pacific, 1941–1945."

Preface

This volume covers Engineer operations in support of the U.S. Army in the war against Japan. The story begins with the defense build-up in 1939 and ends with the Japanese surrender aboard the battleship *Missouri* on 2 September 1945. Geographically, Engineer operations extended from the Panama Canal to India and from Alaska to Australia, in actual or potential areas of conflict. The author has attempted not only to depict various types of Engineer operations but also to indicate how Engineer work helped implement Allied strategy. Included are discussions of the Engineer position in the command structure and a general account of both Engineer combat and service missions within a given theater.

Above all, the author has attempted to indicate the many problems that had to be resolved—problems stemming from terrain and climate, from the inadequacy of long-range planning, from insufficient preparations, and from organizational shortcomings, as well as from the Japanese foe—before the Engineer mission could be successfully accomplished.

I wish to acknowledge my indebtedness to present and former colleagues in the Historical Division who helped in the preparation of this book. Dr. Jesse A. Remington, Director of the Historical Division, gave valuable advice and encouragement. Miss Lenore Fine offered many helpful suggestions. Miss Louise Marr did research and drafted sections on the defense triangle and on the 1945 Southern Philippines Campaign. Dr. Leslie Anders prepared the initial drafts for the chapters on the China-Burma-India theater. Dr. Kenneth J. Deacon wrote the first draft on the Alcan Highway, and Mr. David Latt did the initial research on the engineers in Panama and Alaska. I am indebted to a large number of Engineer officers who were participants in the war against Japan and who reviewed portions of the manuscript and provided additional information and also pointed out errors of fact; the names of nearly all of them are recorded in the volume. In this connection special mention should be made of Col. Desloge Brown, C.E., Maj. Gen. Hugh J. Casey (Ret.), Maj. Gen. Edmond H. Leavey (Ret.), Col. Willard P. McCrone, C.E., Maj. Gen. George J. Nold (Ret.), Col. Earl North (Ret.), Maj. Gen. Bernard L. Robinson (Ret.), Col. Harry A. Skerry (Ret.), Lt. Gen. Samuel D. Sturgis, Jr. (Ret.), Maj. Gen. Leif J. Sverdrup

(AUS, Ret.), Brig. Gen. Benjamin B. Talley (Ret.), Lt. Gen. Walter K. Wilson, Jr., and Col. Theodore Wyman, Jr. (Ret.). For the facts presented, I am alone responsible.

Mrs. Caroline Moore and Mrs. Lois Aldridge of the World War II Reference Branch, Office of Military Records, National Archives and Records Service, were most helpful in locating engineer files. Many typists in the Historical Division labored over the manuscript, but special credit is due to Mrs. Margaret Lillian Tucker, who typed the final version of the manuscript. Mr. George H. Weitzel of the U.S. Army Engineer District Office in Baltimore prepared the maps.

I am also indebted to members of the Office of the Chief of Military History, especially to Dr. Stetson Conn, Chief Historian, and to Dr. John Miller, jr., who, as Deputy Chief Historian, offered numerous valuable suggestions for improving the manuscript. Mr. David Jaffé was responsible for the final editing, assisted by Mrs. Marion P. Grimes. Miss Mary Ann Bacon, Chief of the Editorial Branch, gave valuable advice in the editing of the manuscript. Miss Ruth A. Phillips selected the photographs. Mr. Nicholas J. Anthony compiled the index.

Baltimore, Maryland
18 June 1965

KARL C. DOD

Contents

Chapter		Page
I.	STRENGTHENING THE DEFENSE TRIANGLE: PANAMA, HAWAII, AND ALASKA	3
	Early War Plans and the Corps of Engineers	3
	First Steps in Building Up the Pacific Outposts	6
II.	THE DEFENSE EFFORT GAINS MOMENTUM	27
	Panama	29
	Alaska	33
	Hawaii	38
	The Air Ferry Route	45
	Supplies	48
	War Appears Imminent	50
	Last Days of Peace	52
III.	THE FALL OF THE PHILIPPINES	55
	Preparations for Defense	57
	Withdrawal to Bataan and Corregidor	72
	Bataan	85
	Corregidor and the End of the Campaign	101
IV.	BUILD-UP IN THE SOUTHWEST PACIFIC	107
	Australia—The First Days	107
	Toward a More Aggressive Strategy	128
	Preparing for the Offensive	153
V.	FIRST OFFENSIVES: THE SOLOMONS AND PAPUA	160
	Strengthening the South Pacific	160
	Preparing To Fight in New Guinea	173
	Engineers in Combat	193
	Problems of Logistics	209
VI.	THE DRIVE TOWARD RABAUL	225
	Preparing for CARTWHEEL	225
	CARTWHEEL	245
	The Engineers Continue To Furnish Logistic Support	255
	Arawe, Cape Gloucester, and Saidor	272

Chapter *Page*

VII. THE FAR NORTH 276
Strengthening Alaska's Defenses 276
The Alcan Highway 299
Canol 318
The Danger Passes 328

VIII. HAWAII AFTER PEARL HARBOR 340
The Engineers Organize for War 340
Protection Against Air Raids 344
Military Defenses 346
Change in Organization 360

IX. AFTER MIDWAY 365
Work on Defensive Installations Slows Down 365
First Offensives in the Central Pacific 380

X. THE CHINA-BURMA-INDIA THEATER: 1941–AUGUST 1943 387
Priority on Airfields 389
Ground Communications for a Campaign in Burma 404
Renewed Priority on Airfields 418

XI. THE CHINA-BURMA-INDIA THEATER: AUGUST 1943–JANUARY 1945 426
QUADRANT Directs an All-out Effort 426
The All-out Effort Continues 442
The CBI Is Cut Back 463

XII. THE DRIVE ACROSS THE CENTRAL PACIFIC 476
The Marshalls 476
Logistical Support From Hawaii 486
The Marianas 492
1944 Draws to a Close 506

XIII. AMPHIBIOUS WARFARE AND BASE CONSTRUCTION IN THE SOUTHWEST PACIFIC 520
The Advance to Biak 520
Logistical Support 542
Western New Guinea and the Moluccas 561

XIV. RETURN TO THE PHILIPPINES 570
Leyte and Mindoro 570
Luzon: The Drive to Manila 587
The Capture of Manila and the Islands of Manila Bay 614

Chapter *Page*

XV. THE FINAL MONTHS OF THE WAR 625
Destruction of the Japanese in the Philippines and Borneo 625
Iwo Jima 640
Okinawa 640
Base and Airfield Construction for the Assault on Japan 649
Planning for the Invasion of Japan 672
Conclusion 679

Appendix

A. U.S. ARMY AND ARMY ENGINEER PERSONNEL STRENGTH IN OVERSEAS THEATERS, 1 JANUARY 1942–1 OCTOBER 1945 684

B. TYPES OF ENGINEER UNITS AND THEIR FUNCTIONS 685

BIBLIOGRAPHICAL NOTE 691

LIST OF ABBREVIATIONS 695

LIST OF CODE NAMES 700

INDEX 705

Chart

Major Command Channels and Lines of Engineer Technical Supervision, Southwest Pacific Area, 1 May 1942 132

Maps

No.

1. The Pacific Outposts 4
2. Alaska, 1940 13
3. Hawaiian Islands 17
4. Panama, 1941 30
5. Philippine Islands 56
6. Bataan, 1942 86
7. Australia, 1942 108
8. Pacific Ocean Areas, 1 August 1942 129
9. Papua 173
10. Milne Bay, August 1942 176

No.		Page
11.	Buna	194
12.	Combat Zone, 1943	226
13.	Airfields Constructed or Improved by the Commonwealth of Australia for the United States Army up to 31 December 1943	240
14.	Facilities Other Than Airfields Constructed or Improved by the Commonwealth of Australia for the United States Army up to 31 December 1943	241
15.	Alaska and Western Canada, 1942–43	277
16.	Aleutian Islands	285
17.	Oahu	349
18.	Honolulu Harbor, 1946	368
19.	Makin Atoll	382
20.	The China-Burma-India Theater, December 1942	388
21.	China	441
22.	The Ledo Road	474
23.	Kwajalein Island	477
24.	South Marianas and Saipan	494
25.	Guam, 1945	504
26.	The Western Pacific	513
27.	Hollandia	528
28.	The Southern Philippines, 1944–45	574
29.	Central Luzon	589
30.	Iwo Jima	641
31.	Okinawa	642
32.	Pipelines in CBI, 1 July 1945	667
33.	Planned Attack on Japan	676

Illustrations

	Page
Brig. Gen. Eugene Reybold	46
Malinta Tunnel	67
Col. Wendell W. Fertig	79
Camp Columbia	116
Maj. Gen. Hugh J. Casey and Brig. Gen. Leif J. Sverdrup	131
An Australian Road Builder	142
Nouméa, New Caledonia	166
The Port Moresby Causeway	184
Buna Area Adjacent to Simemi Creek	197
43d Engineers at Dobodura Strip No. 1	199
Improvised Bridge Over Entrance Creek	201
Chow Time at a Native Labor Camp	204
Airstrip at Dobodura, Showing Revetments	221

	Page
Moving Supplies on the Rebuilt Railroad, Nouméa	224
A Section of the Oro Bay–Dobodura Road	237
A Corduroy Road, New Georgia	250
Base B Area, Oro Bay	259
Engineer Troops Making Their Own Hardware	262
Construction of the First Steel Building at Milne Bay	268
Engineers Dressed for −37° F.	292
Digging Out Tundra	294
Constructing a Pacific Hut on Kiska	298
Brig. Gen. William M. Hoge	303
Skagway Harbor	304
Trucking Supplies Through Mud	306
Alcan Highway	316
Peace River Suspension Bridge	336
Refinery at Whitehorse	337
A Pipeline Carried on a Trestle	338
King's Wharf, Butaritari, Makin Atoll	384
Brig. Gen. Raymond A. Wheeler	395
Native Bridge on the Refugee Trail	407
A Pipeline Carried on an A-Frame	442
Stringing a Ferry Cable Across the Salween	460
Footbridge and Ferry on the Salween	461
A Japanese Pillbox, Kwajalein	481
Guam Landing	505
Floating Ponton Pier, Saipan	512
Engineers of the 1881st With Full Jungle Equipment	531
Hollandia Development, 1944	545
Dispensary in Native-Type Building, Milne Bay	551
Liberty Docks, Oro Bay	552
Section of the Map Distribution Area, Finschhafen	555
Dredging Coral for Runway Construction	566
Laying Pierced Steel Plank, Tacloban	580
Repairs on the Carmen Bridge, Agno River	605
Infantry Support Rafts on the Pasig River	616
Laying a Pipeline to the Mortar Pit, Caballo Island	622
Fort Drum	623
Trucks Negotiate the Villa Verde Trail	630
Filipinos Help Construct a Road, Luzon	631
Japanese Truck Supporting a Temporary Bridge	637
Airfield Construction, Iwo Jima	659
Three Examples of Bridging in the CBI	665

All illustrations are from Department of Defense files.

THE CORPS OF ENGINEERS: THE WAR AGAINST JAPAN

CHAPTER I

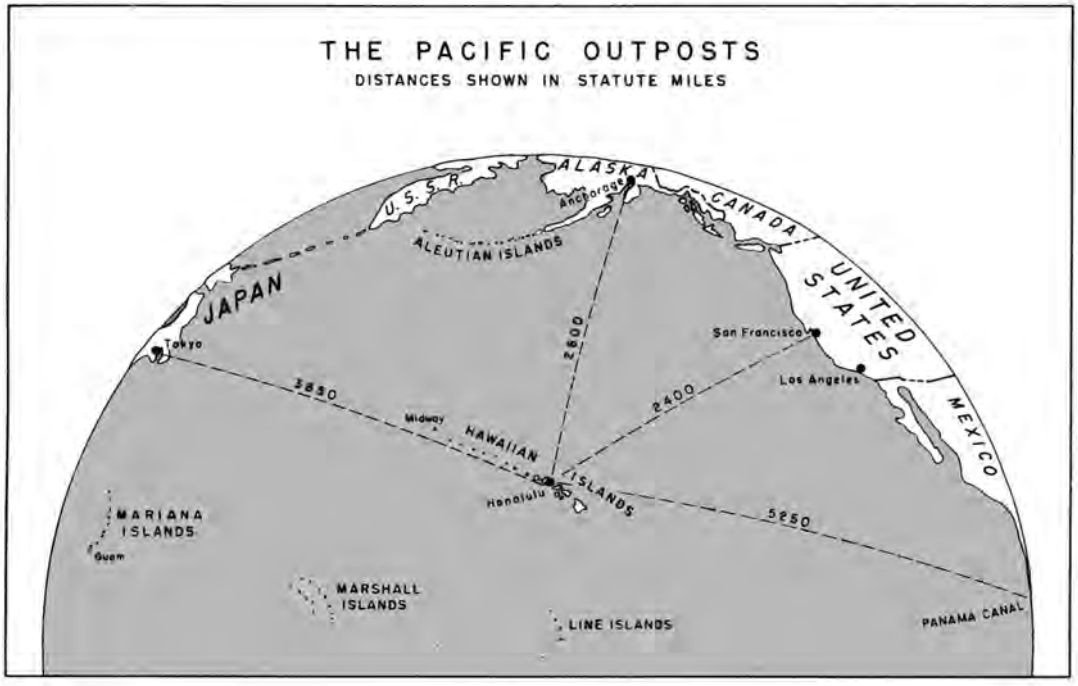
Strengthening the Defense Triangle: Panama, Hawaii, and Alaska

The Japanese attack on Pearl Harbor on 7 December 1941 found the Corps of Engineers, like the rest of the Military Establishment, in the midst of feverish defense preparations. The Corps had been assigned the task of building up defenses in Panama, Alaska, Hawaii, and other Pacific outposts; in areas ranging from the Arctic to the tropics, engineer units were engaged in a wide variety of urgent projects. Plagued by shortages of men and materials and difficult working conditions, these defense preparations were still far from finished when the nation was plunged into war. Along with these desperate efforts to build a bulwark on many fronts, the engineers were engaged in the vital mission of creating an organization and developing equipment that would enable them to carry out their many duties on the battlefronts and behind the lines in case war broke out. By the time of Pearl Harbor much progress had been made in the relatively short time since the defense build-up began. The story of the pre-Pearl Harbor defense preparations is one of an effort gradually getting under way from small beginnings and destined eventually to assume tremendous proportions.

Early War Plans and the Corps of Engineers

The United States Army had been concerned with the possibility of war with Japan for many years before Pearl Harbor. Soon after World War I, American military leaders began to frame a strategy to be followed if war broke out. The first strategic plan, War Plan ORANGE, adopted in 1924, envisaged mainly a naval struggle, with the Army to seize the Japanese mandated islands in the central Pacific, reinforce the Philippines, and then prepare for an attack on Japan itself.

During the 1930's, in view of Japan's growing power and the low state of American armaments, and with the independence of the Philippines scheduled for 1946, the War Department General Staff concluded that the United States should not attempt to hold initially in the western Pacific. Alaska, Hawaii, and Panama, often referred to as the "strategic triangle," should form the main line of defense. (*Map 1*) The last version of War Plan ORANGE, issued in 1938, embodied these views. It was assumed that after a period of strained relations, Japan would attack without



MAP I

notice. The Japanese would in all likelihood seize Guam and the Philippines. Enemy forces could be expected to make raids on Hawaii, Alaska, and the west coast of the United States. The Panama Canal might be wrecked by sabotage or by naval and air raids. Initially, the United States would mobilize one million men. Two armies would defend the Pacific coast, Alaska, Hawaii, and the Canal, while two more would be in reserve. Since it was assumed the Philippines would soon be lost, no plans were made for reinforcing them. Eventually, the Navy, with Army support, would fight its way across the central Pacific toward Japan. Once bases had been established in the western Pacific, the time would be at hand to begin the attack on the Japanese home islands.[1]

A seemingly modest Engineer force was contemplated for a conflict of such magnitude. The Army's strategic plan for a war with Japan, prepared in 1936, called for the mobilization of 46 engineer units on the outbreak of hostilities.

[1] (1) Louis Morton, *Strategy and Command: The First Two Years,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1962), pp. 21–30. (2) Louis Morton, "American and Allied Strategy in the Far East," *The Military Review,* XXIX, No. 9, (December, 1949), 22–39. (3) Mark Skinner Watson, *Chief of Staff: Prewar Plans and Preparations,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1950), pp. 415, 453–54. (4) Joint Army and Navy Basic War Plan—ORANGE (1938). AG Reg Doc 223.

Five engineer combat regiments would support the infantry and 3 squadrons the cavalry.[2] In addition, 4 heavy ponton battalions and 13 light ponton companies would serve with the combat forces. Two general service regiments, 7 separate labor battalions, 4 dump truck companies, 2 depot companies, 2 water supply battalions, a topographic battalion, 5 railway battalions, and a railway shop battalion would be needed in the rear areas. An engineer section would serve with General Headquarters. As the war progressed more engineer units would be formed.[3]

Had war broken out in 1938, the Corps of Engineers, like the rest of the Army, would not have been able to meet the requirements of War Plan ORANGE. Engineer officers numbered 739 and enlisted men 5,786 in an Army totaling 183,455. There were but ten engineer units—7 combat regiments, 2 of them at full strength, parts of 2 squadrons, and a topographic battalion. These units were for the most part undermanned and poorly equipped. This small force could be augmented. The 23 engineer units of the National Guard—18 combat regiments, 4 squadrons, and a general service regiment, in various stages of organization and totaling 8,768 officers and men in 1938—could be called into federal service. There were besides, 8,057 Engineer Reserve officers available for duty.[4]

This engineer force was wholly inadequate to deal with the manifold responsibilities which the Corps of Engineers, both a combat arm and a supply service, would have to discharge in the course of a bitter and probably prolonged struggle in the Pacific. On far-flung battlefronts of that enormous area engineer units would be called upon to remove mines, cut through barbed wire entanglements, reduce fortifications, and build and repair roads to enable the infantry to advance. Units trained in bridging would have to put troops across streams. During enemy offensives, engineers would have to try to slow the advance by placing mines, destroying roads, wrecking bridges, blowing up supplies, and at times fighting as infantry. Behind the fighting fronts the Corps could expect to have its traditional wartime logistical missions—to build fortifications, construct airfields, camps, hospitals, warehouses, roads, and ports; operate light, power, and water systems; repair and operate railroads; [5] camouflage important installations; make maps for the Army; and at the same time procure the necessary supplies.[6]

While the Engineers would do extensive construction for the Army overseas

[2] A brief description of the different types of engineer units is given in Appendix B.

[3] Army Strategical Plan—ORANGE (1936 Revision), an. 2, pp. 1–2. AG Reg Doc 235.

[4] OCE, Annual Rpt Covering Mil Activities of the CE for FY Ending 30 Jun 38, pp. 3, 4, 10, 12, 13.

[5] (1) 41 *Stat.* 759. (2) Responsibility for the repair and operation of railroads was transferred to the Transportation Corps in November 1942. Chester Wardlow, *The Transportation Corps: Responsibilities, Organization, and Operations,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1951), p. 64.

[6] The organization of the Corps of Engineers and its World War II mission are discussed in Blanche D. Coll, Jean E. Keith, and Herbert H. Rosenthal, *The Corps of Engineers: Troops and Equipment,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1958), pp. 3ff.

in time of war, their responsibility for military construction in the United States and its possessions in peacetime was limited. They were responsible only for building fortifications, which, since the United States no longer had to defend its land frontiers, meant almost exclusively seacoast defenses. In the 1920's the term seacoast defenses signified coastal batteries, access roads, and storage space for ammunition. With the growing danger of air attack in the early 1930's, the term came to include searchlight positions and antiaircraft emplacements and, by the late 1930's, aircraft warning stations. All construction for the Army in peacetime other than fortifications was charged to The Quartermaster General.

With a relatively small engineer force at his disposal, it is hardly surprising that Maj. Gen. Julian L. Schley, the Chief of Engineers, had a staff of but 21 officers in Washington in 1938. One of his principal tasks was to organize and train engineer units and develop new types of engineer equipment. This mission was the responsibility of Brig. Gen. John J. Kingman, head of the Military Division of the Office of the Chief of Engineers. The troops, for the most part, received only on-the-job training in the 1930's. At Fort Belvoir, Virginia, some seventeen miles southwest of Washington, was the Engineer School, which provided specialized instruction to officers and specially chosen enlisted men. Also at Fort Belvoir was the Engineer Board, which developed and tested equipment.

General Schley's second major task was construction. This, however, included not merely the building of fortifications. Congress had charged the Corps with two important civil responsibilities—improvement of rivers and harbors and flood control. To perform this civil work and to build fortifications, the Corps had developed a nationwide organization of 11 divisions with 48 districts, staffed in 1938 by 206 engineer officers and some 56,000 civilians, all under the general direction of the Chief of Engineers and directly responsible to Brig. Gen. Max C. Tyler, head of the Civil Works Division of General Schley's office. At that time the Corps was at work on about 1,000 rivers and harbors projects and about 400 flood control projects in the United States, Puerto Rico, Alaska, and the Hawaiian Islands, for which Congress had appropriated $234,465,300 for the fiscal year 1938.[7] The general belief was that the divisions and districts afforded Engineer officers valuable experience which would stand them in good stead in time of war. What is more, a construction organization was already at hand to participate in any defense effort which might be launched.

First Steps in Building Up the Pacific Outposts

Rearmament Begins

The Corps of Engineers began building up the defenses of the United States against possible attack from the Pacific about eighteen months before Pearl Har-

[7] (1) OCE, Annual Rpts Covering Mil Activities of the CE for FY Ending 30 Jun 37, pp. 4, 28–29; FY Ending 30 Jun 40, p. 39. (2) OCE, Chart and Tabs Showing Costs of Engr Dept Work, FY's 1926–41, p. 24. EHD Files. (3) Annual Rpt OCE, 1938, p. 1. (4) Incl, Appns for Mil and Civil Functions, CE, to Memo, C Budget and Programs Div OCE for EHD, 6 Jun 55.

bor. The kind of construction to be done and its location depended largely on the policies of the administration in Washington, the strategic planning of the War Department, and the appropriations voted by Congress. It was to be assumed that by far the larger share of the money for a defense build-up would go to The Quartermaster General. In a period of strained relations likely to precede the outbreak of war with Japan, it could be expected that one of the first tasks assigned the Corps would be the strengthening of seacoast defenses bordering on the Pacific.

The mounting international tension in the late 1930's in Europe and in the Far East indicated that a major defense build-up was probably close at hand. Late in 1938, President Roosevelt advocated that the United States, hitherto concerned only with defending its own territories, protect all of the western hemisphere. Addressing Congress in January 1939, he stressed the need for strong armed forces and asked for $525 million for armaments, half of it to be spent by 30 June 1940. Three hundred million dollars of the total would go for airplanes to bolster the air defenses of the continental United States, Alaska, Puerto Rico, and the Canal Zone. The President wanted some $8 million to improve seacoast defenses in the Canal Zone, Hawaii, and the continental United States.[8]

The General Staff began to work out a strategy of hemisphere defense along the lines suggested by the President. Despite the enlarged scope of responsibilities, the War Department concentrated almost entirely on strengthening the United States and its outlying territories. The latter, especially, needed attention, and Puerto Rico and the strategic triangle figured prominently in the early planning. In the words of Brig. Gen. George V. Strong, chief of the War Plans Division of the General Staff, "Panama, Hawaii, Puerto Rico and Alaska," were "vital links in our defensive chain."[9] Appearing before the Committee on Military Affairs of the House of Representatives on 17 January 1939 during a hearing on a request for funds, Secretary of War Harry H. Woodring and General Malin Craig, Chief of Staff, outlined their defense program. Like the President, they stressed the need for air power. Of the outlying territories, they considered the Canal Zone by far the most important. General Craig wanted $23 million for work on airfields there. He asked for $6.5 million to strengthen coastal defenses in the United States, the Canal Zone, and Hawaii and $4 million to build the first air base in Alaska. An unspecified but modest sum would be needed to build technical facilities and temporary housing for the Air Corps in Puerto Rico. No money was requested for the Philippines.[10]

[8] (1) Stetson Conn and Byron Fairchild, *The Framework of Hemisphere Defense*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1960), pp. 3–5. (2) William L. Langer and S. Everett Gleason, *The Challenge to Isolation, 1937–1940* (New York: Harper & Brothers, 1952), p. 11. (3) *The Public Papers and Addresses of Franklin D. Roosevelt*, compiled by Samuel I. Rosenman (New York: The Macmillan Co., 1938–50), 1939 volume, pp. 70–74.

[9] Memo, Strong for C Budget and Legis Plng Br GS, 6 May 39, with Incl. WPD 3807–31.

[10] (1) Statement of Woodring, pp. 1–3; (2) Statement of Craig, pp. 4–8. Both in H Com on Mil Affairs, 76th Cong, 1st sess, Hearings, *An Adequate*

Existing Defenses

The strength of the existing defenses of Panama, Hawaii, and Alaska varied. The Canal Zone, with possibly the strongest defenses of the three outposts, had two military airfields, France, near the Atlantic entrance, and Albrook, near the Pacific. There were 6 major Army posts, 3 on the Atlantic side, and 3 on the Pacific. Coast artillery and antiaircraft batteries, searchlight positions, and supply depots were numerous. The sole defense installation outside the Canal Zone was Rio Hato airfield in Panama, on the Pacific coast, 50 air miles southwest of the Pacific entrance to the Canal. Rio Hato had originally been a private landing strip, the property of the owner of a nearby resort. The owner gradually improved the strip, and U.S. airmen began using it more and more frequently while on training flights. In 1935 the United States leased it for a dollar a year and, in 1938, for $200 a month. By 1939 Rio Hato had become so important for defense that Air Corps commanders in the Canal Zone urged the War Department to buy it or lease it on a long-term basis. In the Hawaiian chain, almost all military installations were on the island of Oahu. Here were the two major Army airfields, Wheeler, on the central plateau, and Hickam, on the southern shore northwest of Honolulu. The island was protected by numerous seacoast batteries near Honolulu and Pearl Harbor. Alaska had no military defenses, the only Army installation in the Territory being Chilkoot Barracks, some 15 miles south of Skagway. Army and Navy planners believed that Alaska might be subjected to air attack, but thought it unlikely that an enemy would attempt a major campaign in Alaska's frigid wastes. The Navy would be primarily responsible for keeping hostile forces away.[11]

The defenses of Hawaii and the Panama Canal, though elaborate, were outmoded. Most of them had been designed and built in the days before the airplane became an important weapon. For many years it had been apparent that the islands and the Canal were more vulnerable to air attack than to naval bombardment. Maj. Gen. David L. Stone, Commanding General, Panama Canal Department, expressed a widely held view when he wrote on 15 November 1939 that "the first threat against the Canal will come from either land based or carrier based aviation." [12] Despite its more remote location, Panama, like Hawaii, feared attack mainly from Japan. To the east was a protective screen of islands extending from Florida to South America. There was no such barrier in the Pacific. The only islands on which defenses could be built were the Galápagos, Cocos, and Clipperton.[13]

Appropriations

On 26 April 1939 Congress made its regular appropriation for the War De-

National Defense as Outlined by the Message of the President of the U.S., Jan–Feb 39.

[11] (1) Hist Sec CDC, Constr and Real Estate Activities in the CDC, 1 Jul 46, vol I, p. 1. (2) Preliminary Study for Retrospective History, Dept Engr PCD, 6 Sep 39–31 Dec 45 (cited hereafter as Prelim Study), II, 4. EHD Files. (3) Ltr, Acting SW to the President, 22 Nov 39. WPD 3512–50.

[12] Ltr, Stone to TAG, 15 Nov 39. 660.283 (Panama) File 3, 1936–41.

[13] *Ibid.*

partment for the fiscal year 1940. By far the greater share of the money for defense construction requested by the War Department went to The Quartermaster General, who received $24,387,987 for construction in the United States and its outlying territories. The Chief of Engineers got $2,721,960 to improve seacoast defenses, of which $1,146,000 was to be spent in Panama and $268,746 in Hawaii. During the following months Congress made supplemental appropriations. In May it gave the Engineers an additional $1,059,705 to improve seacoast defenses, $828,805 of it for Panama and $230,900 for Hawaii. In July the Quartermaster Corps got $90,349,459 more for military construction in the United States and its outlying possessions, including $3,600,000 to build an airfield near Fairbanks, Alaska, the first money to be allotted to the War Department for defense in that Territory. In August Congress gave the Quartermaster Corps an additional $400,000 for the Alaskan airfield and the Engineers $1,500,000 to improve the road from the Canal Zone to Rio Hato airfield. By 1 September 1939 the Quartermaster General had received a total of $132,466,746 for military construction, about half of it for strengthening the defense triangle. The Engineers had received $6,526,196, of which they were to spend $3,924,451 to strengthen the Canal Zone and Hawaii.[14]

The outbreak of the war in Europe on 1 September had little effect on defense appropriations. Until well into 1940 Congress took no further action. On 12 February it made its last appropriation for the fiscal year 1940, giving The Quartermaster General $11,661,800 in construction funds, of which $112,800 was earmarked for Panama. Nothing was given to the Engineers. This was the period of the "phony war." The conflict in Europe aroused little alarm; many members of Congress, well attuned to public opinion, were strongly disposed to slash the War Department's request for funds. On 23 February, the Subcommittee of the House Committee on Appropriations began hearings on the War Department's requests for funds for the fiscal year 1941. The War Department had asked for $29,461,748 to improve and enlarge military posts—$18,535,560 of this sum to be spent on installations in the triangle. Over $12 million was to go for a second air base in Alaska at Anchorage and for the storage of gasoline and bombs in the Territory. In the report made by the Appropriations Committee to the House on 3 April, the War Department's requests for the triangle were drastically curtailed. In the bill sent by the House to the Senate, the $18,535,560 asked for had been cut to $4,305,675. The funds requested for Panama were only slightly curtailed, but those for Hawaii were cut approximately in half and those for Alaska eliminated completely.[15]

[14] (1) Public Law 44, 76th Cong, 1st sess, 26 Apr 39. (2) Public Law 61, 76th Cong, 1st sess, 2 May 39. (3) Public Law 164, 76th Cong, 1st sess, 1 Jul 39. (4) Public Law 361, 76th Cong, 1st sess, 9 Aug 39.

[15] (1) Public Law 415, 76th Cong, 3d sess, 12 Feb 40. (2) House Subcom of the Com on Appns, 76th Cong, 3d sess, *Hearings on the Military Establishment Appropriations Bill for 1941*, p. 375. (3) Watson, *Chief of Staff*, p. 165. (4) S Subcom of Com on Appns, 76th Cong, 3d sess, *Hearings on House Report 9209*, p. 5.

War Plans

During the months of mounting world tension, the War Department began to revise its war plans. War Plan ORANGE had presupposed a conflict involving only the United States and Japan. After Munich, the view gained ground that the United States might find itself at war not only with Japan but also with Germany and Italy. The Joint Army and Navy Board began a study of various strategies which might be followed if the United States became involved in a struggle with several countries. In April 1939, the Board's Joint Planning Committee reported that it was of the opinion that if Japan should join the European axis in hostilities, the United States could not go on the offensive in the Pacific, but would have to withdraw its forces to the east of 180 degrees longitude. The War Department's immediate task in the Pacific, therefore, was to strengthen Hawaii, the Canal Zone, and Alaska. In May the Joint Board, approving the report, instructed the committee to prepare five strategic plans for a number of possible war situations. These plans were given the code name RAINBOW. The committee completed the first plan—RAINBOW I—in August 1939. According to this plan, the United States would protect all of its territory and that part of the Western Hemisphere north of 10 degrees south latitude. No reinforcements would be sent to the Philippines. The outbreak of war in Europe led to further studies. The subsequent RAINBOW plans outlined, in general, more extensive commitments of the United States in the defense of its territories and the Western Hemisphere.[16]

Engineer Organizations

Both the Canal Zone and Hawaii had going engineer organizations which could take on new defense work. On General Stone's staff was Col. Earl North, the department engineer, with offices at the post of Corozal, near the Canal's Pacific entrance. Colonel North had a force of about 200 civilians, made up of supervisors from the United States and laborers from the Canal Zone and Panama. Under General Stone's command was the 11th Engineer Combat Regiment, headed by Lt. Col. Gordon R. Young. The main job of the combat engineers was to train with the Canal Zone's defense forces, but they also were available to Colonel North on a part-time basis to help with construction. Hawaii had two engineer organizations. At Fort Shafter, just northwest of Honolulu, was the office of the department engineer, Col. John N. Hodges, a member of the staff of Maj. Gen. Charles D. Herron, Commanding General, Hawaiian Department. Colonel Hodges also commanded the Hawaiian Division's 3d Engineer Combat Regiment, stationed at Schofield Barracks on the central plateau, the only Army engineer unit in the Islands. The other organization was the Honolulu Engineer District, which, like district organizations of the Corps

[16] (1) Conn and Fairchild, *Framework of Hemisphere Defense*, pp. 7–10. (2) Ray S. Cline, *Washington Command Post: The Operations Division*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1951), pp. 55–57.

elsewhere, was responsible for building fortifications, improving rivers and harbors, and constructing works for flood control. In late 1939 Maj. Peter E. Bermel was district engineer, serving under the Pacific Division engineer in San Francisco, who in turn was responsible to the Chief of Engineers.

There was no engineer organization in Alaska. Responsibility for such rivers and harbors and flood control work as was done rested on the Seattle Engineer District headed by Col. Beverly C. Dunn, who was under Col. John C. H. Lee, North Pacific Division Engineer. The defense of the Territory was the responsibility of Lt. Gen. John L. DeWitt, commander of the Fourth Army, with headquarters in San Francisco.[17]

An expanding construction effort in the outlying territories would pose difficulties. There were few resources in manpower or materials in the triangle. The Hawaiian chain, about 2,400 miles southwest of San Francisco, with an area of some 6,200 square miles, had a population of 425,000, almost all of it concentrated on the five major islands. Oahu, with the capital city of Honolulu, was the center of the Territory's economy, which was based mainly on the production of pineapples and sugar cane. There was little manufacturing. Almost all of the supplies and the great number of workmen required for an extensive construction program would have to come from the United States. The Canal Zone, a strip of land 10 miles wide through which ran the vital waterway, was 3,350 miles from Los Angeles. Panama, which the Canal Zone bisected, had no industry to speak of, almost no construction equipment, and few skilled workmen. The only manufactured items the engineers could count upon getting locally were structural clay products, principally brick and tile. Of the three outlying territories, Alaska would offer the greatest obstacles to large-scale military construction. About one-fifth the size of the continental United States, the Territory had a scant 75,000 inhabitants. The almost complete absence of industry, public utilities, and highways, and the remote location of the areas of strategic importance, presented a dreary prospect.

Work Begins

During 1939 and the first months of 1940, the engineers began the task of improving the defenses of Panama. Colonel North's organization casemated a few guns, built additional bombproof storage for ammunition, and put in a small number of access roads. In late 1939 the 11th Engineers began to improve Rio Hato airfield.[18] On the whole, the expanded program provided for by the Congressional appropriations remained in the planning stages. Much of the money which Congress did make available for the fiscal year 1940 had to be spent for equipment. "Our dry season," Colonel North wrote on 27 December, "is about here and we were all

[17] (1) Prelim Study, I, 3, 10, 49; III, 127; app. A, pp. 1–2. (2) Ltr, North to C EHD, 19 Jul 57. EHD Files. (3) Hist Review, CE, U.S. Army, Covering Opns During World War II, POA, pp. VI, X. EHD Files.

[18] Hist Rcd of the 11th Engrs, 1943. 314.7, KCRC.

set for a big push. . . . Most of our new equipment is here . . . but we must have a lot more money which I understand . . . is in the War Department Act for 1941." [19]

In January Lt. Gen. Daniel Van Voorhis replaced General Stone. Van Voorhis' staff continued work on the program of modernizing the defenses of the Canal. In mid-February North reported that plans were completed to make all antiaircraft batteries mobile, except ten on the Atlantic side and nine on the Pacific. But up to this time, the War Department had authorized no additional construction at the batteries except the building of more gun blocks at fifteen of the fixed sites. Soon after his arrival, Van Voorhis and his staff began to devote more time to preparing plans for building defense installations in the Panamanian Republic. If the Canal were to be adequately protected, defenses would have to be built far beyond the limits of the Canal Zone.[20]

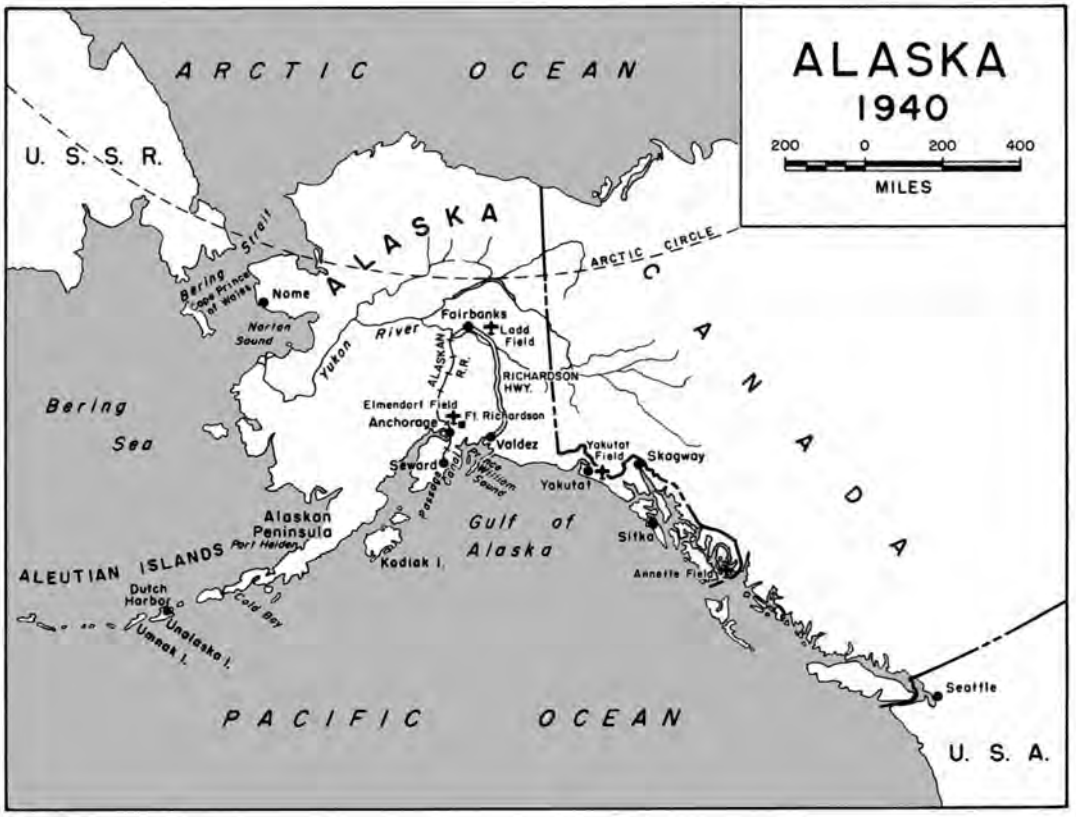
In Hawaii, the department engineer continued to work on plans to bombproof more coastal guns, install additional searchlights, and build aircraft warning stations. In view of the great amount of work local commanders thought necessary, it appeared that funds available in the near future would not be adequate. Merely to bombproof the more important installations, including seacoast defenses, communication centers, command posts, and storage facilities for critical supplies, would, it was estimated in June 1939, cost approximately $4.5 million. The Honolulu District, with its force of hired labor, was engaged in a modest program of strengthening seacoast defenses and improving the ports at Honolulu, Pearl Harbor, and Midway Island.[21]

In 1939 and early 1940 the Engineers had little to do with Alaska. The Navy and the Quartermaster Corps undertook the first construction for defense in the Territory. With funds appropriated by Congress in April 1939, the Navy began work on its new air bases at Kodiak and Sitka in September and at Dutch Harbor in the following spring. Late in 1939 the Quartermaster Corps made preparations to enable work to get under way by spring on the air base at Fairbanks, to be called Ladd Field. (*Map 2*) In August a board of officers proposed that the War Department build several operating and emergency airfields in Alaska. The Civil Aeronautics Authority (CAA) was then embarking on a program of building and improving airfields in the Territory. Of those CAA planned to build, the Secretary of War was especially interested in the one on Annette Island at the southern tip of the Alaska panhandle and the one near the village of Yakutat at the northern end. With fields at these two places, planes would be able to make the 1,500-mile trip from the United States to Ladd in relative safety. Early in 1940 the Engineers became engaged in defense work in the

[19] Ltr, North to C Constr Sec Mil Div OCE, 27 Dec 39. 451.2 pt. 4.

[20] 1st Ind, North to CofEngrs, 13 Feb 40, on Ltr, C Constr Sec Mil Div OCE to Engr PCD, 1 Feb 40. 660.283 (Panama) File 3, 1936–41.

[21] (1) Statement of Capt James C. Marshall, CE, 26 Apr 39. House Subcom of the Com on Appropriations, 76th Cong., 1st sess., *Hearings on the War Department Civil Functions Appns Bill for 1940*, p. 61. (2) Ltr, Maj Gen William H. Wilson, CG HD, to TAG, 22 Jun 39. AAF Central Files, 630–A Hawaii 1939–41.



MAP 2

Territory for the first time. They were directed to make surveys for the staging fields to be built by CAA or the Quartermaster Corps in the panhandle. In February, under engineer supervision, men of the Department of the Interior began to survey the site at Annette. No final decision had as yet been made with regard to Yakutat.[22]

A Sudden Upsurge

The spring of 1940 saw the end of the "phony war." In April Germany seized Denmark and Norway and in May invaded the Low Countries and France. On 25 June France surrendered. There was a violent reaction in the United States, and President Roosevelt and Con-

[22] (1) Navy Department, Bureau of Yards and Docks, *Building the Navy's Bases in World War II* (Washington, 1947) (cited hereafter as *Building the Navy's Bases*) I, 163, 169, 174. (2) Ltr, Maj Edward M. George, CQM Alaska Air Base, to Lt J. B. Rankin, Acting CQM Alaska Air Base, 19 Jan 40. 600.1 (Ladd Field AC Progress) vol. II, 1940–41. (3) Rpt of Bd of Offs on Survey of Airfields in Alaska . . . 7 Jun to 8 Aug 39. 686 (Alaska) 1939. (4) Ltr, SW to Chmn CAA, 4 Jan 40. WPD 4239. (5) Ltr, Kingman to CofAC, 6 Mar 40. 686 (Annette Island, Alaska) vol. I, 1940–41.

gress rushed plans and preparations for building up armaments. On 13 June, Congress, in its regular appropriation for the fiscal year 1941, restored the items for the triangle that it had cut out a few months earlier. The Quartermaster received funds for modernizing and enlarging Fort Shafter and Schofield Barracks in Hawaii, improving Albrook Field and the post of Corozal in Panama, and constructing a second air base, Elmendorf, together with an Army post, Fort Richardson, near Anchorage in Alaska. The Engineers got $8,722,718 for seacoast defenses; $2,896,813 of this sum was to be spent for installations in Panama and $599,686 for those in Hawaii. Of the sum for Panama, $212,193 was to be used to improve fortifications, $328,100 to complete work on the 16-inch guns at Fort Kobbe and on minor batteries, $236,520 to build storage for ammunition, $1,120,000 to buy and install searchlights, and $1,000,000 to put in access roads.[23]

During the summer Congress enacted additional measures to strengthen defenses. On 19 July it passed the "Two Ocean Navy Act," which authorized expansion of the fleet by 70 percent. In August it authorized the President to call the National Guard into federal service. On 9 September it passed the second supplemental defense appropriations act, which increased the authorized program by $5.4 billion. A week later it enacted legislation authorizing the draft. The strength of the Army was to be increased to 1,400,000 men.

The Joint Board accelerated work on the RAINBOW plans. The fall of France had caused a decided shift in emphasis from the Pacific to the Atlantic. During the late spring, Army and Navy planners had concentrated on RAINBOW 4, which presupposed possible operations in the Atlantic and South America and a defensive stand in the Pacific. President Roosevelt approved this plan on 14 August. Thereafter, the planners concentrated on RAINBOW 5, which presupposed operations in Europe and Africa, while, as under RAINBOW 4, the United States would remain on the defensive in the Pacific.[24]

Faced with the threat of a two-ocean conflict, War Department planners regarded the strengthening of the Canal Zone as more urgent than ever. North and his engineers expanded their construction efforts. They got started on the job of making the antiaircraft batteries mobile. A new type of project, assigned in June, was the building of the joint command post tunnel for the department headquarters at Quarry Heights on the Pacific side. For this job, North used men from his regular hired labor force trained in fortifications work. Construction was speeded up at Rio Hato. During the summer part of the 11th Engineers, about 600 men from the Air Corps, and some men loaned by the quartermaster were at work there. A dock was built to unload materials and heavy equipment, which had to be shipped by sea, since the road from the Canal Zone, constructed as part of the Pan American Highway, would not hold

[23] Public Law 611, 76th Cong, 3d sess, 13 Jun 40.

[24] (1) Conn and Fairchild, *Framework of Hemisphere Defense*, pp. 34–36, 92–93. (2) Public Law 781, 76th Cong, 3d sess, 9 Sep 40.

up under military traffic.[25] A hampering factor was the rainy season, which prevailed from May till December. "One of the major difficulties . . . was the climate," North wrote later. "During the rainy season, the clayey earth became a soft sticky gumbo and . . . construction which involved earth excavation and moving was difficult and slow." [26] Construction was not North's only interest. Because military maps of the Canal Zone, made back in 1915, were almost obsolete, North wanted to remap certain areas by using aerial photography. In September, much-needed equipment began to arrive to make possible a start on the aerocartographic program.

By the summer of 1940 General Van Voorhis and his staff were greatly concerned with making defenses more mobile. But mobility of itself would be of little value unless numerous defense installations were built in the Republic of Panama. Some of the 153 searchlights and most of the aircraft warning stations which Van Voorhis wanted would have to be located there. New defense installations in the Republic would necessitate building many additional roads. A big stumbling block was securing land from Panama. By a treaty negotiated in 1936 and ratified in 1939, any tracts of land which the United States authorities wanted in the Republic were to be secured by negotiations with the Panamanian Government, and procedures for leasing had not yet been worked out. The War Department and the State Department were making little progress in persuading the Panamanian Government to lease land for 999 years, as American commanders in the Canal Zone wished. How long it would be before Panama would consent to lease land was a question impossible to answer in the summer of 1940.[27]

In only slightly less emphatic fashion, the engineers in Hawaii felt the impact of the growing defense effort. Between April 1939 and July 1940 Congress had appropriated $1,197,332 for improving seacoast defenses in the islands. General Herron, convinced that the program for peacetime defense construction as outlined in mid-1939 would have to be expanded, continued to insist on more funds for fortifications, and in this he was wholeheartedly supported by Col. Albert K. B. Lyman, who became department engineer in July 1940. Herron wanted more airfields and seacoast batteries, more antiaircraft guns and searchlights. He was particularly anxious to bombproof vital installations on Oahu. He insisted on more underground storage for ammunition, which he planned to distribute on Oahu as a protection against bombing and to relieve congestion at Aliamanu Crater, the main storage area, about one mile east of Pearl Harbor. On 5 July he appointed a board of officers to consider all aspects of defense against aerial and naval bombardment. With construction on new military installations about to begin, the need for more roads and trails was pressing. They would have to be put in to

[25] (1) Public Law 611, 76th Cong, 3d sess, 13 Jun 40. (2) Hist Rcd of the 11th Engrs, 1943. 314.7.

[26] Ltr, North to C EHD, 19 Jul 57. EHD Files.

[27] (1) Memo, C Constr Sec Mil Div OCE for CofEngrs, 29 Apr 40. 660.283 (Panama) File 3, 1936–41. (2) Acquisition of Land, PCD, prepared by Hist Sec AGO HQ PCD, Mar 45, pp. 13–20.

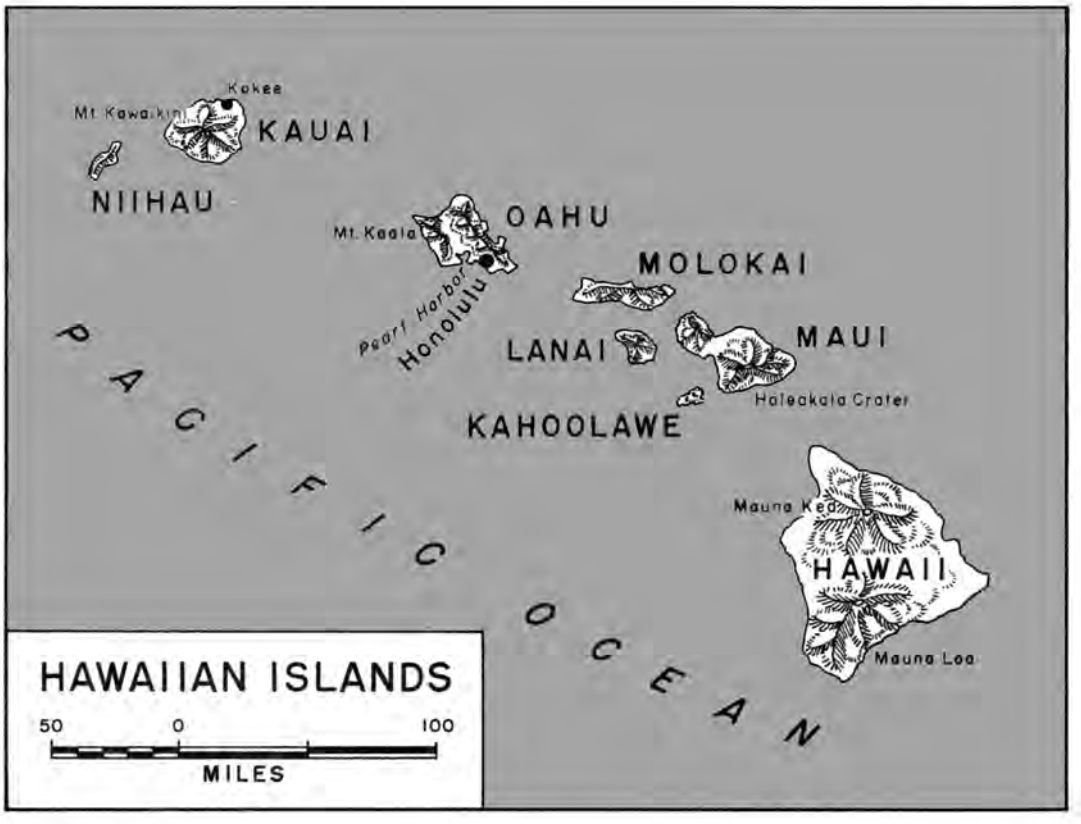
provide access to the new observation posts, antiaircraft batteries, seacoast batteries, and searchlight positions. Additional roads would be needed for military operations. The conflict in Europe had demonstrated that, in the new mobile type of warfare, troops, in order to move forward or withdraw rapidly, required a variety of roads and trails. Lyman doubted that many additional roads could be built if war were imminent or under way; if built at all, they would have to be put in in peacetime. To bolster the defenses of the Islands, General Herron and Colonel Lyman wanted more engineer troops. On 23 August, Herron "strongly recommended" to the War Department that a regiment of aviation engineers, less one battalion—a new type of engineer unit trained to build airfields—be sent. The reply from Washington was that there were so few engineer troops none could be spared.[28]

Especially critical in Hawaii was the need for aircraft warning stations. Early in 1940, a local board of officers had made a study of the need for such stations. The members spent ten weeks surveying the five principal islands from the air and on the ground. It was apparent that the configuration of the archipelago limited construction to a line extending generally northwest and southeast from Oahu. It would be difficult to detect planes approaching from the north, northeast, south, or southwest until they were quite close. The members of the board emphasized the need of providing protection to the westward as this was the direction from which an attack would most likely come. Their report, made in April 1940, called for three fixed and six mobile stations on the four largest islands and an information center at Fort Shafter. The fixed stations were to be built at the most crucial points. The westernmost one would be at Kokee on Kauai. (*Map 3*) On Oahu, the station would be put on steep and craggy 4,000-foot high Mount Kaala, west of Schofield Barracks, while the station on Maui would be atop 10,000-foot high Haleakala. On 27 June the War Department authorized construction, and in July Lyman conferred with Lt. Col. Theodore Wyman, Jr., the newly appointed district engineer, to acquaint him with the project. Building these stations would not be easy, for the sites were remote and inaccessible. The station on Mount Kaala would require a cableway to the summit to bring up supplies. To get construction started in the summer, Lyman planned to have the 3d Engineers begin surveying for an access road to the lower terminal of the cableway to be built to the top of Mount Kaala.[29]

The Engineers in the summer of 1940 somewhat unexpectedly became in part responsible for defense construction in Alaska. On 10 May the War Plans Division had informed General George C. Marshall, Chief of Staff since 1 July 1939,

[28] (1) Rad, Herron to TAG, 8 Oct 40. WPD 1928–27. (2) Memo, Acting ACofS WPD for Marshall, 21 Jan 41. WPD 1928–27. (3) 5th Ind, Herron to TAG, 15 Nov 40, basic unknown. 600–B Hawaii, 1940–42, AAF, Central Files. (4) Interstaff Routing Slip, Dept Engr to CofS HD, 4 Oct 40. Engr AGF PAC. (5) Ltr, Herron to TAG, 3 Feb 41. 381 (Hawaii) 106.

[29] (1) Ltr, Herron to TAG, 17 Apr 40. Engr AGF PAC, Sig 676.3. (2) 4th Ind, TAG to Herron, 27 Jun 40, on Herron Ltr. (3) Ltr, Lyman to CofEngrs, 13 Jul 40. Engr AGF PAC, Sig 676.3.



MAP 3

that strengthening the Anchorage-Seward area and the Navy bases under construction at Kodiak and Dutch Harbor was imperative.[30] It recommended that an infantry battalion and a battery of field artillery be sent to the Territory. On 17 June, the War Department set up the Alaska Defense Force, with headquarters at Anchorage, under Col. Simon B. Buckner, Jr. Buckner was responsible to DeWitt. The first echelon of the garrison, numbering 751, reached Anchorage on 27 June and included the 32d Engineer Combat Company (Separate) of 91 officers and men, the first engineer unit to reach the Territory. The 32d engineers went to Elmendorf Field, where they began to build facilities for their camp and engage in combat training. In August the Joint Army and Navy Board, after a month-long study of Alaska's strategic position, advocated a still greater defense build-up so that the Territory could be held even without naval protection. The board advised stronger defenses for the naval

[30] For a discussion of the War Department's reinforcement of Alaska before Pearl Harbor, see Stetson Conn, Rose Engelman, and Byron Fairchild, *Guarding the United States and Its Outposts*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1964), ch. IX.

stations, and also recommended that the contractors being employed to build the naval bases be used to build posts for Army garrisons. The Secretaries of War and Navy approved these recommendations, which became the basis of Army and Navy policies with regard to Alaskan defenses.[31]

Since Alaska in time of war would be especially liable to air attack, much thought was given to the construction of aircraft warning stations. Late in May DeWitt was directed to make a study of the network of stations which the War Plans Division proposed for the Territory. Included was an information center at Anchorage and four detector stations, three of them to be near the naval bases and one near Anchorage. If possible, the stations were to be mobile. Should General DeWitt judge that more stations were needed, he was to decide where they were to be located. Colonel Lee, as North Pacific Division Engineer, would be responsible for making surveys, preparing estimates, and constructing the buildings for housing the equipment. After studies had been made by a board of officers, DeWitt proposed construction of an information center at Anchorage, one mobile station at Fairbanks, and 7 fixed stations along the coast from Sitka to Norton Sound, just south of Bering Strait. He believed the number of detector stations should eventually be increased to 13. In August General Marshall approved plans for the information center and for 8 of the detector stations. He was in favor of the locations for the installations at Kodiak, Sitka, Fairbanks, and Anchorage, but wanted the 5 other sites resurveyed. He suggested that efforts be made to reduce costs, especially for access roads.[32]

General DeWitt was anxious to improve communications in the almost uninhabited territory. Of vital importance was the government-owned Alaskan Railroad running northward from the port of Seward through Anchorage and on to Fairbanks. From the standpoint of defense, the weakest point in the line was the 100-mile section from Seward to Anchorage, where the railway passed through deep gorges and over high trestles, thus providing attractive targets for saboteurs and hostile aircraft. The railroad's management was considering building a 14-mile cutoff at a point sixty-six miles north of Seward eastward to Passage Canal, an inlet on Prince William Sound. DeWitt suggested to the War Department that it exert every influence to have this project carried out, preferably by the Engineers. On 13 July the War Department authorized Colonel Lee to investigate and consider three choices: improving the line from Seward to Anchorage, constructing the cutoff, and developing Anchorage itself as a port for oceangoing vessels. Two engineers sent out by Colonel Dunn to explore the possibilities recommended that the Alaskan Railroad be authorized to build the cutoff. While this shortened route would require some three and one-half miles

[31] (1) Memos, Strong for Marshall, 10 May, 17 Jun 40. WPD 4297. (2) Hist of the 32d Engr Co (Combat) (Sep) While in Alaska. (3) JB 312 Ser 650, 14 Aug 40. WPD 3512–68. (4) Watson, *Chief of Staff*, p. 456.

[32] (1) Memo, ACofS WPD for TAG, 22 May 40. (2) Ltr, ACofS WPD to TAG, 29 May 40. (3) Note for Rcd on Memo, Acting ACofS for TAG, 9 Dec 40. (4) Memo, ACofS for TAG, 7 Aug 40. All in WPD 3640–6.

of tunneling, it would be easier to defend against aerial attack than the existing line south to Seward and would considerably shorten the haul to Anchorage and Fairbanks. Moreover, Passage Canal had an advantage over Anchorage in that it was ice free the year round. On 31 July DeWitt repeated his earlier recommendation that the job be given to the Corps of Engineers.[33]

More important than any of these projects was the building of airfields. Since the Quartermaster Corps had started work at Ladd and Elmendorf, it was highly important to get work under way on the two staging fields in the Alaska panhandle. In mid-1940 the Civil Aeronautics Authority was planning to build both fields, but DeWitt thought CAA would take too long. Convinced that Annette, especially, should be started at once, he recommended on 9 July—despite the fact that airfield construction was properly the province of the Quartermaster—that the Engineers build the field. Late that month the War Department assigned the job to Maj. George J. Nold, commander of the 28th Engineer Aviation Regiment, in order to give the unit training in building airfields. The Seattle District would supervise work on the field, the site of which was on the reservation of the Metlakatla Indians. On 6 August the Department of the Interior granted temporary use of the land needed, with the understanding that consideration would be given to the Indians with regard to employment and the purchase of supplies. The field was to be extensive, with two asphalt runways 5,000 feet long, concrete aprons and taxiways, a hangar, a dock, a seaplane ramp, roads, housing, and storage for supplies, gasoline, and oil. On 20 August Major Nold, with two battalions of the 28th Engineers, two companies of the Civilian Conservation Corps (CCC) from Oregon and California, and thirty-five civilian technicians sailed from Seattle. They arrived at Annette three days later and immediately went to work on a camp and a dock.[34]

Last Months of 1940

As the international situation continued to deteriorate, Congress voted additional funds for armaments. On 8 October, it passed the Third Supplemental Defense Appropriation Act for the fiscal year 1941, in the amount of $1.7 billion, making a total of over $12 billion appropriated for defense since the previous June. It now appeared more likely that the United States would be involved in a war with Germany, Italy, and Japan. Insofar as the Pacific was concerned, the United States initially would continue to maintain a defensive position and concentrate on strengthening Alaska, Hawaii, and Panama. The RAINBOW 5 plan, which presupposed such a turn of events, had by fall been worked out in broad outlines.[35]

[33] (1) Ltr, DeWitt to TAG, 2 Jul 40. (2) Ltr, AG Fourth Army to Lee, 15 Jul 40. (3) Rpt of Passage Canal Cut-Off by 1st Lt A. C. Welling, CE, and Mr. James G. Truitt, c. 29 Jul 40. (4) Ltr, DeWitt to TAG, 31 Jul 40. All in 617 (Alaska).

[34] (1) Ltr, DeWitt to TAG, 9 Jul 40. (2) 1st Ind, TAG to CofEngrs, 25 Jul 40, basic unknown. (3) Ltr, Acting Secy of the Interior to SW, 6 Aug 40. (4) Ltr, Dunn to Lee, 5 Oct 40. All in 868 (Annette Island, Alaska), 1940–41, vol. I. (5) Maj Gen George J. Nold, Personal Account. EHD Files.

[35] (1) Conn and Fairchild, *Framework of Hemi-*

By this time, there was a declining emphasis in Washington on civil works. The President, while requesting greater sums for military construction, was asking that rivers and harbors work be held to a minimum. Largely for this reason, the Chief of Engineers made a bid for a substantial role in the building of defense projects.[36] The commanders in the triangle were very much in favor of transferring military construction from the Quartermaster Corps to the Engineers. The centralized system whereby local constructing quartermasters were under the direct control of The Quartermaster General in Washington had caused a great deal of dissatisfaction. In the Canal Zone, for example, the department engineer, a member of General Van Voorhis' staff, handled fortifications work, but all other military construction was the responsibility of the constructing quartermaster, who reported directly to The Quartermaster General's office. In Hawaii, the Honolulu District Engineer had broad authority and could, in line with General Herron's suggestions, make decisions on the spot, while the local constructing quartermaster had to refer most design and contractual matters to his superiors in Washington. General DeWitt was of the opinion that The Quartermaster Corps, although it did excellent work, was inclined to carry on construction at a leisurely peacetime pace, while the Engineers, prepared to build in war, put great emphasis on speed. All three department commanders had great confidence in the Corps of Engineers' technical ability.[37]

A change in construction responsibilities was soon forthcoming, for on 9 September the President signed a bill which authorized the Secretary of War at his discretion to transfer to the Engineers any part of military construction then assigned to the Quartermaster Corps. This authority was to expire on 30 June 1942. For the time being, the Secretary did not invoke this power.[38]

In view of the increasingly serious international situation, defense work in the outlying territories seemed exasperatingly slow to the local commanders. There were many reasons for the delays. It took time for the enactments of Congress to be translated into construction. The War Department had to put detailed plans for building into final form. Workmen had to be hired and organized into effective construction forces. In recruiting workers, the Engineers were confronted with increasing competition from the Quartermaster Corps and the Navy. Materials had to be ordered and shipped as prescribed by government regulations. In Panama and Alaska, climatic conditions were a hampering factor. In many cases, work was held up because of strong differences of opinion over sites for installations. To many in the War Department, the possibility of an attack on the triangle seemed remote, with the need for fast action not apparent.

In the Canal Zone, the rains continued to be a major hindrance. Insofar as

sphere Defense, pp. 74–75, 93. (2) Public Law 800, 76th Cong, 3d sess, 8 Oct 40.

[36] Testimony of Robert P. Patterson, USW, 22 Sep 41. S Com on Mil Affairs, *Hearings . . . on S. 1884,* 77th Cong, 1st sess, p. 29.

[37] Interv, Lenore Fine and Jesse A. Remington with General DeWitt, 10 Apr 57. EHD Files.

[38] 54 *Stat.* 875.

possible, the engineers worked on searchlight emplacements, antiaircraft batteries, storage for ammunition, and access roads. They made some progress on Rio Hato. When the 9th Bombardment Group arrived from the United States in November, the 11th Engineers put up a 2,000-man camp for them. The Public Roads Administration, with funds supplied by the Engineers, began to improve the highway from the Canal Zone to the airfield. In November Colonel North set up a Soils Laboratory whose main job was to test the soils of the Canal Zone's generally swampy terrain and recommend methods of compaction and stabilization for roads and airfields.[39]

Van Voorhis was especially anxious to get work started on the aircraft warning stations, and in October the War Department approved his plans for nine. Besides the two at the entrances to the Canal, where experimental facilities were already in place, Van Voorhis wanted seven in the Panamanian Republic. He prepared plans for two coast artillery and forty-six searchlight positions, some of the latter to be set up in Panama. In addition, he wanted the quartermaster to build a number of auxiliary airdromes and landing fields in the Republic. On 11 October he gave a list of the desired sites to the Panamanian Government. Little progress was being made on the leasing question. Dr. Arnulfo Arias, who took office as President of Panama on 2 October 1940, raised many objections to the views of the Government of the United States about acquiring land in Panama. Instead of a 999-year lease —or even a 99-year lease as some suggested—he wished to limit U.S. tenure to the duration of the emergency. The War Department wanted jurisdiction over acquired real estate; President Arias insisted that Panama should retain full sovereignty.[40]

Early in December, Arias proposed that a joint U.S.-Panamanian commission be appointed to investigate the sites. A commission of five—three Panamanians and two Americans, one of them Colonel North—was established. After the commission's first meeting, North informed Van Voorhis that it would take at least four months to inspect the sites and locate the owners. On 30 December Van Voorhis forwarded a list of the most urgently needed tracts to the Panamanian Government, suggesting that, pending final agreement, the United States should be permitted to occupy the lands. By the end of the year, no appreciable progress had been made toward a settlement of the land acquisition problem.[41]

In Alaska the engineers continued to be mainly concerned with the airfields in the panhandle. The aviation engineers at Annette were gaining experience on their first job. Work went ahead on the camp and dock and, late in the fall, the men began clearing the runway sites. Such problems as Major Nold had were mainly with people. A few weeks after

[39] (1) Prelim Study, II, 240–42, 258–60, 345–47; I, 112–17. (2) Hist of 11th Engrs, Panama, 1940–42. 314.7, KCRC. (3) Memo, C Constr Sec OCE for Schley, 29 Aug 40, sub: Progress on Rio Hato Road Panama. 611 Panama 1940–45.

[40] (1) Ltr, Van Voorhis to Marshall, 12 Nov 40. WPD 2674–30. (2) Acquisition of Land, PCD, pp. 20–23.

[41] (1) Ltr, Van Voorhis to Marshall, 3 Jan 41. WPD 2674–31. (2) Acquisition of Land, PCD, pp. 23–25.

work started, the Council of the Metlakatla Indians called upon Governor Ernest Gruening of Alaska to inform him that their tribesmen were not being given jobs or an opportunity to sell supplies and that Nold had exceeded his authority by getting water for his camp from a lake outside the area set aside for the airfield.[42] Agreeing that the Indians were partly justified, Nold was prepared to meet some of their demands. He hired some fifty Indians as laborers, and placed them in their own camp, situated at some distance from the soldiers' bivouac to lessen chances of friction. "The scheme," Nold wrote, "worked pretty well and satisfied the Indians." [43] The lake was the only adequate source of water and, in accordance with Nold's recommendation, the amount of land under lease was extended to include the lake.

There were difficulties not only with the Indians but also with the CCC. Under that organization's regulations, the work-day included the time spent in travel between camp and job. Because the soldiers resented seeing the civilians arrive at work later and leave earlier, Nold set out to have the CCC regulations changed, but without success, at least not then. There were bitter complaints from both the CCC men and the civilian technicians about the inadequate rations for the cold, damp climate. In December more adequate supplies of food began to arrive. By the end of the year the dock had been finished and the camp was nearing completion. Clearing for the runways was continuing.[44]

To get work started at Yakutat, Nold sent part of his slender force to that site. On 23 October Capt. Benjamin B. Talley with Company B of the 28th Engineers and a few civilians arrived from Annette. No CCC labor was desired and none was sent. As this was the off-season for fish canning, a local company leased its buildings, wharf, and narrow-gauge railroad, and some of the troops were housed in the canneries. By the end of the year, clearing for the runways was about to begin. By using engineer troops, DeWitt had gotten a head start on the airfields in the Alaska panhandle.[45]

Other Alaskan projects remained in the planning stages. In late October, G–4 directed the Chief of Engineers to make preparations to start work in the spring on the cut-off for the Alaska Railroad. General Schley assigned the job to Colonel Dunn, who planned to have hired labor and contractors' organizations do the clearing, grading, and tunneling and employees of the Alaskan Railroad lay the track. On 9 December the War Plans Division ordered construction of aircraft warning stations at Kodiak, Sitka, and Fairbanks and an information center at Anchorage. DeWitt now recommended that one or more stations be built north of Cape Prince of Wales, which would extend the line of protection almost to the Arctic Circle,

[42] Ltr, Nold to Dunn, 18 Sep 40. 686 (Annette Island, Alaska), 1940–41, vol. I.

[43] Ltr, Nold to C EHD, 7 Aug 57. EHD Files.

[44] (1) Ltr, Nold to Dunn, 6 Feb 41. 230.44 Alaska pt. I. (2) Ltr, Nold to CG, Ninth Corps Area, 5 Nov 40. 430.2 (Alaska).

[45] (1) Memo, Kingman for ACofS G–4, 16 Sep 40. (2) Ltr, Dunn to Lee, 14 Oct 40. (3) Semimonthly Rpt, Yakutat Landing Field, 1–15 Dec 40. All in 868 (Yakutat Airfield), pt. I.

and the War Plans Division took the suggestion under study. Preparations were being made to photomap many of the little-known areas of the Territory now vitally important for defense. DeWitt planned to send a photoreconnaissance flight and Company D of the 29th Engineer Topographic Battalion to Alaska in the spring.[46] There was much discussion over how many defenses Alaska needed and where they should be located. "Generally speaking," Talley subsequently recalled, "through 1940 an atmosphere of peacetime life prevailed, only those who remembered 1914–1917 furnished the spark of urgency." [47]

In Hawaii, some work was started in late 1940. Construction began on a few roads and trails, since Congress had allotted $70,200 for such work in the Islands in the third supplemental appropriation, made in September. But this was only a small beginning in bettering communications. In Lyman's opinion, improving the rail net was just as important as building new roads. Urgently needed was a connecting link between Wahiawa on the Central Plateau and the island's north shore to keep supplies moving to the coastal defenses. Also of great benefit would be double-tracking part of the line from Honolulu to Schofield Barracks and providing bypasses where the railroad crossed over on high bridges. But the chances were slim that money would be forthcoming for such projects. In September the 3d Engineers began work on the access road for the aircraft warning station on Mount Kaala. There were indications that building this station and the others as well might take considerable time. The site atop Haleakala was in Hawaii National Park. Park officials agreed to give the War Department temporary use of the land, but they were opposed to having structures erected which would "materially alter the natural appearance of the reservation." They insisted on first seeing "the preliminary building plans showing the architecture and general appearance" of the structures. The Honolulu District was finding it difficult to recruit workmen because the Navy and the Quartermaster Corps had already absorbed a large part of the labor force in the Islands. By late 1940, various military units, such as the Hawaiian Separate Coast Artillery Brigade and the Hawaiian Division, were forced to use their own men to build and maintain the roads and trails they needed.[48]

Wyman had planned to do the additional defense work with hired labor, but by fall it was doubtful if enough workers could be found. Using hired labor was a method best suited for small jobs, as a rule, and not practical for larger projects,

[46] (1) 1st Ind, TAG to CofEngrs, 30 Oct 40, on Ltr, DeWitt to TAG, 31 Jul 40. (2) Ltr, Dunn to Lee, 7 Dec 40. Both in 617 (Alaska). (3) Note for Rcd on Memo, Acting ACofS WPD for TAG, 9 Dec 40. WPD 3640-6. (4) 10th Ind, TAG to DeWitt, 20 Dec 40, on Ltr, Kingman to DeWitt, 17 Sep 40. 061.01 (Alaska) pt. I.

[47] Incl to Ltr, Talley to C EHD, 6 Nov 57. EHD Files.

[48] (1) Interstaff Routing Slip, Lyman to CofS HD, 4 Oct 40. (2) Interstaff Routing Slip, Maj Vere A. Beers, 3d Engr Regt, to CO, 3d Engr Regt, 4 Oct 40. Both in Engr AGF PAC. (3) Ltr, Herron to Wyman, 7 Nov 40. Engr AGF PAC, 676.3. (4) Ltr, Short to Marshall, 15 Mar 41. *Pearl Harbor Attack, Hearings Before the Joint Committee on the Investigation of the Pearl Harbor Attack* (cited hereafter as *Pearl Harbor Hearings*, 79th Cong, 1st sess, pt. 30, pp. 3005–3006). (5) Ltr, Herron to TAG, 8 Nov 40. Engr AGF PAC, 611.

especially if speed was a primary consideration, because of the time and effort required to recruit, organize, and administer a large number of workmen. There were alternative ways of getting the work done. Wyman could employ construction firms under lump-sum contracts. This would mean advertising the work, receiving bids from contractors, and giving the contract to the lowest responsible bidder. Once an agreement was signed, it would be up to the contractor to finish the job within the specified time. Another method—new to the Engineers—was to give a job to a construction firm under a cost-plus-a-fixed-fee contract. This type of contract had been designed for emergency conditions, and was to be used especially when there was little or no time for preparing plans and specifications. Congress had first authorized its use in August 1939 for construction in Panama and Alaska. In July 1940 Congress approved its use without restrictions as to time or place. Under the new arrangement, the War Department selected a firm it considered qualified and negotiated an agreement. Advertising, receiving bids, and awarding the job to the lowest responsible bidder —standard procedure under the lump-sum arrangement—were eliminated. To qualify for the new type of contract a firm had to have a good reputation and the financial resources to do the work. Every cost-plus-a-fixed-fee contract had to be approved by the Under Secretary of War. If it amounted to more than $500,000, it had to be approved, in addition, by the Advisory Commission to the Council of National Defense. The contractor furnished his organization and his know-how and supplied materials and equipment. The government was expected to provide him, if necessary, with additional equipment, which it would rent from suppliers of such machinery. Under the terms of the agreement the government reimbursed the contractor for nearly all expenditures and paid him a fee, the amount of which was limited by law. The haste with which such contracts had to be let meant that cost estimates were often not much more than guesses of the most general kind. Cost-plus-a-fixed-fee contracts were frequently used by big construction firms. The government had entered into such contracts in World War I, but had not used them in peacetime. In 1940 few Army officers outside the Quartermaster Corps were conversant with them, or with the difficulties which might ensue from their use.[49]

In October 1940 Colonel Wyman discussed ways and means of accomplishing construction with Col. Warren T. Hannum, the South Pacific Division Engineer, at that time on an inspection trip to the Islands. Like engineer officers in general, Hannum preferred having work done by purchase and hire and was opposed to using cost-plus-a-fixed-fee contracts. But in view of the fact that the Navy was using this type of agreement extensively in the Islands and since there was little time to prepare plans and specifications, negotiating a cost-plus-a-fixed-fee contract appeared to be the best solution. In a letter to Hannum on 4 November, the Office of the Chief of

[49] For a detailed discussion of cost-plus-a-fixed-fee contracts, see Lenore Fine and Jesse A. Remington, Military Construction in the United States, a draft manuscript in preparation for the series UNITED STATES ARMY IN WORLD WAR II.

Engineers approved using the new type of contract. Looking about for reliable contractors, Wyman could find none in Hawaii not already heavily engaged in defense work. Hannum suggested to Wyman that he come to the mainland to look for suitable firms. Interviewing contractors in Los Angeles, Wyman was able to line up three well-known firms, the Rohl-Connolly Company, the W. E. Callahan Construction Company, and Gunther & Shirley Company. Rohl-Connolly had completed several large projects for the Corps of Engineers and other agencies of the federal government, among them the Los Angeles–Long Beach breakwater and Headgate Dam at Parker, Arizona.

On 20 December 1940 Wyman, with the approval of the Chief of Engineers, the Under Secretary of War, and the Advisory Commission to the Council of National Defense, signed a cost-plus-a-fixed-fee contract in Washington, D. C., with the three firms, who formed a joint venture known as the Hawaiian Constructors. The contract called for building fortifications, aircraft warning stations, and storage for ammunition; laying additional railway track; and making additions to the radio station at Fort Shafter. The work was to cost $1,097,673 and the fixed fee was $52,220. The Hawaiian Constructors would receive all plans and specifications from the district as they became ready and would be responsible for detailed construction planning to meet the approval of the engineer in charge of the field area in which the project was located. They would be responsible for transporting materials and equipment from the engineer supply yards in Honolulu to the job sites, for organizing and directing the work crews, and for administering their organization. One of their first tasks would be to recruit workers in the United States to build up a construction organization in the islands.[50]

After Congress had empowered the Secretary of War to transfer any part of construction for the Army from the Quartermaster Corps to the Corps of Engineers, discussions began in the War Department about what changes, if any, should be made in the construction setup. On 19 November, a partial transfer was made. All construction for the Air Corps was transferred to the Engineers, except in the Canal Zone, where many contracts included work for both Air Corps and ground forces and a division of responsibility would have been impractical. In the United States, the first fields were transferred in December, while in the triangle, the first ones were scheduled for transfer early in 1941. Military commanders in Hawaii and Alaska believed the transfer did not go far enough. On 16 December, General DeWitt wrote to Maj. Gen. Richard C. Moore, Deputy Chief of Staff, that "the two parts of the Anchorage construction . . . are so closely tied together that an efficient and expeditious job cannot be done, if both the Quartermaster Corps and the Corps of Engineers are involved." DeWitt wanted the work given to the Engineers, and the General Staff

[50] (1) *Pearl Harbor Hearings*, pts. 28–29, Testimony of Col Wyman, pp. 1748ff. (2) *Ibid.*, Testimony of Brig Gen Warren T. Hannum, pp. 1060ff. (3) Ltr, Asst Dept IG to CG HD, 4 Nov 41. Engr AGF PAC, 331 IG Rpts (Gen)–3. (4) Ltr, Engr CPA to CG CPA, 14 Mar 44. Engr AGF PAC, Contracts, 160, vol. I.

took his suggestions under study. Herron wanted all military construction in the Islands transferred to the Engineers, radioing the War Department on 6 December 1940 that most of the work was for the Air Corps. In Herron's opinion, two agencies engaged in the same type of work would mean duplication of organization and competition for workmen and materials. He wanted the constructing quartermaster's entire organization, plant, and equipment transferred. The General Staff did not agree. On 31 December, General Herron was informed that the transfer of all construction in Hawaii was "not favorably considered."[51] In any case, with work for the Air Corps added to their responsibilities in part of the triangle, the Engineers could look forward to expanded activities in 1941.

[51] (1) Fine and Remington, Military Construction in the United States. (2) Memo, CofS for SW, 1 Apr 41. G–4/31324. (3) Ltr, DeWitt to Moore, 16 Dec 40. (4) Rad, Herron to TAG, 6 Dec 40. (5) DCofS G–4 to TAG, 31 Dec 40. Last three in AG 600.12 (11–19–40) Airfield Constr.

CHAPTER II

The Defense Effort Gains Momentum

The first months of 1941 found the engineers in the outlying territories under increasing pressure as numerous signs pointed to America's becoming involved in open hostilities. Top-ranking American and British military and naval planners, meeting in Washington from late January through March to assign areas of responsibility to the United States and Great Britain in global strategy, agreed that the United States would have primary responsibility in the Pacific if it was drawn into the war. In a strategy at first defensive, American forces would attempt to hold a line running from Alaska through Hawaii to Panama and from there down the west coast of South America. With the passage on 11 March of the Lend-Lease Act, which authorized sending arms and war supplies to Britain and its allies, the United States became virtually a belligerent. A month later, Russia and Japan signed a 5-year neutrality pact. With little to fear from the USSR in the near future, Japan was free to turn southward toward the Philippines and the Indies. The situation in the Pacific appeared even more critical after Germany invaded the Soviet Union on 22 June. With the USSR engaged in a desperate struggle in Europe, Japan could devote its attention almost exclusively to the Pacific.[1]

In Washington and the Pacific outposts anxiety grew in early 1941 over the state of the defenses, and Hawaii now became a major cause of concern. Late in January Secretary of the Navy Frank Knox wrote to Secretary of War Henry L. Stimson of his dissatisfaction with the existing protection for the fleet in the Islands; he was especially apprehensive over the possibility of an attack by carrier planes.[2] Stimson, agreeing fully as to the urgency of preparing a co-ordinated defense, reassured Knox that Hawaii was "the best equipped of all our overseas departments" and that the Islands continued to hold high priority in the overall defense program.[3] Less than two weeks later General Herron, in a letter to the War Department requesting more construction equipment to speed up defense work, stated that it could "be anticipated that the attack on these islands might take the form of a sudden raid without any advance notice."[4] On 7 February, Lt. Gen. Walter C. Short succeeded Herron. Taking up his new post, he informed General Marshall regarding his plans for further strengthen-

[1] Conn and Fairchild, *Framework of Hemisphere Defense*, pp. 98–99, 101. William L. Langer and S. Everett Gleason, *The Undeclared War, 1940–1941* (New York: Harper & Brothers, 1953), p. 354.

[2] Ltr, Knox to Stimson, 24 Jan 41. WPD 3583–1.

[3] Ltr, Stimson to Knox, 7 Feb 41. WPD 3583–1.

[4] Ltr, Herron to TAG, 3 Feb 41. 381 (Hawaii) 106.

ing the Islands. He hoped to build more airfields, improve harbor and antiaircraft defenses, bombproof installations, camouflage important military areas, and put in more roads and trails.

In Panama, a new command—the Caribbean Defense Command—was established in February under General Van Voorhis, who henceforth directed the activities of the Panama Canal and Puerto Rican Departments and the Trinidad Base Command. He continued to press for more defenses for the Canal. He wanted a more extensive network of aircraft warning stations and was troubled over continuing shortages of equipment.

Alaskan defenses, likewise, left a good deal to be desired. General Dewitt, concerned over inadequate protection for the installations at Dutch Harbor, stressed the need for airfields on Umnak Island in the Aleutians just to the west of Unalaska Island and on the Alaska Peninsula at Port Heiden. He persisted in championing these projects against almost unanimous opposition in the War Department. He continued to take a strong interest in CAA's plans for a network of airfields in the Territory. Dissatisfied with the slowness of CAA's preparations, DeWitt made repeated attempts to have construction of the fields of military value placed under the Seattle District Engineer.[5]

Early in 1941 the Engineers, as had been agreed the previous November, took over construction for the Air Corps in Hawaii and Alaska. In Hawaii, the constructing quartermaster had already made substantial progress in improving airfields, and at the time of the transfer on 1 January he had a fund of $18 million for such work. Most of the construction—done by contractors and hired labor—had been finished; the biggest projects were the building of barracks and quarters at Wheeler Field, at a cost of approximately $6 million. Additional jobs were in prospect, such as storage for gasoline and bombs, involving an expenditure of about $1.5 million. Additional improvements at existing fields and the building of new ones would undoubtedly soon be necessary.

In line with General DeWitt's recommendations of the previous December, G–4 on 4 January directed the Engineers to take over all construction for the Army in Alaska, and Ladd and Elmendorf were transferred less than two weeks later. Ladd, being built by hired labor, was 85 percent complete; Elmendorf, being worked on by the contractors Bechtel, McCone, and Parsons, was 80 percent finished. For better supervision of the engineers' growing number of projects, Colonel Dunn set up an area office at Anchorage under Talley, who was transferred from the 28th Engineers at Yakutat.

The engineers in the triangle could expect an increasingly heavy workload. They could also count on growing shortages of workmen, equipment, and supplies and mounting transportation problems. In addition, each of the outlying territories would continue to present difficulties of its own.[6]

[5] (1) Watson, *Chief of Staff*, pp. 462–64, 470–73. (2) 1st Ind, DeWitt to TAG, 13 Jan 41, basic unknown. 452.1 Alaska.

[6] (1) Memo, Constr Sec OCE for Col Frank M. Kennedy and Maj Frank M. Paul, AC, 3 Jan 41. 686 (Airfields) pt. 2, Serials 81–200. (2) 2d Ind,

Panama

With the beginning of the dry season in January, a great push forward in construction in Panama was possible. But it appeared that progress on important projects would, as before, be held back by the disagreement over the acquisition of land. On 5 March, the Panamanian Government stated it would be willing to turn sites over to the U. S. Army, provided the leases were for the duration of the war, compensation was adequate, and Panama would retain jurisdiction over civilians. Negotiations continued until the end of the month when Panama agreed to let the United States occupy the sites, pending the working out of a final settlement. During April, Van Voorhis took over nine tracts for airfields and two for aircraft warning stations.[7]

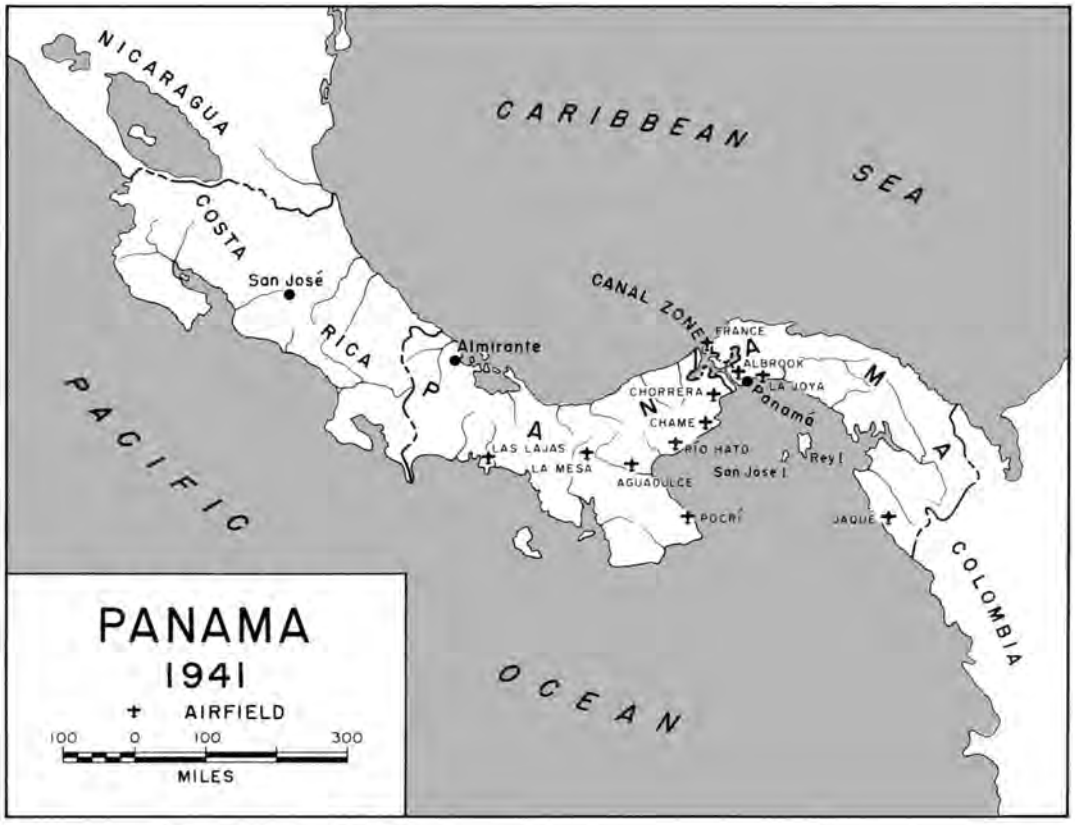
Since construction for the Air Corps in the Panama Canal Department had not been transferred to the Engineers, the War Department directed General Schley to turn over $600,000 from his general fund for airfield work to the constructing quartermaster in Panama to finance work on the new fields. Van Voorhis, however, insisted that the Engineers do the construction. He pointed out that the quartermaster already had more than a full schedule of work in the Canal Zone, and that engineer troops and the civilians had for months been working on airfields in Panama, so that assigning the jobs to the quartermaster would seem to be an inefficient procedure. Brig. Gen. Brehon B. Somervell, Chief, Construction Division, Office of The Quartermaster General, agreed to give the money back to the Engineers and have them do the jobs. Two companies of the 11th Engineers were assigned to the fields. In March the 805th Engineer Aviation Company reached Panama to help with the work. Just as the construction effort was getting well under way, North returned to the United States. His place as department engineer was taken in May by the commander of the 11th Engineers, Colonel Young, who continued with Colonel North's program. Since there were too few engineer units and the supply of local labor was almost exhausted, Young planned to recruit additional workmen and purchase large quantities of equipment and supplies in the United States. At the same time, he planned to make the greatest possible use of local sources of surfacing materials, such as rock and sand.[8]

As Young took over, the engineers were under increasing pressure. Maj. Gen. Frank M. Andrews, chief of the recently organized Caribbean Air Force, was anxious to expedite work on the airfields because the rainy season would

Somervell to CofEngrs, 12 Dec 40, basic unknown. Engr AGF PAC, QM 600.1 C–C (Hawaii). (3) Ltr, SPD Engr to CofEngrs, 7 Dec 40. Engr AGF PAC. (4) Ltr, Acting Asst CofS G–4 to TQMG, 7 Jan 41. G4/30436–13. (5) Lt Col James D. Bush, Jr., CofOpns Constr Div Engr Alaskan Dept, Narrative Rpt of Alaska Constr 1941–44, pp. 12, 441. C 12027, KCRC.

[7] (1) Acquisition of Land, PCD, pp. 25–31. (2) Conn, Engelman, and Fairchild, *Guarding the United States,* pp. 344–45. (3) Memo, Actg ACofS WPD for Marshall, 10 Mar 41. (4) Rad, Van Voorhis to TAG, 12 Apr 41. Last two in WPD 2674–34.

[8] (1) Memo, C Opns Br OQMG for Engineering Br, 30 Apr 41. 686 (Panama) 1940–41. (2) Memo, C Fortification Sec OCE for CofEngrs, 25 Apr 41. Both in 686 (Panama) 1940–41. (3) Prelim Study, I, 11, 51, 160; II, 11–12; III, 84–85, app. A, p. A–2.



MAP 4

begin any day. He suggested that his airmen help the engineers, since substantial numbers of civilian workmen from the United States were not expected for some time. In May, Andrews put the airmen to work on the fields, despite the fact that this prevented them from getting proper training as aviation mechanics. By June six emergency landing strips were ready in Panama with runways sufficiently graded to allow planes to land. Two auxiliary dromes—Aguadulce and Chame—were under construction. (*Map 4*) With the onset of the rains late in May, Andrews demanded better airfields. He wanted the emergency strips developed into auxiliary airdromes with hard-surfaced runways, for the original plans had not specified hard-surfacing. The engineers experimented with soil stabilization and compaction at Chame to find out if such treatment would make all-weather use possible. In June construction began on two of the aircraft warning stations, one at Jaqué near the Colombian border and the other at Almirante, at the extreme western end of the Republic. Both sites were hard to get to, being accessible only by plane or ship. Land had been acquired for two

more stations but the three remaining sites had not yet been taken over. Van Voorhis was already thinking of expanding the system further. The local joint board wanted five more stations in Panama, and proposed extending the service into Costa Rica and Colombia.[9]

Work went ahead in Panama during the summer and fall of 1941 despite the downpours of the rainy season. Additional handicaps as frustrating as the climate were, Colonel Young believed, the "lack of money, of authority, and of certain equipment for special jobs; notably, seagoing vessels to service the construction crews at several distant (AWS) sites." [10]

The protracted negotiations over the acquisition of land continued to hold up engineer work after midyear. Since the original stalemate had been broken in March, a number of sites had been occupied. But the procedures still had to be worked out to make possible the legal transfer of tracts. In July two U. S.-Panamanian boards were established, one of which investigated sites that were to be taken over immediately, while the other arranged for their formal transfer, after investigations were completed, to the United States. This system worked well, and by late August the additional tracts which Van Voorhis had requested late in April had been surveyed and Panama had authorized their occupation by U.S. forces. By now the Panama Canal Department was in possession of all sites for airfields. Tracts needed for other installations would be occupied as soon as enough men and materials were on hand to make occupation practicable. Negotiations for a permanent settlement of the leasing problem were being carried on through diplomatic channels. There was nothing more the military authorities or the engineers could do except finish the surveys and request the transfers.[11]

The engineers continued to put their major effort on the airfields, but despite hard work, they could not keep up with the demands of the Air Corps. Planning to make more intensive use of the fields, Andrews wanted more of the emergency landing strips converted into auxiliary airdromes. Those not converted he wanted improved through better marking of the runways and the removal of obstacles in the approach zones. As the rainy season wore on, the experiments with soil stabilization and compaction proved that such expedients were no substitute for asphalt or concrete. Runways would have to be hard-surfaced, an improvement agreed to by Panama. Washington was requested to approve plans to expand some of the emergency landing strips, particularly the one at Chorrera and the two at La Joya, into airdromes and to provide hard surfacing for the runways. Construction was expected to be so extensive that contractors, already working for the Navy and the quartermaster in Panama, would probably have to be employed. More money was requested but the War Department did not want to ask Congress for additional sums until more land had

[9] (1) Prelim Study, II, 9–12, 23off. (2) Note for Rcd on Memo, WPD for C AAF, 24 Sep 41. WPD 4186–17.

[10] Ltr, Young to EHD, 28 Jul 57. EHD Files.

[11] (1) Acquisition of Land, PCD, pp. 32–40. (2) Conn, Engelman, and Fairchild, *Guarding the United States*, 344–45. (3) Langer and Gleason, *Undeclared War*, pp. 613–15.

been secured. General Andrews, meanwhile, transferred funds from other projects, hoping that he would later be reimbursed. Improvements of airfields continued, but slowly.[12] The airmen occupied Aguadulce in September but construction at Chame was still under way. Work had barely started at Chorrera and La Joya.

During the summer the engineers began work on two more aircraft warning stations and obtained the right of entry to the three remaining sites. With priority in construction going to the stations on the Pacific side, General Van Voorhis pressed for the completion of all seven stations. Colonel Young believed there were only two ways of speeding up construction. One was to postpone work on what he called the "elaborate barracks" at the stations until essential apparatus had been installed. The other was to transfer workers from other jobs. But this would mean slower progress on such important installations as searchlights and antiaircraft batteries. There remained the difficulty of transporting men and supplies to the remote sites, one of the prime causes of delay. As recommended by the local joint board, early in September Van Voorhis asked Washington to approve construction of several more stations in Panama and in Colombia and Costa Rica as well.[13]

The Engineers now had to devote some attention to camouflage, hitherto neglected in the Canal Zone. In line with a suggestion made in the spring of 1941 by Col. Homer Saint-Gaudens, chief of the Camouflage Branch, OCE, an expert in the subject, Capt. Frederick L. Fritsche, was sent to Panama. Captain Fritsche's main concern was how best to camouflage the waterway and in due course he prepared three plans. The first, calling for covering the three sets of locks with netting, was not considered feasible because of mechanical difficulties. The second—building a dummy set of locks in the Chagres River and the old French canal—was not practicable because the river did not present a straight line or follow the contours of the Canal. The third, hiding the waterway under a smoke screen to be supplied by the Chemical Warfare Service, was adopted.[14]

On 19 September, Andrews succeeded Van Voorhis and proved as insistent as his predecessor that defenses be strengthened. The number of Engineer jobs continued to grow, and work had to be carried on in the face of mounting shortages of workmen and equipment. On 1 July Colonel Young had 2,295 employees and 1,500 more were expected before the end of the year, but there were never enough to keep pace with needs. Various ways were tried to increase production. On 16 July, Young received permission to have his employees work eight hours a day, seven days a week. In October, he asked that the restriction of working hours to 56 a week be suspended. Contractors working for the Quartermaster Corps and other services already

[12] (1) Acquisition of Land, PCD, pp. 37–39. (2) Prelim Study, II, pp. 12–14. (3) Memo, C Constr Sec Pan Engr Div PCD to Pan Div Engr, 28 Oct 43. CDC 686 (Airfield Facilities, Pan).

[13] (1) Prelim Study, II, 232–34. (2) Note for Rcd on Ltr, WPD to C AAF, 24 Sep 41. WPD 4186–17.

[14] (1) Prelim Study, I, 36; III, 50–54. (2) Ltr, Young to C EHD, 28 Jul 57.

had their employees work longer hours. One group of new arrivals was dissatisfied with the 56-hours-a-week limit. During the rainy season working hours in some weeks totaled only 30 or 40; in others as many as 70 hours would have been possible except for the limitation. On 16 October, approval was received to extend the work week. As part of an effort to get more equipment, Young in July asked for almost $6 million more for the fiscal year 1942, much of it to go for additional machinery. The rest would be used for hiring more workers, providing housing, and getting materials. Construction could then be vigorously pushed with the beginning of the dry season in January. Late in July the War Department approved this plan, and in the following months additional workmen were recruited in the United States and machinery ordered. A new difficulty arose in October when, in a coup d'etat, President Arias was replaced by Ricardo Adolfo de la Guardia. In the change of administration, the Panamanian members of the land boards lost their places. The land transfer question was stalemated again.[15]

Alaska

With the end of the long subarctic winter, the tempo of work in Alaska quickened. The Alaska Defense Force was in February 1941 redesignated the Alaska Defense Command, and the following April authorized strength was raised from 7,300 men to over 18,500. In May DeWitt asked that a headquarters detachment and one company of an engineer construction battalion be sent to Fort Richardson to help the 32d engineers, who had more than enough to do in working on facilities for their camp, improving roads, and engaging in combat training. Meanwhile, the General Staff directed Schley and DeWitt to prepare plans for housing for the growing garrison. By early May Col. Richard Park, Lee's successor as North Pacific Division Engineer, had finished designs for the buildings for the enlarged Army forts at the three naval stations, for a new post, Fort Raymond, at Seward, and for housing for a small garrison at the airport being planned by CAA for Nome. The engineers were to do all construction, except at the naval stations, where it would be performed by contractors working for the Navy. Additional projects were being planned. In April Colonel Dunn received $1 million to install tanks for aviation gasoline at the airfields and naval stations. That same month, Company D of the 29th Engineers and Flight F, 1st Photo Squadron, arrived in Alaska to begin ground surveys and take photographs for mapping purposes. Areas to be mapped included the region around Anchorage, the Richardson Highway, and a number of major routes regularly flown by military aircraft.[16]

[15] (1) Watson, *Chief of Staff*, pp. 462–65. (2) 1st Ind, 6 Aug 41, on Ltr, TAG to OCE, 29 Jul 41. 600.1 (Pan 1941–45) pt. 3. (3) Ltr, OCE to SW, 15 Oct 41, with 1st Ind, WD to CofEngrs, 16 Oct 41. 2250, pt. 12 Ser 1051–1175, Natl Archives. (4) Acquisition of Land, PCD, p. 40.

[16] (1) Watson, *Chief of Staff*, p. 457. (2) Hist of the 32d Engr Co (Combat) (Sep) While in Alaska. (3) Ltr, Park to Schley, 8 May 41. (4) Memo, G–4 for TAG, 18 Apr 41. Last two in 600.1 (Alaska) May 40–Oct 41. (5) Ltr, DeWitt to TAG, 12 Feb 41. 061.01 (Alaska) pt. 1. (6) List of Units in, En Route

On 5 April the President approved the Fifth Supplemental Appropriation Bill for the fiscal year 1941 which made available funds for the cutoff for the Alaska Railroad.[17] Two weeks later, the Seattle District advertised for bids. Construction was to be under a lump-sum contract rather than under the new and unfamiliar fixed-fee type of agreement. On 12 May Dunn opened the two bids he had received and found that the lower one was about 35 percent above the engineers' estimate of the reasonable cost of building the cutoff. Both bidders, Dunn wrote Park, were undoubtedly trying to protect themselves "against the uncertainties of labor conditions, rising costs in construction, remote location" and other factors which ruled out "normal estimates" in this period of increasing defense construction.[18] Dunn rejected both bids. To get work started with a minimum of delay, he decided to let a cost-plus-a-fixed-fee contract. The following month, he signed an agreement with the West Construction Company of Boston, Massachusetts, for work on the subgrade, drainage, and tunnels. The job was to begin in July.[19]

Receiving a report from General Buckner in May that CAA was making little progress on its airfields in Alaska, General DeWitt again advocated that the work be turned over to the Engineers. There were, he observed, only two major airdromes in the Territory suitable for military aircraft—Ladd and Elmendorf. The fields CAA was preparing to build were urgently needed. In addition, DeWitt recommended that the War Department construct seven dispersal fields. The War Plans Division did not concur, but did agree that the CAA program should be expedited and asked General Schley if the Engineers could take over. Many in the War Department wanted the Engineers to do the work because they questioned whether the runways and facilities put in by CAA would be adequate for Army planes. Countering this view, CAA assured the War Department that the facilities and runways would be adequate and explained that the cause of the delays was the fact that money had not been received in time to start surveys before the winter had set in. Now that spring had come, construction could be expedited. Contracts for two of the fields had recently been let, work on the others would be pushed, and by fall graveled runways would be ready. Persuaded by these assurances, Colonel Park recommended against having the Engineers take over. The War Department decided not to press the matter, and by the end of June CAA had let contracts for four additional fields.[20]

In May, DeWitt decided to go to Alaska to see for himself how construction was progressing. Accompanied by General Buckner and Colonel Park, he made a tour of the various projects. The ones at Anchorage and Fairbanks, begun early by the Quartermaster Corps, were the most advanced. The garrison

to, or Scheduled for Alaska, 28 Mar 41. WPD 4464–9.

[17] Rad, Kingman to NPD Engr, 4 Apr 41. 617 (Alaska).

[18] Ltr, Dunn to Park, 15 May 41. 617 (Alaska).

[19] Rpt of Opns, Seattle Dist, Jun 41. 617 (Alaska).

[20] (1) Ltr, DeWitt to TAG, 1 May 41. 600.1 (Alaska) pt. I. (2) Ltr, DeWitt to TAG, 1 May 41. 600.1 (Alaska) May 40–Oct 41. (3) DF, WPD to Spec Staff, Army Avn, 19 Jun 41. WPD 4503. (4) Memo, WPD for G–4, 22 May 41. (5) Ltr, Park to CofEngrs, 24 Jun 41. Last two in 600.1 (Alaska) pt. I.

of 5,000 men at Fort Richardson was "properly sheltered." Such work on the post and at Elmendorf as was not finished was being rushed to completion by Major Talley and the contractors. At Ladd, living quarters for an infantry garrison of 500 men were nearly finished and it was planned to transfer many of the workmen to Yakutat. Here, improvement of the runway was continuing and a start would soon be made on hangars and storage for gasoline. When DeWitt, Buckner, and Park arrived at Annette on 12 May, they found an emergency landing strip in use but, on the whole, progress was not as marked as at Yakutat. An obstacle was the muskeg, a spongy growth found in low, marshy places, and sometimes as much as eighteen feet thick. When the engineers encountered it at a construction site, they often had to scoop it out and fill the hole with gravel. Nold had solved the troublesome problem of the shorter working hours for the CCC, for in April the head of the organization in Washington had authorized the same working hours for the CCC men as for the troops. After reviewing progress of the work to date and estimating the number of troops and civilians likely to be available, DeWitt concluded that one of the regular runways would be ready by December. At the three Navy bases, the temporary buildings for the Army garrisons, which had geen given priority by the Navy over its own permanent construction, were nearing completion and some troops were already housed. On the whole, DeWitt was well pleased with what he found.[21]

Alaska's defenses still had one glaring weakness. There were no airfields on the Alaska Peninsula or in the Aleutians. DeWitt and Buckner pressed for construction in both areas to protect not only the Alaskan mainland but also the Navy base at Dutch Harbor, which was remote from other defense installations. Fighter planes could not safely fly the 600 miles from Kodiak, the nearest field, because the distance was too great. In view of the increased shipping and naval protection required, Admiral Harold R. Stark, Chief of Naval Operations, argued that airfields should not be constructed in the Aleutians without approval by the Joint Board. General Marshall, on the other hand, pressed for the building of an Aleutian airfield. Construction would have to wait until differences of opinion between the services could be resolved.[22]

The rapid advance of the German armies into the USSR during the summer focused attention especially on Alaska, since many in the War Department feared that a quick Soviet collapse might soon bring German forces to the Bering Strait. Early in July, Secretary of War Stimson directed that the sending of additional troops to the Territory be expedited. On the 15th of that month the War Department increased the authorized strength of the Alaskan garrison from 18,500 to 24,000. Because the Army posts at the three naval stations were far from ready, Stimson promised DeWitt that he would turn over funds to the Navy to assure housing for the military garrisons there as soon as possible.

[21] (1) Excerpts of Ltr from DeWitt to Marshall, 4 Jun 41. 600.1 (Alaska) pt. I. (2) Ltr, Nold to C EHD, 7 Aug 57. EHD Files.

[22] (1) *Ibid.* (2) Ltr, Marshall to Stark, 19 Aug 41. WPD 4503-3. (3) Memo, WPD for Marshall, 16 Aug 41. WPD 4503-4.

General Schley received additional funds to complete previously authorized construction. Meanwhile, DeWitt directed Buckner to prepare, in co-operation with the North Pacific Division and the 13th Naval District, a comprehensive program to strengthen further the defenses of the Territory.[23] "Actual pressure," Talley wrote later, "commenced . . . on the 4th of July 1941, when an alert came to Brig. Gen. Simon Bolivar Buckner, Jr., . . . from that date the tempo changed and Alaska was psychologically and mentally prepared for war. . . ." [24]

The small number of engineer troops continued working on major defense installations. The 32d engineers, immediately after 4 July, began building tactical roads and bombproof shelters at Fort Richardson. At Annette the 802d Engineer Aviation Battalion was fully occupied developing the airfield, especially after DeWitt directed that the runways be lengthened to 7,500 feet. The men were confident that they would have one of the runways ready by the end of the year. At Yakutat the 807th Engineer Aviation Company was making further improvements. On 30 July, DeWitt ordered the unit to construct a third runway and lengthen the two already partially completed; by mid-August, Yakutat had limited runway facilities. During August and September, part of the 1st Battalion of the 151st Combat Engineers reached Alaska to take care of maintenance at Ladd Field and various other Army installations from Dutch Harbor to Sitka.[25] So far, the engineers, their jobs restricted to a few coastal areas, had encountered no major difficulties. "There was cold, rain, 'muskeg,' ice, and snow." Talley observed, "and engineer troops . . . many the first time away from New York—but no other problem *per se*." [26]

Contractors and hired labor were also making progress. By midsummer, runways at Ladd and Elmendorf were operational. Ladd was a comparatively small installation with permanent housing for 560 officers and men. Elmendorf was the largest military base under construction in the Territory. In July the West Construction Company began work on the railroad cutoff. Much preliminary labor was required—unloading supplies and equipment, erecting camps, putting through access roads, and grubbing the right of way. Blasting began in August on the two and one-half mile tunnel at the eastern end of the line. In September the Seattle District advertised for bids for the construction of a dock at the terminus of the cutoff. In addition, work had begun on those aircraft warning stations which had been approved almost a year before, and survey crews were investigating sites for other stations.[27]

---

[23] (1) Watson, *Chief of Staff*, p. 457. (2) Table, Incl to AG Ltr 320.2 (5-6-41) MC-E-M, 15 Jul 41. WPD 4297-1. (3) Memo, WPD for TAG, 9 Jul 41. WPD 3512-120.

[24] Ltr, Talley to C EHD, 6 Nov 57. EHD Files.

[25] (1) Orgns Hists, U. S. Army, Alaska. C12027, KCRC. (2) Ltr, DeWitt to Park, 30 Jul 41. 686 (Annette Island, Alaska), 1940-41, vol. I. (3) In mid-June 1941 the 28th Engineer Aviation Regiment was disbanded. Men and material from the regiment were used to activate the 802d Engineer Aviation Battalion and the 807th Engineer Aviation Company.

[26] Ltr, Talley to C EHD, 6 Nov 57.

[27] (1) Ltr, Schley to Hon. J. Buell Snyder, HR, 6 Aug 41. 600.1 (Alaska) pt. 1. (2) Seattle Engr Dist, Monthly Rpt of Opns, Jul-Sep 41. (3) Ltr, Seattle Engr Dist to OCE, 27 Sep 41. Last two in

Many projects which had been planned did not get under way. During the summer, DeWitt wanted to start construction on the storage tanks for reserve gasoline. Work had been deferred pending further investigation. Storage for five million gallons was to be provided in Alaska, over four million of it near Anchorage, but no final decision had been made regarding the remainder. The Air Corps wanted to put much of it near various airfields, with maximum dispersion and concealment. Discussions continued over building landing fields on the Alaska Peninsula and in the Aleutians. In July, DeWitt suggested putting in a field at Port Heiden and another at Cold Bay, the latter near the tip of the peninsula. He pointed out that the airmen would need more extensive facilities than those being planned by CAA, so that longer runways and hard surfacing would be necessary. He asked that the Engineers be made responsible for building the fields on the Alaska Peninsula. In August the Joint Planning Committee recommended that the Army construct an airfield on Umnak. The Joint Board postponed making its decision because it wanted the engineers first to survey the island to determine if the sites were as suitable as they seemed. Late that month a group of engineers from the Seattle District began a reconnaissance of Umnak and of Unalaska as well. Construction would have to wait until their reports were in.[28]

General Buckner, who had repeatedly requested the War Department for authority to have an engineer on his staff, was authorized in September to appoint Nold. Nold took up his new duties at the close of the month, and during the next few weeks became fully aware of how far the defense build-up still had to go. Ladd, Elmendorf, and Yakutat were operational and refinements were being put in, while Annette was expected to be operational shortly. The CAA fields were coming along fairly well. The Army posts at the naval stations were under construction. Work was progressing slowly on the aircraft warning stations which had been started in the summer, but other projects were, as before, still in the planning stages. On 6 October Colonel Dunn in his preliminary report summarizing the findings of the engineers who had made the surveys for airfield sites in the Aleutians, pointed out that no suitable sites had been found on Unalaska, but Umnak had several which looked promising. Visiting Alaska in the fall, Maj. John F. Ohmer, Jr., of the Office of the Chief of Engineers, an expert in camouflage, found that almost nothing had been done to conceal military installations. He recommended planting trees, using camouflage nets, and painting structures so that they would blend in with their surroundings. Soon thereafter DeWitt had buildings painted in three colors in place of the standard ivory previously directed by the General Staff. In midfall, Alaskan defenses still needed a great deal of work.[29]

617 (Alaska). (4) DF, WPD to TAG, 6 Sep 41. WPD 3640–6.

[28] (1)Ltr, DeWitt to TAG, 15 Jul 41. 600.1 (Alaska) May 40–Oct 41. (2) Ltr, DeWitt to TAG, 25 Jul 41. 600.1 (Alaska) 1940–47. (3) Memo, WPD for SGS, 31 Oct 41. WPD 4503–4. (4) WD Ltr (AG 600.12) (9–23–41) MO–E to CofEngrs, 24 Sep 41. 600.1 (Alaska) May 40–Oct 41.

[29] (1) Ltr, DeWitt to TAG, 16 Jul 41. WPD

Hawaii

Upon assuming his post as department commander in February 1941, General Short began to push especially the program of airfield expansion. During the first months of 1941 Congress did not appropriate large funds for airfields in the Islands. In its Fourth Supplemental Appropriation for the fiscal year 1941, passed on 17 March, it allotted $108,410 for officers quarters at Hickam Field, but in the Fifth Supplemental, passed on 5 April, no funds were included for airfields in Hawaii.[30] Short believed large sums would be necessary. "The development of adequate airfields for the rapidly expanding Hawaiian Air Force is essential," he wrote to Marshall on 2 May. "An effort has been made to develop these fields through use of troop labor and WPA, but this is entirely too slow and uncertain." Short asked for some $17 million for airfields to insure "satisfactory operating conditions." He wanted $10 million of the total for use as a general fund "to finance necessary projects as the need for them occurs," adding that "the situation has progressed to such a point that we can no longer afford the delay in time which has heretofore been required to secure appropriations by Congress after the projects have been approved."[31] Old fields were to be modernized and new ones made available. First priority was to be given those with runways that could be extended to at least 5,000 feet for use by heavy bombers; later, lengths were to be increased to 6,000 feet. In addition to the effort on the airfields, more work would be necessary to house the increased garrison, improve roads, build fortifications, and otherwise strengthen the Islands.

Lyman continued to labor under the handicap of insufficient personnel. His staff consisted of but two officers, eight enlisted men, and four civilians. With construction for defense expanding, WPA labor was almost impossible to get. Lyman needed more troops. The 3d Combat Regiment, still the only engineer unit in the Islands, was spread thin. On 1 April, Lyman wrote General Schley that the engineers made up only about 3 percent of the garrison of 30,000 instead of the more normal 8 to 10 percent. In view of the growing importance of air power, the Hawaiian Department especially needed aviation engineer units. More combat engineers were required for work on roads and trails, fortifications, and cantonments. There was a growing shortage of equipment. Lyman's requests were partly met with the arrival, on 26 April, of the 804th Engineer Aviation Company. But prospects of getting more combat engineers or substantial amounts of machinery in the near future were not bright because the War Department had neither the one nor the other to spare.[32]

Colonel Wyman likewise was faced

4297-1. (2) Data from files of Mil Pers Div OCE. (3) Ltr, Dunn to Park, 6 Oct 41. 600.1 (Alaska) May 40-Oct 41. (4) Ltr, DeWitt to TAG, 30 Oct 41. 618.33 (Alaska).

[30] House Subcom of Com on Appns, 77th Cong, 1st sess, *Hearings on Fourth Supplemental National Defense Appropriation Bill for 1941*, p. 158.

[31] Ltr, Short to Marshall, 2 May 41. Engr AGF PAC.

[32] (1) Ltr, Herron to TAG, 6 Feb 41. 320.2 (3d Engrs) 251/1. (2) Ltr, Lyman to CofEngrs, 1 Apr 41. Engr AGF PAC. (3) Hist of the 804th Engr Avn Bn.

with a growing construction program and inadequate means for carrying it out. The transfer of work for the Air Corps added to his burdens. In January 1941 he began to reorganize the district office so as to be better able to supervise construction. In February he designated Maj. Bernard L. Robinson, his principal military assistant and executive, as operations officer. On Major Robinson henceforth fell the main responsibility for furnishing workmen, materials, and equipment to the widely separated areas where projects were under way. He was soon under constant pressure to insure the uninterrupted progress of the engineer effort in the Islands. To decentralize responsibilities for construction, Wyman established seven field areas in the first months of 1941.[33]

Using data furnished by Maj. Gen. Frederick L. Martin, commander of the Hawaiian Air Force, the Honolulu District office prepared plans for improving old airfields and putting in new ones. Eight were to be enlarged and modernized and two new ones added. Wyman and Martin, while awaiting expected approval from Washington, were anxious to get work started on the airfields. Little money was available for such work, and until more was forthcoming from Washington, only stopgap measures could be used. Wyman had inherited rather meager funds from the quartermaster with which to build temporary barracks at three fields—Hickam, Wheeler, and Bellows. He could enlarge the two military fields on the outlying islands—Morse on Hawaii and Barking Sands on Kauai—with funds supplied by WPA. He could improve the four territorial airports—Burns, Hilo, Molokai, and Maui—with money from CAA. These resources would have to do until Congress appropriated more funds as requested by Short. But even stopgap construction would require more workmen, substantial quantities of equipment, and large amounts of supplies.[34]

For some time the War and Navy Departments had been making plans for storing reserves of 100 octane aviation gasoline for use in wartime. In 1940, the Joint Board had advised construction of storage facilities at eight places, four of them in the United States and four in overseas territories. The board recommended putting in storage for 100,000 barrels in Hawaii, a recommendation approved by the Secretaries of War and the Navy. With the transfer of construction for the Air Corps to the Engineers, Wyman became responsible for this job in the Islands. Since the reserves were to be used only if shipments from the United States were cut off, two considerations were uppermost. One was that the sites selected would make reasonably certain the expeditious delivery of gasoline in time of need. The other was that protection against aerial and naval bombardment would be adequate.[35]

There were two good sites on Oahu,

[33] Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 940–41, 1113.

[34] (1) Ltr, Wyman to SPD Engr, 2 Jun 41. Engr AGF PAC, 686. (2) Memo, Asst Dept Engr for Lyman, 18 Mar 41. Engr AGF PAC.

[35] (1) WD Ltr, AG 463.7 (12–16–40) M–D to CofEngrs, 3 Jan 41. (2) Ltr, Short to TAG, 3 Apr 41. Both in Engr AGF PAC.

one on a ridge at Aliamanu Crater and the other in the side of a steep cliff in Waikakalaua Gulch, two and one-half miles east of Schofield Barracks. The question arose as to how much bombproofing was necessary. Many felt that only completely bombproof storage was practical, while others, believing that complete bombproofing would take too much time and money, urged concealment and protection against light incendiary bombs and bomb fragments only. The District Office reported in June 1941, after an exhaustive study of the problem, that concealment and partial protection were of little value. Complete concealment was impossible because any region on Oahu could be readily identified from the air, and saturation bombing would quickly destroy a lightly protected installation. It would be fairly easy to provide enough "cut and cover" protection to withstand hits from one-ton bombs, the largest used up to that time. Required would be a concrete cover about 6 feet thick, topped with earth. But with larger bombs undoubtedly soon to be used, the question arose as to how much additional protection would be necessary. Only tunnels under 75 feet of solid rock would provide sure protection. Wyman believed the safety provided by tunnels justified the higher cost of construction and the longer time required to finish the work. How much storage should be provided had not been decided. Although the Joint Board had recommended 100,000 barrels, Congress, in the Fifth Supplemental, authorized construction for 250,000 barrels. Then the Navy requested storage along with the Army and allotted $200,000 for the project, but did not specify how much storage it wanted or where it wanted it. As with other defense work, there was the problem of rising costs. Originally estimated at two dollars per barrel, by January the cost for constructing storage had gone up four dollars and, by May 1941, to six.[36]

While concerned with many new projects, Wyman still had to give a good deal of thought to old ones. A matter of importance was the improvement of Honolulu harbor. The city's port facilities had been gradually expanding northwestward. New areas were being developed around Kapalama Basin, lying between the mainland and offshore Sand Island. On 17 October 1940, Congress had authorized the dredging of Keehi Lagoon north of the island to provide a landing place for seaplanes, a project which came under the category of improving rivers and harbors. Primarily of commercial value, the improvement would also benefit the armed forces. The work, financed by CAA, was being carried out by the Engineers. Linked with the dredging of the seaplane basin was the construction of John Rodgers Airport, which was to be built just east of Hickam on the northern shore of Keehi Lagoon, partly on land dredged from the sea bottom. Construction was authorized in May 1941, and preparations were soon being made to begin work. The engineers made little headway on the aircraft warning stations. In May, after Short had decided that a larger number of stations would be

[36] (1) Ltr, Short to TAG, 3 Apr 41. (2) Rpt, Wyman to CofEngrs, Definite Proj Rpt for Installation of War Reserve Avn Gas Storage in Hawaiian Islands, 23 Jun 41. (3) Ltr, OCE to SPD Engr, 19 May 41. All three in Engr AGF PAC.

needed, twelve were authorized, half of them to be mobile. Negotiations with the National Park Service over permission to build on Haleakala were proceeding slowly.[37]

Responsible for more and more construction, Wyman awarded additional cost-plus-a-fixed-fee contracts. On 19 May he signed one in the amount of $1,801,159.70 with the Territorial Airport Contractors, a joint venture including W. E. Callahan Construction Company, Gunther & Shirley Company, and Paul Grafe. This group was to improve the territorial airports with funds supplied by CAA. He signed an agreement with the engineering firm of Sverdrup and Parcel of St. Louis, Missouri, for the preparation of designs for bombproof shelters; this firm was also to do field engineering and supervise some of the work at the territorial airports. For most of the additional construction, Wyman made supplemental agreements with the Hawaiian Constructors, enlarged in May with the addition of Ralph Woolley and Company, a prominent contracting firm of Honolulu. In June 1941 he made such an agreement with the Constructors for cut and cover bombproof storage for 200,000 barrels of reserve gasoline in Waikakalaua Gulch. A tunnel had been considered, but the contractors had estimated it would take twenty months to complete the job, whereas cut and cover construction could be finished in eight at considerably less cost. Nothing was being planned for Aliamanu Crater, but Wyman asked that funds be provided so that work could begin there for storage for the Army and Navy. On 19 May the original contract with the Hawaiian Constructors was modified. Complying with a recent directive from Under Secretary of War Robert P. Patterson for streamlining administrative and auditing procedures, Wyman took over such functions as timekeeping, preparing payrolls, and procuring supplies. The contractor would henceforth be responsible only for construction. Wyman's added responsibilities made an ever larger district organization necessary. By mid-1941 there were 10 officers and 401 civilians in the Honolulu office and three officers and 220 civilians in the field.[38]

In June, Lyman received the first of the additional combat troops he had been requesting. That month, the 34th Engineer Combat Regiment was activated in the Islands, its cadre furnished by units in the Hawaiian Department. Bringing the 34th up to full strength would take some time, since most of the men for the organization were not expected to arrive from the United States until several months later. Meanwhile, efforts were being made to bring the 3d Engineers up to full strength and steps were taken to increase the number of aviation engineers. Plans called for expanding the 804th from a company into a battalion by 15 July.[39] Slowly the defenses of the Islands were being built up.

[37] (1) Arthur D. Llewellyn, "Honolulu Harbor," *The Military Engineer, XXXIX* (February, 1947), 51–53. (2) Rpt [Brief History of the Air Warning Service] n.d. Engr AGF PAC.

[38] (1) Ltr, Asst Dept IG Hawaiian Dept to Short, 4 Nov 41. Engr AGF PAC, 333, IG Rpts (Gen). (2) Ltr, D. C. Wolfe of Sverdrup and Parcel to Hawaii War Rcds Depository, 21 Jan 46. Hawaii War Rcds Depository. (3) Ltr, Wyman to Schley, 24 Jun 41. Engr AGF PAC.

[39] Ltr, Short to TAG, 5 Aug 41. 381 (Hawaii) 113/1.

By midsummer, the Engineers could point to considerable progress in construction in the Islands. The Hawaiian Constructors were at work on five military airfields—three on Oahu, one on Hawaii, and one on Kauai—jobs expected to be finished by the end of the year. Improvement of the territorial airports with CAA funds, just getting started and about 5 percent complete, was to be finished by July 1942. The Constructors were beginning work on coastal defenses, including emplacements for 155-mm. and 240-mm. guns, fire control structures, storage for ammunition, and access roads. Meanwhile, they had made a start on the aircraft warning stations which, along with the coastal defenses, were to be completed by 1 November. The Honolulu District continued dredging Kapalama basin and expected to complete this job by the end of the year.[40]

Still in the planning stage was the underground storage for reserve aviation gasoline. Much confusion developed over this. The Hawaiian Constructors had been ready to start work at Waikakalaua Gulch late in June on cut and cover construction for 200,000 barrels. Investigations at Aliamanu Crater indicated that only a tunnel would be practicable there. General Short and Rear Admiral Claude C. Bloch, Commandant, 14th Naval District, wanted storage for 83,000 barrels at the crater. A pipeline would connect the two installations with the airfields. Since no funds had been received for construction at the crater, Wyman asked General Schley for authority to proceed.[41]

The Office of the Chief of Engineers had misgivings about the whole project. The bombproof storage being planned for Hawaii "would require an impractical amount of cover." Concealment and protection against light incendiary bomb and bomb fragments was all that could reasonably be provided. Aviation gasoline should be placed underground, but for concealment only. Brig. Gen. Eugene Reybold, Assistant Chief of Staff, G–4, advised General Schley that it was "desired that the full amount of storage be provided on the basis of the established construction policy rather than a smaller amount of storage having a greater degree of protection."[42] In September, Schley accordingly informed Wyman that plans providing for the added protection would have to be revised. OCE sent three specialists from the oil industry to Honolulu, where in October they consulted with Wyman and helped revise construction plans. Meanwhile, no work was being done at either site.[43]

While Wyman was struggling with construction, Lyman was trying to get more troops and put his units on a war footing. Repeated requests went to the War Department for more men. The activation of the 34th Combat Regiment and the expansion of the 804th into a battalion with an authorized strength of

[40] Ltr, Wyman to CofEngrs, 14 Aug 41. Engr AGF PAC.

[41] (1) Ltr, Wyman to CofEngrs, 24 Jun 41, with 2nd Ind, CofEngrs to TAG, 26 Jul 41. (2) Interstaff Routing Slip, Dept Engr to G–4 HD, 11 Jul 41. Both in Engr AGF PAC.

[42] 2d Ind, TAG to CofEngrs, 3 Sep 41, basic unknown. Engr AGF PAC.

[43] 3d Ind, CofEngrs to SPD Engr, 9 Sep 41, basic unknown. Engr AGF PAC.

656 officers and men in July only partially met the need for more manpower. More aviation engineers were urgently needed. Heavy construction equipment was in short supply, especially concrete mixers, compressors, and power shovels. Much of the machinery on hand would be worn out before the defense program was completed.[44] "In previous planning for an emergency," Short wrote to the Adjutant General on 5 August, "much reliance had been placed upon the availability of . . . equipment in the hands of local contractors and plantation owners"; now, because of the demands of defense construction, equipment was fast wearing out and, as Short explained, "Manufacturing and transportation bottlenecks are making it extremely difficult for both contractors and plantation owners to obtain needed replacements." [45] The reply from Washington was not encouraging. Reybold informed Short that "no action is being taken at this time with reference to provision of special or additional Engineer equipment for the Hawaiian Defense Project. It is desired that a listing of additional equipment required . . . be submitted for further consideration. . . ." [46]

Most of the men for the 34th and 804th Engineers reached Hawaii in the fall. Now at almost full strength, the 34th took over the Hawaiian Division's job of improving roads and trails on Oahu. Routes leading to searchlight positions and 155-mm. gun emplacements had highest priority. Most of the aviation engineers went to Wheeler and Hickam Fields. From time to time, detachments were assigned to other fields on Oahu and the outlying islands. On 1 October the square Hawaiian Division was converted into two triangular divisions—the 24th and the 25th. The 3d Engineer Regiment was split into the 3d and 65th Battalions, which were assigned to the new divisions. Both units continued on the same tasks, with the 65th engineers working mainly on beach defenses and trails in the southern half of Oahu, and the 3d engineers, in the northern.[47]

Plans had long since been prepared for mobilizing the entire engineer service in case of an emergency. Under the Mobilization Plan of the Hawaiian Department, which would go into effect if an attack on the Islands was launched or appeared imminent, Colonel Lyman would have over-all responsibility for using troops and civilians on engineer tasks as required. He would assume control over the Honolulu District office and the organization of the zone constructing quartermaster. He would be responsible for taking over vital civilian utilities and industries to insure continued operation. The mobilization plans called for recruiting some 12,000 civilians who would work under the supervision of the department engineer. Lyman's staff developed in detail the type of engineer organization which would be set up in case hostilities occurred. Vehicles, equipment, and supplies would be requisitioned from local

[44] Hist of the 804th Engr Avn Bn.

[45] Ltr, Short to TAG, 5 Aug 41. Engr AGF PAC, 381 (Hawaii) 113/1.

[46] 1st Ind, 4 Sep 41, on Short's Ltr, cited in preceding note.

[47] (1) HD GO No. 71, 4 Nov 41. (2) HD GO No. 53, 16 Sep 41.

factories and from sugar and pineapple plantations.[48]

The engineers were at work on plans for better protection of the Islands against air attack, even though Army and Navy commanders at this time seemed to think the chance of such an attack was remote. Capt. James A. Ostrand, Jr., commander of the 804th, together with members of his staff, made a study of the role the aviation engineers would play in case of an aerial assault. For planning purposes, Ostrand assumed that both the USSR and Great Britain would be defeated, and that Japan would have preponderant power in the Pacific. An air attack on the Hawaiian Islands would be possible. There might be an assault by paratroopers, with landings by amphibious forces not to be ruled out. The airfields, a major objective of the enemy, would have to be defended by infantry and engineers. The infantry would try to repel any paratroops or amphibious forces, while the engineers would block the approaches to the airfields with demolitions and obstacles, maintain and repair runways, and put up camouflage. If necessary, they would destroy fields which had to be abandoned. At each field an engineer force of one officer, four noncommissioned officers, and 200 civilians would be required. Considerable engineer work would be necessary in advance to prepare airfields for defense. It would take time to build plane pens, pillboxes, and barbed wire entanglements, ready fields for demolitions, and disguise them with camouflage. Lyman on 10 October approved the over-all plan, which he believed might be especially valuable in the defense of the fields on the outlying islands. He recommended to the Chief of Staff, Hawaiian Department, that the plan of the 804th be adopted.[49]

More emphasis was being put on camouflage. Much study and experimentation would be needed before military installations in the Islands could be hidden effectively. Early in 1941, the engineers began training commissioned and noncommissioned officers at a number of installations and helped plan camouflage treatments. Various groups were making experiments. The Camouflage Section of the 3d Engineers was successful in developing a paint that would not show up as paint on photographs made with infrared filters. On two of the oil tanks at Pearl Harbor the men painted trees which did not appear as camouflage on pictures made with specially equipped cameras. Several men of the 804th prepared a plan for camouflaging Wheeler Field with netting. Hickam could not be effectively concealed unless Pearl Harbor were included. The engineers discussed with a number of naval officers plans for camouflaging this crucial area. The consensus was that about forty-five machines of the type used in Hollywood for producing fog effects in motion pictures would be enough to hide Pearl Harbor and Hickam. Some progress was made

[48] (1) An. No. 12 to Mobilization Plan, HD Engr (Revision 1940). (2) Interoffice Routing Slip, Lyman to G–4 HD, 21 Nov 41. Both in Engr AGF PAC.

[49] (1) Conn, Engelman, and Fairchild, *Guarding the United States.* (2) Hist of the 804th Avn Bn. (3) Memo, Lyman for CofS HD, 10 Oct 41. Engr AGF PAC 600.12 (Gen). (4) Hq 804th Engr Avn Bn (Sep), 8 Oct 41, Rpt, Avn Engrs and the Defense of the Hawaiian Islands. Engr AGF PAC.

in camouflaging a number of gun positions with netting or by planting trees and shrubbery. Very useful in this connection was the hau tree, which could be made to grow in almost any direction and within a year produced branches thirty feet long. Extremely difficult to camouflage were command and observation posts on mountain and hill tops. The most effective expedients for breaking up sharp outlines were the construction of false rock formations and the planting of cacti. On the whole, because Washington, despite requests, provided few funds for camouflage, little effective work was done. There was almost no co-ordination with respect to camouflage among the various units of the Army and no over-all plan. Trees planted to conceal an installation would be removed a few weeks later to make room for a new building. Runways, taxiways, and hardstands being built at Bellows and at other fields in the usual manner could be easily identified from the air.[50]

The Air Ferry Route

In the fall of 1941 a new route was needed to ferry heavy bombers from the United States to the Philippines. The existing one by way of Midway, Wake, and Guam, traversing the Japanese mandated islands, was dangerously exposed. A more secure route would be by way of the islands of the South Pacific and Australia. On 4 October the War Department directed Short to begin work on fields in the South Pacific and to have them finished as soon as possible, as the matter was urgent. "It must be thought of in terms of weeks and not years," he was told. "Every possible expedient must be visualized and utilized. . . ." [51] The General Staff charged General Reybold, who succeeded Schley as Chief of Engineers on 1 October, with construction of the route. Reybold directed Wyman to carry out the work. An initial sum of $5 million was allotted. General Short, after conferences with members of his staff and with Admiral Bloch, in mid-October ordered construction at Christmas Island, Canton Island, Fiji, and New Caledonia; in Australia at Townsville or Rockhampton and Darwin; and at Fort Stotsenburg in the Philippines. At each place, at least one 5,000-foot runway suitable for heavy bombers was to be built. Short set 15 January 1942 as the date for completion of the first runway at each field. Thereafter other facilities were to be finished as soon as possible. Each site would ultimately have three runways at least 7,000 feet long and 200 feet wide. Storage for gasoline and buildings for servicing crews would be provided later. The project was given an A–1–a rating, the highest at that time. Wyman considered this his most important job.[52]

Wyman and his staff knew little about the islands of the South Pacific, except two—Canton and Christmas, which were owned jointly by the United States and

[50] (1) Rpt, Lt Col R. C. Williams, 3d Engrs, 13 Nov 40. (2) Rpt, Maj John F. Oliver, Jr., 11 Jul 41. Engr AGF PAC.

[51] WD Ltr, AG 580.82 (9-30-41) MC-G to CG HD, 4 Oct 41. Engr AGF PAC, 686 (Ferry Route) 1.

[52] (1) Ltr, SPD Engr to CofEngrs, 17 Oct 41. (2) Ltr, Chief Finance Sec OCE to the Priorities Com ANMB, 20 Oct 41, with 1st Ind, 20 Oct 41. Both in Engr AGF PAC, 686 (Ferry Route) I.



GENERAL REYBOLD

Great Britain. CAA had already prepared plans for building an airfield on Canton, and its survey was available to the Engineers. To get more up-to-date information on Christmas, Wyman on 16 October prepared to send out a survey detachment. The next day Short and Wyman agreed that construction on Christmas would be done mainly by the men of the 804th, assisted by civilians; on Canton, by the Hawaiian Constructors under a supplemental agreement to their contract, aided by a few troops. To get firsthand knowledge about the more distant sites, Wyman sent two officers, Maj. Roger M. Ramey of the Air Corps and Capt. Stanford MacCasland of the Corps of Engineers to make a reconnaissance. They set out by Navy seaplane on 18 October, and the same day a party of officers and civilians left by ship for Christmas to investigate conditions on that island and make preliminary preparations for construction. On 21 October an engineer from the district office left by clipper to make a reconnaissance of Canton. Wyman, meanwhile, began securing supplies and equipment. Requiring at least one supply ship based on Honolulu, and finding the Navy short of ships, Wyman chartered an interisland steamer, the *Haleakala.* The Hawaiian Constructors began to purchase plant and supplies in the United States and to recruit workers in San Francisco and Los Angeles.[53]

Ramey and MacCasland sent back optimistic reports. The word from Canton was that "the only acceptable site looks excellent from an airman's point of view." The setup in Fiji was "about perfect." The defenses of that British Crown Colony were being strengthened by New Zealand, which was developing an airfield, Nandi, on Viti Levu, the largest island of the group. On New Caledonia, there might be some difficulties. Here, a field at Tontouta, about 30 miles north of Nouméa, the capital, did not look very good, but other fields on the island held promise.[54] Ramey reported from Australia late in October that he had found two good runways at Townsville. The British, French, and Australian authorities agreed to do the construction in their territories.[55]

On 6 November, Mr. Leif J. Sverdrup,

[53] (1) Ltr, Short to TAG, 22 Nov 41. (2) Rad, Wyman to CofEngrs, 23 Oct 41. Both in Engr AGF PAC, 686 (Ferry Route) I.

[54] Memo, CofS Hawaii Air Force for ACofS G–4 HD, 28 Oct 41. Engr AGF PAC, 686 (Ferry Route) I.

[55] Ltr, Short to TAG, 22 Nov 41. Engr AGF PAC, 686 (Ferry Route) I.

president of Sverdrup and Parcel of St. Louis, Missouri, arrived in Honolulu, and that same day signed a cost-plus-a-fixed-fee contract for architect-engineer services in connection with the ferry route on the British- and French-owned islands and Australia. The next day he and Major Robinson left for the South Pacific to establish the necessary liaison with the local governments. At this time the War Department informed Short that General Douglas MacArthur, commanding U.S. forces in the Philippines, would be responsible for work on the fields west of New Caledonia.[56]

On 18 November 4 officers and 145 men of the 804th Aviation Battalion and 70 civilians of the Hawaiian Constructors and Honolulu District reached Christmas to join the group already there. In command was Maj. John E. Shield of the district office. About 1,350 miles south of Honolulu, Christmas, 35 miles long and 20 miles wide, was the largest coral island in the Pacific. The newcomers found it to be flat and generally only ten feet above sea level. At the western end was a sizable lagoon opening into the sea. The once numerous coconut plantations had been abandoned after the collapse of the copra market. In 1940 the population had been evacuated, but a British resident commissioner and 26 Polynesians had returned in April 1941 and had established two settlements at the mouth of the lagoon. There were a number of warehouses, a dock fifty feet long at high tide, and two residences, all inadequate for present needs. The roads were poor. The engineers would have to build not only runways but also piers, roads, and camps.[57]

On 3 November a transport, with about 130 troops and civilians headed by Capt. C. D. Baker aboard and towing four barges loaded with equipment and supplies, began the 2,000-mile trip from Honolulu to Canton. During the voyage two of the barges filled with water and had to be abandoned though some of the equipment was saved. On 14 November the ship reached its destination. Canton was a narrow strip of coral, enclosing a lagoon eight miles long and four miles wide. The land was covered with scrub; the lagoon, choked with reefs. An Englishman operated the radio station. Pan American Airways had a few facilities on the island. The first jobs were the construction of a temporary dock, the blasting of coral from the lagoon, the erection of shop buildings, and the surveying of the site for the runway.[58]

Meanwhile, work had begun on Fiji. In New Zealand and its possessions, governmental agencies constructed public works. Practically all the heavy equipment which would be needed for airfield construction was government owned. The most feasible solution was to lease or borrow the machinery and hire native workers. Sverdrup and Parcel's original architect-engineer contract was expanded to include supervision of construction. The Dominion authorities were most co-operative. Within thirty-six hours

[56] Ltr, Short to TAG, 22 Nov 41. Engr AGF PAC.

[57] (1) *Ibid.* (2) Rpt, Maj James A. Ostrand, Jr., 5 Nov 41. (3) Rad, Wyman to CofEngrs, 25 Nov 41. Both in Engr AGF PAC.

[58] (1) Ltr, Baker to Wyman, 17 Mar 42. (2) Ltr, Baker to Wyman, 30 Nov 41. Both in Engr AGF PAC.

after Ramey and MacCasland had made the survey for the route and discussed with Prime Minister Peter Fraser the desirability of improving Nandi field, work had begun. New Zealand even gave the project priority over all defense work being done in the Dominion itself. The Governor of Fiji issued a proclamation prohibiting the export of lumber and ordered sawmills to operate under direct orders of the government in order that sufficient lumber might be obtained locally. On 20 November several pieces of equipment arrived from the United States. The next day Sverdrup wrote Wyman that work had started at Nandi. In late November Capt. Carl F. Ende arrived from Honolulu to take up his duties as area engineer.[59]

Accompanying Captain Ende was 1st Lt. Richard P. Sauer, who went on to New Caledonia as area engineer for that island. Visiting Tontouta, Sauer found that the pessimistic report of Ramey and MacCasland was fully justified. One of the field's main drawbacks was that hills obstructed the approaches to the runways. When Sverdrup and Robinson arrived later, they inspected a field the French had started at Plaines des Gaiacs, about 150 miles northeast of Nouméa. They believed the runways there could be developed easily to minimum requirements. It was planned, consequently, to lengthen the runways at Tontouta for emergency use until the field at Plaines des Gaiacs could be gotten ready. Sauer discovered the Hawaiian Department had made no arrangements with the French High Commissioner for construction. Doing any work on the island would be out of the question until an agreement between the War Department and the Free French government had been signed. Since workmen sent over by the Australian Government at the request of the Free French were already improving Tontouta, Sauer asked the Australians to develop Plaines des Gaiacs until an agreement could be made by the American authorities and the Free French to permit sending in American workmen and equipment. The Australians agreed to complete Tontouta as an emergency field. They also made planes available for a reconnaissance of additional sites in the Solomons and New Hebrides, but they were unable to do anything at Plaines des Gaiacs because their resources were too slender.[60] Development of this important field would have to wait.

Supplies

Procurement of supplies and equipment for the burgeoning construction program in the Pacific outposts was increasingly hampered by various obstacles. Transportation bottlenecks began to plague the construction forces. After Congress appropriated funds for projects, it took three or four months to get materials from the United States to the outlying territories. Before long, procurement became entangled with the priorities system. In the summer of 1941, the Army and Navy Munitions

[59] (1) Ltr, Sverdrup to Wyman, 13 Nov 41. (2) Ltr, Sverdrup to Wyman, 21 Nov 41. (3) Ltr, Short to TAG, 22 Nov 41. All in Engr AGF PAC.

[60] (1) Sauer, Narrative Rpt, Airfield Constr. (2) Rad, Sverdrup to Short, 27 Nov 41. Both in Engr AGF PAC.

Board (ANMB) rated projects in Panama A–1–b; those in Hawaii, A–1–c; and those in Alaska, A–1–c or lower. Local commanders tried to get their priorities raised. In July, Short recommended that projects in Hawaii be given the same priority as those in Panama. He wanted especially to have an A–1–b rating for materials needed for the storage tanks for reserve gasoline, a request strongly supported by the Chief of Engineers. But ANMB refused to grant the higher rating. In July, all defense projects in Alaska were rated A–1–c. With this low rating, the Seattle District Engineer had great difficulty in getting materials, particularly steel and copper, all the more so since the Navy's Alaska projects enjoyed the top A–1–a rating. Because of the difficulty of winter delivery, it was essential that the bulk of construction materials be on hand by early fall. Under the current ratings, it would take several months or even a year to get delivery. On 9 August Colonel Dunn requested the A–1–a rating, stating it should be given at least for steel, spare parts, and similar items.[61] A few days later, DeWitt reminded the War Department that he had been instructed to alert the garrisons in the Territory and declared that the "defense of Alaska will be endangered" unless vital construction was helped in every way "during the short working season which is now rapidly dwindling." [62]

Although balking at first, the ANMB Priorities Committee on 4 September assigned an A–1–a rating to construction materials for military projects.[63] General Short was not so successful. The A–1–c rating remained in effect, except for the ferry route. Construction in Panama and Alaska was at this time apparently considered more essential than construction in Hawaii.

It was impossible to stockpile materials. Only after Congress had voted funds for a project could the Engineers place orders for the supplies. All materials shipped from the United States were to be used only on the project for which they were designated, a normal procedure in peacetime. To make possible building up reserves of materials and transferring them from one project to another as deemed necessary, efforts were made to change this system. In the meantime, the Chief of Engineers, in order to ease the supply situation in Hawaii, made an allotment of more than $1,000,000 to Wyman for the purchase of materials and equipment. In November, The Quartermaster General made available $400,000 to the Seattle District for a similar stockpile for work in Alaska. As materials were withdrawn, the Seattle District was to replace them with stocks purchased with funds allocated to the projects. Dunn planned to have the stockpile in operation before the spring of 1942. Still, these sums could not be used for building up stockpiles in any real sense because the money was to be used for the advance purchase of materials for authorized projects. Nor were

[61] (1) Ltr, Short to TAG, 28 Jul 41. (2) Ltr, Fiscal Br OCE to Col D. I. McKay, OCE, 29 Aug 44. Both in Engr AGF PAC. (3) Ltr, Dunn to Schley, 22 Jul 41. (4) Ltr, Dunn to Schley, 9 Aug 41. 161 Alaska (Preferred Rating).

[62] 2d Ind, DeWitt to TAG, 12 Aug 41, on Ltr, Dunn to Schley, 9 Aug 41.

[63] 5th Ind, ANMB Priorities Comm OCE, 4 Sep 41, on Ltr, Dunn to Schley, 9 Aug 41.

commanders in Panama more successful in getting authority to build up reserves.[64]

War Appears Imminent

Relations between the United States and Japan had reached a precarious state by October 1941. On the 18th of that month General Hideki Tojo, an advocate of an aggressive, expansionist policy, became premier of Japan. The American position regarding a settlement in the Pacific, hitherto unacceptable to Japan, remained unchanged. The Imperial Army and Navy were being put in a state of readiness to strike early in December. Last-ditch diplomatic negotiations for a peaceful settlement continued in Washington. Japanese intentions were known to the American negotiators because the Japanese code had been broken, but it was not known when and where Japan would attack. Still greater efforts would have to be made to improve the defenses of the triangle.[65]

Panama needed a good deal more work, even though much had been done. Since the summer of 1939 the cost of construction under the department engineer's supervision had increased from $1.5 million to $17 million. The number of workmen had risen from 1,000 to approximately 5,000. Despite the rains and shortages of men and equipment, work was being accelerated. By mid-November, the engineers had completed more than 100 magazines for storing ammunition and had almost finished the bombproof command post. They had placed the concrete foundations for small defense installations such as antiaircraft guns, had completed emplacements for medium caliber coastal guns, and were preparing plans for casemating large seacoast defenses. In the Panamanian Republic, engineer troops and civilians, and in some cases the using units themselves, were doing all military construction, except some housing at Rio Hato being built by the constructing quartermaster. The auxiliary airfields were being improved. By mid-November, Chorrera had two graveled landing strips. The 805th (which had been expanded into a battalion late in June) continued with construction of the auxiliary drome at Chame, and work was continuing at the two strips at La Joya. A major effort was necessary on the roads. The engineers were building about 225 miles of new paved routes and were resurfacing many existing ones. When completed, hard-surfaced roads would lead to over 100 searchlight positions and other installations. Continued maintenance was required, especially during the rainy season, "to preserve even a semblance of a road in the mountainous areas." A continuing bottleneck was the land acquisition question, since the places left vacant by the dismissal of the Panamanian members in the coup d'etat of October had not been filled.[66]

Alaska, had only a minimum of de-

[64] (1) Ltr, Moore to Short, 29 Sep 41. Engr AGF PAC. (2) Ltr, OCE to TQMG, 21 Nov 41. 400.291 (Stockpiles). (3) 1st Ind, TQMG to OCE, 26 Nov 41, to Ltr, Moore to Short, 29 Sep 41. (4) 1st Ind, Dunn to Park, 7 Nov 41, on Ltr, Park to Dunn, 29 Oct 41. 400.291 (Stockpiles).

[65] Kent Roberts Greenfield, ed., *Command Decisions* (Washington, 1960), pp. 103, 113.

[66] (1) Prelim Study, II, pp. 14–16, 254. (2) Ltr, Lt Col S. N. Karrick, IGD, to TIG, 20 Dec 41. G–4/27963–188.

fenses. With winter approaching the engineers would be able to do little more in the immediate future. In October and November, a group representing the War Department's General Staff divisions toured the Territory to see at firsthand how work was progressing. All were struck by the few defenses and by the lack of camouflage and concealment. Lt. Col. Nelson M. Walker, the G–3 officer, declared that construction in Alaska "invites disaster" from air attack because Army installations made such conspicuous targets and on the whole were inadequately defended, a view shared by most members of the group. On 4 December Lt. Col. James K. Tully of the War Plans Division made several recommendations for Alaska based on observations made during the tour. He urged particularly that construction, approved by the Joint Board a week earlier, be started at Umnak, Cold Bay, and Port Heiden, that Army camps be built at several fields under construction by CAA besides the ten with military priority, and that a number of roads be built as alternate lines of communication. To bring Alaskan defenses up to the level envisioned by the War Department planners would require much more engineer work. Completion of the airfields alone would take another summer season. "Full construction," in the opinion of Colonel Walker, "could only be accomplished within a year by a maximum, and most improbable, effort." [67]

In Hawaii, the contractors continued to improve the airfields. Crews were lengthening the runways, erecting permanent and temporary buildings, and constructing storage facilities for ammunition, gasoline, and water. Wheeler, Hickam, and the new Bellows airfield were getting longer and better runways. On the outlying islands, 6,000-foot strips were under construction or were being planned. But work on most of the other projects lagged. The aircraft warning stations were behind schedule. As expected, in some cases acquiring real estate took an inordinately long time. The Engineers had to negotiate with the National Park Service for almost a year before they were allowed on Haleakala. By late November progress was a little more encouraging. Housing for the station on Mount Kaala on Oahu was finished, and the station on Haleakala was almost completed. Kokee was about two-thirds done. Surveys for sites for the remaining stations were continuing. None of the stations were in operation and would not be for weeks to come because the Signal Corps' apparatus still had to be installed. By late November the revised plans for the reserve gasoline storage were complete and had been given to the Hawaiian Constructors, who were assembling equipment to start work shortly. Nine tanks, each with a capacity of 40,000 barrels, were later to be installed in Waikakalaua Gulch by the Hammond Iron Works of Warren, Pennsylvania. Three major projects for ammunition storage had been started. Two were being built underground—one at Wheeler Field and the other at Aliamanu Crater—while the third, consisting of igloos for storing minor ammu-

[67] (1) Memo, G–2 WD for ACofS G–2, 1 Dec 41. WPD 3512–148. (2) Memo, Walker for G–3 WD, 5 Dec 41, with Incl. WPD 3512–146. (3) Memo, Tully for WPD, 4 Dec 41. WPD 3512–148. (4) Conn, Engelman, and Fairchild, *Guarding the United States,* p. 244.

nition, was under way at Hickam. Work had begun on coastal defenses, principally the bombproofing of command posts, and a start had been made on railway gun positions.[68]

By December, Wyman had added ten supplemental agreements to the originally modest contract of the Hawaiian Constructors. The estimated cost of the work had risen from $1,097,673 to $19,545,557; the fixed fee, from $52,220 to $455,145. The Hawaiian Constructors, plagued with growing scarcities of men and materials, struggled to build up an organization capable of completing the defense projects. To fashion into a smoothly functioning force the relatively small number of workers who could be recruited required an extraordinary effort. Adequate supervision was difficult because the jobs were so widely scattered. The contractor's expanding organization was beset with numerous deficiencies, duly commented on by the inspector general of the Hawaiian Department after his investigation in September. Many property records kept by area clerks were incomplete and carelessly posted, while the handling of money and the keeping of accounts at many of the commissaries were unsatisfactory. The personnel and payroll auditing subdivision lacked proper coordination. To make matters worse, the using agencies often did not furnish exact information as to what they wanted, or, after construction had begun, requested changes in design. Wyman, trying as best he could to keep the construction effort on an even keel, held conferences every Monday morning with key men from the district office and the Hawaiian Constructors. At these conferences Wyman and the contractor's men tried to "iron out any problems that arose," with the district engineer constantly trying to impress on the contractors the need for speed. But even so, the difficulties he faced were great.[69]

Last Days of Peace

Prospects for an agreement between the United States and Japan seemed so slight that on 24 November the Navy informed its Pacific commanders that Japanese troop movements indicated a sudden attack could be expected "in any direction," and especially against the Philippines or Guam. Three days later, the Army told its commanders in San Francisco, Panama, Hawaii, and the Philippines of the imminence of war and directed them to undertake appropriate measures, keeping in mind that it would be desirable to have Japan strike the first blow. All but MacArthur were instructed "not to alarm the civilian population." [70]

At this critical juncture, it appeared that engineer work would soon reach its

[68] (1) Rpt, Wyman to CofEngrs, 5 Dec 41, sub: Semimonthly Rpt of Opns, Constr Progress, AC Stations 16–30 Nov 41. (2) Rpt, Wyman to CofEngrs, 4 Dec 41, sub: Monthly Rpt of Opns, AWS Detector Stations, Nov 41. (3) Ist Ind, Honolulu Dist Of to CofEngrs, 19 Sep 44, on Memo, Army Pearl Harbor Bd to CofEngrs, 1 Aug 44. (4) Ltr, Hq Ist Bn 15th CA to CO Harbor Defense of Pearl Harbor, 15 Dec 41. All in Engr AGF PAC.

[69] (1) Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 98off. (2) Ltr, Asst IG HD to CG HD, 4 Nov 41. (3) Rpt from Div Engr, Pac Div, to the Army Pearl Harbor Bd on Contract No. W-414-Eng-602 and Hans Wilhelm Rohl, Exhibit "B." Both in Engr AGF PAC.

[70] Greenfield, ed., *Command Decisions*, p. 117.

full stride everywhere except in Alaska. In Panama, the impasse over real estate was broken on 3 December when President de la Guardia appointed members to a new land board. The program of extending installations out from the Canal could begin in earnest.[71] In the Hawaiian Islands, where work was just getting well under way, coastal defenses were being steadily strengthened and airfields improved, the aircraft warning stations were nearing completion, and a start was about to be made on storage for reserve gasoline. Construction on the ferry route had begun. In Alaska—aside from the three airfields that were operational, and preliminary construction on some of the aircraft warning stations and the railroad cutoff—projects were still in the planning stage. Little could be done before spring.[72]

Besides building up the triangle's defenses, the Corps was increasing its troop strength, the figures for which were beginning to appear more encouraging. In Panama, there were 1,500 engineers in a total Army force of approximately 32,000—just under 5 percent. In Hawaii, the three combat units and the 804th engineers totaled some 2,800 men—about 7 percent of the 42,000 troops in the department. In Alaska, engineers totaled approximately 1,400 of some 21,000 troops in the Territory.[73]

At 5 minutes before eight o'clock on Sunday morning, 7 December 1941, Japanese planes appeared over Oahu without warning. Some made straight for the warships anchored in Pearl Harbor; others headed for the major Army and Navy airfields. In this attack, lasting about 30 minutes, dive bombers heavily damaged Hickam and Wheeler Fields and machine-gunned Schofield Barracks. At Schofield, a bomb exploded near the area occupied by the 34th Engineers, leaving a large crater. In a second assault, beginning at 20 minutes before nine and lasting about an hour, Bellows Field was also hit. No engineers were killed during these attacks, but a considerable amount of equipment was destroyed, especially at Hickam and Wheeler. At Bellows, although most of the planes on the field were demolished, no equipment was damaged. In both assaults, the attackers directed their most devastating blows against the Navy. They wrecked the bulk of the fleet at Pearl Harbor and partly destroyed the Navy's Kaneohe Seaplane Base in eastern Oahu and its Ewa

[71] Since the Panama Canal, considered a likely target in case of war with Japan, was, in fact, not attacked or directly involved in combat operations, the story of engineer work on the Canal and in the surrounding regions after the outbreak of hostilities has been omitted from the subsequent parts of this book. Information on engineer work in the Canal Zone and the surrounding regions after the outbreak of war to guard against possible attack from the Pacific may be obtained from a monograph on the subject prepared by the author and on file in the Historical Division, Office of the Chief of Engineers. Information on the acquisition of real estate may be found in Conn, Engelman, and Fairchild, *Guarding the United States and Its Outposts,* pp. 346–48.

[72] (1) Acquisition of Land, PCD, p. 40. (2) Honolulu Engr Dist to CofEngrs, 4 Dec 41, Monthly Rpt of Opns, AWS Detector Stations, Nov 41. (3) Honolulu Eng Dist to CofEngrs, 5 Dec 41, Semimonthly Rpt of Opns, Constr Progress AC Stations, 16–30 Nov 41. Last two in Engr AGF PAC.

[73] (1) Strength of the Army WD AGO Rpts. (2) The smaller proportion in Panama reflected the continued responsibility of the Quartermaster Corps there for much military construction. Erna Risch, *The Quartermaster Corps: Organization, Supply, and Services,* Volume I, UNITED STATES ARMY IN WORLD WAR II (Washington, 1953), p. 8.

Marine Air Station in the southwestern part of the island. The period of peacetime preparations for defense was a thing of the past. The United States was plunged into war.[74]

[74] (1) Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 24ff. (2) Wesley Frank Craven and James Lea Cate, eds., "The Army Air Forces in World War II, vol. I, *Plans and Early Operations: January 1939 to August 1942* (Chicago: The University of Chicago Press, 1948), pp. 197–98. For accounts of the attack on Pearl Harbor see (3) Conn, Engelman, and Fairchild, *Guarding the United States,* ch. VII, p. 1ff., and Samuel Eliot Morison, "History of United States Naval Operations in World War II," vol. III, *The Rising Sun in the Pacific, 1931–1942* (Boston: Little, Brown and Company, 1948), pp. 98ff.

CHAPTER III

The Fall of the Philippines

When Japanese fighters and bombers struck at the Philippines, a few hours after the attack on Pearl Harbor, the engineers in those islands were building airfields and strengthening fortifications. Mobilization of engineer units of the Philippine Army was under way, and stocks of supplies and equipment were being increased. After the Japanese landed, the engineers strove to delay their advance by blocking roads and wrecking bridges. They strengthened Philippine defenses by erecting field fortifications, keeping open lines of communication, providing maps, and building in rear areas. Toward the end, the engineers became infantrymen. Determined effort and devoted service could not prevent the tragic outcome. Like the other defenders of the Philippines, the engineers were not prepared to withstand the Japanese forces.

Before World War II it had not been U.S. policy to maintain a strong force in the Philippines, and, apparently, the War Department had no plan for sending reinforcements if war broke out. War Plan ORANGE–3 (WPO–3), the Philippine Department's defense plan being prepared in 1940, stipulated that if the American and the Filipino forces could not beat off an invasion at the beaches, they were to withdrew to Bataan Peninsula. (*Map 5*) There and on Corregidor they were to make a 6-month stand and thus deny the enemy access to Manila Bay. Although it was widely assumed that help would reach the beleaguered defenders within six months, WPO–3 made no mention of reinforcements from the United States.[1]

Late in 1940 the War Department's policy regarding the Philippines began to change. Among the men responsible for modifying the War Department's policy was Maj. Gen. George Grunert, who had become commander of the Philippine Department in June of that year. His insistent pleas for reinforcements at length led the War Department to make a beginning toward bolstering the islands' defenses. Also influential was General Douglas MacArthur, since 1935 military adviser to the Philippine Government. In February 1941 he informed Marshall of his rather extensive plans for building up the military forces of the commonwealth. There was henceforth an increasing emphasis in Washington on strengthening the defenses of the islands. By the summer of 1941 the General Staff believed the Philippines might be reinforced to the

[1] (1) Phil Dept Plan ORANGE, 1940 Rev (Short title: HPD WPO–3). AG 326. (2) Louis Morton, *The Fall of the Philippines*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1953), pp. 61–64.


PHILIPPINE ISLANDS
50 0 150
MILES
LUZON
Aparri
Tuguegarao
Vigan
Cagayan R.
San Fernando
Lingayen G.
Baguio
Agno R.
Carmen
Damortis
Bayombong
Cagayan R.
Tarlac R.
Tarlac
Cabanatuan
O'Donnell Field
Iba
Bamban
Sibul Springs
Pampanga R.
San Fernando
Clark Field
Manila
Tignuan R.
BATAAN
Laguna de Bay
BICOL PENINSULA
Del Gallega
Carlegidor
Los Banos
Pagbilao
Mariquina
Atimonan
Lubang I.
Legaspi
MINDORO
San Jose
SAMAR
MASBATE
PANAY
Iloilo
Tacloban
LEYTE
NEGROS
CEBU
Cebu
BOHOL
Puerto Princesa
PALAWAN
SULU SEA
Del Monte Field
MINDANAO
Malabang Field
Zamboanga Field
Davao
Archipelago
BORNEO
Sulu
CELEBES SEA
SOUTH CHINA SEA
PACIFIC OCEAN

point of not only being able to hold off an invasion, but also, of deterring Japanese expansion southward. Perhaps a deciding factor in altering American policy was the successful development of the B–17 heavy bomber. Now for the first time the Army had a weapon which, if based in the Philippines, could deliver effective blows against the Japanese.[2]

In line with the new policy of strengthening the Philippines, President Roosevelt on 26 July 1941 established in the islands an over-all command, United States Army Forces in the Far East (USAFFE). Headed by General MacArthur, who had been recalled to active duty in the United States Army, the command included both the Philippine Department and the Philippine Army. MacArthur had in mind not merely holding Bataan Peninsula and Manila Bay. With an increasing number of B–17's at his disposal and with a Philippine Army of some 125,000 men to be mobilized by the end of the year and an even larger force in prospect, he believed he could successfully defend the entire archipelago, provided he had time to complete his preparations. On 1 October he asked permission to prepare a new war plan to replace WPO–3, and early in November Marshall told him to proceed. The outbreak of war one month later found MacArthur in the midst of revising his plans for defense.[3]

[2] (1) Watson, *Chief of Staff*, pp. 417ff., 440. (2) Henry L. Stimson and McGeorge Bundy, *On Active Service in Peace and War* (New York: Harper and Brothers, 1947), p. 338. (3) Craven and Cate, eds., *Plans and Early Operations*, p. 125.

[3] (1) Ltr, MacArthur to Marshall, 1 Feb 41. AG 093.5. P.I. (7–2–40) (4). (2) Ltr, MacArthur to Marshall, 28 Oct 41. AG 350.5 (10–28–41) (1). (3) Morton, *Fall of the Philippines*, pp. 64–71.

Preparations for Defense

Plans and Appropriations

The decision to reinforce the Philippines placed a heavy load on the engineers. Col. Henry H. Stickney, an officer of long experience, who had become department engineer in May 1940, had only a small staff to supervise construction, supply, and map making. MacArthur had no engineer in USAFFE until October 1941, when Lt. Col. Hugh J. Casey arrived from the United States. Colonel Stickney thus directed the engineer effort during most of the prewar period. Construction was to be his first concern.

Earliest efforts were aimed at strengthening the harbor installations in Manila and Subic Bays. Guarding the entrance to Manila Bay were four fortified islands, Corregidor, Caballo, El Fraile, and Carabao. Guarding Subic Bay was Grande Island. Corregidor claimed the major share of attention. Construction there, begun in 1904, had continued until after World War I. The result was a maze of defensive works—tunnels, artillery batteries, communications centers, and shops. The island appeared to be impregnable against any probable naval attack, but little, if any, consideration had been given to defense against aerial bombardment. Corregidor's fortifications were becoming obsolete and the same was true of the defenses of the other fortified islands. During the twenties and thirties appropriations for the fortified islands were pitifully meager.[4] For

[4] The Tydings-McDuffie Act of 24 March 1934 provided for Philippine independence after a ten-year

the fiscal years 1939–41 inclusive, funds allotted to the Army for harbor defense projects amounted to but $39,000 annually; in May 1939, however, the Navy transferred $500,000 to the Engineers for the construction of tunnels on Corregidor. With this money, Maj. Lloyd E. Mielenz, the engineer in charge of fortification work at the harbor defenses, built two-thirds of a mile of concrete-lined tunnel. By stretching the Navy funds he was also able to provide Panama mounts (makeshift concrete mountings that permitted the trail of a field gun to be swung in a full circle), access roads for the big guns, and other minor improvements.[5]

War Plan ORANGE–3 linked Bataan Peninsula with the fortified islands in the defense of Manila Bay. Except for a few roads and trails, most of Bataan was virtually a wilderness. On 25 July 1940 Grunert, after outlining for the General Staff what he considered to be the "minimum requirements for an efficient defense" of the peninsula, requested $1,939,000 for roads, docks, and bombproof storage. Marshall replied that it was against War Department policy to put money into large projects of this nature.[6] Grunert nevertheless persisted, and in fact broadened his request to include $346,000 for the harbor defenses. He made little progress until early 1941, by which time the War Department's attitude had begun to change. In March of that year Congress appropriated $946,000 and in June $3,688,000 for work on Bataan and Corregidor. In November 1940 Major Mielenz had recommended that an interservice board be appointed "without delay to formulate a workable plan for modernizing the Harbor Defense protection against heavy shelling and aerial bombing." The commanding general of the Harbor Defenses appointed the board at once, and by early May 1941 it had prepared plans calling for underground protection, gas proofing, and air conditioning. This program was to cost $3,500,000 and take three years to complete. In June, Grunert submitted the plan to the War Department, but he received no money until early October.[7]

Airfields, according to General Grunert, were the most vital element in the defense of the islands.[8] In 1940 and early 1941 there were but two Army airfields in the Philippines—Nichols, just south

transitional period, during which the United States would have the right to "maintain military and other reservations and armed forces" in the islands, and the President of the United States would have the power "to call into the service of such armed forces all military forces organized by the Philippine Government." Morton, *Fall of the Philippines*, p. 4.

[5] (1) Ltr, CG Harbor Defense of Manila and Subic Bays to CG Phil Dept, 26 Oct 40. AG 600.12 (10–26–40) sec. 1 (1). (2) Col. Paschal Strong, "The Lean Years," *The Military Engineer*, XLI (May–June, 1949), 179–81. (3) Col L. E. Mielenz, MS, Engr Preparation for Defense of the Fortified Islands of Manila and Subic Bays (cited hereafter as Mielenz, Engr Preparation). SWPA File M343. (4) TM 20–205, 18 Jan 44.

[6] (1) Ltr, CG Phil Dept to TAG, 25 Jul 40. AG 600.12 (7–25–40) (1). (2) Memo, WPD for CofS, 14 Aug 40. (3) Rad, TAG to CG Phil Dept, 19 Aug 40. All three in AG 600.12 (7–25–40) (1). (4) WD Ltr AG 660.2 Phil Dept (9–9–37) (Misc)–E to CG Phil Dept, 22 Oct 37. 381 (Phils) 1934–45.

[7] (1) 1st Ind, CG Phil Dept to TAG, 1 Nov 40 on Ltr, CG Harbor Defense of Manila and Subic Bays to CG Phil Dept, 26 Oct 40. AG 600–12 (10–26–40) sec. 1 (1). (2) Mielenz, Engr Preparation. (3) Table, Funds Released to Phil Dept [Jul 41] with Ltr, C Constr Sec OCE to CG Phil Dept, 6 Aug 41. 600.1 (Phil Dept Airfields) 1941–42.

[8] Rad, CG Phil Dept to TAG, 25 Jul 41. AG 600.12 (10–26–40) sec 2 (1).

of Manila, and Clark, about 50 miles northwest of the capital. Nichols had the distinction of being the only military field in the islands with a paved runway. But this runway, like the turf strips at Clark, was too small to take B–17's safely. Indeed, there was not a paved runway in the entire Philippines that could accommodate a fully loaded B–17.[9] In October 1940 Grunert began to plan a network of modern military airfields. He envisioned 6 major fields—4 on Luzon and 2 on Mindanao—and a score of smaller ones dispersed throughout the islands. By July 1941 the War Department had obtained $2,773,000 for Grunert's projects.[10] MacArthur, after his appointment as Commanding General, USAFFE, insisted on an even larger sum. By October a total of $4,187,130 had been allotted for airfields in the Philippines, and MacArthur was calling for $5 million more. The War Department immediately allotted him three of the five million, and it promised him the rest in the near future.[11] Part of the construction was to be carried out by the Civil Aeronautics Authority and the Philippine Commonwealth, but the bulk was assigned to the Engineer Department.

[9] (1) Walter D. Edmonds, *They Fought With What They Had* (Boston, 1951), pp. 26–27. (2) Ltr, Stickney to Kingman, 28 Apr 41. 600.1 (Phil Dept Airfields) 1941.

[10] (1) Rad, CG Phil Dept to TAG, 30 Oct 40. (2) Rad, TAG to CG Phil Dept, 7 Dec 40. Both in 600.1 (Phil Dept Airfields) 1941–42. (3) Rad, CG Phil Dept to TAG, 12 Jan 41. AG 600.12 (10–26–40) sec. 1 (1). (4) DF, G–4 to CofEngrs, 3 Apr 41. (5) Ltr, C Constr Sec OCE to Dept Engr, Phil Dept, 6 Aug 41. Last two in 600.1 (Phil Dept Airfields) 1941–42.

[11] (1) Rad, CG USAFFE to TAG, 23 Oct 41. (2) Rad, TAG to CG USAFFE, 4 Nov 41. Both in AG 600.12 (10–26–40) sec. 20 (1).

By 30 November 1941, $4,654,350 had been turned over to Colonel Stickney for construction of airfields. To help protect not only the airfields but the islands themselves against attack, an air warning service was needed. During the latter part of 1941 Stickney received $265,000 to build ten warning stations and an underground information center.[12]

Construction Gets Under Way

By early 1941, the growing program threatened to overwhelm the engineer department. Stickney appealed to OCE for help. On 28 April he wrote to General Kingman that the department engineer's office had until recently been "a sleepy inactive place with two . . . American civilian employees, and was able to transact its business in a few hours each morning. It was similar to all other offices in this headquarters. There were no funds available for new work and all duties were routine." Now the situation had changed completely, and Stickney lacked the wherewithal to carry out a high-speed construction program. With but one regular officer to assist him, he considered personnel to be his "most crying need." The several reservists who had recently arrived from the United States were not acquainted with local conditions and required time "to take hold." Few American civilians were available and only limited use could be made of Filipinos. Stickney nevertheless succeeded in finding enough Reserve officers and civilian engineers to

[12] (1) Memo, WPD for CofS, 5 Feb 41. AG 600.12 (10–26–40) sec. 1 (1). (2) Dept Engr, Constr Progress Rpt for Semimonthly Period Ending 30 Nov 41. AG 319.1 (20 Oct 41) Phil Rcds.

form a skeleton organization in his office and in the field.[13]

The department engineer was anxious to get construction under way before the start of the rainy season, which, on western Luzon, where most of the work was to be undertaken, lasted from June to November. Unless started before the onset of the rains, construction would be almost impossible at some locations. Meanwhile, there was heavy pressure from General Grunert to get things done which everyone now felt "should have been done years ago." [14]

Formidable difficulties stood in Stickney's way. Among them were his remoteness from the United States and the necessity of having to deal with a semi-independent government. Contractors were scarce as were skilled labor, materials, and equipment. The engineer effort and an $11.5 million dollar building program under the department quartermaster's direction severely taxed the resources of the islands.[15] Some of Stickney's most serious difficulties arose from having to follow procedures designed for normal peacetime conditions. He was determined to overcome these obstacles, proposing "to do what is necessary . . . even though the regulations may be temporarily violated." [16]

Construction was in some instances held up by the long time required to obtain title to land. Although large projects such as those at Clark and Nichols were to be built on land already owned by the government, sites for many of the smaller jobs had to be acquired. Without the power to condemn, the department quartermaster was forced into protracted negotiations with land owners. Not until 21 October 1941 did MacArthur and President Manuel L. Quezon agree upon a procedure for breaking this bottleneck. Where few property holders were involved, titles were clear, and the land could be acquired at reasonable cost, USAFFE would continue to obtain land by direct negotiation; otherwise, the Philippine Government would expropriate the land. The agreement speeded up real estate transactions.[17]

Stickney did not have to look far for construction firms as there were only three in the islands with the equipment and experience necessary for doing work on a large scale within a reasonable time —the Benguet Consolidated Mining Company, Marsman and Company (also a mining firm), and the Atlantic, Gulf, and Pacific Company of Manila. The last was the only concern capable of building docks and erecting steel hangars. The two mining companies were specialists at tunneling but were not well equipped to handle airfield construction, though they volunteered to do this type of work in order to aid the defense effort. For less complicated projects Stickney could rely on Filipino contractors, who

[13] (1) Ltr, Stickney to Kingman, 28 Apr 41. 600.1 (Phil Dept Airfields) 1941. (2) Rad, CG Phil Dept to TAG, 29 Jan 41. 600.1 (Phil Dept Airfields) 1941–42.

[14] Ltr, Stickney to Kingman, 28 Apr 41.

[15] Figure for the QM program compiled from Dept QM Constr Serv, Constr Progress Rpt for Semi-monthly Period Ending 15 Nov 41. AG 319.1 (20 Oct 41) Phil Rcds.

[16] Ltr, Stickney to Kingman, 28 Apr 41.

[17] (1) Ltr, AG USAFFE to CG Phil Dept, 19 Aug 41. (2) Ltr, AG USAFFE to CG Phil Dept and CG FEAF, 21 Oct 41. Both in AG 601 (21 Jun 41) Phil Rcds. (3) Wendell W. Fertig, Guerrillero (MS), p. 12. SWPA Files.

generally had small staffs and little equipment. He could also hire workmen and organize a work force of his own. No troops were available. The only U.S. Army engineer unit in the islands in early 1941 was the understrength 14th Engineers (Philippine Scouts), a combat regiment of the Philippine Division, already engaged in improving tactical roads and trails on Bataan. In this situation, Stickney had to make the best use of the construction and engineering talent at his disposal.[18]

One obstacle to speed was the traditionally slow method of awarding lump-sum contracts by advertising for competitive bids. With so few large construction firms in the islands and with their capabilities quite well known to the department engineer, competitive bidding would cause needless delay. Besides, the tunnels the engineers were to construct on the fortified islands and Bataan were of a highly secret nature, the details of which it was not advisable to make public through advertising. Accordingly, on 2 May Stickney radioed to Washington asking authority to negotiate contracts. Under Secretary of War Patterson on 19 May directed the department engineer to use cost-plus-a-fixed-fee agreements. After Stickney wired back that he did not need to make fixed-fee contracts but urgently required authority to negotiate lump-sum and unit-price contracts, Washington on 13 June gave him that authority. Even though he could now negotiate, there still remained the time-consuming tasks of making estimates, preparing plans, and arriving at terms of agreement.[19]

Construction got under way slowly. During April and May, Stickney managed to start 4 projects, including Bataan Field in the southeastern part of the peninsula, a bombproof shelter for general headquarters at Fort McKinley, just south of Manila, and a runway at Nichols Field. June marked the beginning of work on a depot at San Juan del Monte, just east of Manila, and on already existing Kindley Field on Corregidor. Within the next three months the engineers broke ground for 16 projects, among them a dock on Bataan, 2 air warning stations, and 3 new airfields—Del Monte and Malabang on Mindanao and O'Donnell on Luzon. By the end of September construction was in progress at 26 jobs estimated to cost $1,500,000.[20]

Colonel Stickney had barely started to build when the southwestern monsoons began. For the next five months construction crews battled mud and torrential rains. Maj. Wendell W. Fertig, assigned to Bataan early in the summer, later recounted: "[The] rainy season was in full swing and the forest was a morass. . . . Thousands of cubic yards of rock had been placed as surfacing on the secondary roads, but under the pounding of 10-wheel ammunition trucks, all vestiges of hard surfacing disappeared in a

[18] (1) Ltr, Stickney to Kingman, 28 Apr 41. (2) Ltr, Stickney to CofEngrs, 14 Nov 41. 600.1 (Phil Dept (Airfields) 1941. (3) Rpt of Interv, Capt Manning J. Dauer with Maj Gen Hugh J. Casey, Jun 44. Casey File 9.

[19] (1) Rads, Dept Engr to CofEngrs, 2 and 28 May 41. 600.1 (Phil Dept Airfields) 1941–42. (2) 1st Ind, OUSW to TAG, 19 May 41, on Ltr, OCE to USW, 10 May 41. (3) Rad, TAG to CG Phil Dept, 23 May 41. (4) Ltr, TAG to CofEngrs, 13 Jun 41. All in 600.1 (Phil Dept Airfields) 1941–42.

[20] Dept Engr, Constr Progress Rpt for Semimonthly Period Ending 30 Nov 41.

sea of mud. Two tractors were kept busy hauling these monstrous trucks out of mud holes." Transferred to Clark Field in August, Fertig remarked that construction had become a "nightmare." [21] Conditions were so bad at Nichols Field that the Air Corps suspended operations there in July.[22] The engineers continued work on the runways at Nichols but with "25 percent efficiency." The weather had a hampering effect on construction throughout western Luzon.[23]

At the outset the department engineer had little construction machinery. An inventory of 28 December 1940 listed the following items of power-driven equipment: 6 bulldozers, 2 shovels, 2 rock crushers, an earth auger, and a grader. Little help could be expected from the Philippine Government, for, in order to keep down unemployment, the commonwealth used practically no equipment. Few contractors in the islands had machinery, and delivery from the United States would take months. Stickney proposed to rent and buy locally as much equipment as he could and to order from the United States, although shipments from America would arrive too late "to be of much benefit this working season." The Chief of Engineers refused to let him rent but gave him permission to negotiate purchases in the local market, and promised to send equipment from the States along with the first shipment of troops.[24] Stickney hastened to buy the few items of new and used equipment held by local dealers. He begged a few pieces from the Philippine Department of Public Works and borrowed from American commanders. Brig. Gen. Edward P. King, Jr., commanding Fort Stotsenburg, loaned two new 1½-ton trucks to the O'Donnell project. "Without them," wrote an Engineer officer, "it would have been impossible to begin construction . . . [in an area] which could normally be reached only by horse-drawn units and then only during the dry season." Notwithstanding co-operation of this sort, there was never enough machinery. Only by constant shifting of equipment from one location to another could Stickney keep all of his jobs moving.[25]

Efficient maintenance and repair of equipment were hard to come by. Most natives were unacquainted with machines, and the skilled mechanic was "nearly nonexistent." Too often the Filipino was concerned primarily with the appearance of his equipment. Capt. Harry O. Fischer, area engineer at Clark Field, got hold of some tractors belonging to the commonwealth's Bureau of Public Works, "which looked beautiful—freshly painted and shined." "But, I found to my sorrow," he wrote, "that Filipino maintenance went only skin deep—what they couldn't see didn't bother them. One D–8 [tractor] I got had had 7,000 operating hours and had

[21] Fertig, Guerrillero, pp. 5–6, 10.

[22] Edmonds, *They Fought With What They Had*, pp. 31–32.

[23] Dept Engr, Constr Progress Rpt for Semimonthly Period Ending 30 Nov 41.

[24] (1) Ltr, Stickney to CofEngrs, 28 Dec 40. 230.14 (Field Maint Force) Rqmts Br Sup Sec. (2) Ltr, Stickney to CofEngrs, 8 Mar 41. (3) Rad, CofEngrs to Stickney, 26 Mar 41. Last two in 686 (Clark Field) 1938–41.

[25] (1) Ltr, Col Harry O. Fischer to C Staff Br OCE GHQ FEC, 28 Apr 49. SWPA File M343. (2) Fertig, Guerrillero, p. 8. (3) Dept Engr, Constr Progress Rpt for Semimonthly Period Ending 15 Nov 41.

had nothing done to it. It sounded like a corn grinder." There was, besides, virtually no local supply of spare parts. Almost all replacements had to be requisitioned from the United States and delivered over a 7,000-mile-long supply line. These were conditions the engineers could do little to correct.[26]

The islands produced many of the materials needed for construction, including lumber, slag, cement, lime, and aggregate. Local dealers stocked pumps and other common items of installed equipment. Access to these markets was at first restricted by regulations which forbade Stickney to purchase in amounts of more than $500 or to alter standard plans and specifications without consulting the Chief of Engineers. OCE lifted the first restriction in March and the second in May when Stickney made it known that shortages of steel would force him to build hangars of wood. Since time could not be spared for sending the new drawings back to the States for approval, General Schley gave Stickney authority to alter plans whenever necessary. The department engineer could now draw freely on the resources of the Philippines, but many of the supplies he most desperately needed still had to come from the United States. Though shipments of structural steel, steel siding, heavy cable, switchboards, and lighting equipment were anxiously awaited, months were to pass before any of these items would be received.[27]

[26] (1) Ltr, Stickney to CofEngrs, 28 Dec 40. 230.14 (Field Maint Force) Rqmts Br Sup Sec. (2) Fischer Ltr, 28 Apr 49. (3) Rad, Stickney to OCE, 18 Jan 41, and reply 29 Jan 41. 400.312 (Phil Dept) pt. 2.

[27] (1) Rad exchanges Stickney with OCE, 12, 21 Mar 41, 2, 8 May 41. (2) Ltr, C Constr Sec OCE to CG Phil Dept, 24 Mar 41. Both in 600–1 (Phil Dept Airfields) 1941–42.

Construction During the Latter Half of 1941

The arrival of U.S. Engineer units gave an impetus to the airfield construction program. First to come was the 809th Engineer Aviation Company, which, upon disembarking at Manila on 10 July, was assigned to Nichols Field. Well supplied with modern equipment, the 176 men of the 809th worked around the clock, operating their own machinery and serving as foremen of the 800 unskilled native laborers employed on the project. A second unit, the 803d Engineer Aviation Battalion (less Company C), arrived from the United States on 23 October. Headquarters Company began extending the turf runways at Clark to transform this field into a huge base for B–17's. Company A took over the project at O'Donnell, some twenty miles north of Clark, while Company B went to Del Carmen, near the base of Bataan Peninsula, where on 10 November it started construction of a complete airdrome estimated to cost $432,500. On 1 December the 809th became Company C of the 803d. These engineer troops helped greatly to make key airfields operative at an early date.[28]

Construction gained added momentum after the arrival of Colonel Casey on 8

[28] (1) Ltr, CO 809th to CofEngrs, 10 Sep 41. 320.2 (809th Engrs) Mil Files, OCE. (2) Brief Hist (Station, Rcds and Events) Co A, 803d Engr Bn (Avn) (Sep). SWPA Files. (3) Ltr, C Sup Sec OCE to Stickney, 29 Apr 41. 400.312 (Phil Dept) pt. 2. (4) Capt. S. A. Goldblith, "The 803d Engineers in the Philippine Defense," *The Military Engineer*, XXXVIII, (August, 1946), 323–25. (5) Dept Engr, Constr Progress Rpt for Semimonthly Period Ending 30 Nov 41. AG 319.1 (20 Oct 41) Phil Rcds.

October. Having served in the Philippines from 1937 to 1940 as assistant to General MacArthur, Casey was familiar with conditions in the islands. At the time of his appointment as Engineer, USAFFE, he was chief of the Design Section of the Construction Division, Office of The Quartermaster General. There he had worked under General Somervell and had had an opportunity to observe how construction could be pushed at high speed. Casey, losing no time in trying to find out where Stickney's program stood, called for information on the status of major projects. On 1 November Stickney submitted his first semimonthly progress report, and from it Casey concluded that work would have to be greatly expedited. He urged Stickney to intensify pressure on contractors and suggested that certain jobs be switched from purchase and hire to contract. He induced the commonwealth's Bureau of Public Works to undertake additional projects, and used all the influence he could muster to speed deliveries from the United States and to streamline procedures.[29]

Casey was especially concerned over the inadequate progress on the air warning stations. Reconnaissance parties led by Barney Clark, an American civil engineer who had spent many years in the islands, had selected sites on Luzon and on nearby Mindoro and Lubang. Construction of two stations, one on Bataan and the other on the Bicol Peninsula, was begun in September, but at eight other locations nothing had as yet been done. Since many stations were in out-of-the-way places, the engineers had to build hard-surfaced access roads and strengthen many bridges before the detection units, each weighing over eight tons, could be hauled to the sites. On 15 November plans and specifications for eight of the stations were but 5 percent complete. Casey insisted that every effort be made to get these "high priority projects underway." Of even greater concern to him was the underground chamber at Fort McKinley where the headquarters of the air warning service was to be located. This complicated tunneling job was not begun until 15 October. Casey suggested that Stickney bring pressure on the contractor, explaining that this tunnel was "a vital item of the entire Air Warning Service." [30]

With the end of the southwestern monsoons, construction of airfields on western Luzon progressed rapidly. The soil of the Central Plains, composed largely of marine deposits, had admirable bearing qualities. Even without surfacing, the runways at Clark, O'Donnell, and Del Carmen could carry the heaviest aircraft then in use. Because the soil was porous, drainage was easily provided. As one engineer expressed it, Clark Field

[29] (1) Office of the Chief Engineer, General Headquarters, Army Forces, Pacific, "Engineers of the Southwest Pacific, 1941–1945," vol. I, *Engineers in Theater Operations* (cited hereafter as Of C Engr GHQ AFPAC, *Engrs of SWPA*, I) (Washington, 1947), p. 4. (2) Fine and Remington, Mil Constr in the U.S. (3) Ltr, AG USAFFE to CG Phil Dept, 20 Oct 41. (4) DS, Engr USAFFE to AG USAFFE, 27 Nov 41. (5) DS, Engr USAFFE to AG USAFFE, 4 Dec 41. All three in AG 319.1 (20 Oct 41) Phil Rcds. (6) Ltr, CG USAFFE to TAG, 22 Oct 41. 400.312 (Phil Dept) pt. 2.

[30] (1) DF, Engr USAFFE to AG USAFFE, 27 Nov 41. AG 319.1 (20 Oct 41) Phil Rcds. (2) Fertig, Guerrillero, pp. 20–21. (3) Dept Engr, Constr Progress Rpt for Semimonthly Period Ending 15 Nov 41. AG 319.1 (20 Oct 41).

had "vertical drainage." Dust proved to be the major problem. The increasingly large numbers of planes arriving at Clark wore off the turf, with the result that such clouds of dust arose from the runways that the air was seldom clear unless a strong wind was blowing. At Del Carmen the dust was even thicker. There, as at Clark, the engineers had neither equipment nor material for hard surfacing. Nor did they have any calcium chloride, the chemical commonly used for dust control. Fertig, the area engineer at Del Carmen, recalling his tennis-playing days in Colorado, remembered that clay courts were often treated with water and beet sugar syrup to make them dust proof. He decided to experiment by applying to the runway a mixture of water and waste molasses from a nearby sugar refinery. War came before the experiment could be completed, but it was successfully carried out later on Bataan Field.[31]

Although plans for fields on the southern islands developed slowly, considerable work had been done by 15 November. Malabang, a small commercial airport on the southwest coast of Mindanao, was easily enlarged. Its runway, surfaced with fine volcanic cinders, was lengthened by the removal of a few coconut trees. Del Monte, located in the midst of the pineapple plantations of northern Mindanao, was originally nothing more than the fairway of a golf course. By removing a few rocks from a strip of land which extended out into the Tagoloan River and by mowing the grass of a large neighboring meadow, natives quickly prepared two additional strips. Late in 1941 Del Monte was transformed into a second base for B–17's. Zamboanga, the third large field, showed little progress. The War Department had insisted on the construction of a bomber base near the tip of Zamboanga Peninsula, where the only feasible site was in the rice paddies of that area. Local farmers would not give up their land willingly and the government resorted to expropriation. After the land was acquired on 3 November, the engineers drained the paddies, a task that consumed much valuable time. By mid-November runways at Malabang and Del Monte were in use, but construction at Zamboanga had not yet started.[32]

Meanwhile, work was under way on Corregidor, where Mielenz encountered difficulties similar to Stickney's. His chief problem was to find contractors for the big modernization program; begun late, negotiations dragged on throughout the fall. Mielenz did manage to begin a number of smaller projects in the summer of 1941. At the height of the rainy season, convicts from Bilibid Prison in Manila laid four-and-one-half miles of cable six feet underground for the con-

[31] (1) Dept Engr, Constr Progress Rpts for Semimonthly Periods Ending 15, 30 Nov 41. AG 319.1 (20 Oct 41) Phil Rcds. (2) Edmonds, *They Fought With What They Had*, pp. 51 and 239. (3) Fertig, Guerrillero, pp. 18–20.

[32] (1) Rad, CG Phil Dept to TAG, 17 Apr 41. AG 600.12 (10–26–40) sec. 1 (1). (2) Fertig, Guerrillero, pp. 24–25. (3) Edmonds, *They Fought With What They Had*, pp. 53–55. (4) Rad, TAG to CG Phil Dept, 27 Mar 41. AG 600.12 (10–26–40). (5) 2d Ind, Hq Phil Dept to CG USAFFE, 20 Oct 41, on Ltr, Chmn of Bd of Dirs Staff of Zamboanga City Farmers Assn to U.S. High Commissioner in the Phil, 24 Sep 41. (6) Ltr, Office President of the Phil to CofS USAFFE, 24 Nov 41. Last two in AG 600.1 (6 Sep 41) Phil Rcds. (7) Dept Engr, Constr Progress Rpts for Semimonthly Periods Ending 15, 30 Nov 41. AG 319.1 (20 Oct 41) Phil Rcds.

trolled mine system. In July a construction crew began blasting additional space for the hospital in the great tunnel under Malinta Hill and enlarging five laterals to be used for storage. Other projects included construction of a bombproof command post, strengthening beach defenses, and sandbagging.[33]

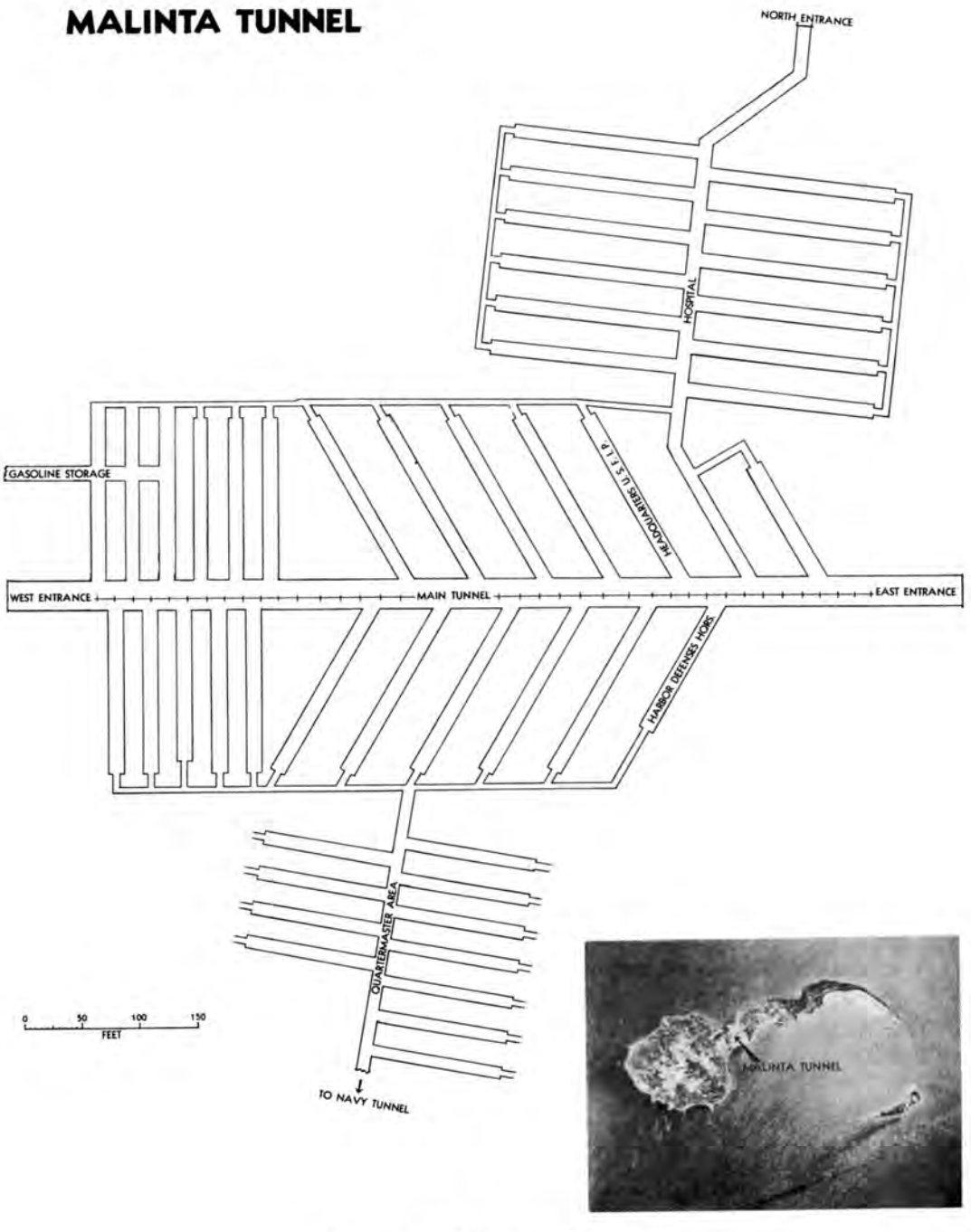
General MacArthur found the progress of construction encouraging, and there was much to support his view. In October Stickney launched projects estimated to cost one-third of a million dollars at Nichols, Clark, and Fort McKinley. The following month he added nine jobs to the list of going projects; included were warehouses and docks on Bataan, an air warning station on Lubang Island, additional facilities at Clark, Bataan, Cabanatuan, and Nielson Fields, and the two new airbases, Del Carmen and Zamboanga. By late November Stickney had a program of $3,600,000 under way. Meanwhile, the Corps of Engineers of the Philippine Army was improving numerous military fields on Luzon, among them Tuguegarao, Aparri, and Legaspi; the Civil Aeronautics Authority was readying commercial fields for military use; and the Bureau of Aeronautics of the Philippine Government was building a considerable number of emergency landing strips throughout the islands. All told, about forty fields, ranging from large installations such as Clark and Nichols to mere strips for emergency landings, were being developed for military aircraft.[34]

Combat Engineers

Concurrently with the construction program, the Engineers prepared for combat. For many years successive department engineers had been at work on defense plans under War Plan ORANGE. Upon mobilization, the department engineer's organization was to be expanded rapidly by the addition of reservists and civilians. Labor companies of Filipinos were to be formed, and full use was to be made of the employees of the commonwealth's Bureau of Public Works. Should the enemy invade Luzon, demolitions were to retard his advance, and the engineers planned to put up roadblocks, mine highways, and destroy bridges. Especially marked for destruction were roads on the sides of precipitous mountains and long bridges over deep gorges and unfordable streams. In the department engineer's office was a "demolition book" containing sketches of every bridge of any importance on Luzon, together with wiring diagrams and computations of the charges required for destruction. Some 400,000 pounds of TNT or the equivalent would be needed. If supplies of TNT were low, the engineers planned to draw on the stocks of dynamite held by mining companies, although dynamite was not as effective

[33] (1) Mielenz, Engr Preparation. (2) Rpt of Opns of USAFFE and USFIP in the Phil Islands, 1941–42, an. VIII, exhibit E. AG 98-USFI-0.3.

[34] (1) Ltr, MacArthur to Marshall, 28 Oct 41. AG 350.05 (10-28-41) (1). (2) Dept Engr, Constr Progress Rpt for Semimonthly Period Ending 30 Nov 41. AG 319.1 (20 Oct 41) Phil Rcds. (3) Rpt of Interv, Dauer with Casey, Jun 44. (4) Fertig, Guerrillero, pp. 26ff. (5) Ltr, AG Phil Dept to TAG, 30 Aug 41. (6) Rad, TAG to CG Phil Dept, 27 Aug 41. Last two in AG 580.82 (8-2-41) (1). (7) Office of the Chief Engineer, General Headquarters, Army Forces, Pacific, "Engineers of the Southwest Pacific, 1940–1945," vol. VI, *Airfield and Base Development* (cited hereafter as Of C Engr GHQ AFPAC, *Engrs of SWPA, VI)* (Washington, 1951).



DRAWING OF MALINTA TUNNEL

for hasty demolitions. Mining engineers would be called upon to help destroy roads and bridges. Colonel Casey began to formulate a plan in line with MacArthur's new strategy of defending the whole archipelago, but war prevented its completion.[35]

The one U.S. engineer combat unit in the islands, the 14th Engineers (Philippine Scouts), a part of the Philippine Division and commanded by Lt. Col. Harry A. Skerry, consisted in mid-1940 of 322 officers and men. While most of the officers were Americans, the enlisted men were Filipinos. When not training or on maneuvers, the 14th built military roads and bridges and cut trails through the jungles of Bataan. In January 1941, when the Scouts were authorized an increase from 6,500 to 12,000, the 14th was ordered to add 544 men to its roster. By late November the regiment had been expanded to include 938 officers and men. Most of the recruits came from the Baguio gold mining area and were old hands at construction.[36]

The mobilization of the Philippine Army, begun in September 1941, was expected to provide the great majority of the engineer units urgently needed by MacArthur. Shortly after Casey arrived, MacArthur ordered him to develop a force "equipped and trained to meet the heavy demands now required of the Engineers in modern warfare." Each of the 12 Philippine Army divisions was to include an engineer combat battalion of 500 officers and men. Also to be organized were 3 engineer combat regiments, 6 separate battalions, 2 heavy ponton battalions, 3 topographic companies, and enough additional units to provide a complete engineer component for a Philippine Army of 160,000 men to be fully mobilized by October 1942. To accomplish this program would be no easy task. Casey had no engineer officer to assist him until 20 November, when Capt. Emilio Viardo of the Philippine Army was assigned. Occasionally officers and men from other arms and services helped out. Casey would have to try to build the force from a cadre with but limited training. Most Filipino officers did not have the necessary background to command technical units, and few American officers could be expected. The bulk of supplies and equipment would have to come from the United States.[37]

Engineer combat battalions of the Philippine Army mobilized with disappointing slowness. As late as 1 December 1941 not a single battalion was completely manned and equipped, with actual strength closer to 400 men than to the authorized 500. Equipment consisted chiefly of hand tools, and there were not enough of these to go around. The Philippine Army as a whole was no better prepared than its engineers, a state of affairs that did not augur well for the future.[38]

To make matters worse, MacArthur's

[35] Phil Dept Engr Plan—ORANGE (1936 Revision).

[36] (1) Ltr, Skerry to C Staff Br, 5 May 49. SWPA Files. (2) OCE, Annual Rpt for Mil Activities of the CE for the FY 1941, pp. 6, 9. (3) Morton, *Fall of the Philippines*, p. 21, n. 16. (4) Ltr, Skerry to C Staff Br, 30 Jun 49, Comment 2. SWPA Files.

[37] (1) Ltr, Casey to CofEngrs, 17 Oct 41. SWPA Files. (2) Fischer Ltr, 28 Apr 49. (3) Ltr, Casey to G–1 USAFFE, 29 Jan 42. Casey File 1.

[38] (1) Skerry Ltr, 30 Jun 49, Comment 4. (2) Ltr, Col William C. Chenoweth (formerly Engr SLF and II Corps) to Chief Staff Br, 30 May 49. SWPA files.

order to reduce the four regiments of the Philippine Division to three, in accordance with the War Department policy of converting square divisions to triangular, decreased the number of U.S. engineers. The conversion of the Philippine Division in early December reduced the 14th Engineers to a battalion. Despite protests by Casey, Stickney, and Skerry, several hundred officers and men of the regiment were transferred to other arms and services. Fortunately, the 14th was allowed to keep its equipment, which it later put to good use.[39]

By early December U.S. Army engineer troops in the Philippines numbered approximately 1,500, the combined strength of the 14th and 803d Battalions. These units made up less than 5 percent of the total U.S. force. Estimates of the engineer strength of the Philippine Army are difficult to arrive at, because that army was never fully mobilized. When war broke out, the engineer component of the Philippine Army amounted to roughly 5 percent of the total, far below the 20 percent generally considered by engineer officers to be the ideal proportion. In the large force which MacArthur and Casey planned, development of engineer units was to receive high priority and the ratio of engineer troops was to approach the optimum.[40]

Supply

The task of providing engineer supplies and equipment for the growing U.S.-Filipino forces fell to Maj. Roscoe Bonham, Stickney's supply officer. In January 1941 the Supply Division, in addition to Major Bonham, consisted of one enlisted man and two native clerks. The Philippine Engineer Depot, which Bonham also commanded, was run by half a dozen enlisted men and roughly 25 native employees. A vigorous program of recruitment produced good results. By December the Supply Division included 5 officers, 4 enlisted men, and 31 American and Filipino civilians; the depot was staffed by 3 officers, 18 enlisted men, and 90 civilians. Located in the Manila port area, the depot had been adequate in the past but was too small to hold the enormous quantities now required. Bonham succeeded in increasing facilities during the summer and fall by constructing a shop and several warehouses and sheds along the Pasig River. But despite his extraordinary efforts, he never succeeded in getting enough people or providing sufficient space.[41]

Bonham found it even more difficult to assemble stocks of engineer items than to find employees and build warehouses. He scoured the islands for steel, wire, hand tools, camouflage materials, explosives, and machinery. Importers, local

[39] (1) Morton, *Fall of the Philippines*, pp. 32, 34. (2) Kent Roberts Greenfield, Robert R. Palmer, and Bell I. Wiley, *The Organization of Ground Combat Troops*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1947), pp. 271–72, 277. (3) Skerry Ltr, 30 Jun 49, Comment 2. (4) Chenoweth Ltr, 30 May 49.

[40] (1) Phil Dept Machine Rcds Unit, Station Strength and Misc, Offs and EM, Nov 41, cited in Morton, *Fall of the Philippines*, p. 49. (2) Skerry Ltr, 30 Jun 49, Comment 4. (3) Chenoweth Ltr, 30 May 49. (4) OCE, May 1920, Study, The Corps of Engrs. EHD Files. (5) Of C Engr GHQ SWPA, 18 Sep 43, Study Gen Engr Problems. SWPA File 139. (6) Ltr, Casey to CofEngrs, 17 Oct 41. SWPA Files.

[41] Col Roscoe Bonham, 1943, Rpt, Engr Sup, Luzon Campaign, 1941–42. SWPA Files.

merchants, manufacturers, and mining companies all contributed to Bonham's stores. No likely source escaped his attention. Learning that the Cadwallader-Gibson Lumber Company was to be liquidated, he quickly bought up its stock of one and a quarter million feet of lumber, paying 40 percent less than the current market price. Devising an "unorthodox plan" whereby he himself guaranteed payment, Bonham was able to import from India enough burlap to make more than half a million sandbags. Ingenuity notwithstanding, scientific instruments, mechanical equipment, and other special engineer items could not be procured in the Orient. These would have to come from the United States.[42]

Colonel Stickney asked the Chief of Engineers to send searchlights, bridging, and water purification units in addition to construction equipment for the troops. He also appealed for spare parts. General Schley promised to fill the requisitions as quickly as possible. Meanwhile, Bonham ordered equipment from American manufacturers through the Pacific Commercial Company of Manila. The U.S. defense program and lend-lease requirements took precedence over the needs of the Philippines, however, and consignments to the islands had a low priority. By 19 September Bonham had accumulated sufficient stocks of earth augurs, assault boats, and gas shovels to equip the U.S. troops at initial war strength. Nevertheless, his inventories showed great shortages of such basic items as explosives, searchlights, ponton bridges, water purification units, tractors, trailers, and gas-motored timber saws. Not until autumn did the War Department take decisive action to speed deliveries to the islands.[43]

Early in September MacArthur expressed dissatisfaction with the low priority assigned to the Philippines. Unless his orders for supplies and equipment were filled more promptly, he would be unable to put the Army on a war footing as rapidly as he considered necessary. Marshall, fully aware of the difficulties that faced MacArthur, agreed to give the Philippines highest priority. The engineers in the islands could now hope to get the troops, supplies, and equipment they so sorely needed. By mid-November a general service regiment—the 47th—was being readied for movement overseas, and equipment for two aviation battalions was en route. OCE was making an all-out effort to speed reinforcements. Encouraged by the Chief's attempts to aid them, Casey, Stickney, and Mielenz sent back a huge requisition. They asked for 21,000 tons of construction materials and equipment costing $5 million dollars, but this request did not reach the Chief of Engineers until after Pearl Harbor.[44]

[42] *Ibid.*

[43] (1) *Ibid.* (2) Ltr, 9 Nov 40, and Rads, 18 Jan, 20 Mar 41, Stickney to OCE. 400.312 (Phil Dept) pt. 2. (3) 1st Ind, 27 Nov 40 on Ltr, 9 Nov 40. (4) Rad, 29 Jan 41 and Ltr, 29 Apr 41, OCE to Stickney. Last three in 400.312 (Phil Dept) pt. 2. (5) Rqns, Bonham to Pacific Commercial Co., 15, 22 Aug 41. 600.1 Phil Dept (Airfields) 1941. (6) Table, Rqmts and Status of Controlled Items of Engr Equip, 19 Sep 41. 400.31 (Phil Dept).

[44] (1) Rad, MacArthur to Marshall, 7 Sep 41, and reply, 9 Sep 41. AG 320.2 (7-28-41). (2) Rqn Form, Dept Engr to CofEngrs, 21 Oct 41. 600.1 Phil Dept (Airfields) 1941. (3) Memo, C Misc Br G-3 for C Opns Br, 10 Nov 41. AG 320.2 (7-28-41). (4) Rad, Acting CofEngrs to CG USAFFE, 18 Nov 41. 400.31 (Phil Dept). (5) Notes of Conf in G-4, with Incl, 13 Nov 41. 381 (Phils). (6) Ltr, AG USAFFE to TAG,

Construction Progress

By the first week of December construction was progressing satisfactorily, but the program was far short of accomplishment. Farthest advanced were Clark and Nichols. Yet several runways at these fields were still building. Bataan Field was 68 percent complete; Del Monte had one usable runway, and the construction of housing was just beginning; and 70 percent of the work on Malabang's runway had been done. The remaining fields were far behind these. Other types of projects were also lagging. The Mariveles dock and the Limay wharf were nearing completion, but the important tunnels on Bataan had not yet been started. Progress on the air warning stations was slow; only two were operating—one at Nielson, the other at Iba. Contracts for the first items in the new program to modernize fortifications on Corregidor were still in process of negotiation. The engineers had succeeded in getting most of their projects under way, but much of the work of construction remained to be done.[45]

To some the prospect was not encouraging. Maj. Gen. Lewis H. Brereton, commanding the Far East Air Force (FEAF), pronounced the progress of airfield construction "disappointing." He observed that work was proceeding more or less on a peacetime basis. It was difficult to change the age-old customs of the tropics. "The idea of an imminent war seemed far removed from the minds of most," wrote Brereton in his diary under the date of 9 November.[46] On the eve of the Japanese attack, Col. Francis M. Brady of FEAF described the outlook as "quite discouraging." In a personal letter to Brig. Gen. Carl Spaatz, he stated: "Construction of airdromes is lagging due to lack of engineer personnel and inability to secure competent civilian assistance from among the Filipinos or local contractors. The dearth of equipment is also a serious factor."[47] The engineers were no better satisfied but offered no apologies. Considering the handicaps under which they labored, they felt their showing was a creditable one.

Except those high-ranking officers who had been informed of the breakdown of negotiations between the United States and Japan, few were aware of the seriousness of the situation and the imminence of war. A peaceful atmosphere still pervaded the islands. How remote war seemed is suggested by Col. Wendell W. Fertig's description of an excursion on the last day of peace:

> Sunday, December 7th, dawned a perfect day for a picnic at Lake Taal. The four officers from our mess had already made arrangements for an old-fashioned steak fry. . . . loading the outboard motor we set out for the lake. . . . [The] entire day

17 Nov 41. 400.312 (Phil Dept). (7) Exhibit B with Ltr in (6) above. AG 320.2 (7-28-41). WD Ltr AG 575.1 (11-17-41) MC-D to CofEngrs, 11 Dec 41. 400.312 (Phil Dept).

[45] (1) 1 Incl to Ltr, Dept Engr, Phil Dept, to CG FEAF (thru CG USAFFE), 3 Dec 41. (2) Dept Engr, Constr Progress Rpt for the Semimonthly Period Ending 30 Nov 41. Both in AG 319.1 (20 Oct 41) Phil Rcds. (3) Ltr, Asst to CofEngrs to USW, 5 Dec 41. 600.1 Phil Dept (Airfields) 1941.

[46] Quotations from Lt. Gen. Lewis H. Brereton, *The Brereton Diaries* (New York: William Morrow and Company, 1946), p. 21. Copyright, 1946, by Lewis H. Brereton.

[47] Quoted in Memo, OCAAF for CofEngrs, 6 Dec 41. 600.1 Phil Dept (Airfields) 1941-42.

was spent in lazy fishing and in enjoyment of the huge steaks prepared over a driftwood fire. The brilliant sunset illuminated the lake and we started home across the reddened waters.

The picnickers were awakened at 4:30 the next morning to the news that the Japanese had attacked Hawaii. "We stood by . . . awaiting the inevitable blow. . . . ," wrote Fertig. "We could only hope that, in matching our puny weapons against the aggressor, somehow help would reach us before too late." [48]

Withdrawal to Bataan and Corregidor

War came to the Philippines with overwhelming suddenness. On the morning of 8 December enemy planes appeared over the islands to bomb strategic targets. About noon Japanese bombers carried out devastating attacks on Iba and Clark Fields. So effective were these and succeeding raids on airfields that within a few days the striking power of the Far East Air Force was almost completely destroyed. On 10 December Japanese troops landed at Vigan on the northwestern coast of Luzon and near Aparri on the northern coast. Two days later a third force came ashore at Legaspi near the southeastern tip of the island. From these three points enemy troops began moving inland—their major objective, the nearby airfields. In the Visayan Islands and on Mindanao no landings of decisive or even critical importance were made until fairly late in the campaign.[49] The story of the defense of the Philippines is thus almost entirely one of fighting on Luzon. It was here that the engineers had to make their greatest effort.

The engineers urgently required a large increase in troop strength, but because of Japan's naval superiority, no more units could be expected from the United States, at least not in the near future. All that could be done to increase the number of men in the field was to speed mobilization of the combat battalions of the Philippine Army. Most retired and Reserve officers had already been ordered to active duty and the remaining few were called up immediately.[50] Casey appealed to civilian engineers to serve with the Army. Many volunteered, with some being commissioned at once and others serving as civilians.[51] American mining engineers, who came to be known as "Casey's dynamiters," were to be of inestimable value.[52] "These men," Casey wrote, "although they in general knew little of the military, were ideally qualified to perform all phases of engineer operations. They were of a pioneer type accustomed to doing crude engineer[ing] under great difficulties . . . and capable of improvising and getting the work done." [53] Since the number of mining engineers was small, each man knew

[48] Fertig, Guerrillero, pp. 40–41.

[49] Morton, *Fall of the Phillipines,* pp. 98ff.

[50] Incl 5 to Ltr, Mielenz to C Staff Br, 17 Mar 47. SWPA Files.

[51] From December 1941 to May 1942, approximately 85 men were commissioned as Engineer officers directly from civilian life or the enlisted grades. Incl 2 to Mielenz Ltr, 17 Mar 47.

[52] Frazier Hunt, *MacArthur and the War Against Japan* (New York: Charles Scribner's Sons, 1941), pp. 39ff.

[53] Casey, Rpt on Conduct of Demolitions in the Philippines (cited hereafter as Casey, Demolitions), draft MS, 1942. SWPA File M344.

most of the others either personally or by reputation. This simplified recruiting. Many of the mining engineers, moreover, brought with them their crews of loyal Filipino workmen.[54]

When war began, two Army ground forces were mobilizing on Luzon. North Luzon Force (NLF), commanded by Maj. Gen. Jonathan M. Wainwright, was responsible for the defense of the part of the island north of Manila. The part south and east of the capital was to be defended by South Luzon Force (SLF), commanded by Brig. Gen. George M. Parker, Jr. A third force, USAFFE Reserve, under the immediate command of General MacArthur, was to hold Manila and the area immediately to the north along the shore of Manila Bay. In USAFFE Reserve were the 14th engineers. The 803d, under Stickney's direction, was kept hard at work repairing bomb damage at Clark and Nichols and rushing Del Carmen and O'Donnell to completion. Each of the divisions in the North and South Luzon Forces had its engineer combat battalion. The first engineer units to see combat were the battalions with Wainwright's North Luzon Force.[55]

Engineers With North Luzon Force

On 4 December, Colonel Skerry had turned the command on the 14th engineers over to Capt. Frederick G. Saint and left to take up his new duties as Engineer, North Luzon Force. When, on the following day, he reported to Wainwright's headquarters at Fort Stotsenburg, he found he was the only engineer on the scene. On 7 December three enlisted men were loaned to him, and he was told he could expect an officer within a few weeks. Four divisional combat battalions were mobilizing, the 11th, 21st, 31st, and 71st. The 91st, also mobilizing, was attached to NLF but was not to be assigned until a week later. There were no force engineer units for work in rear areas; neither was there any equipment. For work behind the front lines Skerry was expected to make use of the divisional combat battalions, insofar as possible. In accordance with plans of long standing, he could also employ the district engineers of the commonwealth's Bureau of Public Works.[56]

The engineers of NLF were to operate in an area some 275 miles long and 100 miles wide. In the north it was mountainous. On the west was a narrow coastal plain and in the east the mountains extended directly to the sea. The only passageway south through the northern ranges was the narrow Cagayan River valley. Southeast of Lingayen Gulf was an extensive level area, the Central Plains. About 40 miles wide and stretching 100 miles from the Gulf to Manila, the plains provided a natural avenue of approach to the Philippine capital. Northern Luzon had three principal rivers, the Cagayan flowing

[54] Ltr, Fertig to C Staff Br, 17 Mar 47. SWPA Files.

[55] (1) Morton, *Fall of the Philippines*, pp. 69ff. (2) [Hist of] The Philippine Division in 1941–42. OCMH Files. (3) Goldblith, "803d Engineers," *The Military Engineer*, XXXVIII (August, 1946), 323–25.

[56] Memo, Skerry to CofS NLF, 1 Aug 42, sub: Rpt of Orgn and Opns of NLF Engrs Between 8 Dec 41 and 6 Jan 42 (cited hereafter as Skerry, Rpt of NLF Engrs). SWPA Files.

northward through the mountains, the Agno following a westerly course and emptying into Lingayan Gulf, and the Pampanga cutting southwestward across the Central Plains to Manila Bay. Except in their upper reaches and in a few other places, these rivers were unfordable. Northern Luzon boasted a fairly good road net. Along the west coast from Lingayen Gulf to Bataan was a graveled highway capable of taking heavy military traffic during the dry season. An all-weather road, Highway 5, ran from Aparri through the Cagayan Valley and across the Central Plains to Manila. Another all-weather road, Highway 3, extended down the northwest coast to Lingayen Gulf and thence across the Central Plains to the capital. Northern Luzon was also served by the main line of the narrow-gauge Manila Railroad, which ran from Manila to San Fernando, La Union, on the coast north of Lingayen Gulf.[57]

On the day the Japanese landed at Vigan and Aparri, Casey ordered the destruction of roads, bridges, and ferries in the Cagayan Valley and the mountainous regions of northern Luzon. Skerry called upon the engineers of the Bureau of Public Works to do this job. No TNT was available, nor were there any tetryl caps or electrical cap exploders, but mining companies of the Baguio region had ample stocks of dynamite, and Skerry asked three of the largest to send him 180 tons. Within a few days shipments began to arrive. Lacking the most powerful explosive and the best types of detonators, Skerry prescribed exceptionally large charges of dynamite and ordered the use of time fuzes. One expert described this method as "plainly a matter of loading heavy charges of dynamite, sandbagging or tamping them as much as possible, and . . . pray[ing] for a complete job of demolition." Steel bridges with concrete floors proved especially difficult to destroy. In the confusion of the times, no use was made of the demolition book, so carefully prepared over the years. It remained in Stickney's office in Manila, to be destroyed shortly before the capital was evacuated. By 19 December, the engineers had completed their demolitions in north central Luzon and had sealed off the region with roadblocks. The enemy advance southward from Aparri to the Central Plains would be difficult.[58]

A greater menace was the Japanese thrust along the coastal road southward from Vigan. On learning of the enemy landing, Casey had issued orders for large-scale demolitions between Vigan and San Fernando. Since no engineer units were available, he asked the Bureau of Public Works to take this assignment. By 16 December enemy troops had penetrated as far south as Tagudin, about twenty-five miles above San Fernando. That same day USAFFE received word that its orders for demolitions were not being carried out. Casey telephoned

[57] Rpt of Opns of NLF and I Phil Corps in Defense of North Luzon and Bataan From 8 Dec 41 to 9 Apr 42 (hereafter cited as Rpt of Opns of NLF and I Phil Corps), p. 2. OCMH Files; copy in SWPA File M278.

[58] (1) Memo, Casey for CofS USAFFE, 10 Dec 41, Casey File 8. (2) Skerry, Rpt of NLF Engrs. (3) McCandlish, "How Explosives Went to War in the Philippines," *The Explosives Engineer*, XXIII, No. 5 (September-October, 1945), 211. (4) Incl, Comment by Stickney, "Engineer Organization," to Mielenz Ltr, 17 Mar 47.

Skerry at once, ordering him to blow the bridges to the north of San Fernando. The next morning Skerry made a hurried reconnaissance of advance positions and found that bridges south of Tagudin had already been destroyed. He saw, however, that the situation called for more engineers. On the afternoon of the 17th he visited the local district engineer to urge greater speed in the preparation of demolitions around San Fernando and the following day persuaded the manager of a nearby mine to lend him twelve foremen. Meanwhile, on orders from USAFFE, Skerry's engineers destroyed the large concrete pier, the telephone exchange, and the oil and gasoline tanks at San Fernando. Although demolitions did not appreciably retard the Japanese advancing down the coast, they entered the city to find little of military value remaining.[59]

A major enemy landing at Lingayen Gulf appeared imminent. On 18 December Wainwright ordered Skerry to prepare for demolition the roads and bridges from Lingayen Gulf to as far south as the towns of Tarlac and Cabanatuan—an area about forty miles wide and sixty miles deep. Holding up enemy forces by demolitions on the Central Plains would be much more difficult than delaying them in the mountainous regions of the north. In the upper Central Plains, there were only two rivers that would be serious obstacles to an invader equipped for modern war—the Agno and the Tarlac. During the dry season even these were fordable at certain points. Because the land was flat, there were few good sites for roadblocks. Tanks could easily traverse the dry rice paddies of the almost treeless Central Plains.[60]

Given this terrain, Skerry prepared a plan of defense in depth, making use of the only important obstacles in the entire region—the natural barriers of the rivers. Under his direction, the engineers of the Philippine Army and employees of the Bureau of Public Works set out to prepare all major highway bridges from the Agno to Tarlac and Cabanatuan for instant demolition. Casey furnished groups of miners under the command of Lt. Col. Narciso L. Manzano (Philippine Scouts) to help with this work. Colonel Manzano and his miners were temporarily attached to North Luzon Force. Casey's office also sent a special detail—a second lieutenant and three miners—to NLF to help Skerry prepare the large railroad bridges for destruction. Small spans and culverts in the area were to be taken care of by the rearmost divisions if and when Wainwright's force withdrew through the Central Plains.[61]

A serious weakness in the defense was the lack of antitank mines. On 18 December Casey asked the USAFFE ordnance officer to order 70,000 from the United States. Meanwhile, Bonham, using designs supplied by Casey, furnished makeshift mines. Consisting of a wooden box about ten inches on a side, with approximately five pounds of dyna-

[59] (1) Memo, Casey for CofS USAFFE, 10 Dec 41. Casey File 8. (2) Skerry, Rpt of NLF Engrs. (3) DF, Engr USAFFE to G-3 USAFFE, 16 Dec 41. (4) DF Engr USAFFE to CofS USAFFE, 16 Dec 41. Last two in Casey File 8.

[60] (1) Skerry, Rpt of NLF Engrs. (2) Memo, Casey for Rcd, 23 Dec 41. Casey File 4.

[61] (1) Skerry, Rpt of NLF Engrs. (2) Ltr, Skerry to C EHD, 13 Apr 56, Comment 5. SWPA Files.

mite, a flashlight battery, and a detonator, each mine was put together and placed by the troops. Bonham could not supply enough materials to mine extensive areas. The most the engineers could hope for was that an enemy tank would occasionally blunder into a mine field. Skerry's success in delaying the enemy would have to depend mainly on the destruction of bridges.[62]

Fears of a landing at Lingayen Gulf proved well founded. On 22 December a large Japanese force came ashore between Bauang and Damortis. The enemy troops were too numerous to be beaten back by the few NLF units near the gulf, and reinforcements were not available. Hopes of defeating the enemy at the beaches vanished. On the night of 23 December, General MacArthur declared War Plan ORANGE–3 in effect. Wainwright would withdraw southward and attempt to hold back Japanese forces coming down from the gulf long enough to enable South Luzon Force to fall back through Manila, cross the Pampanga, and continue on to Bataan. NLF was to carry out its withdrawal in five phases, designated D1, D2, D3, D4, and D5. Making his first stand midway between Lingayen Gulf and the Agno, Wainwright would retire to four successive positions, the last of which, D5, stretched from the town of Bamban on the west to Sibul Springs at the foot of the mountains on the east. This was the critical line. It had to be held until South Luzon Force was safely across the Pampanga.[63]

Because there were few planes left to interfere with the enemy's progress and because the untrained Philippine troops could not withstand the powerful Japanese onslaughts, Wainwright had to rely heavily on his engineers. It was they who had to keep open roads and bridges ahead of the retreating columns—not an easy task in view of the Japanese supremacy in the air. It was the engineers, too, who had to prepare all bridges for demolition and assure their destruction after friendly troops had passed over.

Four of Wainwright's five engineer combat battalions participated in the withdrawal—the 11th, 21st, 71st, and 91st. The 31st had gone with its division to help guard the western coast just above Bataan and on 14 December had been removed from NLF control. Wainwright decided to keep the 11th, 21st, and 71st Battalions with their divisions until they reached San Fernando, Pampanga. Then each battalion, less one company, was to be detached to maintain the roads leading into Bataan.

By Christmas Eve, Wainwright's forces were retreating toward the D2 position, located along the southern bank of the Agno. The engineers had been at work here for more than a week. Anticipating bottlenecks when the heavy traffic from the north reached the bridges at Bayambang and Carmen, Skerry had put men from the Bureau of Public Works to work building two bridges of palm

[62] (1) Office of the Chief Engineer, General Headquarters, Army Forces, Pacific, "Engineers of the Southwest Pacific, 1941–1945," vol. VII, *Engineer Supply* (cited hereafter as Of C Engr GHQ AFPAC, *Engrs of SWPA*, VII) (Washington, 1947), p. 21. (2) Skerry, Rpt of NLF Engrs. (3) Hq USAFFE, Instr on Use of Improvised Antitank Mines, [n.d.]. Casey File 4.

[63] (1) Jonathan M. Wainwright, *General Wainwright's Story* (New York, 1946), pp. 32–42. (2) Morton, *Fall of the Philippines*, pp. 166–69.

logs at Wawa and Urbiztondo. Charges had been placed on all the bridges over the Agno. When the Japanese bombed the big highway bridge at Carmen on 23 December, some of the charges exploded, dropping the southernmost span to the river bed. Wainwright, alarmed because most of his tanks were still north of the river, ordered immediate repair. The 91st engineers, under constant enemy air attack, built a temporary span within 24 hours.[64] After the last of the American and Philippine troops had crossed the river, the engineers demolished all the bridges along the 50-mile front. Wainwright's forces had reached the south bank of the Agno and temporary safety.[65]

During most of the ensuing withdrawal, the front-line engineer battalions were kept intact. They moved in a definite pattern: on completing an assignment in a given area, a unit leapfrogged over the one behind it and continued working farther to the rear. These battalions, with other covering forces, prepared and executed demolitions and put in roadblocks near the front. To the rear, all important demolitions, whether of bridges and roads or of equipment and supplies, were carried out by engineers under Skerry's command. Much of this work was done by the 91st Engineers. On 21 December the entire battalion was placed under Skerry, and, except for one company which later returned to its division, remained with him throughout the withdrawal. Still farther to the rear, other engineers readied roads and bridges for destruction. When War Plan ORANGE–3 went into effect, Wainwright ordered Skerry to prepare demolitions and erect obstacles in the territory south of Tarlac and Cabanatuan. In the large new area, stretching southeast toward Manila and southward to Bataan, mining engineers and district engineers of the Bureau of Public Works again rendered valuable service.[66]

As NLF withdrew farther south, the engineers made ready to blow up every bridge in the path of the Japanese. Skerry personally directed the placing of the charges at the critical highway bridges across the Tarlac and the Bamban Rivers and over the Pampanga at Cabanatuan, Arayat, and Candaba. The special detail of miners, with the aid of troops, prepared the spans on the Manila Railroad, taking special care with the great bridge at Bamban. At all the large bridges on the highways and the railroad the engineers managed to place their charges well ahead of time.[67]

Groups of miners, getting the innumerable smaller spans ready for destruction, had to work rapidly, for they had much to do and time was short. W. L. McCandlish, a demolitions expert who had arrived in the islands shortly before the outbreak of war, worked with a small group under Manzano which operated north of San Fernando, Pampanga. Mc-

[64] Their commander, Capt. Antonio P. Chanco (Philippine Army), writing to Wainwright later, recalled this effort "as one of our best under stress." Ltr, Chanco to Wainwright, 10 Jun 46. SWPA Files.

[65] (1) Morton, *Fall of the Philippines*, pp. 169ff. (2) Memo, Casey for CofS USAFFE, 16 Dec 41. Casey File 4. (3) Wainwright, *General Wainwright's Story*, pp. 39–40. (4) 2d Ind, Skerry to Hq Fourth Army, Awards and Decorations Bd, 6 Sep 46, on Ltr, Chanco to Wainwright, 10 Jun 46.

[66] Skerry, Rpt of NLF Engrs.

[67] *Ibid.*

Candlish's description of the group's activities furnishes an example of how such parties operated. While fighting was going on at Tarlac, about twenty-five miles to the north, McCandlish and his men prepared the bridge at Angeles. After placing the charges, the blasting cap, and six feet of fuze, they arranged to have three Scouts stationed at the south end of the bridge to guard against premature detonation, and then moved southward. Between Angeles and Mexico, they found only small timber structures. They drenched these with fuel oil and directed the troops stationed as guards to ignite them when the order was issued by the proper divisional staff officer. At Mexico, McCandlish and his miners found a 30-foot concrete bridge over a deep gorge. At both sides of the north and south abutments they dug pits six feet deep, and in each of the four holes they placed 150 pounds of dynamite, attaching a cap and a fuze three feet long. They then instructed the detachment at the bridge how to fire the charges, cautioning the men that it would take only two minutes for the fuzes to burn through to the blasting caps.[68]

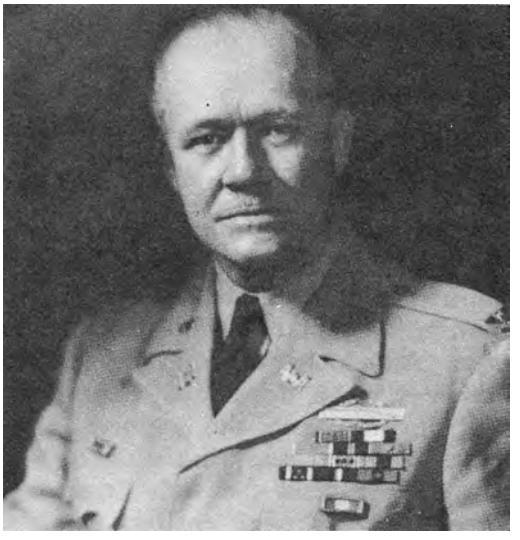
Inexperienced Filipino engineers left to blow up bridges found it difficult to determine when to set the charges off. They frequently could not ascertain whether all friendly forces had crossed, for the Philippine infantrymen very often did not arrive at the right place at the right time. Sometimes the engineers could not find the divisional staff officer who was to notify them when to light the fuzes. An engineer would then have to take upon himself the responsibility of destroying the bridge. Sometimes officers, with but incomplete knowledge of the tactical situation, ordered demolitions too soon. Occasionally, Filipino engineers grew panicky and set the charges off without waiting for any orders at all. The foot soldier who found himself stranded on the wrong side of a wrecked span might somehow manage to get across and rejoin his outfit, but to the tanker, a prematurely blown bridge could spell disaster. Since tanks operated under USAFFE control, the engineers made special efforts to get information on their movements but were not always successful. One tank commander, Col. Ernest B. Miller, concluded that he would have to place his own men at each bridge over which his tanks must pass, "with orders to shoot anyone who attempted to blow it without our authority." On at least one occasion Miller's tankers had to rebuild a bridge before they could move south. Colonel Skerry pointed out that demolition at the proper time was his greatest problem by far. As a rule, the engineers tried to keep a bridge intact until strong enemy action on the far bank made destruction imperative, but the fact remained that some bridges were blown too soon.[69]

In these tense days the engineers were called upon not only to destroy but also

[68] McCandlish, "How Explosives Went to War in the Philippines," *The Explosives Engineer*, XXIII, No. 5 (September-October, 1945), pp. 209–10.

[69] (1) Map 2, facing page 10, Office of the Chief Engineer, General Headquarters, Army Forces, Pacific, "Engineers of the Southwest Pacific," Volume VIII, *Critique* (Washington, 1950), shows the location of the principal demolitions on Luzon. (2) Skerry, Rpt of NLF Engrs. (3) Col. Ernest B. Miller, *Bataan Uncensored* (Brainerd, Minn., 1949), pp. 103–104. (4) Ltr, Skerry to C Staff Br, 4 Jun 49, Comment 6. (5) Casey, Demolitions.

to build. On 18 December MacArthur directed Stickney to prepare temporary landing fields for the "large reinforcements of airplanes" expected from the United States. These fields were first to be developed for pursuit craft and later to be enlarged for bombers. Every likely site was to be turned to use. Ordered to move to Bataan, the companies of the 803d Aviation Battalion built a number of fields while on their way to their new location. On 21 December, Company A left O'Donnell for Dinalupihan, near the base of Bataan Peninsula, where it put in three emergency strips in as many days and then began work on revetments. On Christmas Day, headquarters company left Clark to join Company A. Four days later, both moved south to Orani to build another strip there. Company B, meanwhile, having finished one runway at Del Carmen, moved on to construct two bomber strips at Hermosa and Pilar on Bataan's eastern coast. Company C left Nichols and went to the tip of Bataan to push work on Bataan and Cabcaben fields. Filipino civilians helped greatly in the preparation of these fields. Under the direction of Colonel Fertig, who in October had been appointed chief of Stickney's Construction Division, thousands worked to improve existing runways and rough out additional fighter strips. The engineers provided the fields, but there were few planes to use them. Most of the newly constructed strips were soon to be overrun by the enemy.[70]



COLONEL FERTIG. *(Photograph taken in 1953.)*

The situation confronting Wainwright grew progressively more serious. Six days after their landing at Lingayen Gulf, the Japanese reached the D4 line, and on the night of 30 December Wainwright ordered a withdrawal to the D5 position. That the retreat from Lingayen Gulf had been a planned and orderly withdrawal was owing in no small measure to the demolitions of the engineers.[71] With Wainwright's men now making a determined effort to hold, much depended upon the speed with which the troops of South Luzon Force

[70] (1) Ltr, MacArthur to Dept Engr, 18 Dec 41. Casey File 8. (2) Mielenz Ltr, 14 Mar 47. (3) Goldblith, 803d Engineers," *The Military Engineer*, XXXVIII (August, 1946), 323–25. (4) Brief Hist of Co A, 803d Engrs. (5) Ltr, Fertig to C Staff Br, 5 Jun 47. SWPA Files.

[71] The importance of this work in helping prevent the enemy from disrupting the withdrawal is attested to not only by American but by Japanese officers as well. Lt. Gen. Masami Maeda, chief of staff of the *14th Army*, later stated that "the destruction of all bridges by the American forces delayed our advance" from the gulf to Manila. Statement of Gen Maeda, 2 Mar 50, ATIS Doc 56234. Copies are in Interrogations of Former Japanese Officers, Mil Hist Div, GHQ, FEC, I and II, and in OCMH Files.

could clear the bridges over the Pampanga at Calumpit on their way to Bataan.[72]

Engineers With South Luzon Force

When war broke out, South Luzon Force was mobilizing in the mountainous country below Manila. An engineer organization had barely begun to take form. Arriving at headquarters at Fort McKinley on 8 December, Capt. William C. Chenoweth, the engineer, SLF, found he had a staff consisting of two enlisted men from the 14th Engineers. Force engineers were entirely lacking, nor were any divisional engineers available for work behind the front lines; the only battalions in SLF, the 41st and 51st, could not be spared by their divisions. Chenoweth quickly mobilized the employees of the Bureau of Public Works. Within a few days after the first enemy landings on Luzon, he had 2,000 men at work stockpiling materials to be used in repairing roads and rebuilding bomb-damaged bridges.[73]

With the landing at Legaspi on 12 December, much of southern Luzon was in danger of being overrun by the enemy. About 250 miles southeast of Manila, Legaspi was connected with the capital by a good highway and the main line of the Manila Railroad. The only obstacles in the way of the advancing Japanese were the numerous ravines, gorges, and isthmuses of the long and narrow Bicol Peninsula. Because of its length and the small number of troops at his disposal, MacArthur had decided not to defend the peninsula. He relied chiefly upon the engineers to impede the enemy's advance toward the capital.[74]

Upon learning of the landing, General Parker ordered an engineer detachment to the peninsula, and a group from the 51st Engineer Battalion, under the command of 2d Lt. Robert C. Silhavy, left at once to destroy highway and railroad bridges. The Japanese rushed small motorized units forward in an attempt to head off demolition parties. On 17 December, while placing charges on the railroad bridge near Ragay, 75 miles northwest of Legaspi, Silhavy and his men were fired on by a Japanese patrol. The engineers returned the fire and proceeded with their work. After demolishing the bridge, they took up positions on the near bank of the gorge and soon thereafter the Japanese retired. This was the first encounter with enemy ground forces on southern Luzon. Silhavy and his men continued demolition work on the peninsula until ordered to move to Bataan.[75]

On 14 December Casey directed the district engineers to destroy the bridges and "critical road cuts and fills" on the main highway running along the length of the peninsula. Their work in wrecking many highway bridges and roads greatly hampered the enemy's progress

[72] (1) Wainwright, *General Wainwright's Story*, pp. 41–42. (2) Skerry, Rpt of NLF Engrs.

[73] (1) Ltr with Incls, Chenoweth to C Staff Br, 27 Sep 47. SWPA File M339. (2) Chenoweth Ltr, 30 May 49.

[74] (1) Morton, *Fall of the Philippines*, pp. 109–10. (2) Rpt of Opns of SLF, Bataan Defense Force, and II Phil Corps in Defense of South Luzon and Bataan, pp. 8–9. Copy in SWPA File M281.

[75] (1) Rpt of Opns of SLF, Bataan Defense Force, and II Phil Corps, app. II, p. 7. (2) Casey, Demolitions.

toward Manila. Casey, meanwhile, instructed the Manila Railroad to prepare to dynamite its principal bridges. The president of the railroad, Mr. Jose Paez, on 16 December told Casey that he had ordered all rolling stock and materials moved toward the capital. His crews had already pulled spikes out of thirty kilometers of track. Stocks of gasoline and oil which could not be hauled northward were being burned or dumped into the sea. He agreed to destroy all bridges and promised to give special attention to the destruction of spans over deep gorges. These pledges were in large part fulfilled. By the 17th the piers of the bridges at Libmanan and Banga Caves had been partly wrecked, the trusses dropped about three feet, and the ties and rails thrown into the river. The destruction of the 150-foot center span of the bridge across the gorge at Del Gallego effectively ended all rail traffic between Legaspi and Manila for months to come.[76]

Lack of co-ordination between the Manila Railroad and South Luzon Force increased the difficulties of evacuating supplies. Around 14 December, before any trains could be moved out of the peninsula, the bridges at Malicbuy and Pagbilao, both west of the Bicol Peninsula, were blown on orders of a tactical commander of South Luzon Force. Casey ordered the bridges rebuilt at once. Since they had not been seriously damaged, reconstruction was completed in thirty-six hours. On the 16th a wreck southeast of Manila damaged three cars and tore up a section of track. Casey attributed the accident to "interference by the local military authorities with railroad operation." Seeking an end to mishaps of this sort, he arranged a meeting between officials of the railroad and officers of SLF. Better timing in the destruction of vital bridges and improved scheduling of trains resulted.[77]

With but few mining engineers in his part of the island, Chenoweth had to rely heavily on men from the Bureau of Public Works. McCandlish, who made several inspection trips in southern Luzon, reported that in many instances demolitions were not expertly handled. On the eastern Luzon coast, for example, he happened upon a district engineer and a group of Filipino workmen who were preparing to destroy a section of road near the mouth of the Tignuan River. The road ran along the side of a steep cliff about 500 feet above the river. The men were digging holes two feet deep in the road and loading each of them with two cartridges of dynamite. McCandlish considered these measures entirely inadequate. A tunnel with crosscuts blasted out of the cliff and loaded with three or four tons of dynamite "would have taken out the road, brought down the cliff, and stopped all transportation for a considerable period." With little experience in complicated demolitions work, and lacking the time for adequate planning and preparation, district engineers nevertheless carried out hundreds of small jobs successfully.[78]

[76] (1) Memos, 14, 17, 18, 19 Dec 41, Casey for CofS USAFFE. (2) Memo, M[anzano] for Rcd, 16 Dec 41. Both in Casey File 4. (3) Fertig Ltr, 5 Jun 47. (4) Rpt of Opns of SLF, Bataan Def Force, and II Phil Corps, p. 16, and app. II, p. 25.

[77] (1) Memo, Casey for CofS USAFFE, 16 Dec 41. Casey File 4. (2) Casey, Demolitions.

[78] McCandlish, "How Explosives Went to War in

A Japanese landing on 24 December at Atimonan, at the base of the Bicol Peninsula, threatened to cut off all troops to the east. The day before, MacArthur had decided to withdraw to Bataan. The rapid movement of SLF northward was doubly urgent. The only troops east of Atimonan by the 24th were two reinforced infantry companies and several detachments of the 51st Engineers. These were recalled at once. On 28 December, MacArthur informed SLF of Wainwright's precarious position and urged greater speed in the movement to Bataan. He directed SLF to cross the vital Calumpit bridges not later than 0600 of New Year's Day.[79]

As SLF withdrew across southern Luzon, the engineers destroyed highway and railroad bridges. They dynamited steel and stone structures and soaked wooden spans with fuel oil and burned them. Rolling stock, food, automobiles, trucks, and gasoline were evacuated or destroyed. Brig. Gen. Albert M. Jones, in command of SLF during its withdrawal to Bataan, stated that demolitions in southern Luzon were so effective that if so ordered his troops could have held back the enemy for a much longer time.[80]

Last Days of the Withdrawal

With both SLF and NLF troops converging on Calumpit, much depended on the effectiveness of demolitions in the vital area between the D5 line and Manila. Many small groups were at work here. One party of fifteen miners with Colonel Manzano helped clear fields of fire and erect barbed wire entanglements along the D5 line. Thousands of civilians, recruited by the mayor of San Fernando and the district engineer, aided in this work. After helping to strengthen Wainwright's positions, Manzano and his men moved southward to the region between the Pampanga River and Manila to prepare bridges for demolition. Engineers from Stickney's office placed charges along roads and railroads leading to the capital. Colonel Casey organized several parties who were to destroy important installations in and near Manila.[81]

Of all the bridges being prepared for destruction, those at Calumpit were to furnish the most exacting test of the engineers' skill in demolitions. The Pampanga, 500 feet wide and 16 feet deep at this point, was spanned by two bridges, one carrying Highway 3, and the other the main line of the Manila Railroad. Charges for blasting the great steel and concrete spans had to be figured and laid with exceeding care. Because SLF and some units of NLF were still east of the river, the greatest precaution had to be taken not only against premature blowing but also to insure setting off the charges at precisely the right time.[82] The story of the engineers' work at Calumpit is one of the most dramatic of the Philippine campaign.

On 27 December McCandlish, to-

the Philippines," *The Explosives Engineer*, XXIII, No. 5 (September-October, 1945), 208.

[79] (1) Rpt of Opns of SLF, and Bataan Defense Force, and II Phil Corps, app. II, p. 8. (2) Morton, *Fall of the Philippines*, p. 199.

[80] (1) Rpt of Opns of SLF, Bataan Defense Force, and II Phil Corps, app. II, p. 25. (2) Casey, Demolitions.

[81] (1) Skerry, Rpt of NLF Engrs. (2) Skerry Ltr, 4 Jun 49, Comment 6. (3) Casey, Demolitions.

[82] Skerry, Rpt of NLF Engrs.

gether with other experts from Casey's office and a company of soldiers, began preliminary tasks. They first turned their attention to the highway bridge, breaking holes through the concrete deck directly over the piers. Blowing the north abutment would be easy, since at its base was a recess three feet deep in which a half ton of dynamite could be loaded and tamped with sandbags and boulders. While one group of soldiers packed charges in the holes on the highway bridge, another placed explosives under the railroad bridge. Japanese planes dropped several bombs, but apparently made no determined efforts to destroy the bridges. Still, even near misses were dangerous to the heavily loaded structures. During one raid, a bomb hit a sugar warehouse near the south end of the highway bridge; another landed in the river only fifty yards downstream. At first, air raid warnings delayed the work, but as the men gained confidence, they continued to pack dynamite and fill sandbags, heedless of the wailing sirens.[83]

When Skerry inspected the bridges on 30 December, he found that heavier charges would be required at the lower panel points to insure complete destruction. The highway bridge needed additional dynamite on its concrete deck. Intending to take no chances, he prescribed an extra ton for each of the two structures and ordered an alternate system of firing for the deck charges on the highway bridge. Inspecting the bridges again on the morning of the 31st, he noted that more dynamite had been placed at the critical panel points and covered with sandbags. Before leaving, Skerry instructed his men to lay still more explosives across the decks of the structures after all traffic had passed over. The bridges would then be ready.[84]

By the early morning hours of New Year's Day SLF and NLF had cleared the bridges. A flank guard which had been stationed at Plaridel, some seven miles to the southeast, crossed over between 0430 and 0500. All U.S. and Filipino forces were now safely across the Pampanga—all except Manzano and his men, who were somewhere between Manila and Calumpit. Skerry asked Wainwright to delay the destruction of the bridges as long as possible in order to give Manzano's party time to get across. Wainwright agreed to wait until 0600, even though he felt the situation was becoming more and more serious. Dawn was beginning to break, and rifle fire was increasing on the south bank of the Pampanga. Enemy patrols were getting close to the river. "In weighing the tactical importance of blowing the bridges and making the . . . unfordable Pampanga a real obstacle," wrote Skerry, "against waiting for a small group, that . . . could withdraw to Bataan by other routes, . . . [there could be] but one answer. . . ." Wainwright directed Skerry to blow the bridges. At 0600, the engineer went to the men waiting at the two abutments and instructed them to fire the highway bridge at 0615, the railroad bridge immediately thereafter. Wainwright and the members of his staff took cover, and

[83] McCandlish, "How Explosives Went to War in the Philippines," *The Explosives Engineer*, XXIII, No. 5 (September-October, 1945), p. 210.

[84] Skerry Ltr, 4 Jun 49, Comment 9.

the engineers lit the fuzes. After a few minutes the huge charges went off with a tremendous roar and the spans fell into the river. The broad Pampanga lay in the path of the enemy.[85]

As the Japanese columns neared Manila, the engineers touched off large-scale demolitions in and around the city. Preparations for denying the enemy everything of military value had been under way for more than a week. Industrial plants, radio stations, warehouses and shops of the Manila Railroad, Nichols and Nielson Fields, and Fort McKinley were to be wrecked. Supplies which could not be moved to Bataan were to be destroyed, all except food, the loss of which would inflict greater hardship on the Filipinos than on the Japanese. Casey was especially anxious to leave no oil, since the enemy's stocks were extremely limited. He had therefore made elaborate plans for setting on fire the large oil tank farm in the Pandacan district. Roads and bridges within Manila were to be left intact. On 30 December the work of destruction began. On that day and the next, the city was dotted with fires and rocked by explosions, as the engineers put into effect their scorched earth policy.[86]

Demolition engineers were among the last to leave the city. One of the many to remain behind was Earle Bedford, before the war a civilian engineer in the islands, and now in charge of demolition work south and east of Manila in the provinces of Cavite, Batangas, Laguna, and Rizal. Casey had instructed Bedford to stay in Manila as long as possible to destroy any military equipment he could find, and to make his way to Bataan by whatever means he could command. Bedford and his men destroyed three large bridges and many small ones south of the city. They wrecked the piers at Wawa. While mining bridges, they noticed about twenty-seven native houseboats and barges moored in the tidal waters of the rivers. Bedford succeeded in burning four in the Imus River, but the strenuous objections of the owners stopped him from setting the rest on fire. On New Year's Day he and his crew of Filipinos destroyed quantities of abandoned supplies at Fort McKinley. With another American civilian he went to Pandacan to ignite any remaining supplies of gasoline and oil. The two men found three tanks still intact but surrounded by moats of burning oil. Unable to get near enough to place explosives against the valves, they used rifle fire to perforate the center tank and then ran to escape the ensuing explosion. On 2 January, the day the Japanese occupied the capital, Bedford arranged to leave for Bataan by boat. But while on his way to a rendezvous with two of his Filipino foremen in Intramuros, the old walled city of Manila, he was picked up by the Japanese and interned at Santo Tomas University for the duration of the occupation. Many who stayed behind shared Bedford's fate, but others managed to escape, some finding small boats to take them across the Bay. Among those eluding the enemy were Manzano and his men, who, after destroying six bridges just north of the city, made their way to

[85] (1) Wainwright, *General Wainwright's Story*, pp. 43–44. (2) Morton, *Fall of the Philippines*, pp. 201, 208–10. (3) Skerry Ltr, 4 Jun 49, Comment 9.

[86] (1) Casey, Demolitions. (2) Fertig, Guerrillero, pp. 50–51.

Bataan by walking across country and slipping through the Japanese lines at night.[87]

Meanwhile, American and Philippine forces were completing their withdrawal to Bataan. After clearing the bottleneck at San Fernando, troops of NLF and SLF withdrew southwestward. The rearmost units passed through Layac Junction, at the entrance to the peninsula, in the early morning of 6 January. Here was the last bridge over which the troops had to pass. Before destroying the bridge, Captain Chanco asked the officer commanding the covering force of tanks whether his last tank was across. He replied it was, Skerry later recalled, "taking the usual position for a military oath and swearing by all that was holy all his tanks had crossed. The enemy was not immediately at hand, so a delay was ordered. Suddenly from out of the darkness one of his own tanks came rumbling along!" [88] When the last tank had crossed, Chanco destroyed the bridge. The withdrawal to Bataan was complete.

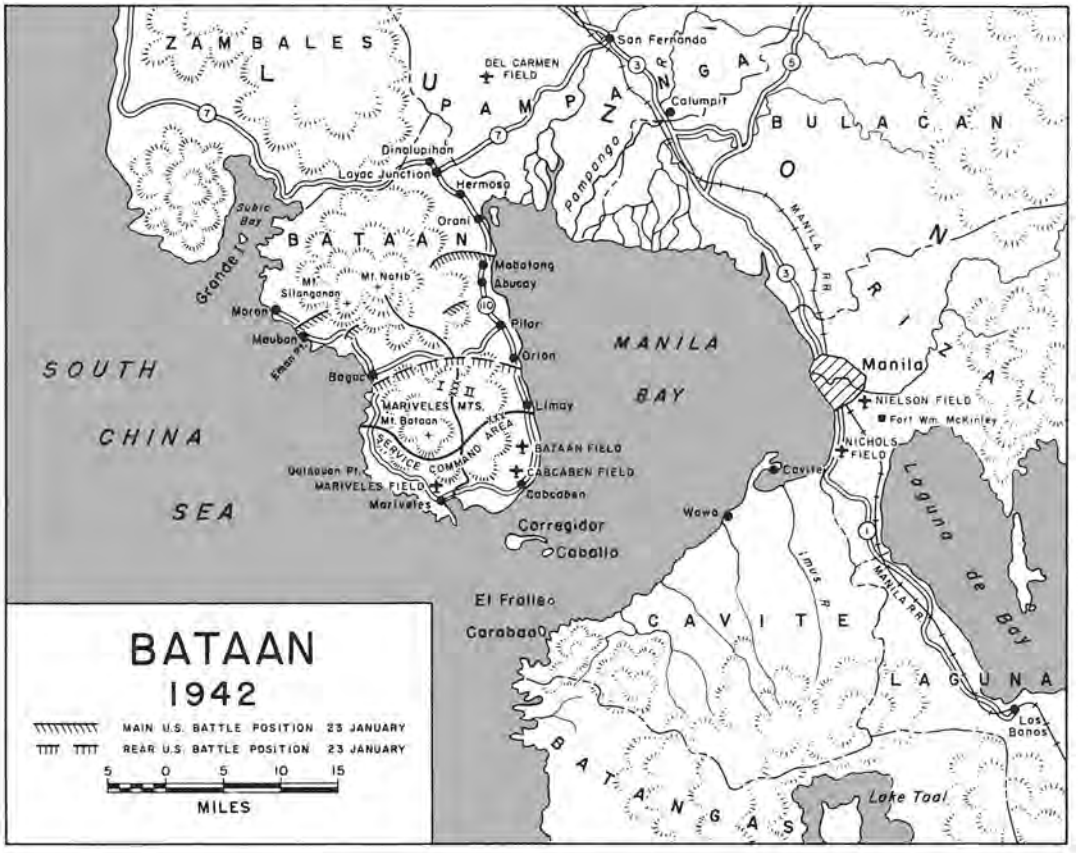
Bataan

The Philippine campaign, so far a war of movement, was henceforth to be a war of position. The defenders of Bataan were to undergo one of the most protracted sieges of World War II. How long they could hold out would depend to a considerable extent on the strength of their fortified positions. One of the oldest arts of the military engineer is the construction of fieldworks, and here was a situation requiring all his skill and experience. Lines had to be drawn that would give the weak American and Filipino forces the greatest advantage. Positions had to be made as strong as possible and given the utmost support. As they dug in, the beleaguered troops were conscious of their desperate situation but were sustained by the hope that help would come before an overwhelming attack or attrition forced them to surrender.

The terrain was on the side of the defenders. About twenty-five miles long and twenty miles wide, rugged, jungled Bataan provided many areas where a small force could hold off a superior one. (*Map 6*) Down the center of the peninsula ran a steep mountain range, with two prominent peaks, Mount Natib in the north and Mount Bataan in the south. The deep jungles of western Bataan, especially, favored the stationary defender rather than the attacker. Here trails afforded the principal means of communication. During the day the oppressive heat made travel through the forests exhausting. Nights were cool, but the dense vegetation reduced visibility almost to zero; even when the moon was full, movement was almost impossible except along well-worn trails. Less primitive was the eastern half of Bataan. Along the coast were several towns, among them Limay, Orion, and Pilar, soon to figure prominently in the fighting. While the many rice paddies would furnish the defenders with good fields of fire, there were fewer strong positions than in the western half of the peninsula. Bataan had two roads suitable for vehicular traffic. One, a single-

[87] (1) Memo, Bedford for Casey, 31 Jan 45. Casey File 5. (2) Skerry Ltr, 4 Jun 49, Comment 9. (3) Fertig, Guerrillero, pp. 52–53.

[88] Skerry Ltr, 4 Jun 49, Comment 9.



MAP 6

lane coastal highway, ran south along the eastern shore to Mariveles at the tip, crossed over to the western side, and extended north as far as Moron. The other stretched across the middle of the peninsula from Bagac to Pilar.[89]

Early in January, Casey and Stickney went to Bataan to help organize the defenses, setting up their offices at "Little Baguio," high on the southern slopes of the Mariveles Mountains. As Engineer, USAFFE, Colonel Casey was to supervise all engineer activities during the siege. By early January he had eight officers to assist him. Five remained with their chief on Bataan; three were sent to MacArthur's headquarters on Corregidor. As service command engineer, Colonel Stickney was to be responsible for work in the rear areas, including all construction. A week after war began, Washington had ordered the duties of the constructing quartermaster in the islands transferred to the department engineer.

[89] (1) Skerry Ltr, 4 Jun 49, Comment 10. (2) Rpt of Opns of NLF and I Phil Corps, pp. 16–17. (3) Wainwright, *General Wainwright's Story*, p. 63.

Stickney immediately took over construction as well as repairs and utilities work in and around Manila, but elsewhere on Luzon the confused tactical situation prevented the transfer. On 28 December Stickney assumed direction of all construction on Bataan and Corregidor. He had succeeded in augmenting his staff considerably since the beginning of the defense build-up and now had forty officers. His organization was divided into three sections: Construction, under Fertig; Supply, under Bonham; and Defense Works on the Fortified Islands, under Mielenz.[90]

When the Filipino troops moving down from the north reached Bataan, all the detached units of combat engineers were once more with their divisions. The 1st, 31st, and 91st Battalions moved to the western half of the peninsula, becoming part of General Wainwright's command, now redesignated I Corps. The 11th, 21st, 41st, and 51st Battalions became part of II Corps, formerly SLF, which, under General Parker, was to defend the eastern half of Bataan. The 2d and 71st Battalions went first to the service command area; the 71st was later transferred to I Corps, the 2d to II Corps. Skerry as Engineer, I Corps, and Chenoweth as Engineer, II Corps, set to work immediately to help ready front-line positions.[91]

[90] (1) Fertig, Guerrillero, p. 60. (2) Memo, Casey for Rcd, 25 Jan 42. (3) Ltr, Mielenz to CG Harbor Defense of Manila and Subic Bays, 19 Jan 41. Last two in Casey File 8. (4) 2d Ind on Mielenz Ltr, O HD QM, Fort Mills to CG Harbor Defense of Manila and Subic Bays, 14 Jan 42.

[91] (1) Ltr, Casey to CofS USAFFE, 19 Jan 42. Casey File 8. (2) Morton, *Fall of the Philippines*, p. 247.

The Main Battle Position

The main battle position, along which Wainwright and Parker would first attempt to hold, extended from Mauban on the west to Mabatang on the east, a distance of about 18 miles. At the center of the line were two precipitous mountains, Mount Natib and Mount Silanganan, covered with jungle, which, it was believed, the enemy would be able to penetrate only with the greatest difficulty. Extensive field fortifications were therefore to be prepared only on the eastern and western portions of the line and were to extend about 5 miles inland from the coast on either side of the peninsula. The position had one obvious weakness. The almost impassable interior made communication between the two corps extremely difficult. Casey believed there was still another drawback. On 2 January he pointed out that between Mauban and Moron, 3 miles to the northwest, lay an excellent beach which would invite a Japanese flank attack. He recommended that the line be anchored at Moron, and that the Mauban line be used as a switch position. The line remained at Mauban, but MacArthur took steps to strengthen the beach, posting a company of infantry and a troop of cavalry at Moron and along the shore to the south to guard against an amphibious landing.[92]

During these first days of strenuous effort to prepare the main battle position

[92] Morton, *Fall of the Philippines*, pp. 248–50. (2) Wainwright, *General Wainwright's Story*, p. 48. (3) Rpt of Opns of SLF, Bataan Defense Force, and II Phil Corps, p. 20. (4) Memo, Casey for CofS USAFFE, 2 Jan 42. AG 381 (2 Jan 42) Phil Rcds.

before the Japanese could strike, the engineer combat battalions were not only developing roads and trails, laying mines, and building gun emplacements but were also clearing fields of fire, digging foxholes, and stringing barbed wire. Inspecting his portion of the line during the first week of January, Skerry found the work but half complete and noted a number of deficiencies. The outpost line of resistance had good fields of fire, but too much of the scarce barbed wire had been placed here. Along the main line of resistance, foxholes were too close to the wire. The regimental reserve line, while well located, was badly in need of the wire which had been used so lavishly on the outpost line. Skerry concluded that engineer troops were not being used to best advantage. He asked division commanders to take their engineers off such jobs as digging foxholes, which should be done by infantry, and put them to building roads and trails. He also arranged to have the engineers work with the infantry in stringing wire. Chenoweth reported troubles, too, but of another variety. The troops "were green and could see no reason for digging foxholes, clearing fields of fire, or laying barbed wire." They expended "no great amount of energy . . . in digging themselves in." The 41st engineers were attempting to build roads across rice paddies, but "as fast as . . . [they] would dry out a rice field someone else would turn in the water." Yet, despite many difficulties, the lines along the II Corps front were fairly well fortified when the Japanese attacked on 9 January. In the I Corps sector, fortifications were less elaborate, but there, because of the difficult terrain, an enemy attack was less likely to succeed.[93]

Skerry was plagued by a shortage of engineer troops, but Chenoweth was more fortunate. During the last days of December a number of mining engineers had made their way to the east coast of Bataan. About 500 troops who had become separated from their units were also in the II Corps area. Most of the soldiers were stragglers, or survivors of a ship that had sunk after hitting a mine in Manila Bay. On 29 December these men were organized into the 301st Engineer Combat Regiment (Philippine Army), which on 13 February was split into two battalions, the 201st and the 202d. The miners were commissioned as officers. Assigned to Chenoweth, these new engineer troops erected field fortifications, prepared tank traps, and laid mines. In time they became some of the best road builders on Bataan.[94]

After the Japanese assaults began, the engineers continued to strengthen the lines. Visiting I Corps positions in mid-January, Casey observed that Skerry's men had felled trees and placed antitank mines and timber piles in front of the main line of resistance. He found infantrymen stringing an additional twenty-five tons of wire on the defense lines and along the shore of the South China Sea. The troops were also constructing underwater obstacles south to

---

[93] (1) Skerry Ltrs, 4 Jun 49, Comment 11–1/2, and 20 Jul 49, Comment 7. (2) Chenoweth Ltr, 27 Sep 47.

[94] (1) 1st Lt P. V. Cardenas, Hist and Composition [of the 301st Engr Combat Regt]. SWPA Files. (2) Hq USAFFE GO No. 26, 13 Feb 42. (3) Ltr, Casey to CofS USAFFE, 19 Jan 42. Casey File 8.

Eman Point. Moving on to the II Corps area, he noted that wire had been placed not only on the main line of resistance but also around sectors down to platoons. Many makeshift mines were in place, and the 11th Division had strung wire along the beach. Chenoweth had built about fifty dummy gun positions of stove pipe and bamboo, and was using small charges of dynamite to simulate the firing of cannon. These dummies were proving effective in drawing enemy fire. While defenses were fairly good at both ends of the line, the Japanese, displaying an unexpected skill in jungle warfare, had begun to penetrate the dense forests on the slopes of Mount Natib and Mount Silanganan.[95]

The Reserve Battle Position

By 22 January, Japanese pressure on I Corps was heavy, and the enemy's penetration of the left flank of II Corps was threatening to envelop Parker's divisions. On that day MacArthur ordered Wainwright and Parker to fall back to the reserve battle position, eight miles to the rear. The withdrawal was to begin on the 23d and be completed by the 26th. Both corps would take over defense of the service command area so that their responsibilities would extend to the tip of Bataan. The reserve line, stretching a distance of about fourteen miles from Bagac on the South China Sea to Orion on Manila Bay, had been selected many years before in accordance with the requirements of War Plan ORANGE–3. The withdrawal would put both corps on less mountainous ground and greatly shorten the extent of the beaches and headlands which the troops of I Corps would have to defend against seaborne attack. The reserve position was to be the final one. When the Japanese broke through it, the battle for Bataan would be over.[96]

The withdrawal was not altogether advantageous. Casey, now a brigadier general, pointed out the many disadvantages that would plague the defenders. The original line, while longer than the reserve line, was better organized and better wired, and it had good fields of fire and artillery positions. Withdrawal to the narrow waist of Bataan would shorten the line but would crowd the defenders into an area about fifteen miles square. Pilar airfield, the 8-inch guns at Bagac, and part of the road between Pilar and Bagac would be lost. Bataan Field would come under long-range artillery fire. Worst of all, almost nothing had been done on the preparation of the reserve battle position. But enemy pressure forced the decision to withdraw, a decision that was "timely and necessary even if more than regrettable." [97]

When Skerry had inspected the reserve battle position in the I Corps area in early January, he found that, except for one stretch of wire at Bagac and another at the center of the peninsula, the defense lines had not even been marked on the

[95] (1) Ltr, Casey to CofS USAFFE, 19 Jan 42. Casey File 8. (2) Wainwright, *General Wainwright's Story*, pp. 50–51.

[96] (1) *Ibid.*, p. 52. (2) Skerry Ltr, 4 Jun 49, Comment 13.

[97] (1) Memo, Casey for DCofS USAFFE, 22 Jan 42. Casey File 8. (2) Skerry Ltr, 4 Jun 49, Comment 13.

ground. The eastern sector of the line was, at that time, not much better prepared. The 14th engineers, sent to the II Corps area in late December, were the only troops to work steadily on the line. Other units, both engineer and infantry, came and went in rapid succession. Outfits were ordered to the area only to be pulled out after a short stay and sent into combat. In mid-January two companies of the 301st and 600 additional Filipino soldiers, most of them airmen, were rushed down to the reserve position. But time was fast running out. When MacArthur withdrew from the first line, much still remained to be done on the second.[98]

On reaching the reserve position, every available man, combat engineer and infantryman alike, was put to strengthening the new line. All the work of digging foxholes, stringing wire, laying mines, and hacking out underbrush had to be repeated. Tools were now fewer and materials more scarce. Much of the wire expended on the first line could not be reclaimed; many picks, axes, and bolos had been broken or lost. When the men of the 41st Combat Battalion fell back from the original battle line, they left everything behind, including 1,700 shovels and 140 rolls of barbed wire. Bayonets, mess kits, and tin cans, which had sometimes served as entrenching tools on the first battle position, were used even more extensively on the second. The engineers of both corps toiled long and hard to build fortifications, occasionally working well in front of the outposts without any covering forces. By the end of the month Casey found positions in the II Corps "relatively well organized." The I Corps sector, where jungles restricted fields of fire, was, in his opinion, the weaker one. He pointed out, however, that a concentrated enemy drive could penetrate either position. He therefore stressed the need for a strong mobile reserve which could be rushed to any point along the front. "If our strength is all tied down," he warned, "it is bound to fail." [99]

There was no lateral communication between the two corps except by the roundabout coastal highway. The front lines cut across the Pilar-Bagac road in such a way that the central portion was held by the Japanese. Troops in the center of the peninsula were isolated. An attempt to carry in supplies to them on pack mules met with little success, and some companies had nearly exhausted their food and ammunition before roads could be cut through. Engineer units in II Corps alone built over 100 kilometers of roads. But the most important and difficult task of all was that of building a road to parallel the Pilar-Bagac highway. The new route cut through the jungles on the northern slopes of the Mariveles Mountains and across river valleys with vertical drops of as much as 2,000 feet. This project was assigned to the 14th engineers. Having but five dozers of their own, they borrowed an angledozer and a tractor from Chenoweth and two graders from the 803d. Beginning the job on 5

[98] (1) Rpt of Opns of NLF and I Phil Corps, p. 18. (2) Skerry Ltr, 20 Jul 49, Comment 7. (3) Ltrs, Casey to CofS USAFFE, 19 and 24 Jan 42. Casey File 8. (4) Chenoweth Ltr, 30 May 49.

[99] (1) Ltr, Casey to CofS USAFFE, 31 Jan 42. (2) Ltr, Casey to MacArthur, 8 Feb 42. Both in Casey File 1.

February, the 14th completed it two weeks later, one day ahead of schedule.[100]

Often the combat engineers had to fight as infantry. On 2 February, when Brig. Gen. Clifford Bluemel, the commander of the 31st Infantry Division, launched a counterattack to prevent an enemy breakthrough in the II Corps area, he took his engineer battalion from reserve to make the assault. The men crossed the defense lines and advanced toward the enemy but soon encountered strong opposition. Infantrymen were sent in to support the engineers, and by sundown the attackers were directly in front of the Japanese position. The next morning engineers and infantrymen again moved forward, this time without meeting any resistance. Under the cover of darkness, the enemy had withdrawn. Frequently engineers became involved in combat when the positions they were fortifying came under attack. One hundred and eighty men of the 51st Battalion worked on the outpost line from 26 January to 8 February. They had no machine guns and but three automatic rifles. Ten percent of the men were sick with malaria and dysentery, yet they helped beat off three attacks and suffered 25 percent casualties. Recalling these grueling times, Skerry wrote, "The problem we had was to stave off pursuit by the enemy after the crushing of the main battle position and to organize and occupy the reserve battle position . . . I doubt if . . . any staff engineer in the I Philippine Corps got over two hours sleep a night. Some nights none." [101]

Field manuals had little to say about the defense of positions in the jungle terrain. Most of their space was devoted to the conduct of operations in country like that of western Europe. Although defensive warfare in the jungle was in many ways similar to that in other types of terrain, Skerry noted certain essential differences. The dense vegetation of Bataan limited visibility to from 10 to 100 yards. In order to provide themselves with fields of fire and with passageways through the jungle, the troops had to cut out trees and underbrush, but they had to be careful not to clear so much that their positions could be spotted from the air. Positions to be mutually supporting had to be closer together than in open, rolling terrain. If units were not to be isolated, the regimental reserve line had to be nearer the main line of resistance. Patrols had to be constantly on the lookout for infiltration parties. It was highly advisable to have the main line of resistance continuous and to have it wired throughout in order to conceal the location of the mutually supporting areas and to prevent infiltration. At all times, maximum camouflage was essential.[102]

With the stabilization of the line between Orion and Bagac, the struggle became a test of American and Filipino endurance. Japanese naval and air

[100] (1) Ltr, Engr USAFFE to CO 14th Engr Bn *et al.*, 5 Feb 42. Casey File 4. (2) Wainwright, *General Wainwright's Story*, p. 63. (3) Ltr, Casey to CO 14th Engrs, 22 Feb 42. Casey File 1. (4) Chenoweth Ltr, 27 Sep 47.

[101] (1) Morton, *Fall of the Philippines*, p. 335. (2) Ltr, Casey to MacArthur, 8 Feb 42. Casey File 1. (3) Skerry Ltr, 4 Jun 49, Comment 14.

[102] (1) With Wainwright's approval, Skerry, prepared instructions incorporating these ideas and distributed them to all units of I Corps. Skerry Ltr, 20 Jul 49, Comment 10. (2) Ltr, Skerry to EHD, 13 Feb 56, Comment 4. SWPA Files.

supremacy precluded sending in any sizable reinforcements. Occasionally a few small boats and planes from the southern Philippines managed to slip through the blockade. The Japanese had the upper hand and could either settle down to await the inevitable collapse or by fighting hasten the end. The defenders, still hoping for help from the outside, could only try to stretch their meager supplies as far as possible and supplement them by every available means.

Supplies

When the siege began, the engineers were among the best supplied troops on Bataan. Their depot near Mariveles and their advance dump in the center of the peninsula were well stocked with dynamite, caps and fuzes, roofing, and food. "We have so much gasoline and fuel," wrote Fertig, "that we need not bother the Quartermaster for some time." Much of the credit for the enviable position of the engineers was owing to Bonham. As soon as War Plan ORANGE–3 went into effect, he and his transportation officer, Capt. Harold T. Gewald, took prompt and vigorous action to get supplies to Bataan. USAFFE had issued instructions that food was to be given first priority. Bonham and Gewald, disregarding priorities, organized their own transportation system. They shipped stocks to the peninsula by rail and truck. In Manila they pressed into service two tugs and a number of barges and lighters which were used to carry supplies to Bataan and Corregidor. In the last few days a number of barges were towed out into the bay and anchored or tied to piling. Later the engineer launch *Night Hawk* combed the bay and found all of them with most of their cargoes still on board. By 1 January, 10,800 tons of supplies had been moved out of Manila. Engineer officers gave Bonham high praise, Mielenz, for example, affirming that Bonham had gotten "the jump on all the other services." [103]

But even with the transfer of thousands of tons of supplies, the situation was critical. Among the items in short supply were barbed wire, burlap bags, axes, bolos, picks, and shovels, as well as construction items such as bitumen, cement, steel pipe, acetylene, and oxygen. Most of the materials and tools needed in field fortification were scarce, and there was far too little construction equipment. When the siege began, the 803d Battalion and the 14th Battalion were fairly well equipped, but the engineer battalions of the Philippine Army had only a few bulldozers and no graders, shovels, rollers, or electrical equipment.[104]

Shortages of supplies and equipment were in part the result of changes in tactical plans. In July 1941 the department engineer had asked for authority to establish a base depot in southern Bataan, but permission was not granted. After MacArthur decided to try to hold the enemy at the beaches, Stickney and Bonham had to give up their project for

[103] (1) Incl 1 to Ltr, Fertig to C Staff Br, 13 Jun 49. (2) Casey, Demolitions. (3) Bonham, Engr Sup. (4) Ltr, Fertig to C Staff Br, 10 Jun 47. (5) Incl 6 with Mielenz Ltr, 17 Mar 47.

[104] (1) Skerry Ltr, 20 Jul 49, Comment 13. (2) Ltr, Fertig to C Staff Br, 17 Jun 49. (3) Ltr, Casey to MacArthur, 1 Mar 42. Casey File 6. (4) Of C Engr GHQ AFPAC, *Engrs of SWPA*, I, 23.

sending supplies to the peninsula and get ready, instead, to disperse them throughout the islands. In November they opened a second depot in Manila and another on the island of Cebu, and shortly after the outbreak of war they started up two more depots on Luzon, one at Tarlac and one at Los Banos. Not until WPO–3 went into effect were they permitted to move large quantities to Bataan. In the confusion of the hurried withdrawal, vital supplies were lost. Stocks at some of the advanced depots had to be destroyed or left behind. On the way to Bataan, Filipino soldiers abandoned much of their equipment and supplies. Colonel Mielenz later commented that "many supplies could have been saved and the troops finally retreating into Bataan would have been much more adequately provided for" had War Plan ORANGE not been temporarily discarded.[105]

Determined to increase their stores, the engineers set out to salvage everything of use on Bataan. Groups dispatched by Bonham to scour the peninsula stripped the fences of barbed wire and took nails, roofing, lumber, and machinery from bombed-out buildings and sunken barges. One of Bonham's parties found 6,500 feet of pipe, six transformers, and four motor boats at Orion. Another raised 100 tons of barbed wire from the waters off Cabcaben. Learning that 150 tons of wire had gone to the bottom off Corregidor, the engineers hastened to retrieve it. Among the more important finds was a sawmill, which Chenoweth located early in January near the Pilar-Bagac road. Stickney dismantled the mill and moved it to Mariveles, where, reassembled and operated by civilians under the supervision of Bonham's Supply Division, it was producing lumber before the end of the month. By March it was supplying 25,000 board feet daily. The 803d moved rice mills from the vicinity of Orion and Pilar to lower Bataan. Though none of the men had ever seen a rice mill, they succeeded in setting up four. Three were turned over to the quartermaster in late January, the fourth in early February. After the mills went into production, the engineers were called upon to keep them in running order.[106]

What they did not have and could not find, the engineers undertook to make. One of their specialties was a mat, 3 feet wide and from 5 to 12 feet long, woven of wire, bamboo, and vines. These mats were used as temporary revetments. Rolled into cylinders and filled with earth, they could also be used in place of sandbags. Another improvisation was the hand grenade or "Casey Cookie" made of a hollow joint of bamboo some six inches long and three inches in diameter. Containing half a stick of dynamite and tightly packed with 2½-inch nails, broken glass, or sharp stones, the bamboo container had its open end sealed with concrete through which pro-

[105] (1) Incl 5 to Mielenz Ltr, 17 Mar 47. (2) Bonham, Engr Sup. (3) Fertig Ltr, 17 Jun 49. (4) Incl 4 with Mielenz Ltr, 17 Mar 47.

[106] (1) Memo, Casey for Engrs, I Corps and II Corps and Dept Engr, 29 Jan 42. Casey File 1. (2) Bonham, Engr Sup. (3) Inspec Rpt, Maj William A. Gay, 11 Feb 42. Casey File 1. (4) Ltr, Chenoweth to C Staff Br, 30 Aug 47, with Incl. (5) Goldblith, "The 803d Engineers," *The Military Engineer*, XXXVIII (August, 1946), 323.

truded a 3-inch fuze. Stickney produced these weapons in sizable quantities. By 15 February he was turning out 500 a day and by the end of the month, 10,000 had been made. At times the grenades were highly successful, but many failed to explode. Bonham meanwhile continued to manufacture mines, producing not only the antitank mine but also a smaller one to be used against personnel. Running short of seasoned lumber, he had to use green timber, which warped in the heat and sometimes set the charges off accidentally. On one occasion, the engineers substituted submarine depth charges, brought over from Corregidor, for mines.[107]

Maps

Even to provide the army with maps, the engineers had to resort to expedients. When the war began, they had on hand two series of topographic maps. The first, based on surveys made between 1911 and 1914, covered most of Luzon at a scale of an inch to the mile. The second, based on surveys made in 1934 and 1935, covered important tactical areas on that island, such as Cavite and Bataan, at a scale of two inches to the mile. Also available was a trail map of Bataan, prepared by the 14th Engineers in 1939. The Engineer maps were not the only ones on hand. Over the years, the U.S. Coast and Geodetic Survey had developed two series, one covering the entire archipelago, the other, the major islands. After the switch to War Plan ORANGE–3, plans to continue map production in Manila had to be quickly revised. Stickney ordered as many maps and as much reproduction equipment as possible transferred to Corregidor by midnight of 31 December. One of the four barges loaded with maps, plates, and equipment sank in Manila Bay, and another disappeared; the remaining two reached Corregidor in heavy seas, their cargoes lost or badly damaged.[108]

Without presses and with few plates, Stickney had to devise some way of making maps for the combat units. He put Maj. Clarence F. Maynard, formerly of the U.S. Coast and Geodetic Survey office in Manila, in charge of map production. Gathering together the pieces of equipment that had survived the voyage from Manila, Maynard rigged up a small reproduction plant in one of the plotting rooms of a gun battery on Corregidor. Here he produced prints and tracings of the Engineer and Geodetic Survey maps. Stickney sent a couple of men to Bataan to turn out copies of the trail map on a gelatin duplicator. The sketch maps were amended from time to time to show the latest information on roads and trails. Although a scarcity of paper limited production, most requests were met. On 1 March Casey reported that "map supply stocks continue adequate for require-

[107] (1) Rpt of Interv, Lt C. C. Peters with Lt Col M. S. Janairo, 23 Nov 45. SWPA File M21. (2) Hq USAFFE, Tng Memo, [n.d.] sub: Improvised Hand Grenade. Casey File 1. (3) Ltr, Casey to MacArthur, 1 Mar 42. Casey File 6. (4) Inspec Rpt, Maj Gay, 15 Feb 42. (5) Skerry Ltr, 4 Jun 49, Comment 19.

[108] (1) Ltr, Brig Gen Herbert B. Loper to C Staff Br, 13 Sep 46. (2) Ltr, C. F. Maynard to C Staff Br, 1 Dec 47. Both in SWPA Files. (3) Office of the Chief Engineer, General Headquarters, Army Forces, Pacific, "Engineers of the Southwest Pacific 1941–1945," vol. III, *Engineer Intelligence* (cited hereafter as Of C Engr GHQ AFPAC, *Engrs of SWPA,* III), (Washington, 1950), pp. 12–14.

ments." For a small area such as Bataan, these primitive methods were satisfactory. Had it been necessary for the defenders to hold a larger area, the story might have been a different one.[109]

Construction in Rear Areas

Fertig, as Stickney's construction officer, carried heavy responsibilities, confronted as he was with the job of completing a number of tasks proposed or started before the war. The little work that remained to be done on the Mariveles dock and the Limay wharf was quickly accomplished, and the big tunnels near Mariveles were soon under construction. Four thousand linear feet of underground storage space was provided during the siege. Fertig kept the quarry at Mariveles going at full blast while Bonham operated a ferry service to transport rock to Corregidor. As the numbers of sick and wounded mounted, construction and maintenance of hospitals, a function recently taken over from the quartermaster, became increasingly important. Roads and airfields, however, claimed the major share of Fertig's effort.[110]

Engineers of the 803d and civilians prepared airfields for the planes that were still expected. They continued to widen and lengthen the runways at the three remaining fields—Bataan, Mariveles, and Cabcaben, the quarry near Mariveles supplying rock for surfacing. At first progress was fair, largely because the 803d still had much of its heavy equipment, but later, as enemy raids took their toll of men and machinery, the pace slowed. Dwindling supplies of gasoline restricted the use of equipment so that much of the rock had to be crushed by hand. Plans to extend runways to 6,000 feet seemed more and more impractical. Soon after the siege began there was but one plane left for each field. And no more were to come.[111]

Roads were more vital than airfields to the defense. The coastal highway was the chief supply artery for both corps. The stretch between Pilar and Orion, the only paved section, had been torn up by heavy traffic during the withdrawal. South of Orion, the road consisted largely of base rock intended as a foundation for paving, while along the west coast from Mariveles to Bagac, the surface was soft dirt. The 803d Aviation Battalion devoted much of its energies to this all-important coastal highway. The men spread gravel over practically the whole length of the road in the service command area. They widened stretches on the west coast and constructed alternate bridges. After air attacks, they filled in bomb craters so that the flow of supplies to the front would not be interrupted.[112] The 71st Engineer Battalion with its attached labor companies maintained the west coast road north of the service com-

[109] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, III, pp. 15–17. (2) Memo, 26 Jan 42, and Ltr, 31 Jan 42, Casey to CofS USAFFE. Casey File 1. (3) Ltr, Casey to MacArthur, 1 Mar 42. Casey File 6. (4) Skerry Ltr, 20 July 49, Comment 13.

[110] Ltr, Fertig to C Staff Br, 16 Jun 49.

[111] (1) Ltr, Maj Albert J. Kircher to Casey, 24 Jan 42. Casey File 7. (2) Ltr, Casey to CofS USAFFE, 31 Jan 42. Casey File 1. (3) Incl 1 to Ltr, Fertig to C Staff Br, 31 Jun 49. (4) Fertig, Guerrillero, pp. 85–86.

[112] (1) Ltr, Kircher to Casey, 24 Jan 42. Casey File 7. (2) Goldblith, "The 803d Engineers," *The Military Engineer*, XXXVIII (August, 1946), 323.

mand area and placed crushed rock on part of it.

In most of their undertakings, the engineers were aided by Filipino civilians. Thousands had fled to Bataan before the advancing Japanese. Many Filipinos were reluctant to leave their families and go to Army projects, which were likely to be bombed; nevertheless, the engineers persuaded hundreds to work for them. At one time Stickney had about 500 on various jobs, and several hundred more were employed in the I Corps area. Short rations, cramped quarters, and frequent bombings led to a steady deterioration in morale, and many natives were unwilling to stay on the job. The engineers offered such inducements as blankets, transportation, and more food. When the ration was increased from two ounces of rice and one-eighth loaf of bread per man per day to nine ounces of rice, two ounces of bread, and some fish, morale improved noticeably. Despite efforts to better the workmen's lot, the high rate of turnover in the labor force continued.[113]

Exposed to constant bombings and frequent artillery fire, the engineers in the rear areas on occasion also had to fight. In mid-January, Company A of the 803d began working on the west road and putting in gun emplacements along the coast. On 23 January, the Japanese made a surprise landing at Quinauan Point, and after scaling the rocky cliffs, managed to work their way through the jungle to within 100 yards of the coastal road. On the 25th, Company A was ordered to help repulse the enemy, and of the 90 engineers who took part in the fight, nine were killed and 38 wounded. According to the company commander, the high casualty rate resulted mainly from the failure of the bamboo grenades to explode and the impossibility of getting cross fire on the enemy. Driven back down the cliffs, the Japanese took refuge in caves and ravines. When assaults by infantrymen and shelling by a small gunboat failed to dislodge them, Wainwright sent Skerry with a platoon of the 71st Battalion to blast them out. The engineers lowered 50-pound boxes of dynamite with time fuzes over the edge of the cliff to the mouths of the caves. After a sergeant was killed while letting down one of the boxes, the engineers tried another method. They threw grenades consisting of four sticks of dynamite with a 30-second time fuze into the ravines at the base of the cliff from where the Japanese were firing. The enemy, numbering about 50, retreated into a large cave. The engineers again lowered dynamite, and "blew the place to pieces." [114] The few survivors were mopped up later.

The End of Resistance

In mid-February, a calm descended over the battlefields of Bataan. The

[113] (1) Of C Engr GHQ AFPAC, "Engineers of the Southwest Pacific 1941–1945," vol. II, *Organizations, Troops and Training* (cited hereafter as *Engrs of SWPA*, II) (Washington, 1953), pp. 13–14. (2) Memo, Casey to Dept Engr *et al.*, 12 Feb 42. Casey File 1. (3) Memo, Casey to CofS USAFFE, 2 Mar 42. Casey File 6. (4) Skerry Ltr, 20 Jul 49, Comment 14. (5) Insp Rpt, Maj Gay, 11 Feb 42.

[114] (1) Morton, *Fall of the Philippines*, p. 311. (2) Wainwright, *General Wainwright's Story*, p. 57. (3) Inspec Rpt, Lt Thomas H. Delamore, 29 Jan 42. Casey File 1. (4) Skerry Ltr, 4 Jun 49, Comment 16.

Japanese guns were silent, and there were few planes overhead. American and Filipino patrols sometimes moved as far north as the original battle position without encountering hostile troops. Many officers, among them General Bluemel, talked of re-establishing the Mabatang-Mauban line. The enemy was merely biding his time. Early in February the Japanese commander had decided to pull back his forces, tighten the blockade, and prepare an offensive aimed at overwhelming the weakened defenders. The pause in battle gave MacArthur's men time to throw up new defenses against the assaults, which would inevitably come.

The engineers now had an unhoped for opportunity to strengthen positions all along the line. In the II Corps area, they dammed the Pilar River, creating a barrier against enemy tanks, and mined roads leading to the river crossings. To provide additional fields of fire, they dynamited or cut out extensive thickets of bamboo. Along the front lines, they constructed more than 1,150 yards of double apron fence. Along the water's edge near Limay, they burned houses to get better fields of fire on the beach. Meanwhile, they pushed work on roads and trails. In the I Corps area, they strung additional barbed wire, connected foxholes by trenches, and flooded rice paddies in front of defensive positions. They built log and earth dams across the Bagac, the Tuol, and the Tiis Rivers. During February, they cleared 875,000 square yards of underbrush from the densely wooded bluffs along the South China Sea and the jungles near the front. Early in March, Casey found some of the front-line positions "outstandingly excellent," others "reasonably well prepared." [115]

As the strain of the siege began to tell on the defenders, the psychological unpreparedness and lack of training of the Filipino engineers, as of the Philippine Army as a whole, became more and more apparent. Many of the soldiers, recently inducted into the Army, had little understanding of the issues of the conflict. The language barrier alone was nearly insurmountable, for 75 percent of the men understood almost no English. Nor was there one native tongue; eight major dialects existed. Efforts to form this polyglot army into an effective fighting force had not begun until shortly before the outbreak of war. Upon induction, most of the combat engineers had been assigned to help the Quartermaster Corps build camps. Not until November 1941 was a training program for engineer enlisted men started. Some inductees were taught how to use hand tools and pioneer equipment and to build field fortifications and bridges. A month before the war, twelve hundred engineer officers began training; the Japanese invasion abruptly terminated the program. The preparation of the Filipino engineer was at best rudimentary.[116]

Performance in battle reflected the lack of training. Many defense lines were poorly prepared and carelessly maintained. Trenches were sometimes

---

[115] (1) Ltr, Casey to MacArthur, 1 Mar 42. Casey File 6. (2) Ltr, Casey to MacArthur, 8 Mar 42. AG 319.1 (5 Jan 41) Phil Rcds.

[116] (1) Skerry Ltr, 20 Jul 49, Comment 11. (2) Rpt of Opns of SLF, Bataan Force, and II Phil Corps, p. 11. (3) Ltr, Fertig to C Staff Br, 10 Jul 47. (4) Rpt of Interv, Peters with Janairo, 23 Nov 45.

so close to the barbed wire that the enemy could easily toss grenades into the ranks of the defenders. Along the shores of Manila Bay, wire strung too far out in the water was beaten down by waves, and no one took the trouble to replace it. The Filipino soldier frequently dug his foxhole behind a mound of earth or a clump of bamboo, which gave him a sense of security but prevented him from firing directly at the approaching enemy. Often he did not appreciate the importance of grazing fire; in many cases, he placed his machine gun on a slope, and his fire thus went over the heads of the advancing Japanese.[117] When Chenoweth asked one platoon commander why his men had their foxholes at the top of a hill instead of at the bottom where they could have delivered grazing fire, the officer replied that "he had placed them up high where they could retreat faster." [118]

In an effort to teach the Filipinos the bare essentials of combat engineering, Casey, Skerry, and Chenoweth launched an intensive training program. Officers of the 14th and the 803d were assigned to the combat battalions to give instruction in the proper use of tools and equipment, placing machine guns, and preparing beach defenses. These instructors found themselves in a difficult position. Without command authority, they were frequently held responsible for the performance of their units. Toward the end of February, as the tactical situation worsened, MacArthur ordered the combat engineers to train to fight as infantry, and during the second week of March, training was begun in both camps. Little could be done at this late date, for "fight and learn" was now the chief, if not the only, method of training. Philippine engineers showed some progress, and American officers reported that on the whole the Filipino engineer, despite his inadequate preparation, performed well when ably led. But basic weaknesses in training could not be overcome.[119]

A number of division commanders, American and Filipino alike, apparently did not understand how to employ their engineer units properly. They frequently required them to do guard duty, bury the dead, transport rations for other units, or serve as infantry even though infantry units were available. Chenoweth relates that "an entire infantry division was found sitting quietly in bivouac" while its half-strength engineer battalion "was stringing barbed wire and digging foxholes for the entire division." Some division commanders would not permit their battalion engineers to make adverse reports to Chenoweth and Skerry. Brig. Gen. Vincente Lim of the 41st Division told 1st Lt. Henry Harris, an instructor assigned to the engineer battalion, that anything wrong would be reported to him, the general, and not to

[117] (1) Insp Rpts, Delamore, 8 and 11 Feb 42. (2) Ltr, Casey to MacArthur, 8 Feb 42. Both in Casey File 1. (3) Ltr, Casey to MacArthur, 8 Mar 42. AG 319.1 (5 Jan 41) Phil Rcds. (4) Ltr, CofS USAFFE to Corps and Beach Defense Subsector Comdrs, 9 Feb 42. (5) Insp Rpt, Maj Gay, 13 Feb 42. Last two in Casey File 1. (6) Ltr, Casey to MacArthur, 15 Feb 42. Same file.

[118] Chenoweth Ltr, 27 Sep 47.

[119] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 16. (2) Incl to Chenoweth Ltr, 30 Aug 47. (3) Ltr, Hq USAFFE to CG's I Corps and II Corps, 25 Feb 42. Casey File 1. (4) Ltr, Stickney to MacArthur, 15 Mar 42. Casey File 6. (5) Skerry Ltr, 20 Jul 49, Comment 10.

the corps engineer. "General Lim," one of Casey's assistants stated, "is determined that no reports of deficiencies in his division will get to higher headquarters but he does not take steps to correct his deficiencies. He considers his division his kingdom and does not intend for anyone to interfere with him." Casey and members of his staff as well as Skerry and Chenoweth had to make repeated and time-consuming inspections of the Philippine engineer combat battalions and front-line positions to check on the progress of engineer work. As a rule, division commanders were cooperative and tried to follow suggestions for improving defenses and for using their engineers properly, but all this required much time and effort on the part of top-ranking engineer officers.[120]

During the first week of March, Casey, inspecting the front-line positions, noted many weaknesses. There was still no mobile reserve; practically all the troops were spread "in a continuously occupied trench line clear across the front." Casey again saw no need for occupying every foot of ground, since natural strongpoints, well organized and mutually supporting, could control many yards. The men thus released could be formed into a reserve. The handiwork of the amateur Filipino soldier was still in evidence—Casey's listing of mistakes in the organization of positions filled half a dozen pages. But, he reassured MacArthur, not everything was wrong; much good work had been done and the troops were determined to hold. Skerry, who accompanied the Engineer, USAFFE, on part of his tour of the I Corps area, was less optimistic. He observed that the men were tired, hungry, and sick and that their supplies of barbed wire and entrenching tools were extremely low. As Casey and Skerry moved from unit to unit, they explained how positions might be improved but refrained from making any adverse criticism, "knowing full well that morale and a determination to fight it out . . . [were] of paramount importance." [121]

Casey had visited the front for the last time. When MacArthur, acting on orders from President Roosevelt, left Corregidor on 12 March for Australia, he took with him seventeen members of his staff, among them Casey. On 21 March U.S. Forces in the Philippines, (USFIP), under General Wainwright, replaced USAFFE as the command in the islands. Colonel Stickney henceforth served as Wainwright's engineer and as staff engineer to Maj. Gen. Edward P. King, who was in charge of Luzon Force. Bonham became service command engineer under Brig. Gen. Allan C. McBride and at the same time served as engineer supply officer for USFIP in Colonel Stickney's office. The engineer organization in the field, not affected by the changes in the high command, remained as before, with Skerry and Chenoweth continuing as engineers of I Corps and II Corps, respectively.[122]

[120] (1) Ltr, CofS USAFFE to Corps and Div Comdrs, 2 Mar 42. Casey File 6. (2) Insp Rpt, Casey and Gay, 7 Feb 42. Casey File 1. (3) Ltr, CofS USAFFE to Corps and Div Comdrs, 9 Feb 42. Casey File 4. (4) Chenoweth Ltr, 27 Sep 47. (5) Insp Rpt, Maj Gay, 17 Feb 42. Casey File 1. (6) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 16.

[121] (1) Ltr, Casey to MacArthur, 8 Mar 42. AG 319.1 (5 Jan 41) Phil Rcds. (2) Skerry Ltr, 4 Jun 49, Comment 18.

[122] (1) Morton, *Fall of the Philippines*, p. 359. (2) Incl with Ltr, Mielenz to C Staff Br, 4 May 51.

The situation of the engineers, like that of the other defenders, was almost hopeless. Supplies of many critical items were nearly exhausted. Early in March the remaining stocks of burlap were given to the troops for use as blankets. On 9 March I Corps received its last issue of barbed wire. Spare parts could be obtained only from equipment turned in for salvage. The critical shortage of gasoline deadlined so much of the machinery that construction work had to be drastically curtailed. Toward the end of the month Chenoweth estimated the effectiveness of his engineers as 10 percent of normal.[123]

The lull in the fighting came to an end during the second week of March. Skirmishes along the outpost line became more frequent. Enemy artillery opened up and aerial bombings increased. On 3 April the Japanese launched their offensive, directing their heaviest blows against II Corps. The next morning the 14th and the 803d Battalions were ordered to stop work and assemble for combat. On 6 April the 51st Engineer Battalion was overrun as the entire line was hurled back. Parker then took the 201st and the 202d from reserve and committed them as infantry. Maj. Harry O. Fischer, commander of the 201st, later recalled that the enemy planes "had a field day. The jungle was so thick we could not see them and they proceeded to fly 300 or 400 feet off the ground . . . and drop bombs on us. The number of casualties was terrific. . . . We were practically dead . . . from fatigue, hunger, and dysentery. . . . We were so tired that the idea that the Japs finally had us didn't bother us a bit." The 201st and the 202d disintegrated, and on the morning of 8 April, in a last effort to stem the Japanese advance, the 803d and the 14th were thrown into the battle. The aviation battalion moved toward its position, but finding no units on either of its flanks, retreated southward. The 14th took its assigned position across one of the trails and hastily erected a roadblock. Enemy tanks, moving south, were stopped by the obstacle, unable to advance further without infantry support. The engineers had no weapons for knocking out the tanks, and later in the day the 14th was ordered to withdraw. The end was now only a question of time, perhaps a matter of hours.[124]

With the fall of Bataan imminent, the engineers, in accordance with plans previously formulated, prepared to destroy all supplies and equipment that could not be moved to Corregidor. By 7 April preparations were complete. On the evening of the 8th General King ordered the work of destruction to begin. The engineer depot at Mariveles was set on fire. Tons of dynamite were detonated, and vehicles were burned or pushed into the sea, each of the combat battalions wrecking its own equipment. During the early morning hours of 9 April, a few engineers of the service command, among them Stickney, Bonham, and Fertig, escaped to Corregidor on the *Night*

[123] (1) Ltr, Casey to MacArthur, 8 Mar 42. AG 319.1 (5 Jan 41) Phil Rcds. (2) Skerry Ltr, 4 Jun 49, Comment 18. (3) Ltr, Casey to MacArthur, 1 Mar 42. Casey File 6. (4) Chenoweth Ltr, 27 Sep 47-

[124] (1) Morton, *Fall of the Philippines*, pp. 431ff. (2) Rpt of Opns of SFL, Bataan Defense Force, and II Phil Corps, pp. 52ff. (3) Fischer Ltr, 28 Apr 49. (4) Goldblith, "The 803d Engineers," *The Military Engineer*, XXXVIII (August, 1946), 325.

Hawk and other craft. With the surrender of all forces on Bataan later that day, the engineers still on the peninsula became prisoners of war. The long siege was over.[125]

Corregidor and the End of the Campaign

To the men on Bataan, Fort Mills on Corregidor seemed a place of security. The elaborate fortifications, many big guns, and subterranean chambers appeared to justify the name, Gibraltar of the East. The power plant, water system, cold storage plant, and sizable stocks of munitions and supplies gave a measure of self-sufficiency. But life on the island, though not so perilous as on Bataan, was still precarious. Four miles long and one and one-half miles across at its widest point, Corregidor offered an excellent target. Its importance as the key to Manila Bay insured repeated bombings. Only by going underground could its garrison be safe. Largest of the tunnels was Malinta, which the engineers had blasted out of the rocky hill in the center of the island many years before. Its main east-west passage, 825 feet long and 50 feet wide, and its fifty-odd lateral tunnels, each about 150 feet long, housed the headquarters, repair shops, and the hospital, and provided space for large quantities of supplies. But all the men on the island could not remain in Malinta. The guns, the power plant, the water reservoirs, and indeed most of the facilities needed to maintain Corregidor as an effective bastion, were above ground. Keeping utilities in operation, maintaining the island's 62 miles of roads and trails and its 13 miles of electric railway, and providing additional tunnels and shelters were the responsibility of the engineers.[126]

Just before the war began, Colonel Mielenz and his assistants were attempting to get the projects for modernizing Corregidor under way. The contractor and his crews were on the scene, but no formal agreement had yet been signed. Most of the requisitions for supplies and equipment sent to the United States months before were still unfilled. Except for the construction machinery brought over by the contractor, items of equipment on the island were few. On hearing the news of Pearl Harbor, Mielenz suspended negotiations, hired the contractor's men as temporary civil servants, and forced into high gear a program previously estimated to take three years to complete. Some of the workmen were soon building bombproof shelters at gun batteries, while others were placing baffle walls and sandbags in front of the doors and windows of the power and cold storage plants. Still others were at work on Malinta Tunnel, where they began laying a concrete floor in the hospital, installing a temporary ventilating system, and putting sandbags at the east and west entrances.[127]

For three weeks the Japanese ignored the island. On 29 December, a few

[125] (1) Fertig, Guerrillero, pp. 92ff. (2) Bonham, Engr Supply.

[126] (1) Strong, "The Lean Years," *The Military Engineer*, XLI (May-June, 1949), 179–81. (2) Rpt of Opns of USAFFE and USFIP in the Phil Islands, 1941–1942, Exhibit J, Malinta Tunnel Plan. AG 98–USFI–0.3. (3) Mielenz, Engr Preparation.

[127] *Ibid.*

days after MacArthur moved to Corregidor, enemy planes made the first of a series of attacks which continued until 6 January. Almost all buildings were destroyed or heavily damaged. Power lines were knocked out, pipelines damaged, water tanks demolished. Large sections of road were obliterated and the electric railway was wrecked. In the huge fires that swept the island, great quantities of supplies were lost, including large amounts of construction materials. When the smoke had cleared, the engineers began removing the wreckage and strengthening the island to withstand further attacks.[128]

Even while the raids were in progress, Mielenz was making frantic efforts to repair the damage. As soon as the all clear sounded, crews went out to patch roads and mend power, sewage, and water lines. Fixing the roads, most of which were surfaced with gravel, was comparatively easy, since bulldozers could quickly fill in craters and smooth out churned-up sections. The few stretches of concrete were more difficult to repair, but detours could be readily provided. Road gangs worked all through the night until raids at dawn forced them to take shelter. The plumbers, electricians, and mechanics who had formed the small peacetime maintenance staff were unable to cope with the extensive damage to utilities. The electric railway was ruined beyond repair. Electric cable was scarce and only the most vital power lines could be maintained. The sewage system was so badly damaged that field latrines had to be used. The restoration of water lines was difficult and time consuming; not until 14 January were the troops again permitted to use fresh water for washing clothes or bathing.[129]

Saturation bombing demonstrated the defects of some of the existing tunnels and shelters and brought home the need for increased passive protection. During the raids several of the shallower tunnels collapsed and a number of bombproof shelters turned out to be death traps. Many of the shelters built before the war were covered with 4 feet of concrete, topped by 8 feet of earth. Bombs penetrated the earth and exploded when they hit the concrete. The soil served as tamping and forced the blast downward. When the troops manning the gun batteries and beach defenses began digging tunnels and building bombproofs for their own protection, the engineers furnished technical advice. Mielenz directed that no new tunnels were to be constructed unless the rock cover was at least 50 feet thick. He also adopted a type of bombproof with a layer of concrete covered with rubble to act as a burster course. Meanwhile, he pushed projects to protect installations above ground and to make Malinta Tunnel safer and more livable. The engineers put covers of reinforced concrete over the large gasoline tank and the telephone exchange. Neither installation was ever damaged. In Malinta, they installed stand-by water and power systems and completed a sewage system

[128] (1) Morton, *Fall of the Philippines,* pp. 479–80. (2) Fertig, Guerrillero, pp. 61–62.

[129] (1) Mielenz, Engr Preparation. (2) Ltr, Mielenz to CG Harbor Defense of Manila and Subic Bays, 7 Jan 42. (3) Hq HD of Manila and Subic Bays, Fort Mills, Official Bull, No. 10, 14 Jan 42. Last two in Casey File 7.

for the hospital. They placed additional sandbags inside the tunnel entrances to deflect the burst of bombs landing behind the protective wall of bags previously stacked outside. Almost until the end, the men on Corregidor continued building shelters and providing cover. Between 8 December and 10 April they blasted about two miles of tunnel.[130]

Keeping the island supplied with water was one of Mielenz' chief concerns. Eighteen wells normally furnished some 675,000 gallons a day, while eight reservoirs held about six million gallons. Wells and reservoirs were scattered in such a manner that it was hardly likely that they would all be hit in one raid. Nevertheless, by 20 January four reservoirs had been knocked out. To replace them, the engineers installed temporary tanks and a stand-by pumping system was also provided. Usually enemy bombings damaged only the pipelines. To prevent the loss of large quantities of water from broken lines, the engineers posted guards at the reservoirs with orders to close the valves when the air raid sirens sounded. On 9 March Mielenz reported that 6,642,251 gallons were in storage. Except for occasional shortages, the supply of water was adequate until the last few days before the surrender.[131]

In January Casey pressed for the improvement of Kindley Field and the construction of five splinter-proof, camouflaged plane pens. Located on the eastern end of the island, Kindley was rocky and muddy, and could be used only for emergency landings. Stickney had started work on the runway in early 1941, but shortages of equipment and personnel had hampered progress. Little had been done before the war, except to extend the runway from 2,100 to 2,400 feet. Since Mielenz could spare no men for work on Kindley, volunteers from the air force in mid-January were given the job of building revetments of sandbags but accomplished little. Casey was at length able to get Company A of the 803d assigned to the project, and on 4 February the unit moved to Corregidor, but it had been so badly mauled in the fighting at Quinauan Point that it was no longer an effective organization. Poorly equipped and subjected to repeated aerial and artillery bombardment, it constructed the five revetments but could do little to improve the runway.[132]

Calls for engineer assistance came from every quarter. Each branch and service had its special construction projects and its urgent need for repairs. The troops building fortifications and shelters required expert direction. Engineers and skilled workmen had to be spread thinner and thinner. Mielenz urged that every man who could be spared be assigned to engineer projects; even so, many jobs went begging. Dynamite, lumber, and crushed rock were sent

[130] (1) Fertig, Guerrillero, pp. 65–66. (2) Ltr, Mielenz to CG Harbor Defense of Manila and Subic Bays, 7 Jan 42. (3) Memo, D. J. Rutherford for Rcd, n.d. Casey File 4. (4) Mielenz, Engr Preparation.

[131] (1) Memo, Mielenz for Rcd, 20 Jan 42. Casey File 7. (2) Memo, Casey for CofS USAFFE, 26 Jan 42. Casey File 1. (3) Ltr, Mielenz to Casey, 9 Mar 42. Casey File 6.

[132] (1) Mielenz, Engr Preparation. (2) Memo, Casey for CofS USAFFE, 26 Jan 42. Casey File 1. (3) Hq USAFFE FO No. 12, 3 Feb 42. (4) Ltr, Mielenz to Casey, 9 Feb 42. Casey File 4. (5) Memo, D. J. R[utherford] for CG Harbor Defense of Manila and Subic Bays, 2 Feb 42. Casey File 7.

from Bataan, but replenishing many of the supplies was almost impossible. In an effort to do first things first, Mielenz tried to hold to a system of priorities, but he was not completely successful. The wishes of high-ranking officers sometimes took precedence over priorities.[133]

Late in January the Japanese moved artillery to Cavite Province on the southern shore of Manila Bay and on 6 February began a prolonged bombardment of the fortified islands. The smaller forts bore the brunt of the shelling. Fort Frank, on Carabao Island, nearest the coast of Luzon, suffered the greatest number of hits. Here the engineers partially casemated several guns and strengthened beach defenses but attempted no tunneling. North of Carabao was El Fraile Island, on which the engineers had built Fort Drum, a thick-walled concrete fort resembling a battleship. When the war began, the fort's dilapidated power plant was being overhauled under the direction of a Mr. Williams of Manila. With the occupation of the city by the Japanese, Williams remained on the island and was mainly responsible for the fact that Fort Drum was never without power. Although the Japanese placed heavy concentrations on the fort, they failed to silence its 14-inch guns. Closest to Corregidor was Caballo, on which Fort Hughes was located. This island was too small to be easily hit by enemy aircraft, but it offered a worthwhile target to the artillery emplaced across the bay. Troops and civilians worked on a tunnel, bombproofed the water storage tanks, and placed wire along the beaches. For forty-four days the guns on the islands answered the enemy bombardment. When the Japanese lifted their fire on 22 March, the forts still commanded the bay. That they had withstood the intense shelling was due to the courage of their defenders, to the fact that utilities were kept in operation, and to the strength of the forts themselves.[134]

Corregidor, rather than the smaller islands, was the enemy's ultimate objective. Working against heavy odds, the engineers tried to check the deterioration of utilities and roads and to strengthen the fortress against the day when it would have to stand alone. Because a number of tunnel entrances were directly in the line of the projectiles coming from Cavite, the engineers relocated some of the entrances and provided baffle walls for the rest. Power lines and water pipes, broken repeatedly by shells and bombs, kept maintenance crews busy. The refrigeration plant required constant attention. When the cold storage room was damaged by a bomb, the engineers immediately undertook to restore it. Much of the ammonia and tubing they needed was salvaged from wrecked ships off the shores of Bataan and Corregidor. A new steel roof was almost finished at the time of the surrender. The defenders meanwhile kept up the continual round of piling sandbags, erecting baffle walls, propping up structures, and covering observation and command posts.[135]

[133] (1) Mielenz, Engr Preparation. (2) Memo, R[utherford] for CG Harbor Defense of Manila and Subic Bays, 2 Feb 42. Casey File 7. (3) Ltr, Mielenz to Casey, 2 Mar 42. Casey File 6.

[134] (1) Morton, *Fall of the Philippines*, pp. 485ff. (2) Mielenz, Engr Preparation.

[135] (1) Mielenz, Engr Preparation. (2) Rpt of

After the fall of Bataan, Corregidor received a still more merciless pounding. The Japanese moved artillery to the heights of the Mariveles Mountains and raked the island with fire. Air attacks mounted in fury. On 29 April, the emperor's birthday, air and artillery bombardments reached their height. During the first week in May, the island shook from incessant shelling and bombing. The engineers found it impossible to repair the damage. Artillery and aerial bombardments were so intense that work in the open was impossible day or night. Roads could no longer be kept free of obstructions. Many broken power and water lines could not be repaired. Company A of the 803d, still struggling with the runway of Kindley Field, was subjected to almost continuous bombing. By the end of April the company commander and 18 men had been killed. In the last days four engineer officers were given the hazardous assignment of acting as observers for the artillery. Two lost their lives. 1st Lt. Hersel E. Philippe, one of Mielenz' assistants, was killed while serving as a spotter on the western part of the island, and Captain Gewald was burned to death on top of Malinta Hill.[136]

Early in April the southern Philippines came under attack. Except for the small force which had come ashore on Mindanao on 20 December, no enemy troops had landed in the southern islands during the first four months of the war. The combat engineers of the Visayan-Mindanao force, the 61st, 81st, and 101st Battalions, had erected fortifications and prepared roads and bridges for demolition. Men from Stickney's office had readied many airfields with the help of contractors and civilian laborers. The Japanese assaults began on 10 April with a landing on Cebu, and within a week the enemy was in control of the coastal areas. On 16 April the Japanese invaded Panay; four days later organized resistance ceased. On the 29th they made a major landing on Mindanao's western coast and on 3 May another on the northern coast. The defenders were quickly overwhelmed. With the seizure of these three islands, the Japanese controlled the southern Philippines. Only the islands in Manila Bay still resisted the enemy.[137]

The landing of Japanese troops on the eastern end of Corregidor on the night of 5 May and their advance toward Malinta Tunnel the next morning convinced Wainwright that continuation of the suicidal struggle could serve no useful purpose. With the surrender on 6 May of the remaining USFIP forces on Corregidor and the southern Philippine Islands, all organized engineer operations came to an end. Except for a few who escaped, the men on Corregidor were sent to prisoner of war camps in the Philippines, and many were later transferred to camps in Japan and Manchuria. Most of the engineers of the Visayan-Mindanao force eluded the enemy by retreating into the almost inaccessible

Opns of USAFFE and USFIP in the Phil Islands, 1941–42, an VIII, Exhibit E. AG 98–USFI–0.3.

[136] (1) Mielenz, Engr Preparation. (2) Brief Hist of Co A, 803d Engrs.

[137] (1) Morton, *Fall of the Philippines*, pp. 498ff. (2) Ltr, MacArthur to CG Visayas-Mindanao Force, 16 Dec 41. Casey File 8. (3) Incl 2 with Fertig Ltr, 5 Jun 47.

mountainous regions of the southern islands.[138]

Within a few months guerrilla warfare began. One of the leaders was Colonel Fertig, who left Corregidor by plane on 29 April for Mindanao, where he helped organize the guerrilla forces. By 1943 he had 45,000 men under his command. Destruction of roads and bridges by Fertig's guerrillas made Japanese overland transport almost impossible. Colonel Manzano made his way to Manila and established an intelligence network. Information gathered by his agents was sent to Fertig on Mindanao and from there to General MacArthur's headquarters in Australia. The guerrillas were still harassing the enemy when American troops returned to the Philippines late in 1944.[139]

[138] (1) Rpt of Opns of USAFFE and USFIP in the Phil Islands, 1941–42, pp. 76ff. (2) Some units in the southern islands did not surrender until several weeks later. See Morton, *Fall of the Philippines,* pp. 574ff. (3) Summary of Activities of 61st Engr Bn, in USAFFE Orgn and Hist 1941–42, prepared by "IJKL" Subsection, ICS. OCMH Files. (4) Claude E. Fertig, "American Engineers with the Filipino Guerrillas," *The Military Engineer,* XLI, No. 283 (September–October, 1949), 366, 368.

[139] (1) Ltr, W. W. Fertig to Casey, 1 July 43. SWPA Files. (2) Fertig, "American Engineers with The Filipino Guerrillas," *The Military Engineer,* XLI, No. 283 (September-October, 1949), 366–68. (3) Fertig Ltr, 17 Jun 49.

CHAPTER IV

Build-up in the Southwest Pacific

Concurrently with their campaign in the Philippines, the Japanese swept rapidly southward into the Netherlands Indies, and were, before long, menacing Australia and the islands of the South Pacific. In all of that vast area Australia remained as the one practicable base of resistance. Because of its great size, the country could not easily be overrun. With its small but expanding munitions industry, its armed strength, and its factories and farms, the Commonwealth could contribute substantially to the Allied effort against Japan. But Australia's resources were too slender, its population too sparse, and its defenses too weak to resist a possible Japanese invasion effectively or to launch offensives without aid from its allies. The continent had to be transformed into an Allied bastion and a base from which to strike back. To reach such a goal, the amount of engineer work required would be enormous.

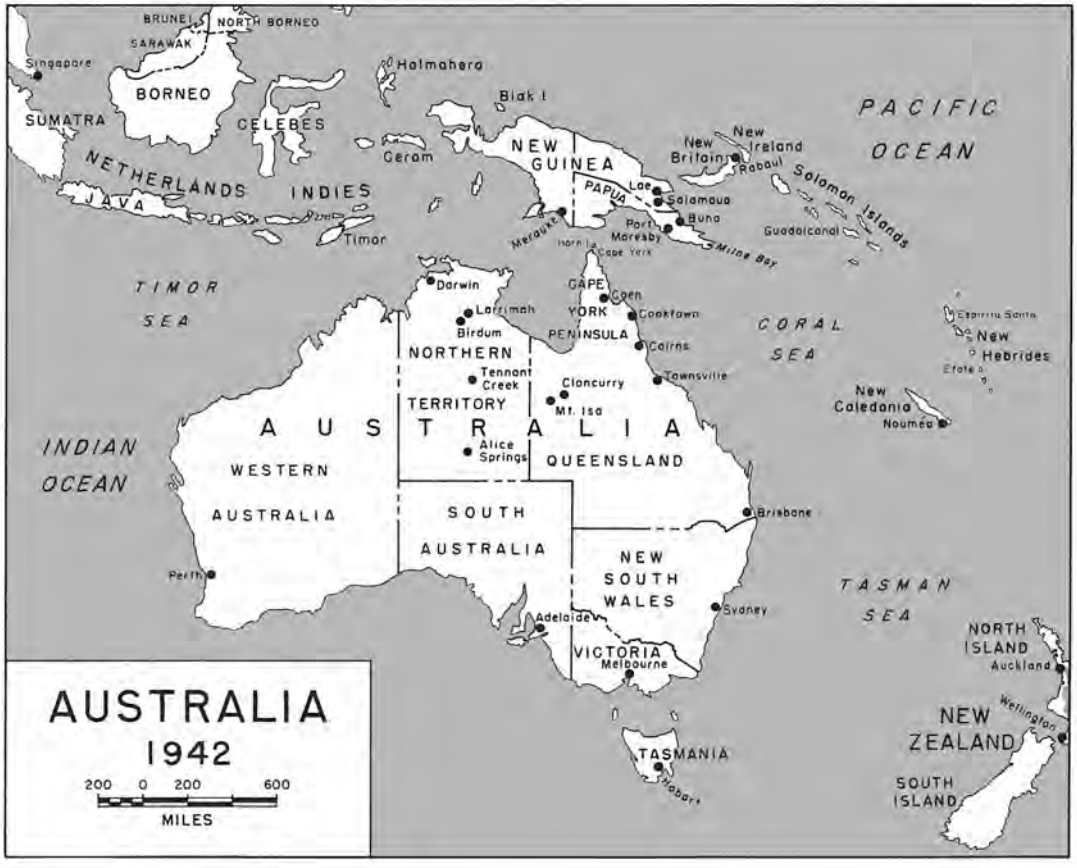
Australia—The First Days

Defense Plans

During the early weeks after Pearl Harbor, Australia had assumed an ever greater importance in Allied strategy. Within ten days Secretary Stimson and General Marshall had decided to establish a base on the southern continent from which to supply the Philippines and provide air support for General MacArthur. By Christmas it was apparent that efforts to help the forces in the Philippines, the bulk of them already withdrawing to Bataan, would be of little use. The Allies had to concentrate on holding farther south, and their hope now was to save the Netherlands Indies. Although Roosevelt and Churchill, meeting at the ARCADIA Conference in Washington in late December, agreed to direct the main Allied effort against Germany first, the seriousness of the situation in the Far East prompted them to divert additional strength to the western Pacific. America's chief contribution was to be air power based on Australia. Toward the close of the year the War Department took steps to send nine air groups to the southwest Pacific.[1]

The outbreak of war with Japan was to put a heavy strain on Australia's resources. As large as the United States, the Commonwealth had a population of

[1] (1) Stimson and Bundy, *On Active Service in Peace and War*, pp. 396–97. (2) Maurice Matloff and Edwin M. Snell, *Strategic Planning for Coalition Warfare, 1941–1942*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1953), pp. 87–88, 95, 114–19, 128–29. (2) Dwight D. Eisenhower, *Crusade in Europe* (New York, 1948), pp. 21, 22, 24, 28.



MAP 7

but seven million. Only the southeastern areas were highly developed; two-thirds of the total population lived in the two states of Victoria and New South Wales. (*Map 7*) Natural resources were limited, with agricultural and pastoral products forming the foundation of the country's economy. By American or European standards, Australia's industrial system was small. Its communications network was poor. Except in the southeast, there were few paved roads. Most rail lines were single track and gauges in the various states ranged from three feet six inches to five feet three inches.

Most of the Commonwealth's trained fighting forces were overseas at the time of Pearl Harbor. Nearly all of the Australian Imperial Forces (AIF) and the Royal Australian Air Force (RAAF) were fighting in Europe and the Mediterranean or helping to protect the Middle East and Malaya. The two heavy and three light cruisers, which comprised the bulk of the Royal Australian Navy (RAN), had only recently returned to home waters after serving in the Medi-

terranean and the Indian Ocean. The air force assigned to defend Australia consisted of forty-three British and American bombers and an equally small number of Australian-built training planes. The troops on hand included the Australian Military Forces (AMF)—a militia poorly equipped and with little training—and one AIF armored division without its tanks. There was, besides, the Volunteer Defence Corps (VDC), an organized reserve of some 50,000 men, most of them veterans of World War I.[2]

Because their means were limited, the Australians understandably adopted a defensive strategy. Soon after the Japanese began their rapid thrust southward, the Australian Chiefs of Staff had come to the conclusion that any attempt to hold the islands northeast of the continent or even the underdeveloped, sparsely inhabited areas of the northern part of the Commonwealth would be ill advised. Should the Japanese invade, the Australians would have no choice but to abandon all territories except the southeastern corner of the continent containing the major cities of Brisbane, Sydney, and Melbourne. Most of the military forces in the Commonwealth were therefore concentrated in this important industrial and agricultural area. Only small forces were sent to such distant outposts as Darwin in the northwest and the Cape York Peninsula in the northeast.[3] Not unless the Australians received substantial reinforcements would they be inclined to adopt a more aggressive plan of action.

Reinforcements Arrive

A few reinforcements were soon to come from the United States. When Japan declared war, a convoy of eight transports, carrying men and supplies to the Philippines, was approaching the Fiji Islands. Instructed by General Marshall not to return to Hawaii but to go on to Australia, the convoy headed for Brisbane, arriving there on 22 December. The 4,600 men aboard, commanded by Brig. Gen. Julian F. Barnes, included a regiment and two battalions of field artillery and the ground echelon of a bomber group. There were no engineer units. Late in December Maj. Gen. George H. Brett, Chief of the Air Corps, at that time on a mission to Chungking, flew down to take command of the American troops. On 1 January his command was designated United States Army Forces in Australia (USAFIA). Marshall gave Brett two major tasks: get supplies to the Philippines and transform Australia into a major air base. As hope of getting help to MacArthur dimmed, Brett concentrated on his second objective.[4]

---

[2] (1) Samuel L. Milner, *Victory in Papua,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1957), pp. 3–4. (2) C. Hartley Grattan, ed., *Australia* (Berkeley, Calif., 1947), pp. 165, 204, 389ff. (3) Richard M. Leighton and Robert M. Coakley, *Global Logistics and Strategy, 1940–1943,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1955), pp. 167–68. (4) Memo, OCE Tr Div Railway Br for C Opns and Tng Br, 29 Aug 42. 617 (Australia) 1942. (5) *Sydney Morning Herald,* February 26, 1942, p. 7.

[3] Milner, *Victory in Papua,* pp. 4–6.

[4] (1) Rpt of Orgn and Activities, USAFIA, pp. 2–7. SWPA File A161. (2) Rad, Marshall to U.S. Mil Attaché in Australia, 17 Dec 41. Incl 6b to Rpt of Orgn and Activities, USAFIA. (3) Rad, Marshall to Brett, 25 Dec 41. Incl 11 to Rpt of Orgn and Activities, USAFIA.

Australia, Brett declared, must be a "second England." On 4 January he laid before the Commonwealth's Chiefs of Staff his plans for strengthening the continent, placing special emphasis on the northern regions. His program called for constructing air bases at Darwin, Brisbane, and Townsville. He considered Darwin, centrally located on the north coast of Australia, an ideal site from which to launch operations against the Indies and the Philippines. This city would be both an advance air base and a port of embarkation for troops and supplies moving northward. Shipments of planes and airmen from the United States would put in at Brisbane, 1,800 miles to the southeast, where Brett wished to establish his main assembly plant and repair shops for all types of aircraft. Townsville, 750 miles north of Brisbane, was to be a secondary port and a subsidiary base for assembling and maintaining planes. To stage fighters to the Indies, Brett proposed to develop still further the existing air ferry route from Brisbane and Townsville to Darwin. He chose Melbourne as the major port of entry for troops and supplies and as the site for his headquarters. The Australians, while pointing out that the areas north of Brisbane would be difficult to defend, agreed to go along with Brett's plan.[5]

A quick trip by plane over eastern and northern Australia revealed to Brett the magnitude of the job ahead. Melbourne and Brisbane would present little difficulty. They were large, modern cities, with deep harbors, well-developed roads and railroads, manufacturing plants, and indeed all the facilities of metropolitan centers. In the surrounding countryside were most of the airfields, camps, and depots of the Australian Army. Townsville and Darwin offered a sharp contrast. A commercial center for the sheepherders, farmers, and miners of northern Queensland, Townsville was a provincial city of 25,000. It was linked with the south by a single-track railroad and a rough coastal highway, neither of them designed to carry heavy traffic. Its harbor was too shallow for large ships. Except for nearby Garbutt Field, being developed for the air ferry route to the Philippines, and the field at Charters Towers, 65 miles to the southwest, Townsville had few of the facilities that go to make up an air base. Darwin, with 1,500 inhabitants, was about 2,000 miles from Melbourne and 1,800 from Brisbane. It had no rail connection with the rest of the continent. The only line out of the city, "two streaks of rust without much rolling stock," extended southeastward for a distance of 300 miles and ended in the desert at Birdum. Not much better than cattle tracks were the roads leading to the more populous parts of the continent. Darwin's docks could take only two ships at a time. Near the city were two small airfields—Darwin RAAF Field and Darwin Civil; a third, Batchelor Field, was located 40 miles to the south. Brereton, while visiting Australia in November 1941, had arranged for the improvement of Batchelor to enable it to take heavy

[5] (1) Notes of Conf Held on 4 Jan 42. Incl 13c to Rpt of Orgn and Activities, USAFIA. (2) Rad, Brett to Marshall, 2 Jan 42. Incl 12a to Rpt of Orgn and Activities, USAFIA. (3) Cable, Brett to TAG, 3 Jan 42. (4) Rad, Brett to MID, 5 Jan 42. Last two in WPD WDGS Msg File No. 5, 1–12 Jan 42.

bombers, and the RAAF had begun work two days later. Circumstances now required not one, but a whole series of bomber fields in the Darwin area. As a result of his trip, Brett saw clearly that carrying out his plans would require large-scale construction, but he was convinced his program was necessary if the enemy advance southward was to be halted.[6]

Asked by the War Department for a rough estimate of his needs, Brett called for a large contingent of engineer troops and generous quantities of construction supplies. In cable after cable, he detailed his requirements—three engineer airdrome units, two labor battalions, one service unit, and one general service regiment; rock crushers, jack hammers, trucks, compressors, landing mat, trucks, 32,000 tons of rail, and 100,000 tons of asphalt. Marshall, when he saw the tack Brett was taking, became somewhat concerned and asked him to trim his sails. The Chief of Staff could not go along with plans for developing "a second England." He explained to Brett that he did not intend to send many service troops to Australia and reminded him that the shortage of shipping was critical and that the War Department had to save "every possible ton of ship space." American forces in Australia would therefore have to exploit local resources to the limit. Brett persisted in asking for large shipments, but Marshall refused to yield.[7]

Eager to do their part, the Australians promised Brett a "maximum measure of co-operation." The Commonwealth government quickly agreed to furnish supplies, provide workmen, hire contractors, and turn over such buildings as could be spared. The Treasury foresaw little difficulty in financing projects. The Australians were careful to point out the limitations of their resources. They emphasized that construction machinery was scarce, that most of their manpower was already committed to defense, and that many materials, among them asphalt and bitumen, now so urgently needed for airfields, would have to be imported. The "most vital and difficult factors" in construction, they warned, "would be materials, labor, and time." [8]

Engineer Tasks

Even though the Australians would do their utmost, the U.S. Army engineers

[6] (1) Rad, Brett to Marshall, 2 Jan 42. Incl 12a to Rpt of Orgn and Activities, USAFIA. (2) Cable, Brett to TAG, 3 Jan 42. WPD WDGS Msg File No. 5, 1–12 Jan 42. (3) Brereton, *The Brereton Diaries*, pp. 25–26, 72–75. (4) [Hist of] Base Sec Two (Draft MS), p. 1. SWPA File A173. (5) Ltr, Col Albert G. Matthews to Staff Br Of C Engr GHQ FEC, 10 Nov 49, pp. 8, 19. SWPA Files. (6) Ltr, Matthews to Staff Br OF C Engr GHQ FEC, 20 Apr 50, p. 6. SWPA Files.

[7] Rad, Marshall to Brett, n.d. Incl 12 to Rpt of Orgn and Activities, USAFIA. (2) Leighton and Coakley, *Global Logistics and Strategy*, pp. 168–69. (3) Rad, Brett to Marshall, n.d. Incl 12a to Rpt of Orgn and Activities, USAFIA. (4) Cable, Brett to MID, 4 Jan 42. G–4/33861 sec. II (Jan 42). (5) Cable, Brett to AGO, 7 Jan 42. WPD WDGS Msg File No. 5, 1–12 Jan 42. (6) Memo, G–4 WD for Marshall, 8 Jan 42. (7) Ltr, Marshall to CG USAFIA, 6 Feb 42. Last two in G–4/33861 sec. II (Jan 42).

[8] (1) Notes of Conf between Australian CofS and their deputies, the Secy Dept of Defense Coordination, the Secy Defense Com, Gens Brett, Brereton, and Barnes, *et al.*, 3 Jan 42. Incl 13b to Orgn and Activities, USAFIA. (2) Min 2, Second Mtg of Admin Plng Com, 13 Jan 42. Incl 13d to Orgn and Activities, USAFIA.

would have to assume heavy responsibilities. They would have to provide plans and specifications, advise in the selection of sites, and guide the Australians in the unfamiliar task of building for the American Army. The officers who had reached Australia by early January were far too few to carry the load. Brett informed the War Department that more engineer officers were urgently needed. He asked that Brig. Gen. Raymond A. Wheeler be sent posthaste to Australia, but since Wheeler was then on an important mission to Iran, General Reybold chose Col. Dwight F. Johns for assignment to the southwest Pacific. The Chief of Engineers also selected several officers of lower rank for Brett's staff. Meanwhile, Maj. George T. Derby, who had come over on the convoy, served as Brett's first engineer. Because Brett had so few men to staff his headquarters, Derby served also as finance officer and briefly as G–4.[9]

On 5 January, Derby moved from Brisbane to Melbourne and before long had set up his office on the top floor of an empty, ramshackle warehouse. During the course of the month, he added an engineer and two infantry officers to his staff and hired a small number of civilians. At the same time he fell heir to a ready-made engineering organization. The firm of Sverdrup and Parcel had built up a staff of Australian civilians for work on airfields for the South Pacific air ferry route. Derby negotiated a contract with the firm whereby he secured the services of about thirty skilled architects, engineers, and draftsmen. The Australians saw to it that he was well supplied with money. The story goes that he went to one of the Melbourne banks, introduced himself, and explained his needs for funds. The bank promptly made out a note for 1,000,000 pounds, adding that he was welcome to more if he needed it.[10] Derby scarcely had time to do more than assemble a staff and secure funds before leaving early in February for Java. He was replaced temporarily by Maj. Elvin R. Heiberg.[11]

To decentralize operations, Brett had established four base sections on 5 January. Base Section One, with headquarters at Darwin, included Northern Territory. Two and Three were set up in Queensland, with headquarters in Townsville and Brisbane, respectively. Base Section Four, with headquarters in Melbourne, included Victoria in southeastern Australia. When the base sections were first organized, there were not enough engineer officers to staff them all. Capt. Willard Farrar was assigned to Brisbane and Maj. Ward T. Abbott to Townsville, while Derby himself, before his departure, assumed the duties of base section engineer in Melbourne. Darwin was left to the RAAF. Base section engineers, like the chief engineer, were to be staff officers only. Under the techni-

[9] (1) Cable, Brett to AGO, 7 Jan 42. (2) Cable, Brett to MID G–2 [recd 3 Jan 42]. Both in WPD WDGS Msg File No. 5, 1–12 Jan 42. (3) DF, G–4 WD to TAG, 7 Jan 42. G–4/33861, sec. II (Jan 42). (4) A Narrative Hist of Engr Hq USAFIA, Jan–30 Jun 42 (cited hereafter as Hist of Engr Hq USAFIA), p. 1. SWPA File A147.

[10] Matthews Ltr, 10 Nov 49, p. 23.

[11] (1) Hist of Engr Hq USAFIA, pp. 1–2, 4. (2) Cable, Mil Attaché in Australia to G–2 WD, 4 Jan 42. WPD WDGS Msg File No. 5, 1–12 Jan 42. (3) Memo, C of Finance WD for G–4 WD, 6 Jan 42. G–4/33861, sec. II (Jan 42). (4) Hq USAFIA GO 10, 7 Feb 42.

cal supervision of Derby and his successors, they were to take orders only from their base section commanders.[12]

The engineers found themselves almost totally dependent on the Australians. Although the War Department gave Brett authority to use fixed-fee or negotiated lump-sum contracts to lease whatever properties he needed and to overobligate funds if necessary for urgent construction, the engineers could do little without Australian advice and assistance. Not acquainted with local contracting or supply firms, they called on the RAAF, which controlled most airfield work, and on government works agencies for help in getting projects started and pushing them to completion. Lacking knowledge of real estate prices, methods of acquisition, or terms of leasing, they turned to the Australian Army's Hiring Service for land and buildings. Because of the Americans' unfamiliarity with the local scene, setting up a procedure whereby the engineers as well as other branches of the Army could work together with the Australians was of fundamental importance. To bring about co-ordination at the highest level, Brett and the Australian chiefs of staff established three joint committees, made up of representatives of USAFIA and the Commonwealth's armed services. The Chiefs of Staff Committee and the Joint Planning Committee, the latter composed of the deputy chiefs, were responsible for formulating "policies concerning the distribution of troops and facilities for the U.S. Army in Australia." In other words, they would decide what to build and where. The Administrative Planning Committee had the task of recommending ways in which the construction effort could best be organized, materials and equipment equitably apportioned between Australians and Americans, and the work of the supply services co-ordinated. The decisions of these three predominantly Australian committees would greatly affect the progress of construction.[13]

Work for the Americans would have to be superimposed on a broad defense program which the Commonwealth government was already carrying out. Soon after the outbreak of hostilities in Europe, Australia had launched a large construction effort, designed both to strengthen the nation for war and to develop the postwar economy. By the time of Pearl Harbor, work had been undertaken on some thirty-five new munitions plants and on seventy-seven additions to existing ones. The RAAF was building fields for forty-two squadrons in the southern half of the continent. Tanks for motor gasoline were being erected at various points located inland at least one hundred miles from

[12] (1) Hq USAFIA GO 1, 5 Jan 42. (2) Hist Summary of Activities of Hq of Base Sec 3 From 23 Dec 41 to 31 Mar 44. (Draft MS). SWPA File A176. (3) [Hist of] Base Two. (4) Hist of Base One (Draft MS). SWPA File A174. (5) Of of the Engr Base Sec Four, [Hist Rpt] From 21 Feb 42 to 30 Mar 44, dtd 20 May 44. (Draft MS). SWPA File A182. (6) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 25–26.

[13] (1) WD Ltr, AG 381 (12–20–41) Misc-D-M to CG American Forces in Australia, 20 Dec 41, sub: G–4 Admin Order—Plan X. G–4/33861, sec. I. (2) WD Ltr, AG 400 (1–31–42) MSC-D-M to CG USAFIA, 2 Feb 42. G–4/33861, sec II (Jan 42). (3) Hist of Engr Hq USAFIA, p. 16. (4) Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, 10. (5) Rpt of Orgn and Activities, USAFIA, pp. 14–15. (6) Notes of Conf Between the Australian CsofS *et al.*, and Gens Brett, Brereton *et al.*, 3 Jan 42. Incl 13b to Rpt of Orgn and Activities, USAFIA.

the eastern and southern coasts, and storage for aviation gasoline was being provided at army and oil company depots. Two major links in the transcontinental highway system were being improved: one, the North-South Road from the railhead at Alice Springs to Darwin, the other, the East-West Road from Mt. Isa in western Queensland to Tennant Creek on the North-South Road. A huge drydock for capital ships was building at Sydney. Two large permanent hospitals were going up, one at Brisbane, the other at Adelaide. These undertakings were already taxing the Commonwealth's slender resources to near capacity, and with the war coming close to Australia's shores, a great deal of additional construction would be needed. In the south, where much could be turned over to the Americans, co-operation with the engineers imposed no great burden, but any help the Australians could give for the new projects in the north would have to be at the expense of their own program and in violation of their own strategic concepts.[14]

Construction Begins

At Melbourne, consequently, the engineers found their task fairly easy. Even though the city was crowded, the headquarters of the Australian Army, Navy, and Air Force being located there, the Commonwealth government found space for the Americans. Headquarters of Base Section Four moved into the Seamen's Mission, which Derby converted into an office building. He had the Sailor's Home altered to accommodate the military police and turned a wool warehouse into an engineer depot. The engineers leased the Royal Melbourne Hospital, 95 percent complete when the war began, thus obtaining space for over 700 beds. They built barracks for enlisted men on the hospital grounds and provided lodgings for nurses and medical officers inside the hospital buildings. Many Americans found quarters in private homes, apartments, and hotels; others pitched tents on cricket fields, race tracks, and other flat ground.[15]

The establishment of a major base at Brisbane was to require more extensive work. In mid-January, Col. Alexander L. P. Johnson, the base section commander, together with his engineer, Captain Farrar, began pushing base development. Here, as at Melbourne, the Australians made a number of properties available, among them two large airfields, Amberly and Archerfield, a wharf near the mouth of the Brisbane River, and several warehouses. Queensland Agricultural College at Gatton, fifty-five miles west of the city, was also turned over to the Americans. Contractors were soon adapting these facilities to American requirements. At Amberly and Archerfield, they began building additional barracks, operations buildings, and bombproof shelters. Near the

[14] (1) Paul Hasluck, "Australia in the War of 1939–1945," *The Government and the People, 1939–41* (Canberra, 1952), pp. 469–70, 560. (2) Of C Engr GHQ SWPA Annual Rpt for 1942 (Draft MS). SWPA Files A1–A6. (3) Allied Works Council, *Report on the Activities of the Allied Works Council for the Period February 26, 1942 to June 30, 1943* (cited hereafter as AWC, *Report, February 1942–June 1943)* (Melbourne, 1943), pp. 49ff., 60ff.

[15] (1) Of of the Engr Base Sec Four [Hist Rpt] From 21 Feb 42 to 30 Mar 44. (2) Of C Engr GHQ SWPA Annual Rpt for 1942. (3) Memo, G–4 USASOS, 2 Nov 42. SWPA File 94.

wharf they erected frame office buildings, a warehouse, and a 40-ton crane. They began converting Queensland Agricultural College into a hospital with 250 beds. Quite a few new projects had to be undertaken. Colonel Johnson directed the building of eight frame warehouses to be dispersed throughout the city and arranged for contractors to build an ordnance depot in suburban Derra. Camps were a major requirement. Johnson selected a site near Wacol, fifteen miles southwest of Brisbane, and soon work was under way on a 5,000-man staging camp, later named Camp Columbia. He also set work in motion on a 1,000-man camp near Archerfield. Farrar designed both camps on a dispersal basis, with buildings to be constructed in wooded areas and concealed from air observation. By far the largest of the jobs was Eagle Farm air base, which was to be Brett's main depot for assembling planes. Designing and laying out the two all-weather runways, assembly plant, hardstandings, shops, and warehouses and finding contractors, workmen, plant, and materials presented Johnson and Farrar with a real challenge, but, with Australian help, they soon succeeded in getting construction started.[16]

Farther north the engineers faced a tough assignment. At Townsville, destined to be the great base in northeastern Australia, most construction would have to be from the ground up. Brett wanted a plant for assembling fighters, shops for repairing them, and a great deal besides. Because of the grave danger of Japanese raids, a strong air defense was needed, but placing more fighter planes at Townsville would necessitate construction of at least one new airdrome to supplement the bomber fields at Garbutt and Charters Towers. If oceangoing vessels were to use the port, the harbor would have to be deepened, new wharves built, and roads to the docks improved. On 5 January the base section commander, Brig. Gen. Henry B. Clagett, and his engineer, Major Abbott, arrived. After checking in at their hotel, they set out for a conference at the local headquarters of the RAAF. Having discussed their needs with the Australian airmen, they inspected several airfield sites selected earlier by General Brereton and found them suitable. A tour of the town and the surrounding countryside convinced them that there were "acres of open country on which to build" but little else. Labor was scarce, many residents having fled to the south. Since local merchants stocked few of the items needed for large-scale construction projects, supplies were low. Despite the discouraging outlook, Clagett and Abbott went ahead. Within a few days, they had obtained the RAAF's permission to award fixed-fee contracts and sent out a call for workmen to all the towns within a radius of 200 miles. By the ninth, contractors had been hired, workmen recruited, and construction started on barracks at Garbutt and on a fighter strip at Charters Towers.[17]

Brett considered Darwin the key point in the fight for the Indies and

[16] (1) Hist Summary of Activities of Hq of Base Sec 3 From 23 Dec 41 Through 31 Mar 44. (2) Craven and Cate, eds., *Plans and Early Operations*, p. 376. (3) Extracts, Maj Farrar, 23 Dec 42. SWPA File 241. (4) Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, 36.

[17] (1) Notes of Conf Held on 4 Jan 42, Incl 13 to Rpt of Orgn and Activities, USAFIA. (2) [Hist of] Base Two.



CAMP COLUMBIA

Australia, and believed the establishment of a major base there was "absolutely necessary." He nevertheless recognized that construction in the town and surrounding territory would be extremely difficult. Living conditions in this forbidding tropical outpost were almost unbearable. There were few workmen to be had, and supplies would have to be brought in by tortuous overland routes or shipped by sea from southeastern Australia. To develop Darwin fully would be a long-term proposition. For the time being it would have to serve merely as a staging area for air units moving northward. Brett called initially only for construction of a field for fighters, shops for emergency repairs, and housing for 2,500 troops. Since no American engineer could be spared for Darwin, he persuaded the RAAF to take charge of construction and asked the Australian Government to speed work on the road and railroad leading into the town. Although little could be accomplished immediately, Darwin continued to figure prominently in Brett's long-range plans.[18]

The construction program, modest as it was, got off to a faltering start. During their first weeks, the engineers had to grope their way along. Since those who had arrived with the convoy had expected to serve in the Philippines, they

[18] (1) Notes of Conf Held on 4 Jan 42. Incl 13c to Rpt of Orgn and Activities, USAFIA. (2) Min of Mtg, Admin Plng Com, 5 Jan 42. Incl 13d to Rpt of Orgn and Activities, USAFIA. (3) Cable, Brett to TAG, 3 Jan 42. WPD, EDGS, Msg file 5, 1–12 Jan 42. (4) Rad, Brett to MID, 5 Jan 42. Incl 13d to Rpt of Orgn and Activities, USAFIA. (5) Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, 12–14.

had not even brought along sets of drawings or field manuals.[19] The engineers knew little or nothing of the local terrain, rainfall, or wind directions. "The rocks, trees, and soil," wrote one, "were without parallel in our previous experience. The very stars and constellations were strange." [20] Derby, in Melbourne, at first had difficulty finding out what his engineers one or two thousand miles away were doing or what their needs were. They, on the other hand, with few regulations to guide them, did not always know how far to go in hiring contractors, buying supplies, and dealing with the Australian authorities. Small wonder that construction appeared to be slow in getting under way. When General Brereton visited Australia in late January he complained that "conditions at Darwin were unsatisfactory" and that projects at Brisbane had not "progressed beyond the planning stage." [21]

Difficulties in procuring scarce building materials and equipment also had a hampering effect. Of the raw materials needed for construction, only iron ore and timber were plentiful, and the country's capacity for turning them into finished products was limited. The output of hardware, steel plate, and lumber fell far short of wartime demands, as did the production of roofing and pipe. Cement was the only manufactured product produced in ample quantities. Bitumen was almost impossible to get. Manufacturers turned out fairly large numbers of concrete mixers and light tractors and trucks. They also produced certain other items of equipment, but without essential parts, which had to be imported; bearings for carryalls, for example, had to come from abroad, as did motors for graders. Spare parts for all types of machinery were at a premium. Only a thin trickle of supplies came from the United States. The Chief of Engineers had little to spare for overseas, and the European Theater of Operations got first priority on that. And, to make matters worse, the shipping shortage slowed delivery of such items as could be earmarked for the southwest Pacific.[22]

Competition for such supplies as there were further aggravated a bad situation. The Australians placed orders without reference to the needs of the Americans, who also bought up meager stocks, heedless of the requirements of their allies. The American services likewise bid against each other. On 21 January the Commanding General, USAFIA, in an attempt to bring about more orderly procurement, ruled that all supplies procured locally must be obtained through Australian military channels. Also, base section commanders could purchase on their own authority only in amounts up to $500; purchases costing more had to be approved by USAFIA. While this order prevented a good deal of indiscriminate buying, it did not put an end

[19] Hist of Engr Hq USAFIA, pp. 4–5, 7.

[20] Col Albert G. Matthews, Data for a Hist Rpt of Engr Activities in SWPA (cited hereafter as Matthews, Data for Hist Rpt), p. 4. Incl to Ltr, Matthews to Casey, 3 Jun 46. SWPA Files.

[21] (1) Matthews Ltr, 10 Nov 49. (2) Brereton, *The Brereton Diaries*, pp. 80–81.

[22] (1) Of C Engr GHQ SWPA Annual Rpt for 1942. (2) Incls, 22 Jun 42, to Memo, Barnes for Somervell, 9 Jul 42. 400.312 (Australia) 1942–43. (3) Matthews, Data for Hist Rpt, p. 3. (4) Memo, OCE Supply Div Intl Sec for C Intl Sec, 1 Apr 42. Office file, Intl Div, DA 400.33 (Australia) (up to 19 Jan 44).

to competition among the American services. Nor did it stop the Australians from pouring materials into projects which some engineers were beginning to think were unnecessary.[23]

Total War

By the beginning of 1942 the Japanese had bottled up MacArthur's forces on Bataan and Corregidor, and enemy troops in Malaya were driving on Singapore. In mid-January, in order to have more unified direction of the war against Japan, the Allied governments had established the ABDA (American, British, Dutch, Australian) Command, under General Sir Archibald Wavell, commander in chief of the British Forces in India. Wavell's main task was to hold the Malay Peninsula and the Netherlands Indies. General Brett was named his deputy. The American forces in Australia now became in effect a supply service of ABDA. Wavell's hastily organized command could not contain the Japanese; the enemy continued to advance, fanning out in several directions. On 23 January the Australian base of Rabaul, at the northeast tip of New Britain, fell. On 15 February Singapore capitulated. The enemy was already invading Borneo and Sumatra and preparing to strike at Java. On the 19th Darwin was heavily bombed. The entire Indies appeared to be doomed, and on 25 February, the ABDA Command was dissolved. Wavell returned to India and Brett to Australia, which now seemed threatened not only from the northwest but also from the northeast.[24]

Where the Japanese would strike next was a question. Brett believed they would launch an attack from the northwest and seize Darwin. The Australian Chiefs of Staff held that the real danger lay to the northeast; the Japanese would want to sever lines of communication between the United States and Australia to prevent reinforcement of the southern continent. Immediately threatened, the Chiefs of Staff believed, were not only New Caledonia and Fiji, but also Port Moresby on the southern coast of New Guinea. To meet the growing peril, Australia would need air power and considerable numbers of ground troops as well. Prime Minister John Curtin had already ordered the AIF divisions home. Roosevelt and Marshall, reversing their earlier stand that only air and service troops were to be shipped to Australia, decided to send ground troops. On 17 February Marshall ordered the 41st Infantry Division to Australia and in early March Roosevelt promised Curtin the 32d Infantry Division also, if the Commonwealth would keep one of its divisions in the Near East. Curtin agreed. With the first troops of the AIF scheduled to return in mid-March and with the American 41st Division due to arrive in April and the 32d in May, the outlook for the defense of Australia appeared to be less desperate.[25]

The planned concentration of Allied power in Australia made necessary a

[23] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 47–48. (2) Ltr, CG USAFIA to CO's of Base Secs, 21 Jan 42. App. 20, Rpt of Orgn and Activities, USAFIA. (3) Ltr, Matthews to C Staff Br Of C Engr GHQ FEC, 12 Oct 50, p. 9. SWPA Files.

[24] Milner, *Victory in Papua*, pp. 1–2, 5, 8–10.

[25] (1) Matloff and Snell, *Strategic Planning for Coalition Warfare*, pp. 128ff., 149. (2) Milner, *Victory in Papua*, pp. 11–13, 14–15.

vastly expanded construction program. Upon his return from the Indies, Brett called for a redoubling of efforts to strengthen the northern bases. Runways at Darwin and Townsville were to be lengthened and the fields provided with camouflaged dispersals. The capacity of the assembly plants at Brisbane and Townsville was to be increased and work on them speeded up. In fact, nearly all the going projects were to be enlarged and given new impetus. Brett knew that this was not enough, and that many new jobs would have to be undertaken. He proposed to build 6 more bomber fields—three near Darwin, 2 near Brisbane, and 1 to the west of Townsville—and 4 more fighter fields—2 south of Darwin and 2 near Townsville. At Darwin he projected a host of smaller jobs, among them increasing the water supply and replacing the bombed-out wharf. He also planned to build a score of aviation fuel depots to be scattered over the continent. The Australian Chiefs of Staff agreed with Brett on the importance of all these projects and at his request gave top priority to those in the Darwin area. But since the steady Japanese advance had forced Allied supply lines southward and increased the danger to the southern part of the continent, Americans and Australians alike recognized the need for additional construction there. Camps and depots would have to be clustered around Melbourne and Adelaide, the safest ports of entry. Airfields would have to be developed in southwestern Australia, particularly around Perth, to defend the continent against attack from the Indian Ocean. On 3 March Brett established two new base sections: Base Section Five in South Australia, with headquarters at Adelaide, and Base Section Six in Western Australia, with headquarters at Perth.[26]

Engineer Problems

The engineers were in no position to plan for and direct adequately such a constantly growing construction program. Their staff sections in USAFIA were hardly bigger than they had been in January. Now headed by Brig. Gen. Dwight F. Johns, who had arrived from the United States by way of Java on 28 February, the engineer office in Headquarters, USAFIA, consisted of 4 officers, 3 enlisted men, and 45 civilians. The offices in the base sections in Victoria and Queensland were still undermanned. Engineers had yet to be found for Darwin, Adelaide, and Perth. The difficulties of building in a foreign land were becoming more apparent. Like the other defenders of Australia, the engineers speculated daily on the next Japanese move and had to plan for the construction program in an atmosphere of growing tension. Worried about the future and uncertain over how to proceed, they had the task, as one high-ranking officer put it, of "developing a country the size of the United States." [27]

Because so much construction had to be done in the north, reconnaissance alone required a vast amount of time

[26] (1)Memo, Of C Engr USAFIA for Rcd, n.d., sub: Priority List as on 10 Mar 42. SWPA File 243. (2) Hq USAFIA, GO 20, 3 Mar 42.

[27] (1) Hq USAFIA, GO 19, 2 Mar 42. (2) Hist of Engr Hq USAFIA, p. 2. (3) Ltr, Brig Gen Stephen J. Chamberlin to Gen Somervell, 26 Feb 42. Logis File, OCMH. Quoted in Leighton and Coakley, *Global Logistics and Strategy, 1940–1943*, p. 168.

and effort. In order to find suitable sites for airfields in this largely unexplored region, the engineers took to the air. General Johns chartered a private plane to fly his engineers on inspections. He was fortunate in finding a civilian pilot who "knew well the behavior of soils under traffic, the class and quality of timber which grew on the various soils and possessed the ability to recognize these." The pilot usually flew at an altitude of 5,000 feet. When he spotted a promising site, he dropped down for a closer look, sometimes circling not much higher than the treetops. Ground parties later surveyed about one-fifth of the areas recommended by the aerial observers and chose the best ones. This method of selection worked so well that it soon became common practice.[28]

A severe handicap was the lack of plans and specifications. Having no American blueprints, Derby had directed the men transferred from Sverdrup and Parcel to develop suitable designs. Because these men had no acquaintance with the American Army's standards of construction, they had to gather information from every possible source. They questioned officers who came into engineer headquarters, visited Australian camps occupied by U.S. troops, and studied Australian plans. At length they succeeded in producing some tentative drawings, though still too few to fill the needs of contractors, who consequently adopted designs of their own choosing. The result was that many facilities were overelaborate. Cables were sent to the Chief of Engineers for complete sets of the standard drawings for theater of operations buildings, which the Engineers had prepared in 1939 and 1940 to simplify overseas construction in time of war. Some time elapsed before the drawings arrived. One package containing plans for different types of airdrome structures was lost in a plane crash. After the engineers had received fairly complete sets of standard drawings, they discovered that quite a few alterations were necessary. Australian hardwoods, among the strongest in the world, had such unusual bearing qualities that much less timber was needed than the theater of operations drawings called for. The plans also had to be modified to conform to Australian sizes of materials. In fact, such radical changes were required that there was some question as to whether the drawings should be used at all. The engineers debated whether it would not be preferable to switch to Australian designs or perhaps develop entirely new plans. The matter was not to be settled for some weeks.[29]

The growing construction program placed a tremendous strain on Australia's manpower and production. Early in February the Administrative Planning Committee had recommended that the Commonwealth government set up more effective machinery to direct construction for the armed forces, Australian and American. On the day Singapore fell, 15 February 1942, Prime Minister Curtin determined to put Australia's

[28] (1) Ltr, Farrar to Johnson, 21 Jan 42. (2) Ltr, Farrar to Johnson, 12 Jan 42. (3) Ltr, Farrar to Abbott, 8 Jan 42. All three in AG 207.3 A45-345. (4) Hist of Engr Hq USAFIA, p. 8.

[29] (1) Hist of Engr Hq USAFIA, pp. 4-5. (2) DF, Somervell to CofEngrs, 4 Mar 42. 400.33 (Australia) 1942-43.

manpower and resources on a "total war basis." In line with this policy, the Australian Government established the Allied Works Council (AWC) on 26 February. The council was to direct and control "the carrying out of works of whatever nature required for war purposes by Allied Forces in Australia." Curtin appointed Mr. Edward G. Theodore, former Commonwealth treasurer, as director general, and Mr. C. A. Hoy, head of the works agency of the Department of the Interior, as assistant director. General Brett, asked to nominate a third member, chose Major Heiberg, who was succeeded within a few days by General Johns. The council was given broad powers, including the right to commandeer supplies and equipment, condemn property, and adopt any form of contract that would expedite construction.[30]

Theodore and his colleagues strove to bring order into the building program. Meeting in Melbourne, they began at once to assemble a staff and to establish offices in each of the states and in Northern Territory. The state organizations would hire contractors, recruit workers, and obtain materials and equipment. Finding it almost impossible to use peacetime methods of contracting, the council adopted the fixed-fee contract for the bulk of the jobs, offering builders an average profit of 3 percent of the estimated cost. In order to alleviate shortages of supplies and equipment, the AWC surveyed existing stocks, impressed privately owned machinery, searched for ways to increase production, and sent urgent requests to the American government for lend-lease aid. One of their major tasks, the members of the council believed, was the recruitment of workers. At first, they relied on private industry and on state construction agencies, such as roads commissions, to round up additional laborers. Appeals for volunteers met with little success. Men could not be readily persuaded to leave defense jobs in Melbourne and Sydney to go to work in the inhospitable regions of the north. When the manpower shortage continued acute, the council considered drafting workers but hesitated to take this unpopular step unless there was no alternative.[31]

The Allied Works Council was no panacea. It could not alter the basic fact that Australia's resources were limited, nor could its members simply ignore political considerations and insist on unpopular measures. It had, moreover, to operate as part of a cumbersome system. Before work on a project could begin, the council had to obtain the approval of what many thought was an inordinately large number of governmental bodies, military and civilian. Among them were the Administrative Planning Committee and the Chiefs of Staff Committee, who assigned priorities. The

[30] (1) AWC, *Report, February 1942–June 1943*, pp. 5–7. (2) *Melbourne Argus*, February 18, 1942, p. 1. (3) Commonwealth of Australia, *Statutory Rules, 1942*, No. 88 (February 26, 1942), Regulations Under the National Security Act, 1939–1940. (4) Rpt of Orgn and Activities, USAFIA, app. 20, Hist Rcd, Gen Purchasing Agent USAFIA, pp. 10–11. (5) *Who's Who, 1943*.

[31] (1) AWC, *Report, February 1942–June 1943*, pp. 80, 85, 107. (2) AWC, Office Memo No. 196, [5 Nov 42], sub: AWC Projects. SWPA File 242. (3) Memo, WD Of Defense Aid Dir Distr Br for CofEngrs, c.17 Mar 42, sub: Constr Engineering Equip for Australia and New Zealand. 400.333 (Australia) 1942–44. (4) Incls, n.d., to Memo in (3), above.

ministers of the Australian armed services were notified of pending construction so that they might determine if existing facilities could be used. The Treasury reviewed projects for American forces to arrange for financing through reverse lend-lease. The war Cabinet reserved the right to pass upon all large projects or those of a controversial nature. Only after all these agencies had approved was the Allied Works Council permitted to go ahead with construction. All too often this procedure proved to be exasperatingly slow.[32]

Yet, despite many obstacles, the Allied Works Council could by mid-March report considerable progress. The number of going projects was mounting steadily. Most of the new jobs were in the south, where the council was to perform extensive construction for the Australian services and provide numerous key facilities for the Americans. Expansion of camps near Melbourne and Brisbane was continuing. A beginning had been made on the largest job in the entire airfield program—the Tocumwal Repair and Assembly Depot in New South Wales, located on the Murray River, which formed the boundary with Victoria. This gigantic project, covering sixteen square miles, was to include 4 runways for heavy bombers, seventy miles of roads, and 608 buildings. But while the bulk of its effort was in Victoria and New South Wales, the council was beginning to devote some attention to the north. Work on roads leading from South Australia and Queensland to Darwin was being speeded up. An accomplishment the AWC took particular pride in was the launching of work on new runways at Charters Towers. The council's field representative in Queensland received the request for this job on a Saturday night early in March. He at once suspended operations at most of the other projects in the area and ordered the equipment sent to Charters Towers. He requisitioned three trains to haul the machinery and called workmen from their homes to get everything in readiness at the airfield for construction to begin. By Monday morning 200 men, with 100 trucks, 12 bulldozers, and a large number of scoops, tractors, and graders, were hard at work. The Australians, well aware that they were just embarking on a vast undertaking, were eager to get on with the program as a whole.[33]

First Engineer Units

While the Australians were intensifying their efforts, the first engineer troops arrived from the United States. On 2 February the 808th Aviation Battalion had landed at Melbourne. The people of the city, says the battalion chronicler, "were very glad to see the U.S. forces come in" and gave the 808th a "rousing welcome." But the men so warmly received were in some ways unprepared for the task ahead. Activated in September 1941, the 808th, like most of the early aviation battalions, had received only haphazard training. The unit arrived without its heavy equipment, except for three dump trucks and two

[32] (1) Of C Engr GHQ AFPAC *Engrs of SWPA*, II, 40–41. (2) Matthews, Data for Hist Rpt, p. 8.

[33] (1) AWC, *Report February 1942–June 1943*, pp. 44–47, 49–53. (2) Of C Engr GHQ SWPA Annual Rpt for 1942. (3) Of C Engr GHQ SWPA, [Rpt on] Warehouses [1942]. (Draft MS). SWPA File A5.

tractors. The bulk of its machinery was to follow later. Brett lost no time in giving the unit its assignment. Under Capt. Andrew D. Chaffin, Jr., the 808th was soon on its way to build airdromes in the Darwin area.[34]

The long journey northward introduced the engineers to the Australian transportation system. On 12 February the men went by truck to Baccus Marsh near Melbourne, where they boarded a special train. The next day, on reaching Terowie, in the state of South Australia, where the broad gauge ended, they transferred to the narrow gauge line which ran through the desert to Alice Springs, a thousand miles to the north. Having a top speed of twenty miles an hour, the train did not reach Alice Springs until 2130 of the 15th. Since there was no railroad northward out of the town, trucks carried the troops on to Larrimah, 635 miles distant. The passengers found the road rough and the "vibration . . . terrific." Arriving in Larrimah on the 18th the men "broke out laughing" when they saw the train that was to take them on to Darwin. "It consisted," one wrote, "of cattle cars for personnel, small open cars (trucks) for baggage, and a small wheezy locomotive which looked as though each hour of existence would be its last." The Australian crew's custom of stopping every few hours to have a "spot of tea" was an added irritation to the Americans, who were impatient to get to their destination. On 19 February the battalion left the train at Katherine, the site of one of the new bomber fields, instead of going on to Darwin, 200 miles to the north, which that day had been hard hit by an air attack. After experiencing the difficulties of movement between Melbourne and the Darwin area, the men of the 808th, deep in what the Australians called the "Never-Never" land, felt "completely isolated as far as the remainder of the U.S. Army was concerned." [35]

The 808th got orders to turn the civil airdrome at Katherine into a field for medium bombers and to find sites for new fields in the area. On his own initiative, Chaffin undertook another project in order to eliminate the need for transshipping cargoes at Larrimah. He decided to improve the road from that point northward so that supplies could be trucked all the way from Alice Springs. The battalion quickly settled down to work. Survey parties, sent out daily, located several good sites for airfields. Men of Company B began removing trees and providing detours around bad spots on the road to the south. At first, the 808th made scant progress on runways. On 6 March Captain Chaffin reported "little . . . has been done towards building airfields in this vicinity because of the complete absence of equipment." The battalion had brought to Katherine only the three dump trucks and two tractors it had unloaded at Melbourne in early February. Chaffin had been able to obtain 11 cargo trucks and 2 old bulldozers at Darwin. But at least 7 of his 14 trucks were needed to keep the battalion supplied with food and water. The others were

[34] Lt Col Ralph C. Glover, The Hist of the 808th Engr Avn Bn (MS), pp. 1, 15, 22, 27. SWPA File A167.

[35] *Ibid.*, pp. 28ff.

used to haul gravel for the Katherine runway. The cargo trucks were of the type which had to be emptied by hand; unloading these trucks in the tropical sun was so exhausting that the men could work only six hours a day. Still, in spite of these handicaps, occasional Japanese bombings, and the ever-present dread of enemy invasion, the battalion persevered. By mid-March the Katherine runway had been lengthened and was being surfaced with gravel, and the clearing of three sites for new strips had begun.[36]

Prospects for construction in Australia brightened with the arrival at Melbourne on 26 February of two general service regiments—the 43d, commanded by Lt. Col. Heston R. Cole, and the 46th, commanded by Lt. Col. Albert G. Matthews. Since these units were older than the aviation battalion, they had received more extensive training in the United States. The 43d, activated in April 1941 and given seven weeks of basic training, had in June taken part in army maneuvers in Tennessee, where, according to an observer from the Office of the Chief of Engineers, the men had performed "as nearly like veteran troops as could possibly be expected from such a short training period." The 46th, activated in July 1941, had undergone training in road building, airfield construction, bridging, fortification, and demolitions—the usual instruction given to general service regiments—and in addition had had the benefit of experience in the Louisiana maneuvers in the fall. On 23 January 1942 the 46th and the 43d had sailed for Australia; three weeks later the bulk of their equipment was shipped. The units were at full strength when they landed, but did not long remain so. "USAFIA shanghaied both officers and men ruthlessly . . . ," Matthews wrote. Brett took the 46th's motor repairmen for the base motor pool at Melbourne. When their vehicles arrived early in March, the commanders discovered that the spare tires had been removed in the States. The first days in Australia seemed to portend difficult times ahead.[37]

The 43d Engineers began work almost at once preparing Camp Seymour near Melbourne for the 41st Division, expected in April. Seymour was an old Australian tent camp. With the addition of huts for kitchens, mess halls, showers, latrines, recreation buildings, and hospitals, it was quickly made ready to accommodate the American division. In mid-March, when the 43d received its vehicles, the headquarters and service company and the 1st Battalion left to join the 808th in Northern Territory. Except for one company which remained at Seymour, the 2d Battalion moved to Adelaide to enlarge Australian camps there for the 32d Division. Using materials supplied by the Commonwealth's Department of Defence, the Engineers strove to complete the facilities by the time the 32d would arrive in May.[38]

[36] *Ibid.*, pp. 36ff.

[37] (1) Hist of 46th Engr GS Regt, 1942. (2) Of C Engr GHQ SWPA Annual Rpt for 1942. (3) Incls, 3 Jul 41, to Of C Engr Info Bull No. 89, 18 Jul 41. (4) Ltr, OCE Mil Div, Opns and Tng Sec, to C Opns and Tng Sec, 9 Jul 41. 354.2 pt. 8. (5) Incls to Memo, Port and Water Sec Transport Br G-4 WD for Somervell, 24 Jan 42. WPD, 4630-41 (Equip and Trps—Australia) (sec. II). (6) Matthews Ltr, 10 Nov 49, p. 7.

[38] (1) Of C Engr GHQ SWPA Annual Rpt for 1942.

After two weeks of combat training near Melbourne, the 46th Engineers left by rail for northern Queensland, an area which might at any time become a battle zone. To protect themselves against enemy air attack the men mounted machine guns on the flatcars of their trains. During the trip they passed trainload after trainload of refugees headed southward. On 13 March the first of the troops reached Woodstock, a town twenty miles southwest of Townsville. Here and in the surrounding countryside the regiment was to build airstrips so vital to the defense of the Townsville area. Colonel Matthews was under exceptional orders. Since the officer who commanded Base Section Two was a major, Matthews was to report directly to General Johns. Matthews was to be largely responsible for the development of airfields in northeastern Australia in the critical days of early 1942.[39]

On 18 March the entire regiment began the work of clearing and grading three runways for a giant airfield at Woodstock. Matthews ordered around-the-clock operations, scheduling three 8-hour shifts a day. Because general service troops were trained as jacks of all engineering trades rather than as specialists in airfield construction, their equipment included no rooters, rollers, or scrapers. The troops worked mainly with picks and shovels, keeping their trucks and few dozers in reserve for pushing over trees and pulling out stumps. Even final grading often had to be done by hand. Still, the regimental historian reports, "the men were eager and enthusiastic, and went about their work with vigor . . . troops laboring under the intense heat of the sun, and in clouds of dust, slashed away at trees and stumps. . . ." Four days after construction began, the first plane landed on one of the runways. Matthews had meanwhile lined up sites for additional strips, but soon the regiment was dispersed. On 22 March Company A arrived at Torrens Creek, a small town about 180 miles southwest of Townsville. Here the men rapidly cleared the site and laid steel mat, 2,500 by 100 feet, in five days—possibly, they thought, a speed record for putting down mat up to that time.[40] On 29 March, Companies B, C, and F moved to Reid River, 40 miles south of Townsville, where they began building a third airfield. Although this job, undertaken in a heavily wooded area, required much clearing, the first landing strip was ready by 15 April.[41]

Matthews described the construction of these airstrips as "field improvisation at its . . . best." The officers of the 46th were largely on their own and "did what seemed good to them and in most cases their engineering common sense was the primary and single qualification for the work." Construction was held to the simplest standards. Because equipment was short, dispersal taxiways,

(2) [Hist of] Base Sec V, Adelaide, South Australia, 3 Mar 42–8 Mar 43, pp. 1off. SWPA File A183. (3) [Hist of] Base Sec V, Rpt of Estimate of Cost of Work Performed to Last Day of Jun 42. Incls to Hist cited in (2), above.

[39] (1) Hist of 46th Engr GS Regt, 1942. (2) Matthews Ltr, 10 Nov 49, p. 40.

[40] Steel mat was also known as pierced steel plank, pierced plank, or Marston mat, from the name of the town in North Carolina near which this type of mat was first tested.

[41] (1) Matthews Ltr, 10 Nov 49, p. 10. (2) Hist of 46th Engr GS Regt, 1942.

hardstands, and revetments were omitted. As the long dry season was just beginning, drainage was dispensed with. Since the engineers had no asphalt or tar, they surfaced the runways with rotted granite, semidecomposed shale, or sometimes merely with gravel and clay. The fields were rough and crude, but planes could land on them. Construction took a heavy toll of equipment. Machinery broke down quickly under hard usage. Constant turning and twisting over rough ground wore out the front tires of the graders, and the tires of many of the trucks were slashed by the stumps of eucalyptus trees, cut off by Australian surveyors just above the ground. Having no maintenance repair truck, Matthews converted a motorized earth augur, "which wasn't any good anyway," into a mobile shop and equipped it with tools obtained from the Air Forces and the Australians. For repair work, he relied on men "who . . . weren't experts but . . . learned fast." The shortage of tires was remedied when the 46th took over a retreading plant whose workmen had been evacuated from the Townsville area.[42] Despite the regiment's many difficulties, building in the bush country of northern Queensland was, as Matthews pointed out, "excellent training for the officers and men engaged in doing much with nothing, [and] . . . living under the most primitive conditions. . . ." [43]

Supplies

If Brett and Johns were cheered by the coming of engineer units, they were no less gratified by the decreasing competition for supplies. On 21 February the Commanding General, USAFIA, had set up the American Procurement Commission, in response to General Marshall's suggestion that a central purchasing board be established in Australia, "along the lines which were so successful . . . in France during the last war." The new commission included representatives of all the Army's procurement services, with Heiberg serving as the Engineer member. Henceforth the services had to send requests for supplies to the commission, which determined priorities and placed orders with the Australians. On 20 March the organization was renamed the General Purchasing Board. It soon succeeded in bettering relations with the Australians and in effecting a more equitable distribution of supplies among the American services.[44]

Ships fleeing before the Japanese advance through Malaya and the Indies meanwhile were bringing large quantities of "distress cargo" to Australia. Ports were crowded with fugitive merchantmen; so great was the mass of material dumped at Sydney that the wharves threatened to collapse. Many ships had to anchor in the harbor to await their turn to unload, and once they docked, supplies were hurriedly removed and thrown into warehouses. The Australian Department of Import Procurement took possession of the cargoes and began

[42] Matthews Ltr, 10 Nov 49, pp. 13–14, 32.

[43] Matthews, Data for Hist Rpt, p. 30.

[44] (1) Ltr, Marshall to Brett [n.d.]. WPD 4630–41 (Equip and Trps—Australia), sec. II. (2) WD Ltr, AG 334.8 (1–3–42) MSC–D–M to CG USAFIA, 3 Feb 42. 400.333 (Australia) 1942–43. (3) Memo, Barnes for Heads of Gen and Spec Staff Sec USAFIA, 21 Feb 42. (4) Memo, Brett for Heads of Gen and Spec Staff Sec USAFIA, 20 Mar 42. Last two in Rpt of Orgn and Activities, USAFIA, app. 20.

sorting them, after which the Commonwealth government gave the U.S. Army first choice of all goods brought in by American and Dutch vessels. Distress cargo proved to be a windfall for the engineers, providing them with more tools, steel plate, pipe, cable, generators, and construction machinery than any other source.[45]

One of the ships which had escaped from Java brought Mr. Albert Wright, a petroleum executive of many years' experience in the Indies. The engineers immediately pressed him into service, commissioning him a major. Named Johns' supply officer, Wright was ordered to get equipment quickly. After conferences with officers of the 808th, the 43d, and the 46th, all of whom stressed the urgent need for earth-moving machinery, Wright began requisitioning farm tractors from the Australians. But these machines were too light for the job, and, since most of them were second-hand, large stocks of spare parts would have to be found. When Wright's efforts to get parts from dealers met with slight success, distress cargo again proved a godsend; a shipload of parts for caterpillar tractors enabled the engineers to keep most of their equipment running. Meanwhile, rock drills, wire rope, and hand tools from Australian gold mines supplemented the engineers' meager stocks of equipment, and carbon dioxide cylinders from breweries were rebuilt to hold oxygen for use in welding. While the engineers still had too few supplies and too little equipment, their lot was gradually improving.[46]

A New Command

On the morning of 17 March the planes bringing MacArthur and his staff from the Philippines to Darwin landed at Batchelor Field. From there the group traveled by plane, train and automobile to Melbourne, where MacArthur set up his headquarters. He and his staff at once began to take stock of the situation. General Casey was particularly anxious to get out into the field and see construction projects firsthand. On 28 March, accompanied by Johns and Theodore, he flew to Amberley Field near Brisbane, which he found "well provided with paved runways." Proceeding to Eagle Farm, he noted that one 5,000-foot runway had been surfaced and another was under construction. The strips at nearby Archerfield were of turf, soft in spots and slippery when wet. Troops were moving into the recently finished camps near the fields. Inspecting these camps, Casey was disturbed by the "relatively high type construction," which included tongue and groove flooring, asbestos roofing, and waterborne sewage systems. He suggested that "temporary and less costly shelter . . . be provided." The members of the party continued on to Townsville, where they were met by Colonel Matthews, who took them to see the fields being built by the 46th Engineers. Casey pronounced the fields "excellent" and was

[45] (1) AWC, *Report, February 1942–June 1943*, p. 109. (2) [Hist of] Base Sec 7, (Draft MS), p. 12. SWPA File A185. (3) Engr Br Proc Div USASOS, 12 Dec 44, Hist Rpt, Engr Proc in Australia. SWPA File M35. (4) Hist of Engr Hq USAFIA, p. 18.

[46] Engr Br Proc Div USASOS, 12 Dec 44, Hist Rpt, Engr Proc in Australia.

pleased to find the troops still out working at 2200. The activities of the Australians at Townsville evoked less enthusiasm. Much effort was going into the dredging of the harbor and the improvement of the road to Brisbane; Casey wondered if such jobs might not be suspended and the men and equipment put to work on airfields. Nor was he overly impressed with Charters Towers. He noted much equipment on hand but remarked that there were not enough men to run it. The job, he felt, should be reorganized and given a "general push." The tour convinced him that designs must be simpler, equipment and manpower allocated more wisely, and efforts centered first of all on airfield construction. Much good work had been done, but the program required better over-all direction.[47]

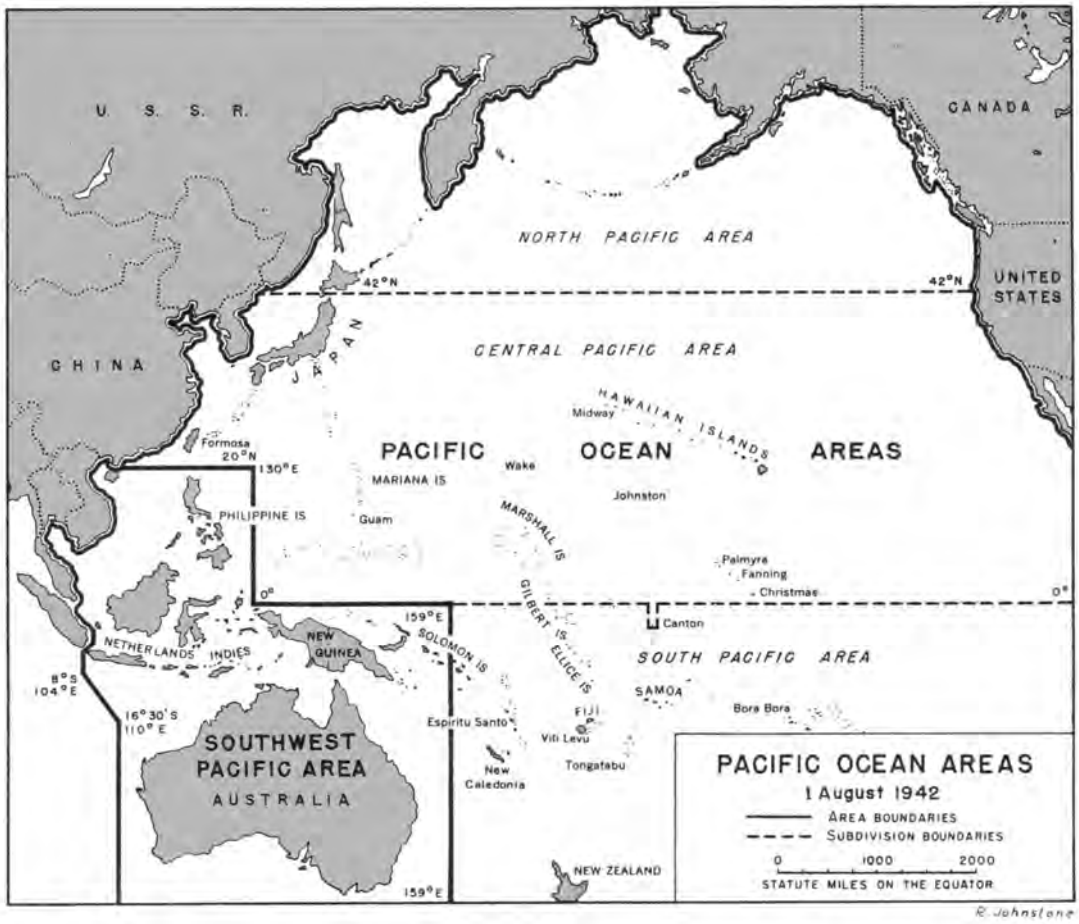
Toward a More Aggressive Strategy

Strategic Plans

While MacArthur had been making good his escape from Corregidor, American and British plans for carrying on the war against Japan were beginning to crystallize. On 9 March President Roosevelt proposed that the United States assume responsibility for the conduct of the war in the Pacific; on the 18th Prime Minister Winston S. Churchill agreed. The Joint Chiefs of Staff meanwhile were dividing the Pacific into two main theaters, the Pacific Ocean Area (POA) and the Southwest Pacific Area (SWPA). (*Map 8*) The latter was to include the large land masses, Australia, New Guinea, the East Indies (except Sumatra), and the Philippines, as well as the Bismarck Archipelago and part of the Solomon Islands. POA was to include most of the remainder of the Pacific. Admiral Chester W. Nimitz, who already commanded naval forces in this area, was named commander in chief of Allied forces. Roosevelt's choice for command of all Allied air, sea, and ground forces in the Southwest Pacific Area was MacArthur. The Australians received Roosevelt's nomination of the general with great enthusiasm. Almost from the time of his arrival in the Commonwealth, MacArthur had had the prerogatives if not the title of commander in chief. His nomination as supreme commander approved by the governments concerned, MacArthur on 18 April officially assumed his position as the leader of the Allied forces in the Southwest Pacific. He organized three new commands under his own General Headquarters, Southwest Pacific Area: Allied Land Forces under Australian General Sir Thomas Blamey, Allied Air Forces under General Brett, and Allied Naval Forces under Vice Adm. Herbert F. Leary. Continuing under MacArthur's direction were USFIP, commanded by General Wainwright, and USAFIA, now headed by General Barnes. As set forth in Marshall's orders, MacArthur's mission was threefold: to hold Australia, prevent the Japanese from cutting supply lines to the United States, and prepare to take the offensive.[48]

[47] (1) Hunt, *MacArthur and the War Against Japan*, pp. 70–74. (2) Ltr, Casey to MacArthur, n.d., sub: Rpt of Inspec Northeast Australia—New Guinea Areas, 28 Mar–3 Apr. SWPA File 158.

[48] (1) Milner, *Victory in Papua*, pp. 16–23. (2) Matloff and Snell, *Strategic Planning for Coalition*



MAP 8

MacArthur, on arrival at Melbourne, had learned of the plans of the Australian Chiefs of Staff which called for a defense of the southeastern part of the Commonwealth. He almost at once came to the conclusion that a different strategy was needed. Plans for continental defense he rejected as impractical. To hold the vast stretches of the sparsely inhabited country would require a large army; even twenty-five divisions might not be enough. Considerable air and naval power would also be necessary, and no such force was available or in prospect. In the near future, the Southwest Pacific could count on having only two American and possibly three Australian divisions and small naval and air forces. But, MacArthur reasoned, it might be possible, with only limited forces, to ward off invasion by striking enemy-held islands and enemy naval forces and shipping during an attempted approach to

Warfare, 1941–42, pp. 165–72. (3) Morton, *Strategy and Command*, p. 253.

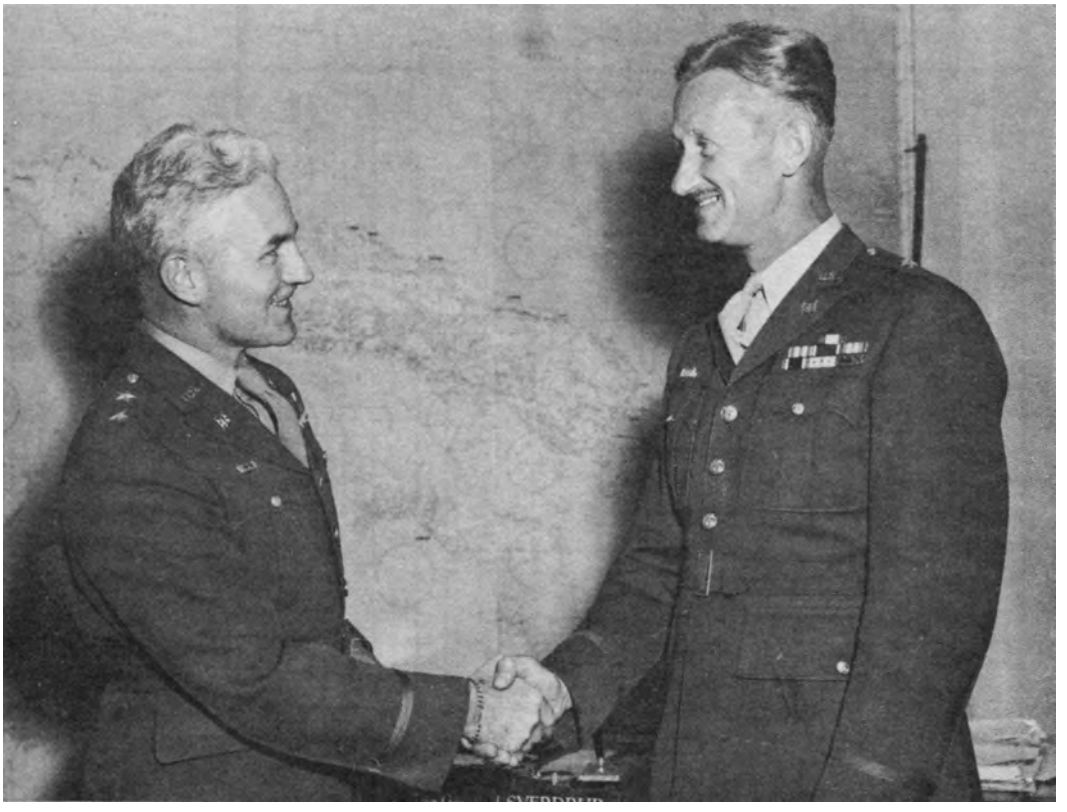
Australia. The Japanese seemed most apt to try to seize the rich industrial regions of Victoria and New South Wales rather than the barren deserts of the west and north. Consequently, the islands to the northeast appeared most liable to attack. Port Moresby, on the southern coast of New Guinea, would be a particularly valuable prize, since it controlled the air and sea lanes southward along the Australian coast. MacArthur decided not to wait for the Japanese to come to Australia, but to go north to meet them. With the forces allotted to the Southwest Pacific a good defensive position could be maintained, and it might even be possible to launch limited offensives.[49]

Role of the Engineers

In choosing to defend Australia in the islands to the north, MacArthur gave the engineers a decisive role. The battle would be joined on mountainous, jungled, rain-drenched islands, where overland movement and supply would be all but impossible. The airplane would be a principal weapon and heavy reliance would have to be placed on water transport. What MacArthur envisioned was a war in which airfields, ports, and bases would be the prerequisites of victory. Northern Australia had few facilities for waging modern war; New Guinea and the nearby islands had almost none. The engineers would have to build what was needed from the ground up and under the most difficult conditions. Construction would be their chief mission, but not their only one. Before Allied troops could advance, the engineers would have to provide maps of the uncharted, enemy-held regions. Once an offensive was launched, they would have to support the infantry in combat, help reduce enemy strongpoints, and perform many of their traditional functions in moving the army forward. Though MacArthur would employ the engineers in many ways, the effectiveness of his strategy would, in large measure, depend on the speed with which they could build bases and, above all, airfields from which fighters and bombers could strike at enemy targets.

That Casey would be chief engineer of SWPA had been a foregone conclusion, and on 19 April MacArthur issued the necessary orders. Having already had several weeks to study conditions in Australia, Casey was aware of the immense task ahead. As chief engineer of an Allied headquarters, he would coordinate the activities of all engineers, Australian and American, under MacArthur's command, frame the policies under which they would work, and give them technical direction. To handle this assignment, he believed he would need a staff of at least 25 officers and men. But the number of officers in the theater was so scant that at first he could set up only a small section consisting of 5 officers and 5 enlisted men. Heiberg, transferred from Johns's office, became his executive officer; Maj. Emil F. Klinke, transferred from the 43d General Service Regiment, became chief of operations and training. Lacking experts in construction, Casey asked Reybold to send him Lt. Col. Bernard L. Robinson, then in Wyman's office in Honolulu, and Leif J. Sverdrup, at that time about to

[49] Milner, *Victory in Papua*, pp. 23–25.

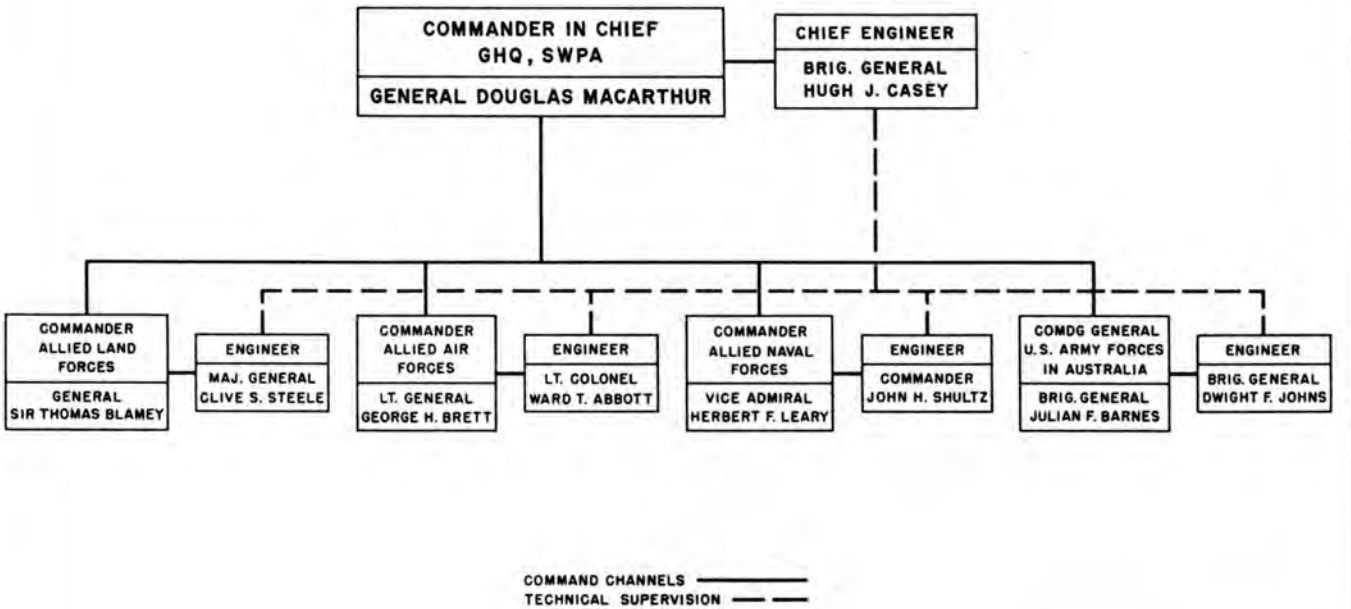


GENERAL CASEY AND GENERAL SVERDRUP *(Photograph taken in 1944.)*

return to the United States in connection with work on the air ferry route and soon to be commissioned a colonel. Sverdrup and Robinson reached Australia in late May. Sverdrup became chief of the Construction Section and Robinson, assistant chief. Although his staff was part of an Allied headquarters, Casey had but one subordinate who was not American, an Australian major who served as liaison officer. He nevertheless intended to work closely with Maj. Gen. Clive S. Steele, who was both Engineer in Chief of the Royal Australian Engineers (RAE) and Engineer in Chief of the Allied Land Forces under General Blamey. Working with the Australians and integrating their engineer effort into the Allied program would require not a little tact and diplomacy, since the Commonwealth's Department of Defence lay outside MacArthur's jurisdiction.[50] *(Chart)*

[50] (1) GHQ SWPA GO 2, 19 Apr 42. (2) Memo, Casey for CofS GHQ SWPA 9 Apr 42. SWPA File 26. (3) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 26–28. (4) Ltr, Casey to MacArthur, 12 May 42. (5) Memo, Casey for Rcd, 20 May 42. (6) Rad, MacArthur to Reybold, 27 Apr 42. Last three in SWPA File 26. (7) Data obtained from Mil Pers

MAJOR COMMAND CHANNELS AND LINES OF ENGINEER TECHNICAL SUPERVISION, SOUTHWEST PACIFIC AREA, 1 MAY 1942



At conferences held during the last weeks of April, Casey and Steele took stock of their resources. They had to assume that they would not have large numbers of American engineers at their disposal. One aviation battalion, 2 general service regiments, 2 separate battalions, and 2 dump truck companies would be in Australia by the end of April. Scheduled to arrive in May and June were 2 divisional combat battalions, 2 topographic units, and a depot company, the only additional engineer units approved by the War Department for SWPA at that time. This small contingent would hardly be sufficient for the tasks ahead, but fortunately, increasing numbers of Australian engineers were available. Units of the RAE were returning home with their divisions, and Steele had launched a strenuous recruiting drive. The engineers of the Australian Military Forces, while poorly trained and equipped, were receiving intensive instruction from veterans of the RAE. Steele expected soon to be in a position to furnish not only combat, construction, and supply units, but also all the camouflage and railway troops MacArthur needed. He was further prepared to supply the Americans with bridging, landing barges, barbed wire, and camouflage nets. Casey reasoned that water supply units from the United States could be dispensed with, since providing water would be difficult only in the parched deserts in the interior of Australia, and in his opinion the Allies did "not propose to have any operations there." He did believe, however, that more troops trained in general and combat engineering must be sent from the United States. Urgently needed were an additional aviation battalion, 2 separate battalions, and 2 dump truck companies, a depot company, and a combat battalion, all fully equipped, and a heavy ponton battalion without its equipage. This was the absolute minimum but probably all that could be expected in view of the shortage of trained units in the United States, the lack of shipping, and the priority of operations planned for Europe. With a few reinforcements from the United States, Casey and Steele believed they could support the kind of strategy MacArthur had in mind. But engineer strength would have to be spread thin in the Southwest Pacific.[51]

While Casey drew long-range plans for the coming offensive, he had to supervise a construction program that was growing rapidly larger and more difficult of accomplishment. In announcing his strategy, MacArthur had indicated the need for prodigies of engineering in northern Australia and New Guinea. Port Moresby, northeastern Queensland, and Darwin were now areas of primary military importance. Greatest stress would have to be placed on developing Port Moresby, which MacArthur regarded as the key to the defense of Australia and the springboard for future offensives. Building an air and supply base in this exposed area would require much more than an ordinary engineer effort. Large numbers of men and

Div OCE. (8) Ltr, Robinson to Lyman, 1 Jun 42. Engr AGF PAC, 686 (Ferry Route).

[51] (1) Memo, Casey for Rcd, 28 Apr 42. SWPA File 27. (2) Of C Engr GHQ SWPA Annual Rpt for 1942. (3) Check sheet, Press Relations Off to Casey, 24 Jun 42. SWPA File 240. (4) Memo, Casey for Rcd, 15 Apr 42. SWPA File 210.

quantities of material and equipment needed to improve facilities in the town and to construct roads and airfields in the surrounding countryside would have to be sent in over supply lines that were vulnerable to enemy attack. If Moresby were to serve as the main air base for operations to the north, a string of supporting airfields would have to be constructed along the coast of northern Queensland. This, too, would be a formidable job, for little was known about terrain and soil conditions of the bush and jungles of the Cape York Peninsula. Darwin figured less prominently in MacArthur's plans, but because the enemy might attack from the northwest and because the Allies might decide to invade the Indies, the hard work of building in remote Northern Territory would have to be continued and indeed stepped up. While emphasis was now on the north as never before, MacArthur could not neglect his flanks; western Australia would have to be provided with more airfields to guard against a Japanese thrust at that part of the continent. Moreover, logistical facilities in southern Australia would have to be expanded. MacArthur chose Sydney, the largest city and port of Australia, as the principal supply center for the American forces, rather than Melbourne, some 400 miles to the south. Thus, not only would a vast new program have to be undertaken, but the existing one would have to be continued.[52] Only after base development was fairly well along would MacArthur be able to take the offensive.

Organizing the Engineer Effort

Since the war in the Southwest Pacific was clearly destined to be a "poor man's war," the engineers would have to make the most of what they had. As Casey saw it, they would have to build "what is wanted within the minimum time and with the minimum expenditure of manpower and material resources." This ideal had not yet been attained. There was evidence of waste, duplication of effort, poor management, and inefficient administration. Too much was being done on "a peacetime basis of permanency." Too many projects were long-term and would be of no help in furthering immediate military objectives and, "in addition, might seriously endanger other urgent military projects direly needed *now*." Priorities were almost meaningless. In one case, a dressing room for women in a defense plant carried a higher priority than a hospital for the RAAF. It seemed that nearly every project of any importance was rated A–1. Although the shortage of equipment was acute, many contractors were not operating on a multiple shift basis. Agencies were duplicating each other's work. In Queensland, the RAAF, the U.S. Air Forces, the Commonwealth government, and the engineers were all engaged in picking sites for airfields. Machinery for working with the Australians was slowed by red tape. It took the Allied Works Council an excessively long time not only to get approval to start a project but also to obtain permis-

[52] (1) Milner, *Victory in Papua*, pp. 25–27. (2) Of C Engr GHQ SWPA Annual Rpt for 1942. (3) [Hist of] Base Sec 7.

sion to make minor changes in specifications. Casey concluded that this state of affairs would force him to take a strong stand.[53]

One of his prime objectives was to give the program unified direction. He therefore set out to view construction in broad perspective, to consider projects not on an individual basis but as parts of an integrated program. As a first step toward this goal, he directed his staff to inventory jobs, under way and projected, and to make a survey of available manpower, materials, and equipment. He next attempted to formulate "a planned program of . . . construction with definite time limits based on . . . a knowledge of requirements and resources." Once the program had been defined, he intended to keep close check on rates of progress and percentages of completion. He asked for uniform progress reports from each project, explaining that "the purpose is to see that the job is approximately up to date and if behind . . . [what] action can be taken to bring it up to schedule."[54] Merely analyzing the program and diagnosing its ills were not enough. Casey would have to persuade others to follow his suggestions. Under the command-staff setup, he could not issue orders, but since he was MacArthur's chief engineer, his recommendations would carry great weight.

He encountered resistance almost at once. The American airmen, not content to be dependent on the base sections, wished to handle their own construction. They were quick to cite examples of waste and inefficiency in the existing arrangement. To strengthen their position, they had already made a beginning toward setting up their own engineer establishment with the appointment on 16 March of Abbott as air engineer. After reminding Casey of the many difficulties the base sections had encountered in getting Air Forces projects finished on time, Brett on 18 April proposed that a separate field organization be created to handle the building of airfields. He asked that each air area commander be assigned an engineer who would be responsible to USAFIA for all Air Forces jobs in the area, selecting the sites and supervising the construction. Casey was unalterably opposed to such an arrangement. Not only would the authority of the air engineers conflict with that of the base section commanders, but this might well be the first step toward the establishment of a dual engineer organization with control of the aviation battalions exclusively by the Air Forces. Because the number of engineers in SWPA was so small, Casey believed that having two separate field systems would merely slow down progress. He countered Brett's proposal with one of his own. What was needed, he suggested, was not another field organization but better co-ordination between the existing one and the Air

[53] (1) Charles A. Willoughby and John Chamberlain, *MacArthur, 1941–1951* (New York, 1954), pp. 83–84. (2) W. A. Rogers, Secy AWC, Memo for Rcd, sub: Conf Held at the Of of the Dep Dir Gen of Allied Works on Sunday, 31 May 42. SWPA File 240. (3) Memo, Casey for Staff Sec Heads, 27 Jun 42. SWPA File 26. (4) Memo, Sverdrup for Casey, 27 Jun 42. SWPA File 243. (5) Rad, Brett to Air Bd, 18 Apr 42. (6) Ltr, Casey to Brett, 24 Apr 42. Last two in SWPA File 490.

[54] (1) Memo, Casey for Brett, 20 May 42. SWPA File 490. (2) Min of Conf Held at Engr Hq Office of Col Bres, . . . Jun 17, 1942. SWPA File 240.

Forces. He persuaded Brett to let Johns assign engineers from the base sections to air commands in areas where extensive airfield construction was under way. These air engineers would act as liaison officers between the air areas and the base sections. They would also help select sites and inspect projects and could order minor changes in plans and specifications, but they would not be responsible for construction. Thus, Casey was able to forestall the setting up of a separate engineer organization under the Air Forces.[55]

Casey had no sooner come to an understanding with Brett than he found himself at odds with the RAAF. Although this organization was engaged in an extensive construction program, Casey was unable to get a list of its projects. Nor was the RAAF inclined to tell him how many fields it planned to build or what its over-all requirements would be. He learned indirectly that it was concentrating heavily on the southeast and was planning to work on some eighty fields in the Sydney area alone. While these matters were not, strictly speaking, his affair, Casey believed that the concentration of so much effort in the southeast was detrimental to Allied strategy. He prepared a memorandum for Brett, indicating that there was not "complete coordination," between the American and Australian air forces. He expressed the belief that it was "desirable that the broad picture of Allied Air Force construction requirements be pulled together into an all embracing program." He went on to say that if "we are to be forced back into the southeastern Australian area, an extensive construction program in that area is undoubtedly wanted" but implied that if MacArthur's strategy were sound, many of the southern projects could be dropped. While this memo was still on his desk, Casey received a letter from General Steele of the RAE, telling him of the RAAF's plan to organize four works units for building airfields, each unit to consist of 1,000 men and to be equipped with heavy machinery. "I feel a little diffident," Steele wrote, "but in view of [the] manpower shortage feel that I should . . . [suggest] that their establishment seems somewhat top-heavy." Casey had additional grounds for objecting—the works units would probably be used exclusively on RAAF projects. He quickly drafted a second memo to Brett in which he recommended that smaller units, modeled on U.S. engineer aviation companies, be formed and placed under Steele. Taking both memos, he set off for the headquarters of the AAF. Brett glanced over the documents and passed them on to his chief of staff, Australian Air Vice-Marshal William D. Bostock.[56]

Two days later Bostock held a meeting of air officers and engineers. Casey, away on a field inspection trip, could not attend. Among those present were Lt. Col. Ward T. Abbott, Col. E. S. Bres of Johns' office, and 1st Lt. Max D. Lovett

[55] (1) TWX, Brett to Air Bd, 18 Apr 42. (2) Memo, Casey for Brett, 24 Apr 42. (3) Memo, Casey for DCofS GHQ SWPA, 24 Apr 42. (4) Memo, Casey for Johns, 24 Apr 42. (5) Memo, Casey for DCofS GHQ SWPA, 26 Apr 42. (6) Ltr, MacArthur to Brett and Barnes, 7 May 42. All in SWPA File 490. (7) Memo, Brett for CG's U.S. Air Commands No. 1 and No. 2, 9 May 42. SWPA File 459.

[56] Memo, Casey for Brett, 20 May 42. (2) Ltr, Steele to Casey, 19 May 42. (3) Memo, Casey for Brett, 20 May 42. (4) Ltr, Casey to Steele, 21 May 42. All in SWPA File 490.

of Casey's staff. A rather heated discussion developed. Bostock opened the conference with the statement that he thought a great many of Casey's misgivings about the RAAF's construction program were the result of "incomplete information" and suggested that the chief engineer possibly had not "had an opportunity of thoroughly dealing with . . . [the] problem." Bostock was not inclined to discuss the question of how RAAF works units should be organized. This, he said "was the concern of the Australian Government and a matter for the Ministry of Air to decide. . . . It was not a question for Allied Air Forces to worry about." Remarking that Casey seemed "somewhat worried" over the amount of construction going on in the southeast, Bostock stated that manpower and materials available there could not always be sent elsewhere. On the island of Tasmania, for example, there were plenty of laborers ready to work at home but unwilling to go to New Guinea. When Colonel Abbott asked if the equipment in Tasmania could not be sent north, Bostock retorted that that was a matter for the Allied Works Council. As Colonel Heiberg put it later, the "general attitude . . . seemed to be that works are now progressing satisfactorily, and no external control is desired or necessary." The RAAF nevertheless agreed to make one concession; it would furnish a statement of its airfield program to Brett.[57]

Even as he attempted to co-ordinate construction work and to centralize responsibility, Casey, together with other engineers, favored the policy of giving more authority to the field. In the early days the men directly in charge of projects had had little leeway. Approval for even the most trifling jobs had to come from Melbourne. The granting of more power to the base section commanders had been advocated for some time. On 26 March Brett had ruled that jobs costing less than £1,000 (about $3,200) could be undertaken by base section commanders on their own authority. On 13 April he raised the ceiling to £5,000 (about $16,000). Since the vast majority of projects were to cost less than this sum, Brett thus decentralized his authority over most of the program. Many engineers believed that Theodore would have to follow suit. Contractors were having to get the AWC's approval for practically everything they did. When Colonel Matthews tried to stop certain work he considered unnecessary at Charters Towers and Cloncurry, the contractor refused to quit, saying that he took "his orders from Brisbane." Both Casey and Steele proposed that the AWC send to the projects representatives clothed with authority comparable to that of the base section commanders. Then, if Matthews wanted a few buildings more or less at Charters Towers, he could get approval directly from the AWC's man at the site. Theodore at first objected, maintaining that a telephone call to him would bring action within twenty-four hours. To this Steele replied that "he was interested in a method of operation that can go on in the event a bomb should cut the telephone lines." Finally Theodore agreed

[57] (1) Memo, Bostock for Casey, 21 May 42. (2) Memo, Bostock for Casey, 21 May 42. Both in SWPA File 490. (3) Min of Mtg Held at RAAF Hq, 22 May 42. SWPA File 481. (4) Memo, Heiberg for G–4 SWPA, 30 May 42. SWPA File 490.

to send out men empowered to make on-the-spot decisions. Soon "coordinating engineers" were on their way to many of the large projects with orders to remove bottlenecks and improve efficiency.[58]

Minimum Construction Requirements

It was difficult to escape the conclusion that much of the construction was overelaborate and some of it unnecessary. On the road from Townsville to Charters Towers Casey observed workmen putting in a heavy type of culvert, better suited for a permanent peacetime highway than for a temporary military supply route. He learned that the RAAF was planning to build an officers' club costing $100,000 at Darwin. There were many projects which would not be finished for years but would benefit the Australian economy after the war. Insisting that construction be held to "bare essentials," Casey suggested that long-term projects be deferred. "The tactical situation might materially alter . . .," he pointed out, 'and works which will not be completed for say a year or more hence will be of no value insofar as near term operations are concerned." Many of the AWC officials agreed with him. They too wished to avoid "spit and polish" construction and to eliminate jobs which would not contribute to the winning of the war. But paring down to essentials was no easy matter. Many commanders, American and Australian, were interested in building elaborate installations for themselves and in promoting their own pet projects. Many jobs had been started before Japan declared war, and supplies and materials had already been allocated. Yet the situation was not quite so hopeless as it appeared. Officials of the AWC through their control of manpower, materials, and equipment could do much to correct abuses, and Casey kept up unremitting pressure to make them do so.[59]

The chief engineer saw still another opportunity to economize. Believing an enemy landing imminent, the Australians were making frantic preparations in the southeast to hold back the invader and, failing that, to destroy everything in his path. Around Sydney, Melbourne, and Brisbane, large numbers of men were mining roads and bridges, digging trenches, preparing tank traps, and making ready to put a scorched-earth policy into effect. Undoubtedly much of this work could be suspended. Fixed positions would be of little value since the enemy could easily bypass most

[58] (1) Ltr, Casey to MacArthur, n.d. sub: Rpt of Inspec Northeast Australia–New Guinea Areas, 28 Mar–3 Apr. SWPA File 158. (2) Memo, CofS USAFIA to G–4 USAFIA, 25 Mar 42. SWPA File 275. (3) Ltr, Hq USAFIA to CG's All Base Secs, 26 Mar 42. SWPA File M51B. (4) Ltr, CG USAFIA to Cs All Arms and Servs and CO's, All Base Secs USAFIA, 13 Apr 42. SWPA File 275. (5) Col Bres, Memo for Rcd, sub: Conf Held at Engr Hq, The Of of Col Bres, . . . 17 Jun 42. SWPA File 240. (6) Telg, Brett to Air Bds, 18 Apr 42. SWPA File 490. (7) Memo, Opns and Tng [Br] of C Engr, GHQ SWPA for Casey, 19 May 42. SWPA File 275. (8) AWC Of Memo 196 [5 Nov 42], sub: AWC Projects. SWPA File 242.

[59] (1) Memo, Klinke for Casey, 19 May 42. SWPA File 275. (2) Matthews, Data for Hist Rpt, pp. 5–6. (3) Memo, Sverdrup for Casey, 27 Jun 42. SWPA File 243. (4) Memo for Rcd, Casey, 8 Jun 42. SWPA File 158. (5) Telg, Brett to Air Bd, 18 Apr 42. (6) Memo, Casey for Brett, 20 May 42. (7) Memo for Rcd, Casey, 24 Apr 42. Last three in SWPA File 490.

of them. Because 10,000 miles of coast line had to be protected, Australia's defenses should be mobile. Casey held that materials for fortifications and demolitions should be stockpiled at points "where they can be procured quickly in an emergency rather than all emplaced . . . beforehand." In place of the scorched-earth policy, he advocated a "two stage" program for wrecking Australia's industrial plant; first, a partial demolition, and second, a complete destruction. The Japanese, he argued, would very likely be expelled from the continent within a few months after their first landing. The Australians had therefore but to put important industrial and power plants out of operation for a comparatively short period, a task that could be quickly accomplished by removing or destroying vital machine parts. Total destruction should be carried out only as a final resort and then only on orders from MacArthur. Although General Steele gave this suggested program wholehearted support, the Australian Government insisted that the work of fortifying the southeast and preparing for total destruction be continued.[60]

Sometimes the engineers themselves were guilty of overelaborate construction. This situation developed largely because they still had so few suitable plans and specifications to work with. Until the Americans had designs for buildings that were both cheap and easy to construct, their projects would continue to consume excessive amounts of effort and materials. On 5 April Johns had settled the question of uniform plans and specifications by ruling that the theater of operations drawings would henceforth be standard. As fast as plans could be modified to meet conditions in Australia, they were to be sent to the field. Base section engineers were permitted to make minor changes which would enable them to utilize locally available materials and to expedite construction.

As the name implied, theater of operations drawings were intended for use in overseas theaters, where only the flimsiest and most temporary structures were required. The Australian Army, building in home territory, erected more durable installations and would have preferred that the Americans also construct along more permanent lines. When MacArthur in April ordered camps for two American divisions in northeastern Queensland, Casey, following the theater of operations plans, directed a minimum of shelter and no conveniences. The enemy, he reasoned, was already accustomed to living under the most primitive conditions. If the Americans were to defeat the Japanese, they must be no less rugged. General Blamey saw the matter in a different light. Contemplating the eventual use of the camps by the Australian Army, he proposed that the Allies work out designs together. If Blamey's suggestion were followed, the engineers might as well forget the theater of operations plans. Pointing out that General Steele considered American structures suitable

[60] (1) Memo for Rcd, Casey, 8 Jun 42. SWPA File 158. (2) Grattan, ed., *Australia*, p. 397. (3) Ltr, CofS SWPA to Blamey, 31 Jul 42. (4) Ltr, Steele to Casey, 29 Jul 42. (5) Commonwealth of Australia Defence Com, Denial of Resources to the Enemy, Directive for Guidance in the Formulation of Detailed Plans. Last three in SWPA File 175.

for Australian units, Casey ruled that adherence to the theater of operations drawings would continue to be required at all American projects.[61]

Supply Policies

Although the campaign to cut down to bare essentials was moderately successful, the demand for materials and equipment still far exceeded the supply. Both Americans and Australians were banking heavily on shipments from the United States. The Commonwealth was calling for tremendous quantities of lend-lease equipment; on one occasion, Prime Minister Curtin had requested nearly a thousand items of heavy machinery, including 445 tractors, 111 carryalls, 142 rollers, 161 rooters, and 83 graders. The U.S. Army's total requests were nearly as large as those of the Australians. By March, Reybold's office had on file numerous orders from USAFIA. A single requisition listed 2,000,000 square feet of landing mat, 3,250,000 gallons of asphalt, 200 motors, 70 D–8 tractors with dozers, 50 carryalls, and large quantities of other types of equipment and supplies. The Chief of Engineers promised to do his best to meet requirements in the Southwest Pacific but offered little encouragement. Manufacturers of construction equipment were booked heavily for many months to come. A few of the items, among them asphalt, bitumen, and landing mat, were immediately available, but ships to carry them to Australia were not. Reybold's advice was to ask for less from the United States and to get more in Australia.[62]

Surveys of Australia's industrial capacity showed that local production of engineer items could be considerably expanded. The Broken Hill Proprietary Company, the country's largest industrial combine, was capable of producing 9,000,000 gallons of tar annually, and this material could be used in place of asphalt or bitumen. Steel fabricating plants could be converted to the manufacture of landing mat. Several concerns had facilities for making stone crushers, portable pumps, and sheepsfoot rollers. The Commonwealth government had ordered the AWC to increase the manufacture of earth-moving equipment. Working closely with members of the council on this job, Casey and Colonel Wright had a hand in promoting the formation of the Earth Moving Manufacturers Group. This body included not only the principal makers of this type of machinery, among them the Australian affiliates of International Harvester and of Le Tourneau, but also a number of concerns which had not previously built such equipment. By pooling their resources and distributing orders so that one plant would not be overburdened with work while others stood idle, the members of the group stepped up production of graders, dozers,

[61] (1) Hist of Engr Hq USAFIA, p. 5. (2) Ltr, MacArthur to Barnes, 11 Apr 42. (3) Memo, Casey for DCofS GHQ SWPA, 18 Apr 42. (4) Ltr, Blamey to MacArthur, 3 Jun 42. (5) Draft Ltr of MacArthur to Blamey, prepared by Casey, 7 Jun 42. Last four in SWPA File 545.

[62] (1) Incls to Memo, Johns for Casey, 11 Apr 42. (2) Cable, Prime Minister's Dept to Dir Gen, Australian War Sups Proc, Washington, D.C., 4 Mar 42. Both in SWPA File 210. (3) Memo, WPD for TAG, 20 Feb 42. AG 381 (11–27–41). (4) Incls with Ltr, Sup Div OCE WD to WPD, 27 Mar 42. 400.333 (Australia) 1942–44.

shovels, rooters, cranes, and scrapers. Although certain special parts still had to come from the United States, a large percentage of equipment requirements could be filled in Australia. Meeting in mid-April, Johns, Casey, and Theodore agreed to defer delivery of most American-made goods and to cancel many orders outright.[63]

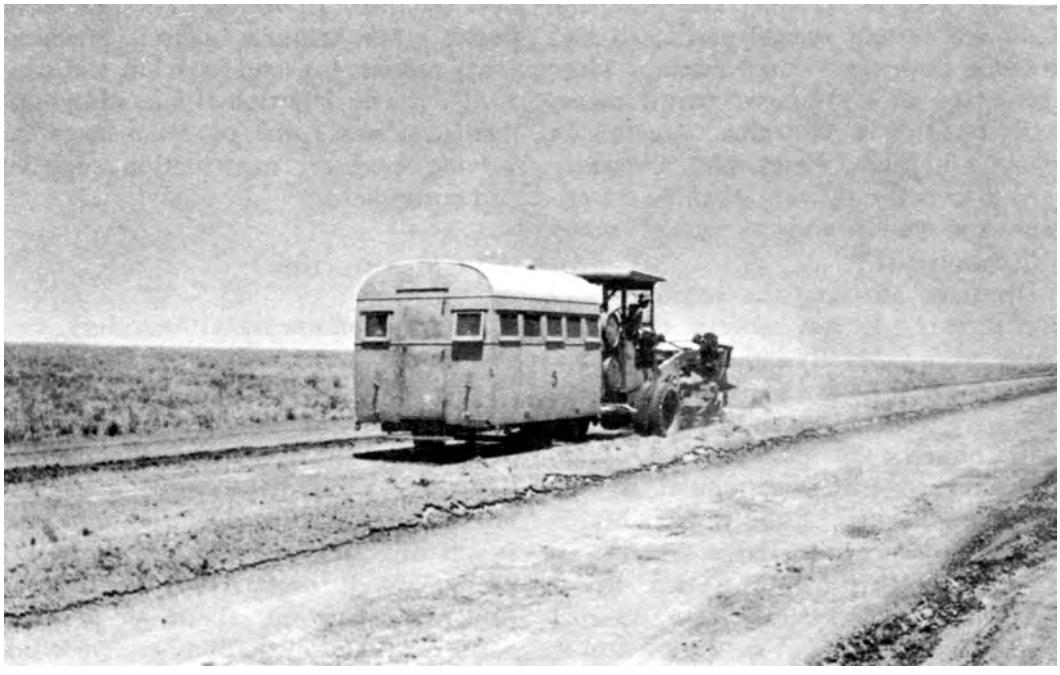
Decisions affecting the engineer supply picture, if not always made by Casey, were generally influenced by him. From the first he saw to it that his opinions were well known to the Allied Supply Council, the policy-making body which controlled procurement in the Southwest Pacific. Established in March 1942, the council included Americans, Australians, British, and Dutch, whose job it was to find means of exploiting Australian resources to the fullest and to determine what must be imported. Casey kept abreast of the council's activities, scrutinizing the minutes of each meeting. By working through the American representative, he obtained sympathetic consideration of the engineers' needs. Because local manufacturers of earth-moving machinery looked to America for engines and bearings, he also assumed responsibility for apportioning the end products among the Australian and U.S. Armies and the Allied Works Council. After the signing of the American-Australian Lend-Lease agreement in May, the chief engineer occupied a position of considerable power. MacArthur's office reviewed every request for lend-lease aid and controlled the distribution of incoming shipments. Casey ruled on all matters involving engineer construction supplies and equipment.[64]

AWC Construction

All these efforts notwithstanding, success of the construction program rested largely with the Allied Works Council. Responsible for the great majority of projects on the continent, the council had made rapid strides during its first few months of existence. By mid-May it was directing a work force of nearly 45,000. Well over 100 airfields were under construction, about 50 in New South Wales alone. Bombers were operating from new runways at Charters Towers, Garbutt, and Eagle Farm; fighters, from numerous smaller fields. The U.S. Air Forces had begun moving into the big depot at Tocumwal. Work had been launched on the 7 fields of an inland ferry route extending from Melbourne to Cloncurry in the interior of Queensland—a communications link that would be vitally needed if the eastern coast came under attack. At Melbourne, Adelaide, and Brisbane, recently completed warehouses were being stocked and more stood ready to receive additional stores. From Sydney, Maj. William Lehr, engineer of the recently organized Base Section Seven in New South Wales, reported that the council

[63] (1) Memo, Casey for Johns, 24 Apr 42. SWPA File 490. (2) Memo for Rcd, Wright, 10 Apr 42. SWPA file 210. (3) Rpt, Engr Br Proc Div USASOS, 12 Dec 44, sub: Engr Proc in Australia. SWPA File M35. (4) AWC, *Report, February 1942–June 1943*, p. 107. (5) Memo, Johns for Casey, 11 Apr 42. SWPA File 210. (6) Incls to Memo, Johns for Casey, 11 Apr 42.

[64] (1) Of C Engr GHQ SWPA Annual Rpt for 1942. (2) Of C Engr GHQ SWPA Annual Rpt for 1943, Sup (Draft). SWPA File A8. (3) Engr Proc in Australia.



AN AUSTRALIAN ROAD BUILDER AND HIS TRAILER

had begun erecting facilities that would enable the Americans to use the port as their main base of supply. Theodore had meanwhile accelerated work on defense highways, on tank farms for storing 114,526,000 imperial gallons of oil, and on munitions plants. He now had to cope with a program that was increasing at the rate of 2,000 jobs a month. So extensive had construction become that the council reluctantly concluded that workers must be drafted. On 14 April, the government had empowered Theodore to establish the Civil Constructional Corps, an organization of civilian volunteers and draftees. All male civilians between the ages of 18 and 60 were liable for service, except defense workers. While the CCC was to be under Theodore's direction, recruitment and conscription were left to the states. Victoria, the first state to conscript workers, started calling up men in May; New South Wales began one month later. The Allied Works Council had made a substantial contribution and would soon be in position to make an even larger one. But the fact remained that most of its efforts, directed as they were to the Australian defense program, were confined to the southeastern part of the continent.[65]

[65] (1) Memo for Rcd, Brief Statement of Works Being Carried out Under Direction of the AWC. SWPA File 240. (2) AWC, *Report, February 1942–June 1943*, pp. 40–47, 87. (3) Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, 25–46. (4) [Hist of] Base Sec 7. (5) Memo for Rcd, Constr Sec Of C

From the American point of view the most crying need was for airfields in the northeast. The critical area of southeastern New Guinea was still almost defenseless. While enemy planes, based at Rabaul on New Britain and at Lae and Salamaua on the northeastern New Guinea coast, bombed Port Moresby at will, Allied airmen were severely handicapped by the lack of bases in New Guinea and on the Cape York Peninsula. At Moresby were two fields, both small and crudely built. Seven-Mile Drome, east of the town, had one 5,000-foot runway, surfaced with bitumen but in poor condition. Surrounding hills made takeoffs hazardous. Kila Drome, a commercial field 3 miles southeast of Moresby, was "a 3,000 foot roller coaster with 300-foot hills at its ends and grades to make your hair stand on end." The fields on the Cape York Peninsula at Cairns, Cooktown, and Coen, and on Horn Island, off the tip of the peninsula, were small and rough, and so near the sea that they were fogged in much of the time. Small numbers of fighters and light bombers could be based at the Moresby and Cape York fields, but B–17's had to operate out of Townsville, far down on the Queensland coast. From there the heavy bombers flew the 600 miles to Moresby, arriving at dusk. Taking on fuel and bombs during the night, they left early in the morning to strike at enemy targets to the north.[66] The Air Forces could not bring their full strength to bear under these conditions. If the Allies were to neutralize Japanese positions on the northern coast of New Guinea and on New Britain and to gain control of the skies over Moresby, more air power must be based farther north.

Construction there would have to be accomplished without the help of the AWC. Theodore was reluctant to send workers to the Cape York Peninsula, much less to New Guinea. In May, when the council began to consider establishing the Civil Constructional Corps in Queensland, the question arose whether the men should be assigned to forward areas. The Australians hesitated to take such a step. Some thought that because of the possibility of attack by enemy raiding parties, the workers would have to be armed for their own protection. General Steele pointed out there was a chance they would be shot if captured. He was of the opinion that employing the Civil Constructional Corps in forward areas would need "careful consideration." Australian commanders in New Guinea were adamant against bringing in civilians, insisting that all persons in that threatened area must be under military control. So long as the grave danger of invasion remained, Theodore would not send civilians north of Townsville. Nor would he send large quantities of supplies. Concerned lest Australian defense projects be slighted, he hesitated to "denude" the works agencies in Victoria and New South

Engr GHQ SWPA, 8 May 42. SWPA File 241. (6) Of C Engr GHQ SWPA Annual Rpt for 1942. (7) Commonwealth of Australia, *Statutory Rules, 1942*, No. 170, Regulations Under the National Security Act, 1939–1940.

[66] (1) Matthews, Data for Hist Rpt, pp. 30ff. (2) Craven and Cate, eds., *Plans and Early Operations*, pp. 416–17. (3) Matthews Ltr, 10 Nov 49, p. 12. (4) Ltr, Casey to MacArthur, n.d., sub: Rpt of Inspec Northeast Australia–New Guinea Areas, 28 Mar–3 Apr. SWPA File 158.

Wales of their equipment and to deplete their stock of materials. Americans found that the farther north they went, the more difficult it became to secure the council's assistance.[67]

For airfields in the Cape York Peninsula, the engineers would have to depend on the Queensland Main Roads Commission. After reconnaissance parties of the 46th Engineers had located two good sites—one near Mareeba, a small town on the Atherton Tablelands west of Cairns, the other, near Cooktown Mission, about a hundred miles to the north—the commission took over the work of construction. Farther north it began lengthening the principal runway of the small field at Coen and improving the strip on Horn Island. These jobs had to be carried out in the face of great difficulties. All of the sites were isolated. There were no rail or road connections with the remainder of the continent so that supply was possible only by air or sea. Men experienced chiefly in building roads now had to build airfields without adequate equipment or supplies. Progress was understandably slow, but the engineers were grateful for Australian help. "I was deeply impressed with the splendid work performed by the Main Roads Commission organization" at Cooktown Mission and Mareeba, Casey wrote later. "Both of these fields are important ones for our present and proposed operations." Matthews also had high praise for the Australians' effort. "Had it not been for Jumbo Jack Mathison, the Main Roads Commissioner, located at Townsville," he wrote, "the work we undertook in . . . [Base Section Two] by civilian forces could not have been accomplished, as AWC was not only unable but apparently unwilling to do much." [68]

Engineer Units in Northern Australia and New Guinea

Matthews needed more engineers desperately. Until early April the 46th was the only engineer unit in Queensland. On the 10th of that month, two battalions (separate), the 91st under Lt. Col. Burton B. Bruce and the 96th under Lt. Col. Leverett G. Yoder, reached Townsville. With the landing of these two units, some 2,200 troops were added to the labor force.[69] Unfortunately, separate battalions were never intended to handle large or complex construction jobs. They were designed rather to serve mainly as labor pools. Men were to be attached as needed to other engineer units. With an authorized strength of 28 officers and 1,059 enlisted men, a battalion had but one motorized road grader, one ½-cubic-yard power shovel, 8 medium tractors with angledozers, and

[67] (1) Memo for Rcd, W. A. Rogers, Secy AWC Queensland Div, sub: Conf Held at the Of of the Dep Dir Gen of Allied Works on Sunday, 31 May 42. SWPA File 240. (2) E. F. Borrie, Dir of Engr, Dept of Interior, Min of Conf of Representatives of State Road Authorities . . . Held in Melbourne . . . 2 and 3 Jun 42. SWPA File 481.

[68] (1) Matthews, Data for Hist Rpt, pp. 30–34. (2) Memo for Rcd, Rogers, sub: Conf held in the Office of the Dep Dir Gen of Allied Works, 31 May 42. SWPA File 490. (3) Ltr, Casey to J. C. Mathison, 14 Aug 42. SWPA File 492. (4) Matthews Ltr, 10 Nov 49, pp. 8, 11–12.

[69] The 91st and 96th Battalions were Negro units. For the role of Negro troops in the Pacific in World War II, see Ulysses G. Lee, Jr., *The Employment of Negro Troops*, THE UNITED STATES ARMY IN WORLD WAR II (Washington, 1966).

47 trucks, nearly one-third of which were 2½ ton. Hand tools were the principal equipment. After they reached Australia, neither the 91st nor the 96th was to receive the greater part of the machinery assigned to it. What happened is something of a mystery. "These units never did get their organic equipment except their half-tracks and their air compressors," Matthews wrote. "We know the equipment was landed. But I never could trace it after that. . . ." The 46th Engineers furnished a few trucks to both the 91st and the 96th, but the men would have to do their daily work mainly by hand. Although greatly disappointed because he had not received general service regiments, Matthews found plenty of work for the troops to do.[70]

Most of the men were put to building airfields. After helping the 46th Engineers at Woodstock for a few days, the 91st Battalion moved to Giru, thirty miles southeast of Townsville, to clear ground for a new strip. Meanwhile, Companies A and C of the 96th were assigned the dual mission of providing three 7,000-foot turf strips at Kelso Field near Townsville and furnishing work parties for other jobs. The troops were severely handicapped by their lack of equipment. The 96th tackled the job at Giru with picks, shovels, wheelbarrows, and a carpenter's level. Requested to supply machinery, the local office of the AWC rented some from farmers in the surrounding countryside. The first implement obtained was a horse-drawn mowing machine. In time the council turned over a few trucks and graders. The three remaining companies of the 96th did not work in Queensland, having been alerted, after a few days ashore, for movement to Port Moresby.[71]

Plans for developing Moresby into a first-class operational base had been in the making for almost a month. After inspecting the town early in April, Casey had written MacArthur, "[this] is one of our most vital areas, and . . . highest priority should be given to the development of the airfields in this locality." Moresby had much to commend it. Besides the two airfields, it had a deep water harbor with a dock for unloading freighters, two piers for barges, and a seaplane ramp. There was also a power plant, a water supply system, and about twenty-five miles of road, seven of which were asphalted. The chief engineer recommended that the port and the two airfields be improved and that three new fields be built. He asked that one general service company, one separate battalion (less two companies), and one dump truck company be sent in as soon as possible.[72]

[70] (1) Hist of 91st Engr Regt, Jan 42–Jun 43. (2) Hist of 96th Engr GS Regt, 1942–43. (3) Memo, Brig Gen Clarence L. Sturdevant, ACofEngrs, for CG AGF, 2 May 42. 320.2 (Engrs, Corps of). (4) Memo, Col F. K. Newcomer, Engr Third Army, for ACofS G–3 Third Army, 21 Jan 42. 320.2 (Engrs, Corps of) pt. 15. (5) Incl 1, Comparison of Pers and Major Items of Equip of the Sep Bn and GS Regt, to Memo, Newcomer for ACofS G–3, 21 Jan 42. (6) Matthews Ltr, 10 Nov 49, p. 17. (7) Ltr, Heiberg to Casey, 29 May 42. SWPA File 469. (8) Interv, author with Lt Col David M. Matheson, formerly CO of Co D, 96th Engr Bn (Sep), 14 Mar 55.

[71] (1) Hist of 91st Engr Bn (Sep), 1942–43. (2) Matthews Ltr, 10 Nov 49, p. 9. (3) Hist of 96th Engr Bn (Sep), 1942–43.

[72] (1) Ltr, Casey to MacArthur, n.d., sub: Rpt of Inspec Northeast Australia–New Guinea Areas, 28 Mar–3 Apr. SWPA File 158. (2) Matthews, Data for

On 22 April an advanced detachment of the 96th left Townsville by air and landed at Seven-Mile Drome, the first American ground troops to reach New Guinea. Late on the evening of the 28th a boat carrying headquarters and Companies B and D steamed into Moresby harbor. Morale was low. The enemy had by some means apparently learned of the movement of the 96th. Someone had picked up a broadcast from Tokyo announcing that on the next day, the Emperor's birthday, Japanese airmen would make a devastating raid on Port Moresby and promised that before long the streets would run red with American blood. During the night, the engineers worked at the docks in a pouring rain to unload their cargo, for the ship had to be out of the harbor before dawn. When the men entered Moresby proper the next day they found a ghost town. The city's 2,000 white inhabitants had been evacuated, and nearly all of the natives had fled to the safety of their own villages. Although most buildings were still standing, the effects of repeated bombings were very much in evidence. The Australians had destroyed utilities and there were signs that they had begun to carry out a scorched-earth policy. The Americans took what encouragement they could from the fact that a small number of Royal Australian Engineers were already at work on Seven-Mile Drome, patching up the bomb-damaged runways.[73]

The 96th had a task it could not perform well—that of building airfields. Company B went to Seven-Mile Drome, where its first job was to help the Australians repair the runway. Then, with their hand tools, the men scraped out extensions at either end and provided additional taxiways and hardstands. Company D began work on two new runways, Bomana and Laloki, about twelve miles northeast of the town. On arriving at the sites, the engineers found that some rough grading had already been done. The men had no specifications to work from, no instructions on how to build, and, as usual, no equipment. Their officers had had little experience in airfield construction. The commander of Company D later described the operation as "building fields with our fingernails." The engineers at Moresby eventually got a few graders and dozers from the Australians and rounded up several flat-bed trucks which still had the name of a Chinese vegetable dealer lettered on their sides. Air raids were frequent, and the men spent much time jumping in and out of slit trenches. In addition to working on the runways, the troops had to do all sorts of odd jobs. They refueled planes, loaded bombs, and worked as stevedores at Moresby harbor. These engineers could not be expected to accomplish much in the way of airfield construction.[74] Until the arrival of more units, better trained and equipped, progress would continue to be slow.

About thirty miles northwest of Port Moresby was a wide, coastal plain, named

Hist Rpt, p. 35. (3) Memo for Rcd, Casey, 7 Apr 42. SWPA File 158.

[73] (1) Hist of 96th Engr Bn (Sep), 1942–43. (2) Interv, author with Matheson, 14 Mar 55. (3) Matthews Ltr, 10 Nov 49.

[74] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, p. 78. (2) Interv, author with Matheson, 14 Mar 55. (3) Hist of 96th Engr Bn (Sep), 1942–43.

Rorona after a native village located there. Airfields at this location would make possible better dispersal of aircraft and would also enable fighters to cover Port Moresby more adequately. But a major drawback was Rorona's almost inaccessible location. Between the plain and Port Moresby were numerous swamps. Coral reefs and sandbars along the coast made navigation extremely hazardous. Despite these adverse conditions, the Air Forces wished to have an airfield there. When on 4 May, Company E of the 43d Engineer General Service Regiment, some 165 men, arrived at Port Moresby, it was not assigned to the fields near that town but to Rorona. With no equipment except their hand tools, one Australian grader, and three dump trucks, the men began work, helped by 150 natives.[75]

Progress in New Guinea was hampered not only by shortages of troops and equipment but also by an inadequate organizational setup. The Royal Australian Engineers were under the Australian commander at Moresby; the American engineers, under the commander of Base Section Two, Maj. Francis I. Irwin. Except for an occasional inspection, neither Irwin nor Matthews, who succeeded him as base section commander on 28 May, could give much attention to the troops in New Guinea. The men at Moresby seemed to be working without any definite purpose, having only vague information as to what to build or why. This partly explained their noticeable lack of incentive. Work of the Americans and Australians was not co-ordinated. More or less by chance, a division of labor evolved. Under Colonel Yoder, the Americans concentrated their efforts on airfields, including access roads and bridges. The Australians worked principally on camps, roads, and base facilities. Under this haphazard arrangement, neither group was very effective. High-ranking engineer officers generally agreed that something should be done but could not agree on what. Colonel Robinson suggested that units working on airfields be placed under the U.S. Air Forces and that an engineer be assigned to the staff of the Australian commander at Moresby to co-ordinate all construction in that area. No more willing to place engineer officers under Australian commanders than to assign engineer units to the Air Forces, Casey did not act on these recommendations. Although various proposals were made to develop a more effective Australian-American organization, no solution was reached.[76]

While the 96th was struggling to get fields started at Moresby, the 808th, the only aviation engineer unit in the theater, reinforced by one battalion of the 43d General Service Regiment, continued to work in Northern Territory, building fields along the rail line from Darwin to Birdum. Even though the area of greatest danger appeared to be in the northeast, the possibility of an enemy assault from the northwest remained. Brett, still thinking in terms of an advance against the East Indies, continued to emphasize the importance of fields

[75] (1) Matthews, Data for Hist Rpt, pp. 37–38. (2) Matthews Ltr, 10 Nov 49, p. 44.

[76] (1) Matthews Ltr, 10 Nov 49, p. 40. (2) [Hist of] Base Sec Two. (3) Memo, Robinson for Sverdrup, 22 Jun 42. SWPA File 158.

near Darwin. At a conference with Casey on 24 April, he talked of using Darwin as the main port for launching an expeditionary force. He stressed that the strengthening of the region around the city was urgent. He believed the entire area should be brought under military control, adding that the Air Forces would soon be very active there, "ultimately embracing as much as 8 to 10 bomber squadrons, each of which would require about 400 tons per day for its operation. . . ." Casey discouraged plans for using Darwin as an expeditionary port, explaining that "overland supply communications . . . [were] too weak to sustain the development of this area" and that forces could be dispatched from large ports for operations in the Indies, in which case there would be no reason for stopping off at Darwin. Nevertheless, the chief engineer went along with Brett's proposal to continue work on the airfields in Northern Territory.[77]

Working in a region of diminishing tactical importance, and far removed from Casey's and Johns' offices, the 808th and the 43d Engineers were left largely to their own devices. Located in Northern Territory since early March, the 808th had already acquired considerable experience in working more or less independently. Upon receiving orders to build an airfield, the engineers selected sites, prepared plans and specifications, and began construction. By the time higher headquarters approved the plans, work was well along. The men sometimes found it expedient to disregard prescribed procedures and to resort to innovations. Their method for clearing wooded areas serves as a case in point. As a rule, the trees of this semiarid region, with shallow root systems and with trunks averaging 12 inches in diameter, could be pushed over fairly easily. Taking a cable about 400 feet long, the men fastened the ends to two D–6 tractors. They then drove the machines forward, parallel to each other, uprooting trees. Light cables about one inch in diameter, while they had to be spliced frequently, proved best because the troops had difficulty in raising heavier ones high enough to topple the larger trees. On several occasions, ten men were able to clear an area 5,000 feet long and 100 feet wide in ten hours. The unit took great pride in such exploits. According to the battalion's chronicler, "the drive and spirit of the 808th seemed to have caught the fancy of the Australians, and from Darwin to Alice Springs and southward the name of the battalion became the watchword for work and efficiency." [78]

By May the 808th was the best equipped engineer unit in the theater, a situation for which the men themselves were partly responsible. Moving heavy machinery across the 600-mile stretch of no-man's-land from Alice Springs to Birdum and then northward on the dilapidated railroad was a hazardous and laborious undertaking. The odyssey of

[77] (1) Glover, Hist of the 808th Engr Avn Bn, pp. 16off. (2) Memo for Rcd, Casey, sub: Conf with Lt Gen G. H. Brett on 24 Apr 42. SWPA File 490.

[78] (1) Glover, Hist of the 808th Engr Avn Bn, pp. 68–69, 78. (2) 3d Ind, Hq 808th Engr Avn Bn to C Engr GHQ SWPA, 3 May 43, on Memo, C Engr GHQ SWPA for CO 808th Engr Avn Bn, 13 Apr 43, in Glover, Hist of the 808th Engr Avn Bn, pp. 154–55ff.

one D–8 tractor illustrates the type of difficulties the 808th encountered. The big "cat" began its journey north from Alice Springs aboard a 20-ton trailer, which bumped along over the washboard road. The trip ruined the trailer, the only one of its size in the area. North of Birdum the flatcar carrying the tractor buckled under the weight of its cargo. A lieutenant and an enlisted man had to go down and drive the D–8 up to Katherine under its own power. Once the engineers got their equipment, they were hard put to keep it running. Spare parts had to come from Melbourne and shipments were infrequent. Two enlisted men, Pvt. Karl F. Bretschneider and Pvt. Jerald F. Patnode, were especially good at keeping the machines in repair. They combed the area for any materials they might be able to use and even searched bombed-out ships in Darwin harbor. By adapting the parts they could find and by improvising others, they succeeded in keeping most of the battalion's equipment going.[79]

The engineers in Northern Territory were meeting the challenge of an arduous assignment. In an area which offered none of the usual American recreations, the men were "enjoying life as far as it was possible . . . under the circumstances." Working in an area 2,000 miles from the main American quartermaster depots, the engineers, after the first few weeks in this remote part of Australia, were able to get abundant quantities of food. They arranged to get rations from the Australian quartermasters, who were able to provide generous amounts of supplies. The country around the Pine Creek airfield had once been a gold mining center, and some of the troops spent their few free hours prospecting and panning for the precious metal. But the greatest boost to the men's morale was the knowledge that their mission was important. Well aware of their nearness to the fighting zone and realizing only too well that a landing at Darwin could easily take place, the men knew that their best defense was the rapid building of airfields.[80]

Eastern New Guinea

The long-expected Japanese thrust soon materialized. During April, the enemy assembled near Rabaul a task force of 2 carriers, 7 heavy cruisers, and 13 destroyers, together with transports. Such a concentration of naval forces, coupled with an increase in enemy air strength in eastern New Guinea and on New Britain, was sufficient indication that the Japanese were about to strike, probably at both the Solomons and Port Moresby. Forces in northeast Australia and on New Guinea were alerted. The engineers near Townsville stopped work to prepare for defense. The 91st and Company F of the 46th took up positions in a gap in the coastal range near Giru. Companies E, D, and Headquarters and Service Company of the 46th remained at Woodstock field, ready to move to the beaches should the enemy attempt a landing. Companies A and C of the 96th

[79] (1) Glover, Hist of the 808th Engr Avn Bn, pp. 72, 73, 75. (2) Ltr, Heiberg to Casey, 29 May 42. SWPA File 469.

[80] (1) Ltr, Heiberg to Casey, 29 May 42. (2) Glover, Hist of the 808th Engr Avn Bn, pp. 77–78.

were held in reserve near Townsville. At Port Moresby, the newly arrived Headquarters Company and Companies B and D of the 96th got orders to carry full field equipment. They were to help defend a line fifteen miles inland from the beach. Should the Japanese break through, the engineers were to retreat into the jungle and make their way back to Australia as best they could. But the Japanese did not land. The Allied victory in the Battle of the Coral Sea saved Port Moresby and stopped the Japanese thrust southward across the Pacific supply lines.[81]

MacArthur believed the Japanese would try again. The enemy would need at least a month to prepare for a second assault on Moresby. In the interim the Allies would have to make every effort to build up their forward defenses. Uppermost in the minds of theater planners was the need for locating more air power in southeastern New Guinea to give added protection to Port Moresby and at the same time enable Allied airmen to strike more effective blows at enemy bases and shipping. MacArthur also intended to base more fighters and bombers on the fields of the Cape York Peninsula. If the Allies were not to be caught short, existing fields would have to be improved and new ones made operational before the Japanese returned.[82]

Of major importance was the construction of a base near the southeastern tip of New Guinea. As demonstrated by the Battle of the Coral Sea, an airfield was needed here so that Allied planes could intercept enemy ships rounding the tip of the island. Brett argued, moreover, that airdromes in that area would be essential to any offensive against Rabaul. On 20 May MacArthur chose as the site for a fighter field the general vicinity of Abau-Mullins Harbor on the southern coast of New Guinea, midway between Moresby and the southeastern end of the island. A landing strip was to be built as quickly as possible and a bomber field constructed later. As soon as a reconnaissance party had picked a specific site, one company of engineers was to be sent in, along with infantry and antiaircraft units. Planes were to be operating from the field three weeks after construction started. Since activity in this area might provoke a Japanese attack, MacArthur enjoined greatest secrecy.[83]

On 22 May, General MacArthur's headquarters directed Yoder, the senior Engineer officer in New Guinea, to make a reconnaissance by air of possible airfield sites on the southern coast of the island. Five days later, Yoder with a party of Australians and Americans explored the region around Abau. The location did not appear promising. Information gathered by the group indicated that it would take about four months to build an airdrome at that

[81] (1) Milner, *Victory in Papua*, pp. 37–39. (2) Hist of 46th Engrs GS Regt for 1942–43. (3) Hist of 91st Engr Bn (Sep), 1942–43. (4) Hist of 96th Engr Bn (Sep), 1942–43. (5) Interv, author with Matheson, 14 Mar 55.

[82] (1) Memo, MacArthur for Blamey *et al.*, 25 May 42. G–3 Jnl, GHQ SWPA. (2) Milner, *Victory in Papua*, pp. 39–41. (3) Memo, MacArthur for Blamey *et al.*, 20 May 42. G–3 Files, GHQ SWPA 385 (Fall River).

[83] (1) Milner, *Victory in Papua*, pp. 39–41. (2) Memo, Brett for MacArthur, 1 May 42. (3) Memo, MacArthur for Blamey *et al.*, 20 May 42. Last two in G–3 Files, GHQ SWPA 686 (New Guinea) No. 1. (4) Memo, Casey for Johns, 22 May 42. SWPA File 491.

point. Twelve days later Yoder, with eleven Americans and Australians, made a second trip, this time to Milne Bay, at the extreme southeastern tip of New Guinea. In and near the coconut plantations at the western end of the bay, they found several good sites for airfields. The next day they turned in a favorable report to Casey. Among the advantages of Milne Bay were the availability of fresh water, coral, and gravel, and the presence of native laborers and Australian overseers. The area already had a landing strip, a road net, and a power plant. One of the principal drawbacks was that the area was "open on all sides to enemy attack." The new information corroborated the sketchy data Casey's office already had about Milne Bay. On 11 June MacArthur canceled the project at Abau and on the next day directed that the airdrome be built at Milne Bay instead.[84]

On 18 June Company E of the 46th Engineers left Townsville for Milne Bay, arriving on the 25th, together with some 500 Australian ground troops. The next day MacArthur's headquarters set 20 July as the date the bomber field must be ready. Prospects were dim for meeting this deadline. The equipment brought in by the engineers consisted of 2 medium bulldozers, both in need of repair, 2 graders, 4 small dump trucks, and one cargo truck. Twenty additional items were at Moresby awaiting shipment, but no vessel had been found to carry them eastward. At Milne Bay, unloading of machinery and supplies was rendered difficult by inadequate wharfage. Only one vessel at a time could discharge cargo. To help remedy the situation, the Australian commander ordered one platoon of Company E to build an unloading ramp and an access road. The rest of the engineers shortly began work on Strip No. 1, about two miles west of the bay. Not the least of the company's troubles was the climate. The heat was intense. This was a notorious malarial region, and before long 6 percent of the men of the task force had become ill with the disease. Since the rainfall was extremely heavy, averaging 150 inches a year, the engineers had to provide the field with an extensive drainage system. Despite their many handicaps, the men of Company E, helped by natives, labored day and night in a race against time.[85]

Meanwhile, the engineers were under pressure to step up construction on the Cape York Peninsula and in the area around Port Moresby. MacArthur directed that going projects be accelerated and that several new fields be built quickly. Responsibility for carrying out these orders now fell on Col. Willis E. Teale, chief engineer of USAFIA after 25 May when Johns became the G–4. Teale was hard put to find enough manpower. No assistance from the AWC

[84] (1) Yoder, Rpt of Reconnaissance—Boston [Abau] Area, 30 May 42. (2) Memo for Rcd, Sverdrup, 9 Jun 42. Both in SWPA File 491. (3) Rpt, Yoder, 9 Jun 42. (4) Memo, MacArthur for Blamey *et al.*, 11 Jun 42. (5) Memo, MacArthur for Blamey *et al.*, 12 Jun 42. Last two in G–3 Files, GHQ SWPA 385 (Fall River).

[85] (1) Hist of 46th GS Regt, 1942, pp. 57–58. (2) Rad, Land Forces, Melbourne, to Mil Comd, Moresby, 26 Jun 42. G–3 Files, GHQ SWPA 385 (Fall River). (3) Rads, Hq New Guinea Forces to Land Forces, Melbourne, 26, 27, 29 Jun 42. Last two in G–3 Files, GHQ SWPA 385 (Fall River). (4) Memo, Robinson for Casey, 14 Jul 42. SWPA Files 492. (5) Memo for Rcd, Casey, sub: Rpt on Inspec of New Guinea and North Queensland Between 29 Jul–7 Aug. SWPA File 491.

was in sight. The Queensland State Roads Commission already had as much work as it could handle. Any impetus the projects received would have to be provided by engineer units, and Teale pulled as many troops out of Townsville as he could. On 19 June Companies A and C of the 96th moved to Moresby, where they began a new runway at Kila and took over the operation of a quarry. Company A of the 46th went to Horn Island to help the Australians complete two runways for B–17's. Companies B and C of the 46th sailed to Portland Roads, 150 miles south of Horn Island, to begin work on an airdrome for light bombers. During June MacArthur ordered construction of a bomber field near the tip of the Cape York Peninsula and of a fighter strip at Merauke, on the southern coast of New Guinea 450 miles west of Moresby. Teale, by this time scraping the bottom of the barrel, could not at once find engineer units for these last two jobs.[86]

Progress by Midyear

As the first half of 1942 drew to a close, construction was progressing over a vast area. By mid-June the Allied Works Council had under way a program comprising more than 10,000 projects estimated to cost a total of £60,520,000. Throughout the southeast new runways, warehouses, tank farms, wharves, camps, and hospitals were coming into use. In northern Australia and on New Guinea, American engineers were providing runways for defense and offense. In Northern Territory 8 fields had been completed by 1 July and 7 more were well along. Of the 4 fields at Port Moresby, one, Seven-Mile, was suitable for all-weather operations; the other three could take bombers in emergencies. The field at Milne Bay had been started. Australians and Americans were developing a chain of fields on the Cape York Peninsula. Few of the runways in these forward areas were sealed, most had not even been treated to hold down dust, and, in the haste to carve out the many strips needed by the Air Forces, drainage had frequently been held in abeyance. Their substantial progress notwithstanding, neither the Allied Works Council nor the engineers were able to keep pace with MacArthur's demands.[87]

The inability of the engineers to do more can be charged chiefly to shortages of men, materials, and equipment. So far only 10 engineer units had arrived from the United States—1 aviation battalion, 2 general service regiments, 2 separate battalions, 2 dump truck companies, 2 combat battalions, and 1 depot company—about 6,000 men in all. The RAE and the RAAF had as yet been able to send but few men to the north. The supply situation was not encourag-

[86] (1) Casey's Notes on Conf, 18 Jun 42. SWPA File 491. (2) Hist of Engr Hq USAFIA, p. 1. (3) Hist of 96th Engr Bn (Sep), 1942–43. (4) Hist of 46th GS Regt, p. 31.

[87] (1) Memo for Rcd, AWC, n.d., sub: Brief Statement of Works Being Carried Out Under the Direction of the AWC on Behalf of Commonwealth Depts and USAFIA. SWPA File 240. (2) Memo for Rcd, Of C Engr GHQ SWPA, 1 Jul 42. SWPA File 491. (3) Progress Rpt, Of C Engr GHQ SWPA Constr Sec, 9 July 42. SWPA File M244. (4) Progress Rpt, G–4 USASOS, n.d., sub: Constr Proj Underway Under Supervision of Hq USASOS SWPA, as of 13 Aug 42. SWPA File 469. (5) Memo, Robinson for Casey, 29 Jun 42. SWPA File 491.

ing. The Australians were continuing to husband their meager stocks, and shipments from the United States were pitifully small. At the end of June, Colonel Teale listed 37 tractors, 62 graders, 36 carryalls, one distributor, and one shovel with dragline, as the principal items received from the United States during the last six months. The one Engineer supply unit, the 391st Depot Company, had reached the theater in May, and its 6 officers and 188 men were attempting to organize and run 3 depots at Melbourne, Brisbane, and Townsville.[88] Summing up, late in June, Colonel Robinson wrote that "equipment and personnel are inadequate to accomplish the Engineer mission in the Southwest Pacific Area, and it is therefore recommended that immediate steps be taken to augment Engineer construction forces and equipment." He declared such action to be "vital to the success of any contemplated offensive." [89]

Preparing for the Offensive

The Battle of Midway proved to be a turning point in the war against Japan. In this decisive naval engagement of 3 and 4 June, the main striking force of the Japanese Combined Fleet was destroyed. For the first time, the Allies were in a position to seize the initiative. The Joint Chiefs of Staff began to revise their plans accordingly. On 2 July, they directed Nimitz and MacArthur to mount a joint offensive, northwestward through the Solomon Islands and eastward from New Guinea, with the ultimate object of capturing Rabaul, the chief Japanese stronghold in the Southwest Pacific. The first phase of the operation was to begin on 1 August, when the marines were to land in the southern Solomons. MacArthur had already been planning a thrust through New Guinea and the Solomons toward Rabaul, a plan of campaign known by the code name TULSA. On receiving the joint chiefs' directive, he further developed this plan and prepared for the attack.[90]

To conquer Rabaul, the Allies would first have to gain air supremacy over the approaches to New Britain. Brett estimated the task would require at least twenty-four squadrons based in New Guinea. On 10 July he informed MacArthur that 12 additional airdromes were urgently needed—4 at Moresby, 4 at Milne Bay, and 4 at Buna on the northeastern coast of the island. All were to be provided with dispersals and sealed runways capable of taking heavy bombers. Brett pressed for "speedy consideration," "prompt action," and "rapid completion." Information from Casey indicated that it would take all the engineers in the theater to do the job. This would mean "the withdrawal of all such personnel now in northern Queensland and perhaps in the Darwin area." Yet, as Brett himself pointed out, much vital work remained to be done in the Cape York Peninsula.[91]

Casey had been concerned with the problem for some time. As early as 2 July he had suggested that the 808th be

[88] (1) Of C Engr GHQ SWPA Annual Rpt for 1942. (2) Hist of Engr Hq USAFIA, pp. 18ff.

[89] Memo, Robinson for Sverdrup, 25 Jun 42. SWPA File 469.

[90] (1) Milner, *Victory in Papua,* pp. 45–48. (2) Miller, *Guadalcanal,* pp. 16ff.

[91] Memo, Brett for MacArthur, 10 Jul 42. SWPA File 491.

transferred from Northern Territory for urgent construction "now in prospect" on New Guinea and New Britain.[92] On 7 July, after receiving advance notice of Brett's plans, he asked Colonel Sverdrup to estimate how long the work would take. The answer was not reassuring. With so few troops available, Sverdrup did not believe the engineers could build what the Air Forces asked for in anything like the time they stipulated. He spoke in terms of a year or more for the New Guinea fields. Two things seemed apparent. First, Brett must lower his requirements. Second, the engineers must get more units—ten aviation battalions or the equivalent. Casey agreed with the first of Sverdrup's suggestions, but, since he was under no illusions as to his chances of obtaining so many additional troops, rejected the second in favor of a scheme for accomplishing a maximum amount of construction with the forces at hand.[93]

What he had in mind was to eliminate all frills from Air Forces projects and to move every available engineer to New Guinea as quickly as possible. He would cut the length of runways from 6,000 to 4,000 feet and treat the surfaces just enough to control dust. He would substitute landing mats for pavements, reduce the number of dispersals, and hold housing to minimum standards. Then, if the engineers remaining at Townsville were moved to New Guinea, it might be possible to complete three dromes at Moresby and one at Milne Bay by 20 July, and more by the end of the month. With the transfer of the 808th from Darwin to New Guinea, scheduled for sometime between 15 and 25 July, other units might be pulled out of Moresby and Milne Bay and sent north to begin work at Buna. At projects in Australia, RAAF works units and civilians could fill the breach left by the departing Americans. The engineers would concentrate on completing facilities first at Port Moresby, next at Milne Bay, and lastly at Buna. By 1 September, the Air Forces would have the requisite number of runways, crude to be sure, but usable. On 10 July Casey laid his plan before Brett, who accepted it in principle. Brett refused, however, to sanction the shortening of runways. Moreover, he reminded Casey that efforts to complete the Cape York fields could not be relaxed. The chief engineer had reservations of his own about the plan, for the difficulties of moving units into advanced areas and keeping them supplied were immense.[94]

A great deal would depend on the speed with which the engineers could finish their work in the Cape York Peninsula. Though Queensland began drafting men for a Civil Constructional Corps on 6 July, the Air Forces could not wait until the civilians were organized into an effective working force and sent north-

[92] Extract from Ltr, Casey to CofS SWPA, 2 Jul 42. SWPA File 481.

[93] (1) Memo, Lt Col David Larr, GSC, GHQ SWPA, for Casey, 7 Jul 42. 686 (Airdromes) 6/42–12/43. G–3 Files, GHQ SWPA. (2) Memo, Sverdrup for Casey, 8 Jul 42. SWPA File 492. (3) Incls to Memo for Rcd, Casey, 11 Jul 42. SWPA File 491.

[94] (1) Memo for Rcd, Casey, 11 Jul 42. SWPA File 491. (2) Incls to Memo for Rcd, Casey, 11 Jul 42. (3) Ltr, MacArthur to Brett, 6 Jul 42. G–3 files, GHQ SWPA 385 (Fall River). (4) Min of Conf Held in the Of of the Comdr AAF, 1000, Fri, 10 Jul 42. G–3 files, GHQ SWPA 686 (Airdromes) 6/42–12/43.

ward. The troops who left Townsville during July went therefore not to New Guinea but to various points on the peninsula. On 12 July, Headquarters and Service Company and Company D of the 46th arrived at Portland Roads to help elements of the regiment already at work there. One week later the 91st Battalion moved to the tip of the peninsula to build an airfield in an area shown on the maps as Red Island Point but more frequently called Jacky Jacky after a small river nearby. Later, one platoon of the 91st went on to Horn Island. While these units were better equipped than before, the conditions they found were not conducive to the rapid completion of airfields. The region was an engineer's nightmare. Around Portland Roads the terrain was jungled and dotted with huge ant hills, some of them twenty feet high. Jacky Jacky was a forbidding place, barren and desolate. Rocky beaches there prolonged the lightering of men and supplies for twelve days. Horn Island was "an ancient lump of granite," devoid of gravel or coral. The isolation of these areas complicated supply. Signal communications were poor, so that requests for materials and equipment were difficult to send out and were seldom acknowledged. The best way of getting action was to send a man by plane to Melbourne or Brisbane. The shipping shortage was often given as the reason why engineering supplies and equipment were not getting to Cape York Peninsula, but frequently large quantities of bombs, aviation gasoline, and telephone poles, not yet needed, were dumped on shore. These articles usually had to be hauled away by the engineers, because quartermaster and Air Forces troops, who should have done the job, were not on hand. There were other interruptions. Because rainfall was infrequent, the engineers had to spend considerable time searching for water. At Horn Island, the Australian commander, fearing enemy attack, insisted that the troops blast a tunnel under the runway. At each of the fields in northeast Australia the men worked steadily, but the pace was slow.[95]

In New Guinea, the troops were experiencing trouble too. The 96th, still the only engineers at Moresby, were having an especially rough time. About all they had received in the way of additional equipment was a shipment of secondhand items from the AWC. This machinery was in such bad repair that "some of it wouldn't even run when it came off the ship and had to be towed off the dock." [96] Since no bitumen, calcium chloride, or molasses had been received, the engineers had to try to keep down the dust by sprinkling water on the runways. Although multiple shifts were at work in the quarry, there were too few trucks to keep the jobs supplied with gravel, the chief surfacing material. The projects at Moresby lagged behind schedule. At Milne Bay, Company E of the 46th was likewise beset by difficulties. Company E, the sole engineer outfit at this location until mid-July, when one company of RAE landed,

[95] (1) AWC, *Report, February 1942–June 1943*, p. 87. (2) Hist of 46th GS regt, 1942. (3) Hist of the 91st Engr GS Regt, Jan–Jun 42. (4) Matthews, Data for Hist Rpt, pp. 33–34. (5) Memo for Rcd, Casey, sub: Rpt on Inspec of New Guinea and North Queensland Between 29 Jul–7 Aug. SWPA File 491. (6) Memo for Rcd, Sverdrup, 8 Aug 42. SWPA File 94.

[96] Glover, Hist of the 808th Engr Avn Bn, p. 92.

had to rely heavily on the help of natives. Not until 6 July did the bulk of its equipment reach Milne Bay, and even then several badly needed items were lacking. Having no rock crusher to break up the coral in the area and no dragline to remove gravel and sand in the river bed, the company hastily laid the landing mat on a silt base. Rains were especially heavy even for this wet region, and the mud oozed up through the perforations of the mat, making a slick film on the surface. There was then nothing to do but send for draglines, take up the mat, and put down a gravel base.[97]

Meanwhile, pressure was mounting on the engineers to build fields in the vicinity of Buna. Once established on the upper coast of Papua, MacArthur would be in a position to get the offensive rolling. Allied intelligence indicated that there was not much time to spare, for the Japanese were showing increasing interest in the Buna area. On the basis of reports he had received, MacArthur predicted that the enemy would attempt to land and then push southward over the Kokoda Trail. This primitive track ran from the vicinity of Buna to Kokoda, a village in the foothills of the Owen Stanleys, and thence over the mountains to Moresby. MacArthur planned to get to the northeastern New Guinea coast first. On 9 July he ordered a reconnaissance to determine if the small emergency landing strip at Buna would take military aircraft, and if not, whether there were suitable sites nearby. The next day, a party of six officers, headed by Colonel Robinson, left Moresby by plane. They found the existing field to be of little military value. But on the grass plains at Dobodura, fifteen miles to the southwest, they discovered many excellent sites. Drainage was good, and gravel and timber were plentiful. Workmen could be drawn from the native population of the region. With little effort, a number of runways could be provided. On 15 July MacArthur issued orders to seize and occupy Buna and build an airdrome. He directed the organization of a special task force, Buna Force, to consist of engineers and protective troops. D-day was set for 10 August.[98]

As plans for the occupation of Buna took form, MacArthur began to ready his command for the offensive. He ordered the 41st and 32d Divisions north from Melbourne and Adelaide to new camps in Queensland, where they were to undergo training in jungle warfare. In order to be nearer the combat zone, he transferred his headquarters from Melbourne to Brisbane, completing the move on 20 July. These shifts of American forces northward were accompanied by organizational changes. On 20 July, MacArthur redesignated USAFIA as U.S. Army Services of Supply (USASOS).

[97] (1) Memo for Rcd, Casey, Rpt on Inspec of New Guinea and North Queensland Betw 29 Jul–7 Aug. SWPA File 491. (2) Rad, Matthews to MacArthur, 7 Jul 42. G–3 Files, GHQ SWPA 385 (Fall River).

[98] (1) Milner, *Victory in Papua*, pp. 50–53. (2) Ltr, MacArthur to Blamey, 9 Jun 42. G–3 Files, GHQ SWPA 385 (New Guinea). (3) Rad, Land Forces, Melbourne, to Mil Comd, Moresby, 20 Jun 42. Last two in G–3 files, GHQ SWPA 385 (New Guinea). (4) Memo, Robinson for Casey, 13 Jul 42. SWPA File 58. (5) Rad, Matthews to MacArthur, 13 Jul 42. SWPA File 491. (6) Ltr, MacArthur to Blamey *et al.*, 15 Jul 42. (7) Memo, Heiberg for Casey, 15 Jul 42. Last two in G–3 files, GHQ SWPA 385 (Buna Bay Plan).

The organization was henceforth to discontinue such administrative and tactical functions as it had acquired during its first months of operations and concentrate its efforts more and more on providing logistical support. Brig. Gen. Richard J. Marshall replaced Barnes as head. The Allied Air Forces was also to come under new leadership. Sometime before, MacArthur had chosen Maj. Gen. George C. Kenney to replace Brett as commander of the Allied Air Forces and the U.S. Fifth Air Force. Kenney, who arrived from the United States on 28 July, assumed his new duties on 4 August.[99]

The Japanese acted more quickly than had been expected. Although their disastrous setback at Midway had ruled out further large-scale assaults, they were still strong enough to undertake limited offensives. Having failed, as a result of the Battle of the Coral Sea, in their attempt to take Moresby from the sea, they decided to launch an overland campaign. As MacArthur had anticipated, their strategy called for a landing on the northeastern coast of Papua, after which their troops were to advance through the mountains and take Moresby from the rear. On 21 July enemy transports put a force ashore near Buna. Encountering little opposition, the Japanese started out over the Kokoda Trail toward Moresby. Within a week they had reached Kokoda Village, eighty miles from Buna and almost half way to their goal.[100]

Four days after the enemy landing at Buna, the 808th engineers reached Moresby. Their arrival was timely, for construction of airfields here was now more imperative than ever before. Additional planes had to be based at Moresby if the Allied Air Forces were effectively to bomb Buna, harass the column advancing along the Kokoda Trail, and drop supplies to Australian infantry units marching north to meet the enemy.[101]

The 808th's first job was to build a new airdrome, Waigani Field, about twelve miles north of the town. A part of the site had already been cleared, but a dense growth of timber had still to be taken out. The men found the work much more difficult than had been the case in Northern Territory. The trees were huge, many of them more than seventy-five feet high and with trunks measuring over two feet in diameter. Their roots were large and deep and their branches entangled in a thick growth of vines. The job of clearing was not one that could be accomplished merely with cables hooked to tractors. These trees had to be chopped down or dynamited. The increasingly serious tactical situation added to the strain brought on by long, fatiguing hours of work. Air raids were frequent, even during day time, and at night, "the continual fight against hordes of mosquitoes, the . . . sounds of the jungle . . . , the rotten limbs dropping off the great trees,

[99] (1) Milner, *Victory in Papua*, pp. 48–50. (2) Wesley Frank Craven and James Lea Cate, eds., "The Army Air Forces in World War II," Vol. IV, *The Pacific: Guadalcanal to Saipan, August 1942 to July 1944* (Chicago: The University of Chicago Press, 1950), pp. 25–26.

[100] Milner, *Victory in Papua*, pp. 56, 64–65.

[101] (1) Glover, Hist of the 808th Engr Avn Bn, pp. 88 ff. (2) Ltr, Casey to Teale, 23 Jul 42. SWPA File 481.

small animals scurrying through grass and leaves, and the flying foxes swishing through the air made the men nervous and irritable from loss of sleep and personal discomfort." The presence of a well-equipped and experienced aviation battalion at Moresby speeded construction, but there was still far more to do than these additional engineers could cope with.[102]

The enemy landing at Buna likewise rendered construction at Milne Bay all the more urgent. Yet for some time no reinforcements could be sent. While the Australian field company worked to provide seventy miles of road, Company E of the 46th struggled to hasten the building of runways. Colonel Teale was by now able to dispatch larger quantities of supplies to Milne Bay, but the difficulty of unloading ships continued to have a hampering effect. To get materials and equipment ashore, the engineers, using floating gasoline drums, rigged a makeshift wharf on which ships could discharge cargo into four trucks at a time. The new wharf helped the situation, but was not adequate for the quantities of cargo coming in. By late July the engineers had succeeded in getting the first strip far enough along to accommodate a squadron of pursuit planes and had begun clearing a second strip, three miles to the west of the first. MacArthur was meanwhile demanding greater speed. And speed was essential, for reports indicated that the Japanese might soon attempt to land at Milne Bay.[103] But if construction were to go any faster, more engineers would be needed.

Help for the New Guinea jobs was in sight. At Darwin the RAAF units had begun to take hold, and Teale was preparing to transfer the 1st Battalion of the 43d Engineers to Moresby. Since efforts by Australian civilians on the Cape York fields were beginning to produce results, the engineers there could soon move northward, turning unfinished construction over to the Main Roads Commission, which would complete its current projects in the peninsula around the middle of August. The increased support provided by the Australians enabled most of the engineers to pull out of Queensland. By early August the last of the units had left Townsville. On 6 August Company F of the 46th reached Merauke, on the southern coast of Netherlands New Guinea, to build a field to protect Moresby's western flank. Two days later Companies D and F of the 43d disembarked at Milne Bay. The withdrawal of the engineers still remaining on the continent would have to be accomplished as soon as possible.[104]

A clash between the Allies and the Japanese in New Guinea could not be long postponed. With enemy forces beyond Kokoda making their way through the precipitous Owen Stanley Range, the threat to the Allied position

[102] Glover, Hist of the 808th Engr Avn Bn, pp. 102–03.

[103] (1) Memo for Rcd, Casey, Rpt on Inspec of New Guinea and North Queensland Between 29 Jul–7 Aug. (2) Memo for Rcd, Sverdrup, 8 Aug 42. Both in SWPA File 491. (3) Memo, Casey for Rcd, 25 Jul 42. (4) Ltr, Casey to Teale, 23 Jul 42. Last two in SWPA File 481.

[104] (1) Memo for Rcd, Casey, 11 Aug 42. SWPA File 491. (2) Memo for Rcd, Casey, 23 Jul 42. (3) Rad, Matthews to Hq USASOS, 2 Aug 42. Last two in SWPA File 481. (4) Hist of 46th GS Regt, 1942. (5) Ltr, CO 2d Bn 43d Engr GS Regt to CG USASOS, 2 Nov 42. SWPA File A1.

in Papua was growing steadily. While the Japanese advance was much slower than it had been across the coastal plain, it was continuous. Meanwhile, on 7 August, American forces in the South Pacific were moving forward, and fighting had begun on Guadalcanal in the Solomons. The engineers were soon to be involved in combat on a broad front. The strides they had already made in building up defenses in the Southwest Pacific had substantially increased the Allied chances of victory in the coming test of strength.

CHAPTER V

First Offensives: The Solomons And Papua

The war in the Pacific had reached a critical juncture by the summer of 1942. A still formidable enemy threatened the line of communication between Australia and the United States. The Japanese had suffered two reverses at sea, but they remained undefeated on land and in the air. Their invasion of Papua and their advance through the Solomons, if unchecked, might yet develop into a major setback for the defenders in the South and Southwest Pacific. By launching a limited offensive, the Allies hoped to halt the Japanese and begin pushing them back on a broad front stretching across New Guinea and extending eastward for hundreds of miles. While containing the enemy, the Allies would gather strength for future large-scale assaults against the Japanese stronghold at Rabaul. The task of carrying out a stopgap offensive while continuing to prepare for an all-out drive would fall with special weight on the engineers, who would have to support the combat forces in the field and at the same time build the bases from which future sustained offensives could be launched.

Strengthening the South Pacific

The South Pacific was hardly less important in the Allied strategy than Australia itself. Through this immense ocean area ran the lines of communication from the United States to the southern continent—lines which would have to be kept open. The South Pacific could do little in its own defense. The widely scattered and more or less isolated islands of the region had, for the most part, sparse populations, primitive industries, and few natural resources. Only New Zealand had a modern industrial system, but with a population of some 1,600,000 and limited resources, that dominion was unable to make substantial contributions to the defense of the area. Having sent one division to the Near East in 1941, New Zealand had few troops left for home defense, and of these one brigade had already been dispatched to Fiji. Australia had agreed to reinforce New Caledonia, but was able to send only one company of troops to the island. In the first weeks after the outbreak of war with Japan, the strengthening of the South Pacific was not immediately urgent. That area did not appear so directly threatened as Australia was. Insofar as the United States was concerned, primary responsibility for defense of the region rested with the Navy. Only with the fall of the East Indies and the emergence of Australia as a great Allied base did the South Pacific become of vital interest to the Army.[1]

[1] (1) Oliver A. Gillespie, *The Pacific*, "Official History of New Zealand in the Second World War

The South Pacific Ferry Route

The engineers, at work on the ferry route when war began, were the first American troops in the South Pacific. At the time of Pearl Harbor, engineer officers were reporting good progress on the airfields. On Christmas and Canton, troops and civilian workmen were clearing and grading runways. On Fiji, natives were lengthening the airstrips, and New Zealand was sending in more men, materials, and equipment. On New Caledonia, the Free French were making headway on the fields at Tontouta and Plaines des Gaiacs. Just before the attack on Pearl Harbor, General Short had assured Washington that the route would be open by 15 January. Events of the following weeks rendered completion more urgent than ever. Heavy bombers were desperately needed to stem the Japanese tide in the Philippines. The Central Pacific route through Midway and Wake was lost in the first days of the war. The only alternate besides that through the South Pacific was the long, roundabout way across the Atlantic, Africa, and the Indian Ocean—two-thirds of the distance around the globe.[2]

In Hawaii Colonel Wyman ordered work on the ferry route pushed with all possible speed. In carrying out his instructions, the engineers in the South Pacific islands were confronted with mounting difficulties. The islands were almost completely isolated. Peacetime sailing schedules were disrupted, and there were few vessels to carry cargo to the South Pacific. Even the project's A–1–a priority was of little help. Wyman complained that, while he assumed the rating to be in effect, it had proven virtually useless for getting materials and equipment to places where they were needed. Shipping was not to be had for the stocks piled up in the San Francisco port. On Christmas and Canton even supplies of food and water ran low. Poor communications complicated matters.[3] "[The] greatest obstacle . . . toward the proper direction of the jobs down here," one of the civilian employees on the ferry route wrote Wyman from New Caledonia, "is the lack of communication whereby detailed information can be transmitted between jobs. Cables and radios are fine, but you cannot say enough, and we always have a certain amount of garbling which sometimes is not recognized as such."[4] General Short's efforts to get a Navy or Pan American plane to fly couriers back and forth among the Pacific islands were unavailing, as were those of his successor, Lt. Gen. Delos C. Emmons, who assumed command of the Hawaiian Department on 17 December. The situation was alleviated to some extent when Wyman

1939–45" (Wellington, New Zealand, 1952), p. 26. (2) Matloff and Snell, *Strategic Planning for Coalition Warfare, 1941–42*, pp. 115, 154–55. (3) Craven and Cate, eds., *Plans and Early Operations*, pp. 428–30.

[2] (1) Incl to Ltr, Dist Engr Honolulu to CofEngrs, 14 Dec 41. 686 (Trans Pac) Serials 1–470, 1942. (2) Rpt by Sverdrup, 9 Dec 41. 319.1 (New Caledonia, Rpts), Engr AGF PAC. (3) Craven and Cate, eds, *Plans and Early Operations*, pp. 192–93, 228–29, 331–32. (4) Rad, Emmons to TAG, 27 Dec 41. WPD, Msg File 4.

[3] (1) Rad, SPD to CofEngrs, 7 Jan 42. 686 (Trans Pac), 1942. (2) Rad, SPD to CofEngrs, 13 Jan 42. 686 (Trans Pac), Serials 1–470, 1942.

[4] Ltr, Wolfe to Wyman, 18 Jan 42. 686 Airflds, Australia, Engr AGF PAC.

obtained a yacht and put it into service early in January.

The enemy's swift advance toward the South Pacific greatly increased the tension under which work had to be carried on. The islands were practically defenseless. Initially the small detachments of engineers on Canton and Christmas had been equipped only with carbines, rifles, and a few machine guns. Late in November, Short had sent to Christmas two 75-mm. guns with 800 rounds of ammunition and a sergeant to train men from the 804th Aviation Battalion as artillerymen. Neither the New Zealanders on Fiji nor the Australians on New Caledonia had any illusions about their ability to hold the islands against determined assaults. On Fiji, the New Zealand troops were expending great efforts fortifying the capital city of Suva, meanwhile leaving the airfields on the opposite side of the island extremely vulnerable to attack. So weak were the forces on New Caledonia that preparation even of minimal defenses was out of the question.[5]

There was near panic on Christmas. When news of the attack on Pearl Harbor reached the island, fantastic rumors began to spread. Three days after the outbreak of war, reports were circulating that a Japanese submarine was based on the shores of the lagoon. The general consternation heightened when an engineer officer was quoted as having told workmen that they would all end up before a Japanese firing squad. Many of the civilians began clamoring for passage to Honolulu. On 19 December Major Shield, the engineer officer in charge, put Christmas Island under martial law, declaring that no one would be permitted to leave. He ordered the men to work seven days a week, with no time off. In an effort to keep work moving, he endeavored personally to run the Hawaiian Constructors' organization, which had been hastily pulled together and was not functioning well. Displaying what appeared to be little respect for the company's foremen, he countermanded their orders so frequently that the men did not know whose instructions to follow. In the words of one of the supervisors, "orders were given indiscriminately to anyone and everyone." The Hawaiian Constructors became less a contracting organization than a gang of hired laborers. When the War Department imposed radio silence on the island and deliveries of mail were delayed, discontent increased. The men promptly blamed Shield for their inability to get in touch with their families. The military as well as the civilians were becoming more and more difficult to deal with. A lieutenant from Wyman's office, inspecting the island in mid-December, noted a "complete lack of cooperation" between Shield and the officers and men of the 804th. Work proceeded, but at a very slow pace.[6]

A calmer atmosphere prevailed on Canton and Fiji, although these islands were more directly in the enemy's path. Convinced that Canton could not be suc-

[5] (1) Ltr, Short to TAG, 22 Nov 41. 686 (Ferry Route), Engr AGF PAC. (2) Gillespie, *The Pacific*, pp. 29–30, and 38–40. (3) Matloff and Snell, *Strategic Planning for Coalition Warfare, 1941–42*, pp. 115–16.

[6] (1) Affidavits of Paul D. Degley *et al.*, 9 Feb 42, with Ltr, Investigating Of to Opns Of Dist Engr Honolulu, 10 Feb 42. (2) Rad, Shield to Wyman, 22 Dec 41. (3) Ltr, Lt. E. B. Roland, Opns Div Honolulu Dist Of to Wyman, 17 Dec 41. All in 319.1 Christmas Island (Rpts), Engr AGF PAC.

cessfully defended, General Short ordered the civilians evacuated. On 14 December the ship to take them off the island arrived, bringing with it ten artillerymen, two 75's, and a dozen machine guns. After the civilians departed, the engineer troops, under Captain Baker's direction, continued work on the airfield, and not without success, since they had plenty of equipment for what they were trying to do. On Fiji, natives, helped by increasing numbers of skilled workmen from New Zealand, continued improving and enlarging Nandi Field. Urged by Short to strengthen the garrison and to step up construction of the airfield, New Zealand replied on 20 December that additional reinforcements were being rushed to the Crown Colony. Within a short time thereafter, the Dominion had 3 infantry battalions on Fiji and had increased the number of skilled workmen to 1,200.[7]

New Caledonia, the most westerly island of the route in the South Pacific, was almost completely cut off from Wyman's office. On 7 December the engineers were represented on the island by Lieutenant Sauer. He was shortly joined by Captain MacCasland, who henceforth served as area engineer. As the only American officers in the French colony, their responsibilities were heavy. When Pan American Airways evacuated its employees soon after hostilities began, MacCasland and Sauer took over the company's property and kept the important seaplane base in operation. When an outbreak of bubonic plague on New Caledonia prevented the firm of Sverdrup and Parcel from sending in civilian engineers and draftsmen from the States, the officers in New Caledonia undertook to do the work of the architect-engineers. When Rear Adm. Thierry d'Argenlieu, the new Free French High Commissioner for the Pacific, announced that he would negotiate only with representatives of the U.S. Army with regard to the airfield program, the engineers had to take a turn at diplomacy. The French were most co-operative. They diverted the bulk of their scant stock of dilapidated equipment to airfield work and hired every man who could be recruited in New Caledonia and nearby islands, even going as far afield as Australia to get skilled labor. The New Caledonia Bureau of Public Works assumed the complicated task of administering a motley force of some 400 men at work on the airfields—Frenchmen, Australians, Javanese, Tonkinese, Indochinese, and Kanakas. Efforts centered on Tontouta. Though the engineers knew this field was poorly located and part of it would probably be under water during the rainy season, construction there was considerably further along than at Plaines des Gaiacs. The outbreak of war rendered imperative the completion of an emergency runway that could serve until Plaines des Gaiacs was ready. Urged on by MacCasland and Sauer, the French set themselves the task of finishing Tontouta before the deadline of 15 January.[8]

On 28 December Wyman announced

[7] (1) AAF Hist Of, AAF Hist Studies, 45, Development of the South Pacific Air Route, 1946, p. 64. Maxwell AFB. (2) Honolulu Dist Of, Rpt for Week Ending Dec 27, 1941. (3) Ltr, Area Engr 8th Field Area to Dist Engr Honolulu, 17 Mar 42. Last two in 319.1 Canton Island, Engr AGF PAC. (4) Rad, Emmons to TAG, 27 Dec 41. WPD, Msg File 4. (5) Gillespie, *The Pacific*, pp. 40–42.

[8] (1) Ltr, with Incls, Sauer to Honolulu Dist Engr, 15 Feb 43. (2) Rpt by Sverdrup, 9 Dec 41. Both in 319.1 New Caledonia, Rpts, Engr AGF PAC.

that the South Pacific ferry route was open. Canton, Tontouta, and Nandi were far enough along to take heavy bombers. Runways were 5,000 feet in length at the first two fields, 4,200 at the third. On 12 January the first flight of B–17's completed its trip over the route, landing at Canton, Nandi, Tontouta, and Townsville. The pilots pronounced the runways excellent. The strip at Christmas, which lagged behind the rest, was reported ready on 20 January, and the next day a flight of B–17's landed there. From this time on, increasing numbers of planes flew over the route. The work of providing adequate gasoline storage and other facilities still remained to be done. There remained, too, the problem of defense.[9]

Arrival of Task Forces

By late December top-ranking Allied strategists were considering means of reinforcing the South Pacific. The danger here had become apparent a few weeks after Pearl Harbor, when the Japanese occupied the Gilbert Islands. At the ARCADIA Conference, the Americans voiced fears that Australia might be isolated, while the British expressed apprehension over the growing threat to New Zealand as well. The Americans promised to strengthen Canton and Christmas and to aid New Caledonia and Fiji if it appeared that Australia and New Zealand could not adequately protect those islands. Steps were soon under way to send 2,000 men to Christmas, 1,500 to Canton, and a pursuit group (700 men) to Fiji. New Caledonia also stood in need of reinforcements, but Australia could spare nothing more for the island. Reports had reached Washington that Admiral D'Argenlieu was threatening to stop work on Plaines des Gaiacs unless more troops and weapons were forthcoming. The War Department assembled a task force of some 16,000 men under Brig. Gen. Alexander M. Patch for shipment to New Caledonia late in January.[10]

Reinforcements reached Christmas and Canton in February. On the 10th, a task force under Col. Paul W. Rutledge landed at Christmas, and three days later another under Col. Herbert D. Gibson arrived at Canton. Soon after going ashore, Colonel Rutledge inspected the air base and was shocked by what he found. There was bickering among the engineer officers and "much friction" between Shield and the workmen. So complete was the demoralization of the civilians that, in Rutledge's opinion, they could not be expected to accomplish anything worthwhile. One runway was completed and another half-finished, but there was "no evidence of any other satisfactory work." Indications of inept planning and weak administration were numerous. Building materials were strewn around and equipment was rusting. Sanitary conditions were intolerable; garbage and filth littered the

[9] (1) Rad, Emmons to TAG, 28 Dec 41. WPD, Msg File 4. (2) Rad, Wyman to CofEngrs, 28 Dec 41. Same file. (3) Rad, Div Engr SPD to CofEngrs, 17 Jan 42. 686 (Trans Pac) Serial 1–470. (4) Rads, 22, 24 Jan 42, Div Engr SPD to CofEngrs. 686 (Trans Pac) 1942.

[10] (1) Matloff and Snell, *Strategic Planning for Coalition Warfare, 1941–42*, pp. 114ff. (2) Memo, WPD to Marshall, 4 Jan 42. (3) Memo, WPD to GHQ G–3, G–4, and CofAAF, 10 Jan 42. Both in WPD 4571–38, Additional Basic Rqmts, BOBCAT.

camp area and formed breeding grounds for swarms of flies. Rutledge asked Emmons to relieve Shield immediately. The situation on Canton, while not so bad as on Christmas, left room for considerable improvement. Colonel Gibson found that much construction remained to be done, that morale was low, and that living conditions were deplorable.

Steps were shortly taken to set matters right on the islands. The disgruntled civilians on Christmas were returned to Honolulu. Shield and Baker were replaced. Both officers had had difficult assignments, starting out as they had with pioneer expeditions to build on remote and undefended islands.[11] Colonel Wyman supported both officers, stating that he found little fault with their performance. They had, he maintained, "accomplished their missions . . . with remarkable speed" and in accordance with directions.[12] Nevertheless, conditions improved noticeably after the construction forces on the islands were placed under the task force commanders.[13]

Meanwhile, on New Caledonia, Sauer, who succeeded MacCasland as area engineer in January, was making strenuous efforts to get Plaines des Gaiacs finished. Upon completion of the emergency strip at Tontouta, he transferred every available man and piece of equipment to the new project. He received an unlooked for addition to his slender labor force when the 125 civilians taken off Canton unexpectedly appeared at Nouméa on 10 January and 100 remained. These men built a camp at Plaines des Gaiacs, while the French, who insisted on retaining direct supervision of their workers, concentrated on the runways. Initial specifications had called for strips of asphaltic concrete, but since there was now small chance of importing this material into New Caledonia, a substitute had to be found. About four miles from the field was a bed of gravel composed of about 50 percent iron ore. The gravel proved to be satisfactory for surfacing. The French made rapid progress; one reason, undoubtedly, being their method of working. It consisted in placing the surfacing material on the ground with little if any grading and no compaction of the soil. As a result, the runways, from which roots and snags protruded, had many bumps and dips. But the iron ore made an exceptionally hard surface, and planes were able to land. On 15 February one strip was complete and two days later the first heavy bomber put down at Plaines des Gaiacs. Work on a second runway began immediately.[14]

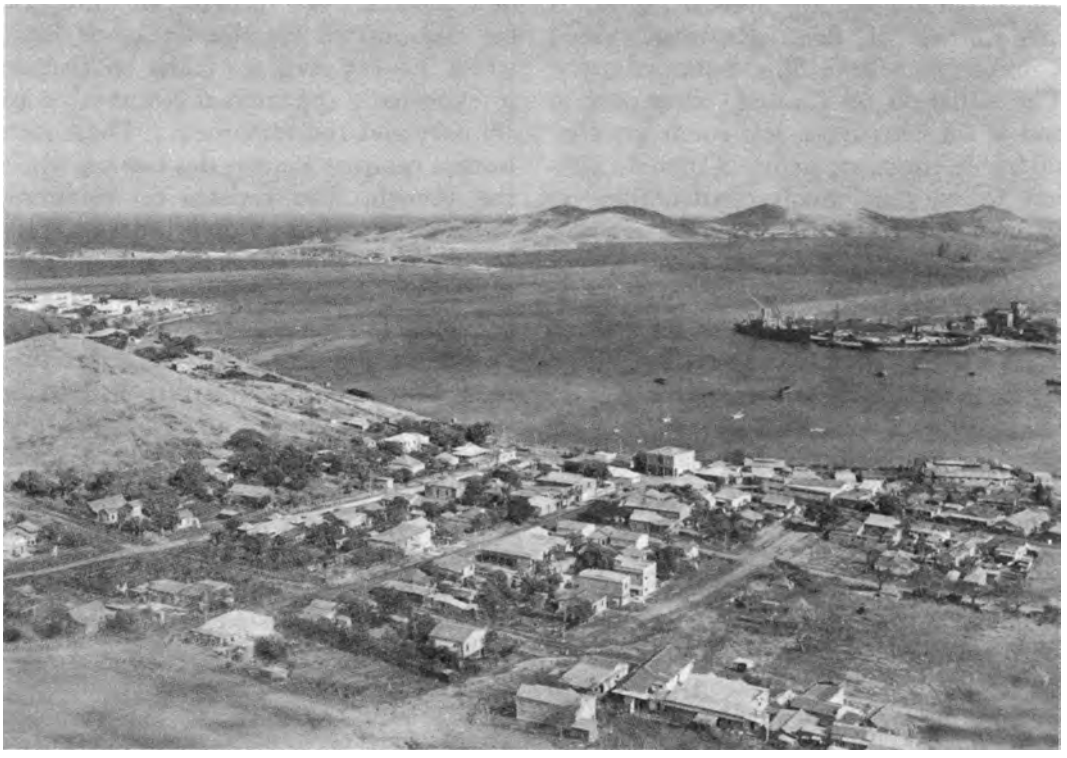
The first ships carrying General Patch's task force steamed into Nouméa harbor on 12 March. Only days before, the Japanese had established a foothold in the northern Solomons, and New Caledonia now appeared to be directly in the enemy's path. Patch's tersely worded orders read, "Hold New Caledonia

[11] (1) Ltr, Rutledge to CG HD, 21 Feb 42. 319.1 Christmas Island (Rpts). (2) Ltr, Baker to Honolulu Dist Engr, 17 Mar 42. 319.1 Canton Island, Engr AGF PAC.

[12] Memo, Wyman for CofS HD, 27 Feb 42. 319.1 Christmas Island (Rpts).

[13] Ltr, Maj Gen Robert C. Richardson, Jr., to Marshall, 22 Jun 42. OPD 333 (Gen Richardson's Trip).

[14] (1) Ltr, with Incls, Sauer to Honolulu Dist Engr, 15 Feb 43. (2) Resident Engr for Sverdrup and Parcel in New Caledonia, Inspec Rpt, 2 Feb 42. Both in 319.1 New Caledonia, Rpts.



NOUMÉA, NEW CALEDONIA

against attack." Making plans for carrying out this directive was the first order of business for the task force commander, his engineer, Col. Joseph D. Arthur, Jr., and other members of his staff. It was obvious that 16,000 men could not garrison the whole island. A mobile defense would have to be ruled out until communications were improved. Almost all of New Caledonia was mountainous. There was but one main highway, a narrow, twisting road running parallel to the western shore line. The only railroad, a line extending a short distance northward from the capital, had been abandoned in 1940. Nouméa was the one port worth mentioning. In the light of these conditions, Patch concluded that he must first of all protect Nouméa. That being the case, the Allied forces could not be stretched to Plaines des Gaiacs, 158 miles away. Patch therefore selected Tontouta as the principal airfield for defense. The work of maintaining Tontouta and completing Plaines des Gaiacs could for a time be left to Sauer. Patch's engineers must at once begin improving the island's system of communications.[15]

[15] (1) Matloff and Snell, *Strategic Planning for Coalition Warfare*, 1941–42, p. 150. (2) Memo, WPD for TAG, 22 Jan 42. WPD 3718 France (Gen). (3) MID WD, A Survey of the French Islands of the Pacific, Feb 1942. USAFISPA, Survey of the French

Three engineer units had come with the task force, the 57th Combat Battalion, commanded by Maj. George H. Lenox, and two aviation battalions, the 810th, commanded by Maj. R. P. Burt, Jr., and the 811th, under Maj. Charles H. McNutt. Except for a detachment of the 57th which remained near Nouméa to rehabilitate the railway, all engineers were put to work on roads. Most were assigned to the coastal highway, which was crumbling under heavy traffic. By early April the engineers were fully occupied in patching and widening this main artery. Though the bulk of their equipment had yet to arrive, the men built several new sections of road. One such project was a detour, eighteen miles long, around a mountain pass, at a place where a direct hit would have isolated the northern half of the island. But even with these improvements, the road was inadequate. Moving heavy construction machinery up to the airfields was no easy feat, as the engineers learned when most of their equipment finally reached New Caledonia in April. To eliminate the need for trucking all supplies from Nouméa, Colonel Arthur started construction of piers near Tontouta and Plaines des Gaiacs.[16]

Dispatching engineer troops to the airfields could not be long deferred. Under heavy use, the emergency strip at Tontouta was beginning to break up. A second runway completed by the Australians on 17 March was too short for heavy bombers to use safely. Plaines des Gaiacs was operational but needed much more work. In April, General Patch began giving special attention to the fields. He ordered one company of the 811th Battalion to Tontouta to repair the runway and build dispersals, which pilots who had been in the Philippine and Java campaigns insisted were necessary. Construction of a pursuit field at Bourake, a short distance north of Tontouta, was undertaken by another company of the 811th. Since the site had good natural drainage, sandy soil, and only scrub vegetation, the task was comparatively easy. In eight days the men were able to clear a 3,000-foot runway. The job at Plaines des Gaiacs was gaining momentum. The Australian crew, their work at Tontouta done, moved with a considerable stock of equipment to this project late in March. On 24 April the entire 810th went to Plaines des Gaiacs and began operations on a three-shift basis. On 10 May, Major Burt assumed direction of all work. When Sauer relinquished control of the project to the commander of the 810th, a second runway was usable, dispersals were almost complete, thirteen miles of access roads were in, and housing and utilities were well along. The job of the 810th was to lengthen the runways, install gasoline storage, provide lighting, and maintain a base from which heavy bombers could attack enemy forces moving south.[17]

Islands of the Pac. (4) Sauer, Narrative Rpt—Airfield Constr—12th Field Area, New Caledonia. 319.1 New Caledonia, Rpts.

[16] (1) Hist of the 57th Engr Combat Bn. (2) Hist of the 811th Engr Avn Bn. (3) Hist of the 810th Engr Avn Bn. (4) Sauer, Narrative Rpt, Airfield Constr.

[17] (1) Ltr, Sauer to Arthur, 23 Jun 42. 319.1 New Caledonia, Rpts. (2) Hist of the 811th Engrs. (3) Hist of the 810th Engrs.

The danger to the South Pacific line of communications was becoming acute. On 3 May the Japanese occupied Tulagi, an island of the southern Solomons, some 800 miles north of New Caledonia, just as their task force at Rabaul was preparing to leave for Port Moresby. Shortly after the Battle of the Coral Sea, the enemy prepared to strike again as a mighty task force assembled in home waters. The islands of the South Pacific seemed a probable objective. Among the most likely targets were the ferry bases. Although the islands had been reinforced, their defenses were still pitifully weak, and reports from the bases were uniformly pessimistic. After inspecting the three easternmost islands in April, Maj. Robert J. Fleming, Jr., of Emmon's G–4 section, confirmed the findings of earlier official visitors. Although he observed that the engineers were making good progress toward completing facilities, he considered the efforts to strengthen the islands against attack largely ineffectual. Needed were ammunition, guns, barbed wire, and, above all, troops. Even camouflage was lacking. The installations on Christmas could be clearly seen from the air, and the acres of brilliant red drums used for storing gasoline on Canton were visible for many miles. Weakly fortified and lightly held, the islands of the ferry route, except possibly New Caledonia, could have been taken with very little effort.[18]

The Alternate Ferry Route

As early as January, Wyman had anticipated the need for a second ferry route—one less in danger of being overrun. On the 25th, he had recommended to General Emmons that a series of airfields be developed in the Marquesas, Society, and Tonga Islands. Late in February, after receiving permission from Washington, Emmons ordered a survey of the proposed route. Wyman picked Sverdrup, at that time still working as a civilian on the ferry route, as the man for the job, and recalled him from Suva to Honolulu for instructions. The district engineer wished to make sure that lessons learned on the first route would be taken into account and that the peculiarities of the weather in the region would be considered.[19] Experiences on Christmas and Canton had demonstrated that American workmen were "not temperamentally suited for construction work on these islands, largely due to the foreign environment, danger of enemy action, and the confinement in a small area without . . . amusement and recreation."[20] Wyman insisted that Sverdrup select islands "with a native population engaged in agriculture or mining."[21] Because the unloading of supplies at Christmas and Canton had been complicated by reefs and shoals, he also instructed Sverdrup to find good natural harbors or lagoons.

[18] (1) Memo for Rcd, SGS, HD, 1 Mar 42. 686, I, 1942–43, Engr AGF PAC. (2) Memo, G–3 HD for CofS HD, 1 Apr 42. OPD 381 (Fiji Islands) 1944. (3) Ltr, Fleming to CG HD, 6 May 42. 686 (Ferry Route) File I.

[19] (1) Memo, Wyman for Emmons, 25 Jan 42. (2) Rad, Emmons to TAG, 27 Feb 42. (3) Ltr, Emmons to Nimitz, 24 Feb 42. All in 686, I, 1942–43.

[20] 1st Ind, 27 Feb 42 on Ltr, OCG HD to Wyman, 27 Feb 42. 686, I, 1942–43, Engr AGF PAC.

[21] *Ibid.*

The violent storms that swept the area just south of the equator would present an added problem. Since the many low atolls of the region were frequently awash in rough weather, Sverdrup was cautioned to pay particular attention to elevation. Early in March, after signing a contract with the Honolulu District, Sverdrup boarded a Navy plane for Tahiti to begin his reconnaissance.[22]

During the latter part of March, he visited some thirteen islands and found a number of good sites. One was on Penrhyn, a possession of New Zealand, 770 miles south of Christmas. Most of this atoll was awash during high seas, as only one of the many islets was more than two feet above sea level. But this one, 4 miles long and a quarter mile wide, offered ample room for a runway, and planes could be dispersed under the numerous coconut trees. All the land was native owned. It was passed down from generation to generation within the family and for a native to dispose of any was illegal. The local representative of New Zealand assured Sverdrup that he did not believe there would be any trouble in arranging for its use. He also estimated that at least 75 of the 500 natives could probably be recruited for work on the runway. Some 800 miles south of Penrhyn, Sverdrup found another promising site on Aitutaki, an island in the Middle Cook Group, also a possession of New Zealand. Of volcanic origin, Aitutaki was rugged, but there was one fairly flat area where two runways could be readily graded and compacted. With a population of 2,000, the island could provide all the common labor needed. The Government of New Zealand would undoubtedly be able to send in a few skilled equipment operators. About 1,000 miles to the southwest, Sverdrup found a third desirable site on Tongatabu in the Tonga group, a protectorate of Great Britain that he had visited before in the fall of 1941. Tongatabu had one great advantage—it already had an airfield. Sverdrup believed little effort would be required to develop three 6,000-foot runways. On 1 April he sent word to the Honolulu District that Penrhyn, Aitutaki, and Tongatabu met Wyman's specifications. Shortly thereafter Emmons informed Washington that an alternate ferry route was feasible. On 11 May authority was given to go ahead with construction.[23]

Further Strengthening of the South Pacific

While the Army had been reluctant to commit itself heavily in the South Pacific during the first months of 1942, the Navy had strongly urged a build-up of forces there. Admiral Ernest J. King, who in March became Chief of Naval Operations, wanted to garrison additional islands, especially Efate in the New Hebrides, an archipelago to the

[22] Rad, Wyman to Div Engr San Francisco, 2 Mar 42. 686, I, 1942–43.

[23] (1) Ltr, Sverdrup to Dept Engr HD, 1 Apr 42. 686, I, 1942–43. (2) Sverdrup, Rpt on North Cook Island, 1 Apr 42. Incl to Ltr, Sverdrup to Dept Engr HD, 1 Apr 42. (3) Paraphase of Rad No. 3643, Emmons to TAG, 25 Apr 42. 686, I, 1942–43. (4) Memo, OPD for WD Msg Ltr, 4 Jul 42. OPD 384 PTO sec. 1.

north of New Caledonia, and Tongatabu. General Marshall was at first hesitant to adopt King's views but finally agreed to go along with them. The Joint Chiefs in May issued two basic plans: one for the occupation and defense of Tongatabu and another for Efate. Tongatabu was to be primarily a Naval base, while Efate was first to be an "outpost for supporting both New Caledonia and Fiji and later was to serve as a minor advance air and naval base for future offensive operations." On 17 March General Patch, following instructions from Marshall, sent a battalion of infantry and a platoon of the 57th engineers to Efate. A small beginning had been made toward strengthening the New Hebrides.[24]

With the formal delimitation of the Pacific theaters on 30 March, responsibility for the South Pacific was more sharply defined. The Pacific Ocean Area was divided into three subordinate areas—the North, Central, and South Pacific. The first included all the region above 42 degrees north. The second was bounded by the 42d parallel and the equator. The third took in the area south of the equator, west of longitude 110 degrees west, and east of the Southwest Pacific Area. Except for the forces responsible for the land defense of New Zealand, which were controlled by the New Zealand Chiefs of Staff, Admiral Nimitz was commander in chief of all Allied forces in POA. His missions were similar to MacArthur's. The two commanders were to hold the lines of communications between the United States and Australia, contain the enemy in the western Pacific, and prepare for major amphibious offensives. Each was to support his neighbor's undertakings. Nimitz was to command the Central and North Pacific Areas directly but was to appoint a subordinate to command the South Pacific. In April he selected Vice Adm. Robert L. Ghormley for the post.[25]

Strenuous efforts were made to strengthen the New Hebrides. On 8 April the small force of infantry and engineers on Efate was joined by a marine defense battalion. Sauer, now a captain, going to the island later that month to line up sites for airfields, found that the engineers, the marines, and some 200 natives had already cleared 2,000 feet for a fighter strip and had begun the arduous task of providing roads. Most of the island was a jungle wilderness. The only roads to speak of were the 15-odd miles of track near the town of Vila. In order to penetrate into the interior, even on the existing trails, it was necessary to have native cutting parties out in front.[26] "[The] . . . roads," wrote one engineer who explored the island by jeep in May, "[were] . . . absolutely the worst in the world—it took us 2½ hours to go about 10 miles. . . ." [27] On 4 May, the day after the

[24] (1) Matloff and Snell, *Strategic Planning for Coalition Warfare, 1941–42*, pp. 151, 155–56, 210–12. (2) Memo, OPD for TAG, 8 Mar 42. OPD 381 Efate, New Hebrides. (3) Joint Basic Plan for the Occupation and Defense of Tongatabu. OPD 381 Tongatabu sec. 1. (4) Joint Basic Plan for the Occupation and Defense of Efate, New Hebrides. OPD 381 Efate, New Hebrides. (5) 57th Engr Combat Bn, War Diary. (6) *Building the Navy's Bases*, II, 204.

[25] Miller, *Guadalcanal*, pp. 2–3.

[26] (1) *Building the Navy's Bases*, II, 204–05. (2) Ltr, Sauer to Arthur, 1 May 42. Engr Files, U.S. Army Forces in New Caledonia, KCRC.

enemy moved into Tulagi, the Efate Task Force arrived from the States, bringing with it Company B of the 116th Engineer Combat Battalion and two companies of Seabees. The newcomers at once buckled down to extend the airstrip to 6,000 feet. With the Japanese about 700 miles to the northwest, pressure for completion of a runway for bombers was intense. By prodigious efforts, the engineers, seabees, marines, and natives completed the field on 28 May. That same day, a small party of infantry and engineers moved 200 miles northwest to Espíritu Santo, the largest island of the group, where extensive defense works would soon be needed.[28]

Efforts to bolster other islands of the South Pacific were intensified. In May the 37th Infantry Division, then being readied for shipment to New Zealand, was ordered to Fiji instead. The unit, which included the 117th Engineer Combat Battalion, reached its destination in June. Later that month steps were taken to enlarge an old French runway at Koumac, near the northern tip of New Caledonia, to enable it to take heavy bombers. The 810th engineers, assisted by Australian workmen, had the field operational by the end of the month. Construction of the alternate ferry route got under way when natives began clearing runway sites on Aitutaki and Tongatabu in June and on Penrhyn in July. The construction program on Fiji received a boost on 8 July with the landing of 687 officers and men of the 821st Aviation Battalion. Work commenced the same day on an airfield at Espíritu Santo. The men on this project were involved in a race against Japanese construction forces who had only recently begun building an airfield on the northern shore of Guadalcanal in the Solomons, within easy bombing distance of the advanced Allied bases.[29]

By June problems of administration and supply had assumed formidable proportions. A well-knit Army organization had yet to be evolved. Each base handled its own affairs. The War Department, the San Francisco Port of Embarkation, the Hawaiian Department, and USAFIA all had a part in supplying the area. Local procurement was not regulated in any way. When Ghormley took command of the South Pacific Area on 19 June, one of his first acts was to set up the Joint Purchasing Board at Wellington, New Zealand. Composed of three officers, representing the Army, the Navy, and the Marine Corps, the board was to control the procurement of all supplies except those obtained from the United States. The War Department was also taking steps to rectify the situation. On 25 June Emmons was relieved of responsibility for directing and supplying Army forces in the South Pacific, except those working on the alternate ferry route. The War Department would henceforth administer the Army forces in the South Pacific, while

[27] Ltr, Robinson to Lyman, 1 Jun 42. 686 (Ferry Route), File I.

[28] Ltr, Chamberlin to C Opns Sec WDGS, 2 Jun 42. OPD 381 Efate, New Hebrides.

[29] (1) Joint Army and Navy Plan for the Relief of New Zealand in the Fiji Islands, [13] May 42. OPD 381 Fiji Islands 1944. (2) Hist of the 117th Engr Combat Bn. (3) Hist of the 810th Engr Avn Bn. (4) Hist Review, CE U.S. Army, Covering Opns During World War II, POA, pp. 1199–1200, 1203, 1207. (5) Hist of the 821st Engr Avn Bn. (6) *Building the Navy's Bases*, II, 228.

the San Francisco Port of Embarkation and the Joint Purchasing Board would see to their supply.[30]

Preparations for the Offensive

Admiral Ghormley had no sooner set up his headquarters at Nouméa than he was plunged into preparations for the coming offensive. With the Japanese making frantic efforts to complete the airstrip on Guadalcanal, it appeared that another, perhaps final, blow would soon be directed at the South Pacific. In their directive for the offensive issued on 2 July, the Joint Chiefs of Staff took cognizance of the acute danger. They combined the plans of Nimitz and Ghormley for a campaign in the southern Solomons with those of MacArthur for an offensive against Rabaul. The joint operation was to be carried out in three phases: first, the taking of Tulagi and adjacent islands; second, the seizure of the northern Solomons, northeastern New Guinea, and western New Britain; and third, the capture of Rabaul. Ghormley was to command the first phase; MacArthur, the second and third. The target date for the invasion of Tulagi was 1 August.[31]

The imminence of the campaign in the Solomons led the War Department to establish an over-all command, United States Army Forces in the South Pacific (USAFISPA)—with Maj. Gen. Millard F. Harmon in command. As Ghormley's subordinate, he was to have direct responsibility for administering and supplying the 52,000 Army troops now in the area and, although he was to have no part in directing tactical operations, he was to make plans for employing Army units in combat. On 21 July Harmon left the United States, accompanied by members of his staff, including his engineer, Col. Frank L. Beadle. Eight days later, the party arrived in Nouméa. Six engineer units had preceded Beadle to the South Pacific—three aviation battalions, two combat battalions, and one combat company, about 3,500 men in all. There was little Beadle could do in the way of building an effective engineer organization or planning for the coming campaign, now only a few days away.[32]

On 7 August the marines landed on the northern coast of Guadalcanal near the airfield. The landing apparently caught the enemy by surprise. The next day the field was in American hands. In the course of violent sea, land, and air battles in the ensuing weeks, the Americans not only held but expanded their positions. But the advance was slow. Guadalcanal was well suited for defensive warfare, and the Japanese poured in reinforcements. The marines, in their efforts to compress the enemy into the northwestern tip of the island, were to have months of fighting ahead of them. While Marine engineers and Navy construction battalions had initial missions on the island, Army engineers contributed by helping with the develop-

[30] Leighton and Coakley, *Global Logistics and Strategy, 1940–43*, pp. 186–92.

[31] Miller, *Guadalcanal*, pp. 17, 20–21. Although Guadalcanal was not mentioned as an objective of the first phase of the plan, it became the main objective after the Allies learned that the Japanese were building an airfield on the northern coast of the island at Lunga Point.

[32] *Ibid.*, pp. 22–24. (2) Ltr with Incls, Harmon to OPD WDGS, 6 Jun 44. 98-USF2-0.5 (3721)M, 6 Jun 44.



MAP 9

ment of bases and airfields on islands to the rear. Since the Marine Corps and Navy carried full responsibility for fighting the Japanese on Guadalcanal during the first two months of combat on that island, the story of the engineers in the first offensives in the South and Southwest Pacific is largely one of their operations in New Guinea.

Preparing To Fight in New Guinea

When the marines landed on Guadalcanal, the enemy forces in New Guinea advancing along the Kokoda Trail had reached Isurava, sixty miles from Port Moresby. (*Map 9*) Intercepts of radio messages indicated the Japanese were planning to land troops on the island of Samarai, at the mouth of Milne Bay. From this vantage point, the enemy could control the waters near the southeast tip of New Guinea and would be in a better position to strike along the island's southern coast. Early in August, MacArthur moved to meet the growing danger. In order to have a unified command in the combat area, he placed all

Allied troops in Australian New Guinea under New Guinea Force, henceforth commanded by Australian Maj. Gen. Sydney F. Rowell. Rowell was given a large assignment. He was to stop the enemy advance toward Port Moresby, recapture Kokoda and Buna, and eventually drive the Japanese from Salamaua and Lae. The 7th Australian Division was being readied in Australia for movement forward; advance elements were already on their way. MacArthur placed one limitation on Rowell's authority: While he had complete command over combat forces, he was to exercise no control over American service troops engaged in base construction unless an attack was under way or imminent.[33]

The sending of so much Allied strength to the forward areas increased enormously the task of the engineers. Though base development had come a long way, much remained to be done. Of the seven fields planned for Moresby, two all-weather airfields and two dry-weather strips were operational. They could not accommodate the great numbers of planes that would have to operate continuously against the advancing enemy. The sole deep-water dock of the city's harbor was so inadequate that only one vessel could discharge cargo at a time. Key installations, some of them many miles inland, were connected to the port by dirt roads. Milne Bay, with its single operational airstrip and its primitive piers and jetties, could not serve as an adequate base for strikes to the north.[34]

With an ever-growing construction program in prospect, a better organization of the Engineer effort in New Guinea was imperative. Visiting Port Moresby early in August, Colonel Sverdrup, now head of construction in Casey's office, concluded that "all construction work under US supervision should be reorganized from top to bottom." Believing that engineer output could be stepped up 30 percent if the work were properly organized and directed, he recommended that a "senior officer well qualified in construction and planning" be sent to the New Guinea port at once.[35] Sverdrup was not alone in this opinion. GHQ SWPA was already preparing plans to set up a more adequate supply and construction organization in New Guinea. On 11 August General Richard Marshall, the commanding general of USASOS, established U.S. Advanced Base at Port Moresby.[36] Naming Matthews base commander, Marshall made him responsible for construction and supply for American forces in the Port Moresby and Milne Bay areas. The next day Matthews arrived by plane at his new headquarters, and was hardly settled before an avalanche of demands descended on him. General Kenney was calling for two additional fields at Moresby to bring the total number there to nine; at Milne Bay he wanted not two but three strips, and by late August, he was asking for the construction of 227 revetments at Moresby alone. Meanwhile, USASOS could not

[33] (1) Milner, *Victory in Papua*, pp. 73–74. (2) GHQ SWPA OI No. 15, 6 Aug 42.

[34] (1) Ltr, Of C Engr USASOS to Casey, 9 Aug 42. SWPA File 459. (2) Milner, *Victory in Papua*, pp. 75–77.

[35] Memo, Sverdrup for Rcd, 8 Aug 42. SWPA File 94.

[36] USASOS SWPA GO No. 7, 11 Aug 42.

ignore the fact that, in view of the shortage of ships in the theater, the ports at Moresby and Milne Bay would have to be enlarged to permit faster unloading and quicker turn around. These demands were only the beginning of many additional requirements the engineers would have to meet. Taking stock of his resources—the few engineer troops and the meager stocks of supplies and equipment—and viewing the task ahead, Matthews could only conclude that the job would not be completed before 1 November and that it could be finished by then only with "weather permitting and God helping." [37]

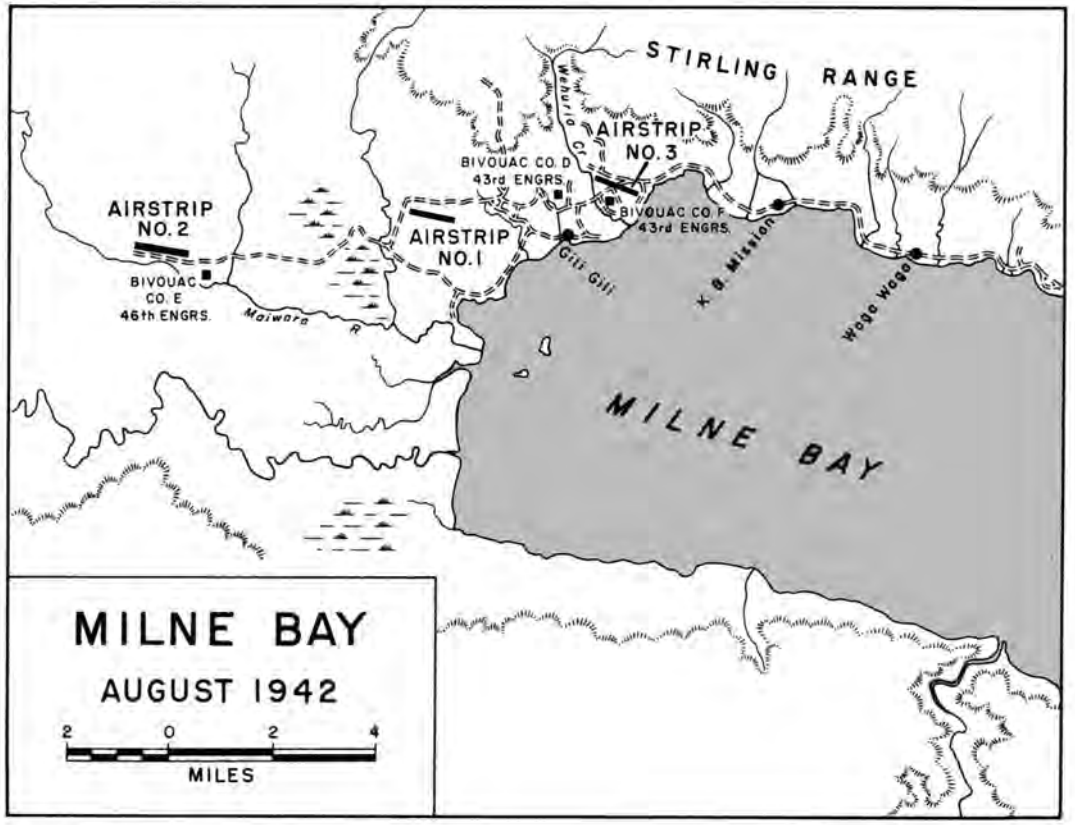
Battle of Milne Bay

While preparations for the offensive were going ahead in Papua, the enemy struck again. Having learned in mid-August of the airfields at the head of Milne Bay, the Japanese decided to land there rather than on Samarai. On the morning of 25 August reports reached the forces at the bay that nine enemy ships were approaching. Three engineer companies—D and F of the 43d and E of the 46th—were in the threatened area, battling mud and almost incessant rains to complete the airstrips. (*Map 10*) All of Company F and part of D were working on Strip No. 3, recently begun at the northwest tip of the bay. They had just finished clearing a site 6,000 feet long and 300 feet wide. Three miles to the west, detachments of Company D were working on Strip No. 1, which, despite its poor foundation, was being regularly used by planes. Company E of the 46th was preparing Strip No. 2, some four miles southwest of No. 1 and five miles from the bay. There were 9,458 Allied troops in the area—the Americans, including the engineers and an airborne antiaircraft battery, numbered 1,365; Australian strength totaled 8,093. On 22 August, Australian Maj. Gen. Cyril A. Clowes had assumed command of all forces at Milne Bay. The engineers and antiaircraft gunners of Clowes' command were to be the first American ground troops to meet the Japanese in combat in New Guinea.[38]

On learning of the enemy's approach, General Clowes began at once to deploy his forces. The Australian infantrymen were readied, and the RAAF pilots at Strip No. 1 were briefed for a strike at the enemy convoy. The engineers were likewise ordered to prepare for combat. On the 22d Company D was taken off the airfields and directed to fortify its bivouac area. Later that day, Company F stopped work on Strip No. 3, and the men were issued rifles and 128 rounds of ammunition each. Farther west, at Strip No. 2, Company E of the 46th was in no immediate danger. General Clowes assigned that unit to the rear sector, about

[37] (1) Memo, Casey for Kenney, 26 Aug 42. 686 New Guinea No. 1, G–3 Files, GHQ SWPA. (2) Memo, Casey for Rcd, 11 Aug 42. (3) Rad, Kenney to Matthews, 23 Aug 42. Last two in SWPA File 491. (4) Rad, Matthews to GHQ SWPA, 7 Sep 42. 686 New Guinea, No. 1, G–3 Files, GHQ SWPA.

[38] The account of the battle of Milne Bay is based on the following sources: (1) Clowes, Rpt by Cmdr Milne Force on Opns Between 25 Aug 42 and 7 Sep 42. SWPA File B188. (2) Rpt, ALF in SWPA, 18 Oct 42. Both in SWPA File B188. (3) Ltr, CO 2d Bn 43d Engr GS Regt to CG USASOS, 2 Nov 42. (4) Ltr, Adj 2d Bn 43d Engr GS Regt to Casey, 18 Sep 42. Last two in SWPA File A1. (5) 46th Engr GS Regt, Hist for 1942. (6) Milner, *Victory in Papua*, pp. 76–88.



MAP 10

four miles square, where it was to construct fortifications and patrol jungle trails. One platoon was to defend the airstrip, about 75 percent cleared, and smash any paratroop landing the enemy might attempt to make. Protected against air attack by overcast skies, 1,171 Japanese landed that night on the northern shore near Waga Waga, about 6 miles east of Strip No. 3, and began advancing westward along the swampy, mile wide, coastal shelf. Since the jungle track skirting the northern shore crossed the center of the runway site, the enemy was expected shortly. The airfield clearing was an ideal location for a defensive stand. It was improbable that the enemy could successfully carry out an encircling movement. Just to the north were the rugged foothills of the Stirling Range. Between the foothills and the northwestern edge of the clearing flowed Wehuria Creek, which continued on behind the airstrip in a southerly direction. The southeastern end of the clearing was only 500 feet from an inlet of Milne Bay. At 0200 on 26 August most of the men of Company F were sent to join the Australians and the antiaircraft troops already in position

along the southwestern edge of the clearing. Most of the engineers were assigned to the center of the line. Company D, meanwhile, continued digging trenches and foxholes around its bivouac area to the rear and prepared its 37-mm. gun and half-track for action.

The first night was a quiet one for the defenders along the airstrip. No attack materialized. The next day Japanese warships shelled Strip No. 3 and planes raided Strip No. 1. There was no serious damage to either field, but many engineers had narrow escapes. Slowed by soggy terrain and the Australians, enemy ground troops doggedly continued their advance westward. On the 26th some 1,200 more Japanese were landed, and on the night of the 27th the enemy approached the clearing. By early morning they stood at the northern edge, directly opposite the positions occupied by Company F. After exchanging fire with the defenders for about half an hour, the Japanese withdrew. During the daylight hours of the 28th there was no further activity, except for occasional enemy rifle fire on the clearing. Since Allied air superiority had forced the Japanese to restrict themselves to night attacks, the defenders, aware that additional troops had landed, looked for a more determined assault that night. They were not mistaken. Under cover of darkness, the enemy made what appeared to be several haphazard attempts to cross the strip. All ended in failure. Two or three riflemen got through the defenders' line and penetrated into Company F's bivouac area but did not inflict any damage.

Ashore for three days, the Japanese had still made no determined effort to seize the airstrip. On the 29th more reinforcements landed, raising the number of enemy troops to some 3,100 men. Convinced an attack was not far off, the defenders again strengthened their line on the 29th and 30th. Three officers and 132 men of Company F, flanked on both sides by Australian infantry, were already fully committed to the defense of the clearing. The remaining 27 men of the company had moved miles to the rear with the company's heavy construction equipment and supplies. Members of Company D who could be spared from their work on Strip No. 1 and on the roads leading from the wharf to the airfields were sent to help man the defenses along the clearing. The company's half-track and 37-mm. gun were moved up to the line alongside those of Company F.

At 0330 on 31 August the attack came. The Japanese laid down heavy rifle and machine gun fire as 300 men prepared to storm across the clearing. Strong counterfire disrupted the enemy's plans, a hail of bullets stopping the advance before it got started. The Japanese failed even to set foot on the clearing. Nor did they break through along the beach or at Wehuria Creek. At dawn they withdrew, pursued by the Australians. The attack had failed completely. Later that day the engineers counted 160 bodies, most of them in the wooded area opposite the position held by Company F. As the surviving Japanese made their way back to Waga Waga, the engineers bulldozed shallow graves for the enemy dead. Although the enemy had been repulsed, General Clowes did not believe the danger of surprise attack had passed. During the first week in September, Companies D

and F exchanged defensive positions daily. Air attacks continued, and on the 8th, Japanese planes bombed Company F's bivouac area, killing 4 men and wounding 7. But ground fighting was over. By the second week of September Japanese warships had evacuated most of the enemy troops. The battle of Milne Bay, which was soon to assume legendary aspects for the engineers of the Southwest Pacific, had ended in a complete victory for the Allies.

Allied Preparations Continue

The beaten invaders withdrew from Milne Bay, but the enemy force on the Kokoda Trail continued to advance through the Owen Stanley Range. Outnumbered and poorly supplied, General Rowell's Australians fell back from one ridge to another. In early September Australian reinforcements were rushed to the front to contain the Japanese advance. MacArthur and Rowell believed the Japanese, overextended as they were, could now be contained. In order to put additional pressure on the enemy, MacArthur planned to execute a flanking movement by sending an American regimental combat team (RCT) from the 32d Division on foot over the mountains to attack the enemy from the rear. Of the trails that led north through the Owen Stanleys, two seemed most practicable. One, starting from Kapa Kapa, a few miles southeast of Port Moresby, wound through the mountains to Jaure on the eastern slopes. But it presented difficult obstacles since it crossed innumerable hogbacks and at the divide reached an elevation of 9,000 feet. The second track, leading northward from Abau to Jaure, crossed what was believed to be gentler terrain; its highest elevation was about 5,000 feet. On 15 September, a reconnaissance party organized by MacArthur's G–4, Brig. Gen. Lester J. Whitlock, began to explore the Kapa Kapa Trail. The day before, a company of the 91st Engineers had begun improving the dirt track from Moresby to Kapa Kapa. On the 16th, Casey and Sverdrup, who were in Moresby at the time, took charge of investigating the Abau Trail. The march through the mountains would have to wait until the reconnaissance reports were in.[39]

Casey and Sverdrup reached Abau on the morning of 18 September. They wanted the answers to two questions: could the harbor be made to serve as a base of supply for a regimental combat team and would it be possible to send jeeps and mule trains up over the trail?[40] Casey took on the job of exploring the harbor. For "hours that stretched into days" the chief engineer lay off shore in a native canoe sounding the depths of the waters.[41] Meanwhile, Sverdrup had started out for Jaure with a party of one American, 2 Australians, 10 native policemen, and 26 carriers. The first day's march was easy and the party covered 13 miles. But the following morning when they reached the foothills

[39] (1) Milner, *Victory in Papua*, pp. 88–91. (2) Memo, Hq Adv Ech Fifth AF for Whitlock, 17 Sep 42. 384 New Guinea 2, G–3 Files, GHQ SWPA. (3) Spec Abau Reconnaissance Party, MAPLE, Order No. 1, 16 Sep 42. SWPA File 631. (4) CO 91st Engr GS Regt, Constr Progress Rpt for Period Ending 30 Sep 42. SWPA File 627.

[40] (1) Memo, Casey for Sutherland, 5 Oct 42. (2) Spec Abau Reconnaissance Party MAPLE, Order No. 1, 16 Sep 42. Both in SWPA File 631.

[41] Ltr, Sverdrup to C Staff Br, 13 Jun 50. SWPA Files.

of the Owen Stanleys, the going got rougher. "Some of the hills we climbed are over 45 degrees—would like to see a mule climb that," Sverdrup wrote in a letter he sent back to Casey by native bearer. At noon of the fourth day, he noted in his log, "elevation 3,380 and still going up." After scaling heights of almost 5,000 feet and toiling up precipitious grades of 80 percent, Sverdrup and the members of his party began to suspect that they were "on a wild goose chase," and would never be able to "build a motor transport road in here and probably not a mule track either." By the time the group reached Jaure on 25 September, after eight days on the trail, Sverdrup doubted whether it would be possible even to march troops over the route. On the 27th the party began its trek back to Abau, arriving there on 3 October. By this time, Casey, having concluded that the harbor was too shallow even for lightering, much less for use by cargo vessels, had returned to Moresby.[42]

The day Casey and Sverdrup went to Abau the Japanese had reached the native village of Ioribaiwa on the southwestern slopes of the mountains overlooking Moresby and the coastal plain. The Allied position was less precarious than it seemed. The enemy column had overreached itself, and Kenney's airmen had been knocking out the enemy's supply line along the Kokoda Trail most effectively. Nor was the war going well for the Japanese elsewhere. The setback at Milne Bay and serious reverses on Guadalcanal induced *Imperial General Headquarters* to change its strategy temporarily. It planned to withdraw the troops on the Kokoda Trail and concentrate them for the time being on the coastal flats at Buna. Operations in New Guinea were to be held to a minimum until Guadalcanal was secured. In Allied eyes, however, the Japanese were still a powerful adversary. On 23 September, General Blamey assumed direct command of New Guinea Force and two days later launched the Allied counterdrive. Soon the Japanese were in full retreat along the Kokoda Trail.[43]

As the enemy withdrew, MacArthur adopted a more aggressive plan of action. He envisioned a three-pronged advance on Buna. The Australians were to pursue the Japanese along the Kokoda Trail. One American force was to cross the Owen Stanleys on either the Kapa Kapa or the Abau Trail. A second was to move in small boats from Milne Bay up the northeastern coast. When all these forces were sufficiently close to Buna, MacArthur would order a concerted attack. The success of such tactics hinged largely on getting the troops across the mountains. Casey's report on the Abau Trail, which he gave to Sutherland on 5 October, indicated a tremendous effort would have to be made to convert the track into a practicable route. The Kapa Kapa Trail appeared to be the more feasible way. By late September, a regimental combat team had been readied for the march. On 6 October, one company of infantry with a platoon of twenty-three engineers set out across the mountains as the ad-

[42] (1) Ltrs, Sverdrup to Casey, 19, 20, 22 Sep 42. SWPA File 631. (2) Memo for Rcd, Sverdrup, 11 Oct 42. SWPA File 629. (3) Memo, Casey for Sutherland, 3 Oct 42. SWPA File 630.

[43] Milner, *Victory in Papua*, pp. 95–100.

vance detachment. On their backs the engineers carried axes, saws, machetes, and shovels to clear the trail for the troops who would follow. The expedition would be supplied by airdrop. None doubted the march would be difficult, but there seemed to be no other way of getting the men to Buna.[44]

While on the Abau Trail, Sverdrup had chanced upon a plateau in the northern foothills of the Owen Stanleys which appeared to offer a good site for an airstrip. On returning to Abau he discussed the possibility of building landing fields beyond the mountains and flying the troops across. The practicality of such a scheme was confirmed by Cecil Abel, a missionary who owned a plantation near Abau and knew well the territory north of the divide. The possibility of flying troops and supplies across Papua had been considered before. As far back as July, air and engineer officers had suggested that a field at Wanigela Mission, sixty-five miles southeast of Buna, on the eastern Papuan coast be developed to make possible ferrying troops and supplies from Moresby. At various times during August and September, Kenney had urged that troops be flown to Wanigela and then be moved up the coast to Buna. MacArthur had held back, waiting to see if the Australians could stop the Japanese on the Kokoda Trail. When the enemy began retreating toward Buna, he accepted the plan. On 6 October, Australians were flown from Milne Bay to Wanigela. Under their direction, natives began cutting the grass and readying the landing strip. But Wanigela was many miles from Buna and surrounded by almost impenetrable swamp and jungle. Sverdrup, as a result of his reconnaissances north of the Owen Stanleys, believed that fields could be constructed rapidly in terrain from which Buna would be easier to get to. Early in October, Mr. Abel, who was flown to Port Moresby to talk to Allied commanders, assured them that a landing field could be readily developed near Fasari in the upper valley of the Musa River. From there the troops could make their way on foot along trails over relatively flat, though heavily jungled, terrain. The idea was enthusiastically received all around and MacArthur approved the project. Sverdrup was to round up natives, hand tools, and supplies and march north from Abau to carry out this mission. On 11 October, Abel was flown to Wanigela, where he recruited over a score of natives and set out with them for Fasari. Sverdrup, after laying in a store of tobacco, calico, boy scout knives, garden seeds, and other trade goods, left Abau on 14 October with 185 natives and 5 white men, among them Flight Lt. Michael J. Leahy, who had spent most of his life in New Guinea and knew personally many of the tribal chieftains.[45]

[44] (1) *Ibid.* pp. 100–103, 111. (2) Memo, Casey for Sutherland, 5 Oct 42. SWPA File 631. (3) 114th Engr Combat Bn, Engr Opns in Papuan Campaign. SWPA File A82.

[45] (1) Memo for Rcd, Sverdrup, 11 Oct 42. SWPA File 629. (2) Ltr, Harding to Sutherland, 12–14 Oct 42. GHQ SWPA G–3 Jnl, 16–21 Oct 42. (3) Check Sheet, G–3 GHQ SWPA to CofS GHQ SWPA, 17 Jul 42. 686 Airdromes, Jun 42 to 1 Dec 43. G–3 Files, GHQ SWPA. (4) Kenney, *General Kenney Reports: A Personal History of the Pacific War* (New York: Duell, Sloan and Pearce, 1949), pp. 41–42, 50, 70, 75–76, 102. (5) Milner, *Victory in Papua*, pp. 102–03, 106, 115–16. (6) Incl with 1st Ind, Hq USASOS to MacArthur, 14 Oct 42, on Ltr, Casey to

Reaching Fasari on the afternoon of 18 October, Sverdrup found that Mr. Abel "had made a fine start on the strip." The site had been burned over and all that remained to be done was to remove some stumps and widen and smooth the clearing. The next morning Sverdrup's natives joined Abel's in finishing up the work. Later that day a DC–3 put down at the field, henceforth known as Abel's Landing. On the 20th Sverdrup and Leahy headed north over jungle trails, leaving an Australian officer and the Papuans to put in refinements at Fasari. Near the native villages of Embessa and Kinjaki Barige, they located two fairly level sites, overgrown with kunai grass some eight to twelve feet high. Lured by the prospect of getting trade goods, entire villages turned out to help with the cutting. Soon the work force numbered in the thousands. By pitting villages "against one another as teams," Sverdrup got the natives to put forth a tremendous effort. At Embessa, "the Musa boys won hands down and got an extra one-half stick of tobacco each as a reward and damn near killed themselves earning it," he wrote. As the natives were rapidly exhausting the expedition's stores, Sverdrup appealed frantically to Moresby for additional supplies. The first airdrop, made on 24 October at Kinjaki, disrupted the work there for some time. "At 9:45," Sverdrup noted in his log, "a B–25 came . . . roaring down . . . with bomb doors open, and then it rained rice and corned beef. . . . When we started to pick up [the] stuff, we found forty percent of [the] corned beef tins smashed and opened. No holding [the] boys after that. Had to go to camp and eat themselves out of shape." The plane having dropped a note instructing him to go to Pongani, Sverdrup on 25 October hiked to that coastal village. Fifty men of Company C of the 114th Combat Battalion were already there, having been part of a group flown from Moresby to Wanigela in mid-October and moved up the coast by boat. Since the troops seemed to be making little progress, Sverdrup went back to Kinjaki to bring up several hundred natives, and returned to Pongani with them on 28 October. Working twelve hours a day in oppressive heat, the natives and engineers completed the Pongani airstrip in two and one half days. By the end of October planes could land there, at Kinjaki, and at Abel's Landing. Sverdrup was proud of his "Papuan Aviation Battalion," defying anyone to beat its performance at Pongani. "One thing has been definitely proven," he wrote. "If strips are to be built by hand in this country, native labor competently led is the only answer." [46]

Meanwhile, the engineers at Port Moresby and Milne Bay were struggling against almost insurmountable odds. Colonel Matthews was hard put to find the wherewithal to push construction at these advance bases. His staff was too small. His engineer, Yoder, was borrowed from the 96th Engineers. He had almost no personnel to help him organize and direct the work, and the troops at his disposal were too few to carry the load. He had the 808th, the

AG GHQ SWPA, 11 Oct 42. 384 New Guinea 2, G–3 Files, GHQ SWPA.

[46] Memo for Rcd, Sverdrup, sub: Diary from 13 Oct to 31 Oct 42. SWPA File 631.

96th, one battalion of the 91st, and Company E of the 43d at Moresby and two companies of the 43d and one of the 46th at Milne Bay—a total of some 3,200 men.[47] But more annoying than the shortage of troops and personnel was the absence of even a general statement of what he was to build. "No one at GHQ, at Hq, Fifth Air Force, or at Hq, USASOS, ever revealed, to me at least," Matthews later wrote, "the probable plan and garrison to be supported."[48] The Australian commanders, asserting the authority granted them of exercising operational control when an enemy attack threatened, took the engineers off important construction projects. When the Japanese were approaching Moresby, General Rowell had ordered the 808th to stop work on airfields and sent them into combat reserve along the Goldie River northeast of Moresby. There they remained until the arrival of the 114th in mid-September. After the Japanese withdrew from Milne Bay, General Clowes refused to let the engineers resume work on Strips No. 2 and No. 3, despite the fact that Matthews had ordered this work expedited. Casey, inspecting Milne on 15 September, discovered that Clowes had overruled Matthews' instructions and had diverted the engineers to repairing strip No. 1, building a dock, and standing guard. It took a direct order from MacArthur to Blamey to get the men back on airfield construction. Marshall, the commanding general of USASOS, meanwhile tried unsuccessfully to get the 116th Combat Battalion to stop training in Queensland and go to Moresby, where under USASOS direction it would help improve port facilities. At the same time, the Allied Air Forces opposed taking engineers off airfields to improve ports and to build such things as the road to Kapa Kapa.[49]

MacArthur, visiting Moresby in late September, quickly concluded that centralized co-ordination of all service activities in New Guinea was urgently needed. On 5 October he established the Combined Operational Service Command (COSC) for New Guinea under the direction of New Guinea Force. This was to be a joint Australian-American logistical organization; its function was to co-ordinate all service activities in the forward areas. General Johns, now Chief of Staff, USASOS, was designated commander both of Advance Base and of COSC. Each of the sections in Headquarters, COSC, had two chiefs, one an American and the other an Australian. Matthews was henceforth Engineer, Advance Base, and together with an Australian lieutenant colonel, head of COSC's Engineer Construction Section. Operating under priorities laid down by Blamey, Johns was to be responsible for all engineer work in the advance bases. He was to prepare a co-ordinated plan for building airdromes, roads, ports, and other installations. Under him were all Australian and American engi-

[47] Incl, 19 Sep 42, with Ltr, Heiberg to Casey, 23 Sep 42. SWPA File 26.

[48] Matthews Ltr, 10 Nov 49, p. 45. Fifth Air Force was established on 3 September 1942 as the subordinate U.S. command of Allied Air Forces.

[49] (1) Kenney, *General Kenney Reports*, p. 41. (2) Rad [Matthews] to Hq USASOS, 18 Sep 42. (3) Ltr, MacArthur to Blamey, 16 Sep 42. Both in SWPA File 491. (4) Memo, Marshall for MacArthur, 30 Sep 42. SWPA File 27. (5) Ltr, CG Adv Ech Fifth AF to CG Fifth AF, 30 Sep 42. SWPA File 494.

neer units in the service areas. He was to allot them to the various projects in such a way as to carry out most expeditiously Blamey's wishes. This was an attempt, insofar as construction was concerned, Johns wrote later, "to provide the maximum utilization of the meager means available. . . ." But bringing about an integration of effort would take considerable time.[50]

As Johns took over his new duties, more and more of the engineer effort was going into port development. On 11 September MacArthur had sent Casey to New Guinea to find out what could be done to increase the capacity of the ports at Moresby and Milne Bay. Casey had seen that it would not be easy to enlarge the Moresby port. Shoal water ran out to about 1,500 feet from shore. With from 11 to 18 feet of water at low tide, the harbor was too shallow for large ships and too deep for construction of a causeway. A piling approach dock seemed to be the only answer, but there was no piling at Moresby and little prospect of getting any from Australia. A deep-water dock had existed at Bootless Inlet, a few miles to the east, but the Australians had destroyed this and mined the harbor without plotting the mines. Matthews had learned that oceangoing vessels could come to within 50 to 100 feet of Tatana Island, about 4 miles northwest of Moresby. The island was separated from the mainland by half a mile of water from 6 to 12 feet deep at high tide. One of Matthews' officers had waded from the mainland to Tatana at low tide and was never in water above his chest. Matthews suggested that a causeway be constructed across this shallow water and that a floating pier be built on the island first and permanent docks later as labor and materials became available. Casey readily accepted this plan. Visiting Milne Bay, he found that docking facilities could be easily expanded. Two crib piers already in could be extended with the addition of pile piers into deeper water 250 feet from shore to provide berths for large vessels. Casey sent word back to USASOS that launches, pontons, lumber decking, and piling would have to be sent to Moresby and Milne Bay immediately.[51]

Once construction started, the engineers made rapid progress. On 6 October Matthews reported the new pier at Milne could take a ship up to 430 feet long and with a 22-foot draft. Two days later he began construction of the causeway to Tatana Island. Part of the 2d Battalion of the 96th Engineers opened borrow pits on the island and on the mainland from which to take rock and dirt. The men loaded their trucks, drove them out on the lengthening causeway, and dumped the loads into the shallows. The gap was gradually closed and the roadway packed by the traffic of the trucks. The floating pier was built concurrently on the north side of the

[50] (1) Ltr, MacArthur to Blamey *et al.*, 5 Oct 42. 385 New Guinea. G–3 Files, GHQ SWPA. (2) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II 50–52. (3) Ltr, Matthews to Staff Br, 16 Jun 50. (4) Ltr, Johns to Casey, 13 May 46. SWPA Files.

[51] (1) Rad, Sutherland to Rowell, 11 Sep 42. 826 Ports, G–3 Files, GHQ SWPA. (2) Matthews Ltr, 16 Jun 50. (3) Rpt, Matthews, 15 Nov 42. SWPA File 675. (4) Matthews, Data for Hist Rpt, pp. 36–37. (5) Rad, Matthews to GHQ SWPA, 18 Sep 42. 826 Ports, G–3 Files, GHQ SWPA. (6) Rad, Casey to USASOS, 18 Sep 42. SWPA File 491.



THE PORT MORESBY CAUSEWAY, LOOKING TOWARD TATANA ISLAND *(General Johns in the foreground, third from left).*

island. On 30 October the causeway was opened to traffic, and on 3 November, the floating pier took its first ship.[52]

Work was proceeding on airfields but far too slowly to satisfy Kenney and his generals. As the tempo of the air war quickened, their discontent with the engineers' progress grew. At Port Moresby increasing numbers of planes were being based on the dusty fields, which had neither camouflage nor adequate revetments. The airmen, among them Brig. Gen. Ennis C. Whitehead, Kenney's deputy and commander of the advance echelon of the Fifth Air Force at Port Moresby, were obsessed with the fear that the Moresby dromes might not be ready for all-weather operations when the rainy season began in late November. Their appeals for the assignment of more engineers to Air Force projects were coupled with predictions that fields would be washed out and planes grounded if the "wet" commenced before runways, taxiways, dispersals, and access roads were hard surfaced. But

[52] (1) Rad, Matthews to USASOS, 6 Oct 42. 826 Ports, G–3 Files, GHQ SWPA. (2) Rpt, Matthews, 15 Nov 42. SWPA File 675. (3) Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, 98.

concern over the progress of the fields did not deter the air force from heaping new demands on the engineers. Among the items they requested were steel huts, electric lighting, and screened mess halls with concrete floors.[53] "As long as we were the only ones doing any fighting in the American forces," Kenney later explained, "I was going to see that if any gravy was passed around, we got first crack at it." [54] One of the Fifth Air Force's frequent protests against the slowness of airfield work was made at the same time that Colonel Matthews was being asked to construct "water-borne sanitary facilities [and] install wash bowls and other china fixtures" at air force installations near Port Moresby. The engineers of Advance Base refused to sanction such departures from theater of operations plans. Unable to get what he wanted through the usual channels, Kenney began procuring materials for air force projects himself and shipping them from Australia to Moresby. Matthews, learning what was afoot, invoked the authority of General Johns as base commander to control construction supplies and confiscated the cargoes. In order to bypass such control, Kenney began flying materials directly to his units in New Guinea. Relations between air and engineer officers were rapidly deteriorating. The air force kept up an almost constant complaint that the engineers were devoting too much effort to projects which, in the eyes of the airmen, were of relatively small importance. The engineers made no secret of the fact that they believed the airmen were too demanding. When, on 8 October, General Whitehead issued a stinging indictment of Colonel Matthews, stating, in effect, that Advance Base was going back on its commitments to the Fifth Air Force, Casey felt obliged to intervene.[55]

Writing to Kenney on 14 October, Casey pointed out that the construction program at Moresby consisted of a good deal besides jobs for the Army Air Forces. "The Air Corps," he reminded Kenney, "is vitally concerned in the program as a whole, as airdromes without access roads will not be usable during the wet season nor will air operations be effective unless unloading facilities and transport facilities in the harbor area are materially improved." The engineers were putting first things first. Not having enough manpower to undertake all the projects requested of them at once, Casey explained, they had to split the program into two parts—jobs which were "absolutely essential" and jobs which were "useful but which can be postponed." In the first category were all-weather dromes, improved ports, minimum shelter and utilities, and hard surfacing for key roads; in the second were blastproof revetments, additional roads, more ample water supplies, and more comfortable quarters. Since the essential projects must be usable before the others were tackled, the Fifth Air Force would have to wait for much of the con-

[53] (1) Ltr, CG Adv Ech Fifth AF to Kenney, 30 Sep 42. SWPA File 494. (2) Ltr, CG Adv Ech Fifth AF to CO Adv Base New Guinea, 17 Sep 42. SWPA File 495.

[54] Kenney, *General Kenney Reports*, pp. 73–75, 119–20.

[55] (1) Matthews Ltr, 16 Jun 50, p. 9. (2) Rad, CG Adv Ech Fifth AF to Kenney, 8 Oct 42. SWPA File 460.

struction it wanted. But they could rest assured, Casey said, that the Moresby fields would be ready for the rains. Apparently mollified, Kenney sent to his airmen at Moresby a radio prepared for him by Casey's office. The chief engineer, the message read, was "fully cognizant of the situation" and would have the dromes "in shape to operate from" when the rains began.[56]

During October the engineers made great strides toward completing the New Guinea dromes. The "roller coaster" runway at Three-Mile was torn up, regraded, and hard surfaced. The field at Rorona was lengthened to take heavy bombers. New strips were begun at Bomana and Ward's Drome. Dispersals were provided for twenty-six planes, revetments for twelve. At Milne Bay, Strip No. 3 was graveled and covered with mat. Still, much essential work remained. The gravel runways at Laloki and Seven-Mile Drome had yet to be sealed or surfaced with mat. Most access roads had to be paved, and nearly half of the three hundred dispersals and plane pens provided so far were suitable only for use in dry weather, and many more were needed. Drainage systems left much to be desired, and taxiways, hardstands, and warm-up areas were far from adequate. Believing that the engineers at Moresby were doing all that was humanly possible to hasten construction, Casey was trying hard to move the units that remained in Australia to New Guinea, but without success. Because of the acute shortage of ships, USASOS could spare no vessels for the engineers. The units already in New Guinea continued to carry the load alone.[57]

The strain of constant operations was beginning to tell. Men and machines were wearing out. Sverdrup, stopping at Moresby on his way back to Brisbane from Pongani, found the situation alarming. The engineer troops were tired and large numbers were reporting for sick call. Many were suffering from malaria, dengue, dysentery, and disease of the skin. Accidents were frequent. "I am much worried," he wrote to Casey, "about how these same Engineer troops will be able to perform when we advance, as we hope to do. . . ." The condition of the units' equipment was just as discouraging. A large part of it was sidelined for repairs. Mechanics were scarce. Spare parts were almost nonexistent. Such cargoes of equipment and parts as were reaching Australia seldom found their way to New Guinea. USASOS could not arrange for shipping space, and cargo space on planes was at a premium.[58]

As the rainy season approached, the airmen grew increasingly impatient. An unseasonable downpour on the night of 21 October seemed to confirm their forebodings. Seven-Mile, Three-Mile, and Rorona were unserviceable for a time. The road to Waigani was barely passable, and the bridge to Laloki was washed out. Greatly perturbed, Kenney again brought pressure to bear on the engineers. In a

[56] (1) Memo, with Incls and notations thereon, Casey for Kenney, 14 Oct 42. SWPA File 460.

[57] (1) Rad, Johns to Casey, 24 Oct 42. 686 New Guinea No. 2. G–3 Files, GHQ SWPA. (2) Rad, Johns to Casey, 28 Oct 42. SWPA File 496. (3) Memo, Casey for Sutherland, 28 Oct 42. SWPA File 495.

[58] (1) Hist of the 96th GS Regt. (2) Memo, Sverdrup for Casey, 8 Nov 42. SWPA File 27.

letter to MacArthur on 26 October he predicted that with the onset of the rains at least two squadrons would have to be returned to Australia. He conceded that the strips themselves were nearly finished but stressed the fact that dispersals, hardstands, and access roads were not. Stating that he could not operate effectively without the missing facilities, he insisted that they be supplied at once. "Otherwise," he warned, "reliance on aviation operations is not well founded." Both Sutherland and Casey hastened to reassure him. Casey again pointed out that there was a big job to be done at Moresby and few engineers to do it, but he promised that "all work necessary to provide maximum use of the New Guinea airdromes during the wet weather season [would] be pushed to the maximum within the limitations of plant and men." [59]

At this juncture Kenney again began to press for operational control of the 808th Aviation Battalion. Early in November he raised the question as to what authority there was for having the unit under USASOS. Protesting to Sutherland that aviation engineers were being taken off the airfields to work on the Tatana causeway and to operate cranes on the docks, he asked that the battalion be placed under him. Casey, as before, strongly opposed placing the aviation engineers under Air Forces' control. Given the tremendous scope of the construction program and the small size of the engineer force, he believed the existing arrangement to be the most efficient. The pooling of construction units and resources had, he felt, worked to the advantage of all concerned. Actually, only twenty-five men had been diverted from the 808th to other jobs, whereas the bulk of the service engineers had been employed in building airdromes. "If it is regarded that the aviation Engineers are an Air Corps unit and the only engineers [intended] primarily for airdrome construction," he told Sutherland, "the counter view may be taken that all other engineer units had been diverted from other assignments to work for the Air Corps. . . ." Engineer dump truck companies and details from general service regiments had worked for long periods hauling gasoline and bombs for the air force and loading planes. This work, Casey said, had been undertaken in the knowledge "that the job had to be done by whatever means were available." As the chief engineer saw it, nothing would be gained by setting up two independent construction organizations to compete for materials and equipment, duplicate each other's planning, and get in each other's way. Casey's views prevailed. The 808th remained under the control of USASOS.[60]

The stir created by the Fifth Air Force had served to emphasize the need for sending more engineers to New Guinea, and Casey was now able to persuade Marshall to make shipping available. By 8 November the 576th Dump Truck Company and elements of

[59] (1) Rad, CG Adv Ech Fifth AF to CG V Bomber Comd, 22 Oct 42. (2) Ltr, Kenney to MacArthur, 26 Oct 42. Both in 686 New Guinea 2, G–3 Files, GHQ SWPA. (3) 1st Ind, 29 Oct 42 on (2). (4) Memo, Casey for Kenney, 1 Nov 42. SWAP File 460.

[60] (1) Memo, G–3 GHQ SWPA for Casey, 3 Nov 42. (2) Memo, Casey for Sutherland, 3 Nov 42. Both in SWPA File 27.

the 43d and 46th General Service Regiments were loading to ship out within a week, and USASOS was promising to transport more units to New Guinea at an early date. Meanwhile, at Moresby additional engineers were being pulled off non-air-force projects and sent to work on the dromes. Australians took over operation of the quarry and construction of docks and dumps as the Americans moved in with their equipment to finish up access roads, hardstands, amd dispersals. By mid-November, the first reinforcements from Australia were unloading their gear on the Moresby docks. On 18 November the chief engineer sent word to Kenny that "every effort [was] being made to get and hold all airfields here to wet weather operational condition." [61]

Maps

The days before the attack on Buna were scarcely less hectic for the topographic engineers than for the engineers engaged in construction. The coming offensive was generating a brisk demand for maps. Top commanders and their staffs had to be furnished with strategic maps of the combat zones. Ranging in scale from 1:500,000 to 1:1,200,000 and depicting large areas with such salient features as mountains, large bodies of water, important lines of communications, and major centers of population, maps of this type were indispensable to men who were planning campaigns. Commanders in the field were calling for tactical maps with scales varying from 1:62,500 to 1:300,000. The scale 1:63,360 was especially popular because it was one inch to the mile. Necessary in moving large bodies of men across unfamiliar terrain, these maps supplied much the same information as strategic maps but in far greater detail. For artillery batteries and small infantry units, the engineers had to provide battle or terrain maps with a scale of 1:20,000. Since these large-scale projections were used in firing on unseen targets, their delineation of distance, direction, and elevation had to be very precise. All these varieties of maps had to be supplied quickly, some of them by the thousands; and because Ghormley had no military mapping units, MacArthur's topographers not only had to cover New Guinea but the Solomons as well.[62]

Among the least explored areas of the world, the islands north and northeast of Australia had been mapped haphazardly or not at all. In months of searching, the engineers of USAFIA had failed to turn up much information of value on the now vital parts of Melanesia. The Army Map Service at Washington, an agency of the Corps of Engineers responsible for providing maps to the Armed Services, could supply but few of the far Pacific. Nor could the Australians do much better. Their topographical surveys had been confined primarily to the continent itself—in fact, almost entirely to the southeastern coastal region. Good maps of Papua and the

[61] (1) Memo, Casey for Teale, 2 Nov 42. SWPA File 460. (2) Memo, Teale for Casey, 8 Nov 42. SWPA File 496. (3) Memo, Casey for Kenney, 18 Nov 42. SWPA File 460.

[62] (1) Memo, ACofEngrs for CofAAF, 23 Sep 41, with Incls. 061. (2) For a detailed discussion of military maps and mapping techniques, see Coll, Keith, and Rosenthal, *Troops and Equipment*, chs. III, XIX.

mandated territories were simply not to be had. The only military maps of the Buna area—Australian sketches drawn to a scale of four miles to the inch—were so seriously in error that they showed some rivers flowing up over mountains. Just as disheartening was the situation with regard to the South Pacific. Although sketches had been made of some of the Solomons, no comprehensive effort to map the islands had ever been made. Data on the topography of Guadalcanal, now the scene of desperate fighting, was both incomplete and unreliable. In mapping the combat zone, a vast land and water area much larger than the United States, the engineers had to start virtually from scratch.[63]

To map the forward areas by the time-honored method of surveying the ground was impossible. Much of the contested territory was occupied by the enemy, and even where the ground was accessible, there was no time for painstaking measurements with transits, tapes, and levels. Chief reliance had to be placed on aerial photography. New techniques, just coming into use, enabled cartographers to make maps from photographs of the terrain furnished them by airmen. Mapping, once the exclusive province of the engineers, was now a joint responsibility of the Corps of Engineers and the Air Forces. A recent development was trimetrogon photography, which involved mounting three cameras in a plane with one pointing straight down and the others pointing sideways. Three cameras arranged in this manner could, of course, photograph a much wider area than could one camera aimed directly down. But aerial photographs had their limitations. Unless the elevation of some point in the picture were known, there was no way of determining the elevation of any of the terrain features. Because the photographs were taken from an altitude of 20,000 feet or more, many objects appearing on the prints, each about nine inches square, were hard to make out. Photo interpreters had to try to identify an object mainly from its outline and its shade of gray. It was not easy to deduce what might lie beneath the heavy jungle growth directly below the camera or behind the mountain off to one side. Shots taken from oblique angles presented an added difficulty—that of determining the elevation of the terrain features and their distance from one another.[64]

The men of the Australian Survey Corps, the only topographers in MacArthur's command at the outset, were surveyors of the ground with little or no experience in photomapping. Although the 8th Photo Squadron, an Air Forces unit trained in trimetrogon photography, began arriving in Australia in April, few, if any, engineers were yet available to transform photographs into maps. Johns, soon after becoming Chief Engineer, USAFIA, had requested two mapping units from the United States—an army topographic battalion and a corps topographic company, but some time was to elapse before these units

[63] (1) Of C Engr GHQ SWPA Annual Rpt for 1942. (2) 648th Engr Topo Bn, *Of Maps and Men, Battalion History, 1941–45*. (3) Of C Engr GHQ AFPAC, *Engrs of SWPA*, III, 19–20. (4) WD MID Survey of the Solomon Islands, 15 Mar 43. RED VAULT, USAFISPA.

[64] 648th Engr Topo Bn, *Of Maps and Men*.

would reach the Southwest Pacific. Casey, who assumed over-all direction of the mapping effort on becoming chief engineer of SWPA, was meanwhile planning to co-ordinate the work of Australian and American topographers. Shortly after the signing in Washington on 12 May of the Loper-Hotine Agreement, a convention between the British and the Americans that gave the latter primary responsibility for mapping in the Pacific, Casey reserved for the American topographic units a dominant role in SWPA's mapping program. The Americans, under USAFIA, were to concentrate mainly on mapping the forward areas; the Survey Corps, operating under General Blamey, on mapping Australia. While the Allies would cooperate fully in all they did, the Australians would, as a rule, be the surveyors, the Americans the photomappers of the Southwest Pacific.[65]

The units that Johns had sent for arrived at Brisbane late in June. One, the 648th Engineer Topographic Battalion (less Company A), commanded by Maj. Emil F. Kumpe, was set up to map limited areas and reproduce existing maps while moving with an army in the field. The other, the 69th Engineer Topographic Company, under Capt. Orris A. Carnegie, was prepared to serve near the front, where it would print maps for immediate distribution and carry out such short-term, emergency assignments as running quick surveys, making hasty sketches, and helping the artillery coordinate its fire. Soon after debarking, the 69th was scattered, as detachments were sent north to begin field surveys in Queensland. The 648th moved to Melbourne, where it was to establish and operate a fixed base printing plant, a mission normally reserved for the larger and better equipped GHQ topographic battalions. The unit had, moreover, to accomplish under pressure of war what would ordinarily have been a long-term, peacetime program and to pioneer in making maps from trimetrogon photographs. Lacking sketchmasters and angulators—the devices used in producing planimetric maps from such photographs—the battalion gave its water purification units to the 8th Photo Squadron in exchange for a set of these instruments. Seventeen men of the battalion who had had training in working with trimetrogon undertook to teach the new mapping technique to others. The engineers located a large Harris offset press in Melbourne which, with the three smaller presses they had brought with them, enabled them to print all required sizes of maps in quantity. The battalion had barely moved into its new headquarters, a 5-story warehouse in downtown Melbourne belonging to Australia's largest department store, when it was put to work. Even before the building was cleared of merchandise, the photomappers were tackling their first job, which was to produce maps of Guadalcanal "with the utmost speed." No sooner had nine halftone photomosaics and nine planimetric drawings of the island been reproduced and shipped out than the battalion turned to compiling maps of eastern New Guinea. But it was immediately apparent that provision of anything like adequate

[65] (1) Of C Engr GHQ SWPA Annual Rpt for 1942. (2) Coll, Keith, and Rosenthal, *Troops and Equipment,* pp. 445–46.

coverage of that area must await receipt of quantities of aerial photos.[66]

Photographs came in slowly. The 8th Photo Squadron had difficulty in getting even a fraction of the shots the engineers needed. Until August 1942, it had only three single-seater planes which could be used for taking photographs. That month it got a number of additional aircraft, but it still had far too few. These planes, "rickety crates . . . little better than flying coffins," had to operate under extremely difficult conditions. In the first place, the Air Forces insisted on using them primarily for reconnaissance and permitted only occasional photographic flights. In the coastal and mountainous areas of New Guinea there were often only fifteen minutes of good, clear weather a day. Time and again missions had to be abandoned because of enemy interference. Even when conditions were best, good aerial photographs were still not easy to come by. The pilots had to make painstaking efforts to interlock the cameras at the exact angle and set them correctly in the plane. Once aloft, the pilots found it difficult to maintain a constant altitude, to fly straight lines without tipping and tilting, and to make sure they got pictures of all the area assigned to them. By late September, the 8th Photo Squadron had accomplished but 5 percent of its photography missions, largely because of the diversion of its planes to reconnaissance.[67]

Getting pictures was only half the battle. Trimetrogon theory was still in its infancy, and the engineers had to learn by trial and error how best to interpret the photographs. To supplement information deduced from the pictures, they gathered as much data as they could from other sources. Australian libraries were ransacked for books on islands to the north. People who fled before the advancing Japanese were interviewed. Many supplies had to be obtained in the Commonwealth. While high-grade inks were satisfactory and some types of paper were scarcely inferior to American brands, a number of products of local manufacture produced unpredictable results. Most of the highly complex technical equipment, so important for map making, had to be gotten from the United States. The men worked long and hard during the chill Australian spring to produce maps of the critical areas of New Guinea as quickly as possible. "This Buna business was . . . miserable because at night the temperature was down to about freezing . . . ," the chronicler of the 648th reported. The men worked on the maps in overcoats and hats and continued work until their fingers got numb. By mid-November, the engineers were distributing strategic and tactical maps of the combat area. To be sure, these maps had inaccuracies, but as one of the topographic engineers pointed out, "any map, based on any photographs, is better than no map at all." [68]

[66] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, III, 25–27. (2) 648th Engr Topo Bn, *Of Maps and Men*. (3) 69 Engr Topo Co, Sixty Ninth Overseas. ENCO–69–0.1, (21115) M.

[67] (1) 648th Engr Topo Bn, *Of Maps and Men*. (2) Memos, for Rcd, Casey, 11, 12 Dec 42. SWPA File 130. (3) Of C Engr GHQ AFPAC, *Engrs of SWPA*, III, 30–32.

[68] 648th Engr Topo Bn, *Of Maps and Men*.

Approaching Buna

By early November, Allied troops were converging on Buna by air, land, and sea. As far back as mid-October, a combat team of the 32d Division together with Company C of the 114th engineers had been flown to Wanigela. From there a party of infantry and engineers had attempted to march overland to Buna. About fifteen miles west of Wanigela, their way was blocked by the swift waters of the Musa. The engineers built a raft to ferry the infantry across, only to find that the trails on the far bank, some under seven feet of water, were impassable. The troops were then ordered to follow the river to its mouth. From there they were taken to Pongani in small boats, completing the movement on the 31st. While the Americans were moving up the coast, the Australians were securing nearby Goodenough Island. On the night of 22–23 October an Australian battalion landed and within twenty-four hours had driven off the Japanese. Americans and Australians were also approaching Buna overland from the southwest and southeast. On 8 and 9 November a battalion of infantry was flown to Abel's Landing, while another went on to Pongani. The day after the infantry put down at Abel's Landing, Company A of the 114th, less one platoon, arrived. Using native rafts and an assault boat, the engineers helped the troops cross the Musa three miles west of Fasari. The men then continued overland along jungle trails toward Buna. Meanwhile, the battalion, which, with its platoon of engineers, was slogging its way across the Owen Stanleys, had reached Jaure by 28 October. That same day advance elements continued their march through the northeastern foothills of the mountains. On 2 November the Australians recaptured Kokoda. The Allies would soon be in a position to attack.[69]

Among the Americans there was widespread optimism. The troops were cocky and their commanders seemed assured of an early victory. The men of the 32d Division had a high regard for their own ability as fighters, an opinion shared by their commander, Maj. Gen. Edwin F. Harding, whose "confidence in the fighting qualities of the American Soldier" prompted him to write on 31 October, "I am not at all pessimistic about the outcome of this scrap." The completion by the engineers of the landing strips north of the Owen Stanleys had greatly raised hopes for an easy campaign. On 20 October, the day after Abel's Landing was completed, Harding sent word to MacArthur that "what promised to be a long, dull, plodding campaign against inhospitable nature is beginning to look more like Marengo than Hannibal crossing the Alps." Nor was Harding greatly perturbed by the terrain around Buna. He reported "considerable open country in the area over which we will operate," rated one native track leading into Buna as "a broad highway for this part of the world," and pronounced a number of trails as suitable for motor traffic. He foresaw the need for rather extensive bridging but was prepared to deal with this contingency. Two weeks before

[69] (1) Milner, *Victory in Papua,* pp. 106ff. (2) 114th Engr Combat Bn, Rpt of Engr Opns in Papuan Campaign. SWPA File A82.

the scheduled assault, he stated his intention of having plenty of engineers on hand.[70]

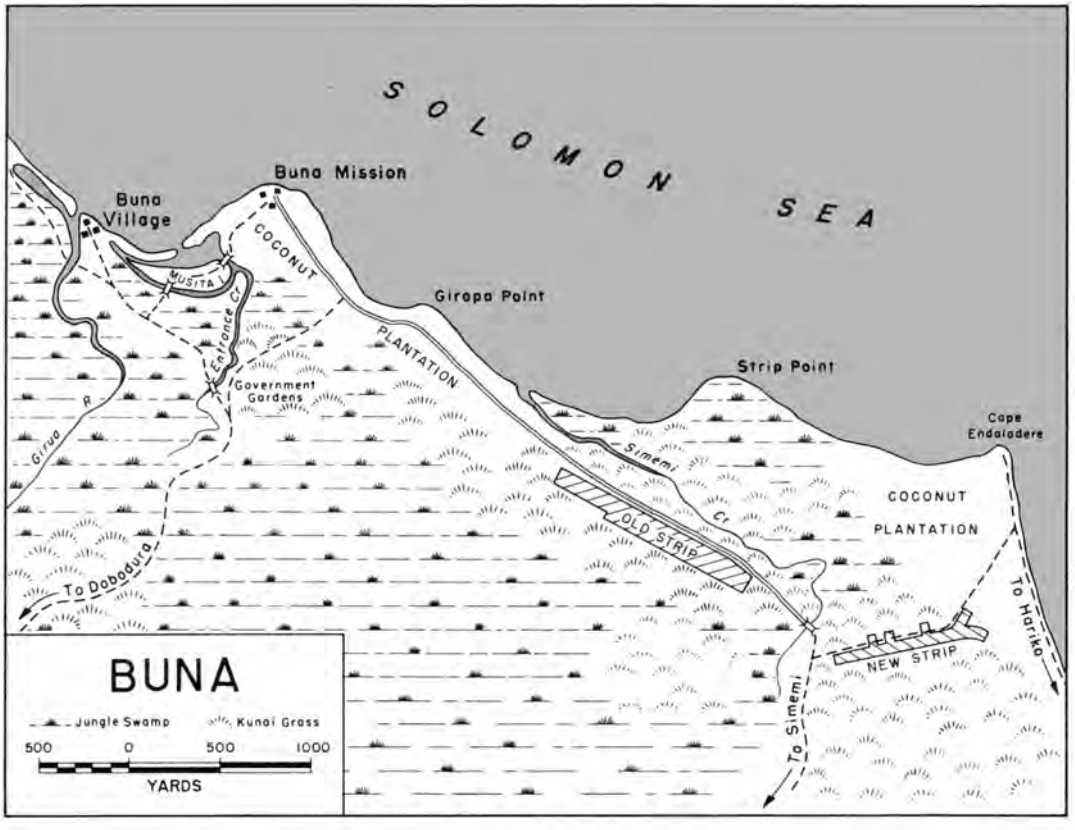
Engineers in Combat

The enemy forces in Papua had withdrawn into three small pockets on the northeastern coast, one at Buna, another three miles to the northwest at Sananda, and a third some five miles still farther west at Gona.[71] The largest was the one at Buna. There the enemy held an area three-quarters of a mile wide, which extended from Buna Village eastward three miles to Cape Endaiadere, where the coast line turned abruptly southward. *(Map 11)* Just to the east of the village was Musita Island and, beyond it, Entrance Creek. On the other side of the creek was the Government Station, usually called Buna Mission, consisting of three European houses and several dozen native huts at the edge of a coconut plantation. Beyond the plantation lay the major Allied objective, the airfield. Between the southeastern tip of this field and the shore to the south of Cape Endaiadere, the Japanese had cleared a dummy runway, which the Allied troops called the New Strip. Simemi Creek, flowing in a northerly direction, passed between the two airstrips. The Japanese occupied practically all the dry ground in the area. South of the enemy perimeter were jungle and boundless, impenetrable swamps, broken here and there by patches of kunai grass. Three native tracks led through this nearly impassable terrain to the enemy positions. One, extending northward from Dobodura, ran along the east bank of Entrance Creek to a point about a mile from its mouth, and then branched, with one fork leading westward across the creek to the village and the other continuing on to the mission. Another track from Dobodura ran northeastward to the native settlement of Simemi and from there continued on along the east bank of Simemi Creek. Crossing the stream between the two airstrips over a low wooden bridge, it curved northwestward to Buna Mission. A third followed the coast to Cape Endaiadere. Since treacherous coral reefs offshore made an attack from the sea well-nigh impossible, the assault would have to be channeled along these three trails.

The attack was set for 16 November. The 7th Australian Division, under Maj. Gen. George A. Vasey, was to take Gona and Sananda; the 32d Division, under General Harding, was to capture Buna. The Australian and American forces would be separated by the Girua River, which emptied into the sea just west of Buna Village. Harding's men

[70] (1) Milner, *Victory in Papua*, pp. 137–39. (2) Ltrs, Harding to Sutherland, 20, 31 Oct 42. GHQ SWPA G–3 Jnl, 27–31 Oct 42.

[71] Unless otherwise indicated, the account of the engineers in the Papua Campaign is based on the following sources: (1) Rpt of the CG Buna Forces, on the Buna Campaign, 1 Dec 42–25 Jan 43. (2) AMERICAN FORCES IN ACTION, *Papuan Campaign, The Buna-Sanananda Operation, 16 November 1942–23 January 1943* (Washington, 1944). (3) Milner, *Victory in Papua*. (4) 114th Engr Combat Bn, Rpt of Engr Opns in Papuan Campaign. (5) Of C Engr GHQ SWPA Annual Rpt for 1942. (6) Ltrs, Maj. David B. Parker, U.S. Engr Liaison Off with the First Aust Army, to USASOS *et al.*, 2 Dec 42, 12 Jan 43. SWPA File 56. (7) Rpt, Work Accomplished by 43d Engr Regt in New Guinea. SWPA File 145. (8) Rpt, Sverdrup to Casey, 5 Jan 43. SWPA File 159. (9) Robert L. Eichelberger, *Our Jungle Road to Tokyo* (New York: The Viking Press, 1950).



MAP 11

were to converge on Buna along the three trails. The troops near the coast would be supplied by small boats moving up the coast from Milne Bay; those in the interior, mainly by airdrop. These makeshift arrangements would have to be relied upon until the engineers could clear fields for transports at Dobodura and open a port for ocean-going freighters at the deepwater harbor of Oro Bay, about fifteen miles south of Cape Endaiadere. The Allied commanders also planned to have the engineers put in a road from Oro Bay to Dobodura. As soon as possible the engineers were to transform the landing strips at Dobodura into a major Allied base for fighters and bombers—the first one north of the Owen Stanleys.

Trails, ports, and airfields figured large in Harding's plans, but only two companies of the 114th Combat Battalion were assigned to the campaign. The makeup of this engineer force was, moreover, decided without the advice of Col. John J. Carew, the battalion's commanding officer and Harding's engineer. Carew knew little of Harding's plans until 28 October, when he received orders to proceed to Moresby with one

member of his staff. On arriving in eastern Papua he found his units, Companies A and C, in poor shape. The men had almost no equipment or supplies. A small number of hand tools, a few coils of rope, and an assault boat or two made up almost their entire stock of engineer items. Carew learned that Harding was planning to bring heavy machinery, tools, and materials by boat from Milne Bay. The engineer units were no better trained than they were equipped. Prepared like the rest of the 32d Division primarily to defend Australia, they had little knowledge of jungle warfare and almost none of night fighting, in which the Japanese excelled. Weary from their hard march to the Buna area, the men had to go into combat carrying on their backs such tools as they had in addition to their usual packs and arms.

First Contacts With the Enemy

At dawn on 16 November one battalion of infantry crossed the Samboga River and began its advance toward Cape Endaiadere, five miles to the north. Another moved inland from the coastal village of Embogo to Dobodura, its destination the eastern edge of the new strip. A third advanced along the trail toward Dobodura on its way to Ango and Buna. A platoon of thirty-five engineers, reinforced by a pioneer platoon of one officer and twenty-two infantrymen and a group of native carriers, accompanied each battalion. Hope ran high for a quick and easy victory. During the morning the three groups pushed ahead without seeing any signs of the enemy. The greatest annoyance was the heat, which was so oppressive that some of the men threw away their tools to lighten their load. As the pioneers hacked away at the underbrush, the engineers put the troops over the streams that crossed the trails every half mile or so. At some of the crossings they built footbridges; at others they constructed rafts to ferry the men over; at still others natives paddled the troops across in dugout canoes, sometimes pulling their craft by hand along a rope the engineers had stretched from shore to shore.

First contact with the enemy came that afternoon. At 1210, Japanese machine gunners near Cape Endaiadere opened fire on the column advancing along the coast but inflicted no damage. At 1300 forward elements on the inland trail routed an enemy patrol near Dobodura. The first big attack came at 1900, when enemy dive bombers strafed the column moving along the coast. Little thought had been given to the possibility of air attack. Now, in a mad scramble for shelter, the men dug slit trenches with whatever tools they could find. Shovels, bayonets, mess kits, and bare hands were brought into play. The main target of the Japanese was not the column of troops, but the luggers offshore bringing up supplies and ammunition. All the small craft were hit. Several sank immediately; the rest caught fire and exploded. Colonel Carew helped to rescue many of the survivors. On the beach when a lifeboat carrying the crew from one of the luggers reached shore, he called for volunteers to help him row the boat back toward the burning ships. Bombed and strafed, the rescuers neared one of the craft as its exploding ammunition was throwing

flaming debris in all directions. Carew and his men pulled a number of survivors from the water and took them safely to shore. The luggers and cargoes could not be saved. Their loss was a severe blow to Harding's forces and the forward movement had to be postponed.[72]

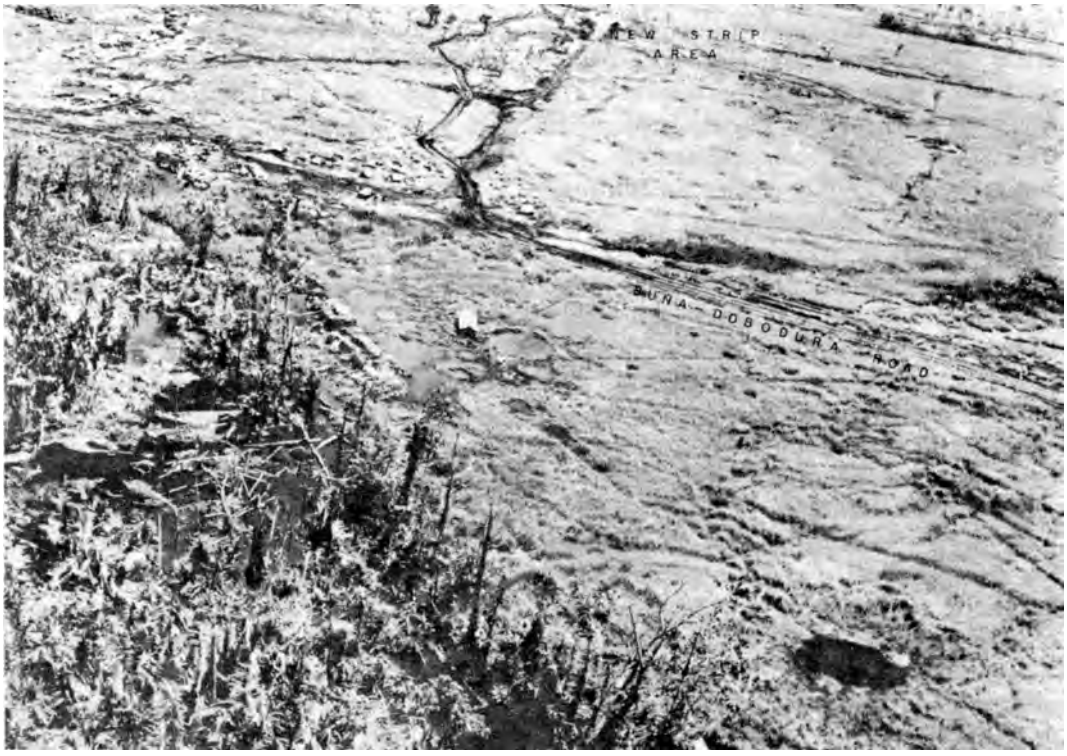
The advance along the coast was resumed on the 19th. As the troops neared the Japanese positions south of Cape Endaiadere, the enemy opened up with murderous fire, pinning the men to the ground. The troops marching along the trail from Simemi to the airfields fared no better. They were stopped in their tracks by machine gun and rifle fire from positions near the bridge over Simemi Creek. To the west, the situation was equally serious. The area where the track from Dobodura branched to Buna Mission and Buna Village—the Triangle as it was called—bristled with defenses. When some of the men tried to flank the enemy positions, they sank into seemingly bottomless swamps.

It was now clear that the Allies had greatly underestimated the strength of the enemy's position and his will to resist. Only about 2,200 troops were entrenched at Buna, but the excellence of their defenses was astonishing. The Japanese engineers had done a masterful job. Maj. David B. Parker, sent to Buna as engineer liaison officer with the First Australian Army, described the enemy's defenses as "well planned," his field fortifications as "comparatively impervious," and his camouflage as "perfect." The area was lavishly provided with bunkers, dugouts, and gun positions, many of them prepared long before the assault began. Bunkers were sturdily built of dirt, logs, and sandbags, topped with thick roofs, and connected by trenches. Gun positions were well sited and mutually supporting. The Japanese had made expert use of leaves and grass for camouflage. Many bunkers and pillboxes were completely concealed by the lush jungle growth which had sprung quickly from their covering of earth. Some were so hard to spot that the attacking troops unwittingly passed them by, only to be shot at from behind.

The attackers were handicapped by a dearth of information on the area they were trying to take. Troops in the jungle swamps and grass flats before Buna could neither see the enemy nor learn much about his positions.[73] The Australian maps to the scale of one inch to four miles, on hand when the campaign began, were so inaccurate as to be almost worthless. The small number of hastily prepared photomaps that shortly began to reach the front were of some help, especially to the artillery, but lacked much essential data. No enemy positions and few jungle trails appeared on them, and many place names were missing. Lt. Gen. Robert L. Eichelberger, commanding general of I Corps, who had under him all American combat forces in the Southwest Pacific, was highly critical of the mapping effort, condemning not only the shortage of maps but also the poor quality of those

[72] GHQ SWPA GO No. 64, 28 Dec 42, and GO No. 1, 1 Jan 43.

[73] Memo for Rcd, Lt. Col. Emil F. Klinke, C Opns and Tng Of C Engr GHQ SWPA, 29 Nov 42. SWPA File 159.



AERIAL VIEW OF THE BUNA AREA ADJACENT TO SIMEMI CREEK

furnished. "[In] a dense jungle where a bunker or entrenchment cannot be seen from thirty yards away," he later wrote, "aerial photography must be swallowed with a full shaker of salt." [74] Since aerial observation was so ineffective, reconnaissance on the ground seemed the only answer. But it proved to be hazardous and difficult. The Japanese held all the high ground, and riflemen who seemed to be everywhere were so well concealed that it was nearly impossible to spot them. Infantry commanders had great difficulty getting their men to volunteer for patrol duty, and Colonel Carew had no engineers to spare. Most of what little information was obtained came from natives who lived near Buna.

On the Buna perimeter, the engineers were fully occupied with roads and bridges. Besides having to maintain twenty-eight miles of existing trails, they had many miles of new construction to do. With the start of the rains in late November, jobs multiplied and became more arduous. Roads were transformed into seas of mud, and flash floods swept bridges away. If routes were to be kept open, bridges had to be repaired quickly and long stretches of corduroy put in.

[74] Eichelberger, *Our Jungle Road to Tokyo*, p. 20.

There was almost no machinery, and the shortage of hand tools remained acute. Machetes, now the most useful of tools, were especially scarce. The small stock of rope originally brought in had long since been exhausted. Between 15 and 24 November no building supplies were delivered to the front. The handful of engineers were limited to pioneer construction. Not properly trained in such work, they sometimes bungled. In laying corduroy, they repeatedly put down logs without first providing bottom stringers, with the result that the corduroy soon sank out of sight in the mud.

The plight of the engineers would have been much worse had it not been for the Papuans. Familiar with the local flora, the natives pointed out the kinds of timber best suited for construction. They demonstrated how to sink poles into sandy stream beds by hand and how to use lashings of bark to hold bridge timbers in place. The size of the native work force available to the engineers fluctuated widely. Although the Australians had recruited well over a thousand Papuan helpers, none were at first attached permanently to any unit. Blamey's headquarters parceled the natives out to the various commands on a day-to-day basis. Of the 400 allotted to Colonel Carew at the start of the campaign, none continued, uninterrupted, on construction. From time to time, large groups were taken off engineer projects to act as stretcher bearers. After especially severe rains, when the roads were impassable to vehicles, all were used to carry supplies. The engineers might have several hundred natives one day and none the next. Papuans were not the only ones to be diverted from construction. When the 1st Platoon of Company A of the 114th reached the front on 21 November, after marching over the Owen Stanleys, it was assigned to carrying rations and ammunition for the infantry, a chore it had for over a month. Since the natives would not go near the front, there was nothing left to do but use the troops to carry supplies.

Because the loss of the luggers had crippled supply up the coast, completion of an airstrip at Dobodura was all the more urgent. By 20 November the 2d Platoon of Company C of the 114th had reached Dobodura, where, together with 22 infantrymen and a group of natives, they began work on the first runway. Clearing away kunai grass and scrub trees with brushhooks, machetes, and bayonets, they completed the first temporary strip in a day. On the 21st, Company A, less one platoon, arrived to help enlarge the field. Next morning the engineers were ordered north to support the infantry trying to get to Buna Mission and Buna Village. Since no quartermaster units had yet arrived, 25 men stayed behind to stake out a cemetery and unload the supplies already being flown in from Moresby. On 25 November, 210 men of the 43d General Service Regiment were flown to Dobodura to build more runways. They brought with them part of their equipment—five mowing machines, two tractors, one sheepsfoot roller, and one grader, all of which they had cut up with torches at Moresby in order to get them aboard the planes. As soon as the machines were welded together again, the engineers, with a force of natives,



43D ENGINEERS MOW KUNAI GRASS ON THE OLD DOBODURA STRIP NO. 1

began clearing the kunai grass for additional strips.

The Fall of Buna

By the end of November little progress had been made against the enemy. On the front near Buna Village and Buna Mission, the troops, now known as Urbana Force, were stymied. Warren Force, fighting near the airfields, was likewise unable to advance. Alarmed by the way the campaign was going, MacArthur prepared to take action. On 1 December he gave General Eichelberger direct command of the bogged down forces. When the new commander reached the front, a number of top officers were relieved, and units which had become jumbled together were unscrambled and assigned to other parts of the line. As Eichelberger took over, things were already taking a turn for the better. Tanks were being brought from Milne Bay, and fresh Australian and American troops were scheduled to arrive soon. The airlift from Moresby to Dobodura was becoming more effective. Efforts of the engineers on the trails were showing results. Supplies could be carried to the front more rapidly, and jeeps could travel the road from Dobodura to Simemi. More accurate maps, though still too few, were being provided. The survey platoon of the 69th Topographic Company was on

its way to Moresby, where it was to help members of the Australian Survey Corps bring maps of Buna up to date.[75] A map depot was being set up at Moresby to speed distribution to the troops. In nearly every respect, the outlook was more favorable than when the campaign began two weeks before.

Five days after Eichelberger assumed command, the offensive was renewed. During the next few days, the troops of Warren Force, at the eastern end of the New Strip, made slight gains. But the progress of those advancing towards the bridge over Simemi Creek was negligible. The span remained in enemy hands. On Urbana front, events took a more favorable turn. The troops worked their way up the west bank of Entrance Creek and then followed the trail to Buna Village. They broke through to the sea just east of the village. The objective now was to clear the entire area west of the Triangle, and then seize the heavily fortified Triangle itself. One noncommissioned officer and twenty men of Company A of the 114th engineers were assigned to Urbana Force as a "roving detachment" to destroy captured bunkers, dispose of duds, and build bridges. Everywhere the enemy's resistance was fanatical. Nevertheless, his defenses began to crack. On 14 December, the Americans entered Buna Village, already abandoned by the Japanese. Gona had fallen to the Australians five days before.

Eichelberger scheduled an all-out attack for 18 December. On Warren front, the American troops, recently reinforced by Australians, were to advance up the coast to Cape Endaiadere, turn westward, and push on to Simemi Creek near its mouth, thus getting behind the enemy's line at the airstrips. One American battalion, supported by the tanks which had recently arrived, was to move over the bridge between the strips and drive on to Buna Mission. At the same time, Urbana Force was to reduce the Triangle and capture Musita Island. The outcome of these operations would depend in considerable degree on the engineers' success in bridging Simemi and Entrance Creeks.

On Warren front, the drive along the coast was a complete success. The Japanese positions on Cape Endaiadere were overrun. But when the troops turned westward and began to push into the area behind the new strip, they were again held back by intense fire from enemy bunkers. Meanwhile, the advance through the swamps towards the bridge over Simemi Creek was painfully slow. When, on the 20th, the troops at last converged on the span, they were fired on by about fifty riflemen and several machine gunners near the old strip. The vitally important bridge, a low, wooden structure, 125 feet long and 10 feet wide, was found to be in fair shape, but the flooring was poor and a 12-foot section had been blown out of the far end. Unable to cross the bridge, the troops tried to ford the creek at several places, but found the water over 6 feet deep. A smoke screen was put down under cover of which infantrymen tried to span the gap with a catwalk, which turned out to be too short. Meanwhile, the Australians discovered a ford some distance to the north and began crossing over. Since tanks were

[75] 69th Engr Topo Co, Sixty Ninth Overseas.



IMPROVISED BRIDGE OVER ENTRANCE CREEK

slated to support the combat troops, repair of the bridge was imperative. At dawn of the 23d, while the infantry strove to clear out the Japanese who were placing fire on the structure, engineers of Company C moved in to repair the bridge. Soon after the work began, the enemy opened up with machine guns and mortars. When the men took cover, the Japanese stopped firing. Staying out of sight for a time, the troops returned to their job and continued working until the enemy fire again became intolerable, when they once more took cover. This round of operations was repeated four times before the bridge was ready. That afternoon, the remaining infantry and four tanks crossed over. By the 27th, the enemy positions around the airstrip were crumbling.

After a faltering start, Urbana Force also scored some decisive gains. Additional troops which had begun arriving in the Buna area were sent into the line to reinforce the weary veterans. A two-pronged attack on Musita Island and the Triangle was launched on 18 December. Attempts to capture Musita were repulsed, and the troops withdrew that evening. To the south, the infantry

made repeated thrusts at the Triangle, all of which failed. Eichelberger then changed his plans. Orders were issued for the infantry to cross Entrance Creek to the north of the Triangle, bypass that heavily fortified area, and push on to Buna Mission. To get the troops over the creek, engineers of the roving detachment lashed coconut logs together and laid them across two captured boats which they had anchored in the middle of the stream. On 22 December one company of infantry crossed this bridge safely. Several hundred yards downstream, the other company, with no bridge, was forced to swim to the opposite bank and a number of men were drowned. That same day the attack on Musita was renewed. The engineers had by this time completed a makeshift footbridge to the island. The infantry swarmed over and, meeting little opposition, pressed on to the bridge near the mouth of Entrance Creek, which they would have to cross to get to the mission. There the men ran into such heavy fire that they could get no farther. By this time the troops who had crossed upstream were driving eastward through the plantation south of the mission. After overrunning the Japanese defenses, they reached the sea on the 29th.

Meanwhile, construction of logistic facilities was not being neglected. An Australian field company had made a start on docking facilities at Oro Bay, some twenty miles southeast of Buna. Part of the unit began work on an urgently needed road from Oro Bay to Dobodura. The Australian engineers had selected a rather difficult route, much of it through hilly country, in preference to an alternate "low level" way which paralleled the coast and then passed through extensive swamplands along the Embogo River. Progress on the air base, port, and road was understandably slow. Though they generally employed several hundred Papuans, the Australians had less equipment than the 43d. On 18 December Company B of the 43d, with a large stock of equipment, left Milne Bay under orders to unload at Oro Bay, make arrangements for forwarding the machinery to Dobodura, and then march inland to work on the airfields. These engineers were not able to carry out their instructions. When Sverdrup visited the front at the end of December, he found part of Company B at work near the bay, building a stretch of road through a swamp where the water sometimes reached a depth of four feet. Noting that the road was so poorly located it might never be completed, he set out to find the rest of the unit. He discovered the men unloading ships and doing odd jobs at Oro Bay. Part of the equipment, he was told, was in the hands of the Australians. Inquiries revealed that one of Blamey's officers, mistakenly thinking the unit had been assigned to New Guinea Force, had taken charge of it. Only after Sverdrup had made it clear that the 43d was under USASOS was Company B permitted to go on to Dobodura. The mix-up, Sverdrup wrote, "had resulted in loss of valuable time which will adversely affect construction of the airstrips. . . ." [76]

By the time the struggle for Buna moved into its final phases, engineer strength was greatly depleted. The heat, the weeks of unceasing labor, the

[76] Rpt, Sverdrup to Casey, 5 Jan 43.

lack of equipment and supplies had taken their toll. Torrential downpours were a regular occurrence. "It was common practice to leave the M1 helmet outside the tents . . . at night in order the next morning to estimate the amount of rain which had fallen," Major Parker reported. ". . . if the helmet was completely full of water, the rainfall was considered . . . normally severe.[77] Many of the men were exhausted. Disease had cut the ranks severely. When the two companies of the 114th arrived at the front, they totaled 304 men. Six weeks later they were down to 140. At Dobodura, where the engineers had a comparatively easy time of it, 12 percent were suffering from fever or malaria at the end of the year.

Reliance on the Papuans became increasingly heavy. By late December 400 had been permanently assigned to the 114th, and attempts were being made to get 100 to assist the 43d. As a rule, the natives camped in groups of 100, with each group supervised by an Australian officer. Through discussions with the Australians as well as through experience, the engineers learned how best to handle the Papuans. Men from the same village were kept together, since the natives were suspicious of anyone not from their own tribe. Since each tribe had its own specialty—for example, the coastal natives excelled in bridging streams and the hill people in hacking out trails—it was advantageous to keep the Papuans on the jobs they could do best. Here, again, competition between villages was an incentive to speed. Quick to learn and proud of the part they were playing in the war, the Papuans made a substantial contribution to the Allied cause. "The success of engineer operations in this campaign," wrote Colonel Carew, "was due, in no small way, to the loyal, whole hearted, and tireless efforts of the natives. . . ." [78]

On 28 December, Eichelberger alerted the troops on Musita for the final assault on Buna Mission. Entrance Creek still barred the way. Spanning the stream near its mouth was a ramshackle, native-built bridge, about 125 feet long, with a large hole in the flooring. Enemy bunkers on a spit of land jutting into the mouth of the creek from the mission side could rake the bridge with machine gun fire. A plan of attack was worked out. A group of infantry was to cross the creek in assault boats and charge the bunkers. While the enemy was busy beating off this attack, several men would carry planks to the gap in the bridge and drop them in place. Then the infantry would race across. When a call was made for volunteers to fix the bridge, 4 engineers of the roving detachment and 2 infantrymen offered to take on the perilous job. Shortly after 1700 on the 29th, the boats shoved off, but on nearing the opposite bank, they came under such heavy fire they had to turn back. Meanwhile, the volunteers ran out on the bridge and hastily threw three timbers over the gap in the flooring. One of the engineers was shot dead. The 5 other men returned unhurt. Two infantrymen succeeded in crossing over, but before the rest could follow, the

[77] Parker's Ltr, 12 Jan 43.

[78] 114th Engr Combat Bn, Rpt of Engr Opns in Papuan Campaign.



CHOW TIME AT A NATIVE LABOR CAMP, NEW CALEDONIA

planks toppled into the water. The way to the mission remained closed.

Visiting Musita Island the next day and hearing of the attempt to repair the bridge, Sverdrup persuaded Cpl. Charles H. Gray, one of the engineer volunteers of the night before, to take him to see the structure. Gray and the two surviving engineers of his party had offered to make another try at repairing the bridge. Since the Japanese were now on the alert, Sverdrup believed that a second attempt, if made while the bunkers were still intact, would be suicidal. While going over the ground with Gray, he noted that a spit of land extending eastward from Buna Village came close to the one jutting into the creek from the opposite bank. On returning to the infantry command post, he suggested that assault troops ford the narrows and make a flank attack on the pillboxes. The infantry commanders had apparently been thinking along the same lines. A reconnaissance made the night before had disclosed that the water between the two spits of land was only ankle deep at low tide, which occurred at four in the morning. That night two companies set out to wade the narrows. In a confused action the men got across but were unable to knock out the bunkers. Re-

pair of the bridge had to wait once again.

On New Year's Day Urbana Force launched its final assault. The troops who had cut across the coconut plantation to the sea attacked the mission from the southeast. The men who had crossed the shallows again advanced along the spit, and by late afternoon of 2 January had wiped out the bunkers commanding the bridge. The engineers thereupon repaired the span and within an hour the infantry were streaming across. By the evening of the 2d, organized resistance had ended. The enemy survivors were mopped up during the next few days.

Sanananda

Between the capture of Gona on 9 December and the fall of Buna Mission, the Australians had made little headway west of the Girua. General Vasey's forces, consisting initially of Australian troops and one battalion of American infantry, had been unable to do much more than maintain roadblocks inside the Japanese outpost area and keep the enemy bottled up. In late December MacArthur sped reinforcements. A regimental combat team of the 41st Division was ordered north from Queensland. In the van went the 1st Platoon of Company B, 116th Engineer Combat Battalion.[79] On 31 December the platoon flew into Dobodura and from there marched to Ango and on across the Girua to the Sanananda front. The engineers relieved the Australians at one of the roadblocks. The first element of the 41st Division to go into combat, the platoon suffered its first casualties when two men were wounded while laying corduroy beyond the American lines. Meantime, the Buna campaign over, an American battalion set out with a number of tanks to reinforce the Australians. Ahead of them went Company B of the 114th, clearing the trail and putting down corduroy so that the armor could pass. In early January the remainder of the regimental combat team of the 41st Division reached the front. The 2d Platoon of Company B of the 116th was committed to combat; the 3d was held in reserve. Though they encountered the same swampy, jungled terrain that the 114th had found at Buna, the 116th engineers were somewhat better equipped, for each man carried along with his field equipment a machete, a shovel or pick, and a coil of rope or wire. The men were kept busy digging trenches, building bridges, corduroying roads, guarding positions, and carrying supplies—often under fire. Gradually the enemy strongholds were reduced, and by 22 January all organized resistance at Sanananda had been wiped out.

Guadalcanal

When the Papua Campaign ended, fighting was still in progress on Guadalcanal. The first phase of the battle, during which the marines struggled to consolidate their foothold and the Japanese tried vainly to dislodge them, had lasted for more than three months. While the Americans strove to hold their beachhead and to gain air and naval superiority, the enemy tried repeatedly

[79] 116th Engr Combat Bn, Opns Rpt, Jan 1–Sep 30, 43.

to reinforce the defending garrison. Sometimes the Japanese convoys moving down from the north were intercepted by Allied ships and planes; more frequently they got through. As the enemy strength increased, Ghormley dispatched more units to the island. In late September, the first regiment of an additional Marine division was sent in, and early in October the first Army ground troops arrived—the 164th Infantry of the Americal Division. In the middle of the month an estimated 16,000 Japanese were put ashore. Shortly thereafter, Admiral William F. Halsey replaced Ghormley as commander of the South Pacific Area. Late in October the Japanese made repeated efforts to retake the airfield, launching five strong, but unsuccessful, attacks from the 23d to the 25th alone. From 11 to 15 November, when a big enemy task force sought to land reinforcements, the contest for Guadalcanal reached its climax. In furious air and sea battles the Japanese power in the area was broken. The campaign now entered a second phase during which the enemy's position deteriorated steadily as his men were pushed into the northwestern corner of the island. Fresh American troops, among them the 25th Infantry Division and the remainder of the Americal, were brought in to relieve the tired marines. General Patch, who assumed command of the Guadalcanal forces on 9 December, got the final offensive under way. By January the enemy was being crushed in a giant pincers, one jaw of which extended westward along the northern coast, the other southwestward through the interior. The issue was no longer in doubt. Destruction of the Japanese on Guadalcanal was merely a matter of time.[80]

During the early months of the struggle, the engineers did their chief work on Espíritu Santo. Since the unfinished Japanese airstrip on Guadalcanal had been damaged in the preinvasion bombardment, Espíritu Santo was for a time the most advanced place from which land-based planes could operate. Even after the runway on Guadalcanal—Henderson Field, the Americans named it—became usable late in August, Espíritu continued to serve as a major base for bombers and reconnaissance planes and as a staging point for transports. Barely finished on 7 August, the Espíritu runway had almost no facilities. Supplies were stored under coconut trees, pilots slept on the ground or in their planes, and bombers were fueled by bucket brigades. With the arrival of additional construction units, conditions began to improve. First to reach the island was the 7th Naval Construction Battalion, joined on 23 September by Company B of the 810th Aviation Battalion. While the Seabees concentrated on completing a bomber field at Pallikulo, near the southeastern tip of the island, the aviation engineers began construction of a second one at nearby Pekoa. Clearing the tangled growth of teak and banyan trees which covered the Pekoa site was in itself a major undertaking, made still more difficult by frequent enemy bombings. Yet, by early December, a coral runway 5,500 feet long, 2 miles of taxi-

[80] (1) Incl to Ltr, Halsey to COMINCH, 3 Sep 44. 6–13.0309/44 (7211) SP Camp—Narrative Acct, 3 Sep 44. (2) Incl to Ltr, Harmon to Handy, 6 Jun 44. 98–USF2–0.5 (3721)M, 6 Jun 44.

ways, and 75 hardstands had been put in. On 23 November, the 822d Engineer Aviation Battalion had landed. Part of this unit went to Pallikulo to build hardstands, taxiways, a pier, and a control tower, and part went to Pekoa to help the engineers there. Most of the battalion, however, was put to building roads, camps, and a hospital. Although the facilities on Espíritu were limited and crude, they played an important role in backing up the forces in the Solomons.[81]

The first Army engineers to reach Guadalcanal were members of the 57th Combat Battalion of the Americal Division who arrived on 12 November in the midst of the decisive battles. After unloading during an air attack and witnessing a naval engagement off the coast, the men took the lay of the land. Clearly, engineers were needed here. Some ninety miles long and twenty-five miles wide, Guadalcanal had a generally rugged terrain. A chain of mountains ran its entire length from east to west, with the highest peak, Mount Popomanisu, reaching an elevation of nearly 8,000 feet. Along the central part of the northern coast were flat, sandy beaches, in back of which was a plain extending west to the Matanikau River. Beyond the river, the plain narrowed and was broken by ridges and ravines. The American beachhead was on the northern coast east of the Matanikau, whereas the main enemy strength was lodged near Mount Austen in the foothills southwest of the American position and in the area beyond the river. Guadalcanal had almost no roads. At the time of the invasion, the island's network had consisted only of a trail along the northern shore and a few native footpaths into the hinterland. Marine engineers had done much good work, improving the coastal track and starting a road toward Mount Austen, but an immense job remained to be done. Although the 57th Combat Battalion was to be employed in clearing mines, supplying water, and doing many different types of construction, its principal concern was to be roads and bridges. The men did not have long to wait before beginning. On 18 November they were sent to support the infantry in an attempt to push the Japanese westward along the coast. In a hard-fought action, the troops succeeded in establishing a bridgehead on the west bank of the Matanikau. By the 21st the engineers had completed a span over the flooded stream and heavy vehicles were rolling across. Two days later the Americans were firmly established west of the river.[82]

Late November and early December witnessed preparations for the final offensive. Now the combat battalion was occupied with what the men referred to as "normal duties." One group helped the marines clear out enemy machine gun nests, using dynamite and

[81] Craven and Cate, eds., *Guadalcanal to Saipan*, p. 37ff. (2) Hq XIII AF Serv Comd Hist Monograph 17, The Opns of Avn Engrs in SOPAC, Jan 42–Aug 44, pp. 82–87. COMD–AF–SV–13–HI, Jan 42, Maxwell AFB. (3) 810th Engr Avn Bn, Hist From Activation to 31 Dec 43. (4) 822d Engr Avn Bn, Hist Data, 15 Apr 42–1 Jul 43. (5) *Building the Navy's Bases*, II, 228–30.

[82] (1) 57th Engr Combat Bn, Jnl–War Diary, 7 Dec 41–21 Mar 45. 300–Engr–0.7 (2540)(M). (2) Hist of the 57th Engr Combat Bn, 19 Jan 42–1 Jul 43. Engr–0.1. (5217) Master. (3) Miller, *Guadalcanal*, pp. 43–44, 202–09, 225.

bottles filled with gasoline and explosives. Another helped construct a fighter strip near the front lines, while marines stood guard against enemy raiding parties. A third worked to complete a hospital and provide shelters for division headquarters. Some of the engineers prepared artillery and radar positions along the northern shore. Others took over the operation of water points. By far the largest contingent worked in the valley of the Matanikau, building bridges and cutting trails. Prevented by the shortage of cargo space from bringing in more than a fraction of their equipment, the men had to do most of their work by hand. As in Papua, the climate and terrain were anything but favorable. The days were intensely hot, the nights were cold, and downpours were frequent. Streams were swollen and roads were mudholes. The ridges west of the river presented an added difficulty. Whenever they could, the engineers ran the roads through the lowland rain forests, laying corduroy of coconut logs to keep the traffic out of the muck. Where the jungles were impenetrable, the road builders had to take to the ridges. Because construction here required innumerable fills, great quantities of coral and gravel had to be hand-loaded and trucked in. The men worked long hours, their clothes often wringing wet, and they shivered through the chilly nights. Before long, symptoms of fever and malaria began to appear.[83]

In mid-December the pace began to quicken. On the 16th General Patch ordered the capture of Mount Austen. Two days earlier, a part of the 57th engineers had started extending the trail the marines had built toward the enemy strongpoint. For a time the road crews kept pace with the advancing infantry. But when the foothills were reached, construction slowed almost to a halt. Here the engineers encountered slopes with grades of up to sixty degrees. The rains became more intense. The battalion's heavy equipment, the trucks and dozers left behind on New Caledonia, were missed more sorely than before. As the engineers tried to extend the trail up the slippery mountainsides, the infantry outran its line of supply. Such food and ammunition as the forward elements received was dropped from the air or carried in by native bearers. The hard work of the engineers was sometimes coupled with danger. On the 19th, a group of enemy infantrymen infiltrated the American lines to harry the men busy on the road. On the 21st one officer and five enlisted men of the 57th answered a call for volunteers to remove a mine field that stood in the way of the advance. These engineers, locating the mines without detection devices, removed 225 before they were ordered to stop. They met their death when the truck in which they were hauling the mines to a depot mysteriously blew up. Occasionally the men of the 57th applied engineering techniques to the problems of other services. When the medics had difficulty evacuating casualties from the

[83] (1) 57th Engr Combat Bn, Jnl-War Diary. (2) Hq 57th Engr Combat Bn, Opns Rpt, 12 Nov 42–9 Feb 43. 300-Engr-0.3 (25307) Master. (3) 57th Engr Combat Bn, Unit Rpt 22. G–3 Jnl File, 300–3.3 (23311). (4) Rpt, Liaison Off for Air Ground Opns Hq HD to CG HD, 27 Jan 43. 381 (SOPAC) 1943.

heights around Mount Austen, the engineers devised litters with skids that could be eased downhill and stretched cables on which litters could be moved across ravines by means of pulleys. The main work of building roads meanwhile went forward, receiving a boost on 30 December when a sizable group of natives was assigned to help. By early January the Japanese on Mount Austen had been compressed into a small area and the infantry had turned west toward the Matanikau.[84]

On 10 January Patch launched the final offensive. The Americal and 2d Marine Divisions struck west along the coast and the 25th Infantry Division pushed through the hills beyond Mount Austen, with the object of surrounding and annihilating the enemy forces. Two engineer combat battalions took part in the advance, the 57th and the 65th, the latter having recently arrived from Hawaii with the 25th Division. The second engineer unit was more poorly equipped than the first, for it lacked not only bridging materials gasoline-operated saws, and many minor items, but dump trucks as well. It had but two bulldozers, described by the battalion commander as being "of inferior make, partially worn out, and too light for the job." Again, the engineers functioned mainly as road builders. But now, in addition to extending the interior and coastal trails, they had to keep open lateral communications between the two spearheads of the advance. Natives helped hack trails through the jungles and put down corduroy. The difficulty of supplying troops in the interior was eased to some extent when the engineers dredged the Matanikau, enabling boats to ply up and down the river. As the fighting moved westward into increasingly rugged terrain, ravines too deep for filling were spanned with trestles. Heavy rains, almost unbearable heat, and frequent bombings and strafings added to the strain. By mid-January the malaria rate in some of the engineer platoons had reached 40 percent. Gradually the Americans made their way westward. On 1 February an amphibious force landed near Cape Esperance, on the northwestern end of the island, cutting off the Japanese retreat. During the following week, some of the enemy were evacuated, the remainder were hemmed in. On the afternoon of 9 February the engineers got the welcome news that organized resistance had ended.[85]

Problems of Logistics

Japan's expansion southward had been stopped. Australia and the islands in the South Pacific at last seemed secure. The victories at Buna and Guadalcanal, however significant in themselves, were also indicative of the growing Allied strength in the Far Pacific. While combat troops were fighting in Papua and the Solomons, service forces, some

[84] (1) Miller, *Guadalcanal*, pp. 237–52, *passim*. (2) 57th Engr Combat Bn, Jnl–War Diary. (3) Craven and Cate, eds., *Guadalcanal to Saipan*, p. 82. (4) Hq USAFISPA GO No. 310, 19 Oct 43.

[85] (1) Miller, *Guadalcanal*, pp. 254ff. (2) Maj George F. Dickson, Rpt, Opns of the 65th Engr Bn in Opns of 25th Inf Div on Guadalcanal 17 Dec 42–5 Feb 43, pp. 145–148. 3.2.11 Guadalcanal Opns. (3) 57th Engr Combat Bn, Jnl–War Diary. (4) Incl to Ltr, Harmon to OPD, 6 Jun 44. 98–USF 2–0.5 (3721) M, 6 Jun 44.

distance to the rear, were laying the foundations for further victories. Australia, New Zealand, and New Caledonia, once hardly more than rallying points, could now be counted as bases capable of supporting major offensives. Stretching from Port Moresby to Fiji was a chain of advance bases that guarded the vital areas to the south and rendered more vulnerable the enemy's forward positions. Communications with the United States were surer than before. Slowly the Allies were gaining the upper hand.

To accomplish so much had not been easy. The very presence of the U.S. Army in the South and Southwest Pacific was the reaction to Japanese offensives rather than the result of prewar planning. Before the outbreak of war, little thought, if any, had been given to the unique problems that now confronted the commanders of the South and Southwest Pacific. Such questions as how to go about building in New Guinea and New Caledonia and what the size and composition of an engineer force should be and how it could be supplied had scarcely been raised, much less answered. Not only the absence of long-range planning but also the immense distances, the shortage of shipping, the production lag in the United States, and the priority of the war against Germany, all conspired to slow the progress of the war in the Pacific. In the two theaters which then bore the brunt of the conflict against Japan, the engineers found themselves under the necessity of relying on makeshifts, exploiting local resources to the utmost, and exercising ingenuity. This was no less true in the rear areas than in the combat zones.

Troop Shortages

One of the principal drawbacks was the shortage of engineers. In both the South and Southwest Pacific the number was far too small. By the end of 1942, there were but 7,684 under MacArthur and 8,770 under Halsey to support about 100,000 Army troops in each theater. Not only were the engineer components too slim, but they were also not properly constituted. There were too few construction units, and most of them were not adequately equipped. Only the aviation battalions had anything like enough machinery. The general service regiments and separate battalions, originally organized as hand labor outfits and expected to use machinery only to a limited extent, were not prepared for the tasks they faced in the Pacific. The combat battalions, which frequently had to be thrown on construction jobs, were neither trained nor equipped for such missions. Efforts to get more of the right kind of construction units from the United States were thwarted by the policy of defeating Germany first and by the shortage of shipping. An alternative was to increase the effectiveness of the units already in the theaters. In the Southwest Pacific the separate battalions were converted into general service regiments, and the tables of equipment of all the regiments were then revised to bring them more in line with those of the aviation battalions. In both theaters, additional equipment was authorized for units engaged in construction. Still, the engineer forces in SWPA and SOPAC (South Pacific Area) could not meet the requirements. Fortunately, additional military and civilian forces were on hand

to perform much vital construction. The engineers of the Southwest Pacific received their greatest support from the Royal Australian Engineers, who by late 1942 totaled some 25,000, from the Royal Australian Air Force engineers, now grown in number to about 2,700, and from the Allied Works Council, which had 52,000 men on its rolls at the end of the year. Seabees and Marine engineers, together with New Zealand troops and civilians, undertook a large share of construction in the South Pacific. In remote and backward areas, it was the natives who often made up a large part of the labor force.[86]

Supply Problems

Just as critical as the shortage of troops was the scarcity of supplies. Insofar as the Engineers were concerned, the War Department's plans for supplying the far Pacific were unrealistic. Five categories of material were furnished the Army. The Engineers were concerned primarily with two of them, Class II and Class IV. Issued to units in accordance with tables of equipment, Class II items were expected to suffice for routine work. Class IV stocks were those needed over and above Class II, usually for extensive construction projects. Soon after the United States entered the war, the Assistant Chief of Staff, G–4, authorized a 90-day level of supply for both Class II and Class IV items in the far Pacific. In July 1942 a 90-day reserve was added. Engineer stocks in the two theaters never approached such levels. Shipments from the United States fell short of requirements, and local resources were not rich enough to make up the deficiency. In rugged jungle terrain where everything had to be built from the ground up, supplies were expended in unprecedented amounts. The engineers in the Southwest Pacific received more matériel in terms of tons from all sources than any other service—about 40 percent of the total. But since most of their supplies were heavy construction materials, which were expended as quickly as they were obtained, the engineers were not able to build up any reserves. To make matters worse, the engineers in the theaters did not get detailed information on strategic plans far enough in advance to make intelligent estimates of what or how much they would need. By the end of the year construction forces were still operating "virtually on a hand to mouth basis." [87]

After construction equipment and materials in the United States had been earmarked for the Pacific, months elapsed before they reached their destinations. One reason for the lag was the small proportion of shipping space allotted to engineer items. Although their supplies were exceedingly bulky, and although the Engineers were more

[86] (1) WD AGO, Monthly Strength of the Army. (2) Leighton and Coakley, *Global Logistics and Strategy*, pp. 412–14. (3) USASOS SWPA GO No. 4, 29 Jul 42. (4) Ltr, Casey to Brig Gen S. C. Godfrey, AF Engr, 1 Jan 43. 381 (Australia). (5) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 32–34. (6) Incl to Ltr, Farrar to Teale, 27 Jan 43. SWPA File 94.

[87] (1) WD Ltr AG 400 (1–31–42) MISC–D–M to CG USAFIA, 2 Feb 42. 33861 sec. II (Jan 42). (2) Leighton and Coakley, *Global Logistics and Strategy*, pp. 335–36, 734. (3) Of C Engr GHQ AFPAC, *Engrs of SWPA*, VIII, 49, 56. (4) Memo, Casey for Lt Col R. C. Kramer, AUS, 14 Mar 43. SWPA File M51.

heavily dependent on shipments from the United States than most of the other services—the Quartermaster Corps, for example, could procure plenty of food in Australia and New Zealand, whereas the Engineers could get almost no heavy machinery there—only 14 percent of the cargo space on transpacific transports was reserved for the Engineers. From April through December 1942, 353,023 measurement tons of cargo were shipped from the United States to the Quartermaster Corps in the Southwest Pacific, only 53,500 tons to the Engineers. Partly because of inadequate transportation and partly because of such factors as equipment shortages and administrative delays, engineer troops were sent from the United States without their machinery. With monotonous regularity, units arrived with little or no equipment. On 7 November the 131st Combat Battalion landed in New Caledonia with three dump trucks; by the end of the year the rest of their equipment still had not arrived. The 828th Aviation Battalion reached Efate in mid-November; its equipment did not show up until February. Much time was wasted because units had almost no equipment to work with. As Matthews pointed out, "an engineer unit without its plant and tools is like an artillery unit without its guns." [88] Once ships put in at Brisbane, Sydney, or Auckland, there remained the work of sorting and distributing their cargoes. Consignments were often jumbled; ships' manifests, incorrect; and labels, missing. Distances within the theaters were enormous. Ships traveling from Brisbane to Port Moresby had to cover a distance of 1,500 miles; those going from Nouméa to Guadalcanal, 1,000. Shortages of local shipping intensified the problem. The lack of port facilities made matters still worse, especially at Nouméa harbor, where congestion was particularly severe.[89] It is hardly surprising that many engineers in New Guinea and the Solomons firmly believed that supplies intended for the forward areas were being held back by commanders at rear bases to be used on their own special projects.

Such little equipment as the units did receive, they had trouble keeping in working order. Part of what they got was in poor repair, while much of it was too light for heavy construction jobs. All of it was put to hard and continuous use by the troops, many of whom had inadequate training as operators and slight knowledge of preventive maintenance. Breakdowns were frequent and once out of commission, a machine might stand idle a long time. First to be reckoned with was the exasperating shortage of spare parts, a shortage aggravated by the great variety of makes and models to be serviced. Four different makes of medium-type tractors alone were sent to the engineers in the Pacific. Each had its own line of parts to be stocked and distributed. Next was the matter of finding skilled mechanics. Repeated re-

[88] (1) James R. Masterson, U.S. Army Transportation in SWPA 1941–1947, Monograph, Transportation Unit Hist Div Spec Staff, U.S. Army, Oct 49, app. 21. OCMH Files. (2) Ltr, Lt Col Raymond L. Harrison to Col C. Rodney Smith, OC of Engrs, 18 Jan 43. EHD Files. (3) Ltr, CO 828th Engrs to AF Engr, 5 Jul 43, in 828th Engr Avn Bn, 314.700, Hist Data. Engr-828-HI, 15 Apr 1942–31 Oct 1945. (4) Matthews, Data for Hist Rpt, p. 9.

[89] Leighton and Coakley, *Global Logistics and Strategy*, p. 390.

quests from the theaters for equipment repair units brought the word from Washington that none were available. Finally, on 10 November, the 472d Engineer Maintenance Company landed at Nouméa, the sole unit of its kind to be sent to the far Pacific in 1942. Within a few days the men were swamped with work. Because their shop equipment was being sent on a later transport, they had to tackle the tremendous backlog of repairs with a few tools borrowed here and there.[90] A month after reaching New Caledonia, the unit's commander wrote, "Life is very busy over here, but very interesting, what with three-cylinder Southern Cross engines, Leeds-Fowler power units, five-cylinder Paxman-Ricardo diesel engines, 75-year-old French locomotives, Nippon brand cement mixers, [and] miscellaneous Japanese electrical apparatus . . . there is never a dull moment."[91] The situation in the Southwest Pacific was not encouraging. Visiting the two theaters in January 1943, Lt. Col. Raymond L. Harrison, head of the Spare Parts Branch, Supply Division, Office of the Chief of Engineers, was alarmed to find that 40 percent of the equipment in SWPA was deadlined. Recalling the prodigal expenditure of equipment and spare parts on construction jobs in the States, he wrote his chief, "I cannot help but believe . . . that sufficient preference is not being given to overseas requirements. . . . I am appalled by the lack of equipment and spare parts in overseas theaters with active fighting fronts."[92]

Both Australia and New Zealand were making determined efforts to ease the shortage of construction supplies. Having diverted as much as they felt they could spare from existing stocks and current production to American projects, the Australians branched out into new manufacturing fields. Using pilot models developed in Colonel Teale's office from designs drawn by General Casey's staff, the seven firms of the Earth Moving Manufacturers Group tooled up to make heavy construction machinery. Between April and September 1942 the engineers contracted for the manufacture of £2,000,000 worth of heavy equipment in the Commonwealth. Not much equipment could be expected from New Zealand. The only supplier in SOPAC, New Zealand had a much smaller productive capacity than Australia and was itself badly in need of machinery. Almost no tractors had been imported since 1938, and in 1940 the best of New Zealand's plant had been sent to the Middle East, Malaya, and Fiji. By September 1942 members of the New Zealand Supply Mission in Washington were complaining that their country was "almost without plant," and Prime Minister Fraser was warning that important defense construction could not be completed unless tractors and carryalls were forthcoming from the United States. But New Zealand was able to contribute some supplies. Like Australia, it furnished materials on reverse lend-lease

[90] (1) Ltr, Hq USASOS to TAG, 22 Jul 42. 400.312 (Australia) 1942–43. (2) 472d Engr Maint Co, Orgn Hist, 1 Oct 42–31 Dec 42.

[91] Ltr, CO 472d Engr Maint Co to Smith, 14 Dec 42. Of Files, R&D Div, Mech Engineering Br Maint Misc No. 1, EHD Files.

[92] Ltr, Harrison to Smith, 28 Jan 43. 400.312 SP Area.

through the Joint Purchasing Board. The New Zealand Joint Supply Council turned over to the Americans names of local firms supplying the Dominion's armed services, with the understanding that these concerns would make goods available at the same preferential prices charged the New Zealand forces. The Dominion became the principal, and for some items the only source of engineer construction materials in the South Pacific. It furnished large quantities of cement, asphalt, plywood, piping, and fibrolite roofing. Yet however hard the Australians and New Zealanders might try, they could succeed in easing only slightly the shortage of construction supplies.[93]

Supply Organization in the South Pacific

In some respects, the engineers in SOPAC were worse off than those in SWPA. The South Pacific had only a rudimentary logistical organization at the time the Guadalcanal Campaign began. Each of the island garrisons was more or less independent and each was left largely to its own resources. Coordination between supply agencies of the Army and the Navy left much to be desired. Once the struggle for Guadalcanal had begun, the need for better control became increasingly apparent. By November action could no longer be postponed. Scores of ships jammed Nouméa harbor awaiting their turn at the docks. Troop movements were slowed. Units building on Efate and Espíritu Santo and troops fighting on Guadalcanal meanwhile waited for sorely needed supplies. On 10 November the War Department activated Services of Supply (SOS), USAFISPA, under the command of Brig. Gen. Robert G. Breene. Headquarters, originally at Auckland, was moved to Nouméa at the end of the month. Breene established three subordinate service commands, one on New Caledonia, another on New Zealand, and a third on Fiji. The setup at the other bases was left unchanged for the time being, but plans were made to organize additional commands if the situation warranted. The job of Engineer, SOS, went to Colonel Beadle. Since he continued to serve also on Harmon's staff, he henceforth acted in a dual capacity. In December he transferred all personnel from his section in USAFISPA to the one in SOS, retaining purely nominal duties as Engineer, USAFISPA. Since his office in SOS was now the sole agency for supervising and planning engineer work in the South Pacific, Beadle had important responsibilities. It was he who must find the wherewithal to carry out the Army's construction program in SOPAC, get more engineer troops and equipment from the United States, and exploit local resources to the fullest. It was he too who must handle the difficult assignment of fitting the Army engineers into an Allied theater under the command of a naval officer.[94]

[93] (1) Engr Br Proc Div USASOS, 12 Dec 44, Hist Rpt, Engr Proc in Australia. (2) Ltr, New Zealand Sup Mission, Washington, D.C., to Defense Aid Unit Rqmts Br Sup Div OCE, 14 Sep 42. 400.333 New Zealand. (3) Incl, U.S. Joint Purchasing Bd, SOPAC, Proc Procedure, with Ltr, Halsey to Joint Purchasing Bd *et al.*, 6 Dec 42. 381 (SWPA) 41. (4) Hist of USAFISPA During World War II, 30 Mar 42–1 Aug 44. Draft MS, OCMH files.

[94] (1) Leighton and Coakley, *Global Logistics and Strategy*, pp. 398–402. (2) SOS SOPAC, Hist Rpt

Australian-American Co-operation

In the Southwest Pacific one of the foremost problems continued to be that of bringing about more effective Allied co-operation. The Australian Government kept a tight rein on military construction within the Commonwealth and its territories. The views of the Curtin cabinet and those of the U.S. engineers did not always coincide. One point of difference was organized labor. The government, drawing much of its support from the trade unions, was sensitive to their demands. The engineers, who had to rely on Australian workmen for many urgent jobs, deplored what they considered the government's pampering of the workers. Of even greater concern to the engineers was the government's attitude toward the construction program as a whole. Many projects that the Australians seemed to consider highly important the engineers continued to regard as unnecessary. By the end of 1942, there were numerous complaints that more jobs had been authorized than could be completed within a reasonable time. In Queensland alone, one member of Teale's staff asserted, there was enough work to keep the "existing labor forces busy until the end of September 1943." A number of engineers believed that the entire construction program in Australia should be radically revised. Few of them realized that the Commonwealth had undertaken its defense construction program with an eye to the postwar period. A policy document prepared by the Economic Cabinet in February 1940, had bracketed plans for increasing the nation's military strength with programs for water conservation, rural electrification, afforestation, and the enhancement of the "beauties and amenities of country towns." Various public officials continued to emphasize that the postwar economy must be kept in mind while industry and commerce were being mobilized for war.[95]

The leisurely pace at which the governmental machinery moved was a constant source of irritation to the engineers, who found it hard to understand why so many agencies had to pass upon every project. Shortcuts were proposed repeatedly. Col. Bernard L. Robinson, for instance, suggested that the War Ministry, instead of investigating to find out if projects were justified, ought to limit its activities to providing funds to get construction started promptly. In an attempt to expedite work for the American forces, Colonel Teale began submitting requests for construction directly to the Allied Works Council as soon as he received word that the Chiefs of Staff Committee had assigned a priority. The engineers saw nothing irregular in Teale's stratagem. As Robinson pointed out, Mr. Theodore was empowered to undertake "works of whatever nature required for war purposes by [the] Allied Forces in Australia." But the Commonwealth Government saw things in a different light. On 4 September Prime Minister Curtin protested to MacArthur. The supreme com-

from Activation to 30 Jun 43. 98-SS2-0.1 (23774) M. (3) Hq SOS SOPAC SO No. 1, 10 Nov 42.

[95] (1) Matthews Ltr, 10 Nov 49, pp. 21–22. (2) Pat Robinson, *The Fight for New Guinea: General Douglas MacArthur's First Offensive* (New York, 1943), p. 25. (3) Ltr, Farrar to Teale, 27 Jan 43. SWPA File 94. (4) Hasluck, *The Government and the People*, pp. 469–70.

mander was reminded that putting requests through regular channels was "not only essential to sound budgetary planning in view of the incidence of the Reciprocal Lend-Lease Agreement, but also . . . to ensure that all important works proposals affecting the war effort in Australia come before the War Cabinet for consideration." MacArthur's reply was an endorsement of Teale's shortcut. He stated that in his opinion the approval of a project by the Chiefs of Staff Committee followed by assignment of a priority was sufficient justification for starting construction. He furthermore assured the Prime Minister that a fund of several million dollars was available in case Australian funds were not sufficient for American construction needs. But MacArthur could not persuade the government to alter its methods. The War Cabinet continued to insist that, in view of Australia's severe limitations in manpower and resources, all requests for construction must be closely scrutinized. Procedures remained as they were.[96]

The Australians did make one major change the engineers considered long overdue. They let their demolitions program go by the board. MacArthur, who was inclined from the first toward an offensive strategy, had never deemed the program appropriate. But the Commonwealth government was fully and it seemed, irrevocably, committed to a scorched earth policy. A directive issued in July 1942 had stated: "Denial plans should aim at total destruction . . . and should not be compromised by any desire to recover resources intact when the enemy withdraws. He will most certainly himself destroy anything of value in his retreat." [97] As General Blamey pointed out to the Americans, even the limiting of destruction to important industries would "involve a major change in a policy that had already been given wide circulation." MacArthur had decided not to press the issue, and the various Australian states had gone ahead with their preparations for total destruction. By late 1942 New South Wales had drawn up a scorched earth code and had mined numerous roads and bridges. Western Australia had completed total denial plans for her principal cities. Even Tasmania had a detailed and comprehensive plan for total destruction. But as the fear of invasion abated, less attention was devoted to denial schemes. By the end of the year preparations for destruction had all but ceased. Although the government was still officially bound to it, the scorched earth policy was a dead letter.[98]

Changes in Design

Since there was little the engineers could do to augment their resources further, they were forced to seek ever more efficient methods of doing things.

[96] (1) Memo, Robinson for Casey, 7 Oct 42. (2) Ltr, Secy of the War Cabinet to MacArthur, 4 Sep 42. (3) Ltr, MacArthur to Curtin, 25 Sep 42. (4) Memo [Capt] M. D. L[ovett] for Casey, 28 Nov 42. All in SWPA File 270.

[97] Incl to Memo, F. G. Shedden for the Secy, Dept of the Army, 27 Jul 42. SWPA File 175.

[98] (1) Memo, Casey for Steele, 2 Sep 42. (2) Incl to Ltr, ALF to Aust Liaison, Of C Engr GHQ SWPA, 8 Dec. 42. (3) Memo, C Engr First Aust Army for G (o), 29 Dec 42. All in SWPA File 175.

As Casey pointed out many times, they had to do more with less. The main idea was to give the combat forces what they required in the shortest possible time and with a minimum of effort. This meant lowering construction standards, devising shortcuts, and resorting to improvisation. During 1942 the greatest strides toward increased efficiency were made in the Southwest Pacific. Here an effective theaterwide engineer organization had functioned at a much earlier date than in the South Pacific. After the Battles of Coral Sea and Midway had ended Japanese naval predominance and placed the South Pacific seemingly beyond the enemy's reach, the danger to the Southwest Pacific still remained, making speed of construction particularly urgent there.

During their first year in the Southwest Pacific, the engineers had to make frequent changes in structural plans. By late 1942 there were few vestiges left of the original theater of operations drawings. To make possible better use of local materials, theater of operations designs had been revised and many of them had been replaced by blueprints for less substantial structures. With the demand for quarters, hospitals, and storage space rising rapidly, the engineers could not afford to miss any opportunities to save on manpower and materials. There was a marked trend toward flimsier housing. In the early days of the war, most Americans had occupied fairly commodious quarters in Australian barracks, hotels, apartments, and private homes, and the first camps constructed for United States troops had featured screens, electricity, and waterborne sewerage. But as time went on, more and more men were living in tents, sleeping on the ground, dining in unfloored mess halls, working in unscreened offices, and doing without electric lights and modern plumbing. For a while floors could be put in mess halls, and bunks and floors in tents, if time and funds permitted, but later, standards became still more rigorous. A construction policy issued by GHQ SWPA in October eliminated tent floors entirely and cut out nearly all other refinements. Although no such drastic innovations could be made in hospital designs, floored tents and prefabricated huts had made their appearance at many medical installations by the close of the year. Similar developments occurred in the design of warehouses. One popular new type was a modified version of the theater of operation warehouse with the interior columns eliminated—a change made possible by the amazing strength of Australian hardwoods. Another was the standard storehouse of the Australian Army, also designed to take advantage of the unique characteristics of native timbers. A third was a prefabricated, portable warehouse of corrugated iron developed by the Australians. A fourth, and among the most widely used, was the igloo warehouse, modeled on a hangar designed by Mr. Brizay, a French engineer who had come to work for the base section engineer in Brisbane after fleeing from Malaya. Brizay's hangar consisted of arches constructed of scrap lumber, held together by purlins and covered with camouflage netting. By taking such a hangar, adding a concrete floor and a corrugated iron or fibrolite

roof, and closing the ends, a large and roomy warehouse could be quickly provided.[99]

Construction for the Army Air Forces, which represented about 80 percent of the engineer program, offered a rewarding field for savings. When the war began, blueprints for military airports were more or less standard. Fields were to have three intersecting landing strips running in the direction of the prevailing winds. Strips for fighters were to have an average length of 3,000 feet, those for medium bombers, 4,000, and those for heavy bombers, 5,000. All runways were to be 150 feet wide with a 1,000-foot clearing on each side. The engineers soon discovered that the shorter runways did not work out in SWPA. Overloaded planes needed extra length to take off, and disabled ones, to land. In the fluid tactical situation, a field might be used by fighters one day and by bombers the next. Six-thousand-foot runways, capable of taking the heaviest craft, became the rule. The added effort expended on longer airstrips was more than offset in other ways. Since it was found that pilots could align their planes just as easily on narrower strips, runways were reduced in width to 100 feet. Because the speed of planes landing or taking off was at least 100 miles an hour, the direction of the wind made little difference. Intersecting runways were replaced by parallel strips, and thus satisfactory sites could usually be located more quickly and less earth moving was required. "We tended," Matthews explained, "to go not to wide runways but to double barreled and triple barreled runways, approximately parallel but separated by 100 feet or so between the edges of the pavement. This actually simplified both drainage and grading and gave us uninterrupted construction and paving work on each of the new strips while the older strip was in full use." [100]

Although the Air Forces generally preferred concrete pavements, few landing strips of that material were built in SWPA. Runway surfaces, the engineers found, had to be neither so thick nor so rigid as had previously been thought necessary. The first designers of airfield pavements, most of them highway engineers, had usually assumed that a runway must be strong enough to carry a wheel load one and one-half times the weight of the plane. With the fast new planes of World War II, most of the weight in landing and taking off was borne by the wings, not the wheels. With this discovery, the concrete runway passed from the scene in SWPA, for it was both expensive and time consuming to build. In Queensland and New Guinea, graveled strips were the rule. But wherever possible, the gravel was topped with bitumen to give a better wearing surface and eliminate dust. A thin bitumen surfacing of the type used on country roads in the United States served the purpose well. Four coats were applied for heavy planes and two for light on a gravel base from three to

[99] (1) Of C Engr GHQ SWPA Annual Rpt for 1942. (2) Ltr, CG USASOS to CG Fifth AF *et al.*, 3 Oct 42. SWPA File 275. (3) Memo for Rcd, Casey, 25 Nov 42. SWPA File 94. (4) Memo for Rcd, Casey, 25 Nov 42. SWPA File 159.

[100] (1) WD OCE, Info Bull No. 53, 1 Aug 40. (2) Matthews, Data for Hist Rpt, pp. 26ff. (3) Ltr, Casey to Godfrey, 1 Jan 43. SWPA File 497. (4) Matthews Ltr, 10 Nov 49, p. 35.

five inches thick. A half-inch layer of pea-size gravel was then spread on the bitumen and rolled. This thin paving saved a great number of man-hours, and although it was sometimes picked up by the wheels of the planes, especially in the turnaround areas, repair was easy. While gravel and bitumen runways became standard, the engineers experimented with other types of paving. Soil cement, a recent development in the United States, was tried for the first time in Australia. The formula called for about six parts of dirt and gravel to one part of cement, with water added. The mixture formed a weak concrete but saved a good deal of labor, since it made use of the materials found at the site of construction and thus eliminated the hauling of gravel and rock. It was tried on an experimental basis at Roto and North Burke, two fields of the Melbourne-Cloncurry ferry route. Visiting Roto in mid-November, Colonel Robinson reported that the first runway there had been completed in six weeks, and the second, in two. He expected the strips to give good service for one or two years. However, since soil cement did not stand up as well at bitumen and gravel and cost half again as much, it was not widely used. The engineers made rather extensive use of the recently developed Marston mat, or pierced steel plank, as an alternate type of surfacing to bitumen and gravel. Capable of being put down quickly, the mat proved very satisfactory when placed on a firm foundation.[101]

Putting in runways was only a small part of the job of building an airfield. In addition to well-paved and well-drained strips, a complete airdrome included miles of taxiways, innumerable hardstands and dispersals, and such necessities and refinements as operations buildings, hangars, fuel storage and dispensing systems, camouflage, and revetments. The engineers in SWPA could not hope to build such elaborate fields. Any feature that could be dispensed with had to be omitted if essentials were to be provided. Little was done with camouflage. Making an airfield invisible from the air was anything but easy, and the engineers considered the effort unjustified in any case, since the enemy would have little trouble locating an active airdrome even if it were camouflaged. During the early months of the war some attention was paid to camouflage in Australia. Several types of hangars were designed which could be quickly erected and would serve to hide planes, the best known being Mr. Brizay's igloo. In the advanced areas, concealment became largely a matter of dispersal. Revetments were gradually eliminated. Originally, the engineers had been called upon to build an enormous number of them, each one consisting of a hardstand with an earthen wall fifteen feet high on three sides. It took three D–8 tractors about three days to produce one such revetment. When it became apparent that the best protection was a strong air force ready to meet the enemy in the skies, the engineers stopped

[101] (1) Matthews, Data for Hist Rpt, p. 27. (2) "Bituminous Surfacing of Flight Strips in Combat Zones," *The Military Engineer*, XXXV (November, 1943), 552–54. (3) Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, 442ff. (4) Of C Engr GHQ SWPA Annual Rpt for 1942. (5) AWC *Report, February 1942–June 1943*, pp. 40ff. (6) Memo, Robinson for Sverdrup, 18 Nov 42. SWPA File 94.

putting earthen walls around hardstands. Still other items were dropped. Hangars were seldom built. Gasoline storage tanks with fueling systems at airfields in the combat zones were a rare luxury. Usually gasoline was stored in drums.[102]

Work that could not be eliminated was sometimes postponed. During the dry season, graveled strips in northern Queensland and New Guinea went weeks and sometimes months before a coating of bitumen was applied. Planes landing and taking off raised huge clouds of dust which sometimes took as long as thirty minutes to settle. Calcium chloride was of no value here, for it was effective only when it could draw moisture from the air. In hot, dry climates it merely became additional dust. Gradually, the engineers brought the situation under control. At some fields they sprinkled the runways with oil and tar, while at others they experimented with solutions consisting of one part molasses and nine parts water, which proved quite effective. The delay in sealing the runways produced little more than a temporary annoyance. In deferring drainage work the engineers ran a greater risk. When the tropical downpours began, they were hard pressed to keep many of the fields, especially the highly critical ones at Moresby, from being flooded out. Hundreds of culverts and drains had to be put in almost overnight. Many of them had to be built of wood or improvised out of gasoline drums with the ends knocked out, since stocks of pipe and cement had been quickly used up. Adequate drainage could not be supplied in a hurry, and several runways gave signs of buckling as water seeped into the subgrades. The strips at Seven-Mile were weakened by underground springs, which put the field out of operation for a time. Early in December, Casey flew to Moresby to see the fields at firsthand and discuss with the airmen some of the problems about which they had been continually complaining. Talking to Kenney, he maintained that the engineers had, on the whole, done a splendid job. Few fields had been out of operation and then only for a short time. But in conversations with the engineers, Casey expressed his dissatisfaction over the way drainage had been handled. He was not convinced "that all had been done that could be done." Suggesting that closer attention and more intelligent thought be given to this aspect of construction, he reminded the engineers that even though a strip might consist of "six-inch armor plate, if it rests on soup it will sink and not support anything." So long as the rains continued, conditions were far from ideal. Even so, the disaster that some had predicted, the grounding of large numbers of planes, did not occur.[103]

Construction Progress

Despite manifold difficulties, construction forces in the South and Southwest

[102] (1) Matthews, Data for Hist Rpt, pp. 28–29. (2) Ltr, Casey to Godfrey, 1 Jan 43. SWPA File 497. (3) Memo, Robinson for Casey, 9 Oct 42. SWPA File 496.

[103] (1) Ltr, Casey to Godfrey, 1 Jan 43. (2) Of C Engr GHQ SWPA Annual Rpt for 1942. (3) Incl, Advice from 808th Engrs, to Ltr, CO, 808th Engrs to Casey, 25 Sep 43. SWPA File 144. (4) Memos for Rcd, Casey, 10 and 11 Dec 42. SWPA File 130.



AIRSTRIP AT DOBODURA, SHOWING REVETMENTS. *Note the dust behind the plane.*

Pacific had succeeded by the close of 1942 in forging a chain of bases to secure the Allied position. All the engineer construction units in SWPA had been sent to New Guinea. At Moresby, where most of them were located, work was fairly well along. Finishing touches were being put on the airdromes, and base development was continuing with the improvement of the port and the building of depots, hospitals, camps, roads, and bridges. Though Milne Bay and Oro Bay were considerably behind Moresby, largely because of the swampy terrain and the shortage of engineers, they nevertheless showed some progress. At Milne, the troops had finished a ponton wharf, a Liberty dock, a pier for small ships, and several stretches of road, in addition to completing two airfields and surfacing them with steel mat. The third had been abandoned because of its swampy site. The engineers at Oro Bay, where work had only recently begun, had built a dock for barges and a few miles of road. In the South Pacific, also, construction had advanced. When the fighting ended on Guadalcanal, Espíritu Santo boasted four airfields, a seaplane base, three hospitals, ten small

camps, and thirty-two miles of roads. Efate had two bomber fields, a fighter strip, a seaplane base, a 600-bed hospital, and a rather extensive roadnet. Facilities on Viti Levu had been expanded to include a narrow-gauge railroad between Nandi and Narewa, several gasoline pipelines, and additional roads, depots, piers, and docks. Farther south, planes were staging over the alternate ferry route, which was operational by late 1942.[104]

Although New Zealand was a major Allied base in the South Pacific, the engineers did no construction there during 1942. Facilities for the U.S. forces, including some $3.3 million worth of camps, warehouses, and hospitals for the Army, were provided by the New Zealanders themselves through reverse lend-lease. The engineers confined their activities in the Dominion to exploring for oil. In April 1942, with the Netherlands Indies falling rapidly to the Japanese, and Allied tankers being sunk in large numbers, the War Department began seeking new sources of oil within the Pacific theaters. On the 29th General Somervell directed the Chief of Engineers to contract with the Superior Oil Company of California for the testing of certain promising geologic structures in New Zealand. A fund of $5 million was set aside for the purpose. By a fixed-fee contract signed on 2 May, the United States underwrote the costs of the exploration, and the company agreed, if oil were found, to reimburse the government with deliveries of petroleum. On 31 May Lt. Col. Cornelius Beard, who was to supervise the project for the Engineers, and a party of the contractor's men, reached Wellington, and from there left immediately for the site of a supposed oil field on the western coast of South Island. Drilling began late in June, after a force of local workmen had been assembled and rigs had arrived from the United States. In August a large shipment of machinery arrived for drilling on North Island. With the help of New Zealand troops, this equipment was moved ten miles beyond Palmerston North. During the first week in November work was abandoned on North Island with "absolutely negative" results, and a short time later drilling was suspended at the South Island site. Explorations were continued at other points on South Island, but, by the end of the year, no oil had been found.[105]

Insofar as the Army was concerned, the great base in the South Pacific was New Caledonia. This island was a beehive of activity. By early 1943 there were twelve Army airports on the island, seven of which were satellite fields and five, major dromes. Plaines des Gaiacs, the largest, had been vastly improved by

[104] (1) 46th Engr GS Regt, Hist for 1942–43. (2) 91st Engr GS Regt, Hist for 1942–43. (3) Incls to Ltr, CO 43d Engr GS Regt, to Of C Engr GHQ SWPA, 27 July 43. SWPA File 145. (4) Hq XIII AF Serv Comd, Hist Monograph 17, Opns of Avn Engrs in SOPAC, pp. 60–65, 82–87. (5) *Building the Navy's Bases*, II, pp. 228–30, 204–06, and 218–20. (6) Ltr, Maj. W. E. Wilhelm to Honolulu Dist Engr, 27 Dec 42. (7) Ltr, Capt H. N. Hockensmith to Honolulu Dist Engr, 3 Feb 43. (8) Ltr, Maj H. D. Wilbert to Honolulu Dist Engr, 12 Jan 43, with Incl. Last three in Engr AGF PAC.

[105] (1) Incl to Ltr, Hq USAF and Serv Comd APO 715, 21 Jan 43. 600.914 (New Zealand) 1943. (2) Beard, Concluding Rpt, 2 Oct 43. 678 SOPAC 1944. (3) WD OCE, Negotiations for Servs of Contractor on CPFF Basis. CE—New Zealand—Contract Negotiations, Rcd of. (4) Rad, Capt F. S. McNamara to CofEngrs, 6 Nov 42. (5) Ltr, Col. Joseph S. Gorlinski to Somervell, 19 Feb 43. Last two in 678 (New Zealand) 1945.

the 810th Aviation Battalion, and Tontouta, as a result of the almost continuous efforts of the 811th, was on the way to becoming perhaps the leading air base in the theater. Considerable attention had been devoted to ports and roads. In November the engineers embarked on a program of extensive development at Nouméa harbor. Reaching New Caledonia on the 7th of that month, the 131st Combat Battalion was given as one of its jobs the building of a new dock, 60 by 500 feet, complete with warehouses and a railroad siding. This unit also repaired the approach to the port's original dock. When the 955th Topographic Company arrived at Nouméa late in 1942, it went to work not on maps but on the harbor. While much of the construction and repair of highways was handled by the New Caledonia Department of Public Works, every engineer unit on the island, with the exception of the mapping company, had a part in widening, surfacing, and maintaining roads. The 810th alone kept up eighty miles of roads in the northern part of the island. Transforming New Caledonia into a major base necessitated all kinds of projects. Besides working on roads, ports, and airfields, the engineers had completed such varied assignments as building a new headquarters for USAFISPA, rehabilitating the tracks and rolling stock of the Nouméa-Paita railway, renovating a sawmill which had been out of operation for fifteen years, working in stone quarries, and putting a fence around Tontouta to keep out cattle and deer.[106]

Within the two theaters, the most extensive construction was still by far on the Australian continent. The program of the Allied Works Council included nearly every type of military installation —airfields, camps, depots, hospitals, arsenals, staging areas, and harbor defenses. Included also were munitions plants, aircraft factories, docks, defense highways, oil pipelines, radio stations, and telephone lines. By 31 December 1942, the AWC had built or improved over 200 airfields—to cite only one figure. In Queensland, a number of camps were going up, including four to house units expected soon from the United States. The center of construction activity remained in the southeast, where the bulk of the Commonwealth's defense projects were located. During the last months of 1942, the Australians began three large jobs in this area for the Americans. Two were hospitals, one of which, the largest in the Southwest Pacific, was being built at Herne Bay in Sydney, while the other, only slightly smaller, was going up at Holland Park in Brisbane. The third project was a huge supply depot at Meeandah near Brisbane, which was to have 47 warehouses dispersed over 260 acres. Notwithstanding the size of some of the installations being built for the Americans, work for the United States forces on the whole had dropped off considerably and accounted for only a small proportion of the AWC's construction by the end of the year. Funds being expended by the council totaled slightly more than forty-five million pounds on 31 Decem-

[106] (1) Hq XIII AF Serv Comd, Hist Mono 17, Opns of Avn Engrs in SOPAC, pp. 7, 66–80. (2) Hist of 810th Engrs, Oct–31 Dec 43. (3) Hist of 811th Engrs, 1 Dec 41–31 Dec 43. (4) Hist of 131st Engr Regt (Combat). (5) *Building the Navy's Bases*, II, pp. 221–25.



MOVING SUPPLIES ON THE REBUILT RAILROAD, NOUMÉA

ber, but only 6 percent of that amount was being spent for the Americans. Yet many of the Australian projects, by strengthening the major Allied base of operations in the Southwest Pacific, would benefit the U.S. forces.[107]

From their bases in the South and Southwest Pacific, the Allies hoped to launch large-scale offensives during 1943. As the old year ended, plans were already being drawn for the reduction of the Japanese stronghold at Rabaul. Once details of strategy and command had been settled and sufficient forces had been assembled in the theaters, operations would commence.

[107] (1) AWC *Report, February 1942–June 1943*, pp. 17–74, *passim*. (2) Of C Engr GHQ SWPA Annual Rpt for 1942. (3) Incl to Ltr, Farrar to Teale, 27 Jan 43. SWPA File 94.

CHAPTER VI

The Drive Toward Rabaul

Preparing for CARTWHEEL

With victory in Papua and on Guadalcanal virtually assured, the Joint Chiefs were ready to consider further offensive moves. On 14 January 1943, Roosevelt and Churchill met with the Combined Chiefs at Casablanca to discuss strategic objectives for the year. By 23 January over-all goals were fairly well agreed upon. Insofar as the South and Southwest Pacific were concerned, the main objectives in 1943 would be the carrying out of Tasks Two and Three of the directive of 2 July 1942. MacArthur's plan of campaign against the Japanese entrenched in New Guinea and the Solomons was named ELKTON. Basically it provided for a two-pronged drive toward Rabaul by Southwest Pacific forces along the coasts of eastern New Guinea and western New Britain and by South Pacific forces through the Solomons. (*Map 12*) But the assault could not be undertaken at once. There were not enough troops or supplies in the two theaters in early 1943, nor had MacArthur and Halsey worked out a co-ordinated plan. On 11 February, Rear Adm. Theodore S. Wilkinson, Halsey's deputy, reached Brisbane for conferences with MacArthur and his staff. In mid-February, the Joint Chiefs scheduled a conference of delegates from the South and Southwest Pacific to be held in March in Washington. There the conferees would review the numbers of men and the amounts of supplies available and determine in general how they were to be allocated.[1] Meanwhile, the engineers in the two theaters were fully occupied in preparing plans for the support of the combat forces in the coming campaign, to be known as CARTWHEEL. Since the capture of Rabaul would require the progressive advance of air and naval forces, not only combat support but also the construction of airfields and naval bases in areas captured from the enemy would continue to be a most important task.

Additional Engineers Arrive

The number of engineers in the South and Southwest Pacific was increased in the first months of 1943. On 17 February, Lt. Gen. Walter Krueger, the commander of Sixth Army, together with members of his advance echelon, arrived by air at Brisbane; five days later, his engineer, Col. Samuel D. Sturgis, Jr., with an engineer officer and an enlisted man came in at Amberley Field.

[1] John Miller, jr., *CARTWHEEL: The Reduction of Rabaul*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1959), pp. 7–12.



MAP 12

Colonel Sturgis set up his headquarters at nearby Camp Columbia. The remainder of the engineer section, on its way to Australia by ship, was expected in mid-April. By visits to engineer offices and installations in and near Brisbane, including Casey's office and the engineer section of Headquarters, Base Section 3, and by trips through eastern Australia and Papua, Colonel Sturgis soon became acquainted with current operations and learned of some of the major engineer problems in the theater.[2] In February and March, several units

[2] (1) Walter Krueger, *From Down Under to Nippon* (Washington, 1953), pp. 5–6. (2) Engr Sec Sixth Army, Engr Hist (Draft MS), Chs. I, III. Sturgis File 31.

arrived in the Southwest Pacific—the first since the preceding June. Among them were two aviation battalions, a heavy shop company, and a maintenance company. Also earmarked for SWPA and scheduled to leave the United States in March, were an aviation battalion, a depot company, a base equipment company, two airborne aviation battalions, and a dump truck company. Scheduled to arrive in the South Pacific in the first half of 1943 were three general service regiments, two depot companies, and a heavy shop company.[3]

The Engineer Special Brigades

Engineer units of a novel type were to be employed in the coming campaign in New Guinea. These were the engineer special brigades (ESB's). Originally called engineer amphibian brigades, they had been organized and developed in the United States beginning in June 1942 in accordance with new concepts for putting a landing force ashore. The required techniques devised by top military and naval planners called for moving fully equipped infantry units in small craft from one shore to another where the distance involved was less than a hundred miles. Because it would obviate using large naval vessels close to shore, where they would be exposed to attacks from land-based aircraft, such a technique would be invaluable not only for operations against continental Europe but also for driving the Japanese out of the many islands of the western Pacific. When this new concept of amphibious warfare was developed, the invasion of Europe took precedence over operations in the Pacific. The innovation was devised primarily to move troops across the English Channel for an invasion of the Continent. Sole reliance on small craft was a departure from traditional naval concepts. Landing craft had always been carried to the target area aboard transports. When an assault force arrived off an enemy-held shore, the craft were lowered over the side of the ships into the water, the troops boarded them by climbing down the ships' nets and, protected by fire from cruisers and battleships, headed for the enemy-held beach.

Moving troops and supplies from island to island in small craft and organizing newly won beachheads would appear to be a joint Army-Navy responsibility. In the first months of 1942, the Navy, still relying on enlistments, was short of men for its ships and shore installations, and so could not embark on a program of organizing and training new types of amphibious units. Responsibility for developing and training the amphibious brigades was given to the Army and assigned to the Services of Supply. Mainly because moving troops across short stretches of sea resembled river-crossing operations, the Services of Supply gave the Corps of Engineers the responsibility of organizing and training the units. Twelve brigades were to be organized, each an integrated but flexible unit capable of transporting one division.

In September, MacArthur had requested one brigade. Col. Arthur G. Trudeau, a pioneer in developing the

[3] (1) Memo for Rcd, Casey, 3 Mar 43. SWPA File 27. (2) SOS SOPAC, Hist Rpt from Activation to 30 Jun 43, app., List of Serv Trp Units, SOPAC, 15 Jul 43.

brigades, visited MacArthur's headquarters in November to discuss the advisability of sending three to the Southwest Pacific. MacArthur strongly favored getting these new units. It was readily apparent to him that they would be ideal for operations against the Japanese in the islands north of Australia. It would now be possible to move men and supplies along the coasts of New Guinea and to nearby islands, through narrow channels, across uncharted, shallow, reef-choked waters, without the use of naval vessels. And the perplexing question of whether amphibious operations in the Southwest Pacific should be largely under Army or Navy control would be solved.[4] In Casey's words, the brigades would "afford [the Army] an independence of operation and unity of control not otherwise attainable if dependence had to be placed on the Navy for such movement." [5]

The initial brigade to go to the Southwest Pacific was the 2d, commanded by Brig. Gen. William F. Heavey. During February and March 1943 the elements of the organization arrived in Australia at various ports from Sydney to Townsville. The entire brigade consisted of just under 7,400 officers and men. Major components were a headquarters and headquarters company and three boat and shore regiments.[6] Each regiment, with approximately 1,950 officers and men, had two battalions: a boat battalion to man the craft that would transport the infantry and other troops from island to island, and a shore battalion to help troops embark on the near shore and establish and organize the beachhead on the far shore. Each brigade had five auxiliary units—a boat maintenance company, a quartermaster battalion, an ordnance platoon, a signal company, and a medical battalion. The brigade got its 180 boats from the Navy. The amphibian engineers arrived in the Southwest Pacific equipped mainly with LCVP's (landing craft, vehicle, personnel). These wooden boats were 36 feet long and had 11-foot beams. Powered with 225 horsepower diesel engines, they had a speed of 9 knots. They could carry 36 fully-equipped infantrymen or 4 tons of cargo. Protection was provided by quarter-inch armor plate on the bow and sides. The amphibian engineers hoped to add soon to their small stock of the newer and larger LCM(3)'s (landing craft, mechanized), which were 50 feet long, 14 feet wide, were made entirely of steel, and had a speed of 10 knots. They could carry 60 men or 18 tons of supplies. Before long, the elements of the brigade were concentrated at Cairns and Rockhampton, and joint training began at nearby beaches with American and Australian infantry units. Some of the amphibian engineers attended specialist schools in reconnaissance, signal communications, and boat maintenance. Others trained in the Australian "bush" in infantry tactics and in fighting in jungle country.[7] The

[4] For discussions of the organization and training of the engineer special brigades and their arrival in the Southwest Pacific, see: (1) Coll, Keith, and Rosenthal, *Troops and Equipment*, Ch XVI; (2) Office of the Chief Engineer, General Headquarters, Army Forces, Pacific, "The Engineers of the Southwest Pacific, 1941–1945," IV, *Amphibian Engineer Operations* (Washington, 1959), pp. 22ff.

[5] Memo, Casey for MacArthur, 17 Nov 42. SWPA File 18.

[6] Known as amphibian regiments until April 1943.

[7] (1) Interim Rpt of the 2d ESB for the period Jan

arrival of the amphibian engineers was not greeted with enthusiasm on all sides. General Heavey found "considerable antagonism" on the part of many Navy officers, a number of whom expressed serious doubts that the brigades could operate successfully.[8]

Late in January the 411th Engineer Base Shop Battalion, 1,145 officers and men, arrived with the first elements of the brigade. The 411th had originally been organized to repair and maintain the amphibian engineers' landing craft. When the decision was subsequently made to send the craft overseas knocked down, the mission of the 411th was changed to boat assembly. The unit was reorganized so that all three companies could put landing craft together. The first job in Australia was the building, with the help of a regiment of amphibian engineers, of an assembly plant at Cairns. Here LCVP's, and later LCM's, were to be launched and used in the drive up the New Guinea coast toward Rabaul. The 411th had not been organized or trained to build an assembly plant; it turned to this job when it arrived at its destination only to find "the plant not even started and the site encumbered with an old saw mill whose owners were holding out for a high settlement." It was many weeks before the battalion retrieved its equipment from the various Australian ports. Thereafter followed the struggle to build the assembly plant with its three production lines.[9]

Problems of Organization

If CARTWHEEL were to have proper Engineer support, the continuing disagreement in the Southwest Pacific between the Engineers and the Army Air Forces over the control of airfield construction would have to be resolved. The Air Forces persisted in its attempts to get control of the aviation units, and Casey continued to oppose strongly the demands of Kenney and Whitehead. He maintained, as he had done previously, that if the aviation units were placed under the control of the Air Forces and were used solely on airfield construction, there would in effect be two construction agencies in the theater. They would have to compete for the limited amounts of materials, equipment, and spare parts. Over-all planning for construction would become needlessly complicated, and control of the construction program would become much more difficult. It was Casey's view that, in the communications zone, there should be not two construction organizations, but one, and it should be under the operational control of USASOS, to be used on any type of work that MacArthur believed was most urgent.[10] The question was settled late in February. MacArthur directed that the construction of airfields continue as

through 30 Sep 43, pp. 1ff. SWPA File E15. (2) Brig. Gen. William F. Heavey, "Down Ramp," *The Military Engineer*, XXXVIII (August, 1946), 334.

[8] Ltr, Heavey to Brig Gen Daniel Noce, formerly commander of the Amphib Tng Comd, 3 Jan 44. SWPA File 62.

[9] (1) Hist of 411th Engr Base Shop Bn, 20 Jul 42–31 Oct 43. (2) Heavey, "Down Ramp," *The Military Engineer*, XXXVIII (August, 1946), p. 334.

[10] (1) Ltr, Kenney to MacArthur, 4 Feb 43. (2) Memo, Casey for G–3 GHQ SWPA, 12 Feb 43. Both in SWPA File 27.

before. USASOS would be responsible for all construction for American forces in the communications zone. Task force commanders would be responsible for construction in the combat zone until that responsibility was transferred to USASOS. When airfields were completed, they would be released to the Air Forces for maintenance.[11]

To provide for better administration of the growing number of American units, MacArthur reconstituted, under his direct command, United States Army Forces in the Far East on 26 February. The headquarters was to provide administrative control for all American units in the Southwest Pacific, including those in USASOS, the Fifth Air Force, and the newly arrived Sixth Army. MacArthur appointed Casey Chief Engineer, USAFFE. Casey transferred some of the men for his new office from his staff in GHQ SWPA; a few came from USASOS. Most were officers and men who had recently arrived from the United States. As Chief Engineer, USAFFE, Casey had duties similar to those he concurrently had as chief engineer of SWPA. But in his new position, he was concerned mainly with providing technical supervision over American units only; as Chief Engineer, GHQ, he was responsible for co-ordinating the entire Allied engineer effort in the theater. Since the functions of the two offices were so much alike, it soon proved difficult to prevent overlapping of functions and duplication of work.[12]

Engineers in Forward Areas

The engineers continued their explorations and studies of the forward regions where the coming campaign was to be fought. Reconnaissance from the air and on the ground provided considerable information about the most desirable sites for airfields and bases. As early as December 1942, Colonel Sverdrup and others had traveled through the Markham Valley in east central New Guinea—a crucial area in any further advance against the Japanese. They found many suitable sites for airfields. Near the native village of Nadzab, the favorable terrain and the long dry season would make construction of runways for heavy bombers and fighters fairly easy. Aerial photographs indicated that at the coastal village of Lae the Japanese had two airfields that could be enlarged and developed, and that the road from Lae to Nadzab could undoubtedly be readily improved to make possible trucking in gasoline and other supplies. Sites would also have to be found for airfields farther west.[13] The Air Forces was concerned about growing Japanese strength in northwestern New Guinea and in the islands of the Netherlands Indies. The enemy apparently was building up his potential for offensive action in the Darwin–Merauke–Cape York area. Kenney therefore wanted to strengthen the airfields at Horn Island, at Jacky

[11] 1st Ind, AG GHQ SWPA, 24 Feb 43, on Kenny Ltr, 4 Feb 43.

[12] (1) Hq USAFFE Staff Memo No. 1, 26 Feb 43. SWPA File M84. (2) Of C Engr USAFFE, No. 1, 26 Feb 43. Both in SWPA File M84. (3) Memo, Of C Engr GHQ SWPA for All Secs, Engr Of, 3 Mar 43. SWPA File 57. (4) Brig Gen Lewis T. Ross, formerly Chief Engr, USASOS, Personal Recollections of the CE (MS). SWPA Files.

[13] (1) Sverdrup, Rcn Rpt, Bena Bena—Markham Valley, 25 Dec 42. (2) Leahy, Rcn Rpt, Bena Bena to Mt. Hagen, 30 Jan 43. Both in SWPA File 460.

Jacky, and in the Millingimbi area near Darwin. These projects were to proceed "simultaneously and with the greatest possible speed." [14] In the South Pacific aerial reconnaissances were being made of the Solomons, especially of those places where Japanese installations were located.[15] In February reconnaissance parties sent out by Casey's office investigated two little-known islands—Woodlark and Kiriwina—midway between Papua and the Solomons and found excellent sites for airfields.

Engineer work was already under way in the most forward areas. A continuing task was improving communications in northeastern New Guinea, where airfields, roads, and trails were primitive, to say the least. A promising link between southern New Guinea and the Markham Valley was the 68-mile-long trail stretching from the native village of Bulldog north over the Owen Stanleys to Wau. Improvement of this track would make possible transporting substantial quantities of supplies overland from the Gulf of Papua to Lae and Salamaua. On 18 February a company of Royal Australian Engineers began work at Bulldog, and three days later another company started in at Wau. American units could not be spared from high priority airfield construction, but a number of bulldozers were sent to the Australians for this difficult construction job. The terrain was rugged, little material could be found for surfacing, and downpours were frequent; the Australians had to do much of the work with picks, shovels, and crowbars. Progress was slow. In out-of-the-way areas to the north, work was speeded on runways.[16] Early in March, Sverdrup directed Lieutenant Leahy to prepare one strip at Mt. Hagen and two at Ogelbang, four miles to the northwest.[17] For these jobs Leahy rounded up 5,000 Papuans who worked with great energy in the way they knew best: They hauled earth in their native baskets, Colonel Robinson wrote later in describing this project, "and compaction was accomplished by thousands of bare native feet tramping in time with their weird chant or 'sing-sing.' " [18]

Troop Requirements for ELKTON

By 22 February, Casey's office had completed a preliminary study of engineer troop requirements for ELKTON. More exact needs, to be worked out later, would in large measure depend on the time allotted for the various phases of the operation, the number of native laborers who could be recruited, and the demands for additional construction which might be made. Principal engineer tasks would include supporting the combat troops, building airfields, ports, and roads in the combat zone, and preparing and distributing maps. It was estimated that 15 new runways would have to be built, 16 improved, and pos-

[14] Ltr, CofS AAF SWPA, to AirO Comdg RAAF Comd, AAF, 22 Mar 43. SWPA File 498.

[15] (1) Maj Merrill E. DeLonge, AAF Representative Engr Bd Fort Belvoir, Rpt on Observations in SOPAC 15 Jan 44. EHD Files. (2) Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, 146–48.

[16] Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, 159–62, 164.

[17] Ltr, Sverdrup to Leahy, 9 Mar 43. 686 New Guinea No. 2, G–3 Files GHQ SWPA.

[18] Ltr, Robinson to C Staff Br, 31 Jul 50. SWPA Files.

sibly 45 maintained. Port facilities in the South Pacific would be built principally by naval construction battalions; in the Southwest Pacific, by engineer units. In both theaters the combat engineers, though handicapped by inadequate equipment, would have to do virtually all road construction and maintenance. Mapping units would be hard pressed. The South Pacific area, which already had one aviation topographic company, needed, in addition, a corps topographic company. All told, a large number of additional units would be required for the campaign—ten general service regiments, two aviation battalions, two port construction and repair groups, two equipment companies, one topographic battalion, one topographic company, two depot companies, and two maintenance companies. Some of these units were already en route to the theaters.[19]

The South Pacific

In the South Pacific the engineers had begun to prepare in January for the coming campaign. Organization in that theater was complicated. Halsey had many more subordinate commanders reporting directly to him than MacArthur had. There were two major ground forces—the Army and the Marine Corps—as well as various Air Forces elements. The bulk of the U.S. Pacific Fleet was serving in the South Pacific. A multiplicity of service commands supported the Army, Navy, and Air Forces. The South Pacific had no chief engineer to supervise and co-ordinate engineer work. There was, instead, a Base Plans Section, consisting of Colonel Beadle and two Navy captains from Halsey's staff. The three members reviewed requests for projects received from island commanders or from the Base Plans Board in Halsey's headquarters. They then approved or disapproved construction, fixed priorities, and designated the constructing agency. Projects were built under the direction of the island commanders. Insofar as the Engineers were concerned, the most important service force was SOS USAFISPA, under Maj. Gen. Robert G. Breene. On Halsey's orders, it and other supply agencies began assembling supplies and developing bases early in 1943. Colonel Beadle, as SOS engineer, and his staff were thus fully occupied during the months before the campaign was scheduled to start.[20]

Engineer units worked with Seabees and Marine engineers to strengthen various islands of the South Pacific. The marines were building up Guadalcanal as a forward base. Engineer construction units were scheduled to be sent in by the middle of the year. In the New Hebrides the 822d and 828th aviation engineers were improving Bauer and Quoin Hill fields.[21] On Fiji the 821st was continuing to improve Nandi airdrome. The battalion was also working on such projects as hospitals and infantry and artillery positions in the

[19] Memo, Casey for Sutherland, 22 Feb 43. SWPA File 111.

[20] (1) Miller, *CARTWHEEL: Reduction of Rabaul*, pp. 67ff. (2) Hq and Hq Co USAFISPA, Hist 1 Jul 42–30 Jun 43. 98-USF2-Hq-0.1 (23779). (3) Memo, Lt Col Emil F. Kumpe for Casey, 27 Sep 43. 061.20 Intel Rpts, SWPA Engr Files, KCRC. (4) Rpt on Conditions in SOPAC [c. 1 Sep 43]. DR-3, G-11 South Pac Theater, pt. III.

[21] Hists of the 822d and 828th Engr Avn Bns.

Nandi area. An extensive road improvement program was under way. The commanding general of the island selected a plateau 2,000 feet above sea level as the site for a rest camp. After conducting an extensive survey, the unit began work on an 18-mile road from Nandi to the camp, a difficult job, as much of the route had to be blasted from almost sheer rock.[22]

On New Caledonia the major task was improving the airfields. The 811th engineers were at various places—Company A was at Tontouta; B, at Oua Tom; and C, at Plaines des Gaiacs. With the installation of aviation gasoline storage tanks on Penrhyn and Aitutaki, work on the alternate ferry route was almost complete. Such slight construction and maintenance as was still required was done by engineer units of the task forces on the islands.[23] Construction was now under way in New Zealand, where work was carried on in and near Auckland. In early 1943 New Zealand's Public Works Department, using local contractors, was building a 1,000-bed hospital, a replacement and supply depot, a camp, and installations for the Quartermaster Corps. The exploration for oil continued. In January 1943 the managing director of the Shell Oil Company in New Zealand asked Colonel Beard for help in testing a geological formation on South Island. In March the War Department approved, and plans were made to begin drilling in several weeks.[24]

The combat forces focused their main attention on the Solomons. The steady infiltration of the Japanese down the island chain posed a continuing threat to Guadalcanal. Halsey decided to seize the Russell Islands, about thirty miles to the northwest. Occupation was scheduled for late February, with the 43d Infantry Division assigned to the operation. The division's 118th Engineer Combat Battalion sailed with the assault forces for the Russells on 15 February and landed on the 21st. No enemy troops were found. Combat engineer missions comprised, for the most part, road improvement, installation of water points, and clearing of gun positions. Naval construction battalions built the airfields. The 118th engineers found their tasks easy. They were able to establish water points in short order, and, since most of the terrain was flat and coral surfaced, road construction proceeded rapidly.[25]

As preparations for the offensive increased, engineer supply was given greater attention than before. In March 1943 a general engineer supply depot was organized at Nouméa. Subsequently, the Seabees, with some help from Army engineer units, built a large depot, where a heavy shop company was installed. Supplies from the United States were stored there and then distributed to engineer units in the South

[22] Hist of the 821st Engr Avn Bn.

[23] Hist of the 811th Engr Avn Bn.

[24] (1) Memo for Rcd, Hq USAFINZ and Serv Comd, Of of the Engr, 8 Dec 42. (2) Hq USAFINZ and Serv Comd, Of of the Engr, Progress Rpt, 2 Apr 43. Both in Engr Files, US Army Forces in New Caledonia, KCRC. (3) Beard, Concluding Rpt—Oil Exploration Opns in New Zealand Under WD Fixed Fee Contract W-412-eng-49.

[25] (1) Memo for Rcd, n.d., Brief Appreciation of Russell Islands Situation. RED VAULT, USAFISPA, Misc Hist Info, Russell Islands, 5 Jan 44. (2) Rpt, G-3 Sec 43d Inf Div, 25 Feb 43. RED VAULT, USAFISPA. (3) *Building the Navy's Bases*, II, 257–58.

Pacific. An additional mission of the depot was to receive, store, and distribute spare parts. Since there was no spare parts company, men had to be taken from the Engineer Section, SOS, and from a maintenance company to man the depot's spare parts section. The result was that a skeleton force had to carry out the important job of distributing parts to engineer units, with about 20 men trying to do the work of 200.[26]

Further Over-all Planning for the Campaign

With plans for the campaign well along, representatives from the Southwest and South Pacific arrived in Washington early in March for a series of conferences with the Joint Chiefs of Staff and War Department planners. General Sutherland, MacArthur's chief of staff, made it plain that large forces would be needed. At least 22⅔ divisions and over 4,000 additional aircraft would be required. The Pacific delegates found that there was no chance of getting that number of men and planes; the shortage of shipping alone precluded sending them. The decision was made to limit operations in the two theaters in 1943 to Task Two—that is, the seizure of the northern Solomons, northeastern New Guinea, and western New Britain —but with the additional objective of seizing the small islands of Woodlark and Kiriwina to the east of New Guinea. Bombers based on these islands could easily reach Rabaul, about 300 miles away. General MacArthur would command operations outlined by ELKTON. The matter of timing was left to the theater commanders. On 28 March, the Joint Chiefs issued their directive for the forthcoming campaign. MacArthur and Halsey were to establish airfields on Woodlark and Kiriwina, seize various areas along the northeast New Guinea coast, including Lae, Salamaua, Finschhafen, and Madang, occupy western New Britain, and occupy the Solomon Islands as far as southern Bougainville. Late in March, Halsey and MacArthur met at Brisbane to work out the many details. They agreed to carry out a series of approximately thirteen assaults in a period of eight months. They planned to begin the campaign with simultaneous invasions of Woodlark, Kiriwina, and New Georgia. Thereafter, Southwest Pacific forces would seize areas along the eastern New Guinea coast while South Pacific forces would move through the Solomons as far as southern Bougainville. Finally, MacArthur's forces would seize parts of western New Britain. CARTWHEEL was to begin about 1 June.[27]

General Casey repeatedly stressed that even with the lowered requirements, the engineer force contemplated for CARTWHEEL was too small. The Air Forces alone required a tremendous amount of construction. On 8 April the total air strength in the Southwest Pacific was 516 planes. There were expected to be 1,330 by the end of the year, plus a 25-percent reserve. If the airfields for this enlarged force were to be provided, a substantial increase in engineer strength was

[26] SOS, SOPAC Hist Rpt From Activation to 30 Jun 43. 98-SS2-0.1 (23774)M, 10 Nov 42–30 Jun 43.

[27] Miller, *CARTWHEEL: Reduction of Rabaul*, pp. 12ff.

necessary. The engineers would have to do much work for the ground and service forces. It was essential to have a balanced engineer force, but such a force was not in the theater in early 1943. Urgently needed were construction units, general service regiments, and dump truck companies. Requirements for such units were so heavy that it was not possible under the troop basis to provide light or heavy ponton units, camouflage, water supply, or additional topographic units. There was a critical need for a forestry company to provide timber in the forward areas and thus reduce shipping requirements. In a campaign such as that contemplated in ELKTON, to be waged in the jungles of New Guinea and the Solomons, engineer work, especially construction, would be particularly heavy during the first three months. From now on the engineers would not be able to count on civilian workmen to meet most or a large part of their construction needs. All that would be available, besides troops, would be the natives of New Guinea and the Solomons.[28]

Further Engineer Preparation in SWPA

By April engineer work for the coming offensive was moving ahead satisfactorily. The 2d Special Brigade was training for its missions. On the 7th the first LCVP slid down the ways of the boat assembly plant at Cairns, and before long the men were completing six a day. The first LCM's were expected from the United States in May.[29] On 17 April the remainder of the Engineer Section, Sixth Army, reached Australia and Colonel Sturgis now had a more adequate staff to help him plan for combat. As rapidly as possible the units arriving from the United States were being sent to New Guinea and were employed around the clock. In mid-April, the 46th, 91st, and 96th engineers were working on airfields, roads, docks, and hospitals at Port Moresby. The 808th Aviation Battalion, which had recently left for Sydney for rest and recuperation, was replaced by the 857th Aviation Battalion, which reached Port Moresby early in April. The 43d engineers were continuing work on airdromes and roads at Milne Bay and Dobodura. Their effectiveness, Casey noted, had been lowered by "a high sickness rate resulting from continued hard physical activity under severe tropical conditions with much of their operations in malarial infested regions." Two companies of the 96th were to be transferred to Dobodura and two to Milne Bay to help the 43d. The 842d Aviation Battalion, just arrived in the Southwest Pacific, was to go to Port Moresby to become acclimatized and to replace other units being moved to more forward areas. A heavy shop company and a maintenance company, which had recently landed in Australia and which had been urgently needed to repair equipment, were to be moved to New Guinea as soon as shipping became available. The American units in New Guinea were being supplemented by

[28] (1) Memo, Casey for Sutherland, 31 Mar 43. (2) Memo, Casey for Sutherland, 8 Apr 43. Both in SWPA File 111.

[29] Heavey, "Down Ramp," *The Military Engineer*, XXXVIII (August, 1946), p. 335.

increasing numbers of Australians. By April, four mobile works squadrons of the RAAF, about 2,000 men, were working at Port Moresby, Milne Bay, and Goodenough. In order to release some of the engineers employed in the Port Moresby area, Casey asked for 700 men of the Civil Constructional Corps to take over part of the work there. Heavy demands on the engineers elsewhere in New Guinea made such arrangements imperative. Of the organization, thirty-nine men who had volunteered for service arrived at Port Moresby in April to work for the American forces, but the Civil Constructional Corps could not send the relatively large numbers of men which the engineers needed.[30]

Engineer units continued to be hampered by shortages of supplies and equipment. "Considerable difficulty has been encountered," Casey wrote to Reybold on 2 March, "in replenishing worn out construction equipment and in building up a suitable stock to take care of operational needs. . . ." Colonel Harrison, the engineer officer expert in spare parts supply, on a tour of the theater in late 1942 and early 1943, suggested to Casey that it might be possible to obtain overhauled and rebuilt machinery from the Construction Division of the Office of the Chief of Engineers, now that building in the United States had begun to taper off. Casey wrote General Reybold, asking if there were any chance of getting a number of items urgently needed and almost impossible to procure in the theater: 25 shovels with pile driver and dragline, 18 truck-mounted cranes, 54 D–7 and D–8 tractors with bulldozers or angledozers, 12 Tournapulls, and 200 dump trucks.[31] It turned out that prospects of getting used equipment were slight. On 1 May, Somervell informed MacArthur that it would not be "feasible to ship used equipment to overseas theaters" and that there was no rebuilt equipment on hand for shipment.[32]

On 21 April USASOS expanded its system of bases in New Guinea. It designated Milne Bay, Oro Bay, and Port Moresby Advance Sub-Bases A, B, and D. Six days later, USASOS set up Advance Sub-Base C on Goodenough Island. These four bases were under the supervision of U.S. Advanced Base at Port Moresby. In New Guinea, as in Australia, decentralization of authority was emphasized in order to expedite work as much as possible. The Commanding General, U.S. Advanced Base, placed responsibility for engineer construction on the base commanders, who in turn assigned to their engineers the planning and execution of the work. It was impossible, however, to find enough engineers to staff adequately the offices at the forward bases.[33]

Early in May, Casey and Sverdrup, accompanied by engineer and naval officers, made an inspection of the forward bases. Visiting Dobodura first, they were impressed by the amount of work which had been done there. Excellent progress had been made on the airstrips. One of the runways was surfaced with 5,000 feet of steel mat. Maj. Gen.

[30] Memo for Rcd, Casey, 15 Apr 43. SWPA File 1.

[31] Ltr, Casey to Reybold, 2 Mar 43. SWPA File 139.

[32] 2d Ind, ACofS for Opns ASF to CINCSWPA, 1 May 43, on n. 30.

[33] Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 66ff.



A SECTION OF THE ORO BAY–DOBODURA ROAD

Horace H. Fuller, commander of the 41st Division, joined the group for an inspection trip of the 25-mile-long road connecting Dobodura with Oro Bay. This was the road on which the Australians had begun work the previous December. The 116th and two companies of the 43d Engineers had taken over from the Australians in February. Just out of Dobodura, the road was "in excellent condition on the long flat reach up to the Embogo River." Beyond was a stretch of about eleven miles, "the high-level road," which was being put through hilly country. A great deal of effort was still necessary here; excessive grades would have to be reduced, and in one area where a cut was made through an artesian well formation, better drainage was required. Engineers of the 116th and 43d, helped by native workmen, had, Casey reported, "performed a tremendous amount of work in the construction of the high-level road under most difficult conditions of terrain and weather." A more thorough reconnaissance of the alternate low-level route had indicated that construction there would not be as difficult as originally supposed. A road had already been put in part way to serve as a cutoff which bypassed much of the hilly section, but

it could not be depended upon during heavy rains. Casey directed that after the high-level road was finished, the low-level route be worked on to provide an alternate highway. Both roads were to be completed eventually to take the heavy traffic which would soon be moving inland from Oro Bay to Dobodura. The party found that facilities at Oro Bay were well advanced. Hastily constructed warehouses, well dispersed, provided excellent storage for the large amounts of supplies arriving daily. On Goodenough, also, Casey found that the RAAF works units had made noteworthy progress on the airfields.[34]

Milne Bay, from which the advance up the New Guinea coast and against the nearby islands would have to be mounted and largely supplied, presented a different picture. Construction was far behind schedule. Some work was going on at three areas on the northern shore —Ahioma, K. B. Mission, and Gili Gili— and at one area on the southern shore —Waga Waga. Farthest along was Gili Gili, where work had been started as far back as July 1942. Here were two airfields, two docks, several warehouses, and a fair network of roads. At the other areas, work was just beginning. Waga Waga was the only other place where piers had been built. Casey believed that K. B. Mission, Ahioma, and Waga Waga were excellent for base development. They had extensive, well-drained areas, ample supplies of water, and beaches with deep water close to shore, well suited for piers. There might be problems at Waga Waga, where, in some places, swamps extended half a mile inland. A major handicap was the almost complete lack of engineer troops. Only Company F of the 96th Engineers was at Milne Bay, together with some Australian troops and natives. The units which had built the airfields the year before were gone; Company E of the 46th Engineers had been transferred to Port Moresby and Companies D and F of the 43d Engineers to Dobodura and Oro Bay. Most of the Papuans at Milne Bay were working for the Australians; 2,500 of them were building facilities for the Australian Army, but only 250 had been assigned to the Americans. Malaria reduced the effectiveness of troops and natives further. Shortages of equipment and materials were serious. Casey, in a radio to Sutherland on 9 May, recommended that the principal advance base be located at Ahioma and that the K. B. Mission area be developed for staging troops. He emphasized the need for sending in more engineer units. USASOS was hard pressed to find additional troops; it had practically none to spare.[35]

At the time of Casey's visit, the prospects were dim that the base would be ready to support combat operations by early June. Colonel Sturgis was greatly concerned over the slow rate of progress. Members of his staff, having made a reconnaissance of Milne Bay in mid-May, reported that much additional work was necessary. On 26 May, General Krueger, with the approval of MacArthur, ordered an advance echelon of Headquarters, Sixth Army, including

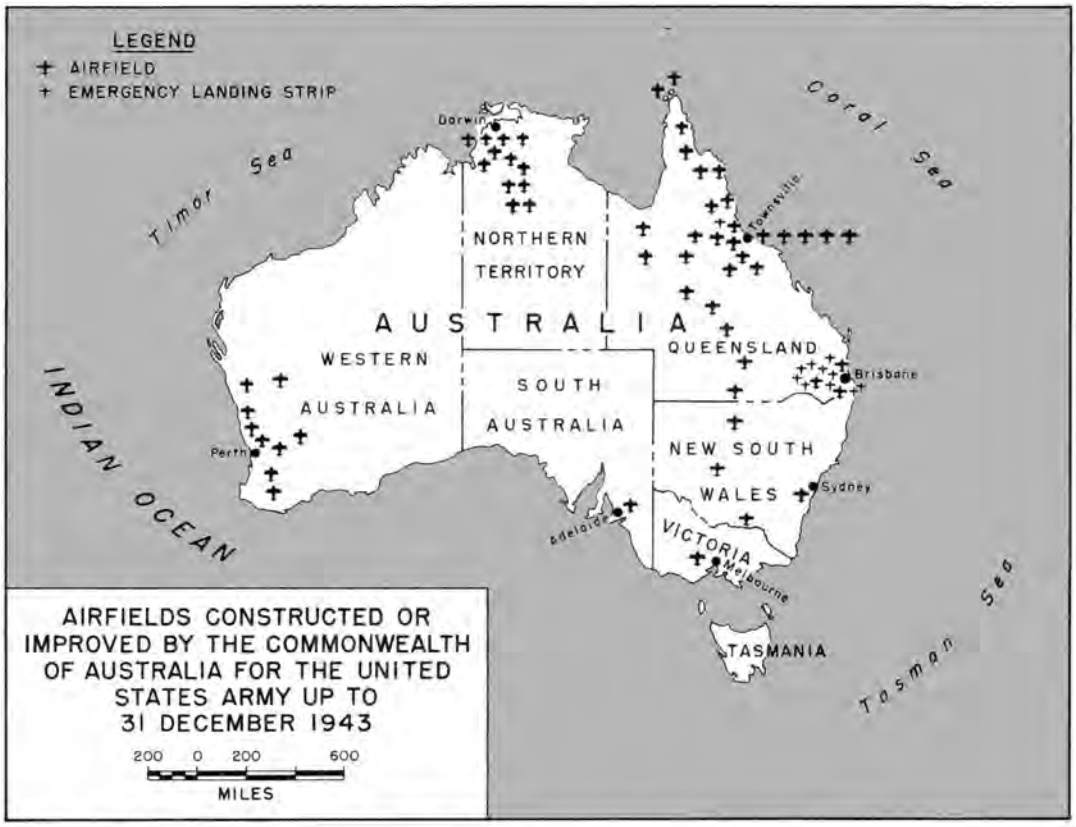
[34] (1) Memo for Rcd, Casey, 13 May 43. SWPA File 98. (2) Memo for Rcd, Sverdrup, 10 May 43. SWPA File 94.

[35] Memo for Rcd, Casey, 13 May 43.

Colonel Sturgis with a staff of thirteen officers and men, to go to Milne Bay to help with the development of the base. The advance echelon reached Gili Gili the next day. Borrowing a launch from the base commander, Sturgis, with part of his staff, cruised along the northern shore, stopping off at K. B. Mission and Ahioma for a closer look at sites for docks, warehouses, camps, and staging areas. A number of units, recently arrived from the United States, were rushed to Milne Bay; included were the 339th General Service Regiment, the 198th Dump Truck Company, and the 445th Heavy Shop Company. The 46th General Service Regiment, a USASOS unit, was put under Sixth Army control; on 1 June, the second battalion and Company B arrived at Milne Bay from Port Moresby. The next day, Sturgis directed that a staging area for 10,000 men be ready east of Ahioma by the 15th of the month. Required were clearing the jungle, putting in access roads, wharves, and water supply points, and erecting buildings for an advanced command post. By 5 June, 2,824 engineers and 700 natives were cutting out patches of jungle, building piers, and erecting native-type structures. It was slow work. Shortages of supplies, especially of piling, were extreme. Sturgis had the natives cut mangrove; the logs, some of them seventy-five feet long, made excellent piling and could also be used for decking. Engineer blacksmiths cut and shaped spikes from lengths of concrete reinforcing rods. The rains were almost continuous, and vehicles became hopelessly mired on the primitive roads, which, for the most part, paralleled the beaches and streams and meandered through swamps. "It was common," the historian of the 46th Engineers wrote, "to see three D–8 tractors stuck in the same mud hole." Meantime, Sturgis readied two advance detachments, one under Col. Orville E. Walsh, the other under Lt. Col. William J. Ely, to go to Woodlark and Kirwina about a week before the assault and select good landing areas, locate sites for airfields, and find possible routes for roads.[36]

Despite growing efforts being made in New Guinea, Australia remained the major base in the Southwest Pacific, and an extensive construction program was still under way there. On 30 June 1943, 48,000 civilians were at work on military projects—an all-time peak. An impressive amount of building had been accomplished. Over 300 airfields had been provided, from unpretentious grass strips without facilities to large airdromes with four or five paved runways. (*Map 13*) The Allied Works Council reported having built or reconditioned 4,621 miles of road. The Queensland Island Defense Road was finished, and about two-thirds of the North-South Road from Alice Springs to Larrimah had been surfaced with bitumen. Hard surfacing of the road from Larrimah to Darwin was in progress, and sealing of the road from Mt. Isa to Tennant Creek was nearing completion. Work had been finished on storage for gasoline—174 tanks with a capacity of 110,092,000 gallons had been provided. The AWC had built hospitals in all the states and Northern Territory. The largest one,

[36] (1) Engr Sec Sixth Army, Engr Hist, ch. I. (2) Comments by General Sturgis on draft of this chapter. (3) 46th Engr GS Regt, Hist Rpt, 16 May–4 Aug 43.



MAP 13

the Temperate Zone Hospital at Herne Bay in Sydney—being built for the American forces—was to be finished by September, and the slightly smaller Holland Park Hospital in Brisbane, likewise being built for the U.S. Army, was also to be finished that same month. Millions of cubic feet of warehouse space had been provided, and construction was still going on. Again, the largest project under construction was a group of forty-seven warehouses being built for the American forces at Meeandah, near Brisbane. (*Map 14*) The program of camp construction was vast, particularly in Queensland. The harbors of Townsville, Darwin, Fremantle, and other cities were being dredged and their port facilities improved. The Brisbane graving dock was more than half finished. Excavation for the dock at Sydney was complete. The largest maritime project was the transshipment port being built at Cairns for American forces at an estimated cost of £3,500,000, work on which was just getting under way by the end of June. Cairns harbor was to be dredged, wharves totaling more than a mile were to be built, almost 100 warehouses were to be erected, and 15 miles of road and 10 miles of railroad were to be put in. When finished the trans-



MAP 14

shipment port would be able to receive and distribute up to 25 percent of all supplies and equipment sent from the United States to Australia. During the fiscal year ending 30 June 1943, the Allied Works Council spent £55,961,398 for military construction. About one-third of this amount went for facilities for the American forces.[37]

The AWC still found it impossible to get enough workmen and equipment for its projects. As before, the jobs in northern Australia were the hardest to complete. In early June 167 major projects, costing from £6,000 to £3,050,000, were under way in Queensland and Northern Territory. The four largest, each costing more than £1,000,000, were the transshipment port at Cairns, the camp at Atherton Tablelands, the road from Mt. Isa to Tennant Creek, and the road from Alice Springs to Larrimah. On 12 June, Theodore wrote to Air Marshal George Jones, Chief of the Air Staff, RAAF, that the council was "experiencing the greatest difficulty in providing sufficient plant, materials and manpower to enable . . .

[37] (1) AWC, *Report, February 1942–June 1943*, pp. 21, 22, 24–26, 40, 50, 53, 56, 57, 60–61, 68, 71, 80. (2) Memo for Rcd, Sverdrup, 17 June 43. SWPA File 94.

works [in Queensland and Northern Territory] to be completed within the period asked for by the Services, and it is safe to say that there are few, if any, works in these areas which are proceeding at the desired rate." As exasperating as the lack of manpower and the shortages of supplies was the transportation bottleneck. On 12 June there were 3,775 tons of supplies piled up at Brisbane, Townsville, and Sydney awaiting shipment to projects in the northern part of the continent.[38]

Procedure for construction, already involved, became still more elaborate—partly the result of the establishment of the additional commands. After Headquarters, USAFFE, was set up, it was empowered to approve all requests for construction before USASOS could forward them to the various Australian-American committees, a procedure instituted principally to curb requests from the Army Air Forces. Moreover, headquarters of both Sixth Army and Fifth Air Force first reviewed all requests from their lower echelons before submitting them to USAFFE for approval. In April 1943, USAFFE directed that all requests for construction in the service areas, whatever their cost, be submitted for approval, if construction required building a new installation or expanding an existing one in order to increase the scope of operations.[39] Considerable confusion resulted. Many base section commanders would not authorize any construction without first getting a decision from higher headquarters. Dissatisfaction with "red tape" grew. Some kind of action was required to simplify procedures.[40]

Little could be done to expedite procedures on the Australian side. The Commonwealth authorities insisted on reviewing all requests for construction from the U.S. Army for which Australia, from its limited resources, had to provide workmen and materials. The Australian authorities studied each request to determine if it was in line with MacArthur's operational and strategic plans and made surveys to ascertain whether Australian facilities were already available. They reviewed all requests for construction of permanent type installations to determine if the standards of construction were in harmony with those of the Australian services. The Australians agreed that confusion and red tape existed; the remedy, they said, was not to change the system but to operate it more efficiently. They complained that full details, plans, and estimates for American projects were not furnished soon enough. Casey stressed the need for prompt submission of the necessary data. But in other respects, the system would have to go on as before.[41]

The South Pacific by Midyear

In the South Pacific Area, construction in the rear areas, except in Fiji, was largely complete by mid-1943. There

[38] Ltr, Theodore to Jones, 12 Jun 43. SWPA File 241.

[39] Ltr, MacArthur to Krueger *et al.*, 26 Apr 43. SWPA File 270.

[40] (1) Ltr, Brig Gen Carl W. Connell, Hq Fifth AF Serv Comd, to Casey, 15 Jul 43. (2) Ltr, Heiberg to Connell, 21 Jul 43. Both in SWPA File 270.

[41] (1) War Cabinet Secret Agendum No. 249/1943, sub: Works for the USASOS, Rec'd Of C Engr, GHQ, 24 Jun 43. SWPA File 241. (2) Memo, AWC to Dep Dir-General of Allied Works, Queensland, 27 Jul 43. SWPA File 270.

was little left to do on the islands of the ferry route. In New Zealand, the camp, depot, and hospital near Auckland had been finished in April. The drilling for oil, resumed in May, had been discontinued after about two weeks when it appeared fairly certain that no oil would be found.[42]

The engineer aviation battalions had initially been assigned to the Services of Supply in the South Pacific. In January 1943 the Thirteenth Air Force was activated, and shortly thereafter the XIII Air Force Service Command. The latter was responsible for the administration and operations of engineer aviation units. The first unit was transferred on 19 April. The remote location of many units and poor communications resulted in a great deal of local autonomy. On many of the outlying islands, the aviation engineers were supervised by the base engineer, and they remained under his supervision. On the islands more centrally located—New Caledonia, New Hebrides, and Guadalcanal—the Air Forces took direct responsibility for the administration and operation of engineer aviation units. On such islands as New Caledonia and Fiji, the aviation battalions were largely responsible for the building of airfields. In the combat zone of the Solomons the Navy directed airfield planning and construction, and work on the fields was done for the most part by the naval construction battalions and Marine engineer units. Army engineer aviation battalions did such minor work as extending and maintaining runways, constructing housing and storage, and building roads.[43]

By 30 June there were 145,443 United States Army troops in SOPAC, of whom 13,434 were engineers. In SWPA, U.S. Army troops at this time numbered 176,254, of whom 23,909 were engineers. The Southwest Pacific, with a more extensive engineer organization, had four major engineer offices, one each for GHQ, USAFFE, USASOS, and the Sixth Army. The Australian military engineer organization worked closely with the U.S. Army Engineers. In the South Pacific during the first months of 1943, there was but one over-all Army engineer office—that of Colonel Beadle in headquarters of the Services of Supply at Nouméa. On 10 June, Beadle reconstituted the theater Engineer Section, which had been discontinued the previous December. The new section had 2 officers and 2 enlisted men. As Engineer, USAFISPA, Beadle was henceforth responsible for formulating policies with regard to Army engineer activities in the theater, advising General Harmon on engineer matters, and co-ordinating Army engineer work in the theater. Col. Lacey V. Murrow took over from Beadle as engineer for the Services of Supply; his staff numbered 21 officers and 53 enlisted men. Even with their expanded setup, the engineers of SOPAC had nothing like the engineer organization of SWPA.[44]

[42] (1) SOS SOPAC Hist Rpt From Activation to 30 Jun 43. (2) Beard, Concluding Rpt—Oil Exploration Opns in New Zealand.

[43] (1) Hq XIII Air Force Serv Comd, Hist Monograph, Opns of Avn Engrs in SOPAC, Jan 42–Aug 44. (2) Memo, Kumpe for Casey, 27 Sep 43. 061.20 Intel Rpt, SWPA Files, KCRC. (3) DeLonge, Rpt on Observations in SOPAC.

[44] Hq and Hq Co USAFISPA, Hist, 1 Jul 42–30 Jun 43.

Operations Instructions for CARTWHEEL

General MacArthur issued operations instructions for CARTWHEEL on 13 June. There were to be three major drives. The most extensive assaults were assigned to General Blamey. American and Australian troops under his command were to seize a large part of northeastern New Guinea. Advancing by air, land, and sea, they were to capture Salamaua, Lae, the Markham Valley, and Finschhafen. They were then to prepare to seize, by airborne, overland, and shore-to-shore operations, the northern coast of New Guinea, including Madang and its surrounding area. Meanwhile, elements of Sixth Army under General Krueger were to seize Kiriwina Island and, using South Pacific forces, were to capture nearby Woodlark. Airfields were to be constructed on both islands. South Pacific Force under Halsey was to take Japanese-held areas in the central Solomons and hold off enemy air and naval forces operating from bases in the northern part of the island chain. As soon as possible USASOS was to develop advance bases in the parts of New Guinea to be taken from the Japanese.[45]

The engineers would have to make a maximum effort to insure the success of CARTWHEEL. They would have to support the combat forces by constructing airfields, roads, ports, warehouses, camps, and hospitals in the forward areas and by furnishing technical assistance in connection with the building of field fortifications. If necessary, they would have to fight as infantry. Most construction would have to be done in eastern New Guinea. In the jungles of that part of the island the engineers would have to improve the existing airfield at Bena Bena and build a new one at Tsili Tsili. In the Markham Valley, their chief task would be enlargement of the airstrip at Nadzab, followed by the construction of a second strip nearby. They would have to enlarge the airfields and port facilities at Lae and improve the road from Lae to Nadzab and extend it to the Leron River. They would have to construct oil storage tanks at Lae and pipelines from there to the airfields in the Markham Valley. On hand to do all this work would probably be, by D plus 30, 2 airborne aviation battalions for Tsili Tsili, 3 aviation battalions for the upper Markham Valley, and 6 aviation battalions, one depot platoon, one heavy shop company, one maintenance platoon, two equipment companies, and one engineer shore battalion for Lae and the lower Markham Valley. Engineer units under Sixth Army would meanwhile do construction on Kiriwina and Goodenough as requested by the Air Forces, and on Woodlark in accordance with specifications furnished by the Commander, South Pacific Force. For these operations the Southwest Pacific theater was to furnish 2 aviation battalions, a general service regiment, and RAAF units; the South Pacific, a naval construction battalion. Of first priority on each island was the construction of a landing strip with dispersals. In the Solomons, Navy and Marine units would undertake major combat and construction missions, supported by Army engineer units. In the Southwest Pacific, USASOS engineers

[45] GHQ SWPA OI No. 34, 13 Jun 43. SWPA File A283.

would begin base construction as soon as the Japanese had been cleared from a newly won area. The commanding general of USASOS was directed to push completion of facilities on the Cape York Peninsula, and at Port Moresby, Dobodura, and Milne Bay. He was to put special emphasis on building up Milne Bay, as this was to be the major supply base in southeastern New Guinea. General Blamey was to begin the development of the base at Lae at the earliest possible time and was to get reinforcements from USASOS for that purpose. As soon as the tactical situation permitted, USASOS would be made responsible for developing the base.[46]

CARTWHEEL

Combat Engineers on New Georgia

CARTWHEEL was to begin with an assault on New Georgia in the central Solomons. A task force including the Army's 43d Division and two Marine raider battalions had been organized for the operation. Landings were to be nade at various points on New Georgia and nearby islands. The principal objective was Munda Airfield, the capture of which was to be followed by the destruction of the major concentrations of the Japanese forces. Since the islands of the New Georgia group were mountainous and blanketed with tropical forests and tangled undergrowth, the destruction of the enemy was expected to be a laborious process.

On 20 June the marines landed at the southern tip of New Georgia island, and soon thereafter Seabees began to build a fighter strip and a base for motor torpedo boats (PT's). Ten days later elements of the 43d Division landed on small Rendova island. On 2 July they crossed the narrow channel and came ashore on New Georgia, some five miles southeast of Munda Airfield. The engineers of the 118th Combat Battalion went in with the infantry. They first cleared beach areas and developed water points and then prepared to support the infantry in the drive toward Munda Airfield. Though the objective was not far away, it was hard to get to because of the almost impenetrable jungle, the swamps, and the skillful resistance of the enemy. The engineers had more than enough to do to clear trails, cut roads through the jungle, and build timber bridges. On 14 July a second landing was made on New Georgia at a more favorable point to the west, named Laiana. The combat engineers again supported the infantrymen in the advance. Early in July Company C of the 118th had landed on southern New Georgia. They helped the marines with base construction and destroyed enemy pillboxes with flame throwers. In mid-July this company moved to Laiana to support the advance on Munda. Meantime, a force of marines had landed on the northern coast and was moving south. Everywhere the forward movement was slow; Munda would not be easy to take.[47]

[46] ELKTON Plan, Engr Annex, 1 July 43. SWPA File 117.

[47] (1) Hq 118th Combat Bn, Opns Jnl, 29 Jun 43–21 Aug 43. 343–43.3 (20433). (2) Capt. Joseph A. Lieberman, "Road Construction on New Georgia," *The Military Engineer*, XXXVI (March, 1944), 75–78. (3) Incl, The Army in the South Pacific, to Ltr, Harmon to Handy, 6 Jun 44 (cited hereafter as

Construction on Woodlark and Kiriwina

There was a different story on the small islands of Woodlark and Kiriwina. Six days before the assault was scheduled, the engineer advance parties under Colonels Walsh and Ely went to the two islands, where their work in clearing and blasting obstacles from the beaches and coral reefs and removing obstructions from the trails—all of it unobserved by the Japanese—was to be of great help to the landing forces. The main assaults, made on 30 June, were unopposed, and, enemy resistance did not materialize during the operation. On Kiriwina two engineer units—the 59th Combat Company (separate), and Headquarters and Service Company and the 2d Battalion, 46th General Service Regiment—came in on D-day, ready to begin work on docks, roads, and two airdromes. Since there were no wharves, the combat engineers, with the help of native workers, first prepared landing areas on the beaches. Because of the heavy rains and the lack of roads, the 46th Engineers, charged with airfield construction, had first of all to build roads to the two sites for the airfields. Within a few days, after a road had been completed from the landing beach to one of the airfield sites, the 46th began work on the first field. On Woodlark, as on Kiriwina, the main concern was construction. The 404th Engineer Combat Company went in with the task force. During the first few days the men had as their main jobs operating water points and opening trails through the forests and widening them into roads. On 2 July the company began work on the airfield. Since the Navy was primarily interested in Woodlark, the naval construction battalion which arrived on D-day did most of the work on the single-runway airfield. On 16 July, when the first plane put down, the landing strip was operational for about 4,000 feet.[48]

Amphibian Engineers in Eastern New Guinea

Simultaneously with the attack on New Georgia and on Woodlark and Kiriwina, a landing was scheduled for the eastern New Guinea coast. This, the amphibian engineers' first combat mission, would be of crucial importance; Navy commanders in the theater, skeptical of the capabilities of the special brigades, were exerting strong pressure to have them turned into "stevedore" outfits with shore duty only.[49] The amphibian engineers were scheduled to land on the night of 29–30 June at Nassau Bay, some 175 miles up the coast from Oro Bay and 10 miles southeast of Japanese-held Salamaua. At Morobe, 50 miles south of Nassau Bay, the 532d Boat and Shore Regiment of the 2d Special Brigade loaded infantrymen, artillerymen, and a few members of the 116th Combat Battalion—some 740 men all told—together with supplies and

Harmon, The Army in SOPAC). 98-USF2-0.5 (3721)M, 6 Jun 44. (4) See Brooks E. Kleber and Dale Birdsell, *The Chemical Warfare Service: Chemicals in Combat*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1966).

[48] (1) Engr Sec Sixth Army, Engr Hist, ch. IV. (2) 46th Engr GS Regt, Hist Rpt, 16 May–4 Aug 43.

[49] Ltr, Heavey to Noce, 3 Jan 44. SWPA File 62.

equipment on 29 LCVP's, an LCM, and 2 captured Japanese landing barges. The small force started out in stormy weather. Rain fell continuously during the trip along the coast, and the winds churned the sea into 12-foot waves. A few minutes before midnight a landing was attempted. All the men reached shore, but 22 of the boats and many pieces of equipment were lost when the craft were swamped on the beach. There was no enemy resistance. The infantry soon established a beachhead; the shore engineers helped to organize the defense perimeter. The next night the Japanese attacked the beachhead on both flanks. The shore engineers, along with the infantry, fought on the southern sector. In hand-to-hand combat, in the course of which an amphibian officer and 6 enlisted men were killed, the enemy was driven off, leaving from 30 to 40 dead. The Japanese made no further attacks. The following day reinforcements and badly needed supplies began to arrive. In the latter part of July the amphibian engineers established a similar beachhead at Tambu Bay, five miles north of Nassau. Soon they were moving supplies to the new location. The men were so close to enemy positions near Salamaua that they were frequently under fire.[50] "Every night our boats carried up more troops, artillery, ammunition, tractors, jeeps, and the hundred other items an army must have," General Heavey wrote. "Every return trip brought something back; casualties, sick, mail, relieved troops." In the course of these operations the shore engineers did considerable construction, including roads, bomb shelters, and a bridge over a stream near Nassau Bay to carry 10-ton loads. Meanwhile, combat engineers supported elements of the 41st Division and Australian troops moving up from the southwest toward Salamaua. Progress was slow. The men had to push through jungle and swamp and struggle across steep mountain ranges. Without amphibious movement up the coast, the capture of Salamaua would be well-nigh impossible.[51]

Airborne Engineers in the Markham Valley

Soon after operations began in the Solomons and on the New Guinea coast, they were also under way in the Markham Valley. In May and June two airborne aviation battalions, the 871st and 872d, arrived in Australia; each had about 30 officers and 500 men. Equipment was lightweight and specially designed to be carried in C–47 transports or 15-man gliders. The heaviest piece, the tractor without its bulldozer blade, weighed about one and one-half tons. Twenty C–47's could carry one company, fully equipped, 1,100 miles. The airborne engineers' primary job was to land with paratroops and rehabilitate captured airdromes or to land with an amphibious force and build new landing strips quickly. Airborne engineers

[50] (1) Interim Rpt of the 2d ESB for Period Jan Through 30 Sep 43. (2) Brig. Gen. William F. Heavey, *Down Ramp! The Story of the Army Amphibian Engineers* (Washington: Infantry Journal Press, 1947), pp. 60–63.

[51] Brig. Gen. William F. Heavey, "Amphibian Engineers in Action," *The Military Engineer*, XXXVI (May, 1944), 147.

could also be used to build airfields in remote, out-of-the-way places into which machinery could not be moved overland. The battalions were ideal for construction in Markham Valley. Airfields built there would enable the Allies to maintain continuous fighter cover over Lae at an early date and make possible raids on Wewak, a sizable enemy base on the northern New Guinea coast.[52]

The initial unit selected for work in the Markham valley was the 871st. Early in July the men trained a few days in loading equipment on C–47's and taking it off again. A major objective was to cut down the time for unloading one plane to three minutes. Since the airborne engineers would have to rely mainly on their own resources to protect themselves against enemy planes and ground troops while working in forward areas, each company of the battalion received additional machine guns. Soon the men learned where they were going. At Marilinan and Tsili Tsili, natives, working under Australian and American officers, had for several days been clearing some old turf runways, once used by missionaries and gold miners. On 7 July a plane carrying five men of Company C, a tractor, and a mowing machine took off for Marilinan along with other planes carrying an antiaircraft battery. Two days later, the remainder of the company—about 125 men—together with equipment and supplies, was loaded on thirty planes and flown over the Owen Stanleys to Tsili Tsili. The thirty planes were unloaded and, except one, were on their way back to Port Moresby by 1100, just two hours after they had first taken off. The engineers immediately began to improve one of the strips at Tsili Tsili, continuing this work until nightfall. The next day they began work with their airborne equipment on a 2-shift basis. By the end of the second day, the runway was in fair shape to take transports. The men then began work on a nearby fighter strip that Colonel Abbott, engineer of the Fifth Air Force, said he wanted as "smooth as a billiard table," an assignment the engineers considered "a pretty big order for airborne equipment." The men were soon working around the clock. Since the kunai was six feet high, the mowing machines brought from Port Moresby were a godsend. About 400 natives helped on the field, clearing, grubbing, and ditching. Defense was provided by two companies of Australian infantrymen "astride all the trails leading into the area." According to intelligence reports, there were about 9,000 Japanese troops at Lae and Salamaua, some forty miles away. The engineers found conditions ideal for construction with airborne equipment. The natural drainage and bearing value of the soil were excellent. The skies were clear with no sign of rain. Company C worked alone until 21 July, when the rest of the battalion landed, after having been held back by bad weather over the Owen Stanleys. By this time the transport runway had been extended to 5,000 feet and the fighter strip to 4,600. On 26 July two fighters landed.[53] "Had

[52] Memo, Engr Sec Directorate of Base Serv Hq AAF WD for Theater Group OPD WD *et al.*, 2 Nov 42. SWPA File 23.

[53] Memo, Maj J. R. Walton, ExecO 871st Engr Avn Bn, for Woodbury, 5 Sep 43. EHD Files.

you been here this morning you too would have been proud of your aviation engineers," Lt. Col. Harry G. Woodbury, Jr., the battalion commander, wrote to Brig. Gen. Stuart C. Godfrey, engineer of the Army Air Forces.[54]

Progress in the Central Solomons

Meanwhile, in the Central Solomons the campaign moved ahead. By late July the troops on New Georgia were slowly closing in on Munda. Engineer support was continuous. The 118th Combat Battalion built a small boat pier at Laiana, cut roads through the jungle, and established water points. Responsible for the defense of the beachhead, the men established a peripheral defense with barbed wire and automatic weapons. At various times, both companies of the battalion went into the front lines with the infantry, using flame throwers with excellent results. Engineer machine gunners shot down an enemy plane. On 22 July the first elements of the 117th Combat Battalion of the 37th Division arrived. Part of the men served as infantry. All regular engineer work had to be carried on under fire and the threat of ambush. Bulldozer operators, to protect themselves from snipers, improvised cabs with armor plates taken from captured or beached Japanese barges. On 5 August, Munda Airfield was captured. Eight days later the first planes landed. Engineer work continued as the enemy troops were destroyed piecemeal or driven into the interior of the island. In mid-August elements of the 65th Combat Battalion landed to help the 117th and 118th engineers in the jungles around Munda. By the 25th of the month organized resistance on New Georgia had ended.[55]

Henceforth, the main engineer job on the island was the building or improving of roads in support of the infantry trying to eliminate isolated pockets of resistance. Even when completed, most of the roads were merely narrow clearings through the tangled vegetation and were just wide enough to take 2½-ton trucks. Many of the routes were located by native guides and with excellent results. Because the advance of the infantry was now so rapid, the engineers found it impossible to provide drainage, not to mention surfacing. The numerous bridges and culverts required were made of local timber and discarded gasoline drums. During the rainy season, the roads became impassable; the engineers attempted to provide surfacing with coral, but the coral was too badly weathered to be suitable. Considerable corduroying was necessary. Although the rainy season lasted, as a rule, from November to May, rains occurred in the dry season too.[56]

Additional airfields were needed in the

[54] Ltr, Woodbury to Godfrey, 26 Jul 43. Engr-871-SU, Tsili Tsili Airdrome New Guinea, Maxwell AFB.

[55] (1) Rpt, CO 65th Engr Bn to CG 25th Inf Div, 2 Sep 43. (2) 65th Engr Combat Bn, Opns of the 65th Engr Combat Bn. (3642) 325-33.4, 16 Aug-12 Oct 43.

[56] (1) Lieberman, "Road Construction on New Georgia," *The Military Engineer,* XXXVI (March, 1944), 75-78. (2) Harmon, The Army in SOPAC. (3) Opns of the 25th Inf Div in the Central Solomons. (3462) 325-33.4, 16 Aug-12 Oct 43. (4) Lt. Col. William B Eubank, "Combat Engineers in the Solomon Islands," *The Military Engineer,* XXXVI (August, 1944), 260-63.



A CORDUROY ROAD, NEW GEORGIA, *capable of supporting 155-mm. howitzers.*

Solomons. The question arose whether Vila Airfield on Kolombangara Island, the other Japanese-held field in the New Georgia group, was worth taking. Aerial photographs indicated it was not suitable for further development; Kolombangara was therefore bypassed, and Vella Lavella, about fifty miles northwest of New Georgia Island, was chosen for a landing. After ground reconnaissance had disclosed that the island was not held in force, Admiral Halsey decided to seize part of it in order to construct an airstrip. Vella Lavella had a mile-wide coastal plain, beyond which the ground rose abruptly to a central ridge about 3,000 feet high. Almost the entire island was heavily wooded. On 8 August, 6,000 men of the 25th Division landed on the southeast coast. Company C of the 65th Combat Battalion arrived seven days later. Principal engineer tasks included clearing landing areas and locating supply dumps. Subsequently the men worked on roads. Because of the heavy rains, the engineers had to corduroy about 10 percent of the roads they built or improved; coconut trees provided ample material for this job. Miscellaneous tasks included installation of radar, operating the engineer supply depot, and putting in floors for a field hospital.[57]

Work was under way on several smaller islands near New Georgia. On Arundel, Company B of the 65th began work in September on roads and piers. Coral outcroppings and potholes made road construction difficult, and considerable blasting and fill were required. Engineer equipment was too light for the rough work. If building roads was arduous, supplying water was easy. As on the other large islands, there were many springs, streams, and wells to take care of all needs. On the smaller islands, where no fresh water could be located, salt water distillation units were set up. In the New Georgia operations, the 65th did not take part in combat as did the 117th and 118th. Nevertheless, the men worked so near the infantry that they were frequently exposed to fire. They usually had to organize their own security parties for each bulldozer and, in addition, had to send patrols to the front, flanks, and rear. All told, the 65th suffered 17 casualties from machine gun and rifle fire on New Georgia.[58]

[57] Opns of the 65th Engr Combat Bn.
[58] *Ibid.*

The benefits resulting from the operations in the central Solomons were well worth the effort made. "The results of the New Georgia Campaign almost exceeded expectations," General Harmon wrote, ". . . the Munda airdrome site proved more advantageous than we had anticipated. [With] four splendid airdromes . . . all of Bougainville [was] within easy bombardment range with fighter cover." [59]

Satisfactory Progress Elsewhere

Meantime, operations were progressing on Kiriwina and Woodlark. On Kiriwina a 6,000-foot coral strip was ready for emergency landings by mid-August. By the end of the month one runway was complete and work was going ahead satisfactorily on a second. At North Drome, about four miles distant, work was also progressing on the runway. The 59th engineers were providing roads and storage facilities. In New Guinea, the Allies were slowly converging on the enemy at Salamaua. The amphibious move along the shores of northeast New Guinea continued. In the Markham Valley things were going well for the airborne engineers. The work went so fast during late July and early August that numerous planes were soon stationed at this new field in the Markham Valley. Not until 15 August did the Japanese attempt to bomb the area, and then their raids were largely ineffectual. Salamaua, beleaguered since early July, was still holding out at the beginning of September, but the end appeared near.[60]

[59] Harmon, The Army in SOPAC.

[60] (1) Engr Sec Sixth Army, Engr History, ch IV. (2) Memo, Walton for Woodbury, 5 Sep 43.

The Assault on Lae

Late in August elements of the Australian 9th Division and the 532d Engineer Boat and Shore Regiment began assembling at Morobe for an assault on Lae, about twenty-five miles north of Salamaua. On the evening of 3 September the task force left Morobe. The U.S. Navy used its own landing craft to transport the Australian troops; the amphibian engineers, using 44 LCVP's, 10 LCM's and a few miscellaneous craft, carried their own boat and shore personnel, equipment, and supplies forward. On the morning of the 4th the task force arrived offshore, twenty miles east of Lae. Three engineer amphibian officers and 12 enlisted amphibian scouts went ashore with the first wave, their job to set up beach markers and direct landing craft toward shore. The remainder of the shore engineers, landing with subsequent waves, unloaded ESB and Navy craft, helped by about 2,000 Australian troops. The few Japanese in the area put up only slight resistance; enemy air attacks were a greater danger. Japanese planes knocked out 2 LCI's (landing craft, infantry) on the beach but had difficulty in hitting the small amphibian craft. About 12 officers and men were casualties. Despite enemy interference, the shore engineers were able to unload supplies quickly, move them away from the beach over hastily constructed roads, and disperse them in supply dumps. By D plus 3 the shore battalion had the beach so well organized that operations could henceforth be carried on in a routine manner.[61] "Our part of this

[61] (1) Heavey, "Amphibious Engineers in Action,"

operation turned out so successfully," Heavey wrote to Col. Henry Hutchings, Jr., head of the 4th Brigade in the United States, "and our Shore Engineers proved so efficient that I think some of our disbelievers will have to have more faith in us in the future." [62] Soon the advance westward along the shore toward Lae was under way. The men found it slow going through the jungle and swamp. Conditions ashore were worse than aerial photographs had indicated, rains having turned most of the area into a quagmire. Almost all supplies had to be forwarded along the coast by the amphibian engineers.

For the Japanese entrenched at Lae there was a growing threat from the west, also. The airborne engineers had maintained their rapid progress in constructing runways at Tsili Tsili, and plans were soon under way to prepare additional strips closer to the enemy positions. On 5 September the 503d Parachute Infantry landed at an abandoned turf strip near Nadzab, about 50 miles northeast of Tsili Tsili and 25 miles west of Lae. The same day some 200 Australian pioneers with light engineer equipment reached Nadzab, having paddled from Tsili Tsili in rubber boats down the Watut and Markham Rivers. While the paratroopers guarded the trails in the vicinity, the pioneers quickly prepared the landing strip for the 7th Australian Division, the first units of which flew in as scheduled the next morning. The following day, Company A of the 871st landed with most of its equipment. After setting up a temporary camp, the men laid out a new and better landing strip, and then began dozing away the heavy kunai grass and leveling the ground. Enemy patrols and ground troops were only 8 miles away. A continual rumble of bombings and artillery fire could be heard from the direction of Lae and Salamaua. Expecting an enemy attack at any time, the men rushed to get the runway in shape as soon as possible. During the next two days, a brigade of the Australian 7th Division began to advance down the Markham Valley toward Lae. The engineers meantime continued to enlarge and improve the runways at Nadzab.[63] Conditions were more difficult at Nadzab than at Tsili Tsili. Rains were heavy, and the light equipment was not satisfactory for the vast amount of earth moving required. But the airborne engineers' work helped speed the advance. The Japanese on the eastern New Guinea coast were in a hopeless position. On 11 September Salamaua was captured; four days later, Lae fell.[64]

Finschhafen

MacArthur had originally planned to attack Finschhafen four weeks after the fall of Lae. Since an earlier assault now appeared practicable and would undoubtedly take the Japanese by surprise, the date for the attack was moved up to 22 September. It was to be carried out by Australian forces, who were

The Military Engineer, XXXVI (May, 1944), 147. (2) Interim Rpt of the 2d ESB for the Period Jan Through 30 Sep 43.

[62] Ltr, Heavey to Hutchings, 7 Sep 43. SWPA File E10.

[63] (1) Kenney, *General Kenney Reports,* p. 292. (2) Rpt, 871st Engrs, The Nadzab Mission. EHD Files.

[64] Ltr, Woodbury to Casey, 15 Sep 43. ENGR–871–SU, Tsili Tsili Airdrome—New Guinea, Maxwell AFB.

to be moved to the area on American transports. About 500 men of the 2d Engineer Special Brigade with ten LCM's and fifteen LCVP's were to help forward men and supplies from Lae along the New Guinea coast to the landing beaches. Finschhafen was situated on a coastal plain about half a mile wide, in back of which were steep, heavily wooded mountains. The assault was made as planned two miles north of the town. The Japanese were at least partially prepared. The amphibian scouts, coming ashore with the first wave, were met by enemy troops. After helping the infantry beat off the attack, the scouts put up beach markers. Landing with the second and third waves, the shore engineers came under intermittent fire from well-concealed enemy pillboxes on the beach. The infantry soon wiped out these emplacements. When the LCT's (landing craft, tank) and LST's (landing ships, tank) came in, the shore engineers were ready to unload them.[65]

The Australians easily overcame the scattered enemy resistance near the beach, and on the second day, the airstrip was captured. The town of Finschhafen, however, proved to be strongly defended and would not be taken without prolonged fighting. Japanese planes made repeated attacks on the landing beaches, especially during the first four days. The craft of the amphibian engineers, moving about or anchored in the open seas, were prime targets. As the fighting continued, the amphibians brought in supplies and equipment and evacuated casualties. They began operating a supply service between Lae and the Finschhafen beaches. On 2 October, Finschhafen fell. The Japanese retreated into the mountainous region to the west of the town. Despite the retreat of the enemy ground forces, the Allied troops along the shore continued to be in constant danger of attack by air and sea.

On the morning of 17 October, an hour or so before daybreak, three barges approached one of the landing beaches. About 600 yards from shore, the occupants turned off the motors and silently rowed their craft toward the beach. An amphibious engineer happened to see the approaching craft and, alerting the American and Australian defenders, opened fire with his 37-mm. gun. One of the barges withdrew; the other two, crippled, managed to land. Ten yards away was a .50-caliber machine gun position manned by 19-year-old Pvt. Junior N. Van Noy and his loader, Cpl. Stephen Popa, both of the 532d Engineer Boat and Shore Regiment of the 2d Engineer Special Brigade. Van Noy, a skilled gunner, held his fire until the Japanese had lowered the ramps and started to jump ashore. An enemy grenade, landing in the gun position, badly mangled one of Van Noy's legs and wounded Popa. Van Noy opened up a murderous fire on the Japanese, who tried to annihilate him with flame throwers, rifle fire, and grenades. Few of the other guns on the beach could be trained on the landing party, and, because of the darkness, the gunners were largely forced to fire blindly. In the course of the fighting, Popa was evacuated. Van Noy, heedless of calls to get

[65] (1) Heavey, "Amphibian Engineers in Action," *The Military Engineer*, XXXVI (May, 1944), pp. 148–49. (2) Interim Rpt of the 2nd ESB for Period Jan Through 30 Sep 43. (3) Final Rpt on Opns of 2d ESB, 20 Jun–30 Sep. 43. SWPA File E17. (4) 2d ESB, Monthly Hist Rpt of Opns, 1–31 Oct 43. SWPA File E18.

back to a defense line being formed a hundred yards to the rear, remained in his pit and continued to fire point-blank at the enemy, now bent on wiping out his position. An Australian rifle platoon moved to the beach to mop up the Japanese. Van Noy was found dead from numerous wounds, his last round of ammunition fired. Estimates were that he killed at least half of the 39 enemy troops who had come ashore. "Van Noy's gallant action," an Australian observer wrote, "gained time for all troops to get into position to repel the landing and undoubtedly saved lives," an opinion shared by the Australians and Americans alike at Finschhafen. Van Noy was awarded, posthumously, the Medal of Honor, the highest award for bravery given by the United States Army.[66]

Airfields in the Interior of New Guinea

During September the engineers continued work on the airfield at Nadzab, concentrating on the construction of a second runway. During October they worked chiefly on graveling and asphalting a third strip. They employed several hundred natives, who cleared camp sites, unloaded aircraft, and worked on the runways, sorting rock and spreading gravel by hand. Although designed as fair-weather strips and gravel-surfaced only, the first two runways constructed at Nadzab remained serviceable in all kinds of weather and required little maintenance in the following months. Meanwhile, the airborne engineers had begun a third major airfield at Gusap in the far northwest part of the Markham Valley, near the source of the Ramu River. After the area had been reconnoitered in September, the decision was made to develop an all-weather airfield including complete servicing and repair facilities and runways to handle 200 transports daily. Early in October an advance party of the 872d laid out the landing strips and taxiways. Later that month, the entire unit arrived and began work. By mid-November, a 6,000-foot gravel-surfaced runway was almost finished. Arriving at Gusap in November, the 871st Battalion supplemented the efforts of the 872d. In December, a 5,000-foot section of the initial strip was given an asphalt surface, the fair-weather strips, previously cleared by the 872d, were maintained and repaired, and a number of buildings were erected. At Gusap the men were fortunate in that they could build comfortable quarters for themselves. For their mess halls all companies erected portable huts with concrete floors. They had screened buildings with walls of lumber and roofs of canvas for their dispensaries and recreation rooms. These were almost unheard of luxuries in the out-of-the-way reaches of New Guinea.[67]

Bougainville

The final operation in the Solomons in which the engineers participated was the

[66] (1) *History of the Second Engineer Special Brigade* (Harrisburg, Pa., 1946), pp. 52–53. (2) Heavey, *Down Ramp!*, pp. 67–68. (3) Ltr, Lt Col H. Boyd Norman, AIF 2/28 Aust Inf Bn, to CO 532d EBSR, 31 Oct 43. SWPA File E18.

[67] (1) Rpt, 871st Engrs, The Gusap Mission. EHD Files. (2) Rpt, 871st Engrs, The Nadzab Mission.

one on Bougainville. The largest island in the chain, Bougainville, for the most part mountainous and jungle covered, had swampy coastal plains. The assault was to be under the direction of I Marine Amphibious Corps. The 3d Marine Division was scheduled to go in first, followed by the Army's 37th Division. On 1 November, the marines landed at Empress Augusta Bay on the western part of the island. Naval construction battalions began work on a base and an airfield. A week later a combat team of the 37th Division, including elements of the 117th Combat Battalion, came in. During their first two days ashore, the engineers cut supply trails through the jungle east of the Koromokina River so that the infantry could be supplied. Late in November they put a 3-span all-traffic bridge across the river in five days. The 117th engineers gained considerable experience in building roads through virgin jungles. Using bulldozers and explosives, the men first cleared a strip a hundred feet wide. Next, shovels and "cats" scooped out drainage ditches ten feet wide and up to ten feet deep on either side of the planned 30-foot road. Under the top soil, about one foot thick, was volcanic sand, which proved to be adequate for surfacing. The sand was excavated, piled up on the road, and then leveled by bulldozers and graders. Dump trucks were not necessary. By 15 December the engineers had completed most road construction. On that date responsibility for operations on the island passed from the Marine I Amphibious Corps to the Army's XIV Corps. A service command was organized for Bougainville, and engineer work thereafter was directed by it. Additional engineer units were scheduled to arrive to begin work on a sizable base.[68]

By this time the decision had already been made to bypass and neutralize rather than capture Rabaul. In June various planning staffs in Washington had reasoned that the advance toward the Philippines and the Japanese home islands would thereby be speeded up considerably, and on 21 July General Marshall suggested to MacArthur that Rabaul be isolated. MacArthur at that time did not believe that this would be a wise course, but the Washington strategists became more and more convinced that Rabaul should not be captured. At the Quebec Conference Roosevelt and Churchill approved the recommendations of the Combined Chiefs that Rabaul be merely neutralized. This decision was forwarded to MacArthur on 17 September. CARTWHEEL would be continued, but, in its final phases, the major objective would be not to take Rabaul but to neutralize it and at the same time provide bases to support operations farther west.[69]

The Engineers Continue To Furnish Logistic Support

The South Pacific

In SOPAC the engineers made even greater efforts on airfields and bases during the last half of 1943. When the 810th Aviation Battalion had arrived on

[68] (1) Hist of the 117th Engr Combat Bn, 1 Oct–31 Dec 43. (2) Lt Col William B. Eubank, "Combat Engineers in the Solomon Islands," *The Military Engineer*, XXXVI (August, 1944), 263.

[69] Miller, *CARTWHEEL, The Reduction of Rabaul*, pp. 222–25.

Guadalcanal in June, Henderson Field, badly in need of repair, was the only one from which heavy bombers could take off; marine engineers were striving to put it in better shape. The 810th went to work on a second bomber field, known as Carney. At the time of the American landing in August 1942, Guadalcanal had no real motor roads. Even as late as mid-1943, improvement of the rough tracks and the construction of new roads were imperative. The work of the 810th was extensive. "Mess halls were constructed of native materials, . . . steel quonset huts and . . . warehouses were erected at assembly line speed," the unit historian reported, "mile after mile of road was built." In September part of the unit with its heavy equipment moved to Fighter No. 2 to improve that field. That same month the 117th Combat Battalion returned to Guadalcanal from New Georgia, its principal job to build camps.[70]

On New Georgia, the 828th Aviation Battalion, the 65th Combat Battalion, part of the 131st Combat Regiment, and, until they left for Guadalcanal, the 117th engineers concentrated almost all their efforts on or near Munda airfield. Their major job was building roads, for the almost complete lack of communications on New Georgia made it necessary to do much more than the normal amount of new construction. Coral was plentiful and was used almost entirely for surfacing. With the onset of the rains in November, some roads became quagmires, with mud so deep that even road building equipment could not get through. Improving drainage became a matter of utmost importance. In the New Hebrides, the 822d and 828th aviation engineers worked on roads, camps, and supply depots. On Fiji, the 821st continued on its various construction jobs. By mid-December, they had finished work on the airfields, completed the 250-bed station hospital, improved a number of roads, strengthened bridges, and finished the 18-mile highway to the rest camp in the Nausori Highlands.[71]

Extensive work was still under way on New Caledonia. At the end of the year, an aviation battalion, an aviation company, and all of one general service regiment and part of another were busy on that island. Three airfields—Tontouta, Plaines des Gaiacs, and Oua Tom continued to receive the most attention. The number of troops stationed at Tontouta was now so large that the engineers had to provide the quartermaster with a complete installation for servicing the area. Most troops and supplies for the South Pacific continued to be funneled through the island. "The continued construction and enlargement of facilities on New Caledonia," General Breene reported, "would indicate that this area will contain a large proportion of the rear installations and base activities for a long time to come." [72]

The Southwest Pacific

In SWPA the engineers concentrated their major efforts on the bases and air-

[70] (1) Hist of the 810th Engr Avn Bn. (2) Hist of the 117th Engr Combat Bn.

[71] (1) Hist of the 65th Engr Combat Bn. (2) Hist of the 131st Combat Regt. (3) Hist of the 821st, 822d, and 828th Engr Avn Bns. (4) Lieberman, "Road Construction on New Georgia," *The Military Engineer* XXXVI (March, 1944), 78.

[72] Rpt on Conditions in SOPAC, pt. I.

fields along the northeast New Guinea coast. Work at Milne Bay continued to be difficult, and as the engineers enlarged the base at Oro Bay, they found construction there more involved than had been expected. The greatest obstacle in both areas was the soggy terrain. USASOS did not have enough engineers to develop the two bases as rapidly as had been planned. There was, moreover, a basic weakness in organization; USASOS, a service command designed for work in rear areas, had up to now also been operating in what was, for all practical purposes, the combat zone; the forward bases, without adequate defense, were in serious danger of being overrun. Construction had gotten so far behind schedule that MacArthur directed Sixth Army to take over the work at Milne and Oro Bays from USASOS on 1 July. The two bases, with engineer units of both Sixth Army and USASOS laboring on them, developed at a more rapid pace. Base C on Goodenough Island, placed under Sixth Army control in July, was inactivated that same month. On 15 August, with construction at Milne Bay and Oro Bay fairly well along, the two bases reverted to USASOS control. With a growing number of Sixth Army as well as Australian combat units in New Guinea, the danger of an enemy attack on USASOS installations in the forward areas lessened considerably. Milne Bay and Oro Bay set the pattern for the future; henceforth, Sixth Army began base construction in the forward areas and, later on, when the tactical situation permitted, USASOS took over.[73]

The demands on the engineers at the two bases continued to be enormous. In October, the program at Milne Bay still called for five Liberty ship docks for the exclusive use of USASOS. Gasoline storage for 2,500,000 gallons had to be put in. Over a million square feet of covered storage had to be built at numerous sites, and an ordnance depot for 30,000 tons of ammunition was required near the southern shore. A hospital program of portable prefabricated huts for 2,500 beds was planned, and possibly 2,500 additional beds would be needed. In general, the base was to provide support for 140,000 men, and indications were that this figure might even have to be increased. By the end of the year work was progressing at a fairly rapid rate. Seven wharves had been constructed for Liberty ships along the shore from Gili Gili to Ahioma. Storage space had been increased to 750,000 square feet. Depots were located along the coast in such a manner that almost each one had its own pier. One hundred miles of gravel road had been provided, together with six major bridges. Two airdromes, Gurney and Turnbull, were in operation. At Oro Bay and Dobodura, work was near completion, largely because extensive facilities were not required. Oro Bay was to be a staging area for 50,000 troops. By the end of the year, Base B had eight runways of bitumen or steel mat, almost half a million square feet of covered storage, 125 miles of road, 35 bridges, 10 wharves, including 4 which could take Libertys, together with hospitals and administrative buildings.[74] Inspecting

[73] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, I, 122ff. (2) Memo, Sturgis for Sverdrup, 17 Aug 43. Sturgis File 35.

[74] (1) Ltr, CG USASOS to MacArthur, 13 Oct 43.

Base B in November, Col. Thomas A. Lane, Casey's operations officer, reported that much work had been done, especially on the airfields. Like so many other observers, he was struck by the great effort which had been put into the road from Oro Bay to Dobodura. He considered the "high road" a "good example" of much engineer effort wasted by "inadequate planning." At Oro Bay, he came upon several long roads on narrow ridges which, apparently, had been built for "the sole purpose of placing headquarters in sunlight and breeze." [75]

At recently captured Lae and Finschhafen, the engineers were starting many new projects. Needs at Lae, where the first construction troops arrived on 18 September, were not so extensive as at Oro Bay or Milne. As elsewhere in New Guinea, shortages of men, equipment, supplies, and shipping were acute; for many weeks, progress was slow. Finschhafen was to be an advance air base and have facilities for eight naval vessels. Early in October, Maj. William J. Ellison, Jr., the commander of the 808th, together with seven of his officers and men, arrived at that newly acquired area to make a start on construction. They put in considerable time and effort surveying sites for an airfield, since a quick reconnaissance on the ground clearly showed that the location picked on the basis of aerial photographs was unsatisfactory. On 23 October, the entire 808th arrived at Langemak Bay, just south of Finschhafen, for work [76] on the airfield. A battalion of Seabees, less one company, helped with this project. Heavy rainfall slowed earth moving and grading. On 5 November MacArthur directed that a major base be constructed at Finschhafen to support air, ground, and naval forces.[77]

On 15 November Lae and Finschhafen passed to USASOS control, the former as Base E, the latter as Base F. Both were placed under Headquarters, Advance Section, at Lae. Intermediate Section was set up at Port Moresby to exercise general supervision over all bases in New Guinea. Engineer work at Lae and Finschhafen continued under USASOS. Late in the year there was a noticeable increase in the scope of the work at Lae. A major effort was required on the high-priority road to Nadzab, especially since heavy rains made it impassable at times. The 836th and 857th Engineer Aviation Battalions did much of the work, completing the road by mid-December. At Lae, rapid completion of docking facilities was held up by shortages of timber and dock hardware. Still, by the end of 1943 work was fairly well along. The engineers had completed an airfield with a steel mat runway and had provided semipermanent housing for 900 troops, 15,000 square feet of warehouse space, aviation gasoline storage for 600,000 gallons, together with a 20-mile pipeline to Nadzab, a dock, and a jetty. At Finschhafen, the runway, surfaced with pierced plank laid on a coral base, was finished on 10 December. The exten-

SWPA File 691. (2) Ltr, ExecO Of C Engr GHQ SWPA to Casey, 9 Nov 43. SWPA File 160. (3) Of C Engr GHQ AFPAC, *Engrs of SWPA*, I, 126–31.

[75] Memo, Lane for Casey, 9 Nov 43. SWPA File 160.

[76] (1) Ltr, Ellison to Casey, 3 Jan 44. SWPA File 102. (2) *Building the Navy's Bases*, II, 292.

[77] Ltr, MacArthur to Comdr New Guinea Force *et al.*, 5 Nov 43. SWPA File 116.



BASE B AREA, ORO BAY

sive construction being planned for Finschhafen was not to reach its full stride until 1944.[78]

At Moresby work had tapered off and by the end of the year was almost complete. Six airfields were in operation. Eighty miles of road had been built, about one-tenth of them surfaced with bitumen. The engineers had built or improved six docks, four of them large enough to take Liberty ships. There were hospital beds, most of them in prefabricated portable units or native-type huts, for over 2,000 troops.[79] "The construction achieved in this area, especially airdrome construction, is most impressive," Colonel Lane wrote to Casey in November.[80] By the end of the year most of the engineer troops had left Port Moresby for more forward areas. The

[78] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 67. (2) Ltr, ExecO Of C Engr GHQ SWPA to Casey, 9 Nov 43.

[79] Of C Engr GHQ AFPAC, *Engrs of SWPA*, I, 122ff.

[80] Memo, Lane for Casey, 9 Nov 43.

road from Bulldog to Wau had been opened to traffic in August. By September jeeps with trailers loaded with about ten tons of supplies could make the rather rough trip in ten hours. With the capture of Lae and Salamaua, the need for a route linking Port Moresby with the Markham Valley became unnecessary, and work on the road was discontinued.[81]

Construction in Australia in the latter half of 1943 was still extensive. From 1 July to 31 December 1943 the Allied Works Council expended £25,845,556. There was less building in the southern part of the continent, but outlays for construction in Queensland and Northern Territory increased slightly. Work for American forces, though declining, was still considerable. In mid-October, the number of projects being built for the U.S. Army totaled eighty-eight.[82] The jobs of highest priority were the improvement of five airfields—Garbutt, Iron Range, Charters Towers, Amberley, and Eagle Farms—the enlargement of two camps—The Caves and Maryborough—and the construction of a cold-storage warehouse at Townsville. The size of the transshipment port at Cairns had been cut drastically because of the rapidly expanding port facilities in New Guinea.[83]

The complexity of the construction procedures remained. Particularly troublesome was the apparent necessity for American commanders to send every request to Headquarters, USAFFE, for approval. Brig. Gen. Carl W. Connell, head of the V Air Force Service Command, writing to Casey on 15 July, requested that something be done so that a base commander could go ahead with his work "without the necessity of writing a scenario concerning his each and every effort, and then waiting a fortnight while it is reviewed by someone who has very little knowledge of his problems. . . ." [84] This matter was shortly clarified. On 21 July MacArthur directed that "construction involving minor repairs, alterations, and improvements at a cost estimated to be less than 5,000 pounds will not be submitted . . . for approval" to Headquarters, USAFFE, "unless such alterations and improvements are not in accord with construction policy and directives." [85]

Supplies

In both theaters, stocks of supplies and equipment were extremely low. In 1943, as in 1942, the authorized level of supply for Class II and Class IV items was a 90-day operating level, plus a 90-day reserve. Most stocks in the two theaters never remotely approached the quantities called for. In the Southwest Pacific, in late 1943, only about 7 percent of the Class II items were on hand in amounts sufficient to meet estimated needs for 180 days. Class IV stocks were equally scarce. The engineers in both theaters needed far more than the ordi-

[81] Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, 159.

[82] AWC, *Report for the Period July 1, 1943–February 15, 1945*, pp. 9–11.

[83] Memo for Rcd, Hq USAFFE, sub: Relative Order of Importance of U.S. Army Constr Projs in Australia, 11 Oct 43. SWPA File 241.

[84] Ltr, Connell to Casey, 15 Jul 43. SWPA File 270.

[85] Ltr, MacArthur to CG USASOS *et al.*, 21 Jul 43. SWPA File 270.

nary amounts of supplies and equipment. Getting materials from the United States was an extraordinarily slow process. In the Southwest Pacific, about 300 days elapsed between the time a requisition was sent to the United States and the time the troops received the supplies. About one-third of this time was taken up with the transshipment of stocks from Australia to New Guinea and their distribution to the using units. One requisition for the Papua Campaign reached the San Francisco Port of Embarkation in October 1942. The War Department did not finish editing it until February 1943, and seven months later, materials ordered on this requisition were still arriving at Australian ports. In 1943 MacArthur's headquarters began sending requisitions for engineer Class II items to San Francisco 300 days in advance. Once a month a new over-all requisition was sent to indicate changes in needs. Thus, there was constantly on file with the War Department a requisition for 300 days of engineer supplies and equipment for the Southwest Pacific. There were frequently difficulties in getting these requisitions approved and many were cut extensively in the United States.[86] General Reybold, visiting the Southwest Pacific in November 1943, reported that "reserve stockages have not been built up in this theater, and as a result the forward displacement of port and airdrome facilities has been retarded both by lack of construction equipment and by lack of sufficient engineer troops. A more liberal policy in editing Class IV requisitions should be adopted." [87]

Both theaters reported many critical shortages. In the South Pacific, lumber, pipe, and electrical wire and fittings were almost invariably in short supply. In the Southwest Pacific, there was a heavy demand for corrugated iron. It was the best material for covered storage because it was easy to erect, easy to ship, and held up well in the tropics; on the whole, it was far superior to sisalcraft, fibrolite, tar paper, or native thatch. The engineers ordered 6,500 tons from the United States in May and another 6,500 tons in August, but by mid-November they had received nothing. Lumber was continually in short supply. It was needed mainly for camps, hospitals, warehouses, wharfs, and bridges. Only about one-sixth of the 154,000,000 board feet requisitioned in 1943 from the United States had been sent by mid-November. Exploitation of New Guinea's lumber resources was urgent, but it was held back by a lack of sawmills.[88] "All engineering troops . . . should come equipped with sawmills; lumber is the big cry here," Col. Carl A. Brandt of the V Air Force Service Command informed General Godfrey. "We in the Air Service Command have had to salvage old saw mills and fly them to forward areas, set them up, and operate them to get any lumber at all." [89] The 43d Engineers and the 116th improvised sawmills from scrapped equipment, but even though the units now had the

[86] (1) Memo for Rcd, Casey, 13 Nov 43. (2) Ltr, Casey to Reybold, 7 Oct 43. Both in SWPA File 139.

[87] Ltr, Reybold to Somervell, 25 Nov 43. SWPA File 88.

[88] Memo for Rcd, Casey, 13 Nov 43.

[89] Ltr, Brandt to Godfrey, 24 Aug 43. AAF, RG 501 Central Files, 322 Comds, Aug–Sep 43.



ENGINEER TROOPS AT ORO BAY MAKE THEIR OWN HARDWARE

equipment, they lacked skilled operators. Casey's efforts to have a forestry company sent from the United States in 1943 were unsuccessful; nevertheless he requested six such companies for 1944. Shortages of dock hardware, especially of nuts, bolts, and steel rods, held back the construction of badly needed wharfs and unloading facilities in the forward areas. The only items not in short supply in both theaters were fortifications materials. Insofar as possible the engineers continued to rely on local resources. Australia furnished considerable quantities of cement, lumber, nails, corrugated iron, dock hardware, and wire screening, but of these items, only cement was available in adequate amounts. In the South Pacific only New Zealand continued to be a supplier of any consequence.[90]

Distribution of Supplies

With the arrival of growing, though still insufficient, amounts of supplies in the theaters, distribution to the units in the combat zones became a vexing

[90] (1) Ltr, Reybold to Somervell, 25 Nov 43. (2) Hist of USAFISPA During World War II From 30 Mar 42 to 1 Aug 44 (Draft MS). OCMH Files.

matter. This problem was particularly acute in the Southwest Pacific. USASOS established engineer supply depots at the various forward bases but set up no systematic procedure for requisitioning, with the result that most units in New Guinea continued to order from depots in Australia. No engineer office was responsible for co-ordinating supply requisitions, nor was there an engineer office which had an over-all view of the supply situation. Since stock control was almost completely absent, locating supplies was difficult. A second problem arose. Insufficient amounts of supplies had to be allocated to engineer units of USASOS for base development and to engineer units of task forces for initial base construction.[91] General MacArthur delegated to USASOS, as the major logistics agency of the theater, responsibility for allocating supplies. Colonel Sturgis suggested that stocks, upon arrival in the Southwest Pacific, be allocated to General Headquarters, to USASOS engineers, and to task force engineers. He believed that resupply for Sixth Army engineer units should be from Army and not USASOS depots. Casey did not look with favor on this suggestion. In his opinion, USASOS, responsible as it was for logistic support in the theater, should determine, on the basis of operational directives, how supplies in the theater should be allocated.[92] Late in 1943 the engineers attempted to co-ordinate distribution of supplies more adequately. In December USASOS set up an advance echelon at Port Moresby and made it responsible for co-ordinating engineer supply in the forward areas. The Advance Echelon was to receive all supply requisitions from the forward areas and decide which engineer depot was to fill them.[93]

Shortage of Supply Units

Difficulties in both theaters were compounded by an inadequate number of engineer depot companies. The South Pacific had to manage with two platoons of one company during the first half of 1943. In the latter part of the year a provisional depot company was organized in Fiji, and one entire company and two platoons of another arrived in the theater from the United States. Elements of these units were dispersed to the various islands. In the Southwest Pacific, there was but one depot company throughout most of 1943. In the second half of the year, three more arrived. These were too few to handle adequately the growing quantities of supplies.[94] General Reybold, upon returning from the Southwest Pacific in November 1943, reported to Somervell, ". . . until recently this theater has operated with one engineer depot company, and . . . [in Australia with] such civilian assistance as could be procured. There have recently arrived three more companies which should ease the situation." [95] To keep supply from sinking into chaos,

[91] Memo, Casey for Sutherland, 3 Sep 43. SWPA File 211.

[92] Memo, Sturgis for Sverdrup, 29 Sep 43. SWPA File 124.

[93] Memo, Casey for Engr Adv Ech USASOS, 23 Dec 43, with 1st Ind, Engr Adv Ech USASOS to Engr GHQ Adv Ech, 30 Dec 43. SWPA File 219.

[94] (1) SOS SOPAC, Hist Rpt From Activation to 30 Jun 43, app., List of Trp Units, SOPAC, 15 Jul 43. (2) Memo for Rcd, Casey, 13 Nov 43.

[95] Ltr, Reybold to Somervell, 25 Nov 43.

men had to be detailed from general service regiments to engineer depots from time to time.

Equipment Shortages

Equipment was chronically short. Because there were so few troops, they usually had to be furnished with more machinery than the tables of equipment called for. Some units, such as general service regiments and combat battalions, needed not only more, but also heavier, machinery. As soon as a machine arrived in either theater, it was immediately sent to a unit which was greatly in need of it. In both theaters units worked in widely separated and isolated areas; because of the shortage of shipping, it was difficult to send equipment back to a central pool for redistribution. As a result, while there might be a considerable stock of some types of machinery in a theater, equipment could not always be delivered where and when it was most needed. In the Southwest Pacific there were serious shortages of tractors, graders, cranes, concrete mixers, ditching machines, and welding equipment. In the South Pacific tractors, cranes, shovels, and dump trucks were most in demand. A bad situation was made worse by the continual arrival of so many engineer units without their machinery. Often the plant did not show up until months after a unit had reached its destination. An equally great cause of confusion was the arrival of a unit's equipment on many ships at widely scattered ports. In the Southwest Pacific the machinery of the 839th Aviation Battalion arrived on 11 ships, that of the 1052d Port Construction and Repair Group on 15, and that of the 864th Aviation Battalion on 18. In an effort to bring about more efficient use of the inadequate amount of equipment available, the War Department required the overseas theaters to submit a Material Status Report at the end of each month, beginning on 31 October 1943. This report was to state how many pieces of machinery were on hand in the theater, the number of items in depots, and the number "lost" during the month. Computations would be made in the War Department as to the numbers of each item of equipment to which a theater was entitled. Late in 1943, Casey reported that "the rate of shipment of construction plant either as Class II or IV has been barely sufficient to replace losses and obsolescent plant and to issue the additional plant required by units. . . ." [96]

Spare Parts and Maintenance

Since spare parts were almost nonexistent, much equipment was deadlined. In some respects, matters were worse in the SOPAC than in the SWPA because the former theater had so few commercial concerns to supply parts.[97] The engineer of the service command on New Caledonia reported in late 1943 that a large percentage of engineer equipment was "down due to lack of parts." [98] Spare parts, especially those needed for shovels, tractors, motor graders, and carryall scrapers, were scarce in both

[96] Memo for Rcd, Casey, 13 Nov 43.

[97] Rpt on Conditions in SOPAC, pt. I.

[98] TWX, Maj Gen Thomas M. Robins to Engr SupO Columbus QM Depot Columbus Ohio, 26 Dec 42. CE South Pac 1.

theaters for a number of reasons. Far larger quantities of equipment were required than had been anticipated. A great deal of the machinery, too light for the work which had to be done, was, nevertheless, subjected continuously to hard usage. Extraordinarily large numbers of parts were needed because engineer equipment was not standardized. One unit arrived in Australia with seven kinds of tractors manufactured by five firms. Because stocks of spare parts in the United States were low and shipment to the theaters infrequent, parts often were not received until eight months after requisitions for them were sent in. After the parts arrived in either theater, it sometimes took as long as five months to get them to the using units. Automatic shipments were just as unreliable. The 842d Aviation Battalion left San Francisco on 26 February; second echelon parts for its D–7 tractors, which should have been sent automatically with the unit, were not shipped until five months later.

A bad spare parts situation was aggravated by an almost complete lack of personnel trained in storing and distributing. During 1942 and 1943 there were no spare parts companies in either theater, even though requests for such units had been sent to Washington repeatedly. On 1 August the War Department stated that no such companies would be available in 1943. Late that year spare parts began to arrive in more adequate amounts. Now the problem of storing and issuing them became acute. Great confusion existed at Milne Bay. "The most striking Engineer problem at this base," wrote Lane, "is the organization of [the] Engineer spare parts services. Some 1,300 cases of urgently needed parts have arrived but cannot be handled for lack of personnel and suitable storage space." [99] Efforts were being made to better the situation. By late December a warehouse, 80 by 400 feet, with a concrete floor, had been completed. Bins were being constructed, and the classification of spare parts was being "vigorously pushed." [100]

Just as scarce were spare parts for the amphibian engineers' landing craft. They were needed in much greater amounts than had been expected. Tropical waters quickly corroded generators and starters; coral reefs tore up propellers and shafts. Since the Navy was responsible for supplying spare parts, the amphibian engineers sent their requisitions to Service Forces, Seventh Fleet, at Brisbane. The Navy procured the items it needed from its stocks in the United States and supplied the amphibian engineers with their share. Although a supply system was set up in the theater, the engineers received only a trickle of spare parts. During the last six months of 1943, the Navy could meet only 5 percent of the amphibian engineers' demands, although it turned over to them half the stocks in its distribution center at Milne Bay.[101] "Our really important and only serious trouble has been [the] shortage of spare parts," Heavey wrote on 3 January 1944 to Brig. Gen. Daniel Noce, formerly head of the Engineer Amphibian Command.

[99] Memo, Lane for Casey, 9 Nov 43.

[100] Memo, Col C. R. Bathurst, SupO Of C Engr GHQ SWPA for Casey, 23 Dec 43. SWPA File 160.

[101] Ltr, Capt Donald Joseph, Liaison Off 2d ESB USAFFE Engr Sec, to Casey, 13 Nov 43. SWPA File 228.

". . . no one foresaw that electrical parts, generators and starters would go so fast in these tropics. . . . Not a spare generator or starter now in this whole theater. . . . Navy is as short as we are. . . ."[102]

The shortage of parts alone would have made it hard to keep machinery in good running order. Now most equipment was being used constantly in isolated areas, hundreds, and sometimes thousands, of miles from repair centers. Maintaining equipment properly under such conditions was extremely difficult. A maintenance company and a heavy shop company arrived in the Southwest Pacific in April; a heavy shop company and a maintenance company, in the South Pacific in June. Elements of these units were sent far and wide in order to get the most urgent repair jobs out of the way. As a rule, construction units had to repair and maintain their own equipment as best they could. Already working on two or three shifts a day, the units were hard pressed to provide operators for heavy equipment and at the same time furnish men for repairing and maintaining it. General Reybold reported to Somervell in November that "the lack of maintenance and shop installations and personnel has been apparent."[103] This was an understatement.

Construction Standards

Building in the forward areas continued to be mainly on a makeshift basis. Though troops were few and supplies scarce, speed, especially in the construction of airfields, was as urgent as ever. In the Southwest Pacific a landing field now consisted of a single runway. If a second strip was put in, it was constructed parallel to the first. Runways were, as a rule, initially grass landing places or captured Japanese airstrips; but in either case they were improved and later surfaced with mat, coral, or bitumen. In the South Pacific, where airfields were built under the Navy's guidance, they were more elaborate. Early in 1943, runways were still crossed in the "traditional" manner and were 150 feet wide and of varying lengths. But by the end of the year it was the rule to put in a single runway and provide two parallel taxiways. In the South Pacific coral was extensively used for surfacing; the airmen preferred it to mat, also widely used. Coconut plantations were generally the most ideal sites for landing strips. Construction at each runway followed standard procedures. Fill was placed in a 4-inch layer and was compacted with sheepsfoot rollers. The final surfacing consisted of a 6-inch layer of coral. The result was a "smooth, hard, impervious, reasonably dust-free surface." If landing mat was used, it was placed on the compacted coral.[104]

In both theaters troops in the forward areas lived in tents. Wherever possible, screened and floored mess halls and kitchens were built of local materials. Makeshift facilities were provided for bathing. In April 1943, General Breene, head of the Services of Supply in the South Pacific, directed that north

[102] Ltr, Heavey to Noce, 3 Jan 44.
[103] Ltr, Reybold to Somervell, 25 Nov 43.
[104] (1) DeLonge, Rpt on Observations in SOPAC. (2) Memo, Kumpe for Casey, 27 Sep 43.

of the New Hebrides only tents or native-type structures requiring no imported materials would be permitted for troop housing. South of the New Hebrides, frame structures were permissible, but such construction would receive the lowest priority. In late 1943 prefabricated buildings began to be used. In the Southwest Pacific, Colonel Teale's engineers developed a number of standard types, the three major ones being 20, 47, and 88 feet wide and of variable lengths. The one 20 feet wide, and usually 54 feet long, was the most practical as it could be used as living quarters, an administrative building, or as a warehouse. In the South Pacific, New Zealand supplied prefabricated hutments 20 feet wide, with lengths in multiples of 4 feet. Very noticeable in the SOPAC was the superior type of housing provided for Navy personnel. They usually lived in comparatively comfortable Quonset or Dallas huts. Colonel Murrow believed that housing for the Army was not good enough, that if troops were to occupy an area for more than six months, they should live in frame buildings of some kind. In the forward areas, makeshift structures were used as warehouses and hospitals. Native huts and canvas-covered native-type frames often had to do as hospital wards but were not satisfactory. Teale's engineers adapted the 20-foot-wide prefabricated buildings to hospital needs. Lengths could be extended by 9-foot increments. Eaves were wide and overhanging. Units contained from 50 to 100 beds. One of Australia's leading building contractors was appointed coordinator of the manufacturing program, and many firms built the prefabricated sections. By late 1943 shipments to New Guinea began.[105]

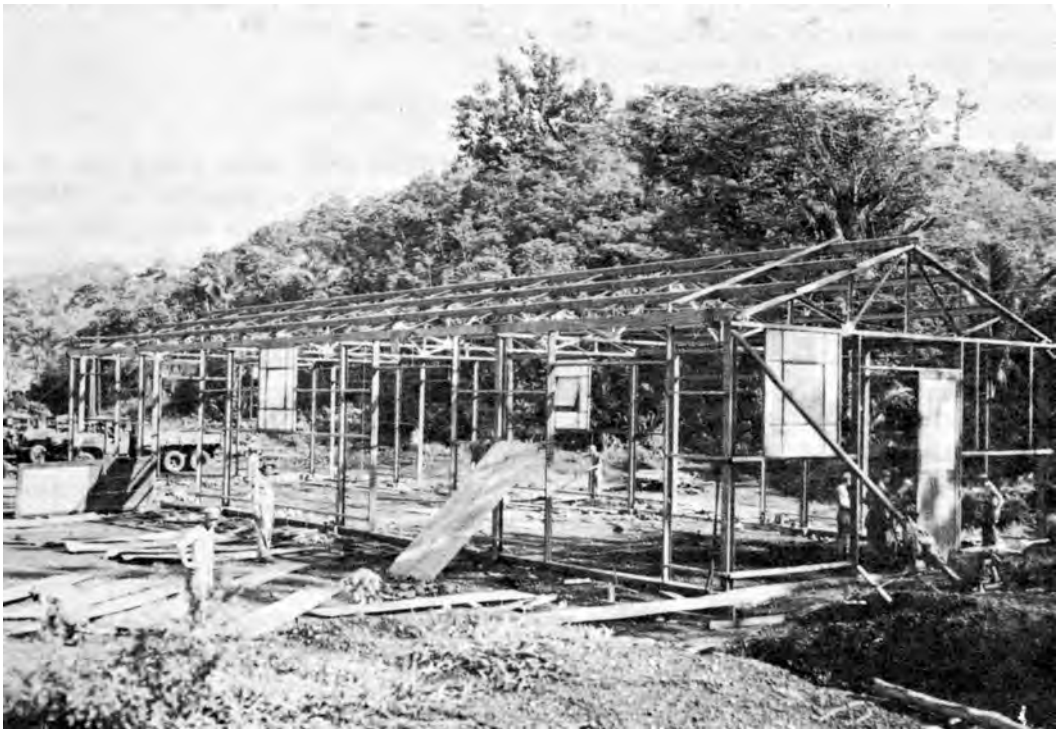
Men and Machines

Engineer units were being put to a severe test. Since operations in SWPA extended over a much wider land area than those in the SOPAC, conditions under which the engineers had to work imposed greater hardships. In the preparation of the tables of organization and equipment of general service regiments and other kinds of construction units in prewar days, it had been assumed that the men would do their work mainly with hand tools and that machines would be used only occasionally. This basic assumption had to be drastically revised. Getting a large amount of machinery and keeping it going around the clock were most important matters.[106] The commander of the 808th Aviation Battalion estimated that the 800 men of his unit, using their machinery around the clock, could do as much work as 50,000 men equipped only with hand tools.[107] Small wonder that machinery was operated for twenty or more hours a day and was stopped only for maintenance and repair. Small wonder, also, that under such usage problems arose. It was hard, in fact, usually impossible, to find enough capable equipment operators and maintenance personnel. Most units, especially general service regiments, did not

[105] (1) AWC, *Report for the Period July 1, 1943–February 15, 1945*, pp. 49–54. (2) Hist of USAFISPA During World War II From 30 Mar 42 to 1 Aug 44, pp. 585–611. (3) Rpt on Conditions in SOPAC, pt. III.

[106] Matthews, Data for Hist Rpt, p. 13.

[107] Ltr with Incls, Ellison to Casey, 25 Sep 43. SWPA File 144.



CONSTRUCTION OF THE FIRST STEEL BUILDING AT MILNE BAY

have enough high ratings for the large numbers of specially trained men required. "Their disadvantage as to grades and ratings in comparison with Aviation and C. B. battalions is resulting in much dissatisfaction," [108] Reybold reported to Somervell after his visit to the Southwest Pacific. The fact that jobs were scattered over such wide areas meant that many detachments had to be sent out from the larger units. This practice led to complications in setting up an efficient organization, providing equipment, performing maintenance, and furnishing supplies. The large general service regiment seemed especially unwieldy in vast theaters with fluid tactical situations. Greater flexibility in organization was needed. Attempts were being made to find solutions to these problems.

Faced with severe shortages of troops and equipment, the engineers, in 1943 as in 1942, had to rely heavily on native workmen, especially in New Guinea. Little interested in the war, the natives of that island were nevertheless eager to work for certain types of goods. Those living near the coast, who had had fairly extensive contact with white men, wanted tobacco, matches, knives, razor blades, calico, and salt. Those living in

[108] Ltr, Reybold to Somervell, 25 Nov 43.

the more inaccessible interior regions demanded beads and, more often, the highly prized gold-lip, mother-of-pearl, and cowrie shells, all found in abundant quantities on the shores of New Guinea. Great numbers of shells were needed. In March 1943 USASOS purchased 2,000 gold-lip shells with which to pay workers at various projects. The Australian-New Guinea Administrative Unit had general charge of native affairs. It organized the Papuans into working parties, with leaders or "boss boys" who spoke some English, and assigned the parties to American or Australian units. As in the Papua Campaign, the natives were much in demand as road and bridge builders, and they often served as carriers of supplies or as stretcher bearers. They sometimes supplied information on the availability of local materials, the nature of the terrain, and the location of enemy forces. Some served as guides to parties traversing the jungle, whereas others helped ESB pilots guide their craft through the unfamiliar coastal waters. By mid-June approximately 24,000 Papuans were employed on American and Australian engineer projects in New Guinea. In the opinion of Maj. Gen. Stephen J. Chamberlin, MacArthur's G–3, the Papuans "almost spelled the difference between victory and defeat." In the South Pacific, natives were employed to a lesser extent. They were occasionally used on airfield construction in the Solomons and were quite frequently used for building native-type huts, especially on Fiji and in the Solomons.[109]

[109] (1) Memo for Rcd, Leahy, sub: Hints on Carrier Transport in New Guinea. SWPA File 100.

Maps and Intelligence

Expanding combat operations in the two theaters greatly increased the requirements for maps and intelligence information. Both theaters enlarged their mapping and intelligence-gathering organizations, and both received additional units from the United States. In the Southwest Pacific, two changes in top-level organization were made, which brought map production more directly under Casey's control. After the Engineer Section, USAFFE, was set up in March, the Engineer Intelligence Section, USASOS, was transferred to it. When, in September, the special staff sections of USAFFE were abolished, the question arose as to whether the men engaged in mapping and intelligence should go back to USASOS or be transferred to General MacArthur's staff. Casey believed mapping and intelligence should be concentrated in the commander in chief's headquarters to permit better co-ordination with other theater commands and with Australian mapping and intelligence agencies. At the same time there would be close at hand a ready source of maps and charts for planning purposes. In line with Casey's recommendations, all responsibilities for mapping and gathering engineer intelligence became henceforth the responsibility of his office. The 648th at Melbourne continued to put out most of the maps for the theater, while the 69th Topographic Company, assigned to Sixth Army, was at work in New Guinea. A

(2) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 106ff. (3) Rad, GHQ SWPA, to Adv GHQ, 18 Mar 43. 384 NG #2 5–40, G–3 Files, GHQ SWPA. (4) DeLonge, Rpt on Observations in SOPAC.

third mapping unit, the 960th Aviation Topographic Company, reached the Southwest Pacific during the year.[110]

In the South Pacific, Army mapping and intelligence functions were the responsibility of Admiral Halsey's G–2 section. G–2 had placed all mapping and intelligence functions, Army, Navy, and Marine, in the Combined Intelligence Center, which, along with other headquarters installations, was located in a converted warehouse in Nouméa. The center had six sections, each concerned with a particular aspect of map making or gathering intelligence; Army, Navy, and Marine personnel worked in all sections. The one Army mapping unit in the South Pacific, the 955th Aviation Topographic Company, had arrived in May 1942 without its equipment. For eight months thereafter it was on construction jobs. With the arrival of its equipment late that year, it began to make photomaps of the Solomons and was in late 1942 engaged in this work on Espíritu Santo.[111]

The map makers had to rely more and more on aerial photography. The South Pacific was better off than the Southwest Pacific in this respect, for the land areas that had to be mapped were comparatively small and there were sufficient numbers of aircraft to furnish fairly adequate photographic coverage. "The photo reconnaissance group has apparently given excellent cooperation in supplying those photographs necessary for planning purposes," Maj. Merrill E. DeLonge wrote in his report to General Reybold. The map makers were mainly occupied with producing hasty terrain maps and photomaps of areas in the Solomons likely to be the scene of combat.[112]

In the Southwest Pacific, even as late as July 1943, a half-strength photographic reconnaissance squadron, equipped with P–38-type F–4 planes, was all that was available for photographic missions. Much of the photography obtained in 1942 had been poor because the airmen were not fully aware of the engineers' needs. To give them a better idea of what was expected, an officer from the 648th began to serve with the photographic squadron in a liaison capacity late that year. He gave the airmen a better understanding of the importance of getting good photographs. Pilots visited the base map plant at Melbourne to see how their photographs were used and to learn how hard it was to make good maps from indifferent photography.[113]

To meet the growing complexities of supplying maps to units, especially in such large theaters as the Southwest Pacific, the War Department activated map distribution units, each with one officer and twelve enlisted men. The first of the units to be shipped to SWPA arrived in late 1943 and was sent to Finschhafen, where it opened a map depot. The Australians opened a similar depot at Port Moresby.[114]

Of growing importance was the gathering of engineer intelligence. Extensive construction needs in the forward areas

[110] Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 97ff.

[111] Memo, Col Kumpe for Lt Col E. A. Dunbar, Intel Sec OCE GHQ SWPA, 3 Oct 43. SWPA Files.

[112] DeLonge, Rpt on Observations in SOPAC.

[113] (1) Of C Engr GHQ SWPA Annual Rpt for 1943, Intelligence. SWPA File I 27. (2) 648th Engr Topo Bn GHQ, Interim Rpt, 1 Jan–30 Sep 43. SWPA File I 4.

[114] *Ibid.*

made accurate analyses of the terrain highly important. Here too, aerial photography continued to be a most important source of information, especially in the Southwest Pacific, where great stress was being put on terrain intelligence. On occasion, members of Casey's intelligence section made personal reconnaissances of the forward areas. The information gathered from different sources was compiled and issued in numerous publications, such as terrain analyses, engineer annexes to terrain studies, preliminary terrain estimates, and spot area studies. Toward the end of 1943 Casey's intelligence section also began to gather more extensive information on the organization of the Japanese engineers and on their equipment and activities.[115]

Training

The training ot troops was the function of engineer training centers in the United States. Sometimes additional instruction was necessary overseas. Occasionally, entire units had to be given special training so that they could cope with conditions peculiar to the theater or meet new tactics developed by the enemy. Specialists were sometimes sent to schools to take refresher courses. If there was a great demand for men with certain skills, such as for operating equipment, removing mines, and making soil analyses, special instruction had to be given to train the additional men needed. Because of the pressure of work in the South and Southwest Pacific, little time could be set aside for teaching entire units. The only exceptions were the combat engineer units, which were given rather intensive training before being sent to the front lines. In SWPA, training centers were set up in early 1943 near the major Australian coastal cities from Melbourne to Cairns to train American and Australian units in all phases of amphibious operations. The 114th and 116th Combat Battalions and the 8th Engineer Squadron of the 1st Cavalry Division spent three weeks at the center north of Brisbane, undergoing training in landing operations. Exercises were realistic, even to the point of including bombardments. But for the men of the service units, unit training almost invariably meant on-the-job training.[116]

A number of men from service units were sent to specialist schools. The Australian armed services had several that enrolled engineers in need of additional training. The RAE school in bomb disposal at Bonegilla in Victoria, one of the first which the engineers attended, provided excellent training. After finishing their course of instruction, the men returned to their units to become heads of bomb disposal squads and train others in the subject. The RAE and the RAAF had several schools to teach camouflage. A small number of engineers attended the courses. On the whole, the instruction provided was too technical to serve U.S. Army needs, and the fast-growing Allied air superiority made training in camouflage seem

[115] Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 100–101.

[116] (1) For a more detailed discussion of Engineer troop training in the Southwest Pacific, see Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 52ff., 108ff.

questionable in any case. Of more practical value was training men in equipment operation and maintenance. The Australians had several schools to provide such instruction. The Allied Works Council opened one in Sydney in April to train equipment operators and maintenance men for six weeks. Forty U.S. engineers attended. The AWC opened a second school in Sydney which offered a similar course beginning in July; ninety engineers attended. The Australian branch of the Le Tourneau Company opened a school in equipment operation and maintenance at Port Moresby in June. The RAAF had a school in diesel mechanics in Melbourne to which a number of men from the 91st and 96th General Service Regiments were sent. Thus, the Australians were able to take care of some of the engineers' instructional needs in the Southwest Pacific.[117]

Two U.S. Army Engineer schools opened in 1943. One was the Engineer Branch of the officer candidate school which began instruction in Brisbane in February. Students were selected from a list of men recommended by commanding officers of engineer units. Qualifications for admittance were the same as for engineer branches in the United States. During 1943 about 125 enlisted men attended the 3-month courses. The second school established was the Soil Mechanics School at Port Moresby, which trained officers and men to make adequate soil analyses for construction projects, particularly airfields. U.S. Army engineer units were given quotas, with a small number of vacancies allotted to the RAE and the RAAF.[118]

Inadequacies in the training of engineers were becoming apparent by late 1943, particularly in the Southwest Pacific. Especially noticeable was the inadequate training of most men in planning construction projects and operating and maintaining equipment. To correct some of these deficiencies, increasing numbers of men were sent to Australian specialist schools. But the schools were a long way from the units, and their courses of instruction were sometimes not well adapted to engineer needs. Unit on-the-job training had to be stressed as much as possible.

Arawe, Cape Gloucester, and Saidor

The capture of Finschhafen had cleared the way for the last phase of CARTWHEEL—the seizure of western New Britain, control of which would give the Allies great advantages. The air forces would be able to make more effective strikes against Rabaul, ships could be sent through the Vitiaz Straits into the Bismarck Sea, and amphibious operations in that area would be possible. MacArthur planned to make two major landings—one at Arawe, the other at Cape Gloucester. Base construction would follow. If western New Britain were lightly held, a landing was also to

[117] (1) Ltr, G–3 USASOS to CO 43d Engr GS Regt *et al*, 3 Sep 42. SWPA File 10. (2) Memo for Rcd, Capt Dean W. Barnes, Opns and Tng, Of C Engr GHQ SWPA, 17 Sep 43. SWPA File 11. (3) Memo, Maj W. D. Murphy, Opns and Tng Br OCE USAFFE, for Casey, 4 Jun 43. SWPA File 10.

[118] (1) Of C Engr GHQ SWPA Annual Rpt for 1943. SWPA File A9. (2) Memos, Heiberg for Dir of Works and Bldgs RAAF and E-in-C LHQ ALF, 13 Aug 43. SWPA File 10.

be made at Saidor, on the New Guinea coast.[119]

MacArthur scheduled the landing at Arawe for 15 December, and the 59th Engineer Combat Company and boat and shore units of the 2d Special Brigade were assigned. This was to be the first assault since the Nassau Bay landing in which the amphibious engineers would support a task force made up solely of American troops. Naval transports took the amphibious engineers with seventeen LCVP's and two LCM's to the rendezvous area about four miles from Arawe. Since the tops of the reefs were just barely submerged, only the Navy's Alligators and Buffaloes were sent in on the first four waves.[120] The first engineer craft to go in—part of the fifth wave—had a hard time. One LCVP, stuck on a reef, was riddled by bullets from Japanese planes. Previous amphibious operations had a serious weakness in that protective naval fire stopped when the assault craft were about a thousand yards from shore. The next few minutes were crucial. Enemy fire from the beach, even if minor, might seriously disrupt the landing. At Arawe, the amphibian engineers used two of the newly developed Dukws equipped with rocket launchers which fired on the beaches after the naval barrage had lifted.[121] Each Dukw had 120 rocket tubes capable of shooting 4.5-inch rockets for a distance of 1,100 yards. At Arawe the Dukws continued their fire until the first wave was only 150 yards from shore. While they did not have pinpoint accuracy, they threw up an effective barrage. Riding low in the water, they made small targets. The barrage at Arawe proved to be largely a practice one, for there was but slight opposition to the landing.[122]

The 59th engineers had few combat missions. They found no mines or obstacles, and rarely saw any enemy troops. Most of the men at first worked as stevedores. Some began to improve the landing beach. One man with a bulldozer stripped off the 15-foot-high undergrowth. Teams of thirteen men laid landing mat, stapled it down, and covered it with sand to keep it from curling. Despite some interruptions caused by bombing and strafing by enemy planes, unloading and dispersing of supplies were carried out in an orderly manner. Supplies unloaded, the 59th turned to construction. The men built a small dock, a refueling pier, a station hospital, five miles of all-weather roads, and three baseball diamonds. They had ample equipment for their work, having recently received the additional machinery required by their unit's table of organization and equipment. Enemy air raids were frequent. During their first ten days ashore, the men bivouacked in a narrow area between the shore and a swamp. One night, planes bombing

[119] Krueger, Rpt of the DEXTERITY Opn, 15 Dec 43–10 Feb 44. SWPA File A167A.

[120] *Alligator* was the popular term for the landing vehicle, tracked, Mark I (LVT (1)); the *Water Buffalo*, or landing vehicle, tracked, Mark II (LVT(2)), was an improved type of Alligator.

[121] The Dukw was a 2½-ton 6x6 amphibian truck.

[122] (1) Heavey, "Amphibious Engineers in Action," *The Military Engineer*, XXXVI (May, 1944), 150. (2) 2d ESB, Monthly Rpt of Opns, 1–31 Dec 43. SWPA File E20. (3) 59th Engr Combat Co (Sep), Engr Opn Rpt. SWPA File 74. (4) Heavey, "Rockets by Army Engineers at Arawe," *The Military Engineer*, XXXIX (August, 1947), 345.

the area killed two men and wounded four. Washing Machine Charley, as the enemy planes were called, caused much loss of sleep. The Japanese made no attacks by land. Amphibian engineers, their craft equipped with automatic weapons, ranged through the swampy inlets and coastal waterways near Arawe, seeking out enemy craft that might attempt to approach the landing area. They came upon several and sank them.[123]

On 26 December the 1st Marine Division landed at two points on Cape Gloucester. The amphibian engineers, their small craft tossed about by high seas stirred up by strong northwest winds, helped bring in the marines, employed rocket Dukws to protect the boats in the first waves and subsequently engaged in resupply missions and carried on patrols nightly off nearby beaches where the Japanese were reported lurking. One rocket Dukw knocked out four pillboxes that were holding up the advance along the coast. On shore, Marine engineers were responsible for combat support; Army engineers, for base construction. Work was under the direction of the Marine task force commander. Already in the area were two Japanese-built airstrips, both poorly constructed. Engineer officers who inspected them believed that the better of the two could be developed. In January, three aviation battalions—the 1913th, the 841st, and the 864th (less one company)—arrived and proceeded to put in two parallel runways. The men removed the humus and cut down the underlying gravel to the required level, using the excess to fill the low spots. Construction was hampered by the almost continuous torrential rains.[124]

On 17 December General Krueger received MacArthur's directive to take Saidor. Five days later he organized a task force made up of elements of the 32d Division which would attack on or after 1 January 1944. The attack was made on the 2d. Boat units of the 2d ESB brought the troops ashore in calm seas with little trouble. The engineers placed landing mat on the loose stones and sand of the beach, thus enabling trucks to move across easily. As the infantry expanded the beachhead, the amphibian engineers carried out numerous resupply missions, necessary because heavy rains had made the few roads and trails almost impassable. There were no Japanese in the area. Company A of the 114th Combat Battalion, responsible for combat missions, built roads and bridges. Much corduroy and many small bridges were required. The Australians, upon abandoning Saidor early in 1942, had dug trenches across the landing strip and had erected 12-foot poles. Trenches and poles were still there and the field was overgrown with kunai grass. The task force engineer directed that the runway be rehabilitated. Shore engineers and field artillery troops, using bulldozers, shoved the dirt back into the ditches while fifteen men of a depot platoon took down the poles. Trucks, ranging back and forth, knocked down the grass and compacted the surface. Combat engineers and field artillery

[123] 59th Engr Combat Co (Sep), Engr Opn Rpt.

[124] (1) Heavey, "Amphibious Engineers in Action," *The Military Engineer*, XXXVI (May, 1944), 151. (2) Hq 1913th Engr Avn Bn, History of the Bn During Dec 43 and Jan 44.

troops policed the area. On the afternoon of the third day the strip was ready for use. The next day the 808th Aviation Battalion arrived and was assigned the job of extending the runway to 6,000 feet. It carried out this work, assisted by the 863d and 860th Aviation Battalions. Soon a minor base was under construction at Saidor.[125]

CARTWHEEL had come to an end. Rabaul was so effectively neutralized that it could be bypassed. Engineer activities in the South and Southwest Pacific had greatly expanded in 1943. The number of U.S. Army engineer troops had increased from 8,770 to 15,261 in the South Pacific and from 7,594 to 42,285 in the Southwest Pacific. The engineers had had their first experience with amphibious operations. They had continued to play an important part in supporting the infantry in combat, and they had had increasing responsibilities for construction in the forward areas. The most striking aspect of engineer operations in the two theaters was the divergence from usual patterns in that service engineers did not work behind the combat forces, but beside them. Almost as soon as the first combat forces landed in a forward area, construction units came in to begin the building of bases and airfields. As a result, adequate support of the combat troops was possible sooner, the air forces were able to strike at the more remote enemy strongpoints at an early date, and the rapid advance of the Allied forces could be sustained. It was becoming increasingly clear that the rapidity of the advance in the two theaters in large measure depended on the speed with which the engineers could build bases and airfields.

[125] (1) 114th Engr Combat Bn, Opns of Co A, 114th Engr Combat Bn From 2 Jan 44 to 29 Feb 44. (2) Task Force Engr Rpt, MICHAELMAS Task Force, 12 May 44. Sturgis File 38.

CHAPTER VII

The Far North

The outbreak of war with Japan brought the northwestern part of the North American continent very much into the foreground. The disaster at Pearl Harbor meant that the United States had lost naval control of the northern Pacific. It was not known whether the Japanese would attack Alaska, or, if they did so, what size force they would use. The defenses of Alaska would have to be strengthened insofar as it could be done without detriment to the build-up in more vital theaters of war. Engineer operations in the Territory were expanded. At the same time the engineers were called upon to construct projects in northwestern Canada to strengthen Alaska. Soon after the outbreak of war they were directed to build a road—the Canada-Alaska, or Alcan Highway—to link Alaska with the United States, and they were directed to develop the oil resources on the Mackenzie River—a project known as Canol. (*Map 15*) The Japanese attack on Dutch Harbor in June 1942 and the seizure of Attu and Kiska increased fears that Alaska was in danger and made engineer construction appear even more urgent. The threat was not entirely removed until the Japanese were driven from the Aleutians in mid-1943. In retrospect, the alarm over the danger seems much exaggerated, but to many at the time it seemed very real. Much of the contruction at first glance appears to have had little to do with the war against Japan. Yet the fact remains that most of it in all probability would never have been undertaken had the United States not been at war with that country. Because of the war with Japan, the Engineers had to do extensive work in a region with which just a few years previously they had been little concerned.

Strengthening Alaska's Defenses

Plans for Alaska

After Pearl Harbor General DeWitt, who, as commander of the Fourth Army and of the Western Defense Command established in 1941, was responsible for the defense of Alaska, estimated that the Territory might be subjected to surprise attack and, possibly, invasion. He wanted more ground troops and an immediate increase in the number of planes. Washington authorities in considering his demands did not believe Alaska to be in imminent danger. But the possibility that the Japanese might launch an attack could not be ignored. On 11 December the Western Defense Command, including Alaska, was made a theater of operations. The alert of late November was intensified. No new construction was contemplated, but the War Department directed speedy completion of approved or planned projects


U. S. S. R.
ARCTIC OCEAN
Bering Sea
PACIFIC OCEAN
ALASKA
YUKON
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
CANADA
UNITED STATES
SEWARD PENINSULA
ALASKA PENINSULA
ALCAN HWY.
Nome
Bethel
Galena
McGrath
Tanana
Fairbanks
Nenana
Ladd Field
Big Delta
Ft. Richardson
Anchorage
Gulkana
Tanana Crossing
Valdez
Whitehorse
Champagne
Carcross
Jake's Corner
Haines
Skagway
Juneau
Watson Lake
Mayo Landing
Norman Wells
Great Bear Lake
Ft. Simpson
Hay River
Ft. Nelson
Ft. Smith
Fitzgerald
Prince Rupert
Ft. St John
Dawson Creek
Peace River
Mc Murray
Waterways
Prince George
Edmonton
Calgary
Vancouver
Seattle
Portland
Yukon River
Tanana River
Kuskokwim River
Kodiak I.
Sheldon Lake
Kluane Lake
Teslin Lake
Taltheilei Lakes
Great Slave Lake
Lake Athabasko
Athabasko River
Peace River
Columbia River
ALASKA AND WESTERN CANADA
1942 - 1943
200 0 200 400
MILES

MAP 15

that were considered urgent. In December a number of jobs, some of them under review since July, were quickly approved. Improvements were to be made at Ladd, Elmendorf, Annette, and Yakutat. All airfields, including those built by the Civil Aeronautics Authority, were to have storage for aviation gasoline and for bombs and ammunition. Army posts were to be enlarged. The camp for the Army garrison at the CAA field at Nome was almost finished; similar facilities were to be built at nine other CAA fields. Eleven of the aircraft warning stations were to be completed. At long last, work was to be started on an airfield and Army post on Umnak; on 9 December Reybold got the signal to go ahead with this construction, which DeWitt had been urging since July. The two fields which CAA was planning to construct on the Alaska Peninsula at Cold Bay and at Port Heiden were to be built by the Army. At all installations dispersion and concealment, hitherto largely ignored, were to be stressed. Refinements, such as family quarters for married officers and fencing around military installations, were to be eliminated. The estimated cost of construction as of 31 December was approximately $90 million. Various projects of benefit to the Army would be undertaken by civilian agencies. The Department of the Interior was getting ready to improve the Richardson Highway, and the Public Roads Administration was preparing to build or improve other roads. The Department of Commerce planned to hard-surface the CAA runways.[1]

[1] DF, Somervell to C AAF, 15 Dec 41. G-4/30436.

The expanded and accelerated construction program meant a great increase in the workload of the engineers. Lt. Col. George J. Nold as engineer of the Alaska Defense Command and Major Talley as area engineer would have far greater responsibilities than before. The Seattle District under Colonel Dunn would likewise have much more to do. At the close of 1941 there were in Alaska Company D of the 29th Topographic Battalion at Seward, the 32d Combat Company at Fort Richardson, the 802d Aviation Battalion at Annette, the 807th Aviation Company at Yakutat, and the 1st battalion of the 151st Combat Regiment, elements of which were at various Army posts from Dutch Harbor to Fairbanks. Contractors for the Navy were building the posts for the Army garrisons at Sitka, Kodiak, and Dutch Harbor. Projects not being built by troops or Navy contractors were the responsibility of the Seattle District. Most of this work was being done by hired labor. Colonel Dunn had made no large contracts, except the one with the West Construction Company for work on the railroad cutoff. More troops and civilians were urgently needed.[2]

Shortages

It was difficult to get either troops or civilians for Alaskan projects after Pearl Harbor. Enlistments and the draft cut

(2) Ltr, TAG to CofEngrs, 31 Dec 41, with 1st Ind, Asst C Opns Br OCE to NPD, 5 Jan 42. (3) Ltr, TAG to DeWitt, 31 Dec 41. Last two in 600.1 (Alaska) 2 Jan–Mar 42.

[2] (1) Hists of the 32d Engr Combat Co, 807th Engr Avn Bn, and 151st Engr Combat Regt, in Orgns Hists, U.S. Army, Alaska.

deeply into the supply of civilian manpower; deferments were as a rule not granted to men who wanted to work in the Territory. Governor Gruening believed more use should be made of local residents. In his opinion, salmon fishermen and packers, unemployed because of war conditions, would make good construction workers. Secretary of the Interior Harold L. Ickes suggested that the 4,000 prospectors in the Territory, many of whom owned construction equipment, could be of help. The Seattle District, while glad to take any qualified residents, could not draw appreciable numbers of workmen from sparsely inhabited Alaska. Because of the great distances and poor transportation, it would, as a rule, have been more of a problem to assemble a working force within the Territory for a project than to send one in from the United States. Local civilians could not always be relied upon to stay on the job. Some of the fishermen who had been hired were planning to quit when the fishing season began in the spring. With the outbreak of war, many workers from the United States wanted to return home. Even if they could be persuaded to renew their contracts, most insisted on interim vacations. Neither local nor imported civilian labor could fill the need. The shipment of more engineer troops was imperative, but few could be spared for Alaska. The first unit to arrive after Pearl Harbor was the 2d Battalion of the 151st Combat Regiment, which reached Cold Bay in January. The next was the 42d General Service Regiment, the first battalion disembarking at Juneau on 28 February, and the second reaching Cordova in the middle of March. After Pearl Harbor, almost all jobs west of Fort Richardson except those at Kodiak and Dutch Harbor were assigned to troops. To ease the manpower shortage, some work was done by troops of other arms and services under engineer supervision.[3]

A persistent problem was the shortage of matériel. Almost all supplies and equipment had to be procured in the United States. Before January 1942, Colonel Park's approval was necessary for all purchases; after that date, the Seattle District was permitted to buy in the open market, but this new freedom was of little value. Despite Alaska's high priority of A-1-a, sufficient quantities of supplies could not be obtained to meet requirements. The greatest need by far was for heavy earth-moving equipment, but prospects of getting any were slight. "After Pearl Harbor," Nold wrote later, "we were practically limited to the equipment we had in hand or could obtain locally. . . ." All such machinery was kept going around the clock and used under very unfavorable conditions. Tractors churned through mud, snow, muskeg, salt water, and sandy beaches. Many of the operators were inexperienced or untrained in handling equipment under such conditions. Repairs were constantly necessary, and there were no maintenance units in the Territory. Spare parts were scarce. Not enough came in with the

[3] (1) Incl, Tab A, ADC to Memo, ExecO Sup Div OCE to G–4, 18 Dec 41. 400.34. (2) Ltr, Stimson to Anthony J. Dimond, Delegate from Alaska in HR, 16 Apr 42. 600.1 (Alaska) (Misc) pt. 2. (3) Ltr, Ickes to Stimson, 19 Jan 42, with 3d Ind, Dunn to NPD, 28 Feb 42. Same file. (4) Hists of 151st Combat Regt and 42d GS Regt, in Orgn Hists, U.S. Army, Alaska.

machinery, and follow-up shipments were inadequate. Units had to maintain their equipment as best they could. Efforts were made to cut down on needs; projects not essential to the war effort were discontinued. Local resources were exploited insofar as possible—particularly lumber. Yet it was difficult to curb extravagance. Talley recalled that a number of post commanders insisted on requisitioning "tapered steel flagpoles in a land of tall timber" where "it was only necessary to select and cut a spruce of any height you might desire." The steel poles were not delivered.[4]

The shortage of ships, severe enough in the months before Pearl Harbor, was now much more pronounced. Dunn's office estimated that demand for cargo space would be four to six times as much as that of the last months before the war. As needs grew, the number of ships fell off. Oceangoing vessels that might have been available were put on more distant overseas routes. Fishing boats which had been leased would have to be returned to their owners when the season opened. Deliveries to Alaska were slowed by the threat of Japanese submarines in Alaskan waters; vessels were forced to travel in convoys or to go by way of the Inland Passage. Dunn did what he could to keep supplies moving northward. He rented such barges and tugs as he could find. But, on the whole, the number of ships on the Alaska run could not be increased. More effective use would have to be made of what was available. Early in 1942 the Seattle subport was made an independent port of embarkation to serve Alaska primarily. Increasing quantities of supplies were sent by way of Prince Rupert in Canada, the first and most important of the subports established in western Canada and southeastern Alaska, and activated on 6 April 1942. Shipping stocks to that port via Canadian railways meant a saving of 600 miles in water transportation. Supplies for Alaskan projects began to accumulate on the docks and in the warehouses at Seattle. Some way would have to be found to get them to Alaska.[5]

Engineer Construction

Despite handicaps, work moved ahead on strengthening the defenses of the Alaska Peninsula and the Aleutians. Dutch Harbor and nearby Fort Mears, and installations on the Alaskan mainland as well, had nothing between them and Japan but the ocean and a string of unfortified, largely uninhabited islands. As soon as construction was authorized at Umnak and Cold Bay, Dunn prepared to ship equipment and supplies. The greatest secrecy was maintained. Materials shipped from Seattle to the airfields were marked to indicate they were to be used by private firms for building fish

[4] (1) Bush, Narrative Rpt of Alaska Construction. (2) Ltr, Nold to C EHD, 7 Aug 57. (3) Ltr, Talley to C EHD, 6 Jan 59.

[5] (1) Ltr, Dunn to NPD Engr, 13 Jan 42. 600.1 (Alaska), 4 Mar 42. (2) Ltr, G–4 to CG SFPOE, 29 Dec 41. G–4/32763. (3) 2d Ind, TAG to CG Field Forces, 20 Feb 42, on Ltr, DeWitt to CG GHQ Field Forces, 28 Jan 42. 600.1 (Alaska), 3 Jan–Mar 42. (4) Wardlow, *Transportation Corps: Responsibilities, Organization, and Operations*, p. 97. (5) Joseph Bykofsky and Harold Larson, *The Transportation Corps: Operations Overseas*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1957), p. 42.

canneries. On 18 January, sixty-four officers and men of the 807th Aviation Company arrived at Umnak from Yakutat. Since the island had no harbor facilities, supplies were landed at Chernofski Bay on Unalaska to the east and barged twelve miles across the strait. This job was not easy. The repeated loading and unloading of equipment caused a great deal of breakage, and some of the barges sank in the stormy waters. It was not the best time of year for airfield construction. Bulldozer operators, trying to level off a runway on Umnak's treeless wastes, were sometimes lost for hours in blinding snow storms. Work also began on the Alaska Peninsula. When, in early February, the second battalion of the 151st Combat Regiment reached Cold Bay from the United States, it took over construction of the runway from the CAA. Here, also, the subarctic winter greatly slowed work. More rapid progress was made on Umnak with the arrival of more troops. By mid-March the entire 807th, now an aviation battalion, was working on the airfield, and by the end of the month, helped by men from the infantry and field artillery, the battalion had finished a landing strip of steel mat. The first plane came in on the 31st. By this time a strip was in at Cold Bay, but its surface was soft and full of ruts. No construction had been started at Port Heiden, reported by Colonel Park, visiting Alaska late in March, as "still frozen in." [6]

Drastic measures were needed to get supplies to Alaska. Toward the end of March, Dunn estimated that by the fall of 1942 some 150,000 tons of materials would be piled up on the Seattle docks awaiting shipment. Completion of important construction during the summer would be impossible. Dunn proposed an ambitious plan. He suggested sending barges loaded with supplies and equipment up the Inland Passage to Juneau. Seagoing vessels would be taken off the Seattle-Alaska run and assigned to Juneau to ply back and forth across the Gulf of Alaska. The haul of oceangoing vessels carrying cargo to western Alaskan ports would be greatly shortened. On 28 March, Dunn proposed building a barge terminal at Cape Spencer near Juneau, complete with covered and open storage. It would be an expensive undertaking, but unless it were done he did not see how urgent materials would reach Alaska in time. DeWitt was enthusiastic. On 15 May, Somervell gave his approval and the Seattle District began to prepare plans for construction. Meanwhile, additional barges were put into service and began carrying materials to Juneau.[7]

Problems of Organization

Some of the engineers' difficulties in the Territory resulted from an apparent conflict in War Department directives. Before the outbreak of war, the right to

[6] (1) Craven and Cate, eds., *Plans and Early Operations*, pp. 304–05. (2) Hist of the 807th Engr Avn Bn. (3) Lt. Col. David G. Hammond, "Aleutian Water Transportation Problems," *The Military Engineer*, XXXVI (November, 1944), 373–75. (4) Ltr, Park to Robins, 20 Apr 42. 333.1 Alaska 1920–45.

[7] (1) Ltr, Dunn to DeWitt, 28 Mar 42, with 3d Ind, SOS to CofEngrs, 15 May 42. 541.2 (Alaska). (2) Bykofsky and Larson, *Transportation Corps: Operations Overseas*, pp. 43–44.

authorize construction had been reserved to the Secretary of War. Soon after Pearl Harbor the War Department had directed DeWitt to undertake emergency work on his own responsibility. Directives for construction now came from Washington and from DeWitt. In February the War Department suspended DeWitt's authority to initiate emergency work, and DeWitt assumed that henceforth he could not start any projects without approval from Washington. On 11 March the War Department made General DeWitt solely responsible for construction and real estate in the Alaskan theater of operations. Henceforth, the responsibility of Colonel Dunn and, after 15 April, of his successor, Col. Peter P. Goerz, to the Chief of Engineers for work in Alaska was limited to flood control and the improvement of rivers and harbors. The Seattle District, however, continued to do work of a technical and administrative nature for all Alaskan projects. It still prepared designs, made up fiscal, accounting, and cost statements, and took care of civilian personnel matters. The district also continued to purchase supplies and equipment. In the words of Colonel Park, "Though our authority is theoretically nil, our responsibility remains about as before." [8]

Further changes in organization were made. On 1 May, DeWitt made the Army commander, Maj. Gen. Simon B. Buckner, Jr., entirely responsible for the execution of military construction in Alaska. Buckner's headquarters absorbed Talley's office in Anchorage, and Talley's title was changed to Officer in Charge, Alaska Construction. Although Talley was now directly under Buckner, his office was not consolidated with Nold's. No over-all organization had been set up in Alaska to repair and maintain buildings which had been completed and turned over to post commanders. In May three colonels, sent from the Corps of Engineers' Mountain Division office in Salt Lake City to investigate the matter, found a pressing need for repair and maintenance. Two were assigned to Buckner's headquarters as liaison officers. They began to recruit qualified civilians in the United States and searched for enlisted men to do repairs and utilities work at Alaskan stations. Some delays had heretofore resulted because project engineers lacked authority to initiate construction. Frequently they had to hold up work of even minor scope for months while awaiting approval from Talley's office, Buckner's office, the Seattle District, or General DeWitt. Now authority was partly decentralized. After 1 May area engineers could build projects costing less than $20,000 without reference to higher authority, and they could start those costing up to $50,000 without getting prior approval from higher authority.

While a great deal was done to improve organization, little could be done to increase the number of troops or civilians. Only two engineer units arrived during the spring. In March the 639th Engineer Camouflage Company reached Fort Richardson and began construction of a

[8] (1) Memo, AC Proj Sec Opn Br Constr Div OCE to Opns and Tng Sec, 13 Mar 42. 600.1 (Alaska), 3 Jan–Mar 42. (2) Ltr, TAG to DeWitt, 11 Mar 42. USW Files, Misc and Sub, Constr Beginning Dec. (3) Nold, Hist of Development and Accomplishments of Of of Engr Alaskan Dept, pp. 15–17. C 12027, KCRC. (4) Ltr, Park to Robins, 20 Apr 42. 333.1 Alaska 1920–45.

depot for the newly established Eleventh Air Force. In May the 813th Engineer Aviation Battalion arrived to begin work on satellite fields for Elmendorf. By 1 June, approximately 4,500 engineer troops and 3,000 civilian workmen were in the territory.[9]

Construction Progress

The engineers could show considerable progress by June. Annette and Yakutat were virtually complete. Cold Bay had a good gravel runway which, while not finished, was usable. No work had as yet been done at Port Heiden because of bad weather. Since their arrival in February, the 42d Engineers had been building camps for the Army garrisons at the CAA fields at Juneau and Cordova. Facilities for gasoline storage were being erected at major airfields. At all projects the engineers were putting in access roads. By the end of May drilling of the tunnels for the railroad cutoff was about half finished, and work on the roadbed was about one-fourth done. With the beginning of spring the strategically important Seward Peninsula began to receive more attention. In March and April Air and Engineer officers made a reconnaissance of that area for a site for an airfield away from the coast where weather conditions would be better than at Nome. A site was found sixty-five miles to the north of the city. In May several groups from Talley's office made a 3-week air and ground survey of the almost unknown region west of Fairbanks in an effort to find a route for a highway or railroad from Fairbanks to the coast and a site for an ocean terminal. The preliminary investigation indicated a route along the Yukon Valley would be feasible. Two locations were found on the Bering Sea deep enough for port construction.[10]

Progress on the eleven aircraft warning stations approved for construction was disappointingly slow. Differences of opinion still existed over where some of the stations should be located. In March the Eleventh Air Force wanted, at its major bases, additional information and filter centers to receive signals from and transmit signals to nearby detector stations. Work was further retarded when a new type of radar detector was developed that permitted 360-degree coverage. Buckner believed 20 of these would be required, but the War Department would allow only 10; after plans for installing 10 of the devices had been prepared, only 5 turned out to be available. Work on the aircraft warning stations, most of them in isolated places, was difficult. At some, cableways had first to be built so that supplies could be brought up. At most stations, the Alaskan winter slowed construction; at four, work was impossible before spring. By the beginning of May only the mobile

[9] (1) Nold, Hist of Of of Engr Alaskan Dept, pp. 20–25. (2) Incl to Ltr, Talley to C EHD, 6 Nov 57. (3) Memo, WDC for Buckner, 21 Apr 42. ADC 600.1, Constr in Genl, vol. III. (4) 2d Wrapper Ind, U.S. EngrO Anchorage, Alaska, to CG ADC, 16 Jan 43, on Memo, SOS to CG ADC, 12 Dec 42. 600.1 (Alaska) (Labor) pt. 1.

[10] (1) Hist of 42d GS Regt, in Orgn Hists, U.S. Army, Alaska. (2) Ltr, Park to Robins, 20 Apr 42. 333.1 Alaska 1920–45. (3) Bush, Narrative Rpt of Alaska Constr, pp. 217, 269–71, 412–413, 424. (4) Anchorage AreaO, Rcn Rpt for RR or Hwy West of Fairbanks, 15 Jun 42. NWSC 617 (NWD).

station at Anchorage and the fixed one at Kodiak were in operation.[11]

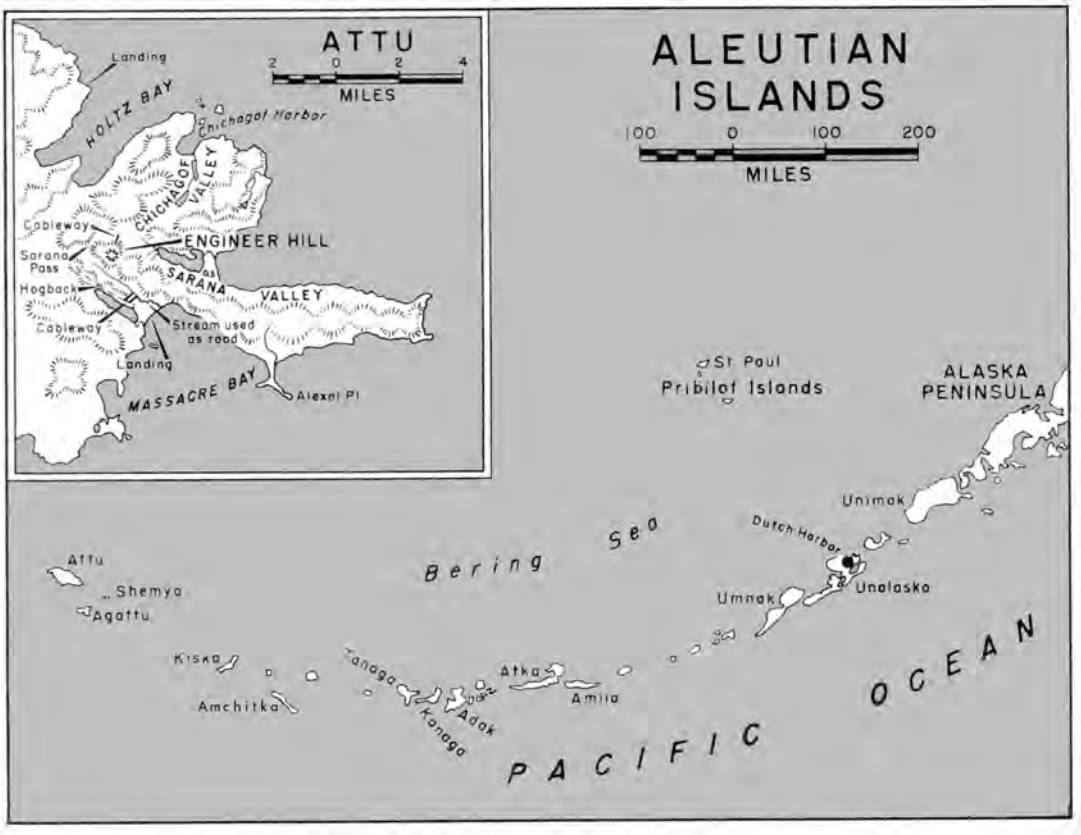
Concentrating on the Aleutians

The attack on the Territory, which many had regarded as almost inevitable, was soon to come. Early in May Navy intelligence learned that the Japanese were planning to strike at Midway and the Aleutians. On 3 June two enemy carriers launched their planes for an attack on Dutch Harbor. (*Map 16*) Despite the bad weather 17 aircraft got through to their target, demolishing barracks and killing about 25 men. On the afternoon of the next day about 30 planes came in and again caused some loss of life and considerable damage to installations. Eight men of Company C of the 151st Engineer Combat Regiment were killed. After the attack some of the enemy airmen chose a rendezvous point near Umnak almost directly over the airfield, of whose existence they were unaware. Here U.S. fighters shot down 4 enemy planes. Meanwhile, two Japanese occupation forces approached the Aleutians. On 7 June one landed on Attu, the most remote island of the chain, and the next day the other came ashore on Kiska. As soon as enough planes could be concentrated on the strip on Umnak, bombing of the Japanese foothold on Kiska began.[12]

Although the Japanese thrust at Alaska, as is now known, served mainly as a feint, preliminary to the major strike against Midway, General DeWitt saw in it the possible beginning of a full-scale invasion and suggested to the War Department on 14 June that an expedition be launched against the Japanese in the western Aleutians. DeWitt's recommendations evoked no enthusiastic response. As far as the Joint Chiefs were concerned, there were more urgent combat theaters than the North Pacific. DeWitt then proposed that an airfield be built on Tanaga Island, about 200 miles east of Kiska, so that the Japanese-occupied islands could be effectively bombed. No time was lost in making a reconnaissance. Talley, together with an Air officer and a Navy officer, landed on Tanaga on 27 June. They found the island to be similar to Umnak and estimated that a runway could be built in three weeks. But the Navy preferred Adak, 60 miles farther east, because of its good harbor. Whichever site was chosen, the engineers would have a formidable construction job. The islands of the Aleutian chain extended southwestward for 1,100 miles. Peaks of a partially submerged mountain range, they were treeless and much of the time shrouded in fog. They were uninhabited; the natives, about 1,300 Aleuts, of Eskimo stock, had been evacuated by the U.S. Navy after the attack on Dutch Harbor. Those on Attu and Kiska had been removed by the Japanese. During the summer the Joint Chiefs ordered airfields put in on Atka and Adak, and on small St. Paul Island in the Bering Sea, 300 miles north of Umnak. Airfields on these various islands would

[11] (1) Memo, Hq Eleventh AF for Buckner, 24 Mar 42. WDC–ADC, 381/32, pt. I. (2) Bush, Narrative Rpt of Alaska Constr, pp. 217ff. (3) Memo, TAG for OinC, Alaska Com System, 29 May 42. WDC–ADC 660.2 AWS/48.

[12] (1) Craven and Cate, *Plans and Early Operations*, pp. 466–67. (2) Matloff and Snell, *Strategic Planning for Coalition Warfare, 1941–1942*, pp. 225ff. (3) 151st Engr Combat Regt, Regtl Hist.



MAP 16

provide a fairly effective barrier against Japanese air fleets operating from carriers or from Attu and Kiska.[13]

Work began first on Adak. Having completed its job on Umnak, the 807th Aviation Battalion, less a company which had begun work at Port Heiden, was scheduled to start the new undertaking. At Unalaska, the men assembled a motley collection of some 250 craft, including tugboats, barges, fishing scows, and a four-masted schooner, to take them to their new destination. They were to go with the task force which would occupy the island. On 26 August, the engineer "fleet," escorted by five destroyers, headed into the Bering Sea in the teeth of a rising gale. The crews worked hard to keep their supplies from being washed overboard. A route well up into the Bering Sea was taken to avoid enemy aircraft and submarines. During the night some vessels became sepa-

[13] (1) Craven and Cate, eds., *The Pacific—Guadalcanal to Saipan*, pp. 368–69. (2) Bush, Narrative Rpt of Alaska Constr, pp. 178, 184, 189, 193. (3) DeWitt, Memo for Rcd, 22 Jun 42. WDC–ADC 384/7, vol. III, Notes by DeWitt, 22 Jun 42. (4) Memo, DeWitt for Marshall, 16 Jul 42. ADC 381 Defense Plans, bk. 4.

rated from the convoy, and the destroyers had a busy time locating and bringing back the wanderers. One barge was lost. After five days, Adak was sighted. Destroyers and boats headed into Kuluk Bay on the island's eastern shore, just as a heavy fog closed in. Several of the barges were beached and some of the tractors and light cranes unloaded. The tractors dozed sand ramps to two scows sunk in tandem to provide access to an oceangoing barge being used as a floating dock. Troops, bivouacked in tents, found living conditions extremely uncomfortable.[14]

The mountainous island seemed to have no good location for an airfield. The sand dunes along the shores of Kuluk Bay appeared promising but would require much more earth moving than could be done with the small amount of machinery on hand. Beyond the dunes was a low, flat area of firmly packed sand, about two miles long. Along the western edge flowed Sweeper Creek, which emptied into Kuluk Bay through a narrow gap in the dunes just to the south of the flat. Tidal waters which entered through the mouth of the creek covered the area twice a day. If the tide could be shut out and, at the same time, the waters of the creek controlled, a strip could be provided quickly. On 1 September the engineers, after bulldozing dikes along the banks of the creek, dozed a sand dam across its mouth to shut out the tide. To keep the pent-up waters from overflowing the dikes, they gouged a new channel into the bay through the dunes, two and one-half miles from the creek's original mouth. On 10 September the sand strip could take a B–18 bomber. In order that planes might operate more effectively, 3,000 feet of landing mat were laid down. On the 13th forty-three planes took off to bomb Kiska. A second runway was ready five days later. To allow water accumulating in the lower reaches of the creek to escape, bulldozers had to break open the dike across the mouth of the creek daily. To eliminate this repeated opening and closing, culverts with gates were installed. Sometimes the accumulated water flooded the runways, especially when rainfall was heavy during high tide, and the gates had to remain closed. The airmen, ignoring shallow flooding, would take off in a cloud of spray. In November water pumps arrived and were put in operation later that month. In dry weather, the sand was kept moist and stable by means of controlled pumping.[15]

In September construction began on Atka and St. Paul. On the 17th Company A of the 802d Aviation Battalion came ashore on Atka near an abandoned fishing village of some fifteen buildings. The men took over a number of the empty structures. As the dock was too small, the engineers provided a temporary pier by turning a barge upside down at the water's edge. They were soon at work leveling nearby sand dunes for an airstrip with mat surfacing. Work was soon well in hand on Atka; two days after Christmas a 3,000-foot runway was ready. One company of the 42d Gen-

[14] (1) Hist of the 807th Engr Avn Bn. (2) Bush, Narrative Rpt of Alaska Constr, p. 178. (3) Incl to Ltr, Talley to C EHD, 6 Jan 59.

[15] (1) Hist of the 807th Engr Avn Bn. (2) Bush, Narrative Rpt of Alaska Constr, p. 230.

eral Service Regiment reached St. Paul late in September, its job to build a fighter strip surfaced with steel mat. The men found a deserted village of fifty-five buildings. Some of the 1,400 officers and men of the garrison were sheltered in the houses, with about one-third living in winterized tents. On 14 November the runway, surfaced with volcanic ash, was completed. From this time on, little work could be done, for blizzards, occurring almost daily, filled the roads with drifts so high that equipment could not get through. Rough seas and masses of floating ice destroyed or damaged almost every boat and barge moored to the island.[16]

Alaska: July–December 1942

During the last half of 1942 the engineers did a substantial amount of work on the defenses of the Alaskan mainland. They undertook additional construction at Ladd and Elmendorf, most of it to house more troops. During the summer elements of the 176th General Service Regiment arrived to build camps for garrisons at the remaining CAA fields in the interior of Alaska. At the naval air stations, Seabees took over from the contractors and finished the facilities for the Army garrisons. The runways were in at Cold Bay and Port Heiden by the end of the year. At long last, work had got under way on the seacoast batteries. Before Pearl Harbor, Alaska's only seacoast defenses were a few 155-mm. gun batteries on Panama mounts at Dutch Harbor, Kodiak, Sitka, and Seward. Work on additional defenses authorized in late 1941 had been held up by delays in site selection and revisions in the numbers and sizes of the batteries. It was finally decided to have the Navy build the defenses at the naval bases and to have the Engineers improve the harbor defenses at Seward. The Corps made a contract with the West Construction Company for this job and work began in September. Work on the railroad cutoff was shaping up well. The 714th Railroad Battalion, men from the 42d and 177th General Service Regiments, and employees of the Alaska Railroad were laying the tracks and the job was expected to be finished by the end of the year. A dock terminal was under construction at Whittier on Prince William Sound. Late in July the War Department authorized going ahead with the barge terminal which Dunn had advocated in March. Plans called for establishing a terminal for nine oceangoing vessels on the eastern shore of Excursion Inlet on Icy Straits to the west of Juneau. In August the Engineers awarded the contract to the Guy F. Atkinson Company of San Francisco. Toward the end of the month the contractor's employees began work on piers and warehouses. In October the 2d Battalion of the 331st General Service Regiment, about 1,300 officers and men, arrived to help the civilian forces. Meantime, the port of Juneau was being enlarged so that it could be used until the barge terminal was operational. Still far behind schedule were the air warning stations. After the Japanese defeat at Midway, previously chosen sites in the Alaskan interior and on the

[16] (1) Bush, Narrative Rpt of Alaska Constr, pp. 184–85, 189–90. (2) Memo, Opns and Tng Br Tng Div OCE for C Opns and Tng Br, 14 Jun 43. 600.1 (ADC).

west coast in the Bristol Bay and Norton Sound areas were abandoned for sites on the Alaska Peninsula and in the Aleutians. Construction plans had to be revised and work started anew.[17]

Interest in improving communications within Alaska heightened in the summer and fall. At the time of Pearl Harbor, Canada was building a string of airfields in the western part of the Dominion from Edmonton to Whitehorse. These fields, soon being used to fly planes from the United States to Alaska, formed part of the Northwest Staging Route. Six fields in Alaska—Northway, Tanacross, Big Delta, Ladd, Galena, and Nome—formed the other part. After the attack on Dutch Harbor, the Engineers got the task of improving the runways at the fields in Alaska. Since the fall of 1941 negotiations had been under way with the Soviet Union to fly planes from Alaska to Siberia. In September 1942 the Russians accepted the first planes via the northern route. Work on the Alaskan fields of the route, now called the Alaskan Siberian Ferry Route (ALSIB), was pushed even more, so that larger numbers of planes could be ferried to Siberia in the spring. Much thought was now given to developing ground communications westward from Fairbanks. During the fall of 1942 the Seattle District made additional surveys for a road or railroad and a pipeline from Fairbanks to the Seward Peninsula. Since building a road or railroad would take too long, a study was made of the possibility of developing river routes. Two were planned—one from Fairbanks to Tanana on the Yukon and another from Fairbanks to McGrath on the Kuskokwim. Supplies could be stored at these two points and, after the spring thaws, loaded on barges and sent down the rivers to the Bering Sea, whence they could be forwarded to various points on the Seward Peninsula. In order to have transportation out of Fairbanks as soon as possible, General Somervell in January 1943 instructed the Engineers to build the winter roads to Tanana and McGrath and develop and operate the barge lines on the Yukon and Kuskokwim Rivers when the ice broke up.[18]

Amchitka

In early November 1942 Admiral Nimitz, conjecturing that the Japanese might be planning to occupy Amchitka Island, between Kiska and Adak, advised sending an American force there to develop an advanced air base. The Joint Chiefs tentatively approved this move on 18 December, providing a good site for an airfield could be found on the island. Colonel Talley, with a party of engineers, went to Amchitka by Navy plane on 17 December, and after a 2-day survey reported finding a site on which a fighter strip could be built in less than three weeks. Accordingly, on 11 Janu-

[17] (1) Bush, Narrative Rpt of Alaska Constr, pp. 170–72, 220–21, 344–45. (2) Hist of the 176th GS Regt, 10 Feb 42–12 Mar 45. (3) Hist of the 331st Engr Regt. (4) Memo, Talley for Buckner, 3 Aug 42. ADC 600.1, Constr in Genl, vol. IV.

[18] (1) Stanley W. Dziuban, *Military Relations Between the United States and Canada, 1939–1945*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1959), pp. 200–204. (2) Memo, C TC for Somervell, 8 Nov 42. ASF HQ CG Alaska, 1943–46. (3) Ltr, SOS to CG NWSC, 16 Nov. 400 (AD). (4) Ltr, Somervell to CG NWSC, 8 Jan 43. NWSC 600.93 (Fairbanks). (5) Matloff and Snell, *Strategic Planning for Coalition Warfare, 1941–42*, pp. 339ff.

ary 1943 the first U.S. troops, including the 813th Aviation Battalion, came ashore at Constantine Harbor. The engineers, finding the flat coastal area excellent for airfield construction, began to put the strip in on a tidal flat, using the methods employed on Adak. The heavily overcast skies required the use of artificial lighting even in the daytime. Operations were not too onerous because the men had an adequate amount of heavy construction equipment. Almost daily visits by Japanese patrol planes with intermittent bombings made it highly urgent to complete the runway quickly. The first American plane landed in mid-February. Henceforth, there was only light enemy activity. Earlier that month, the 1st Battalion of the 151st Combat Regiment had arrived to construct base facilities on the island, and in March the 2d Battalion of the 177th General Service Regiment arrived to build storage tanks for aviation gasoline. The aviation engineers meanwhile began work on the main bomber runway on a high, flat area above Constantine Harbor.[19]

Supplies, Equipment, and Spare Parts

By early 1943 the most critically needed supplies were reaching Alaska in fairly adequate amounts. During 1941 the Seattle District had sent 182,531 measurement tons of construction materials and equipment. In 1942, the amount rose to 585,443 tons. Still larger and speedier shipments to the Territory were possible in 1943 because of improved transportation. By the beginning of that year the expanded rail facilities at the Canadian port of Prince Rupert were being put into use. Additional docks had been built at Juneau, Seward, and Anchorage. The cutoff to the Alaska Railroad and the port of Whittier were finished by June. The barge terminal was in use. Shortages had so stimulated production of local materials that some surpluses accumulated. More lumber was being produced than was required, and Alaskan strip mines were furnishing more than enough coal. But the procurement of some items not produced locally became difficult during late 1942 and early 1943 as needs became greater and Alaska lost its relatively high priority to more active combat theaters. The short shipping season added to the troubles. Supplies for many projects west and north of Juneau had to be delivered after 1 July and before mid-October, when the ice pack began to form. To complete a project during a given year, it was necessary to have most of the materials on hand by the previous fall. But this was extremely hard to do because of the shortage of vessels and the lack of adequate planning in the scheduling of shipments. "It was impossible," Nold later wrote, "for agencies and authorities within the United States to visualize the necessity for . . . early shipment of supplies to permit construction . . . in the short working season." [20]

[19] (1) Bush, Narrative Rpt of Alaska Constr, pp. 193–96. (2) Hist Sec Alaskan Dept Official Hist of the Alaskan Dept, pp. 26ff. OCMH. (3) Conn, Engelman, and Fairchild, *Guarding the United States and Its Outposts*, ch. X.

[20] (1) Bush, Narrative Rpt of Alaska Constr, pp. 39off. (2) Interstaff Memo, C Sup Div Seattle Dist

Especially severe was the shortage of spare parts. Maintenance of equipment under adverse operating conditions was a formidable task and for the most part had to be carried out by the using units in any way they could. Soon after Pearl Harbor, Nold wanted to send the better equipment to Seattle for repair, but was informed that, if sent, it would probably be shipped to theaters with higher priorities, and no replacements for Alaska would be forthcoming. In August 1942 the 468th Maintenance Company arrived at Dutch Harbor. It took over the repair shop there, began building additional facilities, and started repairing machinery on an around-the-clock schedule. Its first job was the rehabilitation of the equipment of the 802d aviation engineers. In January the 2d platoon of the 468th Engineer Maintenance Company went to Adak and found that, as elsewhere in Alaska, maintenance facilities were inadequate and spare parts scarce.[21]

Maps

Work on the three major mapping projects started before Pearl Harbor—the making of maps of the Seward-Anchorage region, mapping the area traversed by the Richardson Highway, and making maps of the major air routes—continued. In the spring and summer of 1942 Company D of the 29th Topographic Battalion established ground control for the Seward-Anchorage region. By December photomapping of this part of Alaska was about three-fourths complete and reproduction of initial editions about one-third done. The engineers were not able to show much progress in mapping the area traversed by the Richardson Highway—an area comprising about 7,000 square miles—or with the making of maps of the major air routes, mainly because poor weather kept the airmen from furnishing adequate quantities of good photographs. By late 1942 the Aleutians were much more important than the Alaskan mainland. The principal effort now had to be concentrated on preparing maps for the troops who would eventually assault enemy positions on Attu and Kiska. The 29th Topographic Battalion at Portland, Oregon, did all the mapping for the planned operations in the Aleutians. It produced a 1:25,000 series from aerial photographs with a coverage of 1:10,000 for critical areas. Again because of bad weather, the Air Forces found it hard to supply good photographs in sufficient numbers. The engineers had to make a large part of their maps from obliques, which were not especially suitable material for the multiplex. Meanwhile, the Army Map Service supplied copies of such maps as it had of the Aleutians.[22]

Camouflage

Within a few months after Pearl Harbor, a comprehensive camouflage program was authorized for Alaska, funds being allotted in excess of $6 million. Great quantities of camouflage materials

for Lt Col Conrad P. Hardy, Seattle Dist, 11 Nov 43. 323.41 (Seattle Dist Of) (3) Ltrs, Nold to C EHD, 7 Aug 57, 22 Aug 58.

[21] (1) 468th Engr Maint Co, Unit Hist of Alaskan Opns . . . 19 Jul 42 Until 15 Oct 44. (2) Ltr, Nold to C EHD, 7 Aug 57.

[22] (1) Ltr, Col Herbert B. Loper, Intel Br Tr Div OCE to G–2, 22 Dec 42. 061.01 (Alaska) Dec 42 thru ———. (2) Ltr, Loper to Engr CPA, 4 Feb 44. Engr AGF PAC.

were shipped to each of the projects under way, but little effective work was done. Except for the dispersal of structures, concealment was as a rule neglected in the haste to complete construction. When the 639th Camouflage Company arrived at Fort Richardson in March 1942, it was put to work not on what it was trained to do but on the building of a depot for the Air Forces. As the likelihood of a Japanese attack increased, more attention was given to camouflage. Nevertheless, by June 1942 so much of the construction had inadvertently made the installations conspicuous that little could now be done to hide them. To make Army posts less noticeable, nets and garlands were hung and trees and shrubs replanted, and at some posts camouflage discipline was observed. In the interior of Alaska, camouflage was limited to dispersing buildings and toning them down with paint. Concealment, highly important in the Aleutians, was at the same time most difficult to accomplish. The absence of trees made effective camouflage seemingly impossible. Ingenious treatments were sometimes devised. Buildings and other installations were dug into hillsides, and the more brightly colored buildings were toned down, often with the use of mud. Driftwood, weeds, grass, tin cans, and chicken wire were used to blend structures into their surroundings. In the winter deep snow often hid installations more effectively than any camouflage could have done. On the whole, camouflage, even in the Aleutians, had very low priority; at a number of bases it was all but ignored.[23]

Building in Subarctic Regions

After two years in Alaska and the Aleutians the engineers had acquired considerable experience in building in subarctic regions. They had gained most of it after Pearl Harbor. Before the war engineer work, not very extensive, had been restricted almost entirely to a few points along the coast where conditions, on the whole, were similar to those in the northern United States. In the interior the engineers had worked only at Ladd, where much of the construction had already been done by the Quartermaster Corps. After hostilities began, the engineers had to build at many points in both the Alaskan interior and the Aleutians. They constructed airfields, wharves, gasoline storage, seacoast fortifications, roads, utilities, barracks, warehouses, shops, mess halls, and hospitals. Information about the various areas was scanty. Since speed was of paramount importance, there was no time to make on-the-spot investigations. "In designing facilities for the Aleutian bases," wrote one of the men working in the Seattle District office, "interesting and perplexing difficulties were encountered, which called for every trick in the engineer's bag." The engineers likewise had to use many "tricks" in actual construction, both in the Aleutians and on the Alaskan mainland, in order to deal with the unusual conditions they encountered.[24]

One of the great hindrances was the long Alaskan winter. During this time of the year, daylight hours were few.

[23] (1) Bush, Narrative Rpt of Alaska Constr, pp. 354ff. (2) Rpt, 639th Camouflage Co (Sep) to Engr Alaskan Dept, 1 Jan 44. KCRC.

[24] Joseph D. Bodman, "Peculiarities of Aleutian Military Design," *Civil Engineering*, XV (September, 1945), 402–04.



ENGINEERS DRESSED FOR −37° F.

For about four months, the sun shone less than eight hours a day; at Fairbanks, in December, there were three hours of sunshine out of twenty-four. In the interior, probably the greatest obstacle was the extreme cold, with temperatures from 50 to 70 degrees F. below zero not uncommon. Drums of pure antifreeze were sometimes frozen solid. The engineers used steam to soften the ground for excavating and to keep newly prepared concrete from freezing. At many Alaskan projects, they placed water and sewerage pipes on the ground in heated wooden conduits called utiladors. "The 'Old Timers' said work could not continue through the winter," Talley wrote later. The engineers proved them wrong. As Talley said, "We poured concrete . . . at −15°F., erected steel at −20°F. . . . We stopped wooden construction sooner since the wood froze." The 176th engineers, who worked on camps for garrisons at the CAA fields in central Alaska, had more experience than most units in living and working in the frigid Alaskan interior. At Northway ". . . frostbitten ears, noses, and feet were common during the first part of the winter," the 176th reported, "but we gradually learned from the Indians and through experience how to prevent this." The men found that keeping their feet warm was their hardest job. Shoes were soon discarded, since "any use of leather or rubber footwear was asking for trouble." Wearing three pairs of socks and Indian-made hide moccasins helped. On one occasion, when the thermometer stood at −60°F., a group of men was sent out to cut wood, with instructions to come in when the cold became unbearable. The men stayed out for two hours. Such assignments were rare. "Only the Indians venture out in these periods and their health shows the results," the unit historian wrote. ". . . approximately 90 percent . . . frost their lungs and develop T.B." At the various stations in the interior, work was usually so arranged that when the temperature fell to −35°F., the men were put on inside jobs.[25]

Building in areas of "permafrost" or permanently frozen ground was a new experience for most engineers. In a

[25] (1) Lt. Col. John R. Hardin, "Engineers Rush Alaskan Defenses," *The Military Engineer*, XXXIV (January, 1942), 1–3. (2) Incl to Ltr, Talley to C EHD, 6 Nov 57. (3) Lt. (j.g.) Frank W. Galbraith, "The Distribution of Utilities in Arctic Advanced Bases," *The Military Engineer*, XLII (March-April, 1950), 121–22. (4) Hist of the 176th Engr GS Regt, 10 Feb 42–12 Mar 45.

large part of the Arctic and subarctic regions, permafrost, possibly a remnant of the Ice Age, was encountered from 2 to 5 feet beneath the surface of the earth and it extended downward sometimes to a depth of 1,500 feet. It was invariably found in regions where the average annual temperature was below 32°F. Permafrost was widespread in Alaska, but there was little of it in the Aleutians. If the thin layer of topsoil which thawed in the summer and froze in the winter was removed, the permanently frozen ground underneath was left without its insulating cover. If subjected to heat, it became soft and lost its bearing power. Unpredictable results followed; the ground might shrink, crack, slide, or creep. When permafrost froze again, it produced an upward thrust. A number of buildings constructed by the engineers were heavily damaged when warm currents of air from the heated structures softened the underlying permafrost and caused parts of the structures to sink. Flowing water presented a constant hazard because it might cause the permafrost to melt. One of the runways at Ladd Field was believed to have failed because the waters of a nearby river inexplicably seeped into the frozen ground underneath the runway. Little was known about permafrost. No scientific studies of it had been made before World War II, except by the Russians as a consequence of structural failures on the Trans-Siberian railroad. Attempts to get information from the Soviet Government were fruitless. The engineers had to learn from experience how best to deal with permafrost. Before constructing buildings and runways, they had to make a thorough study of the conditions at the building site. The most effective treatment generally consisted of excavating the top layer of the permanently frozen ground and replacing it with insulating materials. Sometimes the damage caused by settling could be remedied rather quickly. At Fairbanks a well was drilled in one corner of a powerhouse through more than 200 feet of permafrost to water-bearing gravel. The passage of the water through the pipe softened the permafrost and caused the corner of the building to settle. The pumping was stopped, the soil refroze, and the settling ceased. "Thereafter," Talley wrote, "we located wells from 100 to 200 feet away from buildings." [26]

Muskeg and tundra were troublesome obstacles until the engineers learned how to deal with them effectively. Muskeg was the heavy growth of moss found in bogs, sometimes to a depth of twenty feet, and often extending many square miles in area. In many instances, the semidecayed matter at the bottom had turned into peat; often buried in the muskeg were logs and branches. The surface was spongy. A man walking on it had the feeling of treading on a mattress. Once its surface was broken, muskeg could sustain little weight, and anyone venturing across would sink in to his knees or even deeper. Shallow patches were not a serious hindrance and neither were deeper ones, provided sufficient precautions were taken. If heavy machinery was to be moved across

[26] (1) Col. Lynn C. Barnes, "Permafrost: A Challenge to Engineers," *The Military Engineer*, XXXVIII (January, 1946), 9–11. (2) Col. Walter K. Wilson, Jr., "The Problem of Permafrost," *The Military Engineer*, XL (April, 1948), 162–64. (3) Incl to Ltr, Talley to C EHD, 6 Nov 57.



DIGGING OUT TUNDRA

muskeg, the engineers usually dumped gravel or laid mats over the route beforehand. Sometimes they built trestles over the more treacherous sections. If a runway was to be constructed or a building put up, the muskeg had to be scooped out and replaced with rock or sand. Rare on the Alaskan mainland, tundra was common in the Aleutians. *Tundra* was the term used by the local inhabitants for the heavy, wet, partly decayed masses of grass from two to ten feet deep. When left undisturbed, tundra could support considerable weight. Like muskeg, once its surface was ruptured, it lost its bearing capacity. It usually had to be removed so that runways and buildings could be constructed on the solid base of sand, gravel, or rock underneath. When it could not be easily taken out and extensive construction was not called for, tundra was covered with sand or gravel and would cause no further trouble.[27]

During much of the year, and especially from October to March, violent winds, called the williwaws, swirled over the Aleutians or sped across Alaskan

[27] (1) Hardin, "Engineers Rush Alaskan Defenses," *The Military Engineer*, XXXIV (January, 1942), 1–3. (2) Harold W. Richardson, "Construction in the Tundra," *Engineering News-Record*, CXXXII (29 Jun 44), 106–10. (3) Incl to Ltr, Talley to C EHD, 6 Nov 57.

wastelands, sometimes reaching speeds of more than a hundred miles an hour. Frequently they were accompanied by heavy snow. Transferred to Adak in March 1943, the 18th Engineer Combat Regiment, although used to subarctic weather, found living on the island extremely uncomfortable. "This was the day of the Big Wind," the regimental historian wrote under the date of 7 April. "At breakfast a man emerging from a . . . tent with hotcakes in his messkit saw them take off and gain altitude. . . ." By noon, men were getting lost in a raging snowstorm. By midafternoon it was hard to see a tent at twenty-five yards. Walking against the wind was almost impossible. "The sleet driving against your eyeballs was extremely painful," the writer continued. "You involuntarily turned your back and then with nothing visible but snow you started in a wrong direction." Soon almost every tent had a whirlpool of snow forced in through even the smallest openings. A major job was to keep men and tents on the ground. Similar accounts came from other islands. At one project in the Aleutians nine men trying to reach the mess hall during a snow storm were lost for five hours. At some camps, men followed ropes stretched from one building or tent to another, though the distance was only a thousand feet. Buildings of conventional design were quickly leveled. Some caught fire from downdrafts in chimneys.[28]

Many projects remained virtually isolated despite efforts to improve communications. Even some near the coast were hard to reach because the shallow waters prevented oceangoing vessels from approaching closely. Much lightering and transfer of supplies was necessary. Construction materials for the airfield at Naknek had to be transferred from oceangoing vessels to barges at high tide and then towed 15 miles up the Naknek River to the construction site. After the supplies were ashore, they had to be moved across the muddy flats. Lumber needed at Bethel had to be floated 85 miles down the Kuskokwim River; gravel had to be barged down the same river for 100 miles. Supplies needed at Galena were brought by two small steamers and by barges which plied the distance of 435 miles down the Tanana and Yukon Rivers from Nenana, the transfer point on the Alaska Railroad. Supplies and equipment for the base at Northway were barged from Big Delta via the Tanana and Nabesna Rivers. These out-of-the-way places were readily accessible by plane, but aircraft could carry only limited amounts of supplies. And during Alaska's frequent winter storms, the airplane was often of less use than the Eskimo's dog sled. It sometimes took thirty days for mail from an engineer project to reach Talley's office in Anchorage. To provide an even partially adequate road network would have been impossible. Road construction was limited principally to the areas around important installations at Fair-

[28] (1) Bodman, "Peculiarities of Aleutian Military Design," *Civil Engineering*, XV (September, 1945), 402–04. (2) 18th Engr Combat Regt, Regt'l Diary, 20 Jan–7 Jun 43. KCRC. (3) Hist Sec Alaskan Dept, Official Hist, pp. 177ff. (4) Memo for Rcd, Col A. L. Parmelee, CAC, sub: Winter Conditions and Problems Common to Fort Mears, Unalaska, Alaska. 062.2 (Alaska).

banks, Anchorage, Yakutat, Kodiak, and Unalaska.[29]

Designs

Charged with preparing designs for buildings to be erected in Alaska, the Seattle District was faced with unusual and sometimes perplexing problems. Designs often had to be based on scanty information supplemented by an extensive use of the imagination. The district prepared a set of "typical drawings" for airfields, buildings, docks, gasoline storage, electric utilities, and other installations which could be used as a basis for the procurement of supplies and as a guide in construction. About five hundred copies of this set were made. In Alaska these drawings usually had to be modified to make them suitable for local conditions. As long as the modifications did not affect key points, the designs were useful. The Seattle District also furnished plans for hundreds of specific installations which were built at various projects.[30]

Practically all work the engineers did in Alaska was in some way related to the development of a network of airfields. As a rule, runways were built according to prewar designs. If two or more were put in at one field, they were almost always crossed in the direction of the prevailing winds. Whether built in the coastal, interior, or Aleutian areas, runways, taxiways, parking areas, and revetments were similarly constructed. Although the Seattle District designed airfields for the Alaskan interior, the engineers built only one there. This was the field southeast of Fairbanks known as Mile 26, where contractors put in two parallel 6,000-foot runways. CAA was responsible for building or improving all other runways in the interior for military use. The engineers gained most of their experience in airfield construction on the Alaska Peninsula and in the Aleutians. Here pumice stone, volcanic cinder or ash, gravel, and sand were all used for surfacing. Extensive use was made of steel mat. Concrete and asphalt were rarely used. The only runways of either type put in by the engineers were those at Annette, Yakutat, and Elmendorf.[31]

In the erection of buildings the emphasis was on speed. Prewar types of troop housing, such as permanent structures of brick and stone and mobilization-type buildings requiring skilled labor to put up, were discontinued with a few exceptions, as for example, the reinforced concrete barracks which had been started at Ladd before the outbreak of war. Troops arriving in Alaska or the Aleutians were usually housed in tents for the first few weeks or even months. Several types of housing to provide more adequate shelter, especially in winter, were developed. Among these were winterized tents, consisting of floors and sides of wood, topped with a light skeleton framework over which the 16′ × 16′ Army pyramidal tents could be placed.

[29] (1) Bush, Narrative Rpt of Alaska Constr, pp. 103–04, 108, 396. (2) Hist of the 176th Engr GS Regt, 10 Feb 42–12 Mar 45.

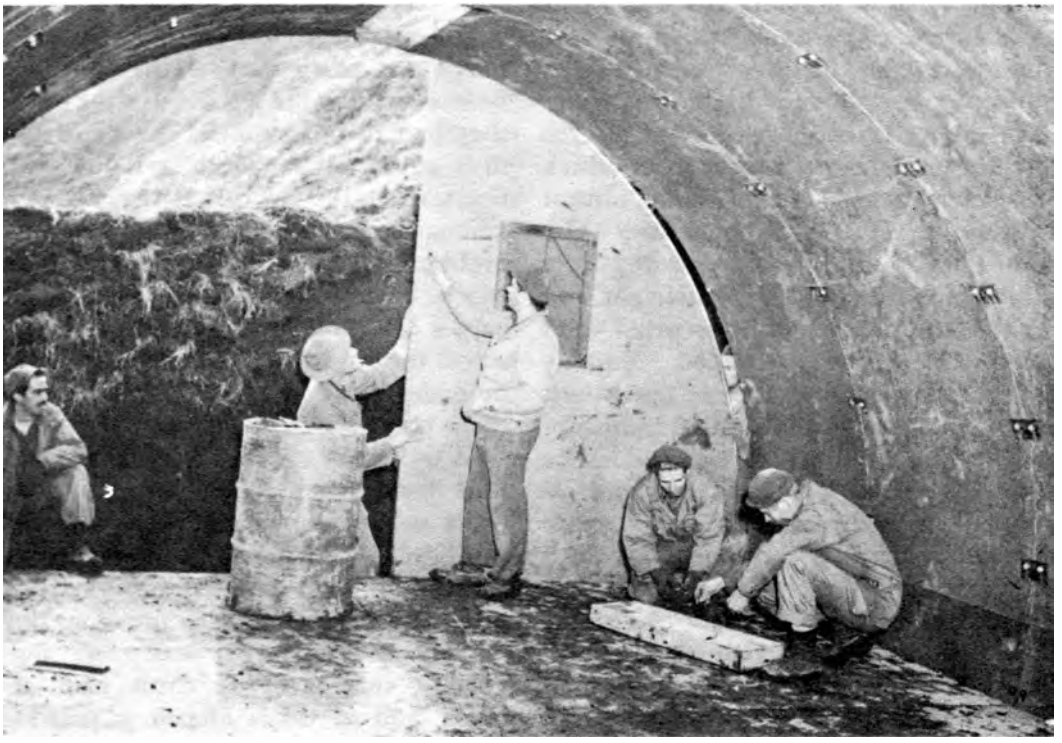
[30] Bodman, "Peculiarities of Aleutian Military Design," *Civil Engineering*, XV (September, 1945), 402–04.

[31] Bush, Narrative Rpt of Alaska Constr, pp. 227ff., 313ff.

Various types of prefabricated structures were developed. Among the most popular were the boxlike Stout houses, built of panels 8 feet high and 8 feet wide. Very satisfactory was the Pacific hut, the prefabricated sections of which were manufactured near Seattle, almost entirely of noncritical materials. The arched sides and roof, inexpensively built of plywood, were lightweight and highly windproof and waterproof, and could be easily assembled. Equally satisfactory was the theater of operations type, which had prefabricated panels of rough lumber and tar paper. The panels could be manufactured and assembled even by inexperienced workmen or troops to form almost any kind of building. Widely used were the Yakutat and Quonset huts. All structures had to be especially designed to make them suitable for Alaskan conditions. The thickness of structural members had to be increased, additional bracing put in, diagonal sheathings applied, and the distance between studs narrowed to reduce the possibility of damage from the wind. Sidings almost invariably had to be put on all important buildings because the wind tore the tar paper off. Air exhaust systems were added to larger heating units to eliminate downdrafts in chimneys. Special chimney caps were put on stoves. Vapor barriers were built into buildings to prevent damage to insulation and interiors which might result from the high humidity. Buildings used as offices or quarters had to be provided with vestibules or storm entrances.[32]

In building harbor facilities, the engineers had to contend with extremely rough seas, particularly in the Aleutians. Before tackling the job of building docks, they had to put supplies ashore as best they could. The 807th aviation engineers, when they landed at Umnak, were among the first who had to deal with this problem. The heavy surf pounded the beach even in calm weather. Before barges bringing supplies and machinery across the strait from Unalaska could be unloaded, a way had to be found to keep them on the beach. At first they were held by winch cables of tractors placed well back from shore, but this kept badly needed equipment from construction jobs. Mooring lines from the barges were then attached to piles driven into the ground back from the shore line. Unloading the barges was even more difficult than keeping them near the shore, and at times almost impossible. At first, the troops unloaded their supplies by hand and put them on tracked trailers. They then installed a trolley hoist which permitted unloading even when the waves rose to tremendous heights, but this method was not entirely satisfactory because only one barge could be unloaded at a time. Three months after the first barge landed the first dock, a T-shaped affair, was near enough to completion to permit its use. The dock was built about ten feet above high tide level so that it would not be flooded by the pounding waves. Barges were tied

[32] (1) Bush, Narrative Rpt of Alaska Constr, pp. 278ff. (2) WD Ltr, AG 600.12 (5-1-42) MO-E to DeWitt, 2 May 42, with 1st Ind, Hq WDC and Fourth Army, to TAG, 18 May 42. 411.4 Alaska 1940-43. (3) Ltr, Gorlinski, Opns and Tng Br Tr Div OCE, to Dist Engr Seattle, 9 Jun 42. (4) Ltr, Asst OSG to OCE, 24 May 43. Last three in 411.4 Alaska 1940-43.



CONSTRUCTING A PACIFIC HUT ON KISKA

up alongside and cranes hoisted the supplies directly into trucks. The dock withstood the battering of the sea, but its excessive height made unloading extremely slow. Two docks built later at a lower level were destroyed, when heavy seas floated the decking off the posts. It was found that it was easier to unload barges in the turbulent surf if they were docked perpendicular rather than parallel to the beach.[33]

By the beginning of 1943 the defenses of Alaska, particularly the airfields, had been built up sufficiently to make it highly improbable that the Japanese, especially after their defeat at Midway, would be able to expand their foothold in the Aleutians or launch a successful attack on the Alaskan mainland. While the engineers were strengthening Alaska and helping to prepare the Territory as a possible springboard for an offensive, they were at the same time at work on two important projects in northwestern Canada, the purpose of which was, at least in part, to strengthen Alaska. One project was the construction of the Alaska-Canada, or Alcan Highway; the other was the development of Canol.

[33] (1) Hist Sec Alaskan Dept, Official Hist. (2) Hammond, "Aleutian Water Transportation Problems," *The Military Engineer*, XXXVI (November, 1944), 373–75.

The Alcan Highway

Plans for a Highway

For many years groups of Americans and Canadians had urged their governments to construct a highway through British Columbia and Yukon Territory to Alaska. They advocated such a project primarily for the purposes of developing the resources and promoting the settlement of those regions. In the 1930's the United States and Canada established commissions to investigate possible routes. The Alaskan International Highway Commission, headed by Warren G. Magnusson, Congressman from the State of Washington, favored a route as near the Pacific coast as the terrain would permit. The British Columbia–Yukon–Alaska Highway Commission of Canada preferred locating the highway farther east, in the Rocky Mountain Trench. Both commissions advocated starting the highway at Prince George in east central British Columbia and terminating it at Big Delta, Alaska, a town about ninety miles southeast of Fairbanks and on the Richardson Highway. In February 1941, Anthony J. Dimond, delegate from Alaska in the House of Representatives, introduced a bill for a road through Canada to Alaska along whatever route President Roosevelt would consider best in the interest of national defense. The War Department, questioned on the military value of such a road, and believing it could continue to rely almost exclusively on ships for transporting troops, equipment, and supplies to Alaska, concluded that while such a highway might be desirable as a "long-range defense measure," it could be justified "only under low priority." [34]

The disaster at Pearl Harbor caused military planners to take a stronger interest in an overland link with Alaska. The War Plans Division now recommended building a road to provide an emergency overland supply line to isolated Alaskan outposts. Such a road could also be used to supply the airfields which were under construction as the Canadian part of the Northwest Staging Route. These fields were located at Edmonton, Fort St. John, Fort Nelson, Watson Lake, and Whitehorse. The Air Forces were already using the partially completed runways, but flights were restricted because of the shortage of supplies and servicing facilities. In a Cabinet meeting held on 16 January 1942, President Roosevelt asked Secretaries Stimson, Knox, and Ickes to study the need for a highway to Alaska, and, if construction appeared practicable, to decide on the best route. Heeding the advice of the General Staff, the Air Staff, and the Engineer members of the War Plans Division, the three Cabinet members recommended building the road along the line of the staging fields from Fort St. John to Big Delta. Construction would begin at Dawson Creek, the end of the rail line fifty miles south-

[34] Unless otherwise indicated, documents cited in this section, except unit histories, are located in Alcan Files, EHD. (1) British Columbia-Yukon-Alaska Highway Commission, Canada, *Report on Proposed Highway Through British Columbia and the Yukon Territory to Alaska, August 1941* (Ottawa, 1942), pp. 7–10. (2) 77th Cong, 1st sess, H Rpt 3095, photostatic copy in Exhibit E of The Alaskan Highway, A Report Compiled for the Commanding General, Army Service Forces, May, 1945 (cited hereafter as Alaska Hwy). (3) Ltr, Stimson to Chmn, Comm on Roads HR, 6 Oct 41. Exhibit E, Alaska Hwy.

east of Fort St. John. The Chief of Engineers would be responsible for the work. On 2 February the War Plans Division informed Brig. Gen. Clarence L. Sturdevant, Assistant Chief of Engineers in charge of the Troops Division, of its decision to build the road and directed him to submit within the next few days a plan for surveys and construction.[35]

General Sturdevant at once consulted with members of his staff and with Thomas H. MacDonald, Commissioner of the Public Roads Administration (PRA). Two days later, he submitted a plan that called for building the 1,500-mile highway in two phases. First, the Engineers would push through a pioneer road. Public Roads would then transform it into a permanent road. The main obstacle to building any kind of highway would stem from the fact that there were so few points of access from which the construction forces could start working. To avoid losing any of the short subarctic working season, Sturdevant advised using engineer troops rather than taking time to assemble and organize a civilian construction force. If the troops could be moved over the frozen expanses of the north before the spring thaws made the terrain impassable and could begin work at several points at once, it might be possible to finish a pioneer road by fall. Along with construction units, topographic units would have to be moved in to reconnoiter the terrain over which the road would pass, and ponton units would have to transport men and equipment across rivers and lakes. Through the access afforded by the pioneer road, civilian contractors, working under the Public Roads Administration, would soon be able to work on many stretches and put in a permanent highway. On 14 February, three days after Presidential approval of the program, the War Department directed the Chief of Engineers to proceed with the project. Because most of the route passed through British Columbia and the Yukon Territory, the consent of the Canadian Government had to be obtained. On 26 February the Permanent Joint Board of Defense, Canada-United States, reported favorably on the project, and less than two weeks later William L. Mackenzie King, the Canadian Prime Minister, announced his government's approval of the board's recommendation.[36]

Organizing for Construction

While discussions between the Canadian and the United States Governments were under way, General Sturdevant organized a task force for building the highway. In mid-February Col. William M. Hoge was named commander and ordered to report directly to Reybold. Two combat regiments, the 18th, commanded by Lt. Col. Earl G. Paules, and the 35th, under Col. Robert D. In-

[35] (1) Paraphrase of Telg sent to American Legation, Ottawa, by Secy of State Cordell Hull, 12 Feb 42. Alaska Hwy, pp. 70–71. (2) Notes of Cabinet Mtg of 16 Jan 42. Alaska Hwy, p. 59. (3) Excerpt from notes of Gen Sturdevant. Alaska Hwy, p. 61.

[36] (1) Memo, Sturdevant for WPD, 4 Feb 42. Alaska Hwy, p. 62. (2) Ltr, TAG to CofEngrs, 14 Feb 42. Alaska Hwy, p. 68. (3) Brig. Gen. C. L. Sturdevant, "The Alaska Military Highway," *The Engineering Journal*, XXVI (March 1943), 117. (4) Memo, Stimson for Roosevelt, 7 Mar 42. Alaska Hwy, p. 81. (5) Memo for Rcd, Permanent Joint Bd on Defense, 6 Mar 42. Alaska Hwy, p. 82.

galls, were the first units assigned. They were to start work on the highway and, at the same time, furnish cadres for new regiments which would move up later for work on the road. On 9 March Maj. Alvin C. Welling, executive officer of the task force, arrived at the town of Dawson Creek, at the end of the rail line from Edmonton, and proceeded northward by way of the provincial road to Fort St. John, situated on the far bank of the Peace River. Here he set up a command post from which Colonel Hoge would supervise the construction of 650 miles of the highway northwestward from Dawson Creek to the town of Watson Lake. A second command post for the remainder of the route was to be set up later.[37]

No time was lost in moving the first troops up. Elements of the 35th Engineers under Colonel Ingalls, forming the vanguard, were on the train with Major Welling. Company A of the 648th Topographic Battalion reached Dawson Creek on the 13th, and the 74th Light Ponton Company came in the next day. The last elements of the 35th arrived on the 16th. Men, vehicles, and supplies were moved northward to Fort St. John. At this point, the Peace River was 1,800 feet wide. There was no bridge, and ice on the river ruled out ferrying men and equipment to the other bank. Speed was imperative because a warm spell made the crossing of the troops with their heavy machinery hazardous. The 35th Engineers laid planks and sawdust over the ice and drove across to Fort St. John without mishap. The men then pushed ahead over 265 miles of frozen muskeg in an effort to reach Fort Nelson before the thaws set in. A drop in temperature from 50 degrees above to 35 degrees below hardened the winter road sufficiently to permit the equipment to move forward easily. But the men suffered greatly from the cold, the bitter wind, and the roughness of the trail. Truck drivers, hauling load after load of troops and supplies, went for days with little rest. The most grueling task was driving the tractors, graders, and power shovels. Frostbitten and shivering operators approached the limits of physical endurance in "walking" their ponderous machines for 40 to 80 miles at a stretch without relief. Upon reaching Fort Nelson, the men were so exhausted from cold and exposure that they could scarcely move. On 5 April the last of the equipment crawled into Fort Nelson, shortly before the spring thaw made the trail impassable. The 35th Regiment and its auxiliary units were ready to begin work westward out of Fort Nelson.[38]

Meanwhile, in a formal exchange of notes on 17 and 18 March, Canada and the United States agreed to co-operate in the construction, maintenance, and use of the highway. The United States agreed to make surveys and to send in engineer troops to construct a pioneer road; to have contractors, Canadian or American, complete the highway under the supervision of the Public Roads Administration; to maintain the road for

[37] (1) Memo, Sturdevant for WPD, 4 Feb 42. (2) Ltr, Sturdevant to Paules, 19 Feb 42. (3) Ltr, Sturdevant to Hoge, 3 Mar 42. Alaska Hwy, pp. 62–64.

[38] (1) Sturdevant, "The Alaska Military Highway," *The Engineering Journal,* XXVI (March, 1943). (2) Ltr, Welling to CofEngrs, 1 Apr 42. (3) Hist of the 74th Engr Light Ponton Co.

six months after the war, unless Canada should prefer to assume maintenance of the Canadian portion sooner; and to turn the Canadian part of the highway over to Canada at the end of the war with the understanding that citizens of the United States would not suffer discrimination in its use. The Canadian Government, in turn, agreed to provide the right of way, to permit the use of local timber, gravel, and rock, to waive all import duties, sales taxes, and license fees in connection with work on the road, and to exempt American citizens employed on the project from paying Canadian income taxes.[39]

Early in April, Hoge, now a brigadier general, set up his second command post at Whitehorse, a point from which he would direct construction of the 850 miles of road from Watson Lake to Big Delta. On the 9th of the month, the 73d Light Ponton Company disembarked at Skagway and during the next two weeks set up camp at Whitehorse. Soon thereafter Company D of the 29th Topographic Battalion reached the town. Meanwhile, the 18th Combat Regiment under Colonel Paules, the 340th General Service Regiment under Lt. Col. F. Russel Lyons, and the 93d General Service Regiment under Col. Frank M. S. Johnson had sailed from Seattle. The 18th Engineers, the first to arrive, set up their headquarters at Whitehorse on the 15th and, with the little equipment they had, began work on the wagon trail leading westward to Kluane Lake. The next week the other two units disembarked at Skagway. They had none of their heavy equipment, though it was expected shortly. Weeks passed with no sign of it. In mid-May, General Hoge flew to the United States to find out the reasons for the delay. In Seattle, he came across tractors, graders, and trucks lined up on the docks and in nearby yards because too few vessels had either sufficient space to carry the machinery or booms capable of putting it aboard. To relieve the overburdened facilities at Seattle, Hoge arranged to have the E. W. Elliott Company send some heavy equipment by barge out of Prince Rupert. After mid-May prospects that the equipment would soon arrive at Skagway were brighter, and, late that month, it began to appear. A major feat was to get it from the docks to its destination. The White Pass and Yukon Railroad, an antiquated, narrow-gauge line, 111 miles long, was the only link between Skagway and Carcross and Whitehorse, the transportation hubs of the Canadian Northwest, both of them on the route of the highway. During the latter part of May the railroad, which had but twelve locomotives, was taxed far beyond its capacity to transport the machinery needed on the highway. But despite the difficulties, the equipment began to arrive for work on the road.[40]

The 18th Engineers, having received

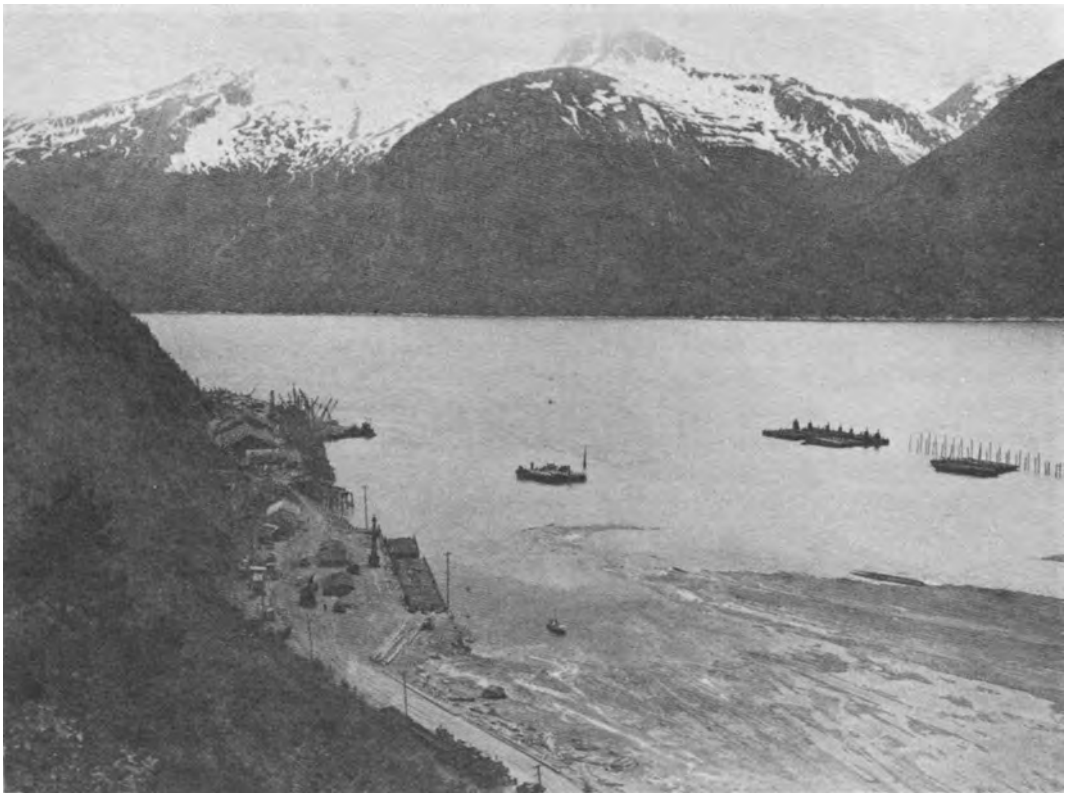
[39] (1) Paraphrase of Telg sent by Secy of State Hull to American Legation, Ottawa, 12 Feb 42. Alaska Hwy, pp. 70–71. (2) Ltr, Pierrepont Moffat, American Minister to Canada, to Mackenzie King, 17 Mar 42. Alaska Hwy, pp. 86ff. (3) Ltr, Mackenzie King to Moffat, 18 Mar 42. Alaska Hwy, pp. 90ff.

[40] (1) Memo, Col Clarence L. Adcock, Exec Asst, Tr Div OCE for Somervell, 18 Apr 42. (2) Sturdevant, "The Alaska Military Highway," *The Engineering Journal*, XXVI (March, 1943). (3) Hist of the 93d Engr GS Regt. (4) Hist of the 340th Engr GS Regt. (5) Ltr, Adj 18th Engrs to CofEngrs, 26 May 42.



GENERAL HOGE (CENTER) WITH STAFF OFFICERS

most of their machinery by late May, continued working on the trail leading to Kluane Lake. The 93d Engineers had about 60 percent of their machinery by the end of the month; with this and two tractors borrowed from the 18th, they began clearing a trail eastward out of Carcross toward the Teslin River, some fifty miles away. The 340th Engineers remained at Skagway till June, when they received enough trucks and equipment to make work on the highway practicable. One platoon remained at Skagway and another went to Whitehorse to do stevedoring. The remainder of the regiment went by train to Carcross, then marched to the Teslin River, part of the way over the trail being blazed by the 93d Engineers, and sailed up the river to Lake Teslin. The men arrived at their destination east of the lake on 18 June and started hacking out a trail. Work had also begun on the part of the route in Alaska. On 7 May, the 97th General Service Regiment, commanded by Col. Stephen C. Whipple, disembarked at Valdez, the southern terminus of the Richardson Highway. The men had brought only a few items of heavy equipment. Before embarking at Seattle they had turned in their wornout trucks and requisitioned new ones. They



SKAGWAY HARBOR

spent their first weeks in Alaska in maintaining the Richardson and Nabesna Highways. Early in June their equipment arrived, including the same trucks they had turned in, still in need of a complete overhauling. The men began working on a pioneer road from the village of Slana, on an arm of the Richardson Highway, northeastward toward the Tanana River.[41]

As over-all commander, General Hoge found he was needed at both Whitehorse and Fort St. John for resolving many important matters regarding construction. There were neither telephone lines nor passable trails between the two towns, which were 600 miles apart by air, and atmospheric disturbances made communication by radio uncertain. To remedy the situation, Reybold late in April split the project into two independent commands, placing Col. James A. O'Connor in charge of the Fort St. John, or Southern Sector, and leaving General Hoge in charge of the Whitehorse, or Northern Sector. Watson Lake was the dividing point. Colonel O'Connor assumed command at

[41] (1) *Ibid.* (2) Hist of the 93d Engr GS Regt. (3) Hist of the 340th Engr GS Regt. (4) Ltr, Maj. C. F. Waite, OpnsO Whitehorse Sec, to CofEngrs, 24 Jun 42.

Fort St. John on 6 May. Both he and General Hoge reported directly to the Chief of Engineers.[42]

Construction Progress

In the Southern Sector little progress could be made during the first weeks. Rain and mud held up the 35th Engineers, working westward out of Fort Nelson. In May, two more units arrived, the 341st General Service Regiment, commanded by Col. Albert L. Lane, reaching Dawson Creek on 1 May, and the 95th General Service Regiment, under Col. David L. Neumann, arriving on the 31st. Both units were assigned to the section between Fort St. John and Fort Nelson. The 341st bulldozed the pioneer trail through forests of alder and poplar; the 95th, directly behind, improved and maintained the completed trail. Both units had come without their road-building machinery. Of all the units on the highway, only Colonel Ingall's 35th Engineers had arrived adequately equipped. But shortages were no major obstacle in the Southern Sector, for excellent rail connections permitted a fairly steady flow of machinery and supplies from Chicago and other centers of the industrial Midwest. More difficult to contend with was the unpredictable weather. At times, the temperature soared to 80 degrees and frozen earth turned into sticky mud. This dried up and became dust, which, under heavy rain, turned into mud again. Soon the men ran into many patches of muskeg. Insofar as possible, the route was detoured around them. Short strips proved to be unavoidable. Shallow patches were usually scooped out and filled with gravel; deeper ones were corduroyed.[43]

Meanwhile, Sturdevant and MacDonald prepared a plan whereby the Engineers and the Public Roads Administration would co-operate on building the road. MacDonald envisioned a smoothly surfaced highway for two-way traffic, with gentle grades and curves, built according to specifications for roads in national forests. It would normally be 36 feet wide but, where construction was difficult, would be temporarily limited to 20 or 22 feet. Local materials would be used for surfacing and for small culverts and temporary bridges. If desired, permanent structures could be put in later. Public Roads would help make reconnaissances for routing the permanent highway, but the military commanders would have the final decision on location because their mission required opening a road for military traffic as soon as possible. If time permitted, engineer troops could improve any section beyond pioneer road standards if this could be done without interfering with the contractors' operations.[44]

Construction had begun before a thorough investigation of the route could be made. Considerable information existed on the sections located in Alaska and the Yukon Territory and on the section between Fort St. John and Fort Nelson, but for the remainder, al-

[42] (1) Ltr, Sturdevant to Hoge, 24 Apr 42. Alaska Hwy, p. 179. (2) Ltr, Hoge to Sturdevant, 3 May 42.

[43] Ltrs, O'Connor to CofEngrs, 19 May, 22 Jun 42.

[44] (1) Memo for Rcd, Sturdevant, 29 Apr 42. (2) Ltr, MacDonald to Sturdevant, 4 Mar 42. Alaska Hwy, p. 183.



TRUCKING SUPPLIES THROUGH THE MUD BY TRACTOR TRAIN

most all terrain data had to be gotten from small-scale, incomplete, and contradictory maps. On these, "lakes were out of position and critical elevations almost wholly useless. . . . The indicated courses of many considerable rivers were largely schematic." Promising trails used by guides and hunters often passed over swampy terrain and were serviceable only when the ground was frozen or were confined to tortuous river valleys where game was most plentiful. The men from the 648th and 29th and surveyors from Public Roads had more than enough to do during the first few weeks. Military and civilian surveyors dovetailed their efforts in order to incorporate as much of the pioneer road as possible into the final route for the highway. Of great help were the local "bush flyers," who knew considerably more about the terrain than most other inhabitants. Going aloft with them, Army and PRA engineers got a general impression of the lay of the land. A bright spot in the picture was that the engineers had a great deal of latitude in locating the road. Restrictions as to the right of way were not a problem.[45]

[45] T. H. MacDonald, L. I. Hewes, and J. S. Bright,

By early June, all engineer troops scheduled for work on the highway had arrived. Colonel O'Connor at Fort St. John had a combat regiment, 2 general service regiments, a light ponton company, and a topographic company, totaling 4,354 officers and men. General Hoge at Whitehorse had a combat regiment, 3 general service regiments, a light ponton company, and a topographic company, totaling 5,806. Auxiliary signal, finance, quartermaster, and medical troops numbered approximately 340 in the Southern Sector and 165 in the Northern. Two gaps remained in the building of the highway. One, at the extreme northern end, extended from Big Delta to Tanacross, a distance of a hundred miles. The other ran southeastward for fifty miles from Whitehorse to Jake's Corner, midway between Carcross and the Teslin River. It was planned to assign these stretches eventually to PRA contractors.[46]

In all sections, the pioneer road was pushed through in more or less the same manner. As stretches were located and surveyed, clearing crews, driving 23-ton D–8 tractors with bulldozers, smashed a corridor through brush and woods. The shallow-rooted trees of the north were easily toppled. While the lead dozer opened a pathway, others widened the clearing and shoved aside fallen trees and debris. General Hoge had originally specified a clearing thirty-two feet wide, but it soon became evident that in wooded areas a corridor two or three times as great was necessary to admit enough sunlight to dry out the ground. Clearing crews readily accomplished this additional work without excessive effort because most of their time was spent in turning and lining up for new cuts. By June the many hours of sunlight of the northern summer day made it possible to work two and sometimes three shifts every twenty-four hours. Working around the clock, crews could clear from three to four miles a day. Behind the clearing echelon, engineer units built log bridges and culverts over gulleys and small streams. Using hand tools and the versatile air compressor with attachments, a platoon could build a bridge, or a squad a culvert, in less than a day. Farther to the rear, other units smoothed the trail with scrapers and graders, corduroying where necessary. Still farther back, others widened narrow spaces, reduced the worst grades, and filled soft spots with gravel. The tactics of rapid construction depended on the use of special equipment, particularly the heavy bulldozer. Every other piece of machinery was auxiliary to this item. Strenuous efforts had been made to supply the units with plentiful amounts of equipment. Under normal circumstances, a combat or general service regiment was furnished 8 medium tractors, but on the highway each regiment was allotted 20 heavy and 24 medium tractors with bulldozers and winches. Equipment lists further included 6 12-yard carryalls, 3 motor patrols, and 2 power shovels; from 50 to 90 dump trucks and many other vehicles; one portable sawmill, two pile drivers, water purification sets, electrical generators, and radio receivers and transmitters. Men sent to northern

"Alaska Highway—Organizing $30,000,000 Job," *Western Construction News* (February 1943), 55ff.

[46] (1) Memo, Sturdevant for Somervell, 7 Jul 42. (2) Alaska Hwy, p. 241.

Canada and Alaska were also furnished arctic clothing, sleeping bags, and tents, as well as mosquito bars and head nets for protection against the great swarms of mosquitoes and flies which infested the northern regions in the summer.[47]

Back in the United States, critics were waging a vigorous campaign against the construction of the highway. Their most violent attacks were directed against the route which had been selected. After the bombing of Dutch Harbor, the project attracted unusual interest. In response to various charges, among them that the road was an "engineering monstrosity because of the muskeg swamp along the major portion of the route," the Senate Foreign Relations Subcommittee held hearings in June to consider a formal probe of the matter. Witnesses appearing before the subcommittee contended that in the Southern Sector a road might be built for a few miles out of Fort St. John, but it would be swallowed up in the hundreds of miles of muskeg near Fort Nelson. The engineers had obviated most of these criticisms before they were made. They had relocated the pioneer road westward on the foothills of the Rockies and thus avoided the poor drainage along the original route. They blazed the trail on the ridges west of the Blueberry River and then east of the Minaker and Prophet Rivers into Fort Nelson. By painstaking care in routing, they bypassed a great deal of muskeg, save for scattered stretches from 200 to 400 yards in length. In the last sixty miles into Fort Nelson, where much muskeg was expected, less than four miles of it were encountered. On 17 June the Senate subcommittee recommended that no further investigation be made of construction on the Alcan Highway.[48]

Reconnaissance

To make rapid construction possible, reconnaissance had to be continuous. Since it was difficult to remember all the features of the ground from a swiftly moving plane, the engineers turned to aerial photography. Photographic aircraft became available to the Southern Sector in May; to the Northern, in June. Examining aerial photographs, sector and regimental commanders were able to avoid locations that involved extreme elevations, long stretches of swamp, or excessively rugged terrain. Location parties made low-altitude flights for on-the-spot inspections of critical areas. Ground survey parties went forward on foot, or by dog sled, horse, or tractor-drawn trailers. To investigate likely river crossings, the parties sometimes used improvised ponton rafts, powered by outboard motors, or flew in with aircraft equipped with pontons. After they decided upon the location of the route, the surveyors blazed a center line to guide the leading bulldozers. In

[47] Sturdevant, "The Alaska Military Highway," *The Engineering Journal*, XXVI (March, 1943), pp. 120–21.

[48] (1) Ltrs, O'Connor to CofEngrs, 22 Jun, 23 Aug 42. (2) Ltr, OpnsO Fort St. John Sec to CofEngrs, 24 Jul 42. (3) Ltr, Gruening to Stimson, 3 Mar 42. (4) Ltr, Chmn of British Columbia-Yukon-Alaska Hwy Cmte to Sturdevant, 21 Mar 42. (5) *Alaska Highway Hearings* Before a Subcmte of Senate Cmte on Foreign Relations, 77th Cong, 2d sess, 1, 12, 16 Jun 42. (6) Rpt of Subcmte of Senate Cmte on Foreign Relations, 17 Jun 42. *Alaska Hwy Hearings*, Exhibit I-f.

many instances, operators swung around obstacles that would cause excessive cutting and blazing. Where the line of least resistance was followed, the road, it was said, "had more curves than Hollywood." [49]

West of Fort Nelson, the engineers ran into innumerable obstacles. The initial route of the highway lay to the northwest along the Fort Nelson River, along the Liard and Crow Rivers, along the southern shores of the Toobally Lakes, and then across open country to Watson Lake. Aerial reconnaissance and closer observation from ponton rafts indicated that this fairly level route had much soft ground and little material for surfacing. In May a pack train sent out by Colonel Ingalls to reconnoiter the country more thoroughly found a better route farther south. It led directly west out of Fort Nelson along the Muskwa River to Muncho Lake and then veered northward to the Liard River. It followed the north bank of that river for 150 miles into Watson Lake. From Watson Lake to Whitehorse, a distance of 300 miles, lay another most forbidding section. It included the Continental Divide separating the Mackenzie and Yukon drainage systems. Maps indicated mountain ranges from 6,000 to 7,000 feet high, which would necessitate prohibitive grades. Heavy snowfall would block a road for many months of the year. Critics freely predicted the engineers would not be able to put a road through this region unless they made a sweeping southward detour, which would add 500 miles to the highway. Aerial reconnaissance revealed that the ranges were not continuous as the maps indicated but were interspersed by low-lying areas and broad valleys. A bush flyer, Les Cook, observed at one point on the Continental Divide a fairly extensive growth of trees which in this latitude could not thrive much above 4,000 feet. Engineer ground parties, exploring the area, located a route which crossed the divide at a maximum altitude of 3,100 feet. This section could be built far more readily than had been anticipated. West of Whitehorse, the route stretched for 318 miles to the Alaskan boundary. Part of it was along the old wagon trail to Kluane Lake. Between the lake and the international boundary, the engineers would undoubtedly encounter some of the roughest terrain between Fort St. John and Big Delta. The most careful reconnaissance indicated it would be impossible to avoid entirely the treacherous permafrost which would make a mockery of normal construction.[50]

Progress During the Summer

By the end of June progress on the pioneer road was encouraging. In the Southern Sector, the 341st Engineers had completed 36 miles out of Fort St. John,

[49] (1) Col. Albert L. Lane, "The Alcan Highway, Road Location and Construction Methods," *The Military Engineer*, XXXIV (October, 1942), 492–99. (2) Memo, Sturdevant for Somervell, 1 Jun 42. (3) Ltr, O'Connor to Sturdevant, 19 May 42.

[50] (1) Sturdevant, "The Alaska Military Highway," *The Engineering Journal*, XXVI (March, 1943). (2) MacDonald *et al.*, Constr Activities of the PRA and Their Contractors in Cooperation with the WD CofEngrs, on the Canadian Alaska Military Hwy (cited hereafter as MacDonald Paper), Paper presented at 19th Annual Mtg of American Society of Civil Engrs, 20 Jan 43. (3) Ltr, O'Connor to CofEngrs, 19 May 42.

which the 95th was improving and maintaining. The 35th had reached a point 48 miles west of Fort Nelson. This unit had perhaps the most trying section of all. "The sloppy soil conditions which prevailed . . . near Charlie Lake [north of Fort St. John]," O'Connor wrote Sturdevant late in May, "were almost of minor magnitude in contrast with the sloppier conditions which prevailed . . . in the vicinity of Fort Nelson. At this latter point the soil was in general nothing better than pure mud." [51] In the Northern Sector, the 93d Engineers had finished 33 miles from Carcross to Lake Teslin and the 340th had completed 10 miles east of the lake. The 18th had pushed 112 miles along the wagon road west of Whitehorse. Working in difficult terrain in Alaska, the 97th General Service Regiment had completed only 6 miles, but it expected to make more rapid progress once it got into the Tanana River valley. Most of the route had been determined, at least tentatively, in both sectors. Detachments of the ponton companies were fully occupied ferrying men and equipment across the many streams. With the beginning of summer, progress could be more rapid. Temperatures ranged up to 84°F. The frost was gone from the ground, save in heavily wooded sections. PRA's operations were gaining momentum, and its contractors were already at work on the permanent road out of Fort St. John. Some of the contractors' men and equipment had been flown from Fairbanks to Tanacross and Gulkana. PRA expected to begin construction in the Northern Sector in July.[52]

Between the 7th and the 18th of July General Sturdevant inspected the entire route by airplane and traveled 500 miles by car over the part under construction or already completed. He observed that the troops, instead of putting in a rough access trail, were building a fairly well-drained and graded highway. This was necessary because the road was the only line of supply the troops had with their bases. It appeared that the pioneer road, besides providing access for PRA contractors, could also be made to serve the airports during the coming winter. To operate vehicles over the entire route the year round would require not only pushing 1,000 miles of pioneer road to completion, but also constructing rest camps, telephone lines, and fuel supply depots. Sturdevant decided to modify existing arrangements with PRA so that the contractors and engineers could merge their forces to expedite work on the pioneer road. So far, PRA had done no work on the permanent highway except for short distances out of Fort St. John and Whitehorse. The contractors were still spending most of their efforts in setting up camps and collecting equipment. Early in August, Sturdevant and MacDonald agreed that for the remainder of the working season the contractors would help put the pioneer road in shape for winter traffic. Sturdevant asked PRA to give precedence in construction to the sections between Big Delta and Tanacross and between Whitehorse and Jake's Corner.[53]

On 8 August MacDonald directed his

[51] Ltr, O'Connor to CofEngrs, 19 May 42.

[52] (1) Ltr, O'Connor to CofEngrs, 22 Jun 42. (2) Ltr, Maj. C. F. Waite, OpnsO Whitehorse Sec, to CofEngrs, 24 Jun 42.

[53] (1) Memo, Sturdevant for Somervell, 1 Aug 42. (2) Ltr, Sturdevant to Somervell, 8 Aug 42. Canol Files.

field offices to comply with the new policy. During the next weeks, he set up additional offices at Edmonton, Whitehorse, and Gulkana. Public Roads meantime enlisted the services of four management contractors, who, by August, had under them forty-seven American and Canadian construction firms, working under cost-plus-a-fixed-fee contracts. The E. W. Elliott Company of Seattle, which had helped the engineers get equipment to Skagway, was now called upon to transport men, supplies, and machinery for PRA. In August, some of the contractors began to clear the sections which PRA was to construct. Other contractors' crews, upon arriving at the highway, moved in behind the troops to widen, improve, and gravel the roadbed. Relieved of heavy maintenance on stretches of road to the rear, the engineers could henceforth apply most of their efforts to the construction of new road.[54]

During the summer, favored by warm, clear weather, and with most of their equipment now on hand, the troops made rapid progress. By 20 August the 35th Engineers had blazed 209 miles of one-way trail to the Liard River and were pushing forward along the river's northern bank. At the end of the month, the 341st and 95th Engineers, having turned their section of the road south of Fort Nelson over to PRA, moved in behind the 35th Engineers and began to convert the pioneer road into a two-lane highway. The 340th Engineers, working eastward from Teslin Lake, first put in a trail for two-way traffic and after mid-July for one-way traffic. By the first week in September, the 340th had pushed through to Watson Lake. Thereupon, one of the battalions widened the last fifty miles of the trail while the other continued eastward.[55]

West of Whitehorse, work was proceeding at an equally fast pace. By mid-August, the 18th Engineers had swung past the western shore of Kluane Lake and had reached the Duke River, 200 miles from Whitehorse. Fording the river, the regiment came up against the forbidding terrain that the survey parties had described. It was at first "heavily wooded and creased with many small ridges." Beyond lay a desolate area of burnt trees that "stood together like thousands of scarecrows." [56] This burnt timber stood on permafrost which defied heretofore tried and tested methods of road building. Once the surface of the ground was disturbed, the sun brought on as much mud as heavy rains could produce. Uprooted trees left gaping holes that deepened as the subsurface thawed. Unaware at first that the permafrost extended for another hundred miles, Colonel Paules on 17 August prodded his troops to push through this final stretch by early October, before the Yukon winter set in. The regiment was unable to attain such a pace, but did find ways of coping with the frozen subsoil. Instead of clearing by bulldozer, the men chopped trees level with the ground. To keep sunlight off the exposed area, they cut a corridor of

[54] (1) MacDonald Paper. (2) Ltr, Hoge to CofEngrs, 24 Aug 42. (3) Ltr, O'Connor to CofEngrs, 23 Aug 42. (4) Ltr, Sturdevant to Somervell, 1 Sep 42.

[55] (1) Ltr, OpnsO Fort St. John Sec to CofEngrs, 24 Jul 1942. (2) Ltr, Hoge, to CofEngrs, 24 Jul 42. (3) Ltr, O'Connor to CofEngrs, 23 Aug 42. (4) Ltr, Ingalls to CofEngrs, 30 Sep 42.

[56] The Eighteenth Engineers (Combat) in Yukon Territory, Apr 42–Jan 43, p. 57. 94 KCRC.

medium width which they immediately corduroyed with small trees and branches. One company spread gravel over the corduroy, while another, using almost all the dump trucks of the regiment, hauled rock day and night. The graveled strip crept forward at the rate of half a mile a day. Meanwhile, in Alaska, the 97th Engineers had by 25 August finished the stretch of pioneer road from Slana to the Tanana River. The regiment then worked southeast along the river toward the international boundary in the direction of the 18th Engineers.[57]

Bridges

Every one of the more than 100 major streams which crossed the route between Dawson Creek and Big Delta was a hindrance to rapid construction. The two light ponton companies had from the first supported the road-building regiments at the water crossings. Wherever possible, equipment was forded across. If streams could not be forded, ponton bridges were used. If there was insufficient equipment for bridging, the pontoniers made rafts by lashing pontons together and decking them with timber. To power these rafts, they generally used outboard motors. As soon as possible, the rear elements of the regiments moved up to build timber bridges. When these were finished, the ponton units moved on to the next crossing. At the wider waterways, the pontoniers operated ferry lines until bridges could be erected. One of the major barriers was the Peace River at Fort St. John. After the ice broke up, the provincial government operated a 20-ton ferry from shore to shore, but this craft was too small to handle the great quantities of equipment that had to be carried over the river. From June on, a detachment of the 74th Light Ponton Company hauled men and supplies across on the *Alcan,* which consisted of a tug and a 65-foot barge, capable of carrying up to sixty tons. In the Northern Sector, detachments of the 73d Light Ponton Company manned tugs and barges which plied back and forth on the Teslin River and on Teslin and Tagish Lakes.[58]

Unfamiliar with the quirks and vagaries of the northern rivers, the engineers believed it best to build only temporary structures at first. They expected spring floods to damage or even carry away many of these spans. The troops used local timber, originally cut and trimmed by hand and later prepared with portable sawmills. Forward bridging crews built simple stringer spans by hand over small streams, leaving the construction of the longer pile and trestle structures to troops with cranes, pile drivers, and other heavy equipment. In Yukon Territory, a number of streams had cut narrow channels through wide valleys, which were strewn with heavy deposits of boulders and gravel. These streams would rise to unpredictable levels. Here the temporary bridges, as a rule, were built only across the channels. To keep the approaches open necessitated considerable maintenance. A

[57] (1) Ltr, Hoge to CofEngrs, 24 Jul 42. (2) Ltr, Johnson to CofEngrs, 30 Sep 42.

[58] (1) Waldo G. Bowman *et al., Bulldozers Come First* (New York, 1944), pp. 136ff. (2) Ltr, O'Connor to CofEngrs, 22 Jun 42. (3) Ltr, Hoge to CofEngrs, 24 Jul 42.

number of structures of more than 500 feet were built. In July, the 18th Engineers built a pile and trestle bridge across Slim's River, a tributary of Kluane Lake. Toward the center of the channel the gravel was frozen so solidly that the piles splintered under the impact of the 3,000-pound hammer. Blasting proved ineffective. Steel caps were radioed for and flown in, enabling the engineers to drive the piles into the bottom. Other engineers, working from the opposite bank, improvised a hydraulic pile-driving machine which consisted of a hose fastened to an iron pipe. Men in boats held the pipe against the bottom near the pile and pumped water under high pressure through the hose and pipe, thus loosening the frozen gravel. When finished, the bridge was 1,040 feet long, had 86 bents, and despite the frozen river bottom and the swift current, took only a month to erect. In August elements of the 35th Engineers constructed a 730-foot combination crib, pile, and trestle bridge across the Muskwa River, just west of Fort Nelson, finishing it shortly before the arrival of construction troops working north from Fort St. John. All these structures were temporary. Once the behavior of the streams was better known, PRA contractors would install the permanent structures.[59]

Preparations for Winter Traffic

During the summer the engineers also had to construct the facilities required for operating the highway and the staging route during the coming winter. To improve the communications system, Somervell authorized a telephone line from Edmonton to Fairbanks, parallel to the highway. Although a private corporation would install the line, the engineers were to build repeater stations at 100-mile intervals. To supplement the fields of the Northwest Staging Route, the Army Air Forces requested that the Corps of Engineers construct eight flight strips and weather observation stations along the highway. Realizing that considerable quantities of supplies and equipment would have to be moved over the pioneer road as soon as it was opened, General Sturdevant made arrangements during August and September for winter traffic. He planned to build barracks for maintenance and snow-clearing crews, way stations for changing drivers, and repair shops for servicing vehicles.[60]

Northwest Service Command

The additional construction, together with the rapidly expanding activities in connection with Canol, made it desirable to have one man in command of all U.S. projects in northwestern Canada. On 2 September the Northwest Service Command was activated to direct work on the highway and related undertakings. O'Connor, now a brigadier general, was placed in command. General Hoge left for the United States and another assignment. Col. W. J. Wheeler took direct charge of work on the highway. The

[59] (1) Bowman *et al., Bulldozers Come First,* pp. 136ff. (2) The Eighteenth Engineers (Combat) in Yukon Territory, Apr 42–Jan 43, p. 54. (3) Ltr, Hoge to CofEngrs, 24 Jul 42. (4) Ltr, O'Connor to CofEngrs, 23 Aug 42.

[60] (1) Memo, DCofAS for Somervell, 29 Jul 42. (2) Memo for Rcd, Col George Horowitz, Opns Br Constr Div OCE, 20 Oct 42. Canol Files.

Northern Sector was henceforth under Colonel Paules; the Southern, under Ingalls. The Chief of Engineers retained technical supervision over the work.[61]

Closing the Gaps

By mid-September, the road in the Southern Sector was almost complete. The 35th and the 340th Engineers had nearly closed the gap between them. On the 24th, "amid the roar and thunder of the big 'cats' and the swishing crash of the giant trees as they bent to the . . . will of the big dozer blades, there was a strong feeling of suspense and anticipation," wrote the unit historian of the 340th Engineers. While the men waited on the west bank of Contact Creek, about fifty miles east of Watson Lake, the 35th Engineers, on the opposite side of the stream, blasted rock from the side of a steep hill which was the last obstacle to the completion of "two long and treacherous stretches of the road through the northwest wilderness of Canada." One of the bulldozers made a run down the yet unfinished cut on the hill and pushed forward through brush and trees. It moved into the creek and met the leading bulldozer of the 340th in the center of the stream. Colonel Lyons, commander of the 340th, and Maj. James A. McCarthy, commander of the 35th, standing on the tracks of their bulldozers, shook hands amid the shouts of the men and the blare of the band of the 340th. Everybody was milling about on land and in the water to get snapshots. Several days later, a truck which had started out from Dawson Creek crossed the stream and continued on its way to Whitehorse. It made the trip of 1,000 miles in seventy-one hours.[62]

In the Northern Sector additional work was needed to complete the road. By October a considerable gap still remained at the Alaskan-Canadian border. Realizing that the construction season would not last long enough for the 18th and 97th Engineers to complete their sections and bring them to pioneer road standards, Colonel Paules sent two platoons of the 18th across the White River on 10 October to build a trail that would be suitable for winter travel. This region had many hillocks, covered with tall grass which slowed travel on foot or horseback. To avoid damaging the ground on which the permanent road would be built, a trail was blazed parallel to the line already surveyed by PRA engineers. The 18th Engineers cut many of the clumps of grass by hand. When the ground was sufficiently frozen, they took bulldozers and "walked down" the heaviest growths.[63]

By November prospects were bright that the remaining gaps in the pioneer road would soon be closed. On 25 October the lead bulldozers of the 18th and 97th Engineers had met at Beaver Creek, a few miles east of the Alaskan-Canadian border. The two units had joined their sections by means of a winter road which would be passable until broken up by the spring thaws. During

[61] (1) WD GO No. 44, 4 Sep 42. (2) Ltr, Sturdevant to TQMG, 4 Aug 42.

[62] (1) Ltr, Ingalls to CofEngrs, 30 Sep 42. (2) Ltr, Johnson to CofEngrs, 30 Sep 42.

[63] (1) Ltr, Ingalls to CofEngrs, 31 Oct 42. (2) Ltr, Welling to CofEngrs, 30 Nov 42. (3) Ltr, Paules to CofEngrs, 31 Oct 42.

the next weeks the engineers and the contractors' forces graveled this road east of the international boundary as far as the White River. Still to be finished was a trestle bridge across the river. It was to be a makeshift affair, the frame bents being placed directly on the ice except in the stream's channel. Meanwhile, PRA contractors finished their sections from Big Delta to Tanacross and from Whitehorse to Jake's Corner; on 20 November, the 18th and 97th Engineers completed the bridge over the White. The Alcan Highway was open from Dawson Creek to Big Delta. A pioneer road, 1,450 miles long, had been pushed through in eight months. That same day Canadian and American officials assembled at Soldier's Summit, overlooking Kluane Lake, to hold a short ceremony in celebration of the completion of the pioneer road. The next day the first trucks from Dawson Creek rolled into Fairbanks.[64]

Winter on the Alcan

Although the pioneer road was finished, the engineers still had many jobs to complete, some of which they had started in September. In the Southern Sector a major task was building a number of connecting roads from the highway. One was put in to the radio station at Toobally Lakes. Another was being run from Fort Nelson to Fort Simpson on the Mackenzie River, to be used as a supply route for the Canol project. Bridges required a major effort, and the engineers built a number of long structures during the fall. The 35th Engineers spent nine days in September erecting a pile-bent structure, 1,270 feet long, across the Liard River 209 miles west of Fort Nelson. Two months later the 340th built a pile-bent bridge 750 feet long across the same stream, 15 miles east of Watson Lake. PRA also put in temporary structures. Late in September the Oakes Construction Company began work on a 2,200-foot timber structure across the Peace River at Fort St. John and finished it in three weeks. In November a sudden thaw hurled huge floes of ice against the bridge, tearing out a 200-foot section. The gap was closed, and traffic resumed within a few days. That same month, the 340th Engineers joined contractors in building a 2,300-foot pile-trestle bridge across Nisutlin Bay. Many of the piles were driven through ice. While temporary bridges were under construction, PRA studied sites for the permanent structures, and contractors prepared to begin work on several late in the year.[65]

As the cold weather set in, many of the troops were shifted to work on camps and shelters. During the summer, the men had slept on the ground in tents, but by October, better quarters were needed, for the temperature had dropped below freezing in both sectors. Hundreds of steel huts and prefabricated buildings were shipped from the United States and distributed along the route. Most of the camps and shelters, however, were built by the troops from standardized plans and specifications prepared by the Construction Division of the Office

[64] Ltrs, Paules to CofEngrs, 31 Oct and 30 Nov 42.

[65] (1) Ltrs, Ingalls to CofEngrs, 30 Sep and 31 Oct 42. (2) Ltr, Paules to CofEngrs, 31 Oct 42.



A View Along the Alcan Highway

of the Chief of Engineers. Except for hardware, windows, wallboard, and tar paper, all materials were obtained locally. Stoves were improvised from gasoline drums. Shortages of materials delayed putting in some of the final touches; spells of intense cold held back logging, milling, and outdoor carpentry work even more.[66]

On 1 December 1942 the Northwest Division was organized under the Northwest Service Command. Its first chief was Colonel Wyman, who, after his transfer from Hawaii, had taken charge of the Canol project. As division engineer, Wyman was to direct all engineer projects in northwestern Canada. Work on the Alcan Highway went on. The relatively few engineer troops and contractors' forces struggled to keep the pioneer road open during the winter in order to move the seemingly endless quantities of supplies and equipment that were needed for future operations. Ice, snow, and cold were the main impediments. In the Northern Sector water from underground warm springs flowed into culverts and ditches and, upon freezing, formed solid mounds of ice across the road. Near Kluane Lake a glacier

[66] (1) Ltr, Paules to CofEngrs, 30 Nov 42. (2) Ltr, Welling to CofEngrs, 30 Nov 42. (3) Ltr, MacDonald to CofEngrs, 15 Dec 42.

blocked a half-mile stretch of road. After attempts to dynamite an opening failed, the obstacle had to be completely detoured. At subzero temperatures diesel fuel solidified and gasoline lines froze. It was frequently impossible to start an engine without first warming it with a torch, and drivers kept their engines running whenever they stopped to eat or sleep. At one time, 1,600 trucks were deadlined. With the aid of repair shops, way stations, and camps along the road, some traffic kept going even under the worst conditions. Work began during the winter on the Haines cutoff, running 150 miles from the coastal village of Haines, about 15 miles from Skagway, to Champagne on the Alcan Highway west of Whitehorse, in order to provide another point of access to the highway. In January the first engineer units to leave, the 18th and 93d Engineers, moved out. In February, the 35th, 95th, and 97th Engineers and the 73d Light Ponton Company departed. The 340th and 341st Regiments and the 74th Light Ponton Battalion were scheduled to remain on the road for several months longer.[67]

As spring approached, Public Roads prepared to build the permanent highway without the aid of engineer troops. Since the road, at least until the end of the war, would serve primarily as a military supply line, General Reybold on 25 March discussed with officials of the Federal Works Agency the possibility of lowering, at least temporarily, PRA's standards for the permanent highway. It was agreed that Colonel Ludson D. Worsham, slated to replace Wyman as Northwest Division engineer on 1 April, should for the time being determine the location and standards of design for the highway. On 2 April Colonel Worsham arrived at Edmonton and within a week had formulated drastic revisions in construction policies. By eliminating unnecessary refinements, he planned to complete rapidly a highway that would meet all military requirements. He directed PRA to follow the pioneer road unless deviations would involve less work. The width of the highway was to be reduced from thirty-six to twenty-six feet, shoulder to shoulder, with a 20- to 22-foot-wide lane for traffic, surfaced with local materials. The maximum grade would be 10 percent. Aside from thirty-four steel bridges already on order, Worsham directed that no other bridges be replaced except those which were unsafe or would not survive the breakup of the ice during the next few months.[68]

During the spring, maintenance of the road and bridges was the most important of the tasks assigned the engineers. After the thaws began, the winter trail west of the White River disappeared entirely. Many temporary trestles and portions of pioneer road were destroyed by rains and floods and repeatedly had to be repaired. Expecting such troubles, contractors had stockpiled replacement timbers at bridge sites and were able to make repairs with minimum loss of time. Despite unfavorable conditions, the

[67] (1) OCE GO No. 42, 14 Nov 42. (2) Ltr, Capt Byron C. Hyde, QMC, to Lt Col Soderston, NWSC, 19 Dec 42. NWSC 333 Insp and Investigations. (3) Memo, Wyman for Robins, 1 Feb 43. Canol Files. (4) Alaska Hwy, p. 241.

[68] (1) Ltr, Reybold to Maj Gen Philip B. Fleming, FWA, 25 Mar 43. (2) Ltr, Worsham to PRA Dist Engr Edmonton, 7 Apr 43. NWSC 1943–44 Dec File 611 (Alcan Hwy) 1944.

Alcan Highway was serviceable as a military road during the winter and spring.[69]

Canol

The second extensive Engineer project in northwest Canada was Canol. It was undertaken to supply fuel to vehicles on the Alcan Highway and to planes using the Northwest Staging Route and at the same time make available to Alaska supplies of gasoline which would not be at the mercy of enemy sea attacks or naval blockade. There was but one known source of oil in the northern part of the continent—the oil field on the Mackenzie River at Norman Wells, just below the Arctic Circle. The Imperial Oil Company, a Canadian subsidiary of the Standard Oil Company of New Jersey, had drilled the first producing well there in 1920. By 1940 three wells, operating during the summer months, yielded 800 barrels of crude oil a day. All of this went to nearby mines. The War Department had given some attention to Norman Wells during the period of the defense build-up. The desirability of developing the field had been pointed out on several occasions by the well-known Arctic explorer, Dr. Vilhjalmur Stefansson, serving as a special consultant to the War and Navy Departments on cold weather and other Arctic problems. In a conference with representatives of the War Plans Division on 8 August 1940, he had called attention to the oil field as a source of supply for Alaska. Again in January 1941, Dr. Stefansson, in reply to an inquiry from General Marshall regarding construction of a road to Alaska, pointed out the desirability of developing Norman Wells for national defense. No action was taken, as the War Department saw no need at that time to build the road or develop an oil field in such a remote and almost inaccessible region. Even after the outbreak of war, the War Plans Division paid little attention to Norman Wells. The Canadian Government considered using the field to supply oil to planes flying the Northwest Staging Route, but gave up the project because there were no refineries in the area to produce 100-octane gasoline.[70]

Canol Approved

The need for oil appeared more crucial early in 1942 as the exposed position of Alaska became increasingly apparent. The matter became particularly critical after the decision was made to build the Alcan Highway. General Somervell, then G–4, was responsible for supplying not only Alaska but also military installations along the Highway. He directed his special assistant on transportation, Col. James H. Graham, to study the problem. Many in the War Department now suggested making use of Norman Wells. Among them was Brig. Gen. Walter B. Pyron, formerly vice president of the Gulf Oil Company and

[69] (1) PRA Monthly Rpt of Constr Activities of PRA Alaska Highway Proj, Apr 43. NWSC 1943–44 Dec File 600–914 (Alcan) No. 1–99. (2) PRA Monthly Rpt for May 1943.

[70] Unless otherwise indicated, documents cited in this section, except unit histories, are located in Canol Files, EHD. (1) Rpt on Canol Proj, prepared by a Cmte Representing Control Div ASF OCE and CG NWSC, 1 Jun 45, pp. 37–38. (2) Ltr, P. W. Lambright, Imperial Oil Ltd., to Robert W. Coghill, Bureau of the Budget, Exec Off of the President, 17 Apr 43.

at the time serving as a special assistant to Mr. Patterson. Some members of the War Plans Division now believed, as Stefansson had already suggested, that a winter road might be built from Norman Wells to Mayo Landing, on the Stewart River, a tributary of the Yukon, to make possible emergency shipments of oil by barge from there to Alaska. Somervell discussed the possibility of developing the oil resources at Norman Wells with Graham, with various members of the War Plans Division, and with General Marshall. President Roosevelt in a Cabinet meeting held on 2 April explained the need for developing oil resources near Alaska, emphasizing that military necessity fully justified exploring the possibilities of developing such resources. On 15 April Stefansson again expressed the view to Somervell that local resources should be exploited. During the rest of April, discussion of the merits of Norman Wells continued. Brig. Gen. A. H. Carter, chief of Somervell's Fiscal Division, held a conference on 29 April at which representatives of the War Department and officials of Standard and Imperial were present and the various problems were considered. The conferees agreed that the project was feasible but that it would be a most difficult undertaking. No Engineer officers had so far participated in the planning and none were present at the conference.[71]

After the meeting, Graham wrote a memorandum for Somervell in which he recommended that the Chief of Engineers be charged with undertaking the development of Norman Wells. The Engineers, he said, should arrange with Imperial Oil to drill at least nine new wells to boost production to 3,000 barrels of crude a day by September 1942. To make possible such an expansion, the Engineers should have in operation a system of transportation on the Mackenzie and its tributaries from the railhead at Waterways in Alberta to Norman Wells by 15 June. They should build a 500-mile-long pipeline from Norman Wells to Whitehorse in the Yukon Territory by 15 September and erect a refining plant at Whitehorse capable of taking 3,000 barrels of crude a day. This plant should be in operation by 1 October. Somervell approved this memorandum at once. The next morning, General Reybold received "a preliminary directive" containing the Graham recommendations with instructions to carry them out. Canol, as the project was soon to be called, was thus authorized with a minimum of delay. That afternoon, representatives of the two oil companies arrived at the Office of the Chief of Engineers to confer with Maj. Gen. Thomas M. Robins, head of the Construction Division. Robins thought that if oil was to be gotten to Whitehorse it would be simpler and much cheaper to send it by barge from Seattle to Skagway and then by rail. But as he later told a Senate Committee, ". . . we had a job to do and . . . we were going to do it." [72]

[71] (1)Rpt on Canol Proj, pp. 38–40, 43–46. (2) Memo, Pyron for Brig Gen Lucius D. Clay, 25 Apr 42. (3) *Investigation of the National Defense Program, Hearings* Before a Spec Cmte Investigating the National Defense Program, U.S. Senate, 78 Cong, 1st sess, pt. 22, "The Canol Project," pp. 9480–81, 9843.

[72] (1) Memo, Graham for Somervell, 29 Apr 42. (2) Memo, Somervell for Reybold, 30 Apr 42. (3)

Work Begins

On 5 May Colonel Wyman was placed in charge of Canol, and was directly responsible to General Reybold. Construction was to be by contractors under cost-plus-a-fixed-fee contracts. No time was lost in making the contracts. In May, OCE made one with Imperial Oil, whereby the company agreed to drill at least nine new wells, operate them, and construct additional storage tanks at the oil field. The production goal was to be 3,000 barrels a day. The War Department agreed to reimburse Imperial for this expansion program. The fixed fee was one dollar. Title to all wells drilled would remain with Imperial. For architect-engineer services, the Engineers made contracts with the firm of Sverdrup and Parcel and with J. Gordon Turnbull, a consulting engineer of Cleveland, Ohio, who had had extensive experience in designing industrial plants. These firms were to make plans for a crude oil pipeline, together with pumping stations, from Norman Wells to Whitehorse, capable of delivering 3,000 barrels a day, and for a refinery at Whitehorse, capable of producing 100-octane gasoline. It was planned to purchase an existing refinery in the United States, dismantle it, and ship it to Whitehorse. Wyman opened negotiations with the W. E. Callahan Construction Company of Dallas, Texas, and the H. C. Price Company of Bartlesville, Oklahoma, the latter recommended by Standard Oil as an experienced pipeline constructor. On the recommendation of the Price Company, the W. A. Bechtel Company of San Francisco was also brought into the negotiations. Various combinations of these and of a number of other firms were considered, but final negotiations centered on a combination of Bechtel, Price, and Callahan. In May, a cost-plus-a-fixed-fee contract was signed, according to which the coadventurers were to construct the crude oil pipeline and refinery "in the shortest reasonable time." All work was to be completed by 31 December 1942. Secretary Stimson recommended that Standard Oil of California act as consultant and operate the pipeline and refinery after they were finished, and on 28 May, Standard accepted. Meanwhile, since the work would have to be done largely on Canadian soil, permission of the Canadian Government was necessary. On 16 May, Canada gave informal approval.[73]

When the Canol project was first discussed, officials of Imperial Oil had warned of the difficulties. It would be impossible to boost production to 3,000 barrels a day unless adequate amounts of supplies and equipment were brought in at an early date. This would require a long journey northward from Edmonton—300 miles by rickety railroad to Waterways and then from the adjacent town of Fort McMurray, 1,170 miles by steamer down the Athabaska, Slave, and Mackenzie Rivers. A continuous voyage from Fort McMurray was impossible

Rpt on Canol Proj, p. 46. (4) *Investigation of the National Defense Program,* pp. 9481, 9845.

[73] (1) Rpt on Canol Proj, pp. 53–58. (2) Ltr, Sturdevant to Wyman, 5 May 42. (3) WD OCE, Contracts and Claims Br, Letter Contract No. W-412-eng-52 with Imperial Oil Ltd., 1 May 42. (4) Ltr, Reybold to SOS, 22 May 42. (5) Ltr, WD to Standard Oil Co of Calif., 25 May 42. NWSC 311.5 (NWD). (6) Telg, Moffat, American Minister to Canada, to Hull, 18 May 42.

because of a series of rapids on the Slave River between Fort Fitzgerald and Fort Smith. Supplies and machinery would have to be unloaded at Fort Fitzgerald, transported 16 miles over dirt roads, and then reloaded on other steamers at Fort Smith. The river boats, dating from the pre-World War I period and the 1920's, and serving mainly prospectors and trappers during the four and one-half months of the late spring and summer, were incapable of moving thousands of men and tons of supplies and equipment during a single season. To expedite the flow of men and materials, the War Department planned to activate a special task force made up of engineer units proficient in stevedoring and in operating barges and pontons and send it to northern Canada. As soon as the transportation system had been sufficiently improved, civilians would replace the troops.[74]

On 28 May Colonel Wyman, together with a small party of civilians from the division office in San Francisco, arrived at Edmonton, where he set up his headquarters. At the same time, the contractors opened their offices in that city. Five days later, Wyman organized an advance headquarters at Fort McMurray. Soon after his arrival, he got an idea of the magnitude of his task. Camps would be needed for troops and civilians; storage areas and depots, for supplies and equipment. Boats would have to be imported from the United States and large numbers of barges and rafts built or improvised to move the supplies and equipment. Docks would have to be constructed at Waterways, Fort Fitzgerald, and at other points on the rivers so that the great tonnages about to arrive could be forwarded expeditiously. Construction of landing strips would be necessary so that some men and supplies could be moved by air. Eventually winter roads would have to be pushed through so that supplies could be shipped northward after the rivers froze over early in October.

On 26 May, the War Department activated Task Force 2600 and placed it under Wyman's command. It included the 388th Engineer Battalion (separate) and the 89th and 90th Engineer Heavy Ponton Battalions, together with signal, quartermaster, finance, and medical units —2,500 men in all. Their job was to improve transportation from Waterways to Norman Wells. The troops and seventy civilians from the Kansas City District Office reached Waterways during the first two weeks in June. It was cold and rainy and the frost was not completely out of the ground. The men lived in pup tents in Camp Prairie, as their bivouac was called. The first jobs of the 388th engineers and the civilians were to build more adequate living quarters, unload the great quantities of equipment already arriving from Edmonton, and cut and stack firewood for the two somewhat dilapidated steamers tied up at Waterways. The ponton engineers lashed their boats together to make rafts and floating docks. To get materials and supplies to Norman Wells would require using the two steamers and as many pontons, rafts, barges, and other

[74] (1) Ltr, R. V. LeSueur, Imperial Oil Ltd, to Gen Carter, 2 May 42. (2) River and Lake Navigation Through Northern Alberta and the Northwest Territories to the Arctic Ocean, Incl with Memo, WD, SOS OCE Tr Div Intel Br for Opns and Tng Br, 9 Jul 42. (3) Ltr, Sturdevant to Wyman, 5 May 42.

kinds of craft as could be procured or improvised.[75]

The pontoniers lost no time in loading supplies and equipment on their improvised rafts. On 6 June a crew from the 89th, with Indian guides, started down the Athabaska with the first raft, which was so heavily loaded that its deck was only six inches above water. The trip down the river was successful, but while crossing Lake Athabaska, the craft ran into a windstorm, was swamped by the 3-foot-high waves, and sank. The engineers had no better luck with a second raft, which went down near the first, but a third one managed to get across the lake. It proceeded up the Slave River to Fort Fitzgerald, where supplies and machinery were unloaded and transported over the portage roads. By 15 June, as the ice was breaking up on Great Slave Lake and the Mackenzie, the engineers had a base at Fort Smith, sufficiently far along to make operations to Norman Wells practicable. Great quantities of equipment were pouring into Waterways. Thirty to seventy-five carloads were arriving daily and were being unloaded by troops working around the clock. "The time limit imposed by the directive for the Canol project," Sturdevant wrote to Somervell on 25 June, "has necessitated an extravagant amount of equipment for the actual work to be accomplished." [76]

[75] (1) Ltr, Wyman to CofEngrs, 30 Jun 42. (2) Memo, Lt Col Joseph S. Gorlinski, Tr Div OCE, for Sturdevant, 22 May 42. (3) Ltr, S–3, 388th Engr GS Regt, to CG NWSC, 6 May 43. (4) *History of Eighty-Ninth Engineer Heavy Ponton Battalion* (Gainesville, Texas), p. 11. ENBN 89–0. (5) Hist of the 90th Engr Heavy Ponton Bn. (6) Memo, Sturdevant for John Hickerson, Dept of State, 15 May 42.

[76] (1) *History of Eighty-Ninth Engineer Heavy Ponton Battalion,* pp. 11–12. (2) Ltr, Wyman to CofEngrs, 30 Jun 42. (3) Ltr, Sturdevant to Somervell, 25 Jun 42.

Changes in Plans

Doubts as to the advisability of undertaking Canol continued to be expressed on all sides. Both Imperial and Standard had been dubious about the project from the start. On 2 May, R. V. LeSueur, vice president of Imperial, had written to General Carter that the production of 3,000 barrels of crude a day was optimistic in the extreme. On 4 June, J. L. Hanna of Standard wrote to Secretary Stimson, expressing his views regarding the impractical nature of the undertaking—it would probably take at least nine months to get Canol into operation. Various agencies of the government were also opposed. On 29 May Secretary Ickes wrote to President Roosevelt, stating that by mere chance he had heard of Canol and that he considered the project impractical. If there was some danger in the first months of 1942 that communications with Alaska might be cut, the danger seemed much greater after the Japanese attack on Dutch Harbor on 3 June and the landings several days later on Attu and Kiska. All doubts were swept aside. Roosevelt remained strongly in favor of Canol. Replying to Ickes on 10 June, he stated that he recognized the project was not commercially feasible, which seemed to be the implied objection of many. "The recent attack on Dutch Harbor," the President wrote, "discloses the possibility of great military need for this additional source of supply. . . . We are daily taking greater chances and, in

view of the military needs of Alaska, the project has my full approval." Still, by mid-June, it had become fully apparent that Canol could not be finished by the end of the year. A more expeditious and yet fairly dependable method of getting oil to the northwestern part of the continent would have to be found.[77]

Many had advocated shipping gasoline by barge from Seattle or Prince Rupert to Skagway and transporting it from there by rail to Whitehorse. The Engineers had suggested this alternative when Canol was first discussed. On 25 June Sturdevant wrote Somervell that the most optimistic date for starting production of 100 octane gasoline at Whitehorse was 1 January 1943. By the following July 65,000 barrels could be produced. One tanker could carry twice that much. That same day Somervell authorized the organization of an oil barge line to operate from Prince Rupert to Skagway, the laying of a pipeline from Skagway to Whitehorse, and the erection of storage tanks at Whitehorse. Construction of the pipeline would mean diverting some workmen and about 110 miles of pipe from the original Canol project. Completion of the refinery and of the crude oil line from Norman Wells to Whitehorse, called for under the original directive for Canol, would have to be postponed from October 1942 to December 1943. On 27 June the Canadian Government gave informal consent to the new project, soon referred to as Canol 2. It would not provide a local source of gasoline, but it could be put into operation much sooner than Canol 1. Late in June, Reybold informed Wyman that the completion of the original Canol project in 1942 was not desired; the remainder of the year should be spent in drilling at Norman Wells to determine if enough crude could be produced to warrant putting in the refinery and the pipeline.[78]

Progress During the Summer

Great quantities of supplies continued to pour into Waterways, and were forwarded by steamer and raft. By the end of June, 5,450 tons had been shipped out. Having gotten their preliminary jobs out of the way, the civilians from the Kansas City District office began to build Missouri River-type barges and to assemble trailers to transport barges and rafts over the portage roads. By early July they had completed twelve of the barges. With the arrival of men and equipment at the oil field, the drilling of additional wells began the first week of July. The first well was in production on the 18th, and four others were being drilled. The outlook was optimistic that the goal of 3,000 barrels a day could be reached. OCE meanwhile procured 550 miles of 4-inch pipe for the crude-oil line from Norman Wells to Whitehorse. That month the first aerial reconnaissance of the route was made. To get enough well-drilling equipment and pipe to Norman Wells

[77] (1)Memo for Rcd, Dept of State, 16 May 42. (2) Ltr, Eugene Holman, Standard Oil Co of N.J., to Stefansson, 18 May 42. (3) Ltr, Hanna to Stimson, 4 Jun 42. (4) Rpt on Canol Proj, p. 61. (5) Ltr, Ickes to Roosevelt, 29 May 42. (6) Ltr, Roosevelt to Ickes, 10 Jun 42.

[78] (1) Ltr, Sturdevant to Somervell, 25 Jun 42. (2) Ltr, Moffat to the Canadian Secy of State for External Affairs, 14 Aug 42.

was a most arduous task. Since the rivers would be frozen over within a few months, Wyman had to begin at an early date to develop other means of supply. He arranged with the Air Transport Command and a Canadian airline to operate a modest aerial transport system from Waterways to Norman Wells, to be fully operational by autumn. To facilitate air transport, he planned in late summer to construct fourteen landing strips from Waterways to Norman Wells. Meantime, Canol 2 was not neglected. Laying of the pipeline from Skagway to Whitehorse began on 17 August.[79]

Transportation remained the main bottleneck. By far the greatest problems were encountered in connection with getting materials and equipment to Norman Wells. In many places the channels of the meandering rivers were shallow and obstructed by shifting sandbars. No charts were available, and Indian guides often had to be used to pilot the engineer craft. The lakes were especially hazardous. In stormy weather Lake Athabaska was dangerous even for the river steamers which regularly made the run from Waterways to Fort Fitzgerald. Sometimes the ships had to wait for days near the entrance of the lake until calm weather set in. Great Slave Lake was just as treacherous. "The lake is difficult to navigate," Wyman wrote to Sturdevant on 3 August, "and during high winds the turbulence approximates ocean conditions, except that the waves are very choppy in character. . . . The approach to the Mackenzie River is very dangerous due to submerged rocks." After the debacles resulting from the first attempts with rafts, the pontons were decked with canvas and boards; later, all rafts were provided with wave breakers. Nevertheless, during the summer of 1942 a number of rafts were swamped by waves or badly damaged by rocks or snags. Several more piled up on sandbars. Only heavy barges of from 200- to 300-tons capacity proved suitable for crossing Great Slave Lake and making the trip down the Mackenzie to Norman Wells.[80]

Canol Is Expanded

On 17 and 18 August, Somervell and Reybold made an inspection of the Alcan Highway and the Canol project. Wyman informed them that Imperial Oil now freely predicted that 3,000 barrels a day would be attained. On the 18th, Somervell, in a conference with Wyman and representatives of the contractors at Edmonton, directed that work on Canol be expanded. The pipeline for Canol 2 was to be finished at the earliest practicable date. Canol 1 was to be continued as planned. During the coming winter Task Force 2600, which had been scheduled to return to the United States, was to remain and help the contractors transport equipment and materials to Norman Wells. A suitable refinery was to be found in the United States, dismantled, and shipped to Whitehorse. A plan for distributing gasoline from

[79] (1) Ltr, Wyman to CofEngrs, 30 Jun 42. (2) Memos, Pyron for Somervell, 7, 23 Jul 42. (3) Telg, Wyman to CofEngrs, 25 Aug 42.

[80] (1) Ltr, Wyman to CofEngrs, 31 Jul 42. (2) Ltr, Wyman to Sturdevant, 3 Aug 42, quoted in Rpt on Canol Proj, p. 70. (3) Ltr, CO Hq Base Zone Canol Proj to Wyman, 10 Oct 42.

Whitehorse to Fairbanks, Nome, and Anchorage was to be devised. Formally directed by Sturdevant on 28 August to carry out these decisions, Wyman consulted his architect-engineers and several days later recommended laying a pipeline along the Alcan Highway from Whitehorse to Fairbanks and thence westward to Tanana. From here barges could carry petroleum products down the Yukon to the Bering Sea. To carry gasoline east of Whitehorse, he proposed putting in a pipeline to Watson Lake, which could transport 800 barrels of gasoline a day to various points along the Alcan Highway.[81]

On 4 September the Transportation Corps sent a report to Somervell concerning the possible use of Alaska as a springboard for an attack on Japan. If such a strategy were adopted, large supplies of oil would be needed, and the continuing scarcity of shipping indicated the necessity for developing resources in or near Alaska. If Norman Wells could produce 20,000 barrels of crude a day, Alaska could be made well-nigh self-sufficient with regard to gasoline. Somervell forwarded this report to General O'Connor, who passed it on to Wyman. On 15 September, Wyman recommended to O'Connor that a wildcat drilling program be undertaken north and south of Norman Wells. Imperial could do some of the drilling, but an additional firm would have to be brought in. On 25 September Wyman signed a contract with the Noble Drilling Corporation of Tulsa, Oklahoma, which called for drilling 100 wildcat wells; Noble was to begin work with the arrival of its equipment at the oil field in mid-November. Although the Transportation Corps report also emphasized the need for more pipelines, Wyman's major emphasis during the fall was on increasing production at Norman Wells, in order to make sure that there was sufficient oil to warrant going ahead with the rest of Canol. Ground reconnaissances of the route for the crude oil pipeline were started. The first party to begin a survey of the route, led by an American surveyor, Kent Fuller, left Whitehorse in September and headed northeast for Sheldon Lake, the midway point. In November a party headed by a Canadian set out from Norman Wells in a southwesterly direction.[82]

In September construction began on the first of the fourteen landing strips between Waterways and Norman Wells. Air transport alone, however, could not bring in the tonnages needed; most freight would have to be moved overland. Wyman began work on a system of winter roads, which could be cleared and smoothed quickly by bulldozers. Without roadbed or surfacing, they could support traffic as long as ground remained frozen but would break up in the spring thaws. Because the routes crossed swamps, construction could not be undertaken until freezing weather set in. Employees of Bechtel, Price, and Callahan and such troops as were available were to bulldoze the main road from the railhead at Peace River north-

[81] (1) Memo for Rcd, Somervell, 18 Aug 42. NWSC 337 Canol. (2) Ltr, Sturdevant to Canol Proj, 28 Aug 42. (3) Ltr, Wyman to CofEngrs, 31 Aug 42.

[82] (1) Rpt on Canol Proj, pp. 76–77. (2) Ltr, Wyman to CofEngrs, 26 Sep 42. (3) Ltr, Robins to Hickerson, 11 Dec 42. (4) Ltr, Sturdevant to Hickerson, 13 Aug 42.

ward to Norman Wells—a distance of 1,000 miles. One company of the separate 388th Battalion and one company of the 90th Heavy Ponton Battalion began working out of Peace River on 23 October. The 35th Engineers, after finishing their part of the Alcan Highway in October, started work on a winter road leading northward from Fort Nelson to Fort Simpson, a distance of 248 miles. When completed, this road would connect the Alcan Highway with the road being bulldozed from Peace River. Drilling at Norman Wells was by now so successful that 3,000 barrels a day was assured, and 20,000 barrels a day seemed possible. On 19 October a directive was issued to the architect engineer to dismantle a refinery at Corpus Christi, Texas, and ship it to Skagway. Work on the pipeline from Whitehorse to Watson Lake—Canol 3—began in October.[83]

In view of the unfavorable war situation in the fall of 1942, Somervell believed that the full development of Canol as planned was justified. Allied fortunes seemed to have reached a low point. In the Pacific, the battle for Guadalcanal was raging indecisively. By November it appeared that the Germans might capture the Caucasian oil fields. Should the USSR seem to be on the verge of collapse, Japan might move into Siberia, and Alaska would then be of even greater strategic importance. Early in November Somervell reviewed the entire Canol project; on the 16th he issued his "final directive." Drilling was to be continued at Norman Wells until 20,000 barrels a day were produced, and a pipeline capable of carrying 3,000 barrels a day, together with a road, was to be built from Norman Wells to Whitehorse. The pipelines from Skagway to Whitehorse—Canol 2—from Whitehorse to Watson Lake—Canol 3—and from Whitehorse to Fairbanks—Canol 4—were to be completed, and the refinery was to be erected at Whitehorse. The landing strips were to be put in between Waterways and Norman Wells. All construction was to be finished by 1 December 1943.[84]

Progress During Winter and Spring

During the winter work was pushed on all the projects except Canol 4, which was to be started in the spring. Canol 2 was perhaps the easiest job. One hundred and ten miles of pipeline were laid alongside the railroad tracks. The final weld was made in December, and by the end of January the line was carrying gasoline. Work continued on Canol 3, but slowly. Additional wells were being drilled at the oil field, despite the freezing weather. The refinery at Corpus Christi was dismantled, packed, and shipped on 275 freight cars to Edmonton. Most of the parts were sent on by way of Prince Rupert and Skagway. Those too bulky for the 11-foot tunnels of the White Pass and Yukon Railroad were trucked over the Alcan Highway from

[83] (1) Ltr, Sturdevant to Hickerson, 26 Sep 42. (2) Force Comdr, Task Force 2600, Opns Order No. 8, 25 Sep 42. (3) Ltr, Wyman to CofEngrs, 30 Sep 42. (4) Memo, Wyman for CofEngrs, 9 Oct 42. (5) Ltr, S–3 388th Engr GS Regt to CG NWSC, 6 May 43. (6) Memo, Maj J. M. Wild, OCE Constr Div, to ExecO Constr Div, 3 Nov 42.

[84] (1) Rpt on Canol Proj, pp. 78–80. (2) Ltr, Somervell to CofEngrs, 16 Nov 42.

Dawson Creek. The winter roads showed rapid progress. By the beginning of January, the 388th and 90th engineers had bulldozed 374 miles from Peace River to Alexandra Falls, and by the end of February, the contractors' men had completed the road to Norman Wells. Additional roads were bulldozed across the Arctic expanses. Company B of the 388th completed one 200 miles long from Fort Smith westward to the Hay River. The reconnaissance parties meanwhile continued their exploration of the route for the crude oil pipeline. In December the party that had set out from Norman Wells finished its survey of the eastern half of the route; the one which had set out from Whitehorse reached Sheldon Lake on 28 February. The route finally selected was 577 miles long, running southwestward, usually along the valleys of streams, from Norman Wells across the Mackenzie Mountains to Johnson's Crossing on the Alcan Highway, 80 miles east of Whitehorse. The maximum elevation was 5,000 feet. In January 1943, elements of the 35th Engineers at Johnson's Crossing began the difficult job of building the road to Sheldon Lake, which would parallel the pipeline, and had to be put in first so that trucks could haul pipe to the welding crews. Employees of Bechtel, Price, and Callahan began work on the other half of the road from Norman Wells. Work also moved ahead on the airfields. Troops and civilians had finished eleven by the end of January.[85]

Despite all efforts to improve transportation to Norman Wells, sufficient materials could not be shipped in to expand crude production as scheduled. Planes could do no more than bring in supplies of food, clothing, fuel, and other necessities to the men stationed at the northern posts during the winter months. To keep trucks going on the rough roads during the bitter cold proved to be an almost impossible task. "The winter roads," the engineers reported, "were nightmares both to the men who built them and to those who operated vehicles over them." Nevertheless, about 8,000 tons of supplies were trucked from Peace River as far as the Mackenzie and stored to be sent down the river when the ice broke up in the spring. Wyman planned to turn traffic on the rivers over to civilians during the coming year. On 2 February he signed a contract with Marine Operators, an association made up of the firms of C. W. Cunningham and Peter Kiewit of Omaha, Nebraska, and Paul Grafe, president of the W. E. Callahan Construction Company. The Marine Operators were to run barges and rafts on the rivers and operate docks and portage equipment between Waterways and Norman Wells.[86]

In the spring of 1943 work on Canol, carried on under Colonel Worsham's direction after Wyman's departure on 25 March, was accelerated. That same month Canol 4—the pipeline from Whitehorse to Fairbanks—was started.

[85] (1) Memo, Maj J. M. Wild, OCE, for WDGS, 5 Feb 43. (2) Northwest Div, Feb 44, Rpt, Winter Road Ops Grimshaw, Alberta, to Norman Wells, Northwest Territory, 1942–43. (3) Ltr, S–3 388th Engr GS Regt to CG NWSC, 6 May 43. (4) Ltr, Maj L. E. Laurion, Whitehorse Dist Engr, to Wyman, 15 Feb 43.

[86] (1) *History of Force 2600* (Gainesville, Texas), p. 65. ENBN–89–0. (2) Rpt on Canol Proj, pp. 59, 90.

Although the route paralleled the Alcan Highway, construction was not easy. There were 101 water crossings. Permanent highway bridges would carry the pipeline over the major rivers, but over the smaller ones the pipe had to be laid on stream bottoms or carried across on A-frames or cable suspension bridges. Often glaciers of ice covered the low temporary bridges, which in the spring were torn out by floods. When the thaws set in, the highway beyond the White River became an impassable quagmire. More rapid progress was made on the pipeline from Whitehorse to Watson Lake, and on 21 May, the line was completed. Sections of the refinery began to arrive at Whitehorse in the spring, and the job of reassembling it began on 19 April. But with the beginning of the spring thaws, work on the crude oil pipeline and the parallel access road came almost to a standstill and was not resumed until May. When the Arctic summer began, Canol was still far from finished. By this time, the tactical situation in the Aleutians had changed the thinking regarding the Pacific northwest. The Japanese were being driven out of the islands, and it appeared that the threat to Alaska would be eliminated.[87]

The Danger Passes

Attu and Shemya

The Joint Chiefs of Staff had begun to make definite plans in late 1942 to expel the Japanese from the Aleutians. Kiska was to be recaptured first. An Army-Navy planning staff was set up at San Diego, and during the winter the 7th Infantry Division began training at Fort Ord. The role of Alaska in the war came under close scrutiny at the Casablanca Conference in January 1943. Roosevelt and Churchill decided that efforts made in the North Pacific should be aimed not so much at driving the Japanese from the Aleutians as preventing them from expanding and consolidating their holdings. Rear Adm. Thomas C. Kinkaid, commander of the North Pacific area, was informed that the ships required for the planned attack on Kiska would not be forthcoming. Since Attu was believed to be less heavily defended, Kinkaid suggested that Kiska be bypassed and that available forces be used to capture Attu and occupy the nearby Semichi Islands. Such a stratagem would isolate Kiska and provide a fine site for an airfield on Shemya Island, 50 miles east of Attu and one of the Semichi group. On 22 March the Army and Navy ordered preparations begun for the capture of Attu. Elements of the 7th Division were to make the landing; the division's 13th Engineer Combat Battalion would support the infantry, while the 50th Engineer Combat Regiment would act as shore party. Lt. Col. James E. Green, commander of the 13th, was named Force Engineer.[88]

[87] (1) Rpt on Canol Proj, pp. 97–100. (2) Ltr, Worsham to Col Thomas F. Farrell, OCE, 21 Apr 43. (3) Ltr, Lambright, Imperial Oil Ltd, to Coghill, Exec Off of the President, 17 Apr 43.

[88] (1) Conn, Engelman, and Fairchild, *Guarding the United States and Its Outposts*, ch. XI. (2) Hist Sec Alaskan Dept, Official Hist, pp. 28ff. (3) Matloff and Snell, *Strategic Planning for Coalition Warfare*, pp. 370ff. (4) Ltr, Col Virgil L. Womeldorff, formerly CO 50th Engrs, to C EHD, 3 Feb 59. EHD Files.

When the task force left Cold Bay on 4 May, D-day was set for the 8th. Because of fog at the landing beaches, the assault was postponed till the 11th. On that day the troops came in at two places on eastern Attu: at Massacre Bay on the southern shore and near Holtz Bay on the northern. (*See Map 16.*) They were to move inland, meet at Holtz Bay pass, and then drive eastward against the enemy troops concentrated in the valleys and peninsulas. At Massacre Bay four companies of the 50th Engineers and three companies of the 13th went in with the infantry. At Holtz Bay, one company of the 50th landed with an infantry detachment. Both forces encountered no resistance at the time of the landings.[89]

During the next few days the troops advanced inland against stubborn enemy opposition. The engineers with the larger force at Massacre Bay had a hard time because of the difficult terrain. Inland from the beach, swamp and tundra extended for about a mile up Massacre Valley to a hogback ridge. Moving equipment across the tundra was impossible. The engineers decided to use the rocky bed of a creek as a road, and lines of heavily laden tracked vehicles were soon moving up this novel highway. The forward movement stopped abruptly at the ridge. Struggling for two days to get a bulldozer to the top of the tundra-covered slope, the men finally succeeded. They then turned the machine around and cut a trough down through the tundra in five minutes. A tractor with a winch was moved up and anchored on top of the ridge. Supplies were hauled up in toboggan sleds attached to a cable. Meantime, the infantry advanced up the valley, along both sides of the hogback toward Sarana Pass.

To improve supply, the engineers started to build a road along the top of the hogback. Here the bulldozers easily stripped the tundra, from one to two feet deep, exposing the rock or hardpan base. The road was pushed through all the way to Sarana Pass, which was reached on 24 May. By this time, the infantry had driven the Japanese out of the pass and forced them to retreat up Chichagof Valley.[90]

On 25 May three companies of the 50th Engineers and elements of the 13th set up their camps on a high point to the east of Sarana Pass, on the south side of Sarana Valley, a site that soon became known as Engineer Hill. Infantry, artillery, and service troops were encamped on both flanks. In order to get supplies into Chichagof Valley, the engineers began to build a switch-back road down the steep slope of the hill, a job that would take several days. A cableway would speed supplies forward even more expeditiously. To operate such a contrivance a tractor would have to be gotten down to the valley floor, attached to the cableway, and run back and forth. Additional tractors would be needed below to move supplies forward. The problem was to get a machine into the

[89] (1) Harold W. Richardson, "Engineers in the Battle of Attu," *Engineering News-Record,* CXXXI (December 30, 1943), 46–50. (2) 50th Engr Combat Bn, Unit Hist, Sep 42–Sep 45.

[90] (1) Richardson, "Engineers in the Battle of Attu," *Engineering News-Record,* CXXXI (December 30, 1943), 46–50. (2) Ltr, ExecO 13th Engr Combat Bn to Hq Task Group 16.11, APO 726, 15 Jun 43. 307 Engr (13) 0.3 (12414)M.

valley. The 1,000-foot slope of Engineer Hill, the most feasible route, was steep, rocky, and partly covered with tundra. Equipment could not descend under its own power. The engineers tumbled six tractors down, hoping that one or two would be in running condition after hitting the bottom. All six were. A cableway was rigged up and attached to one of the tractors. Run back and forth across the valley floor, the tractor lowered and raised the sleds attached to the cable. By the morning of the 29th, a road had been completed down the slope, replacing the cableway.[91]

By this time the enemy's position in Chichagof Valley was hopeless. Despite the heavy odds, the Japanese commander decided to counterattack. At 0300 on 29 May nearly a thousand screaming Japanese who had broken through American infantry lines stormed up Chichagof Valley and within two hours were at Engineer Hill. An attack at this point was wholly unexpected. Some men in the engineer camp were killed while asleep. Confusion and panic gripped many of the others as, partly dressed, they stumbled out of their tents. Company officers and noncommissioned officers hastily organized small groups to form makeshift defense lines. The men fought back as best they could. Some crouched behind tractors and piles of wooden cases, lobbing grenades into the darkness. Others, taking positions behind piles of earth and rock which they had excavated in the course of road construction, fired their carbines and rifles at the onrushing enemy. Some of the machine guns that the 13th engineers brought into play proved highly effective. The fighting continued during the morning but by noon the routed enemy troops were fleeing to the gorges on the far side of Sarana Valley. When wounded or cornered, many of the Japanese killed themselves with their own grenades. By nightfall the enemy had been practically wiped out. Over 250 Japanese bodies were found around Engineer Hill, many of them armed only with bayonets tied to sticks. The engineers had borne the brunt of the attack —29 had been killed and 47 wounded.[92]

The fierceness of the fighting on Attu is attested to by the fact that about 2,350 Japanese were killed but only 29 prisoners taken. Some 550 American lives were lost. The wounded numbered approximately 1,150. Disease and nonbattle injuries claimed another 2,100 men. Certain inadequacies in training and tactics made the fighting on Attu costlier than necessary for the engineers. Lt. Col. Virgil M. Womeldorff, commander of the 50th Engineers, reported that "realistic training in combat tactics, night patrolling, outpost duty and uses of terrain features would have saved many of the casualties encountered and

[91] Richardson, "Engineers in the Battle of Attu," *Engineering News-Record*, CXXXI (December 30, 1943), 46–50.

[92] (1) *The Capture of Attu As Told By The Men Who Fought There* (Washington, 1944), pp. 21–23, 118–19. (2) Hist Sec Alaskan Dept, Official Hist, pp. 71–73. (3) Ltr, Womeldorff to CG Task Group 16.11, 14 Jun 43, in Opns Rpt, 50 Engr Combat Bn, 11 May–2 Jun 43. (4) Hq 50th Engr Combat Regt, Unit Jnl, 11 May–2 Jun 43. Last two in ENBN–50–0.3 (16522)M. (5) Ltr, ExecO 13th Engr Combat Bn to Hq Task Group 16.11, APO 726, 15 Jun 43. 307 Engr (13) 0.3 (12414)M. (6) Maj Gen Eugene M. Landrum, Rpt of Opns on Attu, 25 Jun 43, p. 15. 91–TF4–0.3.

reduced firing at imaginary enemy movements." Training for combat had been neglected because so much time was spent in training for amphibious operations. Colonel Womeldorff also noted that information as to the disposition and movement of friendly troops and units was not available to the men at the outposts.[93]

Late in May, work on the base and airfield began. Colonel Womeldorff, put in charge of construction after the end of the fighting, had, besides the 50th and 13th engineers, Company A of the 807th Aviation Battalion and a detachment of the 349th General Service Regiment, both of which had reached Attu while the battle was raging. The aviation engineers began work on a field at Massacre Bay. They drained a lake and replaced the soft tundra with sand and gravel. Three tractors were sometimes needed to pull a scraper usually hauled by one machine. On 8 June, eleven days after work began on the runway, the first plane landed. By this time, substantial progress had been made in providing the Massacre Bay area with a network of roads, a dock, and other facilities. Meantime, work had begun on Shemya. Colonel Talley with a group of eighteen officers and men had made a preliminary reconnaissance on 28 May. Two days later a task force, including the 18th Combat Regiment, came in. Heavy seas slowed the disembarking of the troops and the unloading of equipment. But Shemya's narrow beaches were soon cluttered with troops and with amphibious tractors towing barges through the water and on to the beaches. By 3 June the engineers had begun work on a fighter strip, which they later lengthened for bombers.[94]

Kiska

Even before the recapture of Attu, DeWitt had asked Nimitz to join him in requesting the Joint Chiefs to approve an attack on Kiska. On 24 May the Joint Chiefs directed that planning start at once, and on 22 June they approved the assault. The target date was set for 15 August. Plans called for building an airfield and a base for 15,000 troops. Kiska appeared to be well fortified, and it was thought to have a garrison of at least 10,000 men. The main enemy forces were believed to be on the southeastern shore at Kiska Harbor and at Gertrude Cove, several miles to the south. The plan was to land on the opposite side of the island and attack these areas from the rear. A task force numbering 34,000, including 5,500 Canadians, would make the attack. The 2d Battalion of the 50th Engineers was to go in with the attacking troops for shore party work. Maj. Gen. Charles H. Corlett, the task force commander, reorganized his force in June for the assault. The basic unit was the battalion landing group. Each was divided into a forward combat team and a beach combat team. The forward team, one of whose components was a platoon of combat engineers, had the mission of

[93] (1) Hist Sec Alaskan Dept, Official Hist, p. 73. (2) Ltr, Womeldorff to CG Task Group 16.11, 14 Jun 43.

[94] (1) 50th Engr Combat Bn, Unit Hist, Sep 42–Sep 45. (2) Bush, Narrative Rpt of Alaska Constr, pp. 201–07. (3) Hist of the 807th Engr Avn Bn.

defeating the enemy's forces. Each beach combat team, with one company of combat engineers, was to unload ships, establish dumps, and move supplies inland. Both teams were organized and equipped to fight.[95]

On the evening of 12 August the task force left Adak, arriving off Kiska two nights later. Soon after midnight, in the light of a bright moon, the troops clambered into their landing craft, "grimly expectant" as they saw the "fog-obscured mass of Kiska for miles ahead. . . ." [96] The first landings were made without incident, and the men advanced over the rocky beaches "with nothing but mysterious silence as welcome." [97] Each combat team moved forward to attack the enemy as it had been directed to do. Defenses were considerably stronger than on Attu. Barbed wire and mines were encountered on most of the beaches. Further inland the men ran into pillboxes, radar installations, and searchlights. But none of the defenses were manned. "Each objective taken without contact of enemy caused the men to be even more tense," wrote the historian of the 50th Engineers, "for the fear of moving into a trap was common." [98] Fog, rain, and strong winds heightened the feeling of apprehension. No enemy troops were ever found. "The impossible had been accomplished," the historian of the 50th Engineers continued, "Japan had completely evacuated the island in spite of our constant naval blockade." At Gertrude Cove, where the Japanese had located some of their important installations, "five ravens as large as turkeys, scratching about in a pile of rotting food, proved to be the only living things there." [99]

Soon after the island was retaken, most of the 7th Division left for Hawaii. The battalion of the 50th Engineers, which had engaged in shore party work, remained behind. The men had plenty of work to do, even though the size of the base that had been planned for Kiska was reduced drastically and no air force units were to be stationed there. Some of the Japanese installations could be used. On a high ridge near the northern part of the island the enemy had partly finished a runway, the two ends of which sloped downward. Considerable cutting was required at the center and fill was needed at both ends. The engineers had only light equipment and had to haul dirt in push carts, but eventually they managed to even up the strip to the proper grade. They also improved the Japanese-built road between Gertrude Cove and Kiska Harbor. In many places it had to be entirely reconstructed. They blasted rock from the hillsides, and carried much of it by hand to the roadway because trucks were not to be had. "This was by no means a pleasant project, or one on which desired progress could be made," the 50th Engineers reported. Late in September, the 50th moved to Hawaii. The 223d and 521st Combat Companies, recently arrived on

[95] (1) 50th Engr Combat Bn, Unit Hist, Sep 42–Sep 45. (2) Hist Sec Alaska Dept, Official Hist, pp. 125–26.

[96] Hist Sec Alaska Dept, Official Hist, p. 134.

[97] *Ibid*, p. 135.

[98] 50th Engr Combat Bn Unit Hist, Sep 42–Sep 45.

[99] (1) *Ibid.* (2) WD, Bureau of Public Relations Press Br, Jap Mode of Living on Kiska Described by A.G.F. [Observer], for release 8 Oct 43. EHD Files.

the island, remained to construct base facilities.[100]

Engineer Reorganization

The expulsion of the Japanese ended the immediate danger to the Aleutians and Alaska. It was not likely that Japan would again try to seize any of the islands. But the North Pacific area was still important because it was near the Soviet Union. Whether the USSR might become an ally in an offensive against Japan was not known. In any case the military forces were kept strong and were reorganized to meet changing conditions.

The engineer organization was revamped. The anomalous situation of having two engineer organizations in the Alaskan Defense Command had worked well in practice. But, as General Nold wrote later, the War Department had not liked it and had objected to it "at intervals of about three months because it did not follow the diagrammatic pattern of relationships that applied to other theaters." [101] The first changes in the engineer setup had been made in the previous June. Colonel Talley's organization with its 250 officers, enlisted men, and civilians, together with the Utilities Engineer Section, was consolidated with Nold's office. Talley, as scheduled, then returned to the United States, and Nold henceforth had technical supervision over all engineer work in the Territory. The three units of his office were the Military Division, the Utilities Division, and the Construction Division. There was little change in the way the engineers carried on their work, apparently the only difference being that correspondence formerly exchanged between Nold and Talley over Buckner's signature was now forwarded in memorandum form among the three divisions. The duties of the Seattle District office remained as before. No new projects were in prospect for the mainland, but additional work was to be undertaken in the Aleutians. When, in November, the Alaska Defense Command became a separate theater of operations and was renamed the Alaskan Department, General Nold became the first department engineer.[102]

Work on airfields and bases in the Aleutians continued. On Kiska, the engineers labored on the docks, the runway, gasoline storage, and quarters for the troops. On Shemya, their main concern was coping with the extremely rough seas. During 1943 most supplies and equipment had to be brought ashore by barge and landing craft; a few could be flown in. In 1944, the engineers built a dock out to deep water, 1,400 feet from shore, and to protect it erected a 2,000-foot breakwater. A violent storm wrecked breakwater and dock. Landing mats, laid on the slopes of the breakwater to give added protection, were tossed about on the boiling seas. Fifty-foot sections of the dock were torn off their piles, some of which broke as the sections were wrenched loose. Tons of rock were thrown on the beach. The

[100] (1) 50th Engr Combat Bn, Unit Hist, Sep 42–Sep 45. (2) Bush, Narrative Rpt of Alaska Constr, pp. 210–11. (3) Nold, Hist of Of of Engr Alaskan Dept, Incl 3, p. 11.

[101] Ltr, Nold to C EHD, 7 Aug 57.

[102] Nold, Hist of Of of Engr Alaskan Dept, pp. 31ff. (2) Ltr, TAG to Buckner, 27 Oct 43. 400.312 (AD).

engineers subsequently built a cellular sheet metal dock, 60 feet wide, for a distance of 300 feet out into the water. They filled the outer end cell with concrete, the others with rock. The deck was 22 feet above mean low water—above the crest of all but the highest waves. This height made for cumbersome unloading, but the dock remained in place and the deck did not have to be cleared of equipment and supplies, except during the most violent storms. On Adak, the engineers did a considerable amount of construction. After the Japanese were cleared from the Aleutians, the Alaska Defense Command made preparations to build a supply base on Adak capable of equipping and maintaining an expeditionary force of 50,000 men. Work began in October 1943 and continued well into 1944.[103]

Alcan Highway

As soon as the danger to Alaska had passed, work on the Alcan Highway was no longer so critical. The last engineer troops left the road in July 1943. The Public Roads Administration continued construction. The contractors concentrated their efforts in the period between the end of June and the beginning of October. At the peak of operations, 81 contractors had on their payrolls 14,000 men, who were working on the highway from Dawson Creek to Big Delta. Using more construction equipment than ever before marshaled on a single job, the workers leveled and straightened the roadway and greatly improved its drainage. The summer rains played havoc with the bridges. The worst floods came between 9 and 12 July, shortly after the construction season was in full swing. In the Southern Sector twenty-four temporary bridges were washed out, including every structure within 160 miles west of Fort Nelson. Construction workers began at once to repair the damage and by 20 July had reopened the road to through traffic. The floods left no choice but to relocate certain stretches of the highway and to replace many temporary structures. Consequently, Brig. Gen. Ludson D. Worsham authorized the restoration of the earlier bridging program. It was too late, however, to procure all the prefabricated steel in time for construction that season. By the end of October, contractors had completed 99 major bridges with spans high above ice and flood waters and had 34 others under construction. Probably the most impressive was the 2,130-foot-long suspension bridge over the Peace River, which replaced the earlier timber trestles that had been washed out so many times. Before the war, it had taken the contractor eight months to construct an almost identical bridge in the Midwest. On 2 August, four months and one week after the first tower was started, this new high-level bridge was opened to traffic, and thus a major bottleneck at the southern end of the route was eliminated.[104]

[103] (1) Bush, Narrative Rpt of Alaska Constr, pp. 210–15. (2) Bodman, "Peculiarities of Aleutian Military Design," *Civil Engineering*, XV (September, 1945), 403. (3) Excerpt from Ltr, Hq ADC to CG WDC, 8 Sep 43. (4) Memo for Rcd, Hallnook, Tr Div OCE, 9 Oct 43. Last two in 600.1 (Alaska), Alaskan Defense 6.

[104] (1) Alaska Hwy, p. 241. (2) Hq NWSC and Northwest Div Engr, Alcan Hwy, Completion Rpt, 6 Apr 45. (3) PRA, Monthly Rpt of Constr Activi-

Canol

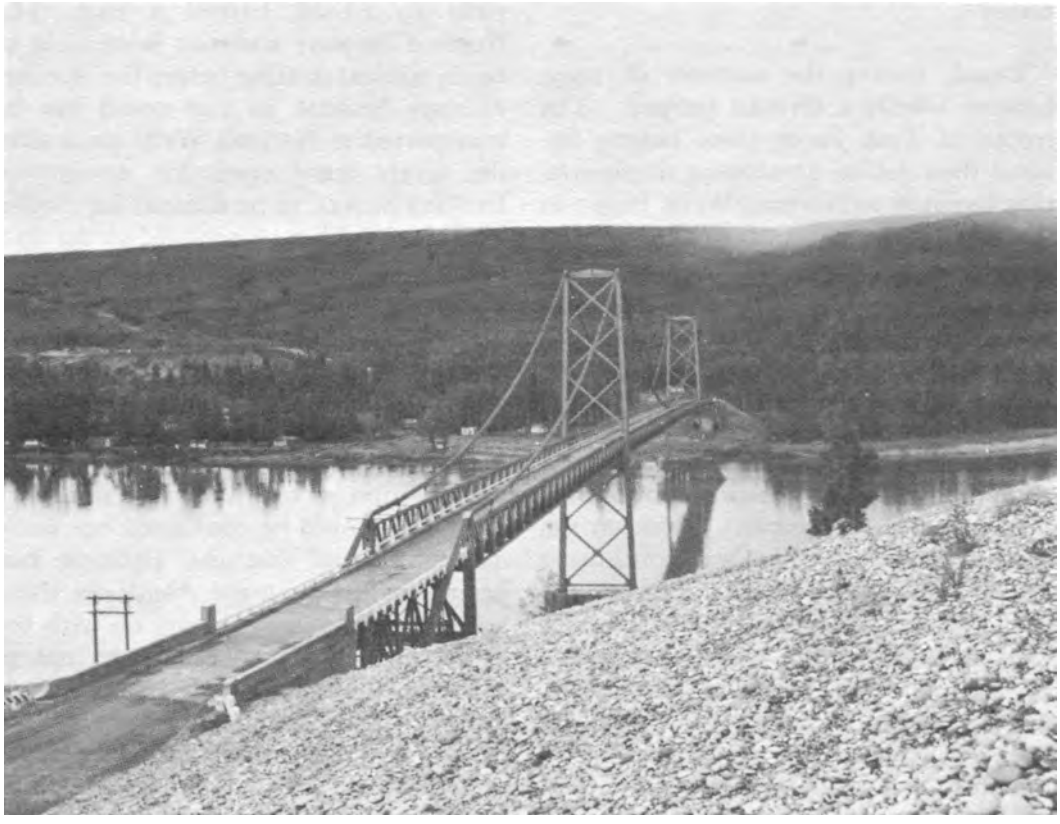
Canol, during the summer of 1943, became wholly a civilian project. The troops of Task Force 2600, having finished their job of developing transportation facilities to Norman Wells, began to leave in July. The 35th Engineers, who worked on the access road for the crude oil pipeline, were pulled out in July and August. By midsummer, gasoline was moving through the Canol 3 pipeline. Two hundred twenty-five miles of the 600 miles of pipe required for the Canol 4 line had been laid, and it was hoped gasoline would be flowing through it by the end of November. Work on the refinery at Whitehorse was continuing and was to be finished by the end of the year. Great difficulties were encountered in building the road and pipeline between Norman Wells and Whitehorse. At the western end, the 35th Engineers had completed about 160 miles of road and the contractors' employees had laid and welded about 106 miles of pipe. In the eastern half, about 50 miles of all-weather road had been completed and 10 miles of pipe welded. An immense amount of work still had to be done—367 miles of all-weather road had to be built and 461 miles of pipeline laid and welded.

Drilling by Imperial at Norman Wells seemed to bear out the most optimistic forecasts. By the end of August 23 wells were in production and the total potential yield was estimated at 4,159 barrels a day. It was now believed possible that wildcat drilling would raise the daily yield to 20,000 barrels a day. The Noble Company had not been able to begin wildcat drilling before the summer of 1943 because its rigs could not be transported to Norman Wells until after the rivers were open for navigation. Drilling proved to be difficult for Noble. The rigs could not be moved to the sites unless roads were first put in. Little progress could be made during the short summer season. Canol was still a sizable project; in October, the number of civilian employees reached a peak of 10,629.[105]

During the summer and fall of 1943 the question as to whether or not work on Canol should be continued was hotly debated. Now that the Japanese had been expelled from the Aleutians, there seemed little point in going on with the project. Various civilian government agencies were still sharply critical of Canol. The special committee of the Senate investigating the national defense program—usually called the Truman Committee—looked into Canol in the fall. A subcommittee held hearings at Whitehorse; the full committee, in Washington. Because the pipelines were already in operation from Skagway to Whitehorse and from Whitehorse to Watson Lake and part of the way to Fairbanks, the committee focused its attention on the as yet unfinished crude oil pipeline and the uncompleted refinery. It was soon apparent that the members of the committee were opposed to Canol. The War Department took the stand that work would have to go on. On 26

ties of PRA–Alcan Hwy Proj, Jul 43. (4) Bowman *et al., Bulldozers Come First,* pp. 142–43.

[105] (1) Rpt on Canol Proj, pp. 94–97, 138. (2) Bechtel, Price, and Callahan, Constr Schedule for the Canol Proj, 1 Aug 43. NWSC 1943–44 Dec File 611 Canol.



THE PEACE RIVER SUSPENSION BRIDGE

October, the Joint Chiefs declared that the completion and operation of the project were necessary for the war effort, and two months later, Secretary Stimson informed the Truman Committee of the War Department's intention to continue work. On 8 January 1944, the committee issued a highly critical report, charging among other things that Canol had been authorized after insufficient study and was continued contrary to the advice of government and industry. One of the criticisms was that a production goal of 20,000 barrels a day was the aim at Norman Wells when the crude oil pipeline would be able to carry only 3,000 barrels. The committee's attacks were directed entirely at the conception and scope of the project and not against the way it was executed. The committee agreed that the War Department should decide whether or not Canol should be completed.[106]

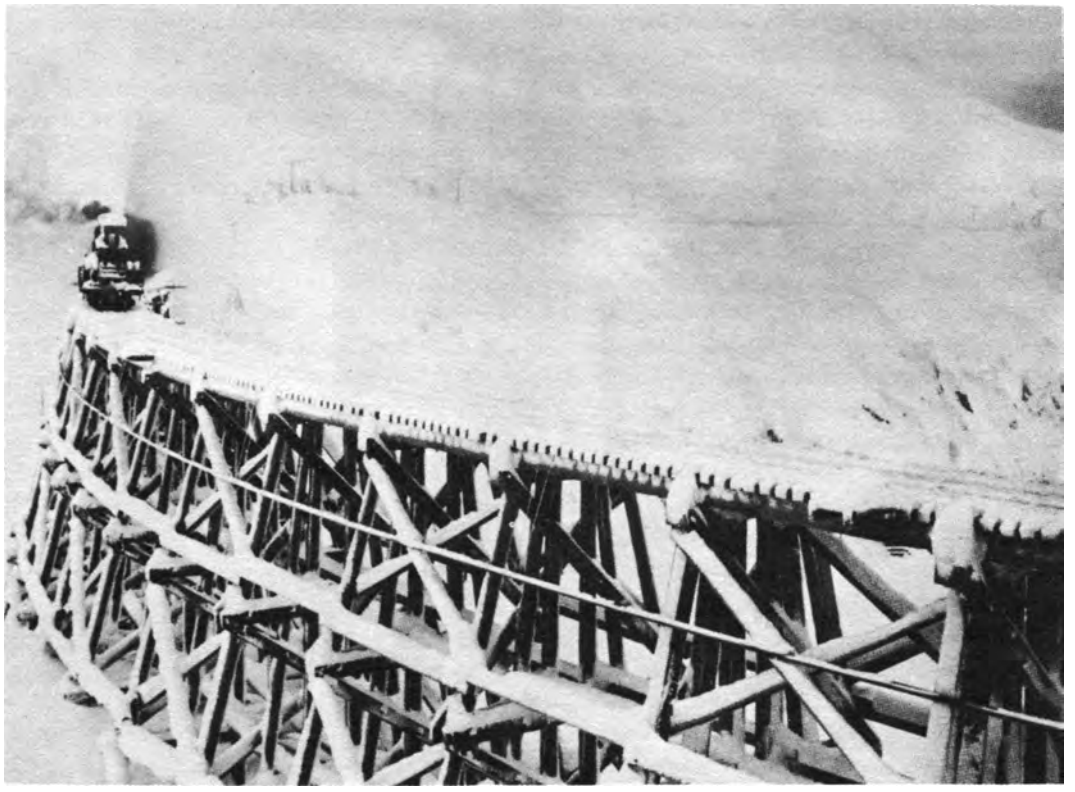
Work moved ahead. By November

[106] (1) Rpt on Canol Proj, pp. 123–25 and app. A. (2) *Investigation of the National Defense Program*, pp. 9287ff., 9337ff. (3) Ltr, USW Patterson to Senator Harry S. Truman, 24 Nov 43. (4) Ltr, Stimson to Truman, 23 Dec 43. *Investigation of the National Defense Program*, p. 9915.



REFINERY AT WHITEHORSE

1943, Imperial had twenty-nine wells in production. Noble found little oil. On 23 November the latter company was told to discontinue all drilling outside the proven field, and later its contract was terminated. The exploratory operations showed that the oil deposits were larger than originally assumed; reserves, once estimated at 2 million barrels, were now believed to range from 60 to 100 million. By the end of the year, the road from Norman Wells to Whitehorse was finished, together with some of the bridges over the many streams, including the 600-foot-wide Pelly River. Completion of the road enabled the contractors to speed up work on the pipeline, 470 miles of which had now been completed. Since tests indicated the oil would flow even at −75°F., the pipe could be laid directly on the ground. A telephone line was installed which connected Norman Wells with the pumping stations and Whitehorse and tied in with the line along the Alcan Highway. In mid-February 1944 the last two pipes were welded. Ten pumping stations were in place. On 16 April the first oil from Norman Wells reached Whitehorse. Two weeks later the re-



A PIPELINE CARRIED ON A WHITEHORSE AND YUKON RAILROAD TRESTLE

finery was completed and turned over to Standard Oil for operation. Thirty-nine wells were in production. The pipeline from Whitehorse to Fairbanks had been completed in the fall of 1943, and the first oil had reached Fairbanks the following February.[107]

It had taken two years to build Canol. Some 4,000 engineers and 10,000 civilians, at an estimated cost of $133,000,000, had developed the oil field at Norman Wells, laid 1,600 miles of pipeline, installed a refinery for processing crude oil, and greatly improved the transportation facilities in a subarctic region half the size of the United States. Canol provided a feasible means of supplying gasoline and oil to the Alcan Highway and the Northwest Staging Route. From April 1944 to April 1945, 1,102,000 barrels of crude oil were sent through the pipeline from Norman Wells to Whitehorse. The pipelines out of Whitehorse proved to be more economical to operate than other means of

[107] (1) Rpt on Canol Proj, pp. 119–22. (2) Ltr, Worsham to CofE, 2 Feb 44. (3) Ltr, Stimson to Truman, 23 Dec 43. (4) Bechtel, Price, and Callahan, Schedule of Progress, 31 Dec 43. (5) Ltr, C. C. Wilcox of J. Gordon Turnbull and Sverdrup and Parcel to Worsham, 31 Dec 43. NWSC 1943–44 Dec File, 823 Canol. (6) Memo, Somervell for the Spec Asst to SW, 4 Mar 44.

petroleum distribution in the areas in which they served. To ship a barrel of gasoline from Skagway to Whitehorse by rail cost $8.40; by Canol 2 pipeline, 23 cents. Nevertheless, Canol could supply the North Pacific theater with only a fraction of its gasoline requirements, and on 1 April 1945, operation of the crude oil pipeline and refinery was suspended.[108]

The Canol project, pushed through at the insistence of General Somervell, served little practical purpose. To many, Canol had seemed a visionary and expensive undertaking. But it was also true that the possibility of an attack on Alaska could not be ignored in early 1942. Many of those who supported Canol were of the opinion that if oil shipments from the United States had been cut off and a local source of oil that existed in the northwestern part of America had not been developed, the War Department might well have come under more severe criticism than it did for having built Canol.

The Engineers had made an extensive effort in Alaska and northwestern Canada. Their work was not altogether futile. Alcan remained as a permanent link between the United States and Alaska. Canol was abandoned, but a great deal had been learned about construction in the far north. And much of the engineer work in Alaska was of permanent value because of Alaska's important strategic position in the postwar world.

[108] Rpt on Canol Proj, pp. 136, 146, 150.

CHAPTER VIII

Hawaii After Pearl Harbor

The war had begun with an attack on the Hawaiian Islands. Thereafter, other areas of the Pacific had borne the brunt of the Japanese onslaughts. The Philippines, Australia, and even the Aleutians had been in the limelight. The possibility of a Japanese assault constantly remained, however, and a great deal of work was necessary to fortify the Hawaiian chain. The Engineers not only strengthened the Islands but also built them up as a tremendous base through which passed the troops headed for the South and Southwest Pacific. At a relatively late date—November 1943—the Central Pacific began to engage in offensive operations. By this time, the Allies had advanced far along the road to Rabaul, and the enemy had been expelled from the Aleutians. Henceforth, he was to be on the defensive in the Central Pacific also.

The Engineers Organize for War

When the Japanese planes made their first attack on Oahu on the morning of 7 December 1941 at five minutes before eight, a number of employees of the Honolulu District were already at work in the offices in the Young Hotel Building, at Hickam Field, and in the supply yard at nearby Ft. Kamehameha, on the southern shore of Oahu. In a broadcast sent out over Honolulu's two radio stations soon after nine o'clock, Colonel Wyman, the District Engineer, directed all employees to report at once to their jobs or to a new headquarters being organized in the Tuna Packers cannery at Kewalo Basin on the Honolulu water front. The additional headquarters, being set up in accordance with plans prepared before the war, was expected to expedite work required for the defense of the Islands; it would function as a forward base and operate independently of the office in the Young Hotel Building, which would continue to carry on the "routine" duties of the district. By half past nine that morning, the new headquarters was in operation.[1]

The first hours after the attack were hectic. There was widespread fear of additional bombings; many expected an enemy landing. One of the engineers' first tasks was to make certain that the principal runways on Oahu were operational and would remain so. The raids were hardly over when the 804th Aviation Battalion set out for Wheeler and Hickam to clear and repair the landing areas. The latter field was highly im-

[1] (1) Historical Review, Corps of Engineers, United States Army, Covering Operations During World War II, Pacific Ocean Area, pp. 24ff. EHD Files. (2) Rad, SP Div to Reybold, 3 Jan 42. 523.07 (Hawaiian Dept) 1942.

portant as it was the only one in the Islands with runways capable of taking B–17's safely. During the evening, workmen from the district began repairing Hickam's broken water mains and damaged utilities. Bellows also received attention. One of the 12 B–17's that happened to arrive in Hawaii during the attack on Pearl Harbor made an emergency landing at this field; the Hawaiian Constructors that same day began lengthening the second runway so that it could take more of the B–17's expected from the mainland within the next few days.[2]

Wyman believed it imperative to move the district's advance headquarters from its exposed position at Kewalo Basin to a safer place. A trustee of Punahou, Honolulu's exclusive and venerable private school, suggested that he move the district office into the school buildings. Located back in the hills, Punahou offered a more sheltered location, had adequate office and storage space, and possessed superior messing and dormitory facilities, a most important consideration, since civilian employees who worked at night were not permitted to travel to and from work while blackouts were in effect. The school's authorities appeared to have no inkling of what was about to happen when, at two o'clock in the morning of 8 December, the first cars from the district arrived at Punahou's gates. When the night watchman rushed out to learn what was going on, he was informed the engineers were taking over. During the next few hours, a stream of cars, buses, and trucks arrived on the campus. Keys not being readily available, some of the doors of the building were forced open. A number of the faculty, hurriedly called in, helped clear out furniture and equipment and made inventories of the items being removed; Monday morning found the new headquarters ready for work.[3]

Martial law went into effect in the Islands on the afternoon of the 7th. General Short became military governor. As stipulated in the defense plans, Colonel Lyman, the Hawaiian Department engineer, became the head of the military engineer organizations in Hawaii.[4] He henceforth directed all engineering activities in connection with defense, except those under the control of the U.S. Navy. He was authorized to spend money without limit on engineer work. Wyman's job was to help Lyman give the commanders in the Islands the defenses they needed. Specifically, he was to maintain permanent fortifications in a state of readiness, help civilian authorities keep the roads and other means of communications open, construct shelters in and around Honolulu, relieve the 804th engineers as soon as possible of the responsibility of keeping permanent airdromes repaired, and lastly, as directed by Lyman, furnish workmen and equipment to the military forces in the Islands. These various tasks got under way immediately. On the 8th

[2] (1) Memo, Wyman for Rcd, 7 Dec 41, sub: Telephone messages. Engr, AGF PAC, KCRC. (2) *Pearl Harbor Hearings,* Statement by Maj. Gen. Walter C. Short, Parts 30–31, p. 2473.

[3] (1) Wyman, Comments on Draft Manuscript of this chapter. EHD Files. (2) O. F. Shepard, former President of Punahou, An Account of the Early Days of World War II at Punahou School. (MS). Hawaii War Records Depository. (3) Ltr w/Incl, Maj Gen B. L. Robinson to C, EHD, 23 Dec 60. EHD Files.

[4] See above, p. 43.

Wyman took over all building materials, supplies, and equipment, called all construction companies into service, and started constructing bunkers and extending runways at the airfields. Lyman distributed material to the troops and got work on field fortifications under way. No sooner had the engineer organization been consolidated than it was also enlarged. The transfer of the constructing quartermaster's staff and field organization to the Engineers had been scheduled for the 16th. Short directed that it take place on the 8th. The constructing quartermaster's 200 employees were transferred to the district. Wyman acquired from the Quartermaster Corps 63 construction contracts for work estimated to cost $12,793,942, about one-fourth of which was finished. He continued to be responsible for the efforts of the Hawaiian Constructors. They moved their main offices to Punahou, so that they could co-operate better with the district. Wyman was still responsible to the Chief of Engineers for the improvement of rivers and harbors and flood control, but such civil work not in some way pertaining to defense was now negligible.[5]

Lyman, besides looking to the district for help, had made plans to use as many civilian organizations as possible. He was prepared to turn to contractors and suppliers of building materials, public roads departments, the Oahu Railway and Land Company, and the pineapple and sugarcane plantations. The plantations were of vital importance. They had extensive repair shops, sizable quantities of heavy construction equipment, and many trained mechanics. Their electric generating facilities could be tied into commercial power circuits. Each plantation was so organized and equipped that its workers could be used as corps engineer troops. Besides helping the engineers, the plantations were expected to contribute to civilian defense. The director of Civilian Defense divided rural Oahu into districts; men from the plantations were organized in each to carry out such jobs as repairing airfields, maintaining roads, railroads, and utilities, fighting fires, and rounding up saboteurs.[6]

Besides the district and civilian organizations, Lyman could rely on troop units. The 34th Combat Regiment, under the direction of the department commander, was already busy on roads and trails; so were the two divisional combat battalions, the 3d and the 65th. The 804th engineers, assigned to the Hawaiian Air Force, were responsible for keeping all airfields used by military aircraft in a state of repair, until relieved by the district. The few troops on hand were hardly adequate to do the work that now had to be done, and Lyman appealed to the War Department for more units. He asked for two aviation battalions, a camouflage company, a topographic company (corps), a depot

[5] (1) Conn, Engelman, and Fairchild, *Guarding the United States and Its Outposts*, ch. VIII. (2) *Pearl Harbor Attack*, Statement by General Short, pts. 30–31, p. 2473. (3) Hq Engr Serv FO No 1, 8 Dec 41. (4) Ltr, Lyman to Honolulu Water Works, 8 Dec 41. Last two in Engr, AGF PAC. (5) Hist Review, CE, U.S. Army, Covering Opns During World War II, POA, p. 11.

[6] (1) Ltr, Lyman to Honolulu Water Works, 8 Dec 41. (2) 1st Ind, Lyman to G–1 HD, 4 Mar 42, basic unknown. (1). (3) Ltr, Military Governor to Territorial Dir of Civil Defense, n.d. All in Engr AGF PAC.

company, and a mobile shop company.[7] He pointed out that his staff was too small for the multitudinous jobs ahead. "I have been making strenuous efforts to obtain suitable officers for the engineer service," he wrote to Reybold on 3 January, ". . . and I find myself blocked by inaction in Washington and cumbersome regulations." [8] He went on to say that he had few military men, Regular or Reserve, who had had much experience. Members of his staff were working from sixteen to twenty hours a day trying to "handle the great volume of Engineer work that has to be done as fast as possible because it was not done before the war began. . . ." "Between overworked officers and inexperienced officers," Lyman concluded, "the Engineer service is in a serious condition." With the over-all shortage of engineers, General Reybold could do little to fill Lyman's request in the near future.[9]

An especially heavy burden fell on the district office. As military governor, Short charged Wyman with the "supervision and direction of all normal civilian engineer activities, including operation of utilities." [10] Under martial law, all employees of essential industries had to stay in their jobs. Construction machinery and materials, vital supplies, and wages were frozen. Wyman signed contracts with a joint committee made up of representatives of the Sugar Plantations and the Pineapple Growers Associations. The plantation owners agreed to make available their equipment, materials, and workers as needed. The Hawaiian Constructors were geared for war. General Short directed that all construction for the Army being done by civilian firms in the Islands be placed under the Hawaiian Constructors; the other firms would henceforth be considered their subcontractors. Many jobs were suspended while Short and his staff reviewed the over-all program. For the time being, work was to continue on only the most urgent projects. Many of the contractors' forces were switched to what were now deemed emergency jobs. Blackouts and restrictions on traffic forced the engineers to provide quarters and subsistence to men who were working in remote or barely accessible places from which they could not return home after the day's work.[11]

Besides his mounting engineer responsibilities, Wyman was given a number of special jobs. He shared with the navy yard supply officer the responsibility for apportioning gasoline and other petroleum products to the armed forces and for rationing them to the public. Huge quantities of war materials and civilian goods were piling up on the piers of west coast ports for shipment to the islands. Much of the accumulating merchandise was destined for Honolulu stores for the Christmas shopping season. Wyman got the job of determining shipping priorities. He appointed a local shipping man to review all orders placed by the local stores and recommend shipment in accordance with the military

[7] Ltr, Lyman to Reybold, 17 Dec 41. 400.312 (HD) 1941–43.

[8] Ltr, Lyman to Reybold, 3 Jan 42. 210.3 (HD) 1919.42.

[9] Rad, SPD to Reybold, 17 Jan 42. 210.3 (HD) 1919.42.

[10] Ltr, Hannum to Reybold, 15 Dec 41. 600.1 (HD) 1941–42.

[11] Rad, SPD to Reybold, 3 Jan 42. 523.07 (HD) 1942.

importance of the material. This complex task required a most diplomatic handling of the Honolulu firms.[12] Since the Islands did not produce enough food to support the population, General Emmons, who replaced Short as Department Commander on 17 December, directed that certain pineapple and sugarcane fields be turned into vegetable gardens, which should be producing "in four months." He put Wyman in charge of this program. The South Pacific Division office in San Francisco began to buy seeds, fertilizer, and farm machinery for the gardens. "It is evident," Colonel Hannum, South Pacific Division engineer, wrote to General Reybold on 15 December, "that the Commanding General leans heavily upon the District Engineer and the forces under his charge." [13]

Protection Against Air Raids

One of the urgent tasks after Pearl Harbor was to quiet the fears of the civilian population, which lived in dread of another air raid. A great clamor arose in Honolulu for shelters to provide at least some degree of protection. The engineers were asked to advise what kind of shelter would, on the whole, be best for the population at large. This was a question hard to answer. Since the fear of another raid was widespread, shelters which offered at least some protection against light bombs and machine gun fire would have to be provided quickly. "I would hesitate," Lyman said, "to recommend that people stay inside their houses no matter how well reinforced . . . the single or double frame walls of the residences in Honolulu offer little or no protection from shrapnel or machine gun bullets. In addition, there is the serious danger of falling debris or the ever present danger of fire. . . ." Lyman recommended the digging of trenches. Most practical would be an excavation about 6 feet deep and from 3 to 6 feet wide. To give added protection against machine gun bullets and bomb fragments, the trench could be covered with timbers 2 inches thick, topped with about 6 inches of earth. A bench put in along one side would make a stay in one of the shelters more endurable. Simpler to construct would be a slit trench 4 to 5 feet deep and 20 inches wide. It would be rather uncomfortable during a prolonged raid, but since an attack would probably be by carrier-borne planes, the cruising time of which was relatively short, attacks would most likely not last long and elaborate shelters would not be necessary. On 9 December Lyman ordered trenches be dug on military posts, in parks, and near schools.[14]

Joseph P. Poindexter, Governor of Hawaii, requested Wyman to undertake a "program of construction for protection of the civilian population of Honolulu." [15] Major stress was to be placed on slit trenches. Emmons subsequently

[12] Hist Review, CE, U.S. Army, Covering Opns During World War II, POA, pp. 828–29.

[13] Ltr, Hannum to Reybold, 15 Dec 41. 600.1 (HD) 1941–42.

[14] Ltr, Lyman to H. A. R. Austin, Consulting Engr and Chmn of the Civilian Engrg Comte, 12 Dec 41. Engr AGF PAC, 383.

[15] Ltr, Emmons to Dir of Civilian Defense, Territory of Hawaii . . ., n.d., sub: Civilian Defense: Protective Measures and Evacuation. Engr AGF PAC, 383/1.

directed that they be at least two feet wide and up to five feet deep. Insofar as possible, they were to be dug under trees, were to have zigzag patterns, and were to be "well away from buildings." As time permitted, they were to be improved by widening, trimming, and removing rocks and debris, and by "planting the revetments with grass for camouflage purposes." Two and one-half feet lengthwise would be allowed for each adult; one and one-half feet, for each child.

The Director of Civilian Defense, assigned to the Office of the Military Governor, shared with Wyman the responsibility for providing shelters. On 24 December the director added Lt. Col. G. K. Larrison, CE, to his staff. With the help of two civilian engineers, and under Lyman's general direction, Colonel Larrison was to help provide protection for the people of Honolulu. He "borrowed" two engineers from the office of the chief engineer of the City and County of Honolulu, and soon he and his organization were working closely with the district office, using materials and workmen supplied by Wyman. Civilians, helped by some fifty volunteers from Hawaiian prisons, dug trenches in parks and on the grounds of public buildings "to provide immediate protection for the general public." [16]

Many thought more adequate protection was needed. Some urged the building of shelters to withstand heavy bombs, or at least of shelters which were splinterproof. The latter were structures which could withstand fragments from 500-pound bombs exploding fifty feet away. Required would be a concrete wall at least fifteen inches thick. There were few buildings in Honolulu with walls so sturdily built that they could withstand splinters even from 100-pound bombs. Building enough splinterproof shelters for the inhabitants of the city would be a considerable, even impossible, task. It was ruled that splinterproof protection was to be provided for employees of vital industries and key installations and for parts of the installations themselves. One of Larrison's duties was to lay out, approve, and construct splinterproofs in Honolulu with labor, equipment, and material furnished by Wyman. Larrison's men built splinterproof shelters of concrete or wood. Generally 6 feet square and 6 feet high, they were provided with benches. If possible, each shelter was placed to take advantage of the protection of trees, was at least 25 feet from other shelters, and was topped with about 2 feet of earth free from rock. Entrances to first-aid stations and hospitals were protected against shell fragments by wooden baffle walls 2.5 feet thick, filled with earth or sand.[17]

In case of dire necessity, the civilian population of the city was to be evacuated. Governor Poindexter directed construction of evacuation centers near Honolulu, a job which Wyman gave to the Hawaiian Constructors. Soon three centers were under construction in the Kalihi and Palolo Valleys. Structures,

[16] Memo, Larrison to Lt Col Frederick W. Herman, Asst Dept Engr, 14 Jan 42. Engr AGF PAC.

[17] (1) Ltr, Lyman to Austin, 12 Dec 41. (2) Ltr, Emmons to Wyman, 11 Mar 42. Engr AGF PAC, 600.96. (3) Ltr, Emmons to Dir of Civilian Defense . . . .

of a temporary nature, were for the most part long, shed-type buildings, with individual quarters for families, together with small sheds which could be used as one- or two-family units. The camps would have public wash houses and latrines. Protective measures against air raids were generally limited to Oahu. On the other islands, the population and the few important installations were so well dispersed that little or nothing could be done to give added protection.[18]

Camouflage

Frantic efforts were made to camouflage important installations. Before the war, some interesting experiments had been made in concealment, but little effective work had been done to disguise telltale targets. Now the aim was to hide, insofar as possible, most, if not all, of the conspicuous structures, both military and civilian, on Oahu. The engineers used paint extensively on large buildings, canneries, oil tanks, piers, and even such a prominent landmark as famed Aloha Tower on the Honolulu water front, covering them with bizarre splotches of green and brown. Netting and garlands were used to conceal smaller targets such as ammunition dumps and gun emplacements. Many of Honolulu's lei sellers wove and dyed the garlands and prepared the netting. Two 8-inch guns at the outskirts of a village were concealed under a dummy house. Fake planes of wood and burlap were placed in open fields to draw enemy fire. To hide, at least partially, some installations, the engineers began extensive plantings of trees and shrubbery. They bought 250,000 seedlings from the Territorial Board of Agriculture and Forestry and replanted many of them on the Punahou football field, which they had turned into a nursery. Most of the camouflage was of little value. Netting hid small buildings and dumps and concealed the entrances to tunnels, but large installations could not be disguised. No way could be found to conceal runways. In flying over Oahu, one could readily recognize camouflaged buildings and airfields.[19]

Military Defenses

Meanwhile, work was being rushed on strictly military defenses. To bring about some kind of order in construction, Emmons set up a list of priorities. At the head of the list was the protection of existing aircraft warning stations and the building of additional ones. Next came the construction of more airfields, complete with revetments, and the strengthening of coastal defenses. This was followed by the protection of vital public utilities, the building of shelters at the airfields, the dispersion of supplies for the Hawaiian Air Force, and the building of underground air depots. Of second priority were slit trenches for military personnel and expansion of existing hospitals. Of third priority were the construction of field fortifications, the improvement of roads and trails, and the erection of minimum housing for the troops arriving from the mainland.[20]

[18] Ltr, Emmons to Dir of Civilian Defense . . . .

[19] (1) Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 629ff. (2) Gwenfread Allen, *Hawaii's War Years* (Honolulu: University of Hawaii Press, 1950), pp. 91–92.

[20] Ltrs, Emmons to subordinate commands, 25 Dec 41; 6 Mar 42. Engr AGF PAC, AG 600.12.

Aircraft Warning Service

At the time of Pearl Harbor, the permanent aircraft warning system was not operating. Among other things, there was a shortage of such important parts as vacuum tubes and oscillators. To give the troops experience in detection with radar, the Signal Corps had set up mobile stations on a temporary basis. By making the best use of the small number of parts on hand, the signalmen were able to have part of the warning service in operation soon after Pearl Harbor. The engineers began to splinterproof all structures at the permanent stations. Early in January General Emmons ordered the structures bombproofed. This meant that each site would have to have a number of subterranean rooms with a cover of at least forty feet of earth or rock for vital equipment and living quarters. At some of the stations, the 100-foot-high steel tower with its revolving antenna would have to be moved so that it would be directly over the chambers, and at all the stations a vertical shaft would have to be drilled through the rock or earth between the tower and the rooms. The district office hurriedly redesigned the stations while continuing work on them. When the equipment at the high altitude stations was tested, the sites proved to be unsatisfactory. Planes zooming in low over the water escaped detection. After the engineers had accomplished the difficult feat of building the cableway to the top of Mount Kaala, the site there was abandoned because it was too high. When the radar equipment was installed atop 10,000-foot-high Haleakala it was found to be unsatisfactory for close-in detection—there was a dead space about thirty miles out. Another place would have to be found. Kokee, at an elevation of 2,000 feet, was satisfactory. Although work on the stations was progressing, it would be some time before any of them would be operating. The Signal Corps hoped to have the system in working order by midyear.[21]

Airfields

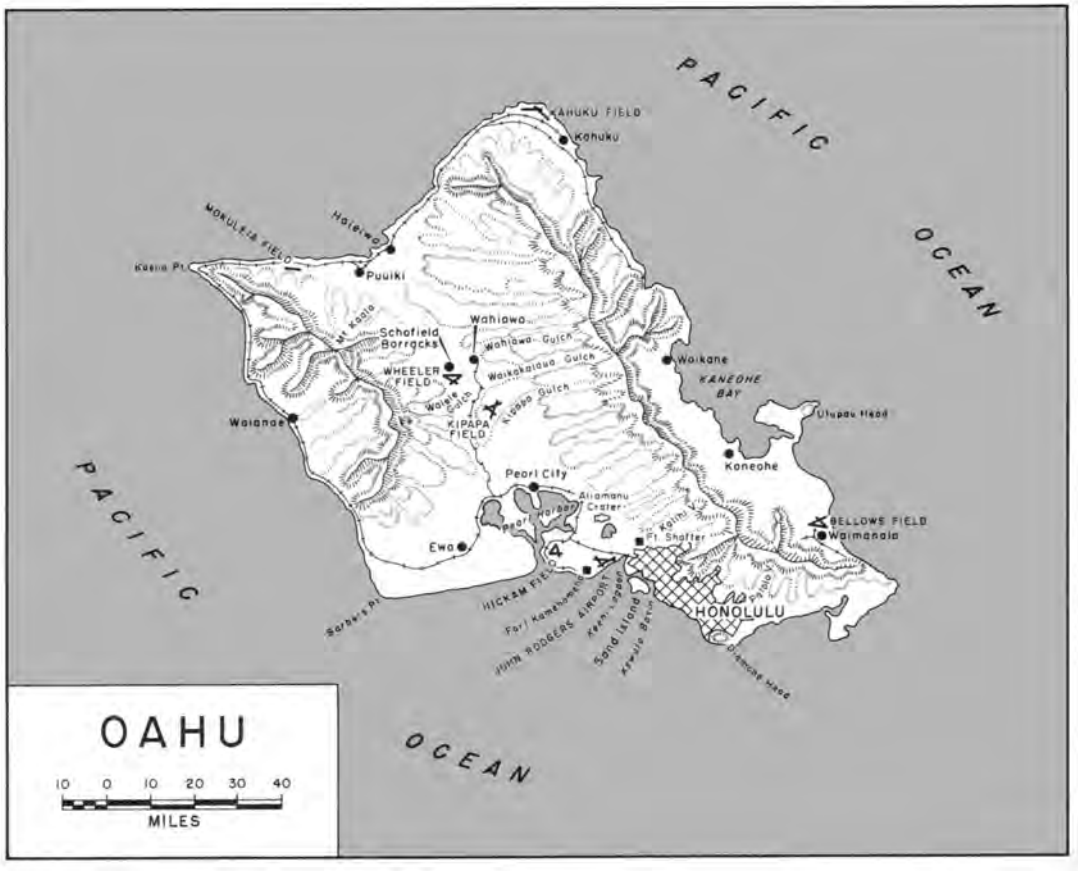
Work on airfields was rushed. Within a few days after Pearl Harbor, the engineers had cleared and repaired the runways at Wheeler and Hickam. At Bellows the second runway, lengthened from 2,200 to 4,900 feet in five days, was able to take the B–17's coming in from the mainland. The war had reversed the roles of the Army and Navy in the defense of the Islands. Until 7 December, the Army had garrisoned Oahu primarily to protect the fleet at Pearl Harbor against attack by land. After 7 December, the Islands had to rely for their protection mainly on land-based planes. Admiral Chester W. Nimitz, who took over from Admiral Husband E. Kimmel soon after the outbreak of war, declared this would necessarily continue to be the case because the fleet would have to fight the enemy at widely separated points and could not always remain near Hawaii. The Engineers would have to build more airfields, and not only on Oahu; now of vital importance was

[21] (1) George R. Thompson, Dixie R. Harris, Pauline M. Oakes, and Dulaney Terrett, *The Signal Corps: The Test,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1957). (2) Hist Review, CE, U.S. Army, Covering Opns During World War II, POA, pp. 275ff. (3) *Pearl Harbor Attack,* Testimony of Col C. A. Powell, pts. 28–29, pp. 1983ff. (4) Memo, Powell for CofS Hawaiian Air Force, 2 Jan 42. Engr AGF PAC.

the improvement of airfields on the outlying islands. Maj. Gen. Clarence L. Tinker, commander of the Hawaiian Air Force, was pressing for a speed-up of work everywhere. Wyman placed all work on airfields for which he was responsible under the Hawaiian Constructors; on 13 December, the contract with the Territorial Airport Contractors was terminated. Hickam and Wheeler continued to receive special attention. Traffic was heavy on Hickam's runways, which had been in service for four years and were not designed to take the new heavy bombers and transports. Additional work was needed not only on runways but also on parking areas. Because of the many aircraft using the field, the runways could not be closed down for complete reconstruction; it was decided to repair the weak spots only, and to apply a one-inch coat of asphaltic concrete to keep water from penetrating through the pavement and softening the subbase. The field was kept in full operation. Bellows likewise had high priority. The airmen were pressing for completion of this field because they wanted to move some of their units from overcrowded Wheeler. The engineers pushed work on a number of additional fields on Oahu, two of exceptional importance being Kahuku on the northern tip of the island and Mokuleia on the north central coast. (*Map 17*) Three more were planned for the central plateau. Work was speeded up on Morse and Hilo on Hawaii and on Barking Sands on Kauai. Additional fields were to be built, even including one on small Lanai island.[22]

General Emmons ordered obstructions placed on all level areas over 400 feet long on which enemy planes could land or take off. "Level areas" meant primarily grazing lands and fields of pineapple and sugarcane. The Hawaiian Pineapple Company, the California Packing Company, and other firms with extensive holdings were enlisted for this work and supplied most of the workmen and materials. The companies were to make every effort to block the level areas as soon as possible, using any practicable means at their disposal. They would be reimbursed by the government. Lyman chose Capt. George E. White, Jr., of the 804th Aviation Battalion, as his representative to approve and co-ordinate plans and inspect the work. On many of the fields, the workers erected posts at least eight inches in diameter, stacked boxes in piles at least five feet high, or parked junked machinery. On some, they dug ditches with embankments three feet high. By mid-March all pineapple fields and 60 percent of the other likely landing areas on Oahu had been blocked, and many level areas on the outlying islands had been similarly treated. On the latter islands, major emphasis was put on rendering all airfields useless to the enemy, except those necessary for defense. The engineers placed mine chambers on the runways at Hilo airport and Upolo Field on the

[22] (1) Ltr, Wyman to Paul J. Lynch, Area Engr 5th Field Area, 29 Dec 41. Engr AGF PAC, ND 686 Bellows, X 201 Misc. (2) Honolulu Engr Dist, Semimonthly Labor Rpt on AC Stations for Dec 16–31, 1941. Engr AGF PAC, ND 319.1 Semimonthly AC Sta. (3) Ltr, Richardson, CG Northern Calif Sector and VII Army Corps, to Marshall, 1 Jun 42. AAF Central File, Misc–C–Hawaii, Apr–Oct 42. (4) Ltr, CO Hawaiian AF Base Comd to Lyman, 8 Feb 42. Engr AGF PAC, 686 (G).



MAP 17

island of Hawaii, but did not load them. On Kauai they mined Burns Field and Barking Sands.[23]

Coastal Defenses

Should the Hawaiian air defenses be incapable of holding off an approaching fleet, the Islands' next line of defense would be the guns of the Coast Artillery. Under Wyman's direction, the Hawaiian Constructors worked around the clock on all the fixed batteries along Oahu's southern coast. Among their main jobs were the casemating of the 16-inch guns of Batteries Hatch and Williston and the 12-inch guns of Closson. At each gun site, casemates, magazines, and storerooms were combined into a single structure of reinforced concrete with walls twelve feet thick, which supported roofs of concrete slabs, eight feet thick. On

[23] (1) Ltr, Lyman to Hawaiian Pineapple Co., Ltd., 20 Dec 41. Engr AGF PAC, 384.3 (2) Interstaff Routing Slip, G–4 to Wyman, 20 Feb 42. Engr AGF PAC, 686. (3) 2d Ind, 1st Lt Edward A. Flanders, 804th Engr Avn Bn, to Dept Engr, 19 Mar 42, basic unknown. Engr AGF PAC, 231.4.

the east and west coasts of Oahu, workmen began to casemate the 8- and 6-inch guns, and at numerous gun sites they built projectile stands and powder storage chambers, replaced disintegrating sandbags, built splinterproof plotting rooms, camouflaged positions, built access roads, and provided adequate utilities. Where the terrain permitted, they drove tunnels to house magazines and operational facilities.[24]

Soon after Pearl Harbor the engineers got an unlooked-for job. They were directed to install various types of guns which the Navy had removed from its warships and turned over to the Army for emplacement on land. On 15 February the Navy gave the Army 11 5-inch gun batteries, which the Coast Artillery wanted installed at four points on Oahu. Next, the Navy offered the Army 12 old 7-inch guns; 2 of these were to be installed on Oahu and 2 on Kauai. The additional armament was expected to provide many advantages. Since practically all fixed seacoast guns had been emplaced at or near the beaches, it was highly desirable to have additional large-caliber guns placed well back from the shore, preferably at an elevation high enough to assure the batteries not being overrun by small landing parties. Considerable ingenuity was required to plan layouts and prepare barbettes for these guns to ensure efficient operation on land; plans for standard batteries proved to be of little help.[25] Lyman considered these jobs of gun installation so important that he directed they be carried on "day and night, seven days a week, until they [were] completed." [26]

The biggest job was yet to come. In mid-December Emmons' G–3 informed Maj. Gen. Harry T. Burgin, chief of the Hawaiian Coast Artillery Command, that there was a good chance that some of the big guns of the battleships and aircraft carriers sunk or damaged at Pearl Harbor could be salvaged and emplaced on land. In numerous conferences, Army and Navy authorities discussed the practicality of the scheme. Under consideration were the 8-inch guns of the aircraft carrier *Saratoga* and the 14-inch guns of the battleships *Arizona* and *Pennsylvania*. On 16 January General Burgin wrote Emmons that the "Navy authorities" believed that "two 3-gun turrets, 14-inch, with all their appurtenances could be obtained and in all probability a third . . . might be obtained for use by the Army." [27] Burgin's staff began to investigate various sites on Oahu where the guns might be emplaced. Nimitz doubted that the 14-inch guns of the *Arizona* and the *Pennsylvania* could be easily installed on land; he thought the turrets with their guns too heavy. But he believed the Army could make good use of the 8-inch guns of the *Saratoga*. Burgin wanted both and requested Emmons to have the engineers make a survey to determine if they could be moved "to locations some 300 feet up on the ridges to the north and east of Pearl Harbor and installed in usable condition with magazines and ammunition servicing from below as . . . on

[24] Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 305ff.

[25] Memo, Asst Dept Engr for Wyman, 14 Dec 41. Engr AGF PAC.

[26] Memo, Lyman for Area Engr 2d Field Area *et al.*, 23 Mar 42. Engr AGF PAC.

[27] Ltr, Burgin to Emmons, 16 Jan 42. Engr AGF PAC, 472.3.

battleships." [28] On the basis of the survey, made by Lyman on orders from Emmons, the engineers concluded that the transfer would be practical. The Coast Artillery decided to take both types. On 8 February Emmons directed Wyman to begin work on four emplacements for the 8-inch guns, two of them at Diamond Head and two in the pineapple fields north of Schofield Barracks. He considered this job extremely important; Colonel Robinson was to give it the "highest priority equal to flying fields," and the engineers were to work around the clock on it.[29] The 14-inch guns of the *Arizona* and the *Pennsylvania,* to be emplaced at Barber's Point and Ulupau Head, were a different matter. It was soon apparent that their tremendous size and weight, their intricate construction, and the vast number of parts would create the most complex problems. Months of planning and preparation would be necessary before the job of moving the big guns to their sites could even begin.

Despite growing defenses, amphibious landings by an enemy force were a distinct possibility. In Lyman's opinion, a most serious problem for an attacking force was the one of providing sufficient protective cover for the first troops to hit the beaches. Naval guns of the attacking force would have to lift their fire just as the landing craft were nearing shore; the enemy would then have to use his planes, which, to give protection, would have to fly so low that they would be vulnerable to the defenders' machine gun fire. To meet such tactics, defensive positions on Oahu, especially those on the beaches and in the foothills close to the shore line, were being strengthened, principally by the construction of "heavy overhead cover" which would "give adequate protection against enemy machine guns and bomb and shell fragments." [30] Little was being done or could be done to increase antiaircraft fire. Few of the coastal guns on Oahu were so emplaced that they could fire on planes. The Navy removed a few antiaircraft guns from its ships for installation on Oahu. Wyman took over this work in February.

Beach defenses had a large number of machine guns emplaced in a single line near the shore. Most were so close to the water that it was impossible to maintain effective wire entanglements at a reasonable distance in front of them, and, as a consequence, penetration of the beach line would be fairly easy. Lyman stressed the need for organizing defenses in depth. It was imperative that these defenses have strongpoints so organized that heavy fire could be placed in any direction. In addition, the defending forces should be kept as mobile as possible. In the positions already organized on hilltops, machine gun emplacements in many instances were so sited that they could deliver only plunging fire in support of the beach defenses. Many were poorly camouflaged. Lyman emphasized that emplacements should be concealed from aircraft, that beach positions close to the water should be moved inland and set up to deliver fire

[28] Ltr, Burgin to Emmons, 18 Jan 42. Engr AGF PAC, 472.

[29] (1) Ltr, Emmons to Wyman, 8 Feb 42. (2) Memo, Capt Joseph Matson, Jr., Asst Dept Engr, for Robinson, 28 Mar 42. Both in Engr AGF PAC, 662.

[30] Ltr, Lyman to Emmons, 8 Jan 42. Engr AGF PAC, 381.

in more than one direction, that the silhouettes of positions should blend with their surroundings, and that antipersonnel mines should be used extensively in the natural avenues of approach. Work was being undertaken along all these lines. At the same time boat obstacles were placed off the shores of Oahu. They consisted for the most part of railroad and streetcar rails, many of them pulled up from the streets of Honolulu, and driven into the coral sea bottom to form tetrahedrons submerged at high tide.[31]

Mines and Demolitions

If worst came to worst, and the Hawaiian air and coastal defenses could not halt an attacking force, mobile ground troops would have to prevent the landings and, if unable to do so, would be responsible for stopping or retarding the enemy's advance across the Islands. Preparing roads, bridges, airfields, and buildings for demolition to slow down a successful enemy invasion would require considerable effort. Because of the Islands' peculiar topography, the use of demolitions was a complicated matter. Normally, local commanders decided when the charges should be set off, but in Hawaii this would not be good practice because the main routes of communication were limited, and the destruction of a vital bridge during retreat, for example, might make an effective counterattack later on impossible. It was suggested that in each critical area two types of roadblock be prepared; a temporary one strong enough to hold off an initial assault, and a permanent one requiring demolition to be executed by the engineers as part of the over-all tactical plan of the combat forces. Co-ordination of major demolitions would have to be worked out between the local commanders of the beach defenses and the combat forces. The engineers placed various kinds of obstacles and prepared demolitions. The 3d and 65th engineers readied roads, highway bridges, and railway bridges, principally by drilling holes for explosives but, except in a few cases, they did not put the charges in place.[32]

Should the Japanese make a successful landing, they would probably attempt to advance first across the low-lying areas and plains of the islands. There were few natural obstacles to slow such an advance, particularly on Oahu. The central plateau had practically no trees, and, in general, streams and marshes were few. On all the islands, the defenders would have to rely heavily on mines. On 23 December Emmons asked the War Department for 160,000 antitank mines. While awaiting shipment, the engineers placed the few on hand and prepared to improvise. Howitzer shells were satisfactory substitutes but would be used only as a last resort. The engineers improvised hand grenades by filling bottles with gasoline and petroleum which would ignite upon striking a tank. Hawaii had a scorched earth plan; it would go into effect in whole or in part only upon orders of the

[31] (1) 1st Ind, Interstaff Routing Slip, Lyman to CofS HD, 13 Aug 42. Engr AGF PAC. (2) Ltr, Col Desloge Brown to C EHD, 21 Dec 60. EHD Files.

[32] (1) Ltr, Lyman to Emmons, 8 Jan 42. Engr AGF PAC, 381. (2) Hq 65th Engr Bn, 30 Dec 41, Rpt, Demolitions, 25th Inf Div Sector, Data and Present Status. Engr AGF PAC.

department engineer or sector commanders, as the case might be. All demolitions and destruction were to be total, since any supplies and equipment falling into the hands of the enemy would have to be regarded as lost in any case.[33]

Problems of Administration

With the avalanche of work descending on the engineer troops and the Honolulu District, it was highly important to have the most efficient type of organization. Spheres of responsibility were quite well defined: all work not performed by troops under Lyman was to be done by the Hawaiian Constructors and their subcontractors under Wyman. On 3 January, the Constructors' organization was enlarged with the addition of the Hawaiian Contracting Company. Wyman was responsible for more than 1,000 jobs, which ranged from the building of large airfields and elaborate underground chambers for storing gasoline and ammunition to the paving of access roads and the minor repair of buildings. He issued job orders almost daily. Supplemental agreements were made with the Constructors, by which the contract was expanded to cover most of the work ordered after the start of the war. Within two months the amount of the contract rose from $15 million to approximately $75 million. Extraordinary efforts were needed to manage such a mushrooming construction program successfully.

Numerous problems arose concerning the work of the Hawaiian Constructors. In the days of frenzied activity after Pearl Harbor, projects had been assigned willy-nilly, and before long no one knew how much work the contract covered. Wyman, Robinson, and the contractor's representatives had many conferences in which they tried to find some way of arriving at a fair estimate of the sum total of the work and its cost. Figures prepared by the Engineering Division of the Honolulu District office were based on what a lump sum contractor would probably bid on the work in peacetime, with no allowance made for the wholly unforeseen conditions arising from the war. Moreover, these estimates did not take into account the fact that work done under a cost-plus-a-fixed-fee contract was often more costly than if done on a lump-sum basis. To the estimates of the Engineering Division, Wyman and Robinson added 10 percent for the cost of mobilizing and demobilizing the working forces, another 10 percent for the expense to the contractor of maintaining offices on the west coast and in Honolulu, and an additional 20 percent for contingencies, including overhead costs, which were exceptionally large because of the many changes in the program. Priorities were, moreover, being continuously revised, which made it necessary to move men and materials from one project to another. Often men and equipment had to be kept on a job with nothing to do because supplies did not arrive as scheduled. Meanwhile, largely because of conditions beyond their control, the Hawaiian Constructors were be-

[33] (1) Ltr, Emmons to Somervell, 6 Jul 42. (2) Interstaff Routing Slip, Lyman to G–4 HD, 2 Jan 42. Both in Engr AGF PAC. (3) Memo, Asst Dept Engr for Engr Offs, 11 Jan 42. Engr AGF PAC, 660.3. (4) Ltr Emmons to Lyman *et al.*, 13 Jan 42. Engr AGF PAC.

ing subjected to mounting criticism for incompetence and inefficiency, not a little of it coming from the contractors who had been placed under their direction.[34]

Wyman had other troubles, among them his inability to resist the demands of many military commanders. Stating they had verbal authorization for their projects, the commanders insisted that Wyman get started on the work at once. Pressure was especially strong from the Hawaiian Air Force, redesignated the Seventh Air Force on 5 February. Insofar as the district engineer knew or could determine, many of the requests from the air force, and from others as well, had not been officially approved by higher authority. More confusion arose because it was not clear what the chain of command really was. The engineer organization had supposedly been consolidated under Lyman; nevertheless, Emmons gave orders directly to Wyman, and the district engineer at times attended the department commander's staff conferences. Inquiries from Wyman to the Office of the Chief of Engineers brought rather vague replies. On 12 January, General Reybold radioed "Wyman is in complete charge of all construction working directly under the commanding general" of the Hawaiian Department. Reybold stressed the need for caution in accepting construction requests. He told Wyman to do "only that construction specifically authorized by the commanding general preferably in writing, but in any event in definite terms and confirmed in writing by proper authority." But commanders in Hawaii continued to press Wyman to get started on their projects. His well-meaning efforts to be helpful to everybody only made his position more difficult.[35]

Supplies and Equipment

Since there was a chance that the shipping lanes from the mainland would be cut, the engineers had to give special attention to supply. Stocks for the troops, stored for the most part at Schofield and Fort Kamehameha, were dangerously low. After Pearl Harbor, Lyman began building up his reserves, particularly of fortifications materials. It was not hard to find and distribute sufficient quantities of supplies for the few engineer units assigned to the Hawaiian Department. Dealers had quite a few items. Lyman stored his new acquisitions at various points on Oahu, including the district's yards in Honolulu. Ample numbers of civilians could be hired as clerks for sorting and distributing. Since Oahu had good roads and excellent rail lines, transportation was adequate. Already evident was the lack of spare parts and of units to distribute them. Fortunately, some spare parts could be procured in Honolulu, and requisitions for additional items were sent to the mainland. The 34th Engineers organized a stopgap parts supply unit at Schofield. The lack of maintenance units was noticeable; civil-

[34] (1) Ltr, Kramer to Richardson, 14 Mar 44, sub: Contract W-414-Engr 602, Hawaiian Constructors. (2) Memo for Rcd, Robinson, 5 May 44. Both in Engr AGF PAC, 160 Contracts, vol. 1. (3) Ltr, Brown to C EHD, 21 Dec 60. EHD Files.

[35] (1) Rad, Hannum to Reybold, 9 Jan 42. 600.1 Hawaii 1927-45. (2) Memo, Robins to SGS 16 Jan 42. (3) Rad, Reybold to SPD Engr, 12 Jan 42. (4) Rad, Reybold to SPD Engr, 16 Jan 42. All in 600.1 Hawaii 1927-45.

ian repair shops were called upon for help insofar as possible.[36]

For Wyman and the Hawaiian Constructors, with their huge construction program, supply was much more complex. Measures had to be taken immediately lest construction bog down. An engineer officer, Maj. Louis J. Clatterbos, arriving in Honolulu on 5 December, bound for Africa by way of the Pacific, was temporarily detained by the tide of war. Reporting to Army headquarters on Pearl Harbor day, he was assigned to the Honolulu District office. He arrived at Punahou at 0900 the next morning, and Wyman made him his supply officer. Hitherto à responsibility of the Operations Division, supply had not been one of the district's most important functions; the division office in San Francisco had taken care of most procurement. Wyman directed Clatterbos to set up a separate supply division, pointing out the rapid expansion that would be necessary to meet wartime needs. Soon requisitions to San Francisco for large amounts of supplies, especially lumber, cement, corrugated iron, and camouflage materials, were being prepared. Wyman was responsible for procuring these supplies and determining the priorities in which they were to be shipped. How much material would actually arrive depended as much on how many ships were available as on anything else. Clatterbos had just gotten started on his many tasks when he left for Africa on 20 December.[37]

One of the district engineer's biggest jobs was to find construction machinery and allocate it to the various projects. The plantations supplied some machinery and local contractors managed to scrape together a few odds and ends. These were makeshift arrangements. It would soon be necessary to turn equipment back to the plantations so that they could begin planting foodstuffs, and equipment would have to be returned to the contractors to enable them to "proceed with the large and complicated fortifications items." Because of the shortage of transports, great amounts of machinery earmarked for Hawaii were piling up on the docks at San Francisco. All ships arriving at Honolulu were thoroughly searched for the equipment they might have aboard. The engineers requisitioned any new automobiles, station wagons, and trucks they could find. Under authority from Emmons, Wyman directed that practically all construction equipment which the engineers could get hold of be turned over to the Hawaiian Constructors.[38]

By the end of the year a start had been made in coping with major supply problems. On 29 December, Wyman sent his first order to San Francisco. It called for 3,740,000 dollars' worth of materials. In January, Capt. Carl H. Trik, transferred from the Quartermaster Corps about a month before, became chief of the Supply Division. Despite the improvement in the outlook for

[36] (1) Ltr, Asst Dept Engr to CG HD, 3 Jan 42. Engr AGF PAC, Engr 475.4 (Defense Reserves). (2) Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 82off.

[37] (1) Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 82off. (2) Ltr, Gorlinski, Tr Div OCE, to Hannum, 17 Jun 42, with 2d Ind, Asst Dept Engr HD to SPD Engr, 1 Sep 42. Copies in Hist Review, cited (1), above, pp. 835–38.

[38] (1) Ltr, Lyman to Reybold, 17 Dec 41. 400.312 HD, 1941–43. (2) Hist Review, CE, U.S. Army, Opns During World War II, POA, p. 827.

supply, Captain Trik had numerous difficulties. Hawaiian projects now had an A–1–a rating, but their high priority did not seem to expedite the sending of cargo. Distribution was slowed because of the poor condition of supplies when they arrived. Manifests were often garbled or were not received before the arrival of a vessel, and identification tags on boxes and crates were frequently indecipherable. Early in February Wyman set up a separate field area on Oahu to operate the base yards, shops, gas stations, and factories which served more than one field area. The district engineer, meantime, had been freed of a few of his more burdensome and rather extraneous supply chores, for shortly after the beginning of the year the Office of the Military Governor took over the rationing of gasoline and construction materials and the allocation of shipping for civilian goods from the mainland.[39]

A muddle developed over equipment. The Honolulu District had turned over practically all the machinery it could get to the Hawaiian Constructors. Because equipment was so scarce, Wyman wanted to buy a large part of the stocks of the Hawaiian Constructors, but they were willing to sell only if the district engineer took over everything they owned. Since there was small chance of getting enough machinery from the mainland, Wyman and Robinson thought it best to buy everything the Constructors had. Poor pieces could be repaired or used to repair other items. The engineers and the Constructors were far apart as to price. Meanwhile, spare parts shortages were causing increasing trouble.[40]

Real Estate

After Pearl Harbor the acquisition of real estate, a function transferred from the Quartermaster Corps, was added to Wyman's growing list of responsibilities. The pressure of events forced the engineers to streamline procedures, particularly those for acquiring tracts for a temporary period. Under the new system, a military unit wishing a piece of land sent its request to the commanding general of the major echelon concerned. If he approved, he informed Wyman, who thereupon directed his real estate officer to acquire property. It took about six weeks to get legal possession. From 11 December 1941 to 16 February 1942, the Real Estate Division of the Honolulu District processed some 200 cases, involving all types of transactions. The Army tried to take as few residential areas or cultivated tracts as possible. For the most part, it occupied forest preserves, pastures, and wasteland. It leased many hotels, offices, shops, warehouses, and schools. In the tense days after Pearl Harbor, numerous tracts and buildings had to be occupied without proper authorization.[41]

Financial Problems

The feverish efforts to build up defenses after Pearl Harbor produced

[39] (1) Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 82off. (2) Ltr, Asst Dept IG HD to Short, 7 Nov 41, with 1st Ind, Wyman to Emmons, 19 Feb 42. Engr AGF PAC, 333 IG Rpts (Gen).

[40] Memo for Rcd, Robinson, 5 May 44. Engr AGF PAC, 160 Contracts, vol. 1.

[41] Ltr, 2d Lt George R. Lumsden, Asst IG HD 16 Feb 42. Engr AGF PAC, 331 IG Rpts (Gen).

growing disorder in the district's finances. To speed up construction, procurement of supplies in the Islands was partially decentralized. Each of the district's fifteen field areas was authorized to purchase at least some of its supplies, and the Hawaiian Constructors were permitted to buy part of what they needed in the open market. As the number of purchases mounted, invoices and vouchers sent to the district office piled up. Not enough bookkeepers and auditors could be found for the swelling volume of paper, and effective control over the purchase of supplies became impossible. Apparently the magic words "Charge it to the District Engineer" were sufficient to get construction supplies from local dealers, who believed that defense required rapid delivery to any purchaser who appeared to be bona fide. The district's Procurement Section often did not know what materials had been contracted for and delivered, and it was frequently not informed when orders for materials had been changed or canceled. Vouchers began coming in from department engineer units, and not always for construction materials; some were for food, lodging, or clothing, and even such extraordinary items as "medicinal liquors." Some supplies ordered from dealers by telephone never reached their destination, yet they were undoubtedly delivered somewhere, if the more or less undecipherable signatures on the receipted invoices meant anything. One invoice came back with the notation "Received by Captain Blackjack of the Horse Marines." Much of the confusion was the result of good intentions, of a laudable desire to cut through red tape, to dispense with the now intolerably slow peacetime procedures, and to get on with vital construction with the greatest possible speed.[42]

A tremendous number of bills from local merchants accumulated. Businessmen pressed the district's Finance Section for the payment of accounts long overdue. By March 1942 the Honolulu District owed local merchants about $3 million, most of which had been outstanding since December. A number of businessmen threatened to protest to Washington, and others stated they would make no more deliveries unless the amounts owed them were paid and they were given assurance that payments for new purchases would be made within a reasonable time.[43]

Mounting Difficulties

The district office was so swamped with work that administrative procedures almost collapsed. The sudden expansion of the organization and the lack of clear-cut lines of authority were largely to blame. In November 1941, the district office had directed or supervised the work of about 3,500 civilians and spent approximately $1,700,000 a month. By March 1942 the number of personnel had risen to 17,000, and expenditures to $8,000,000 a month.[44] Many of the thousands of newcomers were not well qualified for their jobs,

[42] (1) Draft Memo, 1st Lt H.E. Wilbert, Transportation Off Honolulu Engr Dist, for SupO, 6 Feb 42. Engr AGF PAC, IG Rpts (Gen) File 1. (2) Lt Col Willard P. McCrone, The Honolulu District and Pearl Harbor. Draft MS copy in EHD Files.

[43] Allen, *Hawaii's War Years*, p. 282.

[44] Figures for civilian personnel include the contractors' employees.

and time-consuming efforts were necessary to train them. Lt. Col. Howard B. Nurse, before the transfer one of the Quartermaster Corps' top construction men and now Wyman's executive officer, observed that the development of "a smooth-running, well-organized business of that magnitude requires years in civil life." Wyman's place in the chain of command in the Islands remained vague, despite his efforts to have it clarified. Many local commanders in Hawaii continued to put pressure on him to expedite or finish their projects. He was under the additional handicap of being responsible for such jobs as rationing gasoline and planting vegetable gardens—somewhat unusual functions for an engineer district. Colonel Nurse believed that if Wyman had not had to assume so many extra responsibilities, he would have been "more free to pursue the usual functions of a district engineer." [45]

Resentment against the Honolulu District mounted. It seemed the engineers were blamed for everything that had gone wrong, except the disaster at Pearl Harbor itself. Perhaps nothing caused a greater furor than the taking over of Punahou School. Rumors circulated that when the engineers moved in, they smashed the doors, broke the windows, dumped valuable pianos on the lawn during a rain, and unconcernedly threw out a statue of Venus de Milo, since "it was already broken; its arms were off." [46] Weeks later, some workmen, while putting up a barbed-wire fence around the school grounds, needlessly hacked down part of a superb hedge of night-blooming cereus which was "the pride and joy of Punahou, and of all Honolulu." This led to a furious outburst, particularly from the school's alumni, many of them prominent in the city's business and civic affairs. "For two or three days," wrote O. F. Shepard, the school's president, "it seemed as if the Pacific War were a small event in comparison to the partial destruction of the cereus hedge." [47] There were reports that after the engineers had commandeered the Pleasanton Hotel, across the street from Punahou, they tossed chairs and tables out of the windows to make room for the more comfortable furniture they had taken from the swank Royal Hawaiian Hotel. A prominent resident of Honolulu reported that on one Sunday afternoon he counted thirty-five cars with district licenses, most of them "filled with women and children out joy riding." [48] Driving hard to get things done, Wyman had alienated many. The inability of the district to deal with many of its numerous problems in a satisfactory manner irritated most of those who had to deal with it. Wyman's sometimes abrupt manner further incensed the easygoing islanders. "The District Engineer," Lyman wrote to Reybold on 14 February, "has antagonized a great many of the local people as well as some of the new employees and officers who have recently been assigned to this office." He went on to say, ". . . whenever any condition arises . . . even . . . if beyond

[45] Memo, Nurse for Wyman, 5 Mar 42. Engr AGF PAC, 333 IG Rpts (Gen) vol. 1.

[46] Allen, *Hawaii's War Years*, p. 236.

[47] Shepard, former president of Punahou, MS, An Account of the Early Days of World War II at Punahou School. Hawaii War Records Depository.

[48] Memo, Nurse for Wyman, 5 Mar 42. Engr AGF PAC, 333 IG Rpts (Gen) vol. 1.

the control of the District Engineer, the people wrathfully rise up . . . against him." [49] Many engineer officers concurred in these views.[50] When an editorial favorable to the district engineer appeared in one of the Honolulu dailies, a reader called up the editor to find out when the district engineer had taken the newspaper over.[51] This, Colonel Nurse relates, "was considered the joke of the day, and was kicked around with a great deal of glee." [52] Even relations between Lyman and Wyman became so strained that an almost intolerable situation resulted.[53]

The rumors were, of course, almost entirely unfounded. The take over of Punahou was orderly with only a minimum of disturbance, and care was taken to safeguard property. Some damage was inevitable but "much . . . [could] be forgiven," the school's president wrote, ". . . because of the emergency and of the confusion into which everybody was thrown." Furniture was not tossed out of the Pleasanton, and the few items taken from the Royal Hawaiian were obtained in the proper manner. Nevertheless, the fact remains that many residents of Honolulu believed the stories and some still do. In an effort to get at the truth of the charges regarding district employees and their families out joy riding, Colonel Nurse posted eight commissioned officers one Sunday with orders to stop every military vehicle and ascertain the reason for its being on the road. Only one was spotted; its driver was on his way to Bellows Field to make some repairs on a bulldozer. When Colonel Nurse reported his findings to the "prominent resident," the latter replied that he "was glad to hear it . . . turned on his heel, and walked off without further comment." [54] In the growing controversy, the valuable work being done by the district was deliberately ignored.

Perhaps much of the clamor could have been avoided had an effective public relations program been instituted early. Before the war the Honolulu District had been a relatively small and little-known government department; the civilian population could not understand why, after Pearl Harbor, this particular organization had suddenly become so important with so many things to do so fast and on such a large scale. Many people, from lack of information, misconstrued the intentions of the engineers. President Shepard, who had a sympathetic attitude toward the district, relates that he was present when Wyman "in no uncertain terms" told Mr. Ralph Wooley, one of the Hawaiian Constructors, an alumnus of Punahou and a horticulture expert, to replant the destroyed part of the cereus hedge and make sure that no further harm was done to it. But the public was never in-

[49] Ltr, Lyman to Reybold, 14 Feb 42, in ch. V, Rpt of Pearl Harbor Army Board, pp. 53–54. 100 A48–82, pt. II, Army Pearl Harbor Rpt.

[50] (1) Rpt of IG HD to CofS HD, 14 Feb 42. Quoted in part in Ch. V, Rpt of Pearl Harbor Army Board, p. 58. (2) *Pearl Harbor Attack,* Testimony of Gen Hannum, pts. 28–29, p. 1066.

[51] Memo, Nurse for Wyman, 5 Mar 42. Rpt of Pearl Harbor Army Board, pp. 53–54.

[52] Ltr, Nurse to C Mil Hist, 2 Jun 60. EHD Files.

[53] Memo, Wyman for Robinson *et al.,* 4 Mar 42. Engr AGF PAC 333 IG Rpts (Gen) vol. 1.

[54] (1) Allen, *Hawaii's War Years,* p. 236. (2) Shepard, An Account of the Early Days of World War II at Punahou School. (3) Ltr, Nurse to C Mil Hist, 2 Jun 60. EHD Files.

formed of this, and "the Colonel got all the blame for the mutilation of the hedge." On the advice of members of his staff, Wyman eventually started a public relations program. He hired a writer to prepare a series of articles setting forth the importance of the work of the engineer district. Two appeared in one of the Honolulu dailies, the second one along with the favorable editorial. The public reaction was so adverse that the project was dropped.[55]

Change in Organization

For some time the War Department had been making plans to consolidate the engineer organization in the Islands more fully. Despite the reorganization made on 8 December, the explanatory letters from the Chief's Office, and statements by General Emmons, the organization was not functioning well. On 28 February the Secretary of War wrote to Emmons delimiting the responsibilities of the commanding general in Hawaii with regard to engineer work. Emmons, as commanding general, was completely responsible for "military construction . . . in the Department, including administration of existing construction contracts." [56] Within the limits set by Congressional legislation and War Department regulations he could transfer contracts of the department and the district to any command he wished. It was made clear that the district engineer was responsible to the Chief of Engineers only for work in connection with the improvement of rivers and harbors and flood control. All employees and all funds, equipment, and supplies of the district which were not included in the last categories were to be transferred to the department. Henceforth, whoever was department engineer would also be district engineer. Emmons, empowered to set the day for the consolidation, designated it as 15 March.[57] Wyman was returned to the United States and subsequently was assigned to the Canol project.

Colonel Lyman became head of the Honolulu District and at the same time continued to serve as department engineer. For the first time district and department were under one head. Lyman did not try to reorganize or unite the two offices; any attempt to do so would very likely have increased the confusion. The great gain was that Lyman had under him the military engineer organization in the islands and that his place in the chain of command was abundantly clear. He would be able to advise Emmons on the best course of action from the engineer standpoint, and as a member of his staff would not be subject to direct pressure from other commanders in Hawaii. Partly of native Hawaiian descent, Colonel Lyman was a member of an old and widely known island family; a graduate of Punahou and of West Point, where he had been a classmate of General Emmons, he understood well the local temperament and made every effort to improve public

[55] (1) Shepard, An Account of the Early Days of World War II at Punahou School. (2) Ltr, Nurse to C Mil Hist, 2 Jun 60. EHD Files.

[56] Ltr, SW to Emmons, 28 Feb 42. Reproduced in Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 30–32.

[57] Ltr, Lyman to Reybold, 27 Feb 42. Copy in Rpt of Pearl Harbor Army Bd, app No. 1, p. 56.

relations. Soon a marked change for the better was noticeable. There was no lessening in the urgency of the situation. The Japanese continued to enjoy naval preponderance in the Pacific and were still strong enough to attempt an assault on Hawaii.

Strengthening of Defenses Continues Under Lyman

Under Colonel Lyman, work continued on all engineer projects in the Islands. After mid-March great emphasis was put on construction for the air forces. In a conference held on the 30th of March, Emmons, Tinker, and Lyman discussed the construction effort still required. It was agreed that as regards Oahu, work on Bellows was especially urgent and that efforts would have to be speeded up on runways and housing at Mokuleia and Kahuku. At Kipapa, a new field on the central plateau, where some construction had already been done, activities for the time being would be limited to clearing cane, building runways to minimum standards, and providing housing for 225 officers and men. Greater efforts were needed on the airfields on the outlying islands. There the engineers were to remove the demolitions at Hilo and pave two of the runways. They were to pave the runways at Barking Sands as soon as they could get a hot-mix asphalt plant and transport it to the field. They were to continue construction at Homestead on the island of Molokai, the runways of which were to be surfaced with Marston mat or paved with asphaltic concrete. Work on a number of fields, including the one on small Lanai island, was canceled because the terrain and flying conditions were found to be unsuitable.[58]

A special type of project for the air forces was now requiring a considerable construction effort—this was the underground bombproof shop for repairing airplanes. The Honolulu District Office and Hawaiian Air Depot had started preliminary studies for such a shop early in 1941. In September General Short had asked the War Department to authorize construction near Wheeler Field; the War Department disapproved the project. Later the department reversed itself and authorized construction. General Short selected a site in a pineapple field southwest of Wheeler. Two days after Pearl Harbor, Wyman directed the Hawaiian Constructors to begin work. Since the project had the highest priority, it was soon under way. Late in February the Seventh Air Force proposed a different layout; Emmons approved, and in mid-April a new directive was issued. Plans now called for a bombproof cut and cover shop of three floors, air-conditioned throughout, with an elevator of 10-ton capacity. Diesels and generators taken from obsolete submarines would serve as a power plant of about 100,000-kilowatt capacity. A concrete slab roof, 10 feet thick, under a 5-foot layer of earth was considered sufficient to withstand ½-ton bombs and at the same time would be deep enough to permit the growing of pineapples for camouflage. The entrance, in a sheer

[58] (1) Memo, Emmons to Lyman, 1 Apr 42. (2) Interstaff Routing Slip, 2d Ind, AirO Hawaiian AF to Lyman, 25 May 42, on Ltr, Hawaiian Pineapple Co to Lyman, 24 Mar 42. Both in Engr AGF PAC.

cliff on the west side of Waiele Gulch and practically invisible from the air, was to be large enough to admit B–17's. Planes going to the repair shop would land on a runway to be built at the bottom of Waiele Gulch or would approach on ramps leading from Wheeler Field.[59] By May construction was proceeding satisfactorily.

By 1 June, the Hawaiian Islands were far more secure than they had been six months before. Airfields, coastal guns, fortified positions, antiaircraft batteries, offshore obstacles, underground shelters, and an alerted defense force would make an assault anything but easy. Lyman believed there were still certain weaknesses in the defensive system. For one thing, although the engineers had finished their share of construction on 12 of the aircraft warning stations—7 on Oahu and the rest on the outlying islands—none of the stations was as yet operating on a permanent basis, a deficiency made up to a considerable extent by the Signal Corps' use of mobile stations. He was also perturbed by the continued shortage of mines. The Hawaiian Department had requested 160,000 on 23 December, but by June only a few thousand had been received. In Lyman's view, large quantities were needed because of the few natural obstacles in the Hawaiian chain, and because so many airfields, close to excellent landing beaches, could be easily overrun. Yet, despite these minor deficiencies, the state of defenses could, on the whole, be considered encouraging.[60]

Some problems that had appeared earlier persisted under Colonel Lyman—notably shortages of equipment. Shortages existed while large amounts of machinery continued to pile up in San Francisco and Los Angeles for lack of shipping. Members of the Truman Committee, investigating the equipment situation late in March, came across large numbers of items at the Albany Race Track near Oakland that were scheduled for shipment to the Hawaiian Constructors.[61] On 28 March Col. Raymond F. Fowler, assistant chief of engineers for supply, in a memorandum to the Director of Procurement and Distribution, SOS, stated, ". . . every effort is being made to expedite shipment of available articles to San Francisco within the next 30 days." He explained that supplies and equipment were accumulating in California because of the scarcity of transports. "All requisitions received from Hawaii," Fowler stated, "have at present either been shipped from available stocks or placed on expedite procurement requisition." [62] On 1 April Colonel Hannum reported that 57,140 tons of equipment were on hand in Los Angeles and San Francisco for shipment overseas. But the shortage of ships was so great that

[59] (1) Hist Review, CE, U.S. Army, Covering Opns During World War II, POA, pp. 501ff. (2) Memo, Asst Dept Engr for Robinson, 9 Apr 42. Engr AGF PAC, 600.12 (Waiele). (3) Ltr, Brown to C EHD, 21 Dec 60.

[60] (1) 1st Ind, Interstaff Routing Slip, Dept Engr to Dept Ord Off, 11 May 42. (2) 2d Ind to Interstaff Routing Slip noted in (1), above, Dept Ord Off to Dept Engr, 30 May 42. (3) 3d Ind to Interstaff Routing Slip noted in (1), above, Dept Engr to Dept Ord Off, 2 Jun 42. All in Engr AGF PAC.

[61] Ltr, Mr. Hugh A. Fulton, Chief Counsel Truman Committee, to Julius H. Amberg, Spec Asst to SW, 12 Jun 42, copy in Hist Review, CE, U.S. Army, Opns During World War II, POA, p. 834.

[62] Memo, Fowler for Dir of Proc and Dist, SOS, 28 Mar 42. 400.312 HD, 1941–43.

the materials would probably remain on the wharves for months.[63]

Efforts to Resolve Administrative Problems

Also persistent were the difficulties of administering the contract with the Hawaiian Constructors. By 15 May forty-three supplemental agreements had been added to the original contract. The number of projects had risen to about 1,400. It was impossible to amend the contract and make supplemental agreements fast enough to keep pace with the changes and additions to the construction program. Nevertheless, Colonel Robinson and the Constructors reached agreement as to the over-all cost and the fixed fee as of mid-May—the total estimated cost of the work was $84,436,887; the fixed fee, $1,014,690.[64]

Criticism of the Hawaiian Constructors, growing in volume during the first months of 1942, became still louder. Colonel Lyman chose two officers and a civilian from the Honolulu District to review the question of whether the contract should be terminated. Having made their study, two of the men believed it should be; the third thought the interests of the government would be better served "by continuing the contract with clearly defined lines of responsibility and with the Government performing the function of administering and inspecting the work." All three believed the work should not continue under the contract unless a more efficient administration and more effective co-operation between the contractors and the government were achieved. A committee made up of representatives of the Hawaiian Constructors agreed. Lyman informed the Constructors on 9 May that a "substantial revision" would probably soon be made in the handling of construction in the Islands. The contract would not be terminated, but work thereunder would be greatly curtailed. In view of the changes, bound to ensue, the program of work included in the contract and the supplemental agreements would have to be reviewed again.[65]

Meanwhile the district initiated action to eliminate the confusion in finances by hiring additional help to prepare vouchers for payment. It set up a special "detective" section, whose job it was to find out who had signed the vouchers with illegible and unknown signatures; in turn area offices set up their own special "detective" sections to help with this work. Lyman accepted responsibility for vouchers which indicated the goods had been delivered to military units. Trying to find out who had received the materials was often a slow and laborious process; as a rule, the search began with the questioning of the clerk or driver who had delivered the goods. But progress was made. By May the Finance Section was forwarding some 300 certified vouchers a day to Lt. Col. Herbert Baldwin, finance officer of the Hawaiian Department. Some further delays resulted because Baldwin thought

[63] Ltr, SPD to CofEngrs, 1 Apr 42. 400.312 HD, 1941–43.

[64] Ltr, Kramer to Richardson, 14 Mar 44. Engr AGF PAC, 160 Contracts, vol. 1, p. 6.

[65] Rpt of Bd Appointed To Consider Termination of Fixed Fee Contract No. W-414-Eng-602, 6 May 42. Engr AGF PAC, 333 IG Rpts (Gen) vol. I.

the evidence presented with some vouchers that materials had been delivered to people entitled to them was not good enough. Numerous Honolulu merchants were still of the opinion that payments were much too slow.[66]

Early in June the war in the Pacific took a crucial turn. In the first months after Pearl Harbor, Hawaii had not been on the list of Japanese objectives. Japan's main concern had been to seize southeast Asia, the Philippines, and the Netherlands Indies, and, if possible, to cut the lines of communications from the United States to Australia. Having attained most of these goals in the first months of 1942, the Japanese prepared to strengthen their position still further by establishing a defense line to the east and northeast of their home islands—they would seize Midway and part of the Aleutians. By occupying Midway, Japan could extend her air coverage eastward from that island by 1,300 miles. Japanese planes could then sweep over the Hawaiian chain. In June, the Japanese successfully occupied Attu and Kiska, but their thrust at Midway met with disaster. In a battle between a Japanese task force and U.S. air and naval units northwest of Midway on 3 and 4 June, the enemy lost 4 aircraft carriers, 1 heavy cruiser, and some 250 planes, together with 100 of his best pilots.[67] The possibility of a serious attack on the Hawaiian Islands after that was considered most unlikely.

[66] (1) Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 141–42. (2) McCrone, Honolulu District and Pearl Harbor.

[67] (1) United States Strategic Bombing Survey (Pacific), Naval Analysis Division, *The Campaigns of the Pacific War* (Washington, 1946), pp. 58–60, 78–81. (2) Conn, Engelman, and Fairchild, *Guarding the United States*, p. 222.

CHAPTER IX

After Midway

The Battle of Midway was followed by an uneasy period as work on defenses continued and base build-up was accelerated to make possible the launching of offensives. Construction needs, despite the Japanese defeat, were still great. On 14 June Emmons wrote to Somervell that $50 million more was required for work in the Islands. Much remained to be done on airfields; Hickam, especially, needed a great deal of attention, since the runways were in danger of crumbling under the continuous, heavy traffic. The Seventh Air Force was pressing for the completion of additional construction—shops, warehouses, and storage for reserve gasoline. More aircraft warning stations were needed and considerable effort was still required on seacoast defenses, field fortifications, and bombproof storage for ammunition. The growing numbers of troops called for many more camps, warehouses, and hospitals. And there remained innumerable minor jobs, such as fencing critical areas, camouflaging, splinterproofing, and constructing and maintaining utilities. All this work required additional supplies. Some 200,000 tons were still needed—about 35,000 a month. The most pressing demands were for lumber, cement, and asphalt.[1]

[1] Ltr, Emmons to Somervell, 14 Jun 42. 600.1 Hawaii 1927-45.

Work on Defensive Installations Slows Down

As the weeks went by and the Army garrison increased to 100,000, the fear of invasion almost vanished and made work on purely defensive installations less urgent. Some defenses could even be eliminated. The Navy was no longer greatly interested in the seaplane basin in Keehi Lagoon. The request for large numbers of antitank mines was dropped. By July the Hawaiian Department had received 14,000, but there was no indication from Washington that any more would be sent. The need for antipersonnel mines had likewise lessened. Boat obstacles placed offshore lost most of their effectiveness, since the action of the waves had loosened them from their moorings, and they were removed in August.

The growing sense of security had an adverse effect on those projects still deemed important, and much of the work progressed slowly. This was particularly true of the coastal batteries. Headway on the 8-inch gun turrets, for example, was far less rapid than had been expected, and at some of the larger batteries, also, work was considerably behind schedule. One of the main difficulties at the coastal batteries was the short workday. The men had to be taken by car or bus to the job sites, some coming from as far as Honolulu. They

started work anywhere from 0800 to 0930, depending on the distance they had to travel; some quit at 1500. Absenteeism was common. Shortages of equipment, especially of power shovels, further slowed construction.[2]

Construction Tailored to Hawaii's Needs

Stress was now being placed on building up Hawaii as a base to support offensives and as a staging area to move troops westward. From December 1941 to October 1942 alone, the number of Army troops in the Islands rose from 42,000 to 132,000, and the archipelago was also crowded with Navy personnel and civilian war workers. Once again, the engineers had to make as much use as possible of existing facilities, and once again, they had to revise standard theater of operations drawings to meet local conditions. In an important overseas base such as Hawaii, where structures might be needed for an indefinite period after the war, the flimsiest possible construction consistent with safety was not necessarily the most desirable. Where standard theater of operations drawings were modified, it was done to improve and strengthen the buildings and at the same time make as much use as possible of local materials. In some cases the engineers even used critical materials if that was necessary to produce a more adequate building. Standard drawings prescribed earth floors for barracks and latrines; in Hawaii, the engineers installed floors of wood or concrete. The drawings prescribed waterborne sewage for hospitals only; in the Islands it was a feature of other buildings as well. Officers' quarters had interior plumbing and lounge space not called for in the original designs.[3]

Among the greatest changes were those made in troop housing. The first men to arrive in the Islands had been quartered in buildings on permanent posts; soon all space was filled. Quarters of the type built before Pearl Harbor were expensive to construct and required great amounts of now scarce materials. Construction of the 2-story, 63-man, mobilization-type barracks was also discontinued for still another reason. It could not be evacuated as rapidly as a one-story structure. During the attack on Pearl Harbor, men had been trapped on the upper floors in several of these structures.[4]

In any case, shortages, especially of lumber, made imperative the building of a more economical type of barracks. In January 1942 the district office prepared designs for "demountable buildings"—one-story prefabricated structures that could serve as barracks, and, if necessary, as warehouses or administration buildings. Sixteen and one-half feet wide, these buildings, which could be extended in multiples of ten feet, were erected rapidly. Roofs and inside

[2] (1) Ltr, Brig Gen Robert C. Garrett, Hq to C of Arty HD, 24 June 42. Engr AGF PAC, 662. (2) Memo, Of of C of Hawaiian Arty for General Burgin, 19 May 42. (3) 2d Ind, Interstaff Routing Slip, Lyman to CA HD, 5 Jul 42. Last two in Engr AGF PAC. (4) Ltr, Asst Dept Engr to CofEngrs. Engr AGF PAC, 660.3.

[3] (1) Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 369ff. (2) 5th Ind, Interstaff Routing Slip, Kramer to G–4 HD, 2 Nov 43. Engr AGF PAC.

[4] Hist Review, CE, U.S. Army, Opns During World War II, POA, p. 378.

walls were made of "canec," a local wallboard, manufactured from the waste products of sugar refineries. On all of the Islands, large numbers of the troops were quartered in pyramidal tents with wooden floors.[5]

More warehouses were needed. Late in March, Emmons wrote to Reybold, ". . . the expansion of the facilities to accommodate increasing storage needs in this Department requires that fifty . . . T/O type warehouses be constructed."[6] These fifty were in addition to the twelve requested in a letter of 5 March. In a number of ways, the theater of operations type of warehouse, like most theater-type structures, was not suitable for Hawaii. The district office designed a new model, from 50 to 110 feet wide, which could be erected in variable lengths and made the maximum use of local materials. The trussed roof made possible a 30-foot span, without the row of center posts that was such an objectionable feature of the theater of operations buildings. Eaves were wider because the roofs of the standard structures were too narrow to keep out the driving rains of the Islands. In most cases the prescribed floors of earth were covered with asphalt or concrete. The new design also made possible more economical construction. It required 19 percent less lumber and cost only two-thirds as much to erect. Originally warehouses were spaced 100 feet apart. As time passed and the chances of bombing became negligible, the distance was reduced to 50 feet.[7]

Honolulu Harbor

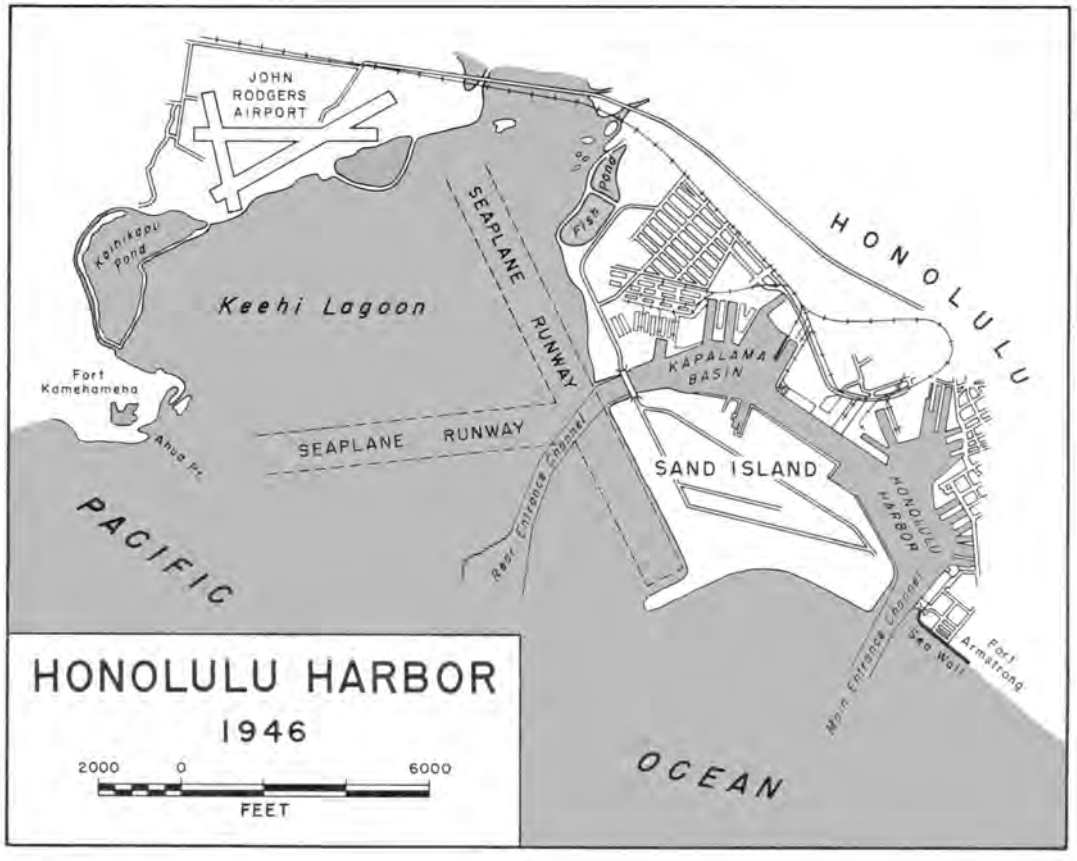
Before the Japanese attack the engineers were dredging Keehi Lagoon and Kapalama Basin and had started placing the fill for John Rodgers Airport. (*Map 18*) After 8 December they had the added responsibility of constructing piers and warehouses along the northeastern shore of the basin, a job previously charged to the Quartermaster Corps. The scope of most of this work greatly increased now that Honolulu harbor was jammed with ships. John Rodgers had high priority. This field, being built in an area of marshes and old fishing ponds, required an immense amount of fill, almost all of it taken from the seaplane runway areas in Keehi Lagoon. The engineers packed the coral at John Rodgers to an average height of 8 feet above low water level. At Kapalama, the dredge *S. G. Hindes* continued work on clearing a channel 1,500 by 1,800 feet to a depth of 36 feet to enable ocean-going vessels to come safely to the docking area. Along the shore, construction was under way on a host of piers, warehouses, and storage yards. The concentration of so many facilities in this small section of northwestern Honolulu was leading to serious overcrowding. In August Lyman suggested that the Army put some of its docks, warehouses, and storage yards on nearby Sand Island, thus providing badly needed facilities without increasing the congestion on the already overcrowded Honolulu waterfront.[8]

[5] *Ibid.*, p. 370.

[6] Ltr, Emmons to Reybold, 26 Mar 42. Engr AGF PAC, 633.

[7] Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 510ff.

[8] (1) Llewellyn, "Honolulu Harbor," *The Military Engineer*, XXXIX (February, 1947), 52. (2) Ltr, Secy of the Navy to CAA, 28 Aug 42. Engr AGF PAC.



MAP 18

Ammunition Storage

Ammunition was arriving in enormous quantities. Pre-Pearl Harbor estimates of the amount of storage space required had to be discarded. General Emmons, fully in accord with General Burgin's plan for dispersing ammunition, wanted storage at various places on Oahu. Smaller facilities were to be above the ground; large ones, underneath. After making reconnaissances, the engineers chose Wahiawa Gulch, about five miles northeast of Schofield Barracks, as the best site for the first large underground storage chamber, and began construction in March. Further investigation indicated that Kipapa and Waikakalaua Gulches in central Oahu afforded even better sites. Tunnels driven into the almost vertical walls of the two gorges would have entrances invisible from the air. To keep out bomb fragments, passageways to the storage chambers would be dog-legged or provided with baffles. The only drawbacks to these sites were lava formations and cinder pockets which would

necessitate timbering or concreting considerable portions of the chambers. By midsummer, the construction of storage areas above and below ground was well along.[9]

Road and Highway Repair

Deterioration of the highways was causing widespread alarm. "The main roads of Oahu," Emmons wrote to Somervell on 14 June, "are nearly destroyed now from heavy military traffic. These, in addition to some new roads, must be built." Meanwhile, the engineers were fully occupied in their struggle to keep the roads and trails on military reservations open. At the time of Pearl Harbor, the combat engineers, together with the units which used the roads and trails, were responsible for this work. The 34th Combat Regiment was busy mainly on the southern half of Oahu; the 47th General Service Regiment, having arrived in the Islands early in 1942, gradually took over from the 3d and 65th Combat Battalions on northern Oahu. Keeping roads on military posts in good repair was the responsibility of the district. Various civilian authorities maintained arterial highways, country roads, and the streets of Honolulu. The civilian authorities were fighting a losing battle. In March 1942, representatives of civilian and military agencies held a conference in Honolulu to work out a plan whereby equipment and manpower could be pooled for work on Oahu's principal highways. It was agreed that the civilian agencies would prepare a program of road maintenance for the island, and submit to the department engineer and the Navy an estimate of the total number of workmen and the amount of materials and equipment needed. Lyman and representatives of the Navy were to determine the relative importance of the various projects and fix priorities of construction. The engineers and the Navy would provide the means to carry out the work. Plans were made, but little, if any, improvement of the public roads resulted, principally because more important jobs had higher priority.[10]

A New Engineer

Lyman died suddenly of a heart attack on 12 August, two days after his promotion to brigadier general. The next day Emmons asked the War Department for a suitable replacement. Col. Holland L. Robb served temporarily as engineer while a search was made for a permanent successor to General Lyman. Reybold radioed Emmons that he believed Col. Hans Kramer, engineer of the Panama Canal Department, was "eminently qualified because of past construction experience, including the construction of additional locks for the Panama Canal." Emmons requested Kramer's transfer to Hawaii, and the Governor of the Panama Canal agreed to his release. Promoted to brigadier general on 18 September, Kramer ar-

[9] (1) Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 217ff. (2) Memo for Rcd, Col W. A. Capron, HD Ord Off, 13 Jul 42. Engr AGF PAC, DOO633/179.

[10] (1) Ltr, Emmons to Somervell, 14 Jun 42, 600.1 HD 1927–45. (2) HD GO No. 87, 20 Dec 41. (3) Memo, Lt Col Earl B. Lockridge, Asst Dept Engr, to Lt Col Frederick W. Herman, Asst Dept Engr, 26 Mar 42. Engr AGF PAC, 611.

rived in the Islands on the 26th and took over as department and district engineer.[11]

Base Build-up Continues

Kramer soon learned that the Engineers in Hawaii were still responsible for an extensive construction effort. The work yet to be done on airfields, even if of a minor nature, was of considerable scope; in the fall of 1942, the engineers were working on eight fields on Oahu alone. Not the least of the many projects on Oahu was the huge 3-story subterranean airplane repair shop. A still sizable job was the construction of the tunnels for reserve gasoline. In Waikakalaua Gulch, nine tanks, each to hold 40,000 barrels, were nearing completion. Enormously increased requirements for gasoline had necessitated construction of more tanks; storage for an additional 240,000 barrels had been approved. Soon after arriving in the Islands, Kramer proposed that tunnels be drilled in Kipapa Gulch, and late in 1942 work on the new tunnels began.

A striking feature of construction in Hawaii was that so many installations were being put underground. Among the big subterranean projects, besides the airplane repair shop and the gasoline storage tanks, which were either under construction or about to be started, were the joint Army-Navy operating center at Aliamanu Crater and the tunnels for ammunition in Kipapa and Waikakalaua Gulches. Many smaller installations, also, including even the telephone exchanges, were being put underground. These underground structures, built on a tropical island that at times had extremely heavy rains, were most unusual; they were "bone dry." In most tunnels in the tropics, even without leakage through rock faults, condensation was a serious problem. On Oahu, because of the remarkably low humidity (60 to 65 percent) and the small range in temperature (25 degrees) the installation of drainage or even the drying of the air was seldom necessary.[12]

Problems of Administration

Surveying the construction effort in Hawaii, Kramer found a number of areas where improvement was possible. He believed many engineers gave in too easily to commanders who wanted to expand their projects; the result was unnecessary construction. Numerous projects had "too many frills." Some installations were being graced with such features as concrete sidewalks and curbed streets. The demand for luxuries was widespread; requests were even coming in for chromium-plated coat hangers. "Engineers," Kramer stated at a conference with his key men, "particularly military engineers—must be realists. . . . Refined design is not needed for . . . most war installations. . . ." In numerous instances, Kramer

[11] Ltr, Brig Gen David McCoach, Jr., Asst CofEngrs, to G–1 SOS WD, 17 Aug 42. 210.3 HD 1940–42.

[12] (1) Ltr, Ostrand to Emmons, 9 Nov 42. Engr AGF PAC. (2) 5th Ind, Interstaff Routing Slip, Engr to G–4 HD, 1 Sep 42. Engr AGF PAC, DOO381.4/459. (3) 5th Ind, Interstaff Routing Slip, Kramer to G–4 HD, 1 Oct 42. Engr AGF PAC. (4) Col G. R. McMeekan, British Army Staff, Rpt on a Visit as Engr Observer to Central Pacific, Aug–Sep 44. EHD Files.

felt, the engineers were adding to the cost by inadequate planning. For example, with the rainy season approaching, or already under way in some areas, buildings were going up without access roads or with roads so poor that the first rains washed them out entirely. Plans for one underground shop provided for gravity drainage, but water was being pumped out during construction, when permanent drainage could have been installed and utilized from the first. "Don't trust to dry weather from now on," Kramer warned.[13]

The new district engineer soon had to turn his attention to the contract with the Hawaiian Constructors. Quite a few changes had been made during the preceding months. In May, Lyman had informed the Constructors that the amount of work would be curtailed. Soon thereafter, the first jobs were transferred to the government, to be completed by hired labor, engineer troops, or, in a few cases, by local firms working under lump-sum contracts. By midsummer numerous jobs had been transferred. The canceling of some projects, the transfer of others, and last-minute additions to still others required a revision of the figure of $84,436,887 which the engineers and the Hawaiian Constructors had agreed in May was a fair estimate of the total cost of the work up to that time. In weeks, even months, of conferring, the two sides could come to no agreement. A number of preliminary matters had been settled, however. Late in August the engineers and the contractors reached agreement as to the extent of the cutback in the contractor's efforts up to that time, and early in September they arrived at an accord on how much work was covered by the forty-three supplemental agreements. Still to be decided was the question of how much work the Constructors had under way or had finished which was not included in the original contract and the supplemental agreements.[14]

After Kramer arrived, the burden of the discussions centered on how the contract should be terminated. This led to an acrimonious wrangle. Some of the engineers believed it should be terminated because of the fault of the contractors; Kramer's position was that since both government and contractor had made mistakes, termination should be at the convenience of the government. Ending the contract on that basis would probably mean retaining, at least for a time, the good will of the contractor and his employees. Another matter of contention coming more to the fore was the amount of the fixed fee. The Hawaiian Constructors felt that the many supplemental agreements and the countless changes in the work had made the fee hitherto agreed upon entirely inadequate. Meanwhile, confusion increased as job after job was transferred to the government. Many of the contractors' employees did not look forward to working for the government any more than the government employees relished the

[13] Notes on Confs presided over by Gen Kramer, 30 Sep 42, 18 Jan, 15 Feb 43. Engr AGF PAC, 337 Confs.

[14] (1) Ltr, Kramer to Richardson, 14 Mar 44. Engr AGF PAC, 160 Contracts, vol. 1. (2) Ltr, Lt Col Edward H. O'Rourke, Asst IG HD, to Emmons, 24 Jul 42. Engr AGF PAC, 333 IG Rpts, 10th Field Area, File 1.

prospect of working with the contractors' men. "Some feeling exists," Kramer remarked, "that, by and large, every Hawaiian Constructors' man is a scoundrel." To make the transition as smooth as possible, Kramer held numerous conferences attended by key engineer employees and representatives of the Hawaiian Constructors.[15]

On 31 January 1943 the contract was terminated at the convenience of the government. Up to that time the engineers had paid a fixed fee of $541,031. They had bought $625,051.75 worth of used equipment from the Hawaiian Constructors and had paid them $124,105.05 for the rental and recapture of new equipment. The debate over the full amount of the contract and the fixed fee continued. Two of the most vexing problems were to determine what changes had been made in various jobs and how much work had been done which had not been stipulated in the original contract and in the supplemental agreements. Representatives of the Hawaiian Constructors and the engineers held many meetings to iron out differences; they were to have months of work ahead of them.[16]

On the whole, the Honolulu District seemed to be plagued by more than the usual difficulties and inefficiencies. To improve the work, General Kramer set up the "Bottleneck Busting Division" in January.[17] Headed by Colonel Nurse, the new unit had a difficult assignment. Its major job, Kramer announced, was "locating and removing . . . all forms of obstruction—too much or too little labor, slackers who cheat and chisel . . . favoritism and cliques, grievances and jealousies, boondoggling, lack or mis-use of equipment."[18] The division was to deal at first primarily with problems on Oahu; those on the outlying islands would be gone into later. Insofar as possible, the members of the division were to make use of the technical assistance of men working on the jobs being investigated; a small force would do administrative and supervisory work in the district office. Colonel Nurse's men found the greatest inefficiencies in connection with the assignment of the workmen to the various projects. Many, improperly classified, were not doing the jobs they were best qualified for. Some projects had too many workers; others, not enough. Low morale and loafing on the job were all too common. A number of projects were administered haphazardly at best; at some, the workmen did not even have regular paydays. By mid-February, about 400 "bottlenecks" had been broken—an average of 14 a day. Difficulties nevertheless continued, and complaints about inefficiency kept coming in. A new problem arose. Because the amount of construction required was diminishing, there was a surplus of some types of labor. "We have been fighting absenteeism," Kramer told key officers and civilians of the district as late as 10 April. "I assure

[15] Rpt of Kramer Conf, 18 Jan 43. Engr AGF PAC.

[16] Ltr, Kramer to Richardson, 14 Mar 44. Engr AGF PAC, 160 Contracts, vol. 1.

[17] Honolulu Engr Dist, Dist Order No. 1, 1 Jan 43. Reproduced in Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 1324–26.

[18] Rpt of Kramer Conf, 15 Feb 43. Engr AGF PAC.

you that loafing, idleness, and laxness on the job are going to disappear." [19]

Despite two years of continuous construction, there was still a great demand for new projects. Kramer's office made an analysis of all requests received by the engineers during the period from 15 February to 15 April 1943; during these two months, 576 came in, of which 101 were disapproved. Of those approved, most were for more troop housing, more water, power, or sewerage facilities, especially for the Seventh Air Force, the improvement of piers, the construction of more warehouses, and the strengthening of fortifications. Of the projects approved, only 14 could be regarded as of major importance.[20] There were great numbers of requests for minor construction. "The current uninterrupted flow of directives authorizing minor . . . work at stations where the major program has already been completed . . . is unduly delaying the desired reduction of overhead and construction personnel," The Adjutant General stated in a memorandum of 2 April, addressed to the Army as a whole.[21] Another memorandum sent out on 15 April directed: "Spartan simplicity must be observed. Nothing will be done merely because it contributes to beauty, convenience, comfort, or prestige." [22]

These instructions seemed especially applicable to Hawaii. The Islands were in a theater of operations and were considered a better than average training area for combat troops. In camps where the troops were to be toughened, such comforts as electric lights, hot water, and flush toilets were not essential. To make matters worse, some commanders in the Islands seemed to feel that tactical troops should be exempt from labor duties. The engineers held that this belief was incorrect. Troops occupying an area should perform such simple jobs as clearing weeds and underbrush, digging ditches for drainage, and doing minor road repair. But, as in other theaters, restricting construction to essentials was difficult. Lt. Col. W. H. Johnson of the Supply Division, OCE, in a memorandum of 26 May 1943 stated, "Hawaii recently submitted a very comprehensive and bulky estimate in six parts embracing over 400 pages and calling for a large amount of air compressors, air diffusers, water valves, thermostats and coils, all of which are to be used principally in installing air conditioning equipment." Johnson went on to say that all these supplies were being requested despite the fact that the status reports from the Hawaiian Department indicated that depots were well stocked with these items.[23]

Construction Progress

Much progress was made in 1943. Work on airfields on Oahu moved ahead steadily, and the underground airplane repair shop was beginning to take shape. By fall, the military outlook had improved so much that the blocking of airfields on the outlying island was dis-

[19] Rpt of Kramer Conf, 10 Apr 43. Engr AGF PAC.

[20] 1st Ind, Interstaff Routing Slip, Kramer to CG/SF, D/C, n.d. Engr AGF PAC.

[21] AG Memo No. W100-7-43, 2 Apr 43.

[22] AG Memo No. W100-10-43, 15 Apr 43.

[23] Memo for Rcd, Johnson, 26 May 43. 400.291 (HD) 43.

continued and at the same time obstacles on grazing lands and pineapple and cane fields on all the islands were removed. Improvement of Honolulu harbor was continuing. By early 1943, five new warehouses at Kapalama Basin were almost finished, and work was well along on two new piers. Army and Navy officials and businessmen in Honolulu had for years stressed the need for a second harbor entrance; now something was being done about it. In February the engineers began to clear underwater obstacles for a second entrance across Keehi Lagoon to Kapalama Basin; at the same time they prepared plans for piers and warehouses to be built on Sand Island. Although the Navy was no longer greatly interested in the seaplane runways in Keehi Lagoon, dredging continued mainly as a quarrying operation to provide coral for John Rodgers Airport. The engineers provided more camps, staging areas, and rest and recreation centers; in midyear, they started work on a number of general, field, and evacuation hospitals, and began surveys for a huge new structure to replace Tripler General Hospital, located northwest of Honolulu. At the same time, some of the schools taken over for hospitals were being returned to the civilian authorities. Still two of the most unusual projects were the drilling of tunnels in Kipapa Gulch for the storage of reserve gasoline and the emplacement of the big naval guns. The tunnels consisted of four parallel, cylindrical excavations, 938 feet long and 22 feet in diameter, with a cover of 200 feet of solid rock. They were being lined with steel plate. Insofar as the engineers in Hawaii could determine, these were the first steel-lined tunnels for storing gasoline ever constructed. Final locations for the big guns were selected by April. The Navy, making good progress in salvaging the turrets, had them ashore by midyear; installing the batteries proved to be even more complicated than earlier engineer estimates had indicated. Detailed plans for the design and assembly of of naval turrets on land were nonexistent. Kramer set up a warehouse near Pearl City to store the hundreds of small parts which were salvaged or newly fabricated, and Emmons appointed a board of four officers, including an engineer, to expedite the work of emplacement. One project on which no progress was made was the repair of disintegrating roads and highways. Army commanders were inclined to feel it was the responsibility of local civilian officials to maintain and repair roads and streets, particularly since local tax revenues had increased enormously during the war, with much of the additional money coming from the armed services. The civilian authorities did not agree, and a workable program of road improvement was not initiated. On the whole, by late 1943, much of the major construction in the islands had been completed. The new work the engineers received was mainly for additional facilities at some of the airfields.[24]

[24] (1) Ltr, Maj Edward A. Flanders, CO 804 Engr Avn Bn, to Richardson, 5 Oct 43, with 1st Ind, G–3 HD to Engr HD, 11 Oct 43. Engr AGF PAC, 661. (2) Kramer to Emmons, 1 Feb 43, Rpt, Comprehensive Study of Honolulu Harbor and Vicinity, Including Kapalama Basin, Keehi Lagoon, and Sand Island. Engr AGF PAC. (3) Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 173ff. (4) Draft of Ltr, Kramer to Reybold n.d. Engr AGF PAC. (5) Ltr, Lt Col O. M. McDale, Asst AG

Supply

The supply system was working satisfactorily after mid-1942. During the remainder of that year, stocks were, as a rule, arriving from the mainland in ample amounts and in excellent condition. Only occasionally were they poorly packed or improperly labeled. If an item was in short supply, local merchants could often furnish it; this was generally true with regard to fortifications materials. Shortages remained in lumber and in parts needed for the tanks for reserve gasoline storage. Machinery was fairly plentiful.[25] "The largest part of the equipment ordered and required is now on hand," Emmons had written to Somervell on 14 June 1942. "Some additional items have been ordered. The tonnage involved is not appreciable." [26]

Spare parts were scarce in 1942. None of the stocks requisitioned from the mainland arrived that year; most of those on hand came from local sources. Parts supply units were lacking. Arriving three months after the attack on Pearl Harbor, the 1st platoon of the 452d Depot Company had taken over spare parts supply from the 34th Engineers, but the platoon was not much better trained than its predecessor in the work of stocking and distributing parts. There were no maintenance units, but this was not so serious a matter because local mechanics were available for servicing machinery.[27]

In 1943 stocks of materials, equipment, and spare parts constantly increased as requisitions sent to the mainland were being filled and shiploads of items reached Honolulu. With construction tapering off late that year, supplies were no longer so urgently needed and the amounts on hand were adequate in most respects. Stocks of equipment were sufficient. Even spare parts became fairly plentiful. The first shipments ordered from the mainland had begun to arrive in January 1943, and by April fairly large quantities were coming in. As before, local firms manufactured some parts and reconditioned others. As in other theaters, principal shortcomings in supply were the lack of a continuous inventory and the absence of over-all stock control. Steps were taken to improve matters. Early in 1943 the 452d Depot platoon was expanded into a company, and one of its platoons was assigned to the spare parts section of the engineer depot. Progress was slow. A representative of the Engineer Spare Parts Depot in Columbus, Ohio, inspecting spare parts supply in Hawaii in January 1944, commented on the need for better organization and stock control.[28] So far, there had been no great pressure on engineer supply in Hawaii. The coming offensive would undoubtedly change this unusual state of affairs. "Hawaii has been on the receiving end for some time," Somervell

HD, to Comdt, 14th Naval Dist, 18 Apr 43. Engr AGF PAC, PLA-Engr 662. (6) Ltr, Richardson to Hon Ingram M. Stainback, Governor of Hawaii, n.d. Engr AGF PAC, 611.

[25] Col Brendan A. Burns, Dep Dept Engr, G–4 Periodic Rpt, 5 Nov 42. Engr AGF PAC, Engr 400.

[26] Ltr, Emmons to Somervell, 14 Jun 42. 600.1 Hawaii 1927–45.

[27] Hist of the 452d Engr Depot Co.

[28] (1) 1st Ind, Interoffice Memorandum Slip, Engr Depot to Dept Engr, 8 Jul 43. (2) Ltr, Maj Howard H. Dougherty to C Parts Sup Sec Engr Field Maint Off, Columbus, Ohio. Both in AGF PAC.

wrote to General Marshall from Hawaii in September. "It must now reorient its thinking and its organization to be on the sending end of the performance." [29]

Meanwhile, the engineers were trying to straighten out their accounts and pay what they owed for supplies they had received from local merchants. As old bills were paid off, new ones kept coming in. At the end of 1943 payment of $1,000,000 was held up because the district contracting officer and the finance officer could not agree on the validity of numerous vouchers. Because payments were so slow, the engineers were still not popular with many of the local businessmen.[30]

Maps

Since the Central Pacific was not involved in combat during 1942 and the first months of 1943, the engineers had to devote only a minimum effort to preparing maps. The department engineer was responsible for supplying maps to the troops; needs were in large part met by the Hawaiian Department Reproduction Plant, operating under the department engineer's command. Draftsmen periodically revised the topographic maps of the United States Coast and Geodetic Survey and printed the revised versions needed for military purposes. Before the war, Lyman had maintained his small stock of maps, together with hydrographic charts, in concrete vaults at Fort Shafter. The 64th Topographic Company, arriving late in 1942, was the only mapping unit in the Islands. With little to do, part of the men were sent out to make surveys of tracts of land the War Department had acquired or was interested in.[31]

This easygoing state of affairs changed in mid-1943. The 64th engineers, henceforth working under "war" conditions, had to prepare maps of Japanese-held islands from photographs supplied by Army or Navy fliers. The men had had little or no experience in preparing such things as "beachstrip mosaics" or in using indifferent photography, obtained by aircraft in spite of bad weather and enemy opposition, but they secured the needed equipment and began work. In 1943 Navy fliers, taking off from carriers west of Hawaii, provided a constantly growing number of photographs for the 64th to work with. The unit co-operated closely with other Army and Navy elements in Hawaii interested in map production and the gathering of intelligence, such as the Seventh Air Force, the Intelligence Center, POA, and the reproduction plant of the engineer department. Soon the men were able to produce on short notice the maps expected of them. The 64th engineers, in addition, made maps and did drafting for the Navy. By late 1943, their work load had increased so much that more men were needed, especially those skilled in drafting, photomapping, and reproduction. Also needed was more equipment for interpreting data supplied by aerial reconnaissance. Best suited for

[29] Memo, Somervell for Marshall, 12 Sep 43. OPD 384 PTO sec. 111, Cases 57–89.

[30] Allen, *Hawaii's War Years*, pp. 282–83.

[31] (1) Memo, Brown for Robb, 17 Jun 42. Engr AGF PAC, 600.92. (2) Memo, Maj John H. Donoghue, Asst Dept Engr, to Kramer, 21 Oct 42. Engr AGF PAC, 061.

the Central Pacific was a GHQ topographic battalion, less one company. The plan was to expand the 64th into such a unit in 1944.[32]

Training

In the rush to complete construction after Pearl Harbor, the engineers had to neglect training. As a rule, the men learned by doing—by going out and building runways, warehouses, roads, fortifications, and obstacles. From time to time, the combat engineers participated in maneuvers designed to test various aspects of the defense plans. The coming offensives forced the engineers to emphasize training as never before. It was especially important to prepare the men for combat. Soon after arriving in Hawaii, Kramer stressed the need for something better than the sketchy instruction being given. He believed, for example, that more training in removing mines was necessary and that qualified instructors—men who had had actual experience in removing enemy mines in a combat zone—should teach the troops. Despite the increased emphasis on training, inadequacies persisted. In March 1943 the Inspector General reported that there was still insufficient stress on preparing troops for combat. The difficulty was that commanders were expected to get the work done and train the troops at the same time. In the fall of 1943, engineer training was stepped up. The troops received more training in small arms fire. Some men were given instruction in laying Marston mat, and specialists were trained in using flame throwers. A school was started to provide instruction in operating water stills. A major drawback in the Hawaiian Islands was the absence of sizable rivers. Little could be done to give the combat engineers adequate training in putting up ponton bridges and in using expedients for crossing streams. In any event, Kramer wanted all units that were alerted for movement to the combat zones to get at least some "catch-as-catch-can training." [33]

Plans for the Offensive

Early in 1943 the Joint Chiefs of Staff began to make plans for an offensive in the Central Pacific to start later that year. At the TRIDENT Conference in Washington in May, they obtained British agreement to a drive from Hawaii to Japan that would begin with the capture of the Gilbert Islands, to be followed by the seizure of the Marshalls. These assaults were to have a higher priority than any possibly conflicting operations in the South or Southwest Pacific. On 1 June Lt. Gen. Robert C. Richardson, Jr., replaced Emmons as commander of the Hawaiian Department. On 14 August General Richardson became the head of the newly activated United States Army Forces in the Central Pacific Area (USAFICPA). He chose Kramer as his engineer. On 1 September Kramer merged the department and district organizations into the Engineer Office,

[32] Ltr, Kramer to Loper, 26 Sep 43. Engr AGF PAC, 061.

[33] (1) Hist Review, CE, U.S. Army, Opns During World War II, POA, pp. 819Dff. (2) Kramer Conf, 6 Mar, and various confs in Jun, Aug, and Sep, 1943.

Central Pacific Area, but the two components continued to have their separate functions. Kramer appointed two deputies—Lt. Col. Desloge Brown, to supervise the activities of the department, and Col. Benjamin R. Wimer, those of the district.[34]

For the coming offensives, Admiral Nimitz set up a joint Army-Navy staff to replace the Joint Logistical Board, POA, which had heretofore resolved supply problems pertaining to both services. The new Joint Staff, POA, directly under Nimitz, had four divisions. Two of them, J–1 and J–3, were headed by Navy officers, and two, J–2 and J–4, by Army engineers. J–2 was under Col. Joseph J. Twitty. He established close contact with Kramer's office with regard to engineer intelligence and mapping. J–4 was headed by Brig. Gen. Edmond H. Leavey, who for many years had worked under Somervell as one of his most capable assistants. In 1943, while Leavey was serving in the Mediterranean Theater, Somervell recommended him for the important assignment on Nimitz' staff. There had been some feeling among high ranking Navy officers, among them Admiral King, over having Army men on Nimitz' staff. Somervell, visiting Hawaii during his tour of the Pacific areas in the fall of 1943, reported to Marshall that Leavey's arrival in Hawaii had been "more or less of a bombshell." But owing to his "outstanding capabilities" he had been "well received." Harmony had apparently been established, since Leavey was living in Navy quarters with the other three members of the Joint Staff. Somervell expected that Leavey would "secure the proper arrangements in the logistics field" through his "tact and downright capacity." [35]

One of the shortcomings of the Joint Logistical Board had been that it did not provide sufficient over-all direction and co-ordination in Army and Navy planning for construction and supply at new bases. The board merely co-ordinated plans already prepared independently by the services. Thus, in advance of each operation, Army and Navy would arrive at a formal agreement as to which facilities and what supplies each would provide for its own use and which each would provide for joint use. Difficulties arose in co-ordinating Army and Navy plans already prepared, especially to prevent unnecessary duplication of such facilities as hospitals, post exchanges, and communications systems. At times, Army and Navy disagreed considerably on how joint supply should be handled. Since the operations so far undertaken had involved the occupation of small islands with no enemy resistance, the difficulties had not been insurmountable. As planning began for more extensive operations, the problems of co-ordination loomed larger.[36]

The Joint Staff, patterned after the concept of the Army General Staff, modi-

[34] (1) U.S. Army Forces, Mid Pac and Predecessor Comds, MS, vol. 3, pp. 360ff., pp. 427ff. OCMH Files. (2) Kramer Conf, 18 Sep 43.

[35] (1) Ltr, Kramer to Loper, 26 Sep 43. Engr AGF PAC, 061. (2) McMeekan, Rpt on Visit as Engr Observer to Central Pac, Aug–Sep 44. (3) Memo, Somervell for Marshall, 12 Sep 43. OPD 384 PTO sec. III Cases 57–89. (4) Min, Staff Conf ASF, 6 Nov 43. Staff Conf, ASF, 337.

[36] Min Staff Conf, ASF, 6 Nov 43. Staff Conf, ASF, 337. (2) Ltr, Leavey to C EHD, 21 Jun 61. EHD Files.

fied to meet conditions in the theater, provided greater over-all direction and co-ordination. In accordance with directives from Admiral Nimitz, it was to prepare a master plan for each operation in advance. J–3 developed the over-all operational plan; J–4 worked out a detailed logistics plan. Both plans were co-ordinated and then discussed with the senior staffs of the various service commands in Hawaii and, if necessary, altered to meet available means. Meanwhile, the Joint Staff prepared the final command directives, which it discussed informally with the staff members of the task force scheduled to conduct the operation. These directives set forth responsibilities for construction and supply, allocated shipping space, and established shipping priorities. Upon receiving their formal directives, task force commanders completed the details of their plans and set out to obtain such additional men and supplies as they needed. Major Army and Navy administrative commands screened requests from task force commanders and computed over-all space and tonnage requirements, which they forwarded to the Joint Staff for final review. Insofar as the Engineers were concerned, the new system not only eliminated some unnecessary duplication in construction and supply, but also centralized responsibility for construction. Each new base would have one engineer, either Army or Navy, directly responsible to the base commander for all construction.[37]

One of the most important responsibilities of the Joint Staff was the shipping of supplies in the proper priorities. Leavey's section had the main responsibility for fixing priorities. Having a representative of the Army in this important job would, Somervell believed, result in better conditions than in the South Pacific, where the Army was at a disadvantage because it was completely dependent on the Navy for getting its supplies sent forward. One of the aims of the staff was to work toward "direct loading" from San Francisco, that is, sending supplies straight to the islands where they were to be used, which would mean bypassing Hawaii.[38]

The new procedures had to be developed gradually. Since campaign plans were formulated some time in advance, those already prepared had to be brought under the new system in somewhat piecemeal fashion and co-ordinated as quickly as possible. When the Joint Staff took over on 6 September 1943, planning for the assault on the Gilberts was already so far along that little could be done to revise arrangements already made. Little could have been done in any case, since the Joint Staff had to spend many weeks in assembling personnel to take care of its multitudinous duties. The staff had to be set up on an experimental basis, since there was no headquarters organization which might have been used as a model. Leavey estimated that 85 officers and 120 enlisted men were needed for J–4 alone; as the war progressed, this estimate proved to be too low. Men began arriving in fairly adequate numbers in the fall of 1943 and

[37] (1) Ltr, Leavey to C EHD, 21 Jun 61. EHD Files. (2) Memo, M. W. Marston for Richardson, 11 Sep 43. OPD 384 PTO sec. III Cases 57–89.

[38] Memo, Somervell for Marshall, 12 Sep 43, OPD 384 PTO sec. III Cases 57–89.

set to work to make the new procedures more effective for operations scheduled to take place after the capture of the Gilberts.[39]

By the fall of 1943 the Central Pacific was ready to launch its first offensives. Hawaii had been converted into a powerful base. The fleet, having overcome the setback it received in the Pearl Harbor debacle, was prepared to strike. The Army was also ready. By 1 October the number of troops in Hawaii numbered 165,423, with the engineers totaling 10,626. Ample and well-trained manpower was on hand to seize some of the Japanese-held islands in the Central Pacific.

First Offensives in the Central Pacific

Baker Island

The offensive got under way in late 1943. The Gilbert Islands, the first objective, were about 2,500 miles southwest of Hawaii; in Allied hands they would provide sites for bases to support operations farther west and would strengthen the lines of communications from Hawaii to the Southwest Pacific. Before the Gilberts could be attacked, certain preliminary operations were necessary. In August, Nimitz ordered the occupation of three small islands east and southeast of the Gilberts and the building of airfields on them. They were Nukufetau and Nanomea in the Ellice chain, and Baker, a lone islet some 500 miles east of the Gilberts. Marines and naval construction battalions were sent to Nukufetau and Nanomea. An Army task force was to go to Baker, garrison the island, and build an airfield. The 804th Aviation Battalion, commanded by Maj. Edward A. Flanders, had the job of construction.

On the morning of 1 September, the task force reached its destination. The island, one mile long and almost a mile wide, was rimmed by a narrow beach behind which the coral rose to a height of about twenty feet. The sand on the beaches was so deep that no equipment except bulldozers could move forward. Men of the 804th dozed roads across the landing beaches, laid down Sommerfeld mat, and cut roadways through the island's rim to the central plateau. A reconnaissance party, making a survey the morning of the landing, found the center of the island was a dry basin. The runway site which had been selected was not the best, and a new center line was run so that a longer strip could be built. Grading began shortly after noon. Seven days later it was complete and 3,000 feet of Marston mat was in place. The runway was adequate for fighters, and soon an Army fighter squadron moved in. Bombers taking off from this field could reach the western Marshalls, a feat hitherto impossible from any Allied base.[40]

[39] (1) Ltr, Leavey to C EHD, 21 Jun 61. EHD Files. (2) Memo, Brig Gen John E. Hull, Actg ACofS for G–1 and G–3, 22 Dec 43. OPD 384 PTO sec. III Cases 57–89.

[40] (1) Philip A. Crowl and Edmund G. Love, *Seizure of the Gilberts and Marshalls*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1955), pp. 52–53. (2) Ltr, Lt Col George E. White, Jr, to CG CPA, sub: Outline Rpt on Ldg and Cons Opns at Baker Island. EHD Files. (3) Participation of USAFICPA in GALVANIC Opn, p. 145. 98–USF3–03(23507). (4) Final Close-out Rpt on Baker. 98–BC4–0.1 (19840) Master.

Makin

Three of the Gilbert islands were to be captured—Tarawa and Apamama by the Marines, and Makin by the Army. Makin was one of the northernmost atolls in the island chain. The 165th Regimental Combat Team of the 27th Infantry Division was selected for the assault; Company C and part of Headquarters Company of the division's 102d Engineer Combat Battalion were to go in with the infantry. The planners in Hawaii concluded that large numbers of service engineers would be needed during the assault phase; they therefore gave the 152d Combat Battalion the job of unloading supplies and equipment.

To defend the bases to be built on the islands seized from the Japanese, General Richardson organized a new type of unit, the defense battalion, patterned after a similar kind of organization in the Marine Corps. Engineer service units and Seabees would be responsible for building bases and, together with the defense battalions, would constitute the "garrison forces" of the islands. Some of the islands would have garrison forces composed solely of Marine and Navy units; others, entirely of Army units; still others of all three. An Army or Navy officer would serve as island commander. If both Army and Navy units were used, care would have to be taken to prevent duplication of functions and organization; as already indicated, each island commander would have one staff engineer.

Elements of the 34th Combat and 47th General Service Regiments, both of which had seen long service in the Hawaiian Islands, were scheduled to serve in the first garrison forces being organized. Any island worth taking in the Central Pacific would probably already have an enemy-built airfield which could be rehabilitated. If none existed, one would have to be built. In that case, aviation engineers would be assigned to the garrison force until the field was finished, whereupon they would return to Hawaii. All other construction would be the responsibility of the 34th or 47th Engineers. If an airfield already existed, the 34th or 47th Engineers would rehabilitate it, build fortifications, erect housing, and operate and maintain utilities. Two companies of the 47th and the entire 804th Aviation Battalion were assigned to the Makin operation; the service engineers totaled 1,169 in a garrison force of some 4,000 men.[41]

The engineers did detailed planning for assault and construction. Planners in major theater headquarters and on the newly organized staff of Col. Clesen H. Tenney, garrison force commander, made estimates of the amount of construction needed. Kramer's staff reviewed the requests, and prepared a plan for base development which listed in detail all the construction the engineers would do. Estimates were then made of the amount of supplies required, and detailed lists of materials needed during the first ninety days were prepared. Supplies earmarked for the operation were to be shipped in three priorities. The 64th Topographic Company fur-

[41] (1) Participation of USAFICPA in GALVANIC Opn, pp. 16–18, 45ff. (2) Memo, Marston for Richardson, 11 Sep 43. OPD 384 PTO sec. III, Cases 57–89.

nished about 100,000 copies of maps prepared from aerial photographs.[42]

The task force reached Makin atoll on 20 November. The troops were scheduled to land on narrow, heavily wooded, 9-mile-long Butaritari Island, on the southeastern side of Makin's triangular-shaped lagoon. (*Map 19*) The men came ashore at two points: on the western end of the island and on the lagoon side. Each of the three platoons of Company C, 102d, went in with its battalion landing team, an engineer squad equipped with bangalore torpedoes going ashore with the first wave to remove obstacles which might impede the landing. Enemy opposition was light, and both beaches were clear of obstructions. As soon as the beachheads were established, the 152d engineers began unloading supplies, each company supporting one battalion landing team. The men did not have an easy time of it. The beaches at the western end of the island were rocky; and on the lagoon side the landing craft grounded in shallow water 600 feet from shore, forcing the troops to reload supplies on Alligators and Buffaloes. Two of the objectives of the infantry landing on the lagoon side were King's Wharf on the east and On Chong's Wharf, on the west. The first fell without a fight; the second, taken after a brief struggle, was heavily damaged. The engineers soon had the former in operating condition, and by the second day, all shore parties of the 152d were busy at this pier unloading LST's, soon helped by the 804th engineers, part of whom landed that day.[43]



MAP 19

Aerial photographs indicated that almost all defenses were between two tank barriers which extended across the island, one of them about a half mile west of the lagoon landing area and the other about a mile to the east of it. At both the Japanese had dug moats and placed coconut logs in the ground to stop tanks. A most important task of the landing forces was to capture the defenses between the barriers. The troops advancing inland from the west end of the island continued

[42] Participation of USAFICPA in GALVANIC Opn, pp. 50ff.

[43] (1) Crowl and Love, *Seizure of the Gilberts and Marshalls*, pp. 75ff. (2) Col Brendan A. Burns, Makin Task Force Engr, 20 Dec 43, Rpt and Recommendations, Makin Task Force Engr. Engr AGF PAC.

to meet light resistance. Those coming ashore at the lagoon pushed across the island and then veered to the east and west. Here too opposition was unexpectedly light. Only a few defense works—antitank gun positions, machine gun emplacements, pillboxes, and air raid shelters—were encountered. The infantry bypassed the strongest of these, leaving a few riflemen to cover them. The 102d engineers then moved up and demolished them with explosives.[44]

Some of the troops moving westward from the lagoon area were stopped by a concrete shelter, about thirty feet long. It had blastproof entrances at either end. When the men tried to reduce the obstacle by tossing in hand grenades, the occupants threw them out again. A tank moved up, firing 75-mm. shells, but without effect. A new maneuver was tried. The tank, followed by 2 infantrymen with automatic rifles and 4 engineers, 2 with rifles and 2 carrying a flame thrower and pole charges, moved up slowly to one of the entrances and stopped within a few feet of it. While the riflemen covered the opening, the 2 engineers with flame thrower and pole charges crept toward the shelter. The flame thrower, still wet from the landing, failed to function. One of the men, taking about a minute, placed a pole charge with a 15-second fuze attached just inside the entrance. The group scrambled for cover. The explosion killed the occupants.[45]

The infantry advancing eastward from the lagoon landing area ran into the island's most strongly fortified area; it consisted of a system of pillboxes and shelters, a number of them connected by passageways, some underground and some above ground. Shelters and tunnels had a covering of logs and earth up to six feet thick. One tunnel, some 100 feet long, had machine gun emplacements at both ends; various well-concealed openings were just large enough for a man to squeeze through. Nearby taro pits served as moats, and kept tanks from approaching. Artillery, bazookas, and hand grenades were largely ineffective, and the flame throwers on hand were too wet to be of value. The infantry commander directed the engineers to reduce the obstacle. They dropped TNT charges into the machine gun positions at both ends; when the Japanese emerged from the openings with bayonets drawn, they were shot down. Having been delayed about four hours, the advance eastward was resumed. On the third day the east tank barrier was taken without opposition; the west tank barrier had been taken the day before. Makin was in American hands. The island was captured easily—in contrast to the bloody battle the marines were waging on Tarawa.[46]

On the fourth day, the 804th Aviation Battalion began work on the airfield. Plans called for a fighter runway, surfaced with Marston mat, to be extended eventually for bombers; if possible, a

[44] (1) Crowl and Love, *Seizure of the Gilberts and Marshalls*, pp. 70–72. (2) Lt Col S. L. A. Marshall, Hist Br G–2 27th Div, Notes on Makin Opn (20–25 Nov 43), p. 182. OCMH Files.

[45] (1) Marshall, Notes on the Makin Opn (20–25 Nov 43), pp. 180–81. (2) Crowl and Love, *Seizure of the Gilberts and Marshalls*, pp. 91–93.

[46] (1) Makin Opn, 2–3.7A AFA, MA (Notes). OCMH. (2) Marshall, Notes on the Makin Opn (20–25 Nov 43), pp. 101–03. (3) Crowl and Love, *Seizure of the Gilberts and Marshalls*, pp. 99–100.



KING'S WHARF, BUTARITARI ISLAND, MAKIN ATOLL

second runway was to be built. Making a reconnaissance of the site, the engineers found that a large swamp covered part of the area, making rapid construction impossible. Nevertheless, the men began work, since there was little chance of having the plans altered without undue delay. When a D–8 dozer almost immediately bogged down in the marshy ground along the center line, work was stopped. A reconnaissance group which had just finished a detailed survey reported that the swamp extended for about half a mile. The engineers ran another center line and began clearing anew. The only complication was a series of taro pits. The men assembled a large amount of equipment, borrowing light and heavy dozers from the infantry, tractors from the artillery, and equipment from service units of the garrison force. Soon the work was proceeding systematically. A D–8 with one push would topple a coconut tree; a second push freed the root mass from the ground; a tractor then towed the tree away. The men removed about a foot of top soil. Underneath was well-compacted sand with a considerable amount of silt. Clean coral from the lagoon was used for surfacing. By 10 December the runway, surfaced with Marston mat, together with a parallel coral taxiway, was operational. The

first fighter planes arrived four days later. The aviation engineers were well on the way toward completion of their first combat mission in the Central Pacific.[47]

Coral

Makin was one of the many coral atolls the engineers would encounter on the road to Tokyo. From now on, the little-known islets of the Central Pacific were to acquire a tremendous significance. They were the steppingstones, the "stationary aircraft carriers" on the way to Japan. For the constructing engineers they were almost ideal "aircraft carriers" because they furnished a valuable, and up to this time little-known, construction material—coral. The great quantities of this material, so readily accessible, would make possible the rapid construction of runways and roads. Coral had long been used in some tropical countries for construction, but little was known in the United States regarding its use before the outbreak of World War II. The Engineers had had little information regarding either coral islands or construction with coral. They had learned from experience on Canton and Christmas and on the islands of the South Pacific, and they collected additional data. The studies made yielded much information not only about construction with coral but also about the formation and structure of coral atolls, information of vital importance in preparing and making amphibious assaults.[48]

Coral, made up of the skeletons of minute spherical animals, was chemically similar to limestone. About one-eighth of an inch in diameter, the animals could live only in tropical or subtropical waters. Most species grew only in salt water. They flourished best if the salt content was between 2.7 and 3.8 percent and the depth of the water less than 150 feet, with temperatures ranging from 66° to 100°F. Coral fed on plankton washed toward them by the waves and currents of the ocean. On an island's windward side, where food was plentiful and the water well aerated, coral grew rapidly. Reefs proliferated and were found from a few yards to several miles offshore. Approaching an island on this side was, as a rule, dangerous, as the reefs were almost invariably numerous and rocky. On the leeward side, the reefs were generally flat, had few rocky patches, and were often submerged at high tide. Coral islands, encircling a lagoon, formed an atoll which usually opened to the sea on the leeward side. In the central Pacific, coral islands were low and flat, being only four or five feet above sea level. In the volcanic islands of the western Pacific, upward thrusts of land accounted for the presence of hills or cliffs of solid coral.[49]

Whether dead or alive, whether taken from the top of a cliff or the bottom of the sea, coral was suitable for roads and runways. The surface of an island usually consisted of coarse coral sand packed hard when dry. In the interior, the soil was often a sandy loam. Coral could be

[47] Of of Engr, Hq Seventh Air Force, Rpt, Avn Engr Mission at Makin.

[48] John R. Perry, "Coral: Our Pacific Lifesaver," *The Military Engineer*, XXXVII (May, 1945), 168–75.

[49] (1) *Ibid.* (2) *Hobart E. Stocking*, "Coral Reefs of the South Pacific," *The Military Engineer*, XXXVI (August, 1944), 249–53.

easily quarried; the engineers had to use explosives only occasionally. The coarser the coral—up to particles about two and one-half inches in diameter—the easier the job of surfacing. Using sheepsfoot rollers, the engineers broke the pieces sufficiently to fill the interstices with the right amount of fines. A smooth, hard runway was the result. Coral had to be kept wet continuously to keep it from becoming dusty. If dry, it rutted easily and blew away. It could be wetted with either fresh or salt water. Some coral runways were sprinkled daily. Roads and runways which were subjected to heavy use were surfaced with asphaltic concrete. In some cases, the engineers first applied a binder while in others, they sprinkled the coral and immediately paved over it. Sometimes they rolled a surface until it was hard and tight and then applied a coating of oil, which bound the surface temporarily and made it waterproof. But such a runway had to be repaired almost daily. It required special attention near the ends where aircraft did considerable turning.[50]

Progress on Makin

Work on Makin moved ahead rapidly. By mid-January 1944, the 804th engineers, helped for a time by the 152d, which had been attached to the Garrison Force, had extended the runway to 7,000 feet, paving the extra 3,000 feet with coral. Two taxiways paralleled the runway. There were hardstands, revetments, and some forty prefabricated buildings. An aviation gasoline storage system was in operation, the tanks of which were filled by means of a submarine pipeline extending out to an anchorage for tankers. The Japanese had reacted violently to the seizure of the Gilberts. After the first American landings they bombed the islands frequently. The heaviest raid took place on 15 January; bombs dropped on the 152d Battalion area on that day killed 6 men and wounded 30.[51] But despite Japanese air attacks, the American hold on the Gilberts was secure. By mid-January, preparations were already well along for further thrusts against Japanese islands in the Central Pacific.

[50] Perry, "Coral: Our Pacific Lifesaver," *The Military Engineer* XXXVII (May, 1945), pp. 168–75.

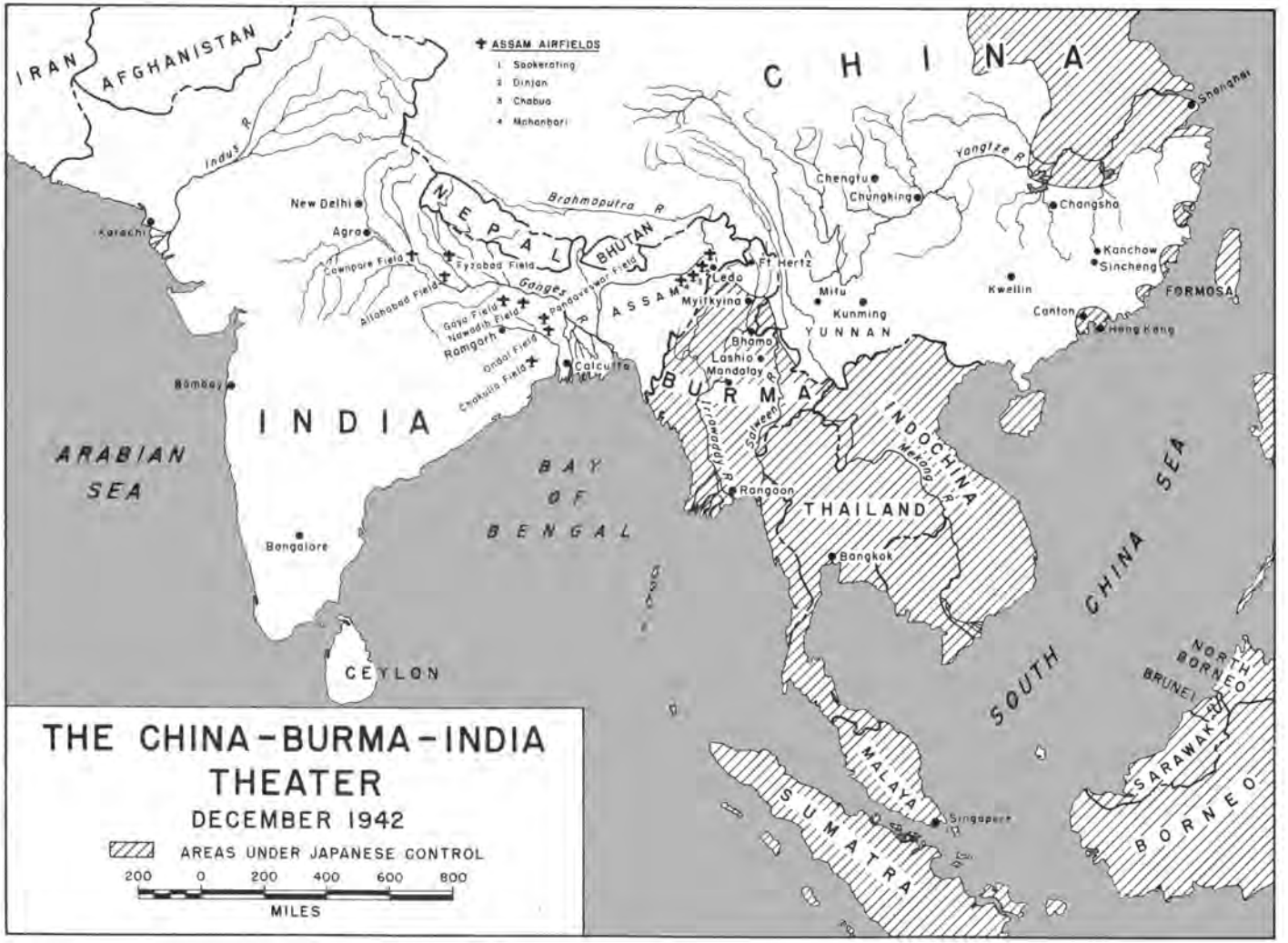
[51] Of of Engr, Hq Seventh Air Force, Rpt, Avn Engr Mission at Makin.

CHAPTER X

The China-Burma-India Theater 1941–August 1943

On the defensive in the Pacific after Midway, the Japanese were under pressure in still another quarter. This was the China-Burma-India (CBI) theater. Operations there, reaching their full stride by the beginning of 1944, had by then been under way for more than two years. Soon after the outbreak of war, Japanese forces had marched on Burma to cut off China's last land communications to the west. (*Map 20*) The United States had reacted by dispatching commanders, troops, planes, equipment, and supplies to help keep China in the war and prepare for ground and air offensives against enemy forces in eastern China and the Japanese home islands. Japanese successes in isolating China by land and sea made it extremely difficult to send in men and supplies. The obstacles encountered in developing an effective fighting force of Americans, British, Indians and other Commonwealth troops, and Chinese proved all but insurmountable. The immense distances in the theater, the conflict of national interests in that part of the globe, and the isolation of China and India from each other and from Burma made the task of organizing the theater's resources effectively an impossible one and led to repeated diplomatic and military crises. The plan to develop China together with Burma and India into a major theater of war never fully materialized. As time passed the strategic importance of CBI declined as it became increasingly evident that the war against Japan would, in the main, be fought and won in the Pacific.

The attempts to develop a major theater of operations in Asia would require prodigies of engineering. Before China could receive material assistance from the outside, a line of communications would have to be created. The only feasible route of entry was from India. But India and China were separated by the lofty Himalayan range, and with the Japanese holding most of Burma by the end of May 1942, supply by air remained the only alternative. Thus, for the first engineers in the theater, construction of airfields, not only to defend India but also to support an airlift to China, was of paramount importance. Late in 1942, when the Allies had completed plans for a campaign to recapture northern Burma, the engineers were given the primary mission of building ground communications to support a campaign in Burma and to make possible the sending of large quantities of supplies overland to China. American engineers


ASSAM AIRFIELDS
1 Sookerating
2 Dinjan
3 Chabua
4 Mohanbari
IRAN
AFGHANISTAN
CHINA
Indus R
Brahmaputra R
Yangtze R
Shanghai
Chengtu
Chungking
Changsha
New Delhi
Agra
Karachi
NEPAL
BHUTAN
Kanchow
Sincheng
Cawnpore Field
Fyzabad Field
Allahabad Field
Ganges
Ft Hertz
Ledo
ASSAM
Myitkyina
Mitu
Kwellin
FORMOSA
Canton
Hong Kong
Kunming
YUNNAN
Gaya Field
Nawadih Field
Ramgarh
Pandaveswar Field
Bhamo
Lashio
Mandalay
Oridol Field
Chakulia Field
Calcutta
Bombay
BURMA
Irrawaddy R
Salween R
INDOCHINA
Mekong R
INDIA
ARABIAN SEA
BAY OF BENGAL
Rangoon
THAILAND
Bangkok
Bangalore
SOUTH CHINA SEA
CEYLON
NORTH BORNEO
BRUNEI
SARAWAK
MALAYA
SUMATRA
Singapore
BORNEO
THE CHINA-BURMA-INDIA THEATER
DECEMBER 1942
AREAS UNDER JAPANESE CONTROL
200 0 200 400 600 800
MILES

MAP 20

were to help the Chinese improve the world-famous Burma Road linking China with northeastern Burma, and were to take sole charge of constructing the Ledo Road from northeastern India across northern Burma to a junction with the Burma Road.

By the time of the QUADRANT Conference at Quebec in August 1943, the development of the B–29 bomber had opened up the possibility of long-range air assaults against the Japanese homeland from bases in China. The engineers in CBI were consequently the first to build airfields overseas for the big bombers. As a further consequence of the decisions made at Quebec, the engineers were called upon to link eastern India and southwestern China with the most extensive military pipeline system ever constructed—to supply the airlift to China, facilitate combat in Burma, and supply American air units in China. Many of the engineer feats in CBI actually contributed little to defeating Japan. But the fact remains that engineer projects in the CBI because of their sheer magnitude were among the most impressive of the war. In no other theater were engineer officers to fill so many key positions in the chain of command.

Priority on Airfields

Prewar Efforts To Help China

The United States began to support China in her fight against Japan well before Pearl Harbor. In April 1941, President Roosevelt approved sending lend-lease aid; by late spring the War Department was administering a program of assistance totaling nearly $125,000,000. Part of this money was being used to buy matériel and rolling stock for a railroad the Chinese and British were building from Kunming, in southwestern China, to Lashio, in northeastern Burma, where it would connect with the Burmese railroad system. In June the United States set aside a hundred new fighter planes for China to form the nucleus of a modern air force. The War and Navy Departments released over a hundred pilots to fly these planes as members of the American Volunteer Group (AVG) being organized in China by retired Air Corps Capt. Claire L. Chennault.[1] In July the War Department established the American Military Mission to China to advise the Chinese in Washington and Chungking with regard to the procurement, shipment, care, and use of American equipment. That same month General Schley sent an officer expert in railway construction to the Far East to act as adviser to the Yunnan-Burma Railroad Authority, which was building the Chinese section of the railroad between Kunming and Lashio. To provide the first of the approximately 30,000 tons of rails needed, the Corps of Engineers procured and started dismantling a 125-mile stretch of abandoned narrow-gauge railway of the Denver, Rio Grande, and Western in New Mexico and Colorado.[2]

[1] (1) Charles F. Romanus and Riley Sunderland, *Stilwell's Mission to China,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1953), pp. 13–32. (2) Craven and Cate, eds., *Plans and Early Operations,* pp. 484–89.

[2] (1) Romanus and Sunderland, *Stilwell's Mission to China,* pp. 26–32, 47. (2) Rpt, Maj John E. Ausland to Brig Gen John Magruder, C Mil Mission to China, 12 Sep 41. (3) Memo, C Railway Sec OCE, for Maj Haydon L. Boatner, 28 Sep 41. Last two in

In September the Shell Oil Company, which had just perfected a light, "invasion-weight" petroleum pipeline, interested the military mission in having such a line installed between Kunming and Bhamo in northern Burma. In agreement with the mission, the oil company sent one of its specialists to Burma to prepare a plan for constructing the pipeline. General Kingman, Assistant Chief of Engineers, had an investigation made of the proposed route. He reported in October that such a line appeared to have "sufficient merit . . . to justify further investigation." [3]

Help for China After Pearl Harbor

After Pearl Harbor all these efforts to strengthen China were in jeopardy. The course of the war soon threatened to bring all of southeast Asia under Japanese control. The capitulation of Thailand in mid-December enabled the enemy to make gargantuan strides toward attainment of his two main objectives, one of which was to seize the British naval bastion of Singapore, and the other to capture southern Burma and cut the railway running northward from Rangoon to Lashio. The latter was not only an important railhead, but also the southern terminus of the Burma Road, a narrow, graveled highway winding 700 miles northeastward to Kunming—China's last line of surface communication with the outside world. The Japanese moved swiftly into Malaya and Burma, and Singapore fell on 15 February 1942. After entering southern Burma in mid-January, the Japanese drove hard for Rangoon. If they captured that key port, China would be isolated.

At the ARCADIA Conference in Washington Roosevelt and Churchill agreed that China should constitute a separate theater and as such be under Generalissimo Chiang Kai-shek, head of the National Military Council governing Free China. Because he was also the head of a state, Chiang would not be under the Combined Chiefs. Churchill and Roosevelt proposed that he establish a planning staff to include American, British, and Chinese officers. Chiang agreed and asked that a high-ranking American general be sent to Chungking to act as chief of the Allied staff. Stimson and Marshall conferred the post on Maj. Gen. Joseph W. Stilwell, who had served for many years in China as military attaché. On 2 February the War Department appointed him Commanding General of the United States Army Forces in the Chinese Theater of Operations, Burma, and India. Stilwell was to go to the Far East with about thirty American officers composing the U.S. Task Force in China.[4]

As his engineer, Stilwell chose Col. William H. Holcombe. In late December 1941, the War Plans Division had designated Holcombe, at that time assistant commandant of the Engineer School at Fort Belvoir, Virginia, to serve

AMMISCA 617, Yunnan-Burma RR, WW II Rcds Div.

[3] Memo, Magruder for CofEngrs, 18 Sep 41 with Ind, 3 Oct 41. AMMISCA 679, Pipelines for China, World War II Rcds Div.

[4] For a detailed account of the events leading up to Stilwell's appointment see Romanus and Sunderland, *Stilwell's Mission to China*, pp. 61–76.

as engineer adviser to Stilwell in the planning for the invasion of North Africa. When Stilwell received his assignment to serve with Chiang instead, he transferred Colonel Holcombe from the North African project. On 11 February, Stilwell and his staff left New York by plane for India.[5]

On the 25th Stilwell and his group reached New Delhi. To the ensuing round of conferences with the British commander-in-chief in India, General Wavell, and his officers in General Headquarters (India), Stilwell brought an impressive catalog of American plans. He emphasized that his major missions were to modernize and rearm the Chinese Army and to step up American participation in the air war over China. To carry out his plans, he intended to increase lend-lease tonnages moving up the railway from Rangoon to Lashio. Should Rangoon fall, he hoped to fly supplies from the Royal Air Force (RAF) fighter field at Dinjan, in Assam, to Myitkyina, in northern Burma, barge them from there down the Irrawaddy River to Bhamo, and then truck them to the Burma Road and China. This roundabout way could possibly be shortened. Work was already in progress on a road to extend eastward from the coal mining community of Ledo, in eastern Assam, across northern Burma to link up with the Burma Road. The Chinese and British had agreed to co-operate in its construction when Chiang visited India the first week of February. Stilwell instructed Holcombe to help the British and Chinese who were preparing plans for this road in the office of Maj. Gen. Richard L. Bond, Wavell's engineer-in-chief.[6]

On 3 March Stilwell flew to Chungking to set up his task force headquarters there. Three days later Chiang announced that Stilwell would head the Chinese Expeditionary Force, which during the past week had been moving into Burma to bolster the British forces, consisting for the most part of Burmese and Indian troops. All available hands were needed now in southern Burma, where the situation was growing more serious by the hour. On 6 March the Japanese occupied Rangoon. The British retreated northward toward Mandalay. Completing his staff assignments and command arrangements, Stilwell hastened to Lashio to assume control of the six Chinese divisions there. He had certain definite strategic aims. His most cherished plan was to drive the Japanese out of Rangoon and reopen the supply line to Kunming. Failing this, he hoped to dig in around Mandalay to protect the future line of communications from India across northern Burma to China.

Meanwhile, the War Department had begun sending some air reinforcements. On 22 February Col. Clayton Bissell, selected as Stilwell's air adviser by Lt. Gen. Henry H. Arnold, commanding the Army Air Forces, left Washington for India to handle arrangements for receipt in the theater of several consignments of aircraft for the Tenth Air Force and for Chennault's volunteers, about to be in-

[5] Ltr, Brig Gen W. H. Holcombe to C EHD, 22 Nov 54. EHD Files.

[6] (1) Romanus and Sunderland, *Stilwell's Mission to China*, pp. 76–77, 93–94. (2) Craven and Cate, eds., *Plans and Early Operations*, pp. 497–98. (3) Ltr, Holcombe to C EHD, 22 Nov 54.

ducted into the U.S. Army. In an independent action approved by Marshall, General Brett, Deputy Chief of Staff, ABDA Command, ordered General Brereton to evacuate doomed Java and re-establish the remnants of his FEAF task force at Karachi.[7] Here, early in March, Brereton activated his base and training center. General Marshall made Brereton commander of the Tenth Air Force and directed him to provide combat air support to Chiang in China and to the British in Burma and at the same time make plans for supplying China by air. He was to be directly subordinate to Stilwell, although as regards the campaign in Burma the War Department expected him to "cooperate with the British as [they] requested." [8]

Engineer Work Begins

Soon after arriving at Lashio, Stilwell directed Holcombe to join him. While waiting in his hotel room at New Delhi for a plane to take him to Burma, Holcombe got word that Stilwell had made him temporarily engineer of the Tenth Air Force. In his new assignment he would have to advise Brereton as to the most feasible way of providing the facilities the airmen needed. He and Brereton had to deal with several fundamental problems. Organization of a port of debarkation and of a training base at Karachi would require major improvements in facilities there. The 2,000-mile supply line to China would necessitate building or improving numerous fields capable of handling transports—particularly in Assam and in Yunnan Province in southwestern China. To accommodate American aircraft which would help to defend India, either bomber fields would have to be built in the central and eastern parts of the country or British fields taken over and improved. Providing adequate facilities for the Air Forces in the Indian subcontinent would necessitate a major construction effort. Holcombe worked in Brereton's office, helping to draw up plans for a headquarters for the Air Forces at Willingdon Airdrome near New Delhi, expansion of Karachi Airdrome, construction of five bomber fields near Calcutta, construction of an air depot at Agra, and the building of four airfields in Assam for the airlift to China. Holcombe gave his preliminary layouts to the airmen for their approval. As soon as satisfactory drawings were ready, they were forwarded to the architects in British General Headquarters (India), who put them in final form.[9]

Since there were no U.S. engineer troops and none could be expected soon, the Americans had to turn to the British for construction. The reverse lend-lease procedure, as worked out between British and American headquarters in India, provided that major U.S. Army commands would send their requests for construction to General Headquarters (India). General Bond would then call upon the Royal Engineers to "put the work in hand" or would ask the government of India to assign the projects to

[7] See above, p. 118.

[8] (1) Romanus and Sunderland, *Stilwell's Mission to China*, pp. 78–80. (2) Craven and Cate, eds., *Plans and Early Operations*, pp. 396–97, 502–04.

[9] (1) Ltr, Holcombe to C EHD, 22 Nov 54. (2) *Brereton Diaries*, pp. 97, 99, 110. (3) Craven and Cate, eds., *Plans and Early Operations*, pp. 511–12.

the Central Public Works Department or some other civilian government agency. Whether civilian or military organizations controlled a particular project, the work was usually done by Indian contractors employing their own labor gangs.[10]

Brereton and Holcombe could not fail to be impressed by the immensity of the Asian scene and its challenge to the engineers. In China, Burma, and India lived nearly half the human race—900,000,000 people—largely undernourished, unlettered, and indifferent to the issues which had brought the war to their homelands. The towering Himalayas isolated the Indian subcontinent from China, and spurs of that range, called the Hump by the airmen, shut off Burma from China. Throughout the year, malaria, typhus, intestinal infestations, and other serious endemic diseases sapped the vitality of native and newcomer alike. The monsoon rains, lasting from May to October, drenched Burma and much of India annually; the world's heaviest rainfall, more than 400 inches a year, fell in the Khasi hills of Assam.[11] In various ways the summer downpours would create engineering problems. Constant repair of the waterlogged roads would be necessary. Workmen would be scarce because they would be needed in great numbers for work on the rice and tea plantations. In general, land communications were far from ideal. In the 1,800 miles between Karachi and Assam, rail gauges changed four times. Nowhere in India were there long stretches of highway capable of sustaining high-speed truck traffic the year around. The scanty Burmese road and rail net was not connected with the transportation system of India. The long and virtually uncharted mountainous frontier between the two countries was an almost impenetrable jungle haven for primitive tribes. In China, the Japanese were in firm control of all the modern highways and most of the railroads of the country. Such control as Chiang's government exercised was confined to the underdeveloped part of the country.[12]

In attempting to have bomber bases and transport fields constructed, Brereton encountered almost insurmountable obstacles. It seemed to him and to other Americans that GHQ (India), despite the threat of invasion, did not shake off its peacetime routine. The government of India, fearful of provoking Indian nationalist outbursts by stepping up demands on the country's agrarian economy, appeared to show little energy in meeting requests for construction and matériel for the American forces. In a diary entry for 20 March, Brereton fumed, ". . . practically nothing had been done in the northeastern area on airfield construction. No one has shown any initiative in assembling labor. . . ."[13] A month later he complained to Stilwell of the ". . . lack of central

[10] (1) GHQ (India), Provision Sec Routine Order No. B–37, 19 Jul 42. (2) Ltr, CG SOS CBI to QMG (India), 2 Sep 42. Both in Reverse Lend-Lease Sup File, Constr Serv Files, KCRC.

[11] In most of the United States rainfall averages between 15 and 45 inches a year.

[12] (1) Anon., "The China-Burma-India Theater of Operations," *The Military Engineer*, XXXVI (June, 1944), 188–89. (2) Irving B. Crosby, "Physiography and War in Burma," *The Military Engineer*, XXXVII (February, 1945), 43–48.

[13] *Brereton Diaries*, p. 112.

control and proper co-ordination in construction projects in Assam and Burma. There are on order various projects in these areas . . . and all apparently have first priority. As a result . . . progress is slow." [14]

As March drew to a close, new disasters overtook the campaign in Burma. With the Allied front in the south crumbling, the defenders resumed their withdrawal up the Irrawaddy Plain. Unwilling to continue without Holcombe's services, Stilwell late in March ordered him to finish his work for Brereton at once and report to the command post near Mandalay. Arriving there on 1 April, Holcombe undertook various assignments. For a few days he was Stilwell's liaison officer with the Chinese division in the Mandalay area. Then, after arranging with the British to allow the Chinese to use the railway to the north during the impending withdrawal, he rejoined Stilwell in mid-April. During the next two weeks, before the collapse of Allied resistance and the fall of Mandalay, he served on a number of liaison and reconnaissance missions.[15]

Establishment of a Services of Supply

The expanding scope of American projects in India pointed up the urgent need for an American logistics organization. In late February the War Department had directed the head of the U.S. Military Mission to Iran, General Wheeler, an engineer officer of wide experience, to report to Stilwell and assume the additional task of creating a "Services of Supply, United States Army Forces in India, Burma and China . . . ." The War Department instructed Wheeler to "initiate required action to push through to Gen[eral] Stilwell all equipment. . . ." and to "Investigate . . . and report upon such matters as special supply requirements; supplies locally procurable; special supply difficulties and availability of skilled labor." Wheeler, whom Stilwell had regarded highly ever since their days at West Point, was to have considerable latitude in determining his mode of operation. He was the first of many engineer officers to achieve a prominent command position under Stilwell.[16]

During March and April, Wheeler, with a small staff borrowed from his Iranian mission, strove to establish order in the supply and construction situation in India. He worked out with British officials a program for expanding storage and dock facilities at Karachi and carried on discussions with members of Stilwell's staff in India and Burma regarding the organization and responsibilities of the proposed services of supply. On 17 April, Stilwell agreed to a directive according to which Wheeler was to operate lines of communication from ports in India to the airfields in Assam and furnish technical advice to the Chinese Army in the operation of its communications zone. Brereton, disgusted with the

[14] Memo, Magruder for Stilwell, 24 Apr 42. AG 600.1 CBI. KCRC.

[15] (1) General Joseph W. Stilwell, *The Stilwell Papers* (Theodore H. White, ed.) (New York, 1948), pp. 76–106. (2) Ltr, Holcombe to C EHD, 22 Nov 54.

[16] (1) Memo, G–4 for TAG, 27 Feb 42. G–4/34208. (2) Interv, Leslie Anders with General Wheeler, 5 Mar 53. EHD Files.

slow progress of construction under reverse lend-lease and having no engineer troops in his command, suggested to Stilwell that all American construction be put under Wheeler to insure maximum effectiveness. On 24 April Stilwell charged Wheeler with all U.S. Army construction in India, Assam, and Burma. To provide him with at least the nucleus of an engineer force sufficiently flexible to perform either airfield or highway construction, Stilwell asked the War Department to send a general service regiment, an aviation battalion, and a dump truck company.[17]

In late April Wheeler began to organize his Engineer Section. His chief of staff, Col. Fabius H. Kohloss, an engineer who had come to India in February as a member of a War Department observer group, recommended setting up a section of seven officers. Whether that many would be available in the near future was doubtful. On 27 April Wheeler chose as his chief engineer, Maj. John P. Johnson, a member of the mission to Iran. On 27 May, he moved his headquarters from Karachi to New Delhi. Johnson remained in Karachi on another assignment. There was a rapid succession of chief engineers at New Delhi from the end of May until August. All had to get along as best they could with small staffs of two officers or less.[18]



GENERAL WHEELER

In May Wheeler set up his field organization. Kohloss prepared a plan of organization calling for two base sections and two advance sections in India and one advance section in China. Wheeler put engineers over four of his five field organizations. Col. Paul F. Yount, formerly of the Iranian mission, took command at Karachi of Base Section 1, which covered roughly the western half of India. Maj. H. Case Wilcox, also transferred from the Iranian mission, went to Agra to set up Advance Section 1 in central India. Maj. Henry A. Byroade, recently arrived from the United States with a small party of Air Forces engineers, took charge of Advance Section 2, which included a large part of Assam. In early June another veteran

[17] (1) Hq USAFCBI, Hist of the CBI Theater, 21 May 42–25 Oct 44 (cited hereafter as CBI Hist) (MS), sec. III, app. IX. World War II Rcds Div. (2) Ltr, Hq American Army Forces CBI to CG SOS Karachi *et al.*, 17 Apr 42. (3) Rad, Stilwell to Brereton, 24 Apr 42. Last two in AG 322 CBI. (4) Interv, Anders with Wheeler, 5 Mar 53.

[18] (1) Hq SOS India-Burma Theater, Hist of the Engr Sec USAFCBI, 23 Apr–30 Jun 42 (cited hereafter as Hist of Engr Sec SOS CBI). 319.1 CBI. (2) Memos, Kohloss for Wheeler, 21 May and 20 Jun 42. Kohloss Pers Files.

of the Iranian mission, Maj. Charles F. B. Price, flew to Kunming to establish Advance Section 3, which was to include the southern half of China. Only Base Section 2, with headquarters at Calcutta and including most of southeastern India, was not commanded by an engineer. Its chief was Col. Edwin M. Sutherland of the Infantry. In each section, the commander, directly subordinate to Wheeler, would control all engineer supply and construction activities. Although shortages of personnel made it impossible for the field commands to organize adequate engineer staffs, this lack was offset somewhat by the fact that engineers headed SOS and four of its major subdivisions.[19]

Construction Progress

Work was urgently needed at Karachi. This city had become the major port of entry for the American forces, since British shipping had already overtaxed harbor facilities at Bombay, and Calcutta was too exposed to enemy attack. When Major Johnson left his job as Engineer, SOS, on 27 May he became engineer of Base Section 1. He had the task of expediting a variety of projects designed to make Karachi an efficient base and port of entry. With contractors and native laborers working under him and the Royal Engineers, construction went forward on a 5,600-foot concrete runway at the former civil airdrome and on two outlying fighter strips. Various improvements were under way at the New Malir and Landhi airports, twelve miles east of the city. Other projects undertaken during the late spring of 1942 were extensions to the wharves and warehousing in the port, remodeling of hotels to provide additional billets in the city, and construction of a cantonment for 20,000 men at Malir.[20]

There was a great need for engineer work in northeastern Assam. Arriving at his post in May, Byroade set out to organize the SOS effort to support the airlift across Burma to China. He found the British engaged in improving four airfields, known as the Hump fields. The area assigned to him, so crucial for the supply line to China and the defense of India, was a scene of confusion. The Japanese forces were approaching India. Retreating and disorganized Chinese troops were straggling over the frontier mountains; the natives were panic-stricken. The Royal Engineers and the Central Public Works Department, supposedly co-operating to prepare the needed airfields, were engaged in a bitter struggle for the control of construction. Fortunately, soon after Byroade's arrival, General Headquarters (India) interceded and placed the Royal Engineers firmly in charge of work at the airfields. "The change," Byroade informed Wheeler, "has been entirely for the better, as the military has many more means at its disposal." Byroade was not alarmed by the absence of personnel with which to man his engineer section. He believed his participation in the airfield program should be "solely a matter of liaison . . . in clearly es-

[19] (1) Memo, Kohloss for Wheeler, 21 May 42. (2) Hist of Engr Sec SOS CBI.

[20] (1)Bykofsky and Larson, *The Transportation Corps: Operations Overseas*, pp. 559–61. (2) Engr Sec Base Sec 1 Prog Rpts, 2 May–20 July 42. AG 600.9 CBI.

tablishing the needs of United States Forces . . . ." [21]

At Calcutta and in central India work made little headway. The exposure of Calcutta to enemy sea and air assaults obliged Wheeler to mark time there. Matters were critical in central India. Brereton was especially anxious to complete the large depot field at Agra and the bomber bases across northern India at Cawnpore, Fyzabad, Allahabad, and Gaya. Contractors were far behind schedule. The onset of the monsoon rains made it difficult to keep laborers on the job. Supervisors seemed lax about informing contractors as to specifications and priorities. Critical materials did not arrive either on time or in desired quantities. American airmen, forced to live in tents while awaiting completion of their barracks, became increasingly irritated over the slowness of the British effort.

The campaign in Burma had in the meantime come to its disastrous end. By the time Stilwell emerged onto the plains of eastern India late in May, the Japanese had overrun all of Burma except the northern tip and had occupied part of China's Yunnan Province west of the Salween gorge. Contact between Stilwell's elements in India and his bases in China was impossible except by air. All supplies, fuel, guns, ammunition, and men needed in China would henceforth have to be flown in. The critical lack of air facilities in India and China would necessitate a major construction effort. Early in June, Stilwell decided to consolidate engineer responsibilities under Wheeler. Colonel Holcombe, seriously ill with dysentery, to which was added malaria contracted during the harrowing, 3-week trek out of Burma, went on convalescent leave to Kashmir. Stilwell left Holcombe's post vacant with the understanding that on his return to duty he would be assigned to the Services of Supply.[22]

The Broadening of Stilwell's Mission

Since the plan for keeping China in the war would require efforts much greater than those contemplated earlier, Stilwell was faced with the necessity of broadening the scope of his mission. By the latter part of June he had begun referring to his command as a "theater" instead of a task force. On 6 July he formally set up a theater-type organization. He established a forward headquarters in Chungking and a rear headquarters in New Delhi. Wheeler and Brereton were his two major subordinate commanders. Although General Marshall approved the reorganization, no formal orders were ever published by the War Department concerning it. By mid-July Stilwell's command was generally known as the China-Burma-India Theater. For that part lying in India and Burma, Stilwell was under Wavell. For the part in China, he was under Chiang, who, as ruler of China, was accountable to no one. Stilwell had other responsibilities. When he took over the personnel and the responsibilities of the

[21] Ltrs, Byroade to Wheeler, 18 May, 1 Jun 42. AG 600.9 CBI.

[22] (1) Craven and Cate, eds, *Plans and Early Operations*, pp. 508–12. (2) Interv with Wheeler, 5 Mar 53. (3) Ltr, Holcombe to C EHD, 22 Nov 54.

American Military Mission to China, he came under the direct command of General Marshall. He also served as President Roosevelt's military representative in Chungking. Stilwell's diverse and exacting responsibilities imposed on him numerous and sometimes conflicting obligations; the resulting confusion made more difficult the work of the engineers and hampered the development of an effective engineer organization.[23]

First Engineer Troops Arrive

Fortunately for Stilwell's construction program, engineer troops were on the way. At the end of July, two units, the 45th General Service Regiment under Col. John C. Arrowsmith and the 823d Aviation Battalion under Maj. Ferdinand J. Tate, disembarked at Karachi. Soon thereafter the 195th Engineer Dump Truck Company, commanded by Capt. Clyde L. Koontz, arrived. The landing of these units coincided with the heightening of domestic tensions in India, where nationalist firebrands were urging the natives to violence against British rule. With a minimum of fanfare, the SOS port authorities issued ammunition to the nearly 2,000 engineers, loaded them on trucks, and sped them to Malir Cantonment through the streets of Karachi, lined with "Americans, Quit India" signs. If the natives were not happy to see the newcomers, Wheeler and Brereton were. In a temporary departure from Stilwell's policy of concentrating engineer resources in Wheeler's hands, the 823d was assigned to the Tenth Air Force; its first job was the construction of a bomb shelter at the Karachi air base. Within a few days Wheeler's staff had worked out plans for deploying the rest of the men. The dump truck company was placed on transportation detail at the port. Arrowsmith's regiment was split. The 1st Battalion was held in reserve at Karachi to be sent wherever it would be needed in central and eastern India. The 2d Battalion was kept in Base Section 1 to improve roads, erect buildings, and provide camouflaging. Since the engineer units arrived without their equipment, SOS was obliged to give them machinery from lend-lease stocks earmarked for China. Most of these items were of nonstandard types and in most categories ill suited to the tasks ahead.[24]

On 1 August Colonel Arrowsmith became Wheeler's chief engineer. Borrowing officers from his own regiment, Arrowsmith filled out the undermanned SOS Engineer Section for the first time. He organized the office into four main branches, with seven officers usually present for duty. The Administrative and Supply Branches had the duties customarily assigned to such units. The Planning and Operations Branch carried out supervision and analysis of all construction in the field. The Utilities Branch had purely local jurisdiction over construction and utilities in the New Delhi area. The vastness of the theater and the almost complete depend-

[23] (1) Romanus and Sunderland, *Stilwell's Mission to China*, pp. 86–90, 191–207. (2) Interv, Anders with Col Frank Milani, AG CBI, 1942–44, 16 May 52. EHD Files.

[24] (1) Histories of the 45th Engr GS Rgt, 195th Engr Dump Truck Co, and 823d Engr Avn Bn. (2) Interv, Anders with Tate, 3 Nov 53. EHD Files. (3) Ltr with Incls, Arrowsmith to C EHD, 12 Feb 54. EHD Files.

ence on the local authorities made the task of Arrowsmith and his staff difficult.[25]

Soon after his appointment, Arrowsmith set out to inspect many of the projects for which the engineers were responsible. At New Delhi itself, the British were improving housing and hangar facilities for the Tenth Air Force's section of Willingdon Airdrome. The work was a month behind schedule and the Tenth Air Force representatives were growing increasingly concerned. Arrowsmith took to the air to visit other projects. Across northern India, the Royal Engineers were continuing their expansion of RAF fields into bomber bases; in southern India they were developing the field at Bangalore and in central India the fields at Guskhara, Nawadih, and Pandaveswar, near Calcutta. Brereton had chosen Ondal, north of Calcutta, as his air service center and Agra, near New Delhi, as his main air depot. Progress at most projects was not satisfactory. At Agra, work was far behind schedule. The British stated that the incessant summer rains, the frequent Moslem and Hindu holidays, and the slow procurement of cement—which the British insisted on using for runways since they believed only concrete would stand up under the monsoon rains—had retarded construction. Arrowsmith returned to New Delhi in mid-August, convinced that engineer troops would have to be concentrated in the most vital areas—Karachi, Agra, and Assam.[26]

Capt. Robert A. Hirshfield, who replaced Major Johnson as base section engineer at Karachi late in July, was soon able to report fairly constant progress. Civilian contractors had under way a large number of projects, including workshops and parking areas at the port, 38 mess halls and 175 ammunition sheds at Malir, and parking aprons and an operations building at the civil airdrome. Early in August, the 2d Battalion of the 45th Engineers was assigned to Hirshfield. He thereupon expanded his construction effort to include a 20-mile road westward from Karachi to the radar station on Cape Muari, wire entanglements and camouflaging at the various airfields in the area, and refrigeration and electric power plants.[27] There were, to be sure, dark spots in the picture, such as shortages of cement and inadequate transportation. The local representatives of the Tenth Air Force registered their dissatisfaction with the quality of the concrete work and the flimsiness of the roofing put in by the native contractors. Nevertheless, of the critical areas in India, Karachi was, by the late summer of 1942, the least source of concern to the Americans.[28]

To expedite work at Agra, Arrowsmith on 23 August asked Wheeler to send the 1st Battalion and half of Head-

[25] (1) Hist of the 45th Engrs. (2) Interv with Arrowsmith, 12 Mar 53. EHD Files. (3) Memo, Arrowsmith for Wheeler, SOS, 17 Dec 42. Opns Br File, Constr Serv Files.

[26] (1) Memo, Arrowsmith for Wheeler and Kohloss, 18 Sep 42. Agra Air Depot Folder, Constr Serv Files. (2) CBI Hist, sec. III, app. IX. (3) Ltr, CO Tenth AF Serv Comd, to Wheeler, 24 Jul 42. Agra Air Depot Folder, Constr Serv Files. (4) Interv, Anders with Arrowsmith, 12 Mar 53.

[27] (1) Engr Sec Base Sec 1 Prog Rpts, 27 Jul–12 Sep 42. AG 600.9 CBI. (2) Hist of the 45th Engrs.

[28] (1) Ltr, CG Karachi Air Defense Area to CO Base Sec 1, 17 Aug 42. (2) Memo, Hirshfield for Arrowsmith, 5 Sep 42. Both in Specs File, Constr Serv Files.

quarters and Service Company of the 45th to supplement the efforts of the contractors. The men arrived on 5 September to take over construction of warehouses, repair shops, and steel hangars. Work was by this time about six weeks behind schedule. The assumption by the 45th Engineers of all trucking details for American forces at Agra somewhat relieved the British transportation problem. But the Royal Engineers continued to have trouble obtaining the necessary labor and materials to keep work going on the runways and other operational facilities remaining under their jurisdiction. Because of the Indian nationalists' sabotage campaign, one engineer company had to be kept constantly on guard duty at a time when every man was badly needed for construction.[29]

Most critical of all was the situation in Assam. By late July Byroade's Engineer Section had acquired two officers and two enlisted men, but the section's many responsibilities made it impossible to spare more than one officer to prepare layouts and inspect work at the four fields. Byroade found himself increasingly concerned with the details of airfield construction, as the Royal Engineers turned to him time and again for decisions on the phasing of various portions of the airfield program. Contractors and laborers continued to make disappointingly slow progress during the long rainy season. Byroade could do little except to resort to friendly persuasion.[30] The British did not fail to point out that their efforts suffered from the inadequacy of materials and transportation. On 18 August Brig. Gen. Clayton Bissell, who had just succeeded Brereton as commander of the Tenth Air Force, took the 823d off bomb shelter construction at Karachi and ordered them to Assam. By the end of September most of the men had arrived at their new location.[31]

Byroade welcomed Tate and the 823d, for there was no end of work. About half of Company A was put on camouflaging the airfield at Chabua. The other half and Company B took over the loading and unloading of air freight at Chabua and the other three Hump fields at nearby Mohanbari, Dinjan, and Sookerating, from which planes took off for China. While such use of the aviation engineers was not to the liking of Byroade and Tate, there were compensating factors; the 823d could be counted upon for efficient loading and unloading with a minimum of pilferage and breakage, and the assumption of freight handling by the Americans released large numbers of natives for return to airfield construction. Meanwhile, Company C, encamped at nearby Dibrugarh, began assembling urgently needed trucks. The surveyors, draftsmen, and truck drivers of Headquarters Company were also welcome reinforcements to Byroade's hard-pressed Engineer Section. One recurring discordant note was the insistence of the Royal Engineers upon concrete runways. Byroade held out for asphalt, which was procurable not only from

[29] (1) Hist of the 45th Engrs. (2) Ltr, CO Adv Sec 1 to AdminO Central Com Agra 14 Nov 42. (3) Ltr, Hq SOS CBI to Air Hq India, 28 Nov 42. Last two in Agra Air Depot Folder, Constr Serv Files.

[30] Ltrs, Byroade to Wheeler, 1 Jun (AG600.9 CBI), and 26 Jul 42 (Adv Sec 2, Admin File, Constr Serv Files).

[31] (1) Ltr, Maj James W. Sloat, CO Adv Sec 2, to Arrowsmith, 20 Oct 42. Adv Sec 2, Admin File, Constr Serv Files. (2) Hist of the 823d Engrs.

lend-lease materials destined for China and stored in Assam but also from an oil refinery in the province. As far back as May, Byroade had attempted to reverse local British decisions to use concrete. By summer, he had succeeded in getting specifications for asphalt.[32]

With the end of the monsoon in October, the Japanese launched a series of air raids on the airfields in Assam. On the 25th of the month, about a hundred enemy planes bombed and strafed, concentrating their attacks on Dinjan and Chabua. The enemy airmen returned the next day for a second attack. Two days later they made a reconnaissance-in-force. The effects of the raids went far beyond the destruction of runways, housing, and parked aircraft. The ensuing panic materially reduced the number of native workmen at the fields. Meanwhile, the Americans were alarmed by the apparent apathy of the British. Colonel Kohloss, after witnessing the raids and their aftermath while on an inspection tour of the area, was especially critical of British laxity in airfield construction and repair; he noted that at one field Byroade's engineers were repairing the runway hours before the British "garrison engineer" appeared with his coolies.[33]

Problems of Reverse Lend-Lease

By autumn the Americans had many complaints with regard to construction under reverse lend-lease. Elaborately departmentalized British civil and military offices seemed exasperatingly slow in untangling red tape and approving requests for construction. Delays in getting projects started were frequent. Few local officials would turn a hand before receiving the written "sanction" or directive authorizing construction. More than once American works suffered from the preoccupation of the British with their own projects. A noticeably weak link in the chain was the native contractor, as a rule poorly educated, little concerned with specifications or deadlines, and scarcely familiar with machinery. Further retarding the British effort was the shortage of supervisors, without whom the Indian laborer was almost certain to adopt a lackadaisical attitude toward his work. The last phases of an airfield project frequently ushered in an administrative crisis when it became evident that the British could not meet the target date. Arrowsmith would express his concern in appropriate British quarters, while his engineers in the field encountered the dissatisfaction of Air Forces commanders over the "failure" to finish air bases on schedule. It had been agreed at the outset that the British would build accommodations for the Americans on the same scale as for equivalent British units. Nevertheless, the airmen all too often sought greater refinements than those standards allowed. Their insistence on showers and sewerage at airfields caused several disagreements with SOS, which was carrying out construction according to theater policy. In general, Arrowsmith could point out that, while British standards must govern, American airmen were receiving more elaborate accom-

[32] (1)Hist of the 823d Engrs. (2) Rads, 14227, Byroade to Wheeler, 11 Feb 42; T2190, Wheeler to Byroade, 11 Apr 42. Specs File, Constr Serv Files. (3) Ltr, Byroade to Wheeler, 1 Jun 42.

[33] (1) Hist of the 823d Engrs. (2) Memo, Sloat for Wheeler, 30 Oct 42. (3) Memo, Kohloss for Wheeler, 31 Oct 42. Both in Adv Sec 2, Admin File, Constr Serv Files.

modations than those they would have gotten under War Department specifications for theater of operations construction.[34]

Equipment and Supplies

Engineer troops assigned to construction were hampered by the scarcity of supplies and the lack of equipment. The units that had arrived in July had not received their machinery by fall. SOS had to provide them with makeshift allowances to enable them to get their work under way. For months, most of their equipment and a good part of their supplies came from the stockpiles of lend-lease matériel scheduled for China. This source furnished trucks, trailers, rock crushers, air compressors, road rollers, generators, power shovels, pneumatic drills, and concrete mixers. However, each diversion of lend-lease machinery was a major operation, requiring Chiang's personal approval. Besides, the engineers had to put forth much effort just to find the equipment stored haphazardly at various points across India.[35] The British were able to lend the Americans considerable numbers of trucks and trailers. Lesser amounts of supplies and equipment were gotten through local procurement, diverted shipments, and distress cargo. But it simply was not possible to build up large stores. By the fall of 1942 the engineer supply officer of Base Section 1 had succeeded in assembling in the general depot at Karachi a small and unbalanced assortment consisting mostly of pioneer-type equipment and drafting supplies—the only stockpile of engineer materials and equipment belonging to the American forces in India.[36]

The Engineers in China

There was little activity in Advance Section of SOS in China. The Engineer Section, set up by Major Price on 4 July, consisted during the next few months of Lt. Francis C. Card. Card gave most of his attention to finding ways of improving the airfield at Kunming and planning new fields near the city. He persuaded the local officials of the Committee on Aeronautical Affairs, a department of Chiang's government, to extend the runways at the Kunming field to about 6,800 feet, begin expansion of hangar and storage facilities, and construct a headquarters for Chennault's airmen, now known collectively as the China Air Task Force. By September the Americans had worked out plans for two new transport fields, one to be built at Chengkung, just outside Kunming, and

[34] (1) Hq SOS CBI, Hist of SOS CBI, 11 Jun 42–24 Oct 44, p. 137. OCMH Files. (2) CBI Hist, sec. III, app. IX. (3) Brig. Gen. Stuart C. Godfrey, "The Airfields of the Far East," *The Military Engineer*, XXXVII (January, 1945), 17–23. (4) Ltr, Chakulia Area Engr to Works Liaison Gp RAF Calcutta, 29 Dec 42. Admin File, Constr Serv Files. (5) Ltr, Bissell to CG Rear Ech Hq USAFCBI, 5 Jun 43. AG 322 CBI. (6) Memo, Chakulia Area Engr for CG SOS CBI, 16 Mar 43. Last two in Admin File, Constr Service Files. (7) 1st Ind, CO Base Sec 1 to Wheeler, 2 Mar 43, on Ltr, CG Karachi American Air Base Comd to CO Base Sec 1, Mar 43. Base Sec 1 Admin File, Constr Serv Files.

[35] (1) Intervs, Anders with Arrowsmith, 12 Mar 53, and Tate, 3 Nov 53. (2) Hist of the 45th Engrs. (3) ASF Activities in the Sup of CBI, 1942–1943 (MS), pp. 257–58. OCMH Files.

[36] (1) Rad, 136, Wheeler to Stilwell, 14 Oct 42. AG 600.9 CBI. (2) Memo, Hirshfield for Arrowsmith, 12 Sep 42. Specs File, Constr Serv Files.

another at Yangkai, forty miles to the north. Chinese civilian and military agencies were to be in charge of construction, and the Chinese Government was to pay for the work. Such nonoperational features as housing and recreational facilities would be paid for by reverse lend-lease. The hiring of contractors and the direction of work at the fields was to be the responsibility of the Committee on Aeronautical Affairs or of the Military Engineering Commission, a subordinate office of the Ministry of Communications, also a department of Chiang's government. The Yunnan-Burma Railroad Authority, idle since the fall of Burma, was now given the job of helping to build the airfields. The first two organizations were to employ civilian contractors; the Railroad Authority was to use both contractors and peasants, the latter to be conscripted by Governor Lung Yun of Yunnan. By October 1942 work was under way on the airfields at Chengkung and Kunming.[37]

Training

Having won Chiang's consent for the organization of a Chinese corps in India to be used eventually for the recapture of Burma, Stilwell planned to provide the corps first of all with adequate training. He got from the British a camp which they had built at Ramgarh, about 200 miles west of Calcutta, to house Italian prisoners taken in the North African campaign. Here he assembled the Chinese survivors of the retreat from Burma and filled out their ranks with raw replacements flown in from China. Taking over Ramgarh in August 1942, the Americans found that much work had to be done to put it in shape. SOS, organizing the station complement, established an Engineer Section under Capt. George J. Mason to build access roads, firing ranges, utilities, and housing.[38] One officer and 42 enlisted men of the 195th Dump Truck Company were at Ramgarh from August on, providing transportation and helping with the engineer phases of the training program worked out between Stilwell and the Chinese officers there.[39] For the training program, Stilwell set up an Engineer Section under Lt. Col. Edwin B. Green, who would give basic and unit training. The program included a course for Chinese engineer officers on bridges, road construction and maintenance, mine warfare, battlefield recovery of matériel, rigging, knots, lashings, explosives, river crossing, engineer reconnaissance, camouflaging, field fortifications, mapping, water supply, and assault tactics. Green's staff, consisting usually of over a dozen engineer officers, also helped organize a Chinese task force by setting up and training pioneer-type engineer units modeled after German pioneer organizations described in Chinese field manuals paraphrasing German training literature. Chinese officers

[37] (1) Hq SOS in China Theater, Hist Background of Engr Sec, Period Ending 31 May 43. Admin Div File, China Theater, SOS Engr Files. (2) Oliver LaFarge, *The Eagle in the Egg* (Boston, 1949), p. 112. (3) *Stilwell Papers,* pp. 152–53. (4) Capt Paul J. Sampson, Hq 1339th AAF Base Unit, Hist of Chengkung Air Base, Jul 42–Jun 45. Air Univ Lib Maxwell AFB Ala.

[38] (1) Hist of Engr Sec SOS CBI, 1 Oct–31 Dec 42. 319.1 CBI. (2) Ltr, CO Camp Ramgarh to CG SOS CBI, 18 Sep 42. Specs File, Constr Serv Files.

[39] Hist of the 195th Engrs.

trained the Chinese troops, applying precepts conveyed, often through interpreters, by Green and his assistants.[40]

The close of October found the engineers at work in an area stretching from Karachi some 2,200 miles eastward into Yunnan. Numbering only 14 in late spring, their strength had risen to 1,986 by 1 October 1942. But even this force was hardly adequate to meet the demands of an airfield construction program embracing seven transport fields in eastern India and southwestern China and about twenty bomber fields scattered across northern India. Although the greater part of the work was being done by the Indians, British, and Chinese, U.S. engineer troops were applying their efforts in the most crucial links of the chain—Karachi, Agra, and Assam. Far too weak in personnel and equipment for the tasks at hand, the engineers had at least achieved an organization which was making the best possible use of available resources.

Ground Communications for a Campaign in Burma

Campaign Plans

While the engineers were striving to build airfields for Stilwell's expanding air establishment, high-level planners in the War Department gave them an additional mission—that of constructing ground communications to support a future offensive in Burma. Since the close of the campaign in Burma, Allied strategic planning for developing overland communications across the foothills of the Himalayas had hung fire mainly because domestic turbulence in India was casting grave doubts on that country's usefulness as a base for military operations. On 25 August 1942 General Marshall gave an impetus to planning for an offensive by warning the Combined Chiefs that only by reopening land communications across northern Burma could China be kept in the war and the Pacific front spared the disastrous consequences of a total collapse of Chinese resistance. During September, the War Department worked out a plan for a combined Chinese-British advance into Burma. By the beginning of October, the plan had developed to the point where it could be referred to the theater for detailed arrangements among American, British, and Chinese commanders. On 14 October, after receiving a radio from President Roosevelt stressing the need for operations to open the Burma Road, Chiang directed Stilwell to take the lead in planning for a concerted Allied drive to achieve that objective. In mid-October, Stilwell flew to New Delhi to confer with Wavell and arrange a series of conferences to work out a strategic plan, with 1 March 1943 as the date for the opening of the attack. Wavell informed Stilwell almost at once that, mainly because of logistical difficulties, the British could do no more than occupy the western fringes of Burma during the first part of 1943. The conferees consequently prepared a plan for clearing only northern Burma. As finally developed, the plan of campaign called for the brunt of the fighting to fall on the Chinese. Stilwell's Ramgarh-trained Chinese, organized as

[40] (1) CBI Hist, sec. II, app. V. (2) Ltrs, Green to C EHD, 3 Feb, 20 Feb 55. EHD Files.

X-Force, would advance eastward from Assam, while a Chinese force to be known as Y-Force would advance westward from Yunnan. The meeting of the two would mean the expulsion of the Japanese from a large part of northern Burma.[41]

The Ledo and Burma Roads

The clearing of northern Burma would make possible the construction of a road to link India with China. With Wavell's assignment of the campaign in northern Burma to Stilwell, Lt. Col. Frank D. Merrill, Stilwell's G–3, suggested on 28 October that Wheeler's engineers start to build a base at Ledo and gradually replace the British on their languishing road project. A road across Burma could be built during the course of the campaign and the completed portion used as a supply line. To build a road across Burma to link India and China would be an extensive undertaking. The most likely route ran east from Ledo to the Patkai Range on the Burmese border and then veered south to the towns of Myitkyina and Bhamo. From the latter it ran east to the Burma Road. The entire distance was about 500 miles. The rugged country from Ledo to Myitkyina, a distance of some 275 miles, was largely uncharted jungle. Beyond Myitkyina, a one-lane, dry-weather track extended to Bhamo. From there a one-lane blacktop road went to the Burma Road. The first 275 miles would require by far the greatest construction effort. The first stage of road construction by the Americans, Merrill believed, should be a short stretch running eastward from Ledo to the Patkais and then southward to Shingbwiyang in Burma, a total distance of about 120 miles. Shingbwiyang would be the jumping-off place for the coming offensive.[42] On 29 October, Stilwell told Wheeler to carry out Merrill's proposals, emphasizing that he wanted the road open to Shingbwiyang by 1 March 1943. "The importance of this mission is obvious," he declared, "and far-reaching results depend upon its successful accomplishment." [43]

Thereupon, Stilwell flew back to Chungking to persuade Chiang to assemble an expeditionary force along the Salween and to authorize early reconstruction of the demolished sections of the Burma Road in western Yunnan. The latter project was equal in importance to the building of a road out of Ledo, not only from the standpoint of its short-range usefulness as a tactical supply route, but also because of its eventual importance in the strategic line of communications linking India with China. On the surface, matters appeared to be progressing smoothly as Stilwell explained to the Generalissimo the Anglo-American plans for 1943. Chiang agreed to organize along the Salween a group of armies, 15 divisions strong—the Y-Force. But he reserved the right to cancel Chinese participation

[41] Romanus and Sunderland, *Stilwell's Mission to China*, pp. 222–28.

[42] (1) CBI Hist, pp. 61–62. (2) Min, Mtg of British-American Staff Cmte, 22 Oct 42. (3) Min, Conf between Wavell and Stilwell, New Delhi, 27 Oct 42. Last two in Opns Br File, Constr Serv Files. (4) Memo, Merrill for Rcd, 28 Oct 42, sub: Estimate of Situation. LAC Files.

[43] Memo, Wheeler for CofS Branch Hq, New Delhi, 29 Oct 42. Opns Br File, Constr Serv Files.

in the offensive should the British Navy fail to demonstrate a "dominance" of the Bay of Bengal sufficient to prevent seaborne reinforcements from reaching the Japanese in Burma. Anxious to get repair of the Burma Road started, Stilwell called Wheeler to Chungking in mid-November to open discussions with the Chinese high command looking toward formation of a services of supply for the Y-Force in addition to the development of a line of communications.[44]

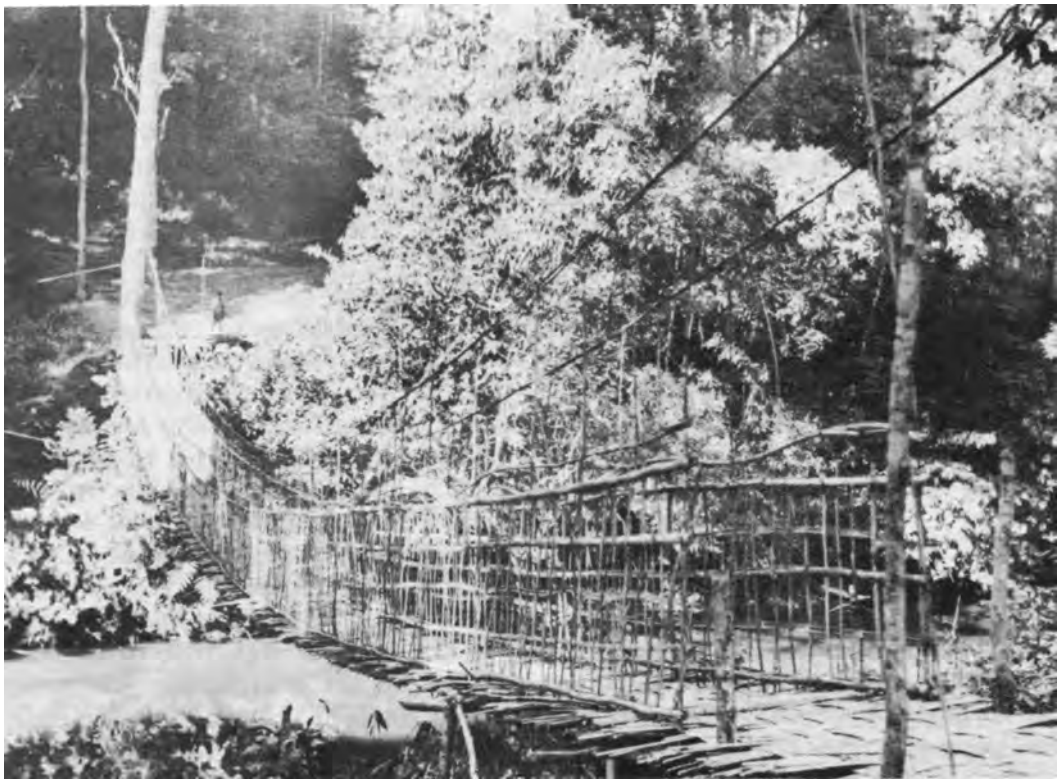
Preparation for Work on the Ledo Road

Wheeler took immediate steps to get work started on a road from Ledo. On 29 October, he placed Arrowsmith in command of the Ledo base and road projects and instructed him to draft a plan of construction for Stilwell's approval. Arrowsmith made determined efforts to put "the show on the road." He spent five days in New Delhi in conference with members of Wheeler's staff in order to get information regarding the project and the problems involved. Little was known about routes which might be followed. The plan was to use the "refugee route," which the British had used in withdrawing from Burma. It was roughly the same as the one suggested by Merrill. The road when finished would be all-weather and one-lane with turnouts. In estimating troop requirements and the amounts of materials and equipment needed, Arrowsmith found the situation bleak. There were still but three engineer units in the theater. Only part of the equipment of the 823d and 45th engineers had arrived, and only that of the 823d was heavy enough for efficient road construction. During the first week of November Arrowsmith asked Wheeler to request from the United States, among other units, a general service regiment, a maintenance company, and a depot company. He sent a lengthy requisition to the supply depot at Karachi for items that would be needed. He suggested to Wheeler that the War Department be asked for several thousand tons of equipment, including 40 D–7 bulldozers, 30 H–20 steel bridges, and a 6-month supply of spare parts—all to reach Ledo by 1 March 1943. On 5 November Arrowsmith flew to Assam as a member of a British-American reconnaissance party to collect data with regard to constructing the road and a base at Ledo. He soon formulated his general plans for building the road. On 7 November, his operations officer flew to Chungking to hand Stilwell a copy of the road construction plan. The theater commander approved it at once and radioed Wheeler's requests for troops and equipment to the War Department.[45]

Implementing the plan would be more difficult than drawing it up. The 45th and 823d engineers were alerted for movement to Ledo early in November; the work they were doing on airfields was to be taken over by the British. It

[44] (1) CBI Hist, pp. 61–62. (2) *Stilwell Papers*, p. 166.

[45] (1) Ltr with Incls, Arrowsmith to C EHD, 12 Feb 54. (2) Material from Diary of Lt Col James W. Sloat Covering the Early Days of the Ledo Road Project (cited hereafter as Sloat Diary). EHD Files. (3) Memo, OPD for CG SOS, 14 Dec 42. 400.312 (CBI). (4) Rad, Wheeler to Arrowsmith, 8 Nov 42. LAC Files.



NATIVE BRIDGE ON THE REFUGEE TRAIL

would, however, be about a month before the American units would arrive at Ledo. To get the project started, the British in the middle of November put several hundred natives on the job of extending the existing road out of Ledo. Later that month, part of an Indian excavation company arrived to help. Arrowsmith directed Lt. Col. James W. Sloat, executive officer of the 45th Engineers, and Maj. Robert A. Hirshfield, Base Section 1 engineer, both members of the reconnaissance party, to initiate work on the road and base. On 19 November he returned to New Delhi with the report of the reconnaissance party and prepared to "arrange the details" of getting the work started. The British exhibited little enthusiasm for Stilwell's plans for an offensive or for the construction of a road out of Ledo through the jungles of northern Burma. Wavell's staff believed that the British military establishment in India could not spare the engineering and transportation resources even to tide the Americans over until March, when reinforcements from the United States would arrive. The British stated they had been taxed to the limit during 1942 to build or modernize 222 airfields, develop training centers and other installations

for the expanding Indian Army, and, at the same time, furnish matériel to the hard-pressed Eighth Army in Egypt. Weather, terrain, and disease would be formidable obstacles to any road construction project in Assam and Burma.[46] To the British staff's insistence that mud and malaria would drive the Americans out of Burma, Arrowsmith bluntly retorted on 24 November that he intended to carry out the road project "even if he had only one man." [47] The Ledo Road was started with a minimum of planning and few resources. As Arrowsmith observed later, "It was a case of kicking a cat out the door and telling him to scat." [48]

Preparation for Work in China

Meanwhile, the Chinese showed little inclination to get on with preparations for an offensive beyond the Salween or for improving the Burma Road. Unknown to Stilwell, they had become enamored of Brig. Gen. Claire L. Chennault's new plan for a vigorous air offensive aimed at destroying Japanese air power in eastern China and compelling the enemy to evacuate Chinese soil. This line of thought appealed to the Chinese because it involved little or no effort on their part and put off indefinitely the politically explosive task of modernizing the army. During the last week of November, Stilwell learned that the War Department was cutting in half his request for troops and equipment because of the shipping shortage. The engineer contingent would be substantially intact, but other categories would be drastically reduced or eliminated.[49] Stilwell likened himself and Chiang to two men "on a raft, with one sandwich between . . . [them] and the rescue ship . . . heading away from the scene." [50]

Despite the rather discouraging outlook, General Wheeler concentrated on organizing a communications zone for the Y-Force. After extensive conferences with the Chinese War Ministry, he decided on 26 November to place his chief of staff, Colonel Kohloss, in command of the new Eastern Section. Kohloss' headquarters would be in Kunming. He was to work with the Y-Force headquarters wherever it operated. His primary mission was that of advising Y-Force in the organization and operation of its SOS. Arriving in Kunming with his staff at the end of November, Kohloss directed his engineer, Maj. Louis Y. Dawson, Jr., to work with the Yunnan-Burma Highway Engineering Administration, the Chinese agency responsible for rehabilitating and reconstructing the Burma Road in the rear of the Chinese divisions which would be moving southward against the Japanese in Burma.[51]

Work Begins on the Ledo Road

General Marshall, in steering the Ledo Road project through to its final ap-

[46] (1) Memo, Wheeler for Stilwell, 9 Aug 43, sub: Notes on Construction of the Ledo Road. Engr Sec File, LAC Files. (2) Sloat Diary.

[47] Merrill, Notes on Joint Staff Mtg, 24th Nov. Opns Br File, Constr Serv Files.

[48] Interv, Anders with Arrowsmith, 12 Mar 53.

[49] (1) Romanus and Sunderland, *Stilwell's Mission to China*, pp. 250–52. (2) Leighton and Coakley, *Global Logistics and Strategy*, p. 540.

[50] *The Stilwell Papers*, pp. 170–71.

[51] (1) Interv, Anders with Kohloss, 1 Dec 52. EHD Files. (2) CBI Hist, sec. II, app. XII.

proval by President Roosevelt on 8 December 1942, indicated the reasons why War Department planners placed such great stress on ejecting the Japanese from northern Burma and on opening land communications with China. The great American objective in China, Marshall declared, was "the build-up of air operations . . . with a view to carrying out destructive attacks against Japanese shipping and sources of supply." [52] A dependable overland line of communications with China was essential. But before this could be provided, the Chinese, with some help from the British, would have to advance from Assam and Yunnan across northern Burma and get control of the route for the road. So important did the Combined Chiefs consider the proposed operations in northern Burma that they gave them a priority surpassed only by that of the North African campaign, then in its critical phase. A most difficult matter would be supplying men and equipment in time for work on the line of communications. Marshall gave Stilwell "some hope" on 10 December that the needed 6,000 American service troops and 63,000 tons of road construction and maintenance equipment could be delivered at Ledo by early March.[53]

Arrowsmith pushed preparations for building the road. At the beginning of December he assumed command in the Ledo area. The British units, supported by a growing number of laborers, were barely making headway. An advance detachment of the 45th Regiment had arrived at Ledo late in November; the remainder of the unit and the 823d Battalion were scheduled to arrive early in December. Arrowsmith, intending to take over activities around Ledo gradually, planned to leave most of the work on the road, for a time, in the hands of the Royal engineer already in command—an able colonel determined to do things his own way until the formal transfer of authority. Dissatisfied with the slow advance of the grading and the colonel's emphasis on graveling, Arrowsmith soon moved up the date of the takeover to the first week of December. Relegating the British commander to a liaison role, he gave command of the road force to Colonel Sloat, who was henceforth "Road Engineer." [54] Discarding "boulevard specifications," Sloat proceeded to carry out Arrowsmith's instructions to "put the leading piece of equipment ahead as fast as we could and . . . [build] the best road we could to keep up with it." [55] With the arrival of the 823d and most of the 45th in the first half of December, work speeded up considerably.

On 15 December General Wheeler activated Base Section 3, with headquarters at Ledo. Arrowsmith was now in formal command of work on the Ledo Road, as it was henceforth called. At the same time he continued to be Engineer, SOS. For the time being, he, and Wheeler as well, were so preoccupied with reconnaissance and planning for the road that they had to leave their New

[52] Ltr, Marshall to Field Marshal Sir John Dill, 21 Dec 42. WDCSA 381 China. World War II Recds Div.

[53] (1) Ltrs, Marshall to Dill, 10, 13, 21 Dec 42. WDCSA (China). (2) Ltr, Somervell to Maj Gen Orlando Ward, C of Mil Hist, 1 May 50. OCMH. (3) Ltr, Dill to Marshall, 10 Dec 42. WDCSA (China).

[54] (1) Ltr, Arrowsmith to C EHD, 12 Feb 54. (2) Memo, Wheeler for Stilwell, 9 Aug 43. Engr Sec File, LAC Files.

[55] Ltr, Sloat to C EHD, 22 Dec 52. EHD Files.

Delhi offices almost entirely in the hands of assistants. Since the frontier area was largely uncharted, several officers and men of the 823d were sent to Arrowsmith's headquarters to produce much-needed maps. Maj. James A. Walker, Arrowsmith's supply officer in SOS, set up a supply depot in a group of brick godowns at Likhapani, four miles northeast of Ledo. Major Hirshfield took over as base engineer and started converting Ledo into a major supply point and staging area. Working closely with British civil affairs officers, he took over houses and tea sheds for use as quarters, offices, and depots. The Chinese divisions and American service units expected soon would be bivouacked on the tea estates. Hirshfield hired native labor to build more administrative buildings and warehouses and enlarge the railhead facilities at Likhapani.[56]

Of the various routes that might be followed, the refugee trail appeared best, since it reportedly had been used for many years as a caravan route and would therefore probably follow the easiest way into Burma. An alternative was the route of a proposed railway which had been surveyed about twenty years earlier. This was eliminated as a possibility because of the large tunnels and long river crossings which would be required. Arrowsmith decided to follow the refugee trail wherever possible. The British in building their highway out of Ledo had followed the railroad route; soon after taking over, Arrowsmith directed that the road builders switch to the higher ground of the refugee trail.[57]

By late December, the road team had taken shape. Out in front, a group of Tate's 823d engineers were in charge of reconnaissance. Several Royal Engineer surveyors helped to select the exact course the route was to follow. Most of the 823d followed close on the heels of the surveyors, clearing a roadhead through the jungle. The unit's six bulldozers, the only available machines with the power and traction to clear a trail, had arrived in India without blades, which were being sent from the United States on another ship. Four months after the 823d arrived in India the blades had still not come. To get work started, Tate had borrowed a blade from a British engineer unit on the road. It was attached to the lead tractor. When the machine was returned to the rear for servicing or repairs, another was moved up and the blade attached to it. In back of the 823d, the 45th did final grading and graveling. A British excavating company and a mechanical equipment section worked briefly on the road before withdrawing to British projects. Progress was gratifying to the Americans. The 823d advanced a fresh graded trace five miles during the last week of December.[58]

By mid-January 1943, the lead dozer was thirty miles from Ledo and nearing the mountains. A more rapid advance was possible after Arrowsmith got two more blades from a training school in Lahore. Chinese troops moved in to

[56] (1) Hist of Engr Sec SOS CBI, 1 Oct–31 Dec 42. (2) Hist of the 823d Engrs. (3) Memo, Engr SupO for Staff Depot, Likhapani, 28 Jan 43. Engr Sec File, LAC Files.

[57] (1) Sloat Diary. (2) Ltr, Sloat to C EHD, 22 Dec 52.

[58] Interv, Anders with Tate, 3 Nov 53.

protect the road force; a battalion of infantry and a battery of field artillery took up positions beyond the Patkais near Shingbwiyang, and other Chinese troops were ordered to remain at least a day's march ahead of the engineers. The road was rather winding. This was inevitable because of the way it was being built. The method was to bulldoze a narrow path through the jungle, move up all additional equipment to clear out trees and underbrush on both sides, and then fit the road into the best part of the clearing. Because the light D–4 bulldozers of the 45th could not always cope with the rugged terrain, detours had to be made around the many large stumps which the machines could not pull out. The men put temporary timber bridges across the major streams and installed culverts at the minor water courses. In the flat sections, the road could easily take two lanes of traffic, but on the sides of hills it was quite narrow.[59] On 21 January Wheeler reported to Stilwell that graveling had reached Mile 26.[60] The theater commander was jubilant, but agreed with Wheeler's suggestion that satisfaction be kept "in the American family" to avoid embarrassment should the units on the road be unable to maintain their pace.[61]

Progress continued during February, but at a much slower pace. By the end of the month, the roadhead had reached Pangsau Pass on the Burmese border, 38 miles from Ledo, still some 80 miles from Shingbwiyang. The slowdown was caused mainly by the rugged terrain of the Patkais. Earthmoving was especially troublesome. The engineers had to apply greater and greater efforts to widening the road and sloping the high banks. In mid-March, a brief rainy spell—the "early monsoon"—temporarily halted work. An 8-mile stretch of the road in the mountains soon became so sodden that trucks could not get through. Tate had to use natives to carry supplies to the 823d. After the weather cleared, operations were back to normal. By the end of the month, the leading elements were 48 miles from Ledo and still 70 miles from their goal.[62]

The monsoon season was approaching. Arrowsmith hoped to receive his first reinforcements before it struck. Early in March Shipment 4201 landed at Bombay; it included the 330th Engineer General Service Regiment, the 479th Engineer Maintenance Company, and a platoon of the 456th Engineer Depot Company. Only the depot platoon was on the road by the end of the month. It took over operation of the engineer depot at Likhapani. General Wheeler persuaded Chiang to send in the 10th Chinese Independent Engineer Regiment, a crack outfit which reported directly to the Generalissimo. The Chinese engineers, who arrived in mid-March, cleared the jungle and did pioneering ahead of the 823d. During March and April the 823d's blades and the D–7 tractors and other heavy equipment on order since November arrived at Calcutta and began moving up the rickety railroad to Assam. Whether the

[59] (1) Hist of the 823d Engrs. (2) Interv, Anders with Tate, 3 Nov 53.

[60] Rad, Wheeler to Stilwell, 21 Jan 43. Engr Sec File, LAC Files.

[61] (1) Rad, Stilwell to Wheeler, 25 Jan 43. AG Files, CBI. (2) Ltr, Sloat to C EHD, 22 Dec 52.

[62] Hist of the 823d Engrs.

blades and equipment would arrive soon enough before the rains to be of much good was doubtful.[63]

Early in April Stilwell visited Ledo. As he looked over the various projects with Arrowsmith, doubts rose in his mind. In a letter to Wheeler, he expressed the view that the buildings constructed for the base were not sturdy enough and suggested that a greater effort be made to provide better housing. He believed Arrowsmith was concentrating too much on pushing the road, when he should be expanding the system of access roads in the base and preparing supply trails for jeeps through the jungles to Chinese outposts along the eastern slopes of the Patkais. In order to have this additional work done, Stilwell was willing to accept the "sacrifice of a little progress on the road." But, after considering the critical shortage of troops and equipment, he conceded that "there has been so much done here, and everybody is so willing and interested that I have no business to criticise anything. So I won't." [64]

The monsoon, unusually early, was in full swing by the first week of April. Viewing the extreme difficulties with mud slides and drainage in the Patkais, and realizing that his meager force was stretched too thin, Arrowsmith on 8 April instructed Colonel Tate to give top priority to sloping, widening, and ditching. Late that month, advance elements of the 330th Engineers came up to reinforce the 823d at the roadhead. The 1st Battalion of the 45th Engineers then turned to road maintenance while the 2d Battalion moved back to Ledo to repair the vital access roads before they disintegrated completely. By May, the engineers were struggling to restore or save more than 120 miles of roads in and out of the base. The rains did not cause as much damage to the bridges as had been feared. Some of the temporary structures turned out to be too low for the swollen streams and a number were washed away, but by the time the rains began, the permanent bridges were nearly ready. American and British engineers put steel spans over the larger rivers, while the Chinese 10th Engineer Regiment built hand-hewn timber bridges over the smaller streams.[65]

The monsoon struck just as the condition of the equipment on the road was nearing an all-time low. There were almost no spare parts. A few pieces of machinery did arrive from Calcutta in April and May, but by far the greater part of Shipment 4201 would not be available until summer. In the meantime, the winter-long operations had taken their toll. By the end of April a third of the 823d's tractors and trucks were awaiting repairs. A month later two-thirds of its tractors and half its trucks were out of service. The 45th Engineers fared no better.[66] The rains were not so severe that all work had to be

[63] (1) Ltr, Arrowsmith to C EHD, 12 Feb 54. (2) Memo Hq Base Sec 3 for Secs and Units, Base Sec 3, 18 Mar 43. Engr Sec File, LAC Files. (3) Hist of the 456th Engr Depot Co. (4) CBI Hist, p. 83.

[64] Ltr, Stilwell to Wheeler, 6 Apr 43. Stilwell Pers Files, Ltrs, World War II Rcds Div.

[65] (1) Plng Div ASF, The Ledo Road, pt V. OCE Lib. (2) Hist of the 45th and 823d Engrs. (3) Rad, Arrowsmith to Wheeler, 27 Feb 43. AG Files CBI. (4) Ltr, Sloat to C EHD, 22 Dec 52. (5) Interv, Anders with Tate, 3 Nov 53.

[66] (1) Ltr, Harrison to Smith, Sup Div OCE, 8 Mar 43. 400.312 CBI. (2) Hist of the 823d and 45th Engrs.

stopped, but with their equipment in such a poor state the engineers would not be able to extend the roadhead much beyond Mile 50 during the remainder of the monsoon.[67]

Engineer Work in China

In China, likewise, work on the all-important roads was the main concern during the first months of 1943. Chinese and American officers were generally agreed that the main Chinese drive beyond the Salween would follow the route of the Burma Road toward Lashio. A secondary thrust would be made along the partially completed right-of-way of the Yunnan-Burma railway. The latter route left the Burma Road near Mitu some 225 miles west of Kunming and wound south through the mountains east of the Burma Road. Kohloss believed the Chinese should establish depots along the Burma Road—their main supply route—and put the road itself in shape. They should also build a highway from Mitu into Burma along the right-of-way of the railroad. At the same time, Kohloss strove to persuade General Chen Cheng, the Y-Force commander, to organize a services of supply. In the winter of 1942–43, Kohloss and Dawson set themselves the task of achieving these primary goals, despite such obstacles as official apathy in Chungking and Kunming, the runaway inflation of the Chinese currency, and the technological backwardness of the Chinese.[68]

Dawson's main job was to help the Yunnan-Burma Highway Engineering Administration improve the Burma Road. As his first order of business, he set out in December 1942 on a trip down the road as far as the Salween to gather the data necessary for making intelligent plans and estimates. He discovered that the celebrated Burma Road, started by the Yunnanese administration in the 1920's and completed by the central government in 1940, was not a highway in the American sense of the word. Construction had proceeded without benefit of specifications, with the result that each "hsien" or local district had built its section as economically as possible. The road was two-lane in some sectors, but poorly surfaced, and partially demolished as a result of the defensive measures carried out the previous spring. With a surface consisting for the most part of crushed rock and clay, with some sections asphalted but in poor condition, the road was dusty when dry and slippery when wet. Dangerous hairpin curves were frequent, grades were steep, and shoulders were eroded.[69] There were fourteen passes with an elevation of more than 7,000 feet. The bridges, as a rule one-lane and usually lower than the level of the road, consisted of fairly sound masonry abutments, but some had superstructures of rotting wood. The more he saw, the more Dawson was convinced that only a major construction effort could put the Burma Road in shape

[67] Ltr, CO Base Sec 3 to Wheeler, 29 May 43. AG 611 CBI.

[68] (1) Ltr, Kohloss to Lt Gen Chen Chin-chieh, 7 Feb 43. Kohloss Pers Files. (2) Rpt, Dir Yunnan-Burma Hwy Engrg Administration, 9 Jan 43. Engr Br File, Constr Serv Files. (3) YOKE Rpt 5, Kohloss to Stilwell, 18 Apr 43. Kohloss Pers Files.

[69] Original plans for the Burma Road called for a maximum grade of 8 percent; actually many grades were close to 15 percent; a few, as high as 30 percent.

either as a supply route for the coming campaign or as the Chinese portion of a truck highway from Ledo to Kunming.[70]

Fortified with Dawson's description of the road and his recommendations for improving it, Kohloss succeeded in getting Lt. Gen. Chen Chin-chieh, commander of the SOS of Y-Force, to make an inspection tour of the road from Kunming to Paoshan, some 40 miles east of the Salween. The first week in February, Chen, accompanied by Kohloss, Dawson, and Dr. Lee Wen-ping, a senior engineer of the Highway Administration, set out on the 430-mile trip. Thus, the Americans had at last been able to get key Chinese officials "on the road"—two months after the Eastern Section was established. Kohloss discussed with Chen and Lee Major Dawson's role in the proposed improvement of the Burma Road. The Chinese agreed to accept Dawson's participation in their planning work. At the same time, the Highway Administration, complying with American urging, ordered a thorough road survey, the first in the road's history.[71] Having discovered that the Highway Administration had about a dozen pieces of mechanical equipment, including three American tractors, two German air compressors, and a British power shovel—all in poor condition—Dawson got the Chinese to promise that they would assemble this machinery and have it repaired.[72]

In the latter part of February Dawson and the officials of the Highway Administration completed their estimates of how much it would cost to transform the Burma Road into an all-weather, two-lane highway. Dawson brought to the meetings with the Chinese engineers his estimate of 79,823,400 Chinese dollars for improving the 370-mile stretch between Kunming and the Mekong River and 37,601,000 dollars for restoring the 226 miles of demolished roadway beyond the Mekong to the Burmese border, a total of 117,424,400 dollars, equivalent to $5,871,220 in American money at the official rate of exchange which fixed the Chinese dollar at 5 cents. The uncertainties caused by the runaway inflation in China were difficult to contend with. It was impossible to determine what the purchasing power of the money might be even in the near future. The Chinese, therefore, almost tripled Dawson's estimates. Believing that their figures would not be accepted in Chungking, he persuaded the Highway Administration to reduce them by about 25 percent. The figure eventually agreed upon was 295,566,000 Chinese dollars. Late in February, this estimate was sent to the Ministry of Communications at Chungking with a request for an early allotment of funds.[73] There was nothing to do but wait.

A long period of inaction ensued. A few laborers remained on the road performing desultory maintenance. When the April rains started, they withdrew to their homes. It was Dawson's unpleasant duty to report periodically to Koh-

[70] (1) Dawson, Rpt on Burma Road, Kunming to Hsia Kwan, Dec 42, Engr Br File, Constr Serv Files. (2) Ltr, Dawson to C Mil Hist, 2 Aug 60. EHD Files.

[71] (1) Ltr, Kohloss to Chen, 7 Feb 43. (2) CBI Hist, sec. II, app. XII.

[72] Dawson, Rpt 2, Yunnan-Burma Hwy, 26 Jan 43. Engr Br File, Constr Serv Files.

[73] (1) CBI Hist, sec. II, app. XII. (2) Engr Memo 76, Dawson for Kohloss, 20 Oct 43. 400.312 CBI.

loss on the progressive deterioration of the Burma Road. In May, the Highway Administration, in the throes of merging with the Yunnan-Burma Railroad organization, acquired a new director, C. C. Kung, who promptly installed his own group of railway-construction specialists. They had almost no knowledge of modern road machinery and little desire to see it used. Dawson encountered only indifference when he importuned the Chinese to have their rusty equipment repaired. The road survey, for which funds had been borrowed against future appropriations, was being carried out with neither centralized direction nor a common benchmark; the data gathered would represent an almost complete waste of time and money. In spite of Dawson's insistence that final plans be formulated for the best utilization of the coming appropriation for improving the road, the engineers of the Highway Administration declined to bestir themselves on the grounds that Chungking would never make the appropriation. It would appear that the only solid engineering achievement of the first half of 1943 was a 160-mile reconnaissance of the route for the road out of Mitu to a point 50 miles west of the Mekong, carried out during April and May by an infantry officer, one of Kohloss' deputies.[74] The Americans, trying to persuade the Chinese to prepare Y-Force for action, were frustrated at every level of command. While Kohloss was able with his own small organization to construct and stock depots at Yunnanyi and Kunming, he could not get the Chinese to do anything toward organizing a supply service.

Underlying the official apathy was the Chinese disagreement with the basic American strategy for the theater, a strategy that emphasized the need for a successful campaign in Burma to make possible the establishment of ground communications between India and China. The Chinese, far more interested in aerial supply and air power, displayed an altogether different attitude toward airfield construction. Back in November and December 1942, Yunnanese authorities had impressed thousands of laborers to enable the Yunnan-Burma Railroad organization to complete the airfield at Chengkung. Chiang himself ordered a bonus paid to the conscripted laborers. By late January 1943 Advance Section 3 had three transport fields in operation at Chengkung, Kunming, and Yangkai. By spring Capt. Harry F. Kirkpatrick, Advance Section engineer, and his staff began making improvements at two fields near Kunming formerly used by Chennault's volunteers—Chanyi and Yunnanyi. Each field originally had a runway and small hostel. Kirkpatrick extended the runway at Yunnanyi and put in more taxiways and hardstands at both fields. By 31 May major construction at Yunnanyi was complete. Progress was less spectacular at Chanyi, but this field had been in better shape from the start.[75]

[74] (1) Rpt, Dawson to Kohloss, 27 May 43. (2) Engr Memo 8, Dawson for Kohloss, 4 Jun 43. (3) Engr Memo 35, Dawson for Kohloss, 21 Jun 43. All in Engr Br File, Constr Serv Files.

[75] (1) Romanus and Sunderland, *Stilwell's Mission to China*, pp. 350–53. (2) Memo, Kohloss for Brig Gen Thomas G. Hearn, CofS CBI, 29 Aug 43. Kohloss Pers Files. (3) Hq SOS in China Theater, Hist Background of Engr Sec, Period Ending 31 May 43. Admin Div File, China Theater SOS Engr Files.

The Office of the Theater Engineer

Ever since Colonel Holcombe had gone on convalescent leave in June 1942, Stilwell had been without an engineer on his staff. When Holcombe returned to duty it was as Wheeler's deputy. The position of engineer was filled once more on 3 January 1943 with the arrival in New Delhi of Col. Francis K. Newcomer. Newcomer soon came to the conclusion that his office was little needed in India, where Arrowsmith, as SOS engineer, with the major engineer responsibilities and resources at his disposal, was "well established and well equipped" to handle all tasks. Because of the distance involved, Arrowsmith could exercise little control over the American construction program in China. Consequently, Newcomer in March transferred his office to Chungking. His functions included coordination with the Chinese military in matters relating to airfield construction for the Americans in China, policy making in such matters as mapping and supplying Chinese troops in training at Ramgarh and in Yunnan, and a "considerable amount of housekeeping for the forward echelon of theater headquarters." Newcomer was able shortly after his arrival in Chungking to add an assistant theater engineer and three enlisted men to his office. Stilwell rarely consulted Newcomer, and there was little the latter could do to further the engineer effort in China.[76]

Airfields in India

Since the principal American effort in late 1942 and early 1943 was directed toward opening ground communications across Burma, the airfields in India received comparatively little attention. Work on them was beset with difficulties, and the slow rate of progress, especially on those in central India, severely strained relations among the engineers, Tenth Air Force, and the British. Keeping an anxious eye on the bomber fields near Calcutta, General Bissell during December and January repeatedly taxed the engineers with failure to inspect regularly the work being done by native contractors.[77] Maj. James F. Hyland, area engineer at Chakulia, stated that he and his one assistant were giving "a prorata share" of their time to each of the five fields in their area. In Hyland's view progress was not what it should have been, because of the inefficiency of many of the native contractors and the inability of the Public Works Department's few engineers to give effective supervision.[78]

Work on the four Hump fields in Assam, left almost entirely to the British since the start of the Ledo projects, showed definite signs of floundering. The plan to complete work on the fields before the rains could not be carried out. From the American point of view, the failure of "slow acting and unsympathetic" echelons in British command

(4) *Stilwell Papers*, pp. 152–53. (5) Sampson, Hist of Chenkung Air Base.

[76] (1) Ltr, Holcombe to C EHD, 22 Nov 54. (2) Ltr, Newcomer to C EHD, 5 Dec 54. EHD Files. (3) Hq Rear Echelon USAFCBI, Theater Engr Staff Journal, 1943. Admin File, Constr Serv Files.

[77] Interoffice Memo, Engr for CS SOS CBI, 25 Jan 43. Admin File, Constr Serv Files.

[78] Ltr, Hyland to Works Liaison Gp, RAF, Calcutta, 29 Dec 42. Admin File, Constr Serv Files.

channels to grant adequate priorities was largely responsible for slowing construction. Local British headquarters persisted in diverting resources away from the airfields. On 3 March Byroade stated that it was "very doubtful if more than about 75% of the . . . work will be completed in time.[79] Holcombe expressed American dissatisfaction in a letter of 28 April to the new engineer-in-chief, Maj. Gen. Horace L. Roome, in which he urged the British to make "every effort . . . to expedite completion of these airfields." [80] Expressions of dissatisfaction came from other quarters. Col. Frederick S. Strong, who arrived from the United States in April to take over as Engineer, SOS, so that Arrowsmith could give full attention to the Ledo Road, soon became aware of the lack of progress on the airfields. "Those jobs," he wrote to Somervell on 15 May, "were a British responsibility and they fell down. At the same time we lacked sufficient engineer personnel to keep in close touch with the work. . . ." [81]

Things seemed no better at Karachi. There were many differences of opinion between the engineers on the one hand and the airmen and the British on the other. In January 1943 the local Public Works officials charged the SOS engineers with slowing construction at the local civil airdrome by stopping work at sunset and by refusing to allow the mixing of concrete by hand when mechanical mixers were out of order. Maj. John P. Nolting, Hirshfield's successor as base engineer, explained that he stopped work at nightfall because of insufficient lighting, and he would not allow mixing concrete by hand because indifferent native labor might unwittingly cause a runway failure at a key airfield. He was fortified in his stand by the clause in the contract that, he declared, specifically called for a "2-minute mix." At the Karachi air base the airmen attempted to "constitute themselves additional inspectors of construction." They constantly needled the engineers about construction standards, made surprise inspections, tried to get possession of blueprints, and on one occasion invaded the base section engineer's drafting room to alter a set of drawings.[82]

Chennault and the Air War

As 1943 wore on, there were few signs that an offensive in Burma was near. Stilwell thought that General Headquarters (India) showed an "extremely pessimistic and obstructionist" attitude. Chiang, hoping to avoid committing his inadequately prepared troops to a ground campaign in Burma, had written to President Roosevelt in January suggesting that Chennault be allowed to conduct an all-out air war against the Japanese as a substitute. Neither Stil-

[79] Memo, Byroade to All Units in Adv Sec 2 Area, 3 Mar 43. Adv Sec 2, Admin File, Constr Serv Files.

[80] Memo, Holcombe for Roome, 28 Apr 43. Specs File, Constr Serv Files.

[81] Ltr, Strong to Somervell, 15 May 43. Somervell Files, CBI 1942–43. Natl Archives.

[82] (1) Ltr, Hq SOS to CO Base Sec 1, 11 Jan 43, with Inds, 16 Jan, 18 Jan 43. Specs File, Constr Serv Files. (2) Ltr, ExecO Karachi Air Base to Hq SOS CBI, 19 Feb 43, with Inds, 21 Feb and 1, 6, 8 and 17 Mar 43. (3) Ltr, ExecO Karachi Air Base to CG Karachi American Air Base Comd, 3 Mar 43, with Inds, 4, 5, 6, 8 Mar 43. Last two in AG 600.1 CBI. (4) Ltr, Engr Base Sec 1 to CO Base Sec 1, 1 Mar 43. Base Sec 1 Admin Files Constr Serv Files.

well nor Marshall would give up his plans for an offensive at the earliest possible time. At the Casablanca Conference in January 1943, Marshall had earnestly argued for an early rescheduling of the invasion of Burma. At the close of the conference the Combined Chiefs approved intensified planning for a campaign to begin in November 1943. Meanwhile, Chiang kept up his pressure to place the main burden of the war in China on Chennault's airmen. Roosevelt gave strong support to Chiang's views, despite the opposition of Marshall and General Arnold. He directed establishment of an air force under Chennault "to see that . . . [he] gets his chance to do what he believes he can do." On 3 March, Roosevelt nominated Chennault for the rank of major general. Eight days later Stilwell activated the Fourteenth Air Force and placed it under Chennault's command.[83] Wheeler thereupon set up Advance Section 4 with headquarters at Kweilin, 525 miles east of Kunming. Major Price headed the new organization, with the mission of building half a dozen bomber fields for Chennault in the region around Kweilin.[84]

In mid-April, Stilwell and Chennault went to Washington to advise Roosevelt and Marshall at the TRIDENT Conference, scheduled to begin 12 May. Two weeks before the conference began, Chennault greatly impressed the President when he told him that he could "sink and severely damage more than a million tons of shipping" if his Fourteenth Air Force could get 10,000 tons of supplies a month by air from India. Stilwell's prosaic plans for the reform of the Chinese Army and the reconquest of Burma failed to fire the President's imagination. Roosevelt went to the TRIDENT Conference apparently committed to the program Chennault had outlined. On 9 May he sent direct orders to General Wheeler to rush the construction of airfields in Assam "to the limit." [85] Given the President's predisposition toward Chennault's views, it should have occasioned little surprise to Stilwell that the TRIDENT Conference ordered air facilities in Assam developed to permit an increase in deliveries to 10,000 tons a month by September. TRIDENT approved reducing the campaign in Burma to a vigorous and aggressive air-ground action to take place after the 1943 rains and to be limited to the northern part of the country. Stilwell disgustedly concluded, ". . . everything was thrown to the air offensive." [86]

Renewed Priority on Airfields

The decisions made at the TRIDENT Conference meant that the airfields would again require a major effort. Having finished with them, the engineers would be called upon to support an offensive in northern Burma, to be staged the following November, provided men and materials were available to give such an undertaking a good

[83] Romanus and Sunderland, *Stilwell's Mission to China*, pp. 277–84.

[84] Hist of the Engr Sec SOS CBI, 1 Jul–30 Sep 43.

[85] (1) Maj. Gen. Claire L. Chennault (USA Ret.), *Way of a Fighter: The Memoirs of Claire Lee Chennault* (New York, 1949), pp. 225–26. (2) Robert E. Sherwood, *Roosevelt and Hopkins* (New York, 1948), pp. 730–31.

[86] *Stilwell Papers*, p. 205.

chance of success. At the same time, they would have to continue work on the line of communications from Ledo to Kunming, with a view to completing it as soon as possible after the conclusion of the campaign. As envisaged by the conferees at TRIDENT, the line would be a comprehensive one, including not only the Ledo and Burma Roads, but also telephone and telegraph systems, auxiliary airstrips, depots, and hospitals. Visiting the theater in February 1943, Somervell, in his talks with various commanders, had stressed the need for a pipeline. The TRIDENT Conference, thanks to Somervell's representations, directed construction of such a line to extend eventually from Assam to Kunming. All this would have to be built by the few engineer troops in the theater, with such help as could be gotten from the British and the Chinese.[87]

Airfields in China

No time was lost in getting on with the work in eastern China. By the first week of June, Major Price and his small staff were supervising or planning additional construction at seven existing fields near the city of Kweilin in Kwangsi province, about 300 miles northwest of Canton. The work consisted mainly of providing communications facilities, repair shops, taxiways, revetments, and housing for upwards of 1,500 airmen. A half-dozen fighter strips north and east of the bomber fields were to be improved. Byroade, who relieved Price early in August, reported to Wheeler late that month that work was "progressing at about half speed" on some fields and was "completely stopped" at others.

Because the Chinese Government was in such a disorganized state, it was sometimes difficult to know with whom to deal in the selection of contractors. The engineers wanted some of the men they had at Kunming and elsewhere to work on the fields. Two of the fields, one at Kanchow and the other at Sincheng, were in Kiangsi province, located in a part of China threatened with economic paralysis because of the chronic warfare. The lieutenant governor of Kiangsi, looking for ways to put his part of the province on its feet economically, was well aware of the profits to be made in working on American military projects. He organized two contracting firms, the Kanchow Construction Company and the Sincheng Construction Company; an ordinance was enacted which required all contractors to register so that they might be officially certified for work on the fields. It turned out that the lieutenant governor's two firms were the only ones deemed qualified for certification. To get an even firmer grip, the local authorities took over the distribution of rice to the workers in the localities where the fields were to be built. The governor expected to receive his share of the profits or "squeeze" from the certified contracting firms. Regarded as proper in China, "squeeze" was considered a form of racketeering by the Americans. In August Byroade's resident engineer arrived at Kanchow with his own contractors. The local authorities put the

[87] (1) ASF's Activities in the Sup of CBI, 1942–43, pp. 54–58. (2) Ltr, Somervell to C Mil Hist, 1 May 50. OCMH. (4) Ltr, Strong to C EHD, 21 Nov 52. EHD Files.

contractors in prison, and the resident engineer had to cancel his agreements with them. He found he had no recourse except to deal with the duly certified local contractors and pay the higher price necessitated by the squeeze. Work began in September at Kanchow but was suspended until the following spring at Sincheng.[88]

Airfields in Assam

After TRIDENT, one of the main objectives of the War Department was the construction of some twelve transport and fighter fields in Assam. Marshall's personal instructions to Wheeler on 22 May were that the four fields upon which so much effort had already been expended were to be ready by 1 July to make possible flying 7,000 tons monthly from then on.[89] Such a goal could be reached only by the most strenuous efforts; still, there was some optimism that it could be achieved. Colonel Strong, after inspecting the water-logged fields of Assam in May, expressed hope that the airfield projects would soon be "on their feet." The War Office in London had just sent a harsh radiogram to GHQ (India) directing an immediate acceleration of the work in Assam. Consequently, Colonel Strong found on his tour that Wavell's staff was "marshalling additional resources and placing a top-flight Engineer in charge." He noted further, ". . . we are reorganizing our own engineer service there, and, by robbing other places, are getting a good officer at each field. . . ." [90] British officials at New Delhi suggested to Wheeler that they would like to withdraw from the airfield projects in Assam if the Americans would bring in enough men and equipment. But Wheeler refrained from exercising more than a nominal command over these projects, thus giving the British no pretext for leaving. He strove to meet the goals set by TRIDENT by borrowing men from the 330th Engineers, and bulldozers, carryalls, graders, and trucks from units on the Ledo Road. While the rate of progress moved steadily upward as compared with that of earlier months, the work never caught up with the schedules. By 1 July three of the runways had been completed to specifications; four needed additional steel plank, and three others had only gravel.[91] Hampered by inadequate airfields and poor weather, the transports flying the Hump could deliver no more than 4,500 tons in July.[92]

Preparations for the Offensive in Burma

Stilwell, returning from the TRIDENT Conference in mid-June, set out to

[88] (1) Hist of Engr Sec SOS CBI, 1 Jul–30 Sep 43. 611 CBI. (2) Rad, Stilwell to Marshall, CM-IN-9875, 14 Jul 43. 611 CBI. (3) Ltr, CO Adv Sec 4 to CG Fourteenth AF, 30 Jun 43. Air Engr File, China Theater of Opns, KCRC. (4) Memo, Byroade for Wheeler, 31 Aug 43. AG 686 CBI. (5) Ltr, Engr Adv Sec 4 to CG USAFCBI, 17 Sep 43. Opns Br File, Constr Serv Files.

[89] (1) Romanus and Sunderland, *Stilwell's Mission to China*, pp. 341–45. (2) Min, Mtg at Engr Off Adv Sec 2, 20 May 43. Specs File, Constr Serv Files.

[90] Ltr, Strong to Somervell, 15 May 43. Somervell Files, CBI 1942–43.

[91] (1) Byroade, Notes for Rcd on Airdome Constr and Cargo Availability for India-China Freight Line, 23 Jun 43. Somervell Files, CBI 1942–43. (2) Rad, Wheeler to CG ATC, CM-IN 540, 1 Jul 43. 611 CBI.

[92] Craven and Cate, eds., *Guadalcanal to Saipan*, p. 443.

reorganize and unify the American effort in support of the Y-Force. On 18 June he organized the Y-Force Operations Staff (Y-FOS) at Kunming. This was a group of American officers who were to advise the Chinese in planning for operations in Burma, train native troops, expedite the flow of supplies and equipment, and help improve lines of communication. While Stilwell was nominally the commander of the Y-Force Operations Staff, his responsibilities were actually exercised by the chief of staff, Col. Frank Dorn. Colonel Dorn made Kohloss his G–4 and Dawson his engineer. Kohloss and Dawson continued their attempts to get the Chinese to improve their logistical setup. The two succeeded in getting them to complete the building of the general depots at Kunming and Yunnanyi early in August, but they had few illusions about the future. The Chinese continued to display almost no interest in an offensive beyond the Salween—Chiang even proposing that the advance be held off until January 1944 at the earliest—and there were no signs during the summer that he was organizing the Y-Force for a campaign in Burma.[93]

The Road Projects

Despite the overriding priority now given to Chennault's air war, and the discouraging prospects with regard to the campaign in Burma, the engineers continued to push their road projects. Since it appeared the Chinese would continue to procrastinate, Stilwell himself felt obliged to intervene in Chungking. On 6 July he succeeded in getting Dr. Tseng Yang-fu, Chiang's Communications Minister, to agree to begin work at once on the Burma and Mitu Roads with a view to opening them to trucks, at least part way, by October. No action had been taken in Chungking on the request for funds made in February. Tseng promised to ask Chiang for 350 million dollars for work on the two roads. In mid-July, Chiang acted. His decision was a great disappointment to the Americans. He authorized only 100 million dollars, to be used solely for the improvement of the Burma Road. How much could be accomplished with this sum was questionable; the Chinese dollar of July was worth only a third of that of February, and its value was continuing to decline rapidly.[94] Chiang's allotment took the Highway Administration unawares. C. C. Kung, the director, called the members of his staff and his six district engineers to Kunming for conferences on how to get the work on the Burma Road under way by early August. Dawson tried to persuade Kung to approve a plan for widening the road. Widening would be more desirable than surfacing during the coming dry season, for it would interfere less with military traffic. Kung agreed. But he allotted the funds in what seemed a most haphazard manner. As Dawson put it, it was "by guess and not based on any definite plan or estimate—

[93] (1) CBI Hist, sec. II, app. III. (2) YOKE Rpt No. 50, 16 Aug 43. Kohloss Pers Files.

[94] (1) YOKE Rpt No. 36–B, 6 Jul 43. Kohloss Pers Files. (2) YOKE Rpt No. 45, 1 Aug 43. Both in Kohloss Pers Files. (3) Memo 76, Dawson for Kohloss, 20 Oct 43. Engr Br File, Constr Serv Files. (4) CBI Hist, sec. II app. III.

rather 'on a share-the-wealth scheme.' "[95]

By the beginning of August planning for work on the road was complete. Kung agreed to accept Dawson and Dr. Lee Wen-ping, a graduate of the School of Engineering of the University of Michigan, as his deputy directors. Kohloss arranged to have a U.S. engineer officer on duty at each of the Highway Administration's district offices along the road. After getting enough mechanics in July from General Wheeler to repair the Highway Administration's equipment, Kohloss arranged with Kung early in August to set up a "Mobile Construction Force" to operate under the administration's direction. Commanded by an American engineer, Capt. Harvey W. Gehr, and including 4 American officers, 6 American equipment operators, 4 Chinese civilian road engineers, and a crew of coolies, the Mobile Construction Force was to improve those sections of the Burma Road where machinery would be most effective. By far the greater part of the work on the road would be done by hand labor. On 2 August Governor Lung of Yunnan agreed to conscript 36,000 peasants who were to start work late that month.[96]

All these efforts produced few results. Governor Lung was nearly a month late in getting conscripted peasants on the road. Dawson could not conceal his misgivings over the Highway Administration's leisurely approach toward its work. By September only one district engineer had prepared an engineering analysis of the improvements which were to be made under the current allotment. In Dawson's view, the Highway Administration had "too much overhead doing nothing at headquarters and too little in the field." The district engineers had "too few capable foremen and engineers to properly supervise the . . . 'conscripted labor.' The result will be that the work will not be well planned and the road will suffer." Meanwhile, Kohloss, concerned over the potential consequences of inflation, urged Stilwell to secure additional funds. Chiang's War Ministry did increase the allotment for the Mitu Road by 44 million Chinese dollars, but, no matter how great the allotments made in Chungking, work on the roads progressed hardly at all. The Highway Administration's direction of such work as was carried out seemed to the Americans quite haphazard. In some sectors the Chinese went to extremes in widening the road; in others they accomplished almost nothing. When the administration, having exhausted its funds, stopped work early in October, the Burma Road was essentially what it had always been—a one-lane road with steep grades, horseshoe curves, and narrow bridges. And it was now more in need of repair than before.[97]

The renewed emphasis on airfield

[95] (1) Rpt, Dawson to Kohloss, 27 May 43. (2) YOKE Rpt No. 45, 1 Aug 43. (3) Engr Rpt 6, Dawson to Dorn, 27 Dec 43. All in Engr Br File, Constr Serv Files.

[96] (1) YOKE Rpts No. 46, 2 Aug 43, and No. 50, 16 Aug 43. Kohloss Pers Files. (2) CBI Hist, sec. II, app. XII.

[97] (1) YOKE Rpt No. 55, 5 Sep 43. Kohloss Pers Files. (2) Engr Memo 58, Dawson for Kohloss, 5 Sep 43. Engr Br File, Constr Serv Files. (3) Memo, Kohloss for Hearn, CofS CBI, 29 Aug 43. Kohloss Pers Files. (4) Engr Memo 57, Dawson for Kohloss, 31 Aug 43. (5) Engr Memo 76, Dawson for Kohloss, 20 Oct 43. Last two in Engr Br File, Constr Serv Files.

construction placed the Ledo Road project in a precarious position. Its loss of priority in troops and equipment in May 1943 could scarcely have occurred at a worse time. With the roadhead at the crest of the Patkais, the monsoon storms created endless problems. Torrential rains swept out bridges and culverts and undermined the roadway. Rain-soaked embankments collapsed without warning and blocked the road with massive slides. Disabled equipment piled up as the small force of mechanics struggled against forbidding odds to make the necessary repairs. The men working on the road saw their ranks dwindling away as malaria rates rose steadily. It is small wonder that work went into low gear and the once-high morale declined.[98] Nevertheless, the engineers continued improving the road insofar as possible, although little could be done to extend the roadhead through the jungle.

Early in July Maj. Gen. Wilhelm D. Styer, Somervell's chief of staff, made an inspection of the road. In a detailed report to Somervell of his impressions, he urged, among other things, immediate shipment of five general service regiments. Referring to earlier British statements that work would be impossible during the summer, he reported that the British still seemed "to think . . . we are crazy for trying." There was much to justify their views. Among the American troops, the malaria rate had reached 955 per 1,000 per year; among the Chinese, 2,200. "In spite of all the obstacles encountered on the construction of the Ledo Road, it is progressing," Styer concluded, "and General Wheeler and his force deserve a great deal of credit for what they have accomplished under the conditions imposed upon them." [99] Shortly afterward, an Air Corps officer inspecting the road at Stilwell's personal request found that "the officers and men are doing a good job under the circumstances." [100] But others had different opinions. Col. Frank D. Merrill, theater G–3, had inspected the road only a few days before Styer's visit. He had come away highly critical. While many of the resources of Base Section 3 had admittedly been drained away to the airfields, Merrill believed that commanders in SOS were making too much of the effect of such diversions on the rate of progress on the road. Merrill particularly blamed the situation at Ledo on Arrowsmith, recently promoted to brigadier general. He asserted that Arrowsmith's leadership was not sufficiently energetic for such trying circumstances.[101]

In mid-July, Stilwell hastened to Ledo for a firsthand look. Finding him "vinegary," Wheeler and Arrowsmith tried to mollify him and give him a clearer understanding of the difficult situation. Wheeler again emphasized that Base Section 3, "milked daily" of troops for

[98] (1) Ltr, Sloat to C EHD, 22 Dec 52. (2) Hist of the 45th Engrs. (3) Base Sec 3, Prog Rpts, 29 May, 5 Jun, 9 Jul, 23 Jul 43. AG 611 CBI.

[99] Styer, Notes on Ledo Road Being Constructed in N.E. Assam Into Northern Burma by U.S. Forces, 2, 3 Jul 43. Somervell Files, Ledo Road, 1943.

[100] Ltr, Col Thomas D. Campbell to Maj Gen George E. Stratemeyer, CofS AAF, 14 Jul 43. 312.-1E, AAF Central Files, WW II Rcds Div.

[101] (1) Excerpts from Ltr, Merrill to Stilwell, 29 Jun 43. OCMH Files.(2) Rad, Merrill to Stilwell, 25 Jun 43. Stilwell Pers File, Rads.

other projects, could use "thousands" of engineers. Stilwell, staying on at Ledo for three days, made no specific complaints.[102] After he left, Wheeler continued to point out to him the difficulties on the road. In a memorandum of 9 August, he stated that Base Section 3 had shipped to the airfields in Assam, 5,612 carloads of gravel, "enough . . . for over 30 miles of single-track road. . . ." The 330th Engineers, who should have been sent directly to the road, had been put to work as stevedores in Calcutta until July, and, upon arriving at Ledo, the greater part of the regiment had to be held at the base to work on access roads and in gravel quarries.[103] Wheeler further emphasized that progress on the road had suffered considerably from the failure of the British to provide sufficient laborers.[104] He might have added that Arrowsmith had been obliged during the summer to rotate the 823d and 45th engineers to rest camps in Calcutta to forestall exhaustion from their continual around-the-clock efforts.[105]

Anxious to get the road to Shingbwiyang before fall, and stung by the knowing smiles of the British, Stilwell was not disposed to give much weight to extenuating circumstances. On 21 August he again visited the road for a 1-day inspection. He held a series of meetings culminating in a night session with General Arrowsmith. Stilwell's questions and remarks at the meetings and conferences appeared "more or less routine" and seemed to indicate no displeasure with the way the project had been managed. Nevertheless, that night, Stilwell sent a radiogram to Wheeler ordering Arrowsmith's relief. Criticizing Arrowsmith in terms reminiscent of Colonel Merrill's report of 29 June, he stated he could not "take chances on that project." Branding the rate of progress on the road as a threat to the "whole operation" in northern Burma, Stilwell asked Wheeler to look into the possibility of getting a "top-flight man" from the States.[106]

Wheeler reluctantly recalled Arrowsmith the next day and placed a Quartermaster colonel, Ellis F. Altman, temporarily in charge of work on the road. On 23 August Arrowsmith's command of the project, on which 90 percent of the engineers in the theater were engaged, came to an end. As he departed for temporary duty with Wheeler's headquarters, before leaving for the United States, Arrowsmith was deeply disappointed. "We knew what we were up against. . . ." he wrote later. "We proved that we could not only overcome the physical difficulties . . . but we also held up against the mosquito. . . . We were nearing the end of the long uphill pull."[107] Arrowsmith was relieved just as better times were almost in sight. The dry season was approaching and engineer reinforcements were on the

[102] Rads, Wheeler to Stilwell, G78, 10 Jul, E183, 13 Jul 43. AG Files, CBI.

[103] Memo, Wheeler for Stilwell, 9 Aug 43. Engr Sec File, LAC Files.

[104] Memo, Wheeler for Stilwell, 10 Aug 43.

[105] Ltr with Incls, Arrowsmith to C EHD, 12 Feb 54.

[106] (1) Ltr, with Incls, Arrowsmith to C EHD, 12 Feb 54. (2) *Stilwell Papers*, p. 218. (3) Rad, Stilwell to Wheeler, 21 Aug 43. Item 681, Stilwell Pers File, Rads.

[107] (1) Memo, Wheeler for Arrowsmith, 20 Oct 52. Copy in EHD Files. (2) Ltr with Incls, Arrowsmith to C EHD, 12 Feb 54.

way. With the end of the rains the natives would be more inclined to work on the road, and the British would have less trouble in mobilizing them. The Anglo-American high commands, meeting at Quebec, had just a few days before resolved to support a redoubled Allied effort to open northern Burma and build a supply road to China.

Chennault's Air Offensive

Meanwhile, Chennault's offensive, despite the support given it, was floundering. During May, June, and July his flyers destroyed only 3,300 tons of Japanese shipping and appeared to be making no headway in driving the enemy out of the Yangtze Valley, as Chennault had promised the President he would do. The logistical structure supporting his effort was unable to meet the demands made on it. Deliveries from India had fallen short in July and no great improvement was in sight. In September, when the airlift was to have attained the goal of 10,000 tons a month, it carried but 5,000. Many obstacles had arisen to hamstring the supply efforts, one of the most serious being the inadequate number of airfields in Assam. Of the seven fields the British were to have completed by 1 September, only three were ready. Logistical difficulties in China were equally serious. The five large and well-kept fields in Yunnan were no problem, but the inefficiency of the line of communications eastward from Kunming to Chennault's forward bases left much to be desired. Even if the airline from Assam to western China had met its tonnage targets, it seems unlikely that Chennault's position would have been noticeably improved.[108]

The approaching end of the monsoon season found engineer work in a discouraging state. Progress on the Ledo Road had come to a virtual standstill. Almost nothing was being done to improve the Burma Road. The airfields in Assam were not being put in shape as rapidly as had been hoped, and the prospects of finishing the fields in eastern China were disheartening. Unless high-level changes in policy were soon made, the engineer effort in the theater might bog down completely.

---

[108] (1) Romanus and Sunderland, *Stilwell's Mission to China*, pp. 336–47. (2) Craven and Cate, eds., *Guadalcanal to Saipan*, pp. 443–49. (3) Memo, Marshall for Roosevelt, 4 Oct 43. WDCSA 452.1 (China). (4) Rad, Somervell to Marshall, 20 Oct 43. Somervell Files, Wires, Round-the-World Trip, Sep 2–Nov 1, 1943.

CHAPTER XI

The China-Burma-India Theater August 1943–January 1945

QUADRANT Directs an All-out Effort

Plans for CBI

A change for the better for the engineers in CBI seemed to be at hand. Meeting in the QUADRANT Conference at Quebec from 14 to 24 August 1943 to discuss world strategy, the Anglo-American high commands gave much thought to operations in the China-Burma-India theater. The Combined Chiefs, assuming that the Chinese trained and rearmed by Stilwell would eventually link up with U.S. forces in southeastern China, agreed to commit enough British and U.S. strength to the theater to keep China in the war as an effective ally and as a base for operations against Japan. To facilitate strengthening China, they directed the capture of the northern part of Burma in order to increase the safety of flights over the Hump and to make possible the restoration of overland communications by mid-February 1944.[1] Much thought was given to developing the line of communications from India to China. Somervell went into this matter with the Quartermaster General of the British Army, Sir Thomas Riddell-Webster. The two worked out a comprehensive program for improving logistical support for the Chinese war effort. Their plans called for an increase in deliveries over the Hump to 20,000 tons a month by mid-1944. There would have to be a redoubled effort to open the Ledo and Burma Roads to make possible trucking 30,000 tons of supplies a month to China by January 1945.[2]

Plans for constructing a pipeline from India to China figured prominently in the talks. To ship sufficient quantities of fuel to China by truck and plane to support a sustained drive against the Japanese would be impossible. "The old Burma Road ate its head off in gasoline," Merrill had declared at TRIDENT. "A pipeline is the only way to cure this." [3] Construction of a pipeline system in a combat zone might have met with insurmountable obstacles had it not been for improvements, such as the Shell Oil Company's invasion-weight pipe. This

[1] (1) Romanus and Sunderland, *Stilwell's Mission to China*, pp. 357–60. (2) Memo, Stilwell for Chiang, 11 Nov 43. Stilwell Pers Files, Ltrs. (3) Plng Div ASF, The Ledo Road, app. A, pp. 12–14. OCE Library.

[2] (1) ASF Activities in the Sup of CBI, pp. 83–88. (2) CBI Hist, sec. II, app. VIII.

[3] Memo, Merrill for Lt Col Donald F. Horton, Plans Div ASF, 14 May 43. Stilwell Pers Files, Ltrs.

pipe was thin-walled, portable, and weighed about half as much as standard pipe. There were two sizes—one, four inches in diameter; the other six. Each piece of pipe was twenty feet long. A piece of 4-inch pipe weighed about 90 pounds; of 6-inch, about 150. The sections were not welded together as were those of standard weight, but were joined by "victaulic couplings." These were collars with rubber gaskets, made tight by the pressure of the oil or gasoline flowing through the pipes. A mile of invasion-weight pipeline together with pumping stations weighed thirteen tons. Pipe and stations could be easily transported and installed in any kind of terrain accessible to trucks. Improved types of submarine lines, ship-to-shore loading equipment, and bolted steel tanks holding 250, 500, or 1,000 barrels had also been developed. In July 1943 the Office of the Chief of Engineers reported that construction of a 4-inch, invasion-weight pipeline from the town of Dibrugarh on the Brahmaputra River in Assam through the mountains of northern Burma to Fort Hertz and on to Kunming was practicable.[4] The QUADRANT Conference approved construction of a line via Fort Hertz which would skirt enemy-held territory and would be used mainly to supply gasoline to Chennault's air force. The Combined Chiefs further approved the laying of a second 4-inch invasion-weight line; this one would follow the Ledo and Burma Roads to supply gasoline to trucks hauling supplies from India to China. In addition, the Combined Chiefs directed that two 6-inch pipelines be put in, one to extend from Calcutta to Kunming via the Ledo and Burma Roads to provide gasoline for American and Chinese ground operations, and the other to run from Calcutta to Dibrugarh to feed the 4-inch lines. When finished, these 4- and 6-inch lines would form the most extensive pipeline system in the world.[5]

The QUADRANT Conference also took up the matter of guerrilla warfare. British Brigadier Orde C. Wingate, who had carried on such warfare in Burma, had come to Quebec to support Churchill's arguments for broadening the scope of commando operations behind enemy lines. Wingate was convinced that in his recent campaigning he had developed a method of harassment that would cripple Japanese defenses. He proposed to augment his specially trained brigades of Chindits—named after the mythical lionlike animals which guarded Burmese temples and made up of natives of India, whites from the British Isles, and Negroes from West Africa—so that they could strike really effective blows. He wanted to improve the means of sending his forces behind enemy lines by air. Given enhanced mobility and dependable air supply, Wingate was certain the Chindits could harry the Japanese sufficiently to force them out of northern Burma. The Allied commanders approved his proposals. General Marshall directed the assembling of an American task force of

[4] (1) Memo, C Opns and Tng Br OCE for Dir of Opns ASF, 29 Jul 43. 678 (CBI.) (2) See also above, p. 390.

[5] John D. Millett, *The Organization and Role of the Army Service Forces*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1954), p. 71.

some 3,000 volunteers who would serve with the Chindits. General Arnold promised to supply pilots from the AAF to fly the planes Wingate said he needed. He directed Air Force Col. Philip G. Cochran to go to India in the autumn to organize these men into the 5318th Air Unit, which would be a "custom-made" aggregation of bombers, fighters, transports, gliders, and helicopters. It would be up to the engineers to provide the landing fields for the air commandos behind the enemy lines. Wingate would carry on guerrilla warfare in Burma while the Chinese under Stilwell launched their full-scale offensive.[6]

General Arnold announced a project at the conference which was destined to have a tremendous impact on the engineer mission in CBI. The Army Air Forces had almost perfected the B–29 or "superfortress" bomber, which was to be capable of delivering 10 tons of bombs on a target 1,500 miles away. Arnold informed the Combined Chiefs that the first B–29's would be ready during the coming winter. If bases could be provided in the Changsha area of China, midway between Kunming and Shanghai, the Air Forces would be ready to launch a massive assault on Japan by October 1944. This plan of overwhelming Japan with fleets of superbombers appealed to the imagination of the President. The number of fields to be built was left rather indefinite and methods of providing logistic support were not clearly formulated. Planning staffs in Washington and in the theater would have to work out the details in the next few months. Roosevelt believed that if the plan could be carried out as Arnold proposed, there would be a material improvement in Chinese morale and an early end of the war with Japan.[7]

Theater Reorganization

The decisions at Quebec were undertaken simultaneously with two basic changes in the Allied command structure in the theater designed to promote more effective use of resources. Hoping to eliminate some of the confused relationships of the existing "loose coalition of Allied headquarters," Roosevelt and Churchill agreed to set up the Southeast Asia Command. Vice Adm. Lord Louis Mountbatten was named commander. With his main forces based in India, he would control Anglo-American operations in Burma. Stilwell's position in the new setup was not clear. He would be under Mountbatten insofar as operations in Burma were concerned, and it was generally assumed he would be Mountbatten's deputy, but there was no official confirmation of this assumption. Arnold's chief of staff, Maj. Gen. George E. Stratemeyer, was to go to CBI as Stilwell's air adviser. He was appointed commanding general of U.S. Army Air Forces, India-Burma Sector, and as such was the ranking American air officer in the theater. Under him

[6] (1) Craven and Cate, eds., *Guadalcanal to Saipan*, pp. 494–95, 503–07. (2) Romanus and Sunderland, *Stilwell's Mission to China*, p. 366.

[7] (1) Wesley Frank Craven and James Lea Cate, eds., *The Army Air Forces in World War II*, Vol V, *The Pacific—Matterhorn to Nagasaki: June 1944 to August 1945* (Chicago: The University of Chicago Press, 1953), pp. 16–22. (2) Henry H. Arnold, *Global Mission* (New York, 1949), pp. 476–80.

was Tenth Air Force, commanded, after General Bissell's return to the United States in mid-August, by Brig. Gen. Howard C. Davidson. Stratemeyer, arriving in the theater in August, set up his headquarters near Calcutta. He soon learned that he would have little control over Chennault. Roosevelt had assured Chiang that Stratemeyer would not interfere with the operations of the Fourteenth Air Force, and Stilwell exempted Chennault from Stratemeyer's operational control. To most observers, command relationships in CBI remained as involved as before, and the complexities of the engineer organization as great as ever.[8]

The growing emphasis on air power led to the organization of engineer offices in the Air Forces in CBI for the first time. On 15 August Col. Herman W. Schull, Jr., organized an Engineer Section in Chennault's Fourteenth Air Force headquarters at Kunming. Schull and his one assistant were henceforth responsible for maintaining liaison with the Services of Supply regarding the building or maintenance of five airfields in Yunnan and ten in eastern China, together with a dozen reserve fields in widely scattered localities. A similar development took place in India. On 20 August Stilwell activated the CBI Air Service Command with headquarters near Calcutta, to succeed the X Air Force Service Command. The new organization was charged with supporting the Tenth Air Force in India and the Fourteenth in China. Col. Lyle E. Seeman, who arrived from the United States in the summer of 1943, became the first engineer of the new organization. At the same time he became theater air engineer under Stratemeyer. Like Schull in China, Seeman, with his small staff, maintained liaison with SOS on airfield construction in India.[9]

Planning for New Operations

Because of the shortage of planning staffs in the theater, Army Service Forces in Washington had to assume the main burden of planning for the line of communications projects the Combined Chiefs had approved. This responsibility Somervell and his staff accepted with enthusiasm. Styer wrote that the "development of the line of communications from India to China bids fair to be the greatest engineering undertaking of the war. . . ." [10] Early in September, Somervell established the India Committee. It included specialists from the technical services. The committee's job, Somervell said, was to keep ASF "in a position at all times to back up and even anticipate the demands which are made on us in the way of men and materials." [11]

[8] (1)Winston S. Churchill, *Closing the Ring* (Boston: Houghton Mifflin Company, 1951), p. 89. (2) Craven and Cate, eds., *Guadalcanal to Saipan*, pp. 45–54. (3) CBI Hist, sec. III, app. IX. (4) Ltr, Arnold to Stilwell, 28 Aug 43. Stilwell Pers Files, Ltrs. (4) Ltr, Maj Edward E. Voynow to Hq AAF, 4 Jan 44. AAF Central Files 312.1—H Opns, Ltrs, Nov 43–Feb 44.

[9] (1) Hq Fourteenth AF Engr Sec, Office Diary, 15 Aug 43–3 Apr 44, p. 1. Air Force Files, CT. (2) CBI Hist, sec. III, app. IX. (3) Ralph G. Hoxie, Frederick J. Ericson, and Robert T. Finney, Hist of the Fourteenth AF (MS), pp. 109–13, 312–22. Air Univ Lib Maxwell AFB. (4) Hist of CBI Air Serv Comd, pp. 28–32. Last two in Air Univ Lib Maxwell AFB. (5) Ltr, Seeman to EHD, 29 May 53. EHD Files.

[10] Quoted in ASF Activities in the Sup of CBI, p. 41.

[11] *Ibid.*, pp. 88–89.

The principal representatives of the Corps of Engineers on the committee were Col. Louis G. Horowitz, for theater liaison, Col. Thomas F. Farrell, for construction, and Col. Harry A. Montgomery, for supply.

With such co-operation as the CBI staffs could give, headquarters in Washington worked at top speed during the autumn to get men and supplies to the theater. Somervell was determined to obtain for the Ledo Road its full allotment of eighteen engineer construction battalions. As of September 1943 only six were in the theater. Subject to the availability of shipping and the troop priority lists established by Stilwell, Somervell intended if possible to have the entire eighteen on the road by the following January.[12] The Corps of Engineers expanded the Petroleum Section of the Engineer Unit Training Center at Camp Claiborne, Louisiana; nine petroleum distribution companies were to be trained and readied for shipment to India by early 1944.[13] General Godfrey, the Army Air Forces engineer, was deeply interested in a number of projects scheduled for CBI. At his urging, General Arnold directed that the headquarters of an aviation regiment and four aviation battalions be sent to the theater for work on the B–29 fields. Godfrey, having played a key role in securing the adoption of airborne engineer units by the Army in the summer of 1942, was especially interested in Wingate's plans for the air commandos. He was largely instrumental in getting airborne engineers assigned to the commandos for the coming campaign in Burma.[14]

In procuring supplies and equipment for road and pipeline construction, Somervell's hand was greatly strengthened by the fact that Army Service Forces had already assembled many of the materials needed; they had been intended for the now-abandoned line of communications from Rangoon to Kunming. All of the pipe required for the 4-inch line via Fort Hertz was en route to the theater by late August. Nearly a fourth of the 900 miles of 6-inch pipe and accessories which ASF had originally ordered for the line from Bhamo to Kunming was on its way. Of the 55,715 tons of road construction equipment requested by Wheeler during 1942 and 1943, all was either en route or being procured by Army Service Forces by 1 September. Since additional pumping stations and pipe would be needed, the Corps of Engineers undertook procurement during September and October.

It soon became evident that the B–29 program would have to be curtailed. It ran aground on the shoals of logistics. Having the fields at Changsha would mean developing a line of communications from Calcutta to Kunming of a magnitude and at a speed not contemplated by the Combined Chiefs. The supply effort required would be herculean. As modified by Stilwell and Stratemeyer in October and November, the MATTERHORN project called for the construction of five air bases west of Calcutta and four staging fields near the

[12] *Ibid.*, pp. 88–101.

[13] Coll, Keith, and Rosenthal, *Troops and Equipment*, p. 432.

[14] Craven and Cate, eds., *The Pacific—Matterhorn to Nagasaki*, p. 62.

city of Cheng-tu in Szechwan Province, northwest of Chungking. This reduced program would move up the advent of the bomber offensive to the spring of 1944, but mass bombings would have to be given up in favor of careful selection of strategic targets, such as Japanese steel mills and aircraft factories.[15]

The preparations being made in the United States soon had their repercussions in the theater. The engineers had to make still greater efforts to meet the goals set by the QUADRANT Conference. Work on old projects had to be speeded up and new ones begun. Whether much more could be done until more troops arrived was doubtful. Highly desirable would be a better organization of the theater. In any case, by the fall of 1943 there was a noticeable quickening of engineer work in the theater from eastern China to western India.

Airfields in China and India

In eastern China, Byroade continued to supervise construction of the fields near Kweilin and began to improve several more about 200 miles to the east and southeast. In this part of China, the engineers, as before, met with unexpected developments. Outside Kiangsi Province, where the local authorities were not so fully in control, "uncertified contractors" were permitted to start work on some of the fields. Soon organized gangs were carrying out systematic acts of violence and intimidation against contractors and workers alike with little or no interference on the part of the authorities. A number of additional contractors were subsequently "certified," after they indicated they were willing to share profits with local officials. Despite such hindrances, progress was made in construction. During the autumn Byroade presented Chennault with 5 improved fields near Kweilin and 7 more 200 miles farther east and southeast. By this time SOS engineers in China were responsible for maintaining 27 fields for Chennault.[16]

The fields in Assam, upon which so much work had been done to make possible flying larger tonnages to Chennault, also showed progress. This improvement was accompanied by high-level struggles in the final, critical phases of the construction effort. The British, pointing to the top priority assigned by the Combined Chiefs to ground operations scheduled for 1943, explained that it would be necessary to withdraw their military engineers from Assam for duty on the line of communications supporting the British forces facing southern Burma. Stilwell and Wheeler were able early in October to convince them that a wholesale withdrawal would be uneconomical. The British agreed to leave their engineers on the most important of the remaining uncompleted fields. Late that year the Air Transport Command had available ten fields along the upper Brahmaputra.[17]

With more fields in India and China to

[15] (1) ASF Activities in the Sup of CBI, pp. 88–101. (2) Plng Div ASF, The Ledo Road, pt. V, p. 29; app. B–1, pp. 37–45.

[16] Hoxie *et al.*, Hist of Fourteenth AF, pp. 109–13, 312–22.

[17] (1) Hq USAF in CBI, G–4 Periodic Rpt, 30 Sep 43. EHD Files. (2) Rad, Stilwell to Marshall, 4 Oct 43. 611 CBI. (3) ASF Activities in the Sup of CBI, p. 93.

give him support, Chennault in October was able to make a more effective showing. Deliveries of supplies over the Hump increased, and two additional fighter squadrons arrived. After the failure of his trial offensive in August and September, Chennault now found the going much easier. He began to take the initiative in China's eastern skies. In the last quarter of 1943 his flyers carried out highly successful strikes against Japanese shipping on the Yangtze and off the China coast.[18]

The Ledo Road

Meanwhile, the engineers in Base Section 3 labored to provide the overland communications indispensable for expanded operations in China and Burma. Inasmuch as Arrowsmith's successor was a Quartermaster officer, supervision of work on the road now rested largely with Col. Robert E. York, road engineer since 21 May. The return of the 45th Engineers from their rest camp near Calcutta early in September and the tapering off of the monsoon gave Colonel York a chance to push road construction once more. With the 330th Engineers breaking the trail and doing the advance grading and the 45th Engineers doing the final grading and graveling, the Ledo Road inched southward through the jungle and defiles of northwestern Burma, despite the 23 inches of rain that fell during the remainder of the month.[19] By 15 October the lead bulldozer had advanced nearly seven miles and was beyond Mile 60.[20] By this time there were on the road 2 general service regiments, 3 aviation battalions, and one engineer maintenance company, about 5,250 engineers in all.[21]

On 17 October a new chapter began in the history of the road. Col. Lewis A. Pick, Missouri River Division engineer, arrived to take command of Base Section 3.[22] He lost no time in inaugurating a new order of things. On the evening of his arrival, he bluntly told his assembled staff, "I've heard the same story all the way from the States. It's always the same—the Ledo Road can't be built. Too much mud, too much rain, too much malaria. From now on we're forgetting this defeatist spirit. The Ledo Road is going to be built—mud, rain, and malaria be damned!" [23] Pick set up his command tent near the roadhead. He reinstituted the around-the-clock schedule that General Arrowsmith had been forced to abandon five months before with the onset of the rains. Pick was determined to brook no obstacle to the speedy advance of the road. He sought to provide adequate lighting for work at night by stripping the base of all generators, wiring, sockets, and bulbs that could possibly be spared. He told the troops that if necessary they were to put flares in buckets of oil. Work would have to go on without interruption.[24]

Pick believed that one of his first jobs

[18] Craven and Cate, eds., *Guadalcanal to Saipan*, pp. 529–36.

[19] (1) Hist of the 45th and 330th Engrs. (2) Ltr, CO 330th Engrs to CO Base Sec 3, 11 Oct 43. Engr Sec File, LAC Files.

[20] Rad, Hirshfield to Stilwell, 16 Oct 43. AG Files CBI.

[21] Plng Div ASF, The Ledo Road, app. C, p. 42.

[22] Hq Base Sec 3 GO 20, 17 Oct 43. AG File, LAC Files.

[23] Plng Div ASF, The Ledo Road, app. F, p. 22.

[24] *Ibid.*, p. 23.

was to relieve the forward elements on the road. The day before his arrival, orders had gone out withdrawing Company D of the 330th Engineers from the roadhead. This unit, which had spearheaded the advance since early July, had been reduced to a handful of men by malaria and dysentery. Its removal for rest and recuperation was clearly necessary. On 1 November Pick lauded Company D for displaying a fortitude "comparable to that cited for combatant troops." Shortly afterward, he began pulling back the rest of the 2d Battalion for road maintenance and improvement south of Pangsau Pass. By 14 November he had moved up the 1st Battalion of the 330th to take the lead. The roadhead stood at Mile 63. The advance was about to begin in earnest.[25]

Early in November Stilwell visited road headquarters. He impressed on Pick the urgent importance to the tactical plan of having a jeep trail open to Shingbwiyang by the first of the year. "I can't build you a jeep road," Pick replied, mindful of the difficulty of maintaining a narrow track in the swampy jungle, "but I'll build you a military highway to handle truck traffic." With Pick's assurance that such a road could be built to Shingbwiyang by 1 January 1944, Stilwell took him up on it.[26] In mid-November, the 330th and the Chinese 10th engineers at Mile 63 began the 54-mile "race to Shingbwiyang," by breaking a path through the jungle. To the rear, the 45th Engineers were joined by a number of newly arrived units. The 849th and 1883d Aviation Battalions helped with final grading and graveling from Pangsau Pass southward. The 209th Combat Battalion operated a sawmill, did road maintenance at the pass, and a little farther south built a 157-foot-long girder bridge over the Nawngyang River. The 823d engineers maintained the older sections of the road, while the 479th Maintenance Company repaired equipment. With the help of Company C of the 45th Engineers, which had made an overland trek to open an advanced roadhead at Mile 70 early in October, the 330th had pushed its lead bulldozer twenty-two miles beyond that point by the close of November.[27]

Under Lt. Col. William J. Green, who became road engineer on 3 December, progress was rapid. Favored by generally clear weather, the 330th Engineers gradually improved their performance until they attained early in December an average of a mile a day. The units to the rear maintained the pace set by the those in the lead. Specifications called for a minimum width of twenty-seven feet, shoulder to shoulder, with a 20-foot roadway, maximum grades of 10 percent, and a minimum curve radius of fifty feet. Accounting for the rapid progress in construction were various factors, including around-the-clock operations, the trickling forward of new equipment, and Pick's insistence on constant supervision of construction and maintenance by all commanders and on giving junior officers

[25] (1) Ltr, Surgeon 330th Engrs to CO 330th Engrs, 1 Oct 43, with Inds, 4, 14, 15 Oct 43. (2) Ltr, ExecO 330th Engrs to Road Engr, 1 Nov 43. Both in Engr Sec File, LAC Files.

[26] Plng Div ASF, The Ledo Road, app. F, p. 23.

[27] (1) Road Hq Tab, Distr of Functions of Engr Units on Ledo Road, 22 Nov 43. Engr Sec File, LAC Files. (2) Rads, Col Pick to Brig Gen William E. R. Covell, 27 Nov, 4 Dec 43. AG Files CBI. (3) Hist of the 45th, 330th, and 1883d Engrs.

a detailed insight into the planning behind each phase of the work. The ingenuity of maintenance crews made up somewhat for the scarcity of spare parts but was not equal to the task of preventing entirely the continual deterioration of the heavy equipment, too long in constant use. At any rate, by making the best use of the equipment they had and by throwing fresh grading parties from the recently arrived 1905th Engineer Aviation Battalion to create new roadheads, Green pushed his trace to within eleven miles of Shingbwiyang by 23 December. The engineers now pressed forward through the remaining stretch. Green split the 330th to put in advance roadheads and organized two more grading parties. Shortly before noon on 27 December, the 330th engineers connected their traces 3 miles north of the town. Pick flashed the word to New Delhi that the 117-mile road from Ledo to Shingbwiyang was open. He then rode into town at the head of a convoy of jeeps and trucks. He had beaten his target date of 1 January by five days. Finished grading and graveling remained to be done, but the road from Ledo to Shingbwiyang, which Stilwell wanted, was open.[28]

Soon after his arrival in the theater, Pick had taken steps to begin work on that part of the pipeline system for which he was responsible. Wheeler had informed him that Stilwell was no longer interested in a line over the mountains by way of Fort Hertz. Early in October the Chief of Engineers had recommended against using the light, invasion-weight pipe in the high elevations of the China-Burma divide. Consequently, on the 16th Stilwell had gone back to the original plan of putting the pipeline along the road. Because materials could be moved forward more easily there, construction would be simplified. Pick had a considerable stock of 4-inch pipe in his warehouses, but no troops to build the line were scheduled to arrive before January.[29] Determined not to waste two months of good construction weather, he decided to use men from the 330th Engineers and from the recently arrived 209th Combat Battalion and 382d Construction Battalion. On 27 October he put the men to work laying pipe from the refinery at Digboi, toward Ledo, fourteen miles to the south. Early in November Col. Kenneth MacIsaac, who had recently arrived from the United States with a staff of four petroleum engineers, took charge of the project. Almost totally inexperienced in this type of construction, the troops under MacIsaac caught on quickly. The line was soon complete to Ledo and was being extended down the road. The men were laying an average of 1.2 miles of pipe a day. The rate slowed down when they reached the mountains, where they rarely laid more than half a mile a day. By the last week of December, the pipeline crews had almost caught up with the graveling details at Mile 60.

[28] (1) Hist of the 330th Engrs. (2) Memo, ExecO 330th Engrs, for Bn CO's, 5 Dec 43. Engr Sec File, LAC Files. (3) Rad, Pick to Wheeler, 9 Dec 43. AG Files, CBI. (4) Memo, CO 1st Bn 330th Engrs, For All Concerned, 17 Dec 43. Engr Sec File, LAC Files. (5) Rad, Pick to Covell, 27 Dec 43. AG Files CBI.

[29] (1) Rad, Somervell to Stilwell, 13 Oct 43. 678 (CBI). (2) Memo, OCE for CG ASF, 20 Oct 43. 320.2 (CBI).

Thereafter, MacIsaac slowed the pace of the advance to that of the gravel-head in order not to hamper the forward elements on the road.[30]

Stilwell's campaign in northern Burma had gotten off to a premature start on 16 October. The tactical plan called for the Chinese to advance from Shingbwiyang to the Tarung River, which flowed in a southerly direction about twenty miles to the east. From the Tarung, Stilwell's forces were to drive southward on 1 December toward the town of Myitkyina, some 140 miles away. Myitkyina was the main operational base for the Japanese forces holding northern Burma. Astride the route planned for the Ledo Road, it was a key rail terminus. Near the outskirts of the town was a vitally important airfield. Operations against the Japanese did not develop as planned. On 30 October the Chinese ran into unexpectedly strong enemy formations on the west bank of the Tarung. What was to have been a quiet "forward displacement" became a see-saw struggle.[31] The possibility of a counterattack against Shingbwiyang and the roadhead had loomed large in the minds of the engineers near the front. Writing to Pick on 14 December, Lt. Col. William E. Hicks, executive officer of the 330th Engineers, complained that his forward battalion, approaching Shingbwiyang, had only piecemeal information on the location and status of the front. Liaison of the engineers with the ground forces was practically nonexistent, Hicks declared, and the air-raid warning system was totally inadequate insofar as his forward elements were concerned. On 30 December Hicks reiterated his fears, but by the time his letter reached Ledo the Chinese had scored a signal victory at Yupbang Ga. This triumph clinched their hold on the line of the Tarung.[32]

The Burma Road

Prospects in late 1943 for opening a line of communications in Assam and Burma appeared brighter, but such was not the case in western China. Colonel Dawson could report but slight progress on road work there. By the end of October, funds allotted for the repair of the Burma Road east of the Mekong were exhausted. West of the river the Chinese did some work on bridges, but since they were still haunted by the spectre of a Japanese crossing of the Salween, it was impossible to get them to resurface the demolished portions of the road within thirty-five miles of the river. In December Stilwell proposed a further allotment of 480,000,000 Chinese dollars for widening, surfacing, and reducing grades, but the likelihood of getting the money appeared slight. Little work was accomplished. The Burma Road, Dawson disclosed late that month, was "still essentially a one-track road. . . ." Nor could he report any real progress on the Mitu Road. Having appropriated 168,000,000 dollars in September for construction of the first

[30] (1) Hist of the 209th, 330th, and 382d Engrs. (2) Constr Serv SOS CBI, Informal Progress Rpt for Jan 44—4" Pipeline (Digboi-Kunming). Opns Br File, Constr Serv Files.

[31] Romanus and Sunderland, *Stilwell's Command Problems*, pp. 122ff.

[32] Ltrs, Hicks to Pick, 14 and 30 Dec 43. AG File, LAC Files.

300 kilometers, the Chinese Government organized a makeshift Mitu Road Authority. Despite Dawson's repeated protests, the Chinese ignored the graded and generally satisfactory roadbed of the Yunnan-Burma Railroad; they planned instead to turn a nearby supply trail into a one-lane, dry-weather road. This trail occasionally followed stream beds, which meant that monsoon rains would wash a road out altogether. In February the director of the road authority quit. His successor refused to take over because the agency's funds were exhausted. By this time American hopes for the Mitu Road had been dashed to pieces by Chinese indifference and mismanagement.[33]

Supplies

Engineer supply for the theater was an immense problem by the latter months of 1943. In October General Somervell, on a worldwide inspection trip, visited Base Section 3. His observations and his talks with General Wheeler and Colonel Strong convinced him that Army Service Forces would have to intensify its efforts even more if Stilwell's vital supply line across Burma was to be completed before the monsoon began in 1944. The engineers' most common complaint about their equipment was that the D–4 tractors and ½-yard shovels were too small for the work the general service regiments had to do. On 21 October Somervell radioed Styer, directing him to procure and ship to the theater by January 1944 a large number of heavy construction items. Included were 100 D–7 tractors, 40 shovels, 70 scrapers, 75 graders, and 110 rock crushers. Somervell assured Wheeler that on his return to Washington he would institute changes in tables of equipment for general service regiments to provide machinery of greater earth-moving capacity. Noting that local sources of engineer material were almost exhausted, particularly in the categories of electrical and water distribution systems and builder's hardware, Somervell directed his subordinates to begin shipment by January 1944 of a 6-month supply of such materials.[34]

In reviewing the troop situation with Somervell, Wheeler emphasized the fact that units from the United States were not reaching Base Section 3 on time. The causes were varied—insufficient shipping, the relatively low position of the engineers on the theater priority list, and the frequent unreadiness of units in the United States for overseas movement when they were scheduled to go. The troop basis for pipeline companies, which Somervell proposed to expand from ten to seventeen, was a case in point. Three companies were needed at once, but for the reasons given above none would be in the theater before January 1944.[35] Commenting on the over-all engineer troop situation in a radiogram to Styer on 22 October, Somervell stated that it was impossible "to over-emphasize the importance of getting these units here at

[33] (1) Engr Rpt 6, Dawson to Dorn, 27 Dec 43. Engr Br File, Const Serv Files. (2) Ltr, Dawson to CofS Y–FOS, 16 Feb 44. 611 (CBI). (3) Memo 95, Dawson for Dorn, 29 Feb 44. Engr Br File, Constr Serv Files.

[34] (1) ASF Activities in the Sup of CBI, p. 205. (2) Rad, Somervell to Styer, 21 Oct 43. Somervell Files, Wires, Round-the-World Trip. (3) Ltr, Somervell to Reybold, 27 Nov 43. 400 CBI.

[35] ASF Activities in the Sup of CBI, p. 117.

the earliest . . . date." "Adequate shipping should be secured," he directed. In addition Styer should insure "that these units are ready to meet new priorities . . . and all delays due to defects in equipment, training, or other causes should be avoided at staging areas." Also needed in order to "strengthen the general situation" were maintenance, heavy shop, depot, and parts supply companies.[36] Stilwell's staff agreed to improve the engineers' position on the theater priority lists. The rest was up to Army Service Forces.[37]

Problems of Organization

The latter part of 1943 saw far-reaching changes in the assignments of key officers in the theater. Wheeler was transferred from the Services of Supply, CBI, to the Southeast Asia Command to become Mountbatten's chief administrative and supply officer. Mountbatten's engineer-in-chief was British Maj. Gen. Desmond Harrison; his deputy engineer-in-chief was Col. Walter K. Wilson, Jr., recently arrived from the United States along with Maj. Gen. Albert C. Wedemeyer, who had been selected as Mountbatten's deputy chief of staff. As Wheeler's successor in SOS, Stilwell accepted Somervell's choice of Brig. Gen. William E. R. Covell, an Engineer officer, at that time head of the Fuels and Lubricants Division in the Office of The Quartermaster General. Colonel Farrell of ASF's India Committee went to CBI as Engineer, SOS, to replace Colonel Strong, who was to return to the United States. General Godfrey was scheduled to become Stratemeyer's engineer, with Colonel Seeman as his deputy. More officers were now available. Between mid-November and mid-December about fifty arrived from the United States to staff the engineer structure in the theater.

At this time Chennault and Stratemeyer were making vigorous attempts to take airfield construction away from the Services of Supply. Seeking control of airfield construction in China, Chennault criticized, as contrary to established policy, the arrangement of having fields built under the direction of SOS. "If the present system were working well, it might be best to let it ride," he declared on 9 October 1943, but, he stated, SOS engineers were in many instances unprepared to do the work which the Air Forces wanted. Moreover, he felt the presence of SOS in the chain of command merely served to extend the interval between the request for and the start of construction.[38] Stratemeyer, hoping to get control over construction of the B–29 fields, had placed his aviation engineers on preliminary planning early in November. Wheeler pointed out that the proposals of the airmen, if carried out, would result in the formation of two competing engineer services. The Services of Supply was already critically short of engineers, and things would only be worse if the few that were available had to be shared.[39] Upon taking up his duties as commander of SOS, General

[36] Rad, Somervell to Styer, 22 Oct 43. Somervell Files, Wires, Round-the-World Trip.

[37] Ltr, Hq SOS CBI to CG Rear Ech USAF CBI, 13 Nov 43. AG 322 CBI.

[38] Ltr, Chennault to Stratemeyer, 9 Oct 43. AG 322 CBI.

[39] Memo, Wheeler for DCofS Rear Ech CBI, 8 Nov 43. AG 322 CBI.

Covell supported Wheeler's views. He explained to Stilwell on 17 November that aviation engineering was "not unlike other construction." Building up a separate engineer organization for the Air Forces would only delay getting MATTERHORN off the ground. In his opinion, it would be "more expeditious to expand a going organization." [40] After weighing the arguments, Stilwell on 19 November transferred responsibility for building airfields in China and Burma to the Air Forces. He approved enlarging the Fourteenth Air Force Engineer Section and sending an Air Forces engineer headquarters company to China for service with Chennault. But he kept SOS in charge of airfield construction in India.[41]

One of General Covell's first jobs was to deal with a request from Stilwell for a report on SOS and for proposals as to how that command might be reorganized in line with recent War Department plans for reorganizing communications zones in theaters of operations. These plans called for centralizing control of major technical activities in headquarters, SOS, rather than delegating control to the commanders of base and advance sections. In a report made on 2 December recommending strict adherence to the War Department's plans, Covell suggested that command over construction projects "of a nature that involves highly technical control and operation" be placed directly under his headquarters. Insofar as engineer work was concerned, commanders of base and advance sections would henceforth be responsible only for administrative and housekeeping functions.[42] Although Stilwell modified parts of Covell's proposals, he approved fullest possible application of the principle of centralized command over engineer construction.[43]

On 22 December Covell established the Construction Service as one of his subordinate commands and made Colonel Farrell its head. At the same time, Farrell remained as Engineer, SOS.[44] On 15 January Farrell took charge of all engineer work for which SOS was responsible except that in Pick's Base Section 3 and in the advance sections in China. To staff his new headquarters, he merely made use of his SOS Engineer Section. Retaining its organizational structure substantially as it was, he took advantage of the recent influx of engineer officers from the United States to expand the various sections.[45]

By the end of January, Farrell, responsible for engineer work in a vast area, had set up a field organization modeled on what the Corps of Engineers had in the United States; that is, one made up of divisions and districts. There were two divisions and six districts. Division 1, under Col. Philip F. Kromer, included most of central and eastern India, except Assam. In this division, District 10, headed by Lt. Col. Kenneth E. Madsen, was in charge of the

[40] Memo, Covell for Stilwell, 17 Nov 43. Stilwell-Covell Corresp File, Constr Serv Files.

[41] Ltr, Stilwell to Stratemeyer and Covell, 19 Nov 43. Theater Engr Policy File, Constr Serv Files.

[42] Ltr, Covell to Stilwell, 2 Dec 43. Opns Br File, Constr Serv Files.

[43] 1st Ind 10 Dec 43 on Ltr, Covell to Stilwell, 2 Dec 43.

[44] Hq SOS CBI GO No. 82, 22 Dec 43. AG 325.455 CBI.

[45] (1) Hq SOS CBI Memo No. 219, 22 Dec 43. AG 321 CBI. (2) Ltr, Covell to Somervell, 1 Feb 44. Admin File, Constr Serv Files.

work on the B–29 fields west of Calcutta, just getting under way. District 12, placed under Col. William C. Kinsolving, a petroleum engineer, formerly general manager of the Sun Pipeline Company and recently arrived from the United States, had the task of laying the two 6-inch pipelines from Calcutta to Assam. District 11 had charge of all remaining projects, located principally around Calcutta. Outside the divisional area and reporting directly to Colonel Farrell was District 9, which was responsible for construction in the New Delhi area. Pick was in charge of Division 2, which included most of Assam and part of Burma. He had two districts. District 20 was to do all construction and maintenance at the Hump airfields in Assam. District 22 was in charge of building the pipelines along the Ledo Road. Pick remained in command of Base Section 3, which included the Ledo Road. He retained firm control of all construction for which he had been responsible; work on the Ledo Road was not under Farrell's jurisdiction.[46]

In view of the transfer of airfield construction in China from the Services of Supply to the Air Forces, Covell and Stratemeyer in December prepared a plan for reassigning engineer personnel on duty there. All engineer officers assigned to airfield work in Advance Sections 3 and 4 were transferred to the CBI Air Service Command. At the close of the month, the latter organized the 5308th Air Service Area Command, with headquarters at Kunming. The new organization was to direct all airfield construction in China. Colonel Byroade was transferred from Advance Section 4 and assigned temporarily to the area command as project engineer. In early 1944 the area command organized three districts. The first had charge of work on the eight fields near Kunming, the second was to build the B–29 fields, and the third was to build more fields for Chennault in eastern China.[47]

The B–29 Fields

Late in 1943 work on the B–29 fields began. The amount of construction required was considerable, for the size and weight of the B–29 were unprecedented. The craft's wing span was 141 feet as compared to the 104 feet of the B–17, or Flying Fortress, the next largest bomber; its loaded gross weight of approximately 70 tons was twice that of the Flying Fortress. Its wheel load was 34 tons as against the 19 tons of the B–17. According to estimates made in the United States, the B–29 required a runway 8,500 feet long and 200 feet wide, an area almost twice that of the 6,000 by 150 foot runway used by the B–17.

In India, the engineers set out to provide the runways for the B–29's by enlarging and improving five existing fields in the flatlands west of Calcutta. Little could be done unless help was forthcoming from the government of India. Much of the impetus for getting work started came from the engineers on Mountbatten's staff. The SOS engineers appealed to General Harrison and

[46] Hq Constr Serv SOS CBI GO No. 1, Dec 43. AG 325.455 CBI.

[47] (1) Ltr, Covell to Hq Fwd Ech CBI, 24 Dec 43. Covell Ltr File, Constr Serv Files. (2) CBI Hist, sec. III, app. IX.

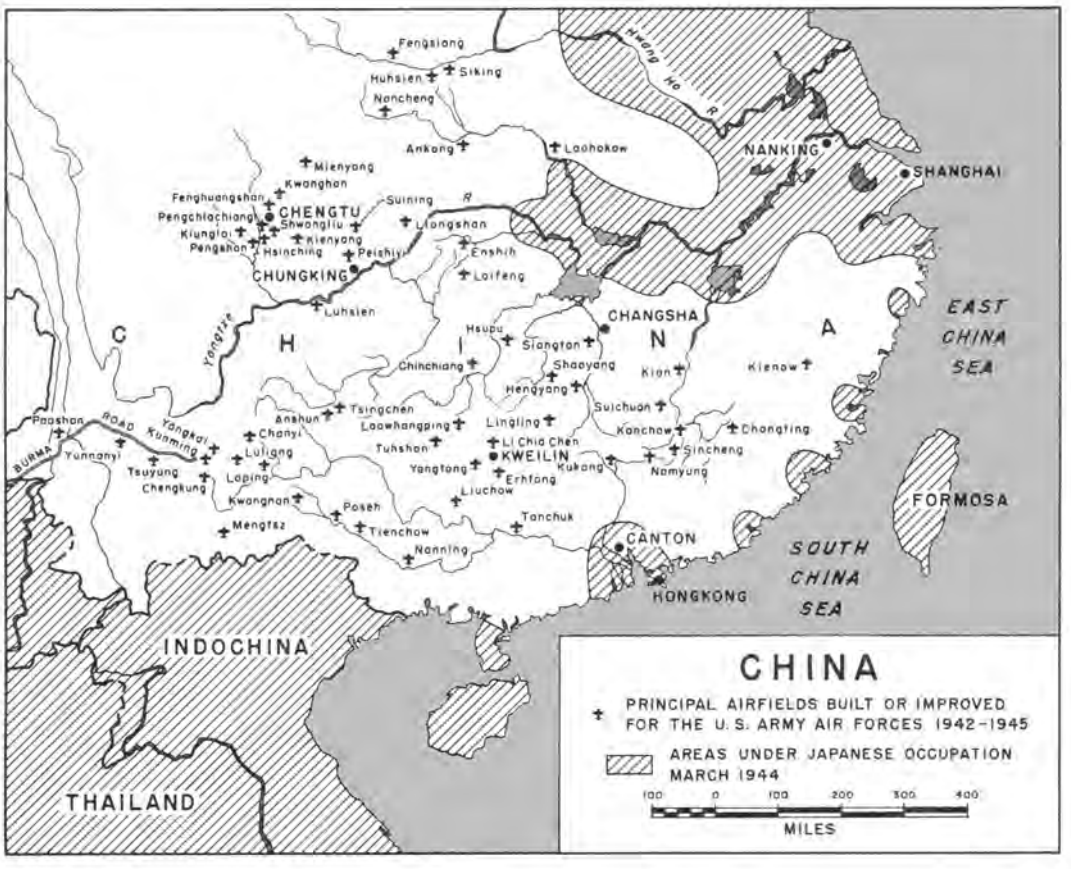
Colonel Wilson for help. They in turn appealed to Mountbatten, whose influence on the government of India was considerable, and help was promised. In mid-December, Stratemeyer's engineers turned over to Covell the preliminary construction plans already prepared. Company A of the 653d Topographic Battalion began to survey the fields in order to determine how the extensions could best be made. So that the runways could be made operational at an early date despite the shortages of men and materials, the SOS engineers persuaded the airmen to accept, for the time being, runways 7,500 feet long and 150 feet wide. Since the aviation engineers who were to build the fields would not reach India until February, the engineer-in-chief of the British Eastern Command agreed to furnish local contractors to begin work at the sites. In December, District 10 borrowed 170 equipment operators from various engineer units, together with 300 trucks. By the end of the month the district had provided each field with a project engineer to serve as a liaison officer with the Royal Engineers supervisor. In January Pick released the 382d Construction Battalion temporarily to rush work on the field at Kharagpur.[48] These various makeshift arrangements would have to do until the aviation engineers arrived.

By late 1943 work on the B–29 fields in China was also under way. Byroade and his staff had begun planning during the last week of November. To find sites for the fields, Byroade personally reconnoitered the plains around Cheng-tu, 150 miles northwest of Chungking. He believed the area to be the best in Free China. The terrain was similar to that of the American midwest, and in the Cheng-tu Valley a number of fields already existed, the runways of which could be easily lengthened for the big bombers. After studying his report of 8 December,[49] Chinese and American commanders worked out an agreement to get construction started. The Superfortresses would be based at four sites—Kwanghan, Pengshan, Kiunglai, and Hsinching. (*Map 21*) There were to be seven fighter fields. The Chinese Military Engineering Commission would control construction; American engineers would do mainly staff work. The responsibility of Lt. Col. Waldo I. Kenerson, head of District 2, would be limited to drafting specifications, preparing layouts, making inspections, and assisting with the organizing, administering, and paying the hundreds of thousands of peasants who would be conscripted for work on the airfields.[50] Since the runways would have to be built largely by hand and probably could not be brought up to required standards, the full length of 8,500 feet was authorized

[48] (1) Hq Constr Serv SOS CBI, Final Rpt, B–29 Bases, India, Nov 44, pp. 1–11. 686.61 (CBI). (2) Memo, CG Air Serv Comd CBI to Farrell, 26 Nov 43. (3) Rad, Arnold to Stratemeyer, 4 Dec 43. Last two in Constr File, Constr Serv Files. (4) Hist of the 653d Engr Topo Bn. (5) Memo, Off C Engr SOS CBI to Air Engr AAF IBS CBI 11 Dec 43. Constr File, Constr Serv Files. (6) Ltr, Covell to CG Hq Rear Ech, 25 Jan 44. Specs File, Constr Serv Files. (7) Hist of the 382d Engrs.

[49] Ltr, Byroade to Chennault, 8 Dec 43. Air Engr File, CTO.

[50] (1) Memo, Hq AAF China Theater for Bd of Offs, 8 Sep 45, sub: Chengtu Constr Program. AAF 319.1 CTO. (2) Craven and Cate, eds, *The Pacific—Matterhorn to Nagasaki*, pp. 65–70.



MAP 21

to lessen the chance of serious mishaps in takeoffs and landings.

Particularly irritating to the engineers was the radical departure from existing financial arrangements whereby the Chinese had paid for building operational facilities, and the Americans had supplied quarters, recreational facilities, and other nonoperational features. President Roosevelt had promised Chiang reimbursement for all labor and materials expended on MATTERHORN in China. How far Roosevelt had committed himself became evident in mid-December when the Chinese came up with a preliminary cost estimate of two to three billion Chinese dollars. "Appalling," wrote Stilwell on 18 December, suspecting that "squeeze" accounted for a large share of this astronomical figure, which at the official rate of exchange amounted to $100–150 million in American money.[51]

By early 1944 the engineers were making progress in providing the logistic

[51] Romanus and Sunderland, *Stilwell's Command Problems*, p. 77.



PIPELINE CARRIED ACROSS A STREAM
on an A-frame.

basis for the impending Allied offensives. Of a total U.S. Army strength in Stilwell's command of 100,000, 11,000 were engineers. Five thousand more were on the high seas, due to arrive within the next few months. The engineers were building or maintaining some forty-five airfields in India and twenty-five in China. Nearly 90 percent of the troops were working on the Ledo Road and the pipelines in Base Section 3. There were now about 80,000 tons of supplies and equipment in the hands of engineer troops in the theater, almost all of the tonnage being in Base Section 3. The condition of most of the equipment was poor. Nearly half of the machinery in Pick's command was deadlined because of the lack of spare parts. Local sources of supply, almost depleted because of India's low level of industrialization and the difficulty of maintaining imports from the West, furnished no remedy to alleviate this situation. The engineers were becoming increasingly dependent on the United States for men and materials, and Army Service Forces was working against time to make good Somervell's commitments to the theater.

The All-out Effort Continues

There was no slackening in the pace in the first months of 1944. With the Japanese brought to battle in northern Burma, work on the Ledo Road was of great importance. The engineers in western China continued urging upon the Chinese the necessity for early reconstruction of the Burma Road to support the Y-Force's coming advance. At the same time engineer commanders were taking advantage of their growing resources in men and matériel to push the pipelines northward from Calcutta to Assam, and from there southeastward into Burma. To help prepare the great surprise which the B–29's had in store for the Japanese, the engineers had ahead of them the enormous job of completing the bases in India and China for the Superfortresses. In addition, the demands of the struggle in northern Burma were to involve the engineers in combat for the first time.

Combat Support

After the Chinese won their victory over the Japanese at Yupbang Ga in the last week of December, Stilwell made plans to push the enemy farther southward. One of the prominent terrain features in northern Burma was the Tanai River, which flowed northwest-

ward for about 50 miles through the Hukawng Valley to within ten miles of Shingbwiyang, where it made an abrupt turn to the south. The Tarung River, its source in the northern hills, flowed southward into the Tanai in the Hukawng Valley at a point about 18 miles southeast of Shingbwiyang. An oxcart trail led from Shingbwiyang eastward across the Tarung and then south across the Tanai to the village of Mogaung, 30 miles southwest of Myitkyina. This trail was the main supply route for the Japanese. Stilwell wanted to move a Chinese force across it some 30 miles southeast of Shingbwiyang in order to envelop the Japanese believed to be along the north bank of the Tanai east of the Tarung. While the main body of the division would assault the enemy frontally along the Tarung, a Chinese regimental combat team would slip across the Tanai south of Shingbwiyang and proceed along the river's left bank. At the same time, a Chinese infantry regiment, assembled 25 miles southwest of Shingbwiyang, would move eastward into the upper Hukawng far behind the Japanese. If this plan of campaign could be carried out successfully, the Japanese would be trapped and destroyed in the Hukawng Valley. After that, the march on Myitkyina would be virtually unopposed.[52]

While the Chinese were preparing for the offensive, Stilwell detached two companies of the 330th Engineers to clear trails through the ten miles of jungle between Shingbwiyang and the Tarung so that the infantrymen could move forward more easily. This area was so near the enemy troops that patrols from both the 330th and the Chinese units had to be kept on both flanks. On 6 January a route to the Tarung was open to jeeps. The engineers then graded and widened a 12-mile-long, dry-weather road leading eastward from Shingbwiyang, to be used as a supply line for the Chinese.[53]

The attack was soon under way. On 13 January the Chinese crossed the Tarung and came to grips with the main body of the enemy. The regimental combat team which crossed the Tanai southeast of Shingbwiyang, hoping to envelop the enemy left flank, encountered unexpectedly strong resistance on the south bank. Although it managed to push the enemy eastward beyond the confluence of the Tanai and Tarung, it had to pause to root out pockets of resistance and consequently could not put any serious pressure on the main enemy force north of the Tanai. The envelopment of the Japanese flank failed. Elsewhere, the Chinese made reasonable progress. During the first week of February, they reached the village of Taihpa Ga located at the point where the oxcart trail crossed the Tanai, four miles east of the Tarung.[54] The stubborn Japanese resistance halted progress on the Ledo Road. Pick had to keep almost all of his men north of Shingbwiyang, where they were engaged in grading and widening the stretch of road already put in.

Stilwell had decided that as soon as Taihpa Ga had been captured, he would

[52] Romanus and Sunderland, *Stilwell's Command Problems*, 129–38.

[53] Hist of the 330th Engrs.

[54] Romanus and Sunderland, *Stilwell's Command Problems*, pp. 134–38.

send Col. Rothwell H. Brown's Chinese tank group down the oxcart trail toward Mogaung. He directed Pick to send in engineers to improve and hold open this "combat trail," as it was henceforth usually called. This would mean a serious diversion of Pick's engineers from the Ledo Road. The combat trail, lying dangerously below the flood levels of the Hukawng Valley, had already been rejected as a possible route for the road. A great deal of work would be needed to make it passable for military vehicles. Pick, bowing to tactical necessity, put a strong engineer force on the job of improving the trail and bridging the rivers. Men of the 1st Battalion, 330th Engineers, worked long and hard to make the trail passable for military vehicles. They were joined by the 76th Light Ponton Company and Company A of the 1883d Aviation Battalion. Early in February a detail from the 330th built a dry-weather transport strip at Taihpa Ga, despite the frequent shelling from Japanese artillery south of the Tanai. In the first half of the month the 76th pontoniers put a 470-foot pneumatic ponton bridge across the Tarung. The over-all situation was encouraging.[55]

During March Pick, now a brigadier general, had to lend a number of his engineers to the infantry to provide support for the forward movement. At the beginning of the month, at Taihpa Ga, the 71st and the 77th Light Ponton Companies built a 470-foot ponton bridge across the Tanai over which Brown's Chinese tankers and infantrymen passed and then moved down the combat trail.[56] Ten bulldozer operators from the 330th General Service Regiment volunteered to support Brown's forces with their machines. On 3 March they went into action with the tankers at a point thirteen miles southeast of Taihpa Ga. The engineers' mission was to hew a trail through the jungle to the southeast and help get the tanks across numerous streams so that they could make a surprise assault on the Japanese at the hamlet of Walawbum, twenty-two miles southeast of Taihpa Ga. Three of the engineers were wounded the first night. Three were subsequently awarded the Silver Star, and the entire group was commended, as Stilwell put it, "for resolute conduct under very difficult terrain conditions and while frequently in contact with enemy opposition." [57]

As infantry and tanks closed in on Walawbum from the northwest, a new threat to the Japanese appeared from the east. The American infantrymen originally scheduled at QUADRANT to serve under Wingate were, upon arrival in the theater, diverted to Stilwell to be used as a hit-and-run force. Merrill, now a brigadier general, was in command. Correspondents dubbed the force "Merrill's Marauders." On their first mission, the Marauders suddenly appeared at Walawbum on 3 March and threatened the Japanese there with entrapment. The enemy commander on the same day ordered a general retreat to the south. By 9 March the Japanese were gone.[58]

Early in March Wingate was ready to

[55] (1) Plng Div ASF, The Ledo Road, app. G, pp. 16, 37. (2) Rpt, Hirshfield to Pick, 24 Jan 44. LAC Files. (3) Hist of the 76th, 330th, and 1883d Engrs.

[56] Hist of the 71st and 77th Engrs.

[57] Hist of the 330th Engrs.

[58] Romanus and Sunderland, *Stilwell's Command Problems*, pp. 130–31, 148–57.

begin his airborne offensive. He had assembled Colonel Cochran's Air Commando unit, 4 brigades of Chindits, and the 900th Engineer Airborne Aviation Company at 2 airfields, 300 miles northeast of Calcutta. The engineers were to prepare strips in the Burmese jungle for the Chindits to land on. Engineers in other theaters had already carried out airborne missions; this one would be the first mission in which they would travel to their destinations in gliders. Airmen, reconnoitering at low altitudes over the Burmese forests, had come upon two fairly level clearings near the western bank of the Irrawaddy, eighty miles south of Myitkyina. Engineers flown in with the first infantry detachments were to prepare the clearings for the large number of planes to come in later. Aerial photographs made shortly before the scheduled takeoff showed that trees had been dragged onto one of the clearings to block a landing. All the gliders would therefore have to be flown to the other clearing despite the congestion likely to ensue.

On the evening of 5 March men, planes, and gliders were ready to take off for their destination, 250 miles deep in enemy-held territory. Accompanying the infantry were Capt. Patrick J. Casey, commander of the 900th engineers, with 13 of his men. They had four bulldozers, two scrapers, a grader, a jeep, and hand tools. The men loaded the bulldozers, with blades attached, on the gliders. The air fleet took off, the planes towing the gliders in tandem. Crossing the 7,000-foot-high mountains of the Indo-Burmese border, the fleet soon approached the clearing. The heavily loaded gliders came down at high speed. Some of the first ones ran into unforeseen difficulties. The field was crisscrossed with ruts, which, overgrown with grass, had been invisible to the reconnoitering parties. The ruts tore off the landing gear of some of the craft and caused a number of crashes. With so many craft coming down at once, several pile-ups resulted. Some of the gliders rammed into the trees surrounding the clearing. The glider in which Captain Casey and an engineer enlisted man were riding came in too high. Attempting to circle the clearing for a landing, the pilot lost control of the craft; it plunged into a tree, and the occupants were killed. All told, about 5 percent of the landing force was lost. A bulldozer and a scraper were wrecked.

The first infantrymen to land dispersed to guard against possible enemy infiltration. The engineers began to prepare the landing strip. Their main job was to level the clearing as rapidly as possible with their machinery. Some of the infantry, using hand tools, filled in ruts and cut grass. The soil, with a high clay content, would be satisfactory for dry-weather operations. The next night, about seventy C–47's safely brought in troops and supplies on a runway already provided with lights, radios, and radar. That same night another detachment of the 900th was flown to a glade fifty miles farther south. This landing was made without mishap. Using their bulldozers, the engineers smoothed the surface of the clearing sufficiently to enable transports to land without serious damage. Chindits, flown to these two fields, set out to dynamite the Burma Railway.[59]

[59] (1) Lowell Thomas, *Back to Mandalay* (New York, 1951), pp. 198–225. (2) Hist of the 900th

Harassed from the front and rear, the Japanese in the Hukawng Valley withdrew southward, hoping to make a stand on a ridge at the southern end of the valley. On 19 March the Chinese upset these plans by seizing the ridge. They then pushed on, while the Marauders repeatedly hit at the enemy's rear and flanks. In late March, with his forces only seventy-five miles from Myitkyina, Stilwell planned a bold stroke to seize the city and its important airstrip before the monsoon closed in. The Chinese were to continue the advance in such strength as to lead the Japanese commanders to believe that Mogaung, not Myitkyina, was their goal. While the Japanese moved troops from Myitkyina to defend Mogaung, two Chinese regiments and the Marauders would slip over the Kumon Range and descend on Myitkyina from the northwest.[60]

Meantime, the Japanese began an offensive of their own against the British Fourteenth Army near Imphal on the Indian-Burmese border. The British had been expecting an attack for months and had their plans ready for meeting it. At the first enemy attacks, they intended to retire from the mountainous frontier and draw the Japanese into the Manipur Plain. When the Japanese reached Imphal, British ground troops with the help of airborne reinforcements would turn on them. But the enemy struck with much greater speed and strength than expected, and the British position soon appeared to be precarious.[61]

The extent of the Japanese offensive suggested to Mountbatten the need for stronger measures against the enemy's lines of communications. Additional airborne troops would have to be flown into Burma. To place his last two Chindit brigades across enemy lines of communications and to supply his more or less isolated units already in Burma, Wingate called upon the airborne engineers to prepare a landing strip in a clearing about eighty miles southwest of Mogaung. At dusk of 21 March a third detachment of the airborne engineers was flown to Burma. Construction of this landing field was a race against time. Wingate's staff believed the Japanese, who would undoubtedly learn of the landing, would attack within twenty four hours. The engineers would have to prepare the strip so that the Chindits could land before the enemy arrived. The race was won by two hours; this was the length of time it took the first Chindits to make contact with the approaching Japanese. Personally directing this new assault, Wingate was killed in a plane crash on 24 March. He left to his successor, Maj. Gen. W. D. A. Lentaigne, the problem of coping with the desperate situation of those Chindits holding the railroad block at Mawlu against frantic Japanese attempts to break their grip.[62]

On the plains of Manipur, things continued to go badly for the British. By 30 March the Japanese vanguard had reached the highway leading north from Imphal to Dimapur, about 170 miles southwest of Ledo. The British Four-

Engrs. (3) Rpt, Godfrey to Stratemeyer, 28 Mar 44. AAF, Central Files, Folder for Gen Davidson.

[60] Romanus and Sunderland, *Stilwell's Command Problems*, pp. 118, 185–88, 200–205.

[61] *Ibid.*, pp. 172–75.

[62] (1) Craven and Cate, eds., *Guadalcanal to Saipan*, pp. 507–08. (2) Hist of the 900th Engrs.

teenth Army, 70,000 strong, found itself cut off from contact with friendly forces. In an emergency meeting on 3 April at Jorhat with Mountbatten and his principal subordinates, Stilwell was relieved to discover that the British were confident of ultimate success because of the logistical overextension of the Japanese forces. In fact, for the first time, Stilwell's British colleagues seemed really enthusiastic about his offensive against Myitkyina.[63]

Because of the desperate plight of the Chindits at Mawlu, Lentaigne sent the commandos and the engineers on a rescue mission. On 4 April the commandos landed five gliderloads of engineers with equipment in a clearing near the roadblock. The men prepared a landing strip at the foot of the high hill upon which the Chindit stronghold was located. Additional troops and supplies flown in enabled the Chindits to keep the Burma Railway blocked until the monsoon rains began one month later.[64]

Progress on the Ledo Road

During the first months of 1944 work on the Ledo Road lagged. Because of the unfavorable tactical situation east of the Tarung, nothing was done on the roadhead east of Shingbwiyang until 26 January. Between then and early February, the engineers cleared twelve miles beyond the city. Work stopped. The proximity of the Japanese and the diversion of troops to the combat trail made it advisable to halt. For the time being, the 45th and 330th General Service Regiments and four aviation battalions graded and graveled the road north of Shingbwiyang. The beginning of March saw the resumption of sustained work on the roadhead. The 1st Battalion of the 45th Engineers took the lead. Hardly had it finished its clearing and grading to the Tarung during the last week of March, when Stilwell directed it to move south of the Tanai to help maintain the combat trail. Moving up to the forefront on the Ledo Road, the 1883d Aviation Battalion began pushing through the forests and marshes beyond the Tarung. The unit did both grading and graveling. In April, to speed the work, General Pick sent the 1905th Aviation Battalion and Company A of the 330th Engineers ahead of the 1883d to put in a finished and separate four-mile stretch of road. At the same time, details of engineers built a number of landing strips along the road so that supplies could be flown in and defense of the road facilitated.[65]

It had been recognized from the first that one of the biggest jobs on the Ledo Road would be bridging the turbulent rivers of northern Burma. Materials had been requisitioned early and had begun to reach the theater in the first months of 1943. The engineers in the theater had decided that the H–20 bridge would be best. This bridge consisted of decking, supported by two trusses made up of rectangular, latticed steel sections, each 12½ feet long, 6 feet high, and 2 feet wide, weighing nearly a ton

[63] (1) Romanus and Sunderland, *Stilwell's Command Problems*, p. 192. (2) *Stilwell Papers*, p. 287.

[64] (1) CBI Hist, sec. II, app. IX. (2) Hist of the 900th Engrs.

[65] (1) Constr Serv, Progress Rpts, 12 Feb, 5 Apr, 5 May 44. 611 CBI. (2) Hist of the 45th, 330th, and 1883d Engrs.

apiece, and bolted together. The maximum span, made up of ten sections on a side, was 125 feet; it could carry loads up to 15 tons. With shorter spans and more than two parallel trusses, the capacity of the bridge could be increased to 54 tons. Early in March, General Pick placed the main responsibility for bridging on the 209th Combat Battalion. One company of the battalion, helped by the 76th Light Ponton Company, built an H–20 bridge, 960 feet long, over the Tarung in 27 days, completing it early in April. The other companies of the 209th bridged the lesser streams beyond the Tarung. In mid-March, Company A of the 209th started to build an H–20 over the Tawang. This bridge, together with its wooden trestles over the swampy approaches, was 1,200 feet long. The major accomplishment of Company F of the 330th Engineers during the dry season was the erection of a third H–20, 607 feet long, over the Tanai. This job was completed early in May.[66]

As a result of the QUADRANT Conference, bridging for the Ledo Road had become a major subject for planning in the Office of the Chief of Engineers and in Army Service Forces in the fall of 1943. During the following winter OCE sponsored various study projects in order to find the most suitable types of bridges for the major river crossings. Since the structures for the road would be built far behind the front lines, various types of military bridges and even commercial bridges could be considered. At this time a new type of structure, the Bailey bridge, was replacing the H–20. Named after its British inventor, Sir Donald Coleman Bailey, it was based on an entirely different principle from that of the H–20. Its basic unit was a flat panel 10 feet long and 5 feet high, weighing about 600 pounds. The panels were connected by pins to form trusses, which were joined beneath by transoms to support the decking. Multiple trusses and multiple stories of panels made it possible to erect spans of 30 to 220 feet that could carry loads from 10 to 100 tons. The panels could also be used to build piers. One great advantage of the Bailey was its adaptability to various loads. Another type of bridge which might be used was the I-beam bridge, produced commercially, the decking of which rested on steel beams from 30 to 60 feet long.[67] Confronted by a shortage of engineering data within and without the theater, the Chief's Office sent a team of bridging specialists to CBI in January 1944 for firsthand consultations with engineers in the theater. As a result of investigations and discussions held at Ledo and New Delhi during February and March, the theater engineers chose the H–20 bridge as still the best for the Ledo Road. This decision created something of a stir in Washington, since the H–20's during the past year had been replaced by Baileys in the Engineers' catalog of standard equipment. Attempts by the Office of the Chief of Engineers to get Pick and Farrell to accept substitutes were to no avail. Bailey bridge panels would require more cargo space for a given bridge capacity than would the H–20, and I-beams were

[66] (1) Ltr, CG SOS CBI to OPD, 17 Apr 44. OPD 400 CTO, Case 150. (2) Hist of the 76th, 209th, and 330th Engrs.

[67] For a fuller discussion of the characteristics and relative merits of the various types of bridges in use at this time, see Coll, Keith, and Rosenthal, *Troops and Equipment,* pp. 483–97.

too long for shipment on the diminutive cars of India's railways. Faced with these irrefutable logistical arguments, OCE accepted the theater's decision and reinstituted procurement of H–20 bridging in late April 1944.[68]

The longer the finished portion of the Ledo Road became, the greater was the effort needed to keep it open to traffic. Pick systematically turned over to various engineer battalions the responsibility of maintaining each new section of the road as soon as the forward troops finished compacting the final layer of gravel or crushed rock. On 29 April, he set up a road maintenance division under Lt. Col. Donald L. Jarrett, to direct the work of engineer troops who were to keep completed sections in repair.[69] By mid-May, Jarrett had three aviation battalions working full time on maintaining the road between Ledo and Shingbwiyang. They built and repaired bridges, resurfaced poor sections, eliminated some of the worst curves, reduced grades, and installed better drainage. Since Jarrett's organization was directly under Pick, Colonel Green as road engineer was able to concentrate his attention almost entirely on road construction.[70]

Progress on the Pipelines

During the first months of 1944 Colonel MacIsaac began to make more rapid progress on the pipelines. Late in January specially trained troops arrived from the United States and took over construction of the 4-inch line along the road. The 699th and 706th Petroleum Distribution Companies, joined by the 775th in February, strove to complete the line from Ledo to Shingbwiyang as soon as possible without getting in the way of the graveling crews. Having arrived without their equipment, the troops had to borrow hand tools, welding machines, bulldozers, and trucks from units at Ledo and on the road. They soon discovered what troops on the road had long known—that constant hauling and rough roads gave trucks a merciless beating and burdened drivers and mechanics with ceaseless maintenance chores. As if to climax their trials, the 699th engineers had hardly gotten pumping operations under way early in March when a 1,000-barrel tank of gasoline at Logai, fifty miles down the road from Ledo, burst into flames and had to be junked. Nevertheless, by mid-March the line was through to Shingbwiyang. Thereafter, MacIsaac moved the 706th and 775th forward as rapidly as the tactical situation permitted.[71]

Colonel Kinsolving, head of District 12, had hoped to begin construction in January on the first standard-weight 6-inch line, which would extend from Calcutta to the Assam Oil Company's storage tanks at Tinsukia, 30 miles west of Ledo. The diversion of troops to build a 6-inch line to the MATTERHORN fields, and the delay in the arrival of salvaged standard-weight pipe from British depots in the Middle East forced Kinsolving to mark time until mid-February. Then,

[68] (1) Leslie Anders, "Bridges on the Ledo Road," *The Military Engineer*, XLV (July-August, 1953), 293–95. (2) Memo, Madsen for Farrell, 19 Apr 44. Opns Br File, Constr Serv Files. (3) Memo, OCE for CG ASF, 25 Apr 44. 823 CBI.

[69] Hq Base Sec 3 GO No. 6, 29 Apr 44. Engr Sec File, LAC Files.

[70] Hist of the 823d, 849th, and 858th Engrs.

[71] (1) Hist of the 699th and 706th Engrs. (2) Hq Constr Serv Progress Rpts, Pipelines, 5 Mar, 5 Apr 44. 678 CBI.

with three petroleum distribution companies, the 709th, 776th and 777th, he began to build the line from the tanker terminal at Budge-Budge, south of Calcutta, up along the Bengal-Assam Railway toward Tinsukia—a distance of 750 miles. At Tinsukia the line would connect with the 4-inch invasion-weight line running along the Ledo Road. It must have seemed to Kinsolving that many factors were in conspiracy against his plans to complete the project by 1 August. When the pipe began to come in, it was frequently in damaged condition and without couplings and screws. Farrell and Kinsolving decided in late February to build the line with invasion-weight pipe, newly arrived from the United States and intended only for the northern reaches of the line. This decision produced complications, for in the densely populated lower Brahmaputra Valley it was necessary to bury this thin pipe, which was highly subject to corrosion and leakage. Stilwell's drive in Burma and the Japanese invasion of Manipur Province placed such a strain on the Bengal-Assam Railway that the tonnage allotted to District 12 had to be cut by nearly 75 percent in March. There were bright spots, however. The railway officials and crews proved highly co-operative in hauling and unloading pipe along the right-of-way, and the British garrison engineers at various posts along the route did effective work in securing land and rounding up local workmen.[72]

Progress on the B–29 Fields

Meanwhile, the engineers were rushing work on the MATTERHORN fields. In West Bengal, Colonel Madsen, head of District 10, had the 879th Airborne Aviation Battalion, the 382d Construction Battalion, and the 853d, 1875th, and 1877th Aviation Battalions. These units began work on the five B–29 fields in March with borrowed equipment, pending the arrival of their machinery. In mid-April, with the arrival of the 1888th Aviation Battalion, Madsen had 5,000 engineers on the job. By the end of the month Kinsolving announced substantial completion of a 6-inch pipeline from the tanker terminal at Budge-Budge to the fuel distribution systems at the airfields. With the arrival of the aviation battalions' machinery in April more rapid progress was possible on the runways. A major task was to make the best use of the local workmen, who were not too efficient at best. It was soon obvious that native customs would have to be observed, if the construction was to go on smoothly. At Chakulia, the 1877th engineers, unaware that the Bengalese regarded the quarrying of rock as man's work and the screening of it as woman's, bulldozed stockpiles for both sexes to screen. Everyone walked off the job. Religious considerations obliged the engineers in District 10 to stock seven types of rations. Work moved ahead, but slowly.[73]

[72] (1) Min, Mtg at Off Engr-in-C GHQ (India), 28 Jan 44. Opns Br File, Constr Serv Files. (2) Hq Constr Serv Progress Rpts, Pipelines, 12 Feb, 5 Mar, 5 Apr, and 9 May 44. 678 CBI. (3) Hist of the 709th and 776th Engrs.

[73] (1) Hq Constr Serv SOS CBI, Final Rpt B–29 Bases, India. (2) Hq Constr Serv Progress Rpts, MATTERHORN Proj, 12 Feb, 5 Mar, 9 Apr 44. 678 (CBI). (3) Hist of the 382d Engrs. (4) Hist of the 853d, 879th, 1875th, 1877th, and 1888th Avn Engrs. (5) Col. Kenneth E. Madsen, "Army Engineers and

In China, progress on the B–29 fields was encouraging. Each field was to consist of a runway, taxiways, hardstands, a fuel distribution system, revetments, and housing for service crews. Since it was impracticable to transport either cement and concrete mixers or asphalt from India, runways would have to be built of rock, gravel, and sand. Limited in theory to staff and liaison functions, Colonel Kenerson, as District 2 engineer at Cheng-tu, had to assume numerous responsibilities which the Military Engineering Commission was charged with but could not perform adequately. Kenerson had to supervise much of the administrative work required in hiring and utilizing the 365,000 peasants conscripted by the Governor of Szechwan. Despite centuries of experience in building hard-surfaced roads by hand, the Chinese were largely unprepared to construct the 8,500-foot runways capable of sustaining the 70-ton bomber. Kenerson found he had to teach them the elements of soil mechanics; then he had to supervise them constantly to see that they applied what he had taught them. As a rule, the peasants toiled dutifully, but there were some serious riots caused by disgruntled workers whose only desire was to go home.[74]

In late February there was a noticeable slowdown, partly as a result of the failure of the Chinese to find enough trucks for hauling material and partly because of the breakdown in the government's system for distributing funds. Brig. Gen. Thomas F. Farrell, supporting Kenerson's efforts insofar as possible, sent several small rock-crushers by air and supplied a detachment of engineers to install gasoline distribution systems at the bomber fields. By the time construction had started in January, Chinese estimates of the cost of the fields had risen to a fantastic five billion dollars. "Squeeze" in the Cheng-tu area would inflate even that figure. By late spring cost estimates were to reach seven billion dollars. At the official rate of exchange, the United States would have to pay $350,000,000 for the fields at Cheng-tu.[75]

Airfields for Chennault

Work was continuing on the fields in eastern China for the Fourteenth Air Force. Since the fall of 1943 Chennault had been trying to enlarge his engineer staff of four men to make possible more effective supervision of the work. Shortly after the 5308th Air Service Area Command activated its Engineer Division under Byroade at Kunming on 1 February 1944, Chennault conceived the idea of merging Byroade's office with the Engineer Section of the Fourteenth Air Force. On 16 March Byroade assumed the dual role of Engineer, Fourteenth Air Force, and Engineer, 5308th Air Service Area Command. He merged his two offices within the month. On 18 March, Stilwell gave Chennault control of all construction for air force elements in China, a control Chennault delegated

the Superfortress," *The Military Engineer*, XXXVI (October, 1944), 332–34. (6) Ltr, Lt Col Alvin B. Auerbach, formerly CO 1877th Engr Avn Bn, to C EHD, 22 Dec 52. EHD Files.

[74] (1) Engr Dist 2 Air Serv Comd China Sec Engr Memo No. 1, 1 Feb 44. Air Engr File, CTO. (2) Ltr, Col Austin W. Betts, Air Engr Fourteenth AF, to C EHD, 11 May 53. EHD Files.

[75] Fourteenth AF Hist, pp. 537–46.

to Byroade.[76] The air force engineers had their work cut out for them.

District 3 in eastern China inherited all the harassments and irritations Advance Section 4 of SOS had experienced with Chinese officials and contractors. The lieutenant-governor in South Kiangsi, who had tied up construction at Kanchow and Sincheng during the winter because of a dispute over the certification of contractors, finally had the situation sufficiently under control to permit construction to start early in March. "He has merged all the contractors in the area into a company of his own," one engineer wrote to Byroade, "and has jacked prices for earthwork, paving, etc., up 200% at Sincheng and 100% at Kanchow." [77] Merchants supplying materials for American projects, informed that local officials expected generous kickbacks on each sale, adjusted prices accordingly. In many instances work was held up, specifications were flouted, and schedules disrupted by the paramount importance of "face." The engineers learned that the Chinese could easily lose face if they took orders from foreigners, admitted their ignorance, or dealt with officials of lesser rank. In China, ways and means had to be found to remove even the most minor incompetent officials without affronting their dignity. But progress was made on the airfields. By 1 April 1944 Engineer District 3 was maintaining eight major fields in eastern China, and construction was well under way on eight more.[78]

Even at this late date work on the Hump airfields was continuing in Assam to enable them to handle bigger loads for Chennault. As head of District 20, Lt. Col. Karl M. Pattee had a staff of twenty officers and the 848th Aviation Battalion at his disposal. Most construction and maintenance continued to be a responsibility of the Royal Engineers. But Pattee was able through his control of his aviation battalion to exercise a more than nominal control over the course of airfield work in Assam. As before, airfield construction conformed to British specifications at all of the eight airfields regularly used by the Air Transport Command in Assam. By the spring of 1944 the airlift was beginning to realize its potentialities.[79]

While the Fourteenth Air Force was unable during the first quarter of 1944 to carry out all of Chennault's claims, the successes that it did achieve were such that the Japanese high command was compelled to act in the spring. Shipping on the Yangtze River had become so unsafe that the enemy determined to reopen the Peiping-Hankow railway as an alternate supply line. Because of Chennault's crippling attacks on the sea-lanes linking Japan to her southern conquests, the high command ordered its mainland armies to overrun Chennault's eastern airfields and open railroad communications from the Yangtze Valley to Canton and French

[76] CBI Hist, sec. III, app. IX.

[77] Ltr, Capt R. D. Hunter to Byroade, 24 Feb 44. Air Engr Files, CTO.

[78] (1) Ltr, Resident Engr Sincheng, to CO Dist 3, 1 Mar 44. (2) Memo, with Incls, Engr Fourteenth AF for CG XX Bomber Comd, 5 May 44. Both in Air Engr Files, CTO.

[79] (1) Hq USAF CBI, G–4 Periodic Rpts for the Quarters Ending 31 Mar and 30 Sep 44. WW II Rcds Div. (2) Rad, Covell to Somervell *et al.*, 26 Jul 44. 678 CBI. (3) Hist of CBI Air Serv Comd, pp. 34–42.

Indochina. The first phase of this operation, starting in April, was to be the conquest of a large pocket north of Hankow. In May the Japanese began to move south from their base at Hankow to drive the Fourteenth Air Force off its advanced bases around Kweilin.[80]

The Theater Engineer

Colonel Newcomer, Stilwell's engineer, was little concerned with all this activity in China. Although his responsibilities were theaterwide, Newcomer never looked upon his office as playing "a critical role." His staff at peak strength included one officer, Lt. Col. Robert F. Seedlock, and three enlisted men. Stilwell rarely consulted Newcomer. His principal job remained that of co-ordinating with the Chinese on airfield construction for Chennault and MATTERHORN and supplying Chinese troops to be sent to Burma. His office continued to take responsibility for supervising housekeeping duties for the American forces in Chungking. To do such administrative work as was needed for the engineer units in India, Newcomer had set up a small rear echelon office in New Delhi.

Early in May, General O'Connor, formerly head of the Northwest Service Command, arrived in India to replace Newcomer, who was transferred to Panama. Newcomer later stated that he was never so happy as when he received his orders for his new assignment. General O'Connor set up his theater engineer office in New Delhi and maintained a forward echelon in Chungking under Colonel Seedlock. The office of theater engineer assumed no more importance under O'Connor than it had under Newcomer.[81]

Over-all Progress in Burma During the Early Monsoon

Work on the Ledo Road continued well into May. The 45th Engineers, taking over the lead on the road on the 15th of that month at Mile 168, began clearing and grading. But it was soon evident that the 1944 monsoon would be the equal of its predecessor. "The rain never stopped," recorded the regimental historian.[82] Progress through the mud slowed to a crawl. Toward the end of the month, General Pick came to definite conclusions about the immediate future. Mindful of the loss of engineer troops to the fighting front and the increasing maintenance efforts required by the rains, Pick decided that for the time being his engineers could do little more insofar as road construction was concerned. Having advanced about 70 miles during the past four months, the road was open to trucks as far as the Tanai, 145 miles from Ledo. The roadhead had reached a point 30 miles beyond the river. "I do not wish to give you the impression," Pick wrote to General Covell on 25 May, "that we are folding up." He went on to say:

But I thought you would like to know

[80] (1) Fourteenth AF Hist, ch. XI. (2) Romanus and Sunderland, *Stilwell's Command Problems,* pp. 316–20.

[81] (1) Interv, Anders with Wheeler, 5 Mar 53. (2) Ltr, Newcomer to C EHD, 5 Dec 54. (3) Ltr, Seedlock to O'Connor, 16 May 44. O'Connor Ltr File, Constr Serv Files.

[82] Hist of the 45th Engrs.

what the conditions are. . . . Our equipment to a very great extent is just about shot. Our troop strength has been reduced to such an extent that we can not be expected to go any further [than] Warazup during this season. . . . But unless I can get troops and equipment, I don't think we can advance any farther and maintain the soft, spongy, newly completed road. . . . .[83]

It was hardly likely that the Ledo Road would be extended much further during the monsoon.

The campaign in northern Burma was so far behind schedule that it was questionable whether the road could have been pushed through to Myitkyina before the monsoon rains in any case. To make matters worse, the Chinese had persistently hung back from launching the Y-Force across the Salween. These unfavorable developments, together with the British reverses on the Manipur Plain, had gradually forced Stilwell to give up hope of extending the road into Myitkyina during May. But since late March he had been making plans for taking Myitkyina by an air attack before the monsoon set in. Capture of the town would be desirable for many reasons. It would have beneficial effects for the airlift to China. Seizure of the airfield would drastically curtail the enemy's power to interfere with the airlift and would at the same time permit the Air Transport Command to use a lower and more southerly route across the mountains to Kunming. Besides, the extension of the two 4-inch pipelines to Myitkyina, which could probably be achieved before the Ledo Road was completed that far, would enable transports to refuel there and thus conserve valuable cargo space for supplies for China.[84]

On 17 May the Marauders and the Chinese swooped down on the surprised Japanese garrison at Myitkyina. The attackers easily overran the bomb-cratered airstrip, but the defenses of Myitkyina itself were stronger than expected. Instead of winning a quick victory, the attackers were pushed back from the outskirts of the town. The great need now was for more men and supplies, which could come only by air. The airfield would have to be repaired in a hurry. On the evening of the first day of the battle, a group of men from the 879th Airborne Aviation Battalion arrived in gliders and began filling craters in the 4,800-foot runway. Two days later a detachment of the 504th Light Ponton Company, flown in from Ledo, prepared to ferry troops across the Irrawaddy and reconnoiter southwest of Myitkyina. When the tide of battle turned in favor of the enemy, Stilwell decided to put engineer troops in the line with the Marauders holding on at the northern edge of the town. On 24 May the 209th Combat Battalion, commanded by Lt. Col. Leslie E. Sandvall, was pulled off the Ledo Road and hastily flown to the front; four days later, the 236th Combat Battalion, under Lt. Col. Harold E. Greenlee, was sent in from Ledo. The struggle for Myitkyina promised to be a long one. Meanwhile, the monsoon made it necessary to put an end to guerrilla warfare. When the

[83] Ltr, Pick to Covell, 29 May 44. Admin File, Constr Serv Files.

[84] (1) Romanus and Sunderland, *Stilwell's Command Problems*, p. 205. (2) Ltr, Maj Gen Daniel I. Sultan to Covell, 15 Jan 44. Opns Br File, Constr Serv Files.

rains set in, Mountbatten began withdrawing the Chindits. Early in May engineer detachments were flown to two villages some thirty miles south of Myitkyina to prepare the fields from which the air commandos were to fly the Chindits back to eastern India.[85]

During June and July the fighting at Myitkyina showed no signs of abating. The engineers continued with their missions in support of the siege. By early June all the 879th Airborne Aviation Battalion was at work on the airfield. The detachment of the 504th Ponton Company, having established a boat landing on the Irrawaddy three miles below Myitkyina, was busy ferrying Chinese troops across the river and carrying Gurkha riflemen far downstream for reconnaissance missions. In the lines being drawn ever tighter around the town were the two combat battalions. After combining the engineers into a provisional regiment early in June, Brig. Gen. Haydon L. Boatner, Stilwell's field chief of staff, brigaded them with the Marauders on the northern approaches to Myitkyina. Their baptism of fire proved costly and painful because of their unfamiliarity with the ways of the enemy and the peculiar demands of the battlefield. Like the incoming replacements for the Marauders, they were at first lax in security measures and too prone to panic when surprised. Within a short time, however, experience and behind-the-lines training enabled the engineers to fight like veterans. Casualties were heavy—the 209th engineers reported 71 enlisted men killed and 179 wounded; the 236th engineers, 4 officers and 52 enlisted men killed and 142 wounded. All of the 209th and elements of the 236th Battalion received high praise for their action at Myitkyina.[86]

One hopeful development in the Burma campaign was that the Chinese forces in Yunnan were at last on the move. On 11 May the Y-Force attacked along the Salween, sending spearheads of three divisions across the river above and below the demolished bridge of the Burma Road. The Chinese engineers of the Y-Force now had an opportunity to show how much they had profited from instruction in river crossings given at the Kunming Training Center by American engineers serving with the Y-Force. From nightfall of 11 May until the next morning Chinese engineers ferried the infantry across the turbulent Salween in pneumatic assault boats and makeshift rafts, with the loss of but one Chinese infantryman. Once across the Salween, the Chinese infantry engaged the Japanese in a battle that raged back and forth for many weeks in the rugged mountains along the west bank. Eventually, the numerical preponderance of the Chinese began to tell. During late May they made a two-pronged attack. One force advanced yard by yard down the Burma Road toward Lung-ling, thirty-five miles west of the Salween, and another moved toward

[85] (1) Leslie Anders, "The Engineers at Myitkyina," *The Military Engineer,* XLIV (November-December, 1952), 446–50. (2) Hist of the 209th, 236th, 504th, and 879th Engrs.

[86] (1) Anders, "The Engineers at Myitkyina" *The Military Engineer,* XLIV (November-December, 1952). (2) Memo, Capt Leo A. Vecellio, Airfield Engr Myitkyina, to Col. Manuel J. Asensio, 6 Jun 44. Air Univ Lib Maxwell AFB. (3) Hist of the 209th, 236th, 504th, and 879th Engrs.

Teng-chung, thirty-five miles to the north. On 8 June the Chinese laid siege to Lung-ling and on 2 July attacked Teng-chung. Repeated attempts to take the cities were repulsed.[87]

By late spring the work of the engineers on MATTERHORN had begun to pay dividends. The rock and gravel fields in western China were ready on 15 May. During the following weeks, the engineers accelerated work on the paved fields in India. Kharagpur, a field "barely operational" in mid-March, was the one nearest completion by June. The 7,500-foot long runway and fifty hardstands were complete. Hangars, salvaged from the Mediterranean theater, operational buildings, and housing were almost finished.[88] On the 5th of the month the 382d Construction Battalion standing beside Kharagpur's concrete runway, saw the first B–29's leave for Bangkok to bomb railway shops there. On 14 June the Superfortresses took off for the first time for Cheng-tu, from where they flew to the Japanese home island of Kyushu to bomb the steel mills of Yawata.[89]

The monsoon had brought an end to the forward progress of the Ledo Road. But efforts were under way to bring up men and machinery so that work could start with redoubled vigor in the fall. Assuring Pick that he would make certain "no one spares the horses in supplying your needs," General Covell got from the Los Angeles Port of Embarkation a promise that it would load thirty-seven tons of spare parts on ships sailing in June and July. He had parts flown in from Calcutta for Pick's 73 tractors and other machines deadlined at the beginning of June.[90] Farrell's representatives at Calcutta made special efforts to expedite the shipment of new machinery, an undertaking favored by the rising efficiency of the Bengal-Assam Railway. During the first three weeks of June, the Engineer Supply Officer of Base General Depot No. 2 at Calcutta sent 39 tractors, 27 graders, nine shovels, nine scrapers, and many other pieces of much-needed equipment to Ledo.[91] Pick wrote Farrell on 24 June that he was as "pleased as a two-year-old at his first Christmas tree. I believe with the equipment which you are getting up to us we are going to be better off than I ever dreamed we could be. Most of us here have worn out our patience, and I might say our lifetime good looks, trying to make this old equipment go." [92]

Equipment was more plentiful, but attempts to get more troops attained little success. On 1 June 1944 there were still only 7,200 on the road. The most critical need was for more shop and parts supply companies. Since early 1943 the struggle to obtain more such units had been going on. The basic difficulty had always been CBI's low priority. In the United States there was, moreover, a serious shortage of trained mechanics and parts supply specialists. The War Department found

[87] CBI Hist, sec. II, app. III.

[88] Hq Constr Serv Progress Rpts, MATTERHORN 12 Feb, 5 Mar, 5 Apr, 9 May, 7 Jun 44. 678 CBI.

[89] (1) Hist of the 382d Engrs. (2) CBI, sec. III, app. IX.

[90] Ltr, Covell to Pick, 18 Jun 44. Constr Serv Files.

[91] Ltr, Farrell to Pick, 21 Jun 44. Engr Sec File, LAC Files.

[92] Ltr, Pick to Farrell, 24 Jun 44. Engr Sec File, LAC Files.

it impossible to organize and train new units to keep up with demands of even those theaters overseas with the highest priorities. The most Washington could promise Covell was that it might allot one parts supply and one heavy shop company to the theater late in the summer of 1944.[93] Such reinforcements as Pick was able to get for his projects during the summer months consisted of but three pipeline companies, one construction battalion, and a depot company organized at Ledo in May 1944 from two platoons of the former 456th Depot Company and casual personnel.[94]

Despite the downpours of the monsoon, the troops laid additional miles of pipeline. On 8 June the 706th and 775th engineers connected their lines along the Ledo Road. With this connection, 180 miles of 4-inch pipe were in place from Digboi. Since Myitkyina was under siege, Stilwell deemed it inadvisable to extend the line further. As construction on the line came to a halt, work began on the second 4-inch line along the road. MacIsaac had received three additional petroleum distribution companies, the 778th, 779th, and 780th. He put the 778th to work hauling pipe from the engineer depot at Likhapani down the Ledo Road for the future construction drive. He assigned the 779th the job of putting in an underground line from Digboi to the tank farm under construction at the railway terminal in Tinsukia, twenty-two miles to the west. To the 780th he gave the job of laying the second 4-inch line from Digboi into Burma. The pace was retarded by such problems as reluctant laborers, flooded areas, washed-out bridges, and delayed pipe shipments from Calcutta. Meantime, in District 12, Colonel Kinsolving's men were pushing ahead with determination. On 1 July they coupled the last pipe in the first 6-inch line from Calcutta to Tinsukia. The longest invasion-weight pipeline in history was ready to carry 250,000 barrels of gasoline a month from Calcutta to Assam.[95]

Maps

Both the campaign in Burma and the work on the Ledo Road had been handicapped by the lack of adequate maps. The Americans had to depend mainly on maps of British or Chinese origin, many of which were out of date and inaccurate. Wavell's General Staff Geological Survey, responsible for mapping India and Burma, did not have the resources to carry out adequately its responsibilities of revising maps and distributing them. The Chinese were too disorganized to carry on a mapping effort. In the autumn of 1942 General Reybold had sent three officers and three enlisted men to New Delhi as a liaison group. Headed by Maj. Frank N. Gunderson, they were to get from the British such maps as the Americans needed. Early in 1943 Gunderson's group was directed to include liaison with the Chinese in Chungking in order to obtain data that might enable the Army Map

[93] Ltr, OPD to CG SOS CBI, 2 May 44. Admin File, Constr Serv Files.

[94] Ltr, Covell to Somervell, 22 May 44. Admin File, Constr Serv Files.

[95] (1) Constr Serv Progress Rpts, Pipelines, 7 Jun, 4 Jul, and 4 Aug 44. Opns Br File, Constr Serv Files. (2) Hist of the 699th, 706th, 778th, 779th, and 780th Engrs.

Service in Washington to help supply Stilwell's command with satisfactory maps. Because of Chinese suspicions that the data might fall into the hands of "third powers," particularly Britain, Gunderson's men could at first get little information in Chungking. The situation in India improved somewhat during the summer of 1943, with the arrival of the 653d Topographic Battalion to handle general publication and map-reproduction work for the American forces and of the 958th Aviation Topographic Company to provide aeronautical charts for the Tenth Air Force. In 1944 Gunderson reported greater success. In the summer of that year, the Chinese agreed to let the Air Forces carry out a program of aerial photography to make possible the production of up-to-date maps of China and adjacent countries. The Chinese handed over to Gunderson material on geodetic and astronomic stations, river surveys, and towns—it being understood that "third powers" would not get the data. The 653d engineers undertook to co-ordinate the information with that obtainable from aerial photographs supplied by the Fourteenth Air Force and the XX Bomber Command. Late in the summer the Combined Chiefs gave the U.S. Army responsibility for supplying maps to Anglo-American forces in Asia. General O'Connor set up a map depot at Chabua to supply American forces with maps produced by the 653d and 958th engineers or sent by Army Map Service. Gunderson's office in New Delhi was to take care of British requisitions on American stocks, dealing directly with the depot at Chabua or with Army Map Service. Unfortunately, the aerial photography program in China was of little help to the engineers in their efforts to increase the flow of up-to-date maps to the field. Much of the photography failed to meet specifications. Too much cloud coverage and, during good weather, priorities of combat sorties cut down on the number of photographic missions. A further handicap was the strict rationing of gasoline. Consequently, little could be done to supply more adequate maps of China and Burma.[96]

Over-all Progress During the Late Monsoon

The Chinese drive into Burma gave Allied commanders considerable cause for optimism. The performance of the Chinese engineers also contributed to the brighter outlook. On 18 June local Chinese commanders permitted the reconstruction of the partially demolished 25-kilometer stretch of the Burma road just east of the Salween. This job was turned over to Colonel Dawson and his engineers as their first major project in support of the drive west of the Salween. After four days of around-the-clock operations under occasional enemy shell fire, Dawson's men opened the stretch to one-way traffic on 24 June. Their next

[96] (1) Bd of Off to Brig Gen John W. Middleton, 12 Oct 45, Rpt, Mapping and Aerial Photography. Hq CTO Files, KCRC. (2) Ltr, Mil Intel Div OCE to Dir Survey Div SEAC, 20 Sep 44. 812.3 China. (3) Rad, Reybold to Wheeler, CM-OUT 7866, 25 Aug 42. 210.3 CBI. (4) Ltr, Lt Col Francis R. Sullivan to C EHD, 7 Dec 54. EHD Files. (5) Rad, Reybold to Gunderson, 3 Mar 43. 812.3 China. (6) Ltr, Gunderson to Newcomer, 28 Aug 43. Opns Br File, CTEF. (7) Memo, C Mil Intel Div OCE for G-2 WDGS, 1 Sep 44. 061.01 China. (8) Hist of the 958th Engr Avn Topo Co.

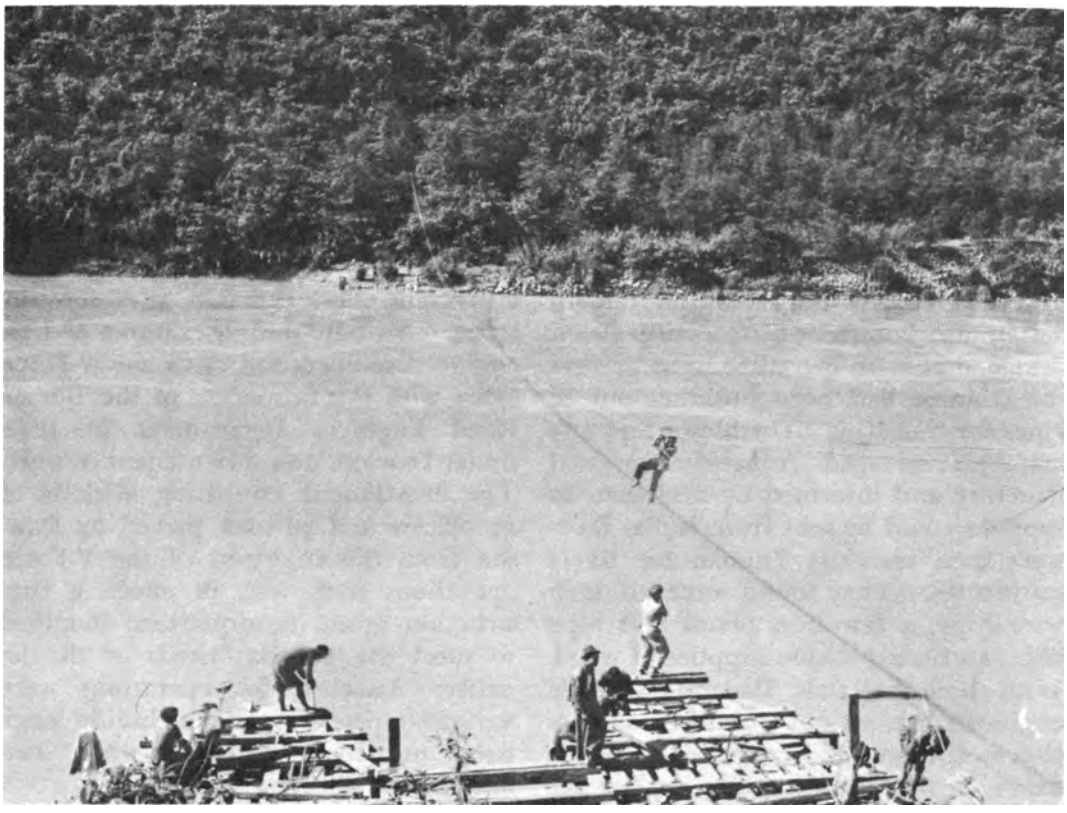
job was to rebuild the bridge across the Salween, since rafts and pneumatic boats had great difficulty in coping with the swift and treacherous river. The previous span had been a suspension bridge with stone towers and a steel trussed deck. The Chinese had left the south tower with its two anchorages intact but had completely destroyed the north tower. Dawson's engineers set out to design an improvised steel suspension bridge similar to the suspension bridges the Chinese had been building out of vines for centuries. Unable to find any materials salvaged from the original structure and informed by SOS that no supplies could be sent from India, Dawson's men searched Yunnan for likely substitutes. They found some 1¼-inch wire rope, a few iron plates and rope clips, and fairly ample supplies of wood. With these materials, Dawson's Chinese engineers first set out to build a suspension footbridge. They erected a wooden tower on the north bank to replace the destroyed stone tower. They then stretched two cables across the river, anchored them to the towers, and along the cables hung V-shaped stirrups, about five feet apart. They then placed 2-inch boards along the bottom of the stirrups. The footbridge was soon improved with the installation of four cables from anchorage to anchorage and 3-inch planks along the bottom of the stirrups. The bridge could safely take loaded jeeps. The entire job required little more than a month.[97]

As the Chinese continued to drive the Japanese back west of the Salween, American engineers supported practically every phase of the advance. Through the efforts of the Y-Force engineers, explosives and hand tools went forward to the Chinese at the front, and each Chinese field army had a few American engineers as advisers to help locate mines and find the best sites for airstrips. An outstanding example of U.S. engineer co-operation with the Y-Force came with the formation of the Burma Road Engineer Detachment in June under Dawson, now a lieutenant colonel. The detachment, consisting initially of 27 officers and 46 men picked by Dawson from the engineers of the Y-Force operations staff, was, in effect, a construction group headquarters, modified to meet the peculiar needs of the locality. Attached for operations were various types of units, including engineer, ordnance, signal, medical, and antiaircraft artillery.[98]

Beyond the Salween, the engineers had a great deal of work to do. Rising to a height of 3,000 feet above the west bank of the river was Sung Shan Mountain. Japanese artillery emplaced on it commanded thirty-six miles of the Burma Road's winding approach west of the river. In their drive on Lung-ling the Chinese had bypassed this strongpoint. During late June and early July, Chinese cannoneers exchanged shots regularly with the enemy. During late July and

[97] (1) Memo, Engr Adv Sec 1 SOS to CO Adv Sec 1, 21 Aug 44. GED Files, CTOSOSEF. (2) Ltr with Incls, Dawson to C of Mil Hist, 2 Aug 60. EHD Files.

[98] Ltr, Hq USAF CBI to General Marshall, 26 Jul 44. Engr Br File, CSF. (2) Hq and Hq Det Burma Road Engrs GO No. 1, 1 Jul 44. Burma Road Engr Files, China Theater Engr Files. (3) Engr Memo No. 116, Dawson for CO Adv Sec 1 SOS, 20 Jul 44. CTO 611 Burma Road Engrs.

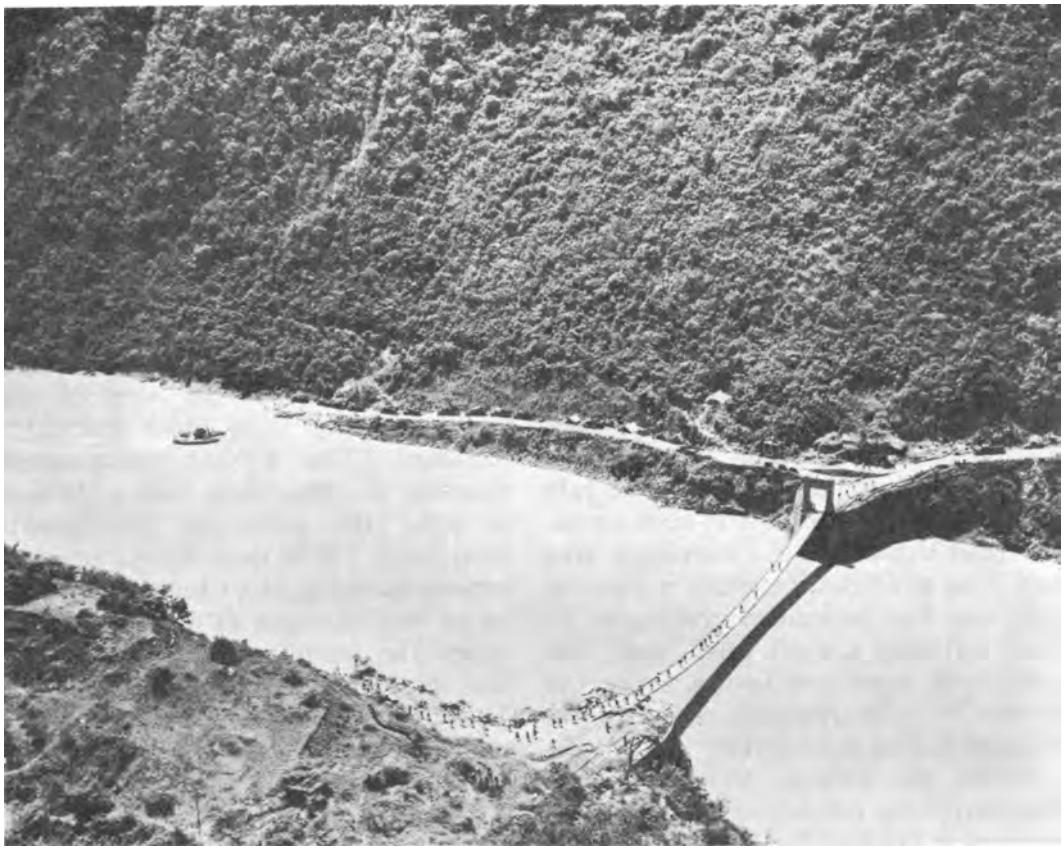


A WORKMAN STRINGS A FERRY CABLE ACROSS THE SALWEEN *while men in the foreground build the ferry.*

early August the Chinese made repeated assaults up the mountain but could not dislodge the 1,200 Japanese.[99]

Favorable developments along the Salween in July, especially the siege of the city of Teng-chung, had repercussions in headquarters at Ledo. The fall of Teng-chung, 100 miles east of Myitkyina, would clear an old caravan trail which linked Myitkyina with the Burma Road at Lung-ling. A number of engineers in the theater believed the Ledo Road should be built along this trail. In the summer of 1944 a heated controversy developed over the relative merits of this route as against the one Pick wanted, which ran 80 miles farther south through the town of Bhamo. The origins of the dispute went back to March 1944, when Stilwell thought he would have to limit his advance in northern Burma to a line including the Teng-chung trail but not the Bhamo area. In late March, CBI commanders had begun to press Chiang to make a

[99] (1) Ltr with Incls, ExecO Theater Engr Sec USAF CBI to OCE, 11 Oct 44. 370.2 CBI.



THE FOOTBRIDGE AND FERRY ACROSS THE SALWEEN, *during Chinese advance.*

positive contribution to lifting the blockade of China by constructing a military highway from Lung-ling through Teng-chung toward Myitkyina as soon as the Y-Force drove the Japanese from that part of Burma. In April Colonel Dawson made an analysis of the project and reported that building the road would be feasible from an engineering standpoint. In July General O'Connor approved construction of a road along the trail on the grounds that the region would be cleared of the enemy sooner and a road there would be 200 miles shorter than one by way of Bhamo.[100] The Chinese agreed in June to adopt the American proposals and to survey the route preparatory to calling out laborers and initiating construction.[101] Stilwell felt construction along the new route was urgent. "Essential that route and work be started from the China side without delay," he radioed to O'Connor.

[100] (1) Romanus and Sunderland, *Stilwell's Command Problems*, p. 435. (2) Ltr, Dawson to C EHD, 10 Jun 53.

[101] Rad, Hearn to Sultan, 27 Jul 44. Engr Br File, Constr Serv Files.

"Coordinate through Pick on this work." [102]

Pick was strongly opposed to the whole concept of building the road along the trail, which wound through the mountains and over the steep ridges of the Himalayan spurs in northern Burma. He regarded it as a visionary undertaking, incapable of fulfillment with available resources. Upon receiving an unfavorable analysis of the project from his own engineering branch in June, Pick had ordered out a reconnaissance party in the last week of that month to gather additional data on the problems involved. Pick radioed Farrell on 18 July that it might be desirable to have a combat road through the Teng-chung area and even to consider routing a pipeline that way, but he wanted nothing to do with building a truck road along the trail until more was known about the terrain.[103] The question was left undecided during the summer.

While the Chinese were advancing westward from the Salween, the tide was turning in favor of the British in eastern India. By 22 June the British had broken through to relieve Imphal. The Japanese forces were now withering at the end of a communications line consisting of little more than a network of jungle trails sodden from more than a month of monsoon rains. Malaria and starvation were hastening the decimation of the invading army. The enemy commanders resolved early in July to pull back the survivors of the ill-fated offensive. The Japanese withdrew to their Chindwin River lines, leaving a third of their 155,000 troops dead on the Manipur Plain or along the mountain footpaths. The threat to the Ledo Road and to the Allied forces in northern Burma thus ended for good.[104]

And things continued to go badly for the Japanese in western Yunnan. The Chinese blasted the Japanese from one stronghold after another west of the Salween. Only Sung Shan Mountain remained. The Y-Force commanders, resorting to classic siege tactics, decided to mine the seemingly impregnable stronghold. With their American counterparts advising, the Chinese engineers on 11 August began to dig two tunnels under the main centers of resistance; nine days later they set off three tons of TNT, whereupon some of the Chinese engineers rushed into the breach with flame throwers as a spearhead for the infantry. Nothing remained but to hunt down the survivors; by the first week of September, the last ones were mopped up. Farther west, Y-Force engineers gave active support to the Chinese troops besieging Teng-chung. The first serious attempt to reduce this bastion took place early in August. Chinese engineers under American supervision mined the southeastern section of the city wall. The breach, together with the damage subsequently inflicted by Chennault's bombers, was not sufficient to insure Teng-chung's immediate fall. But Chinese troops secured a foothold

[102] Rad, Stilwell to O'Connor, 16 Jul 44, quoted in Rad, Hq Admin Sec 1 to Hq SOS CBI, 20 Jul 44. Engr Br File, Constr Serv Files.

[103] (1) Ltr, Capt James H. Kaminer, EngrgO Adv Sec 3, to Pick, 22 Jun 44. Engr Br File, Constr Serv Files. (2) Rad, Pick to Farrell, 18 Jul 44, quoted in Rad, Hq Admin Sec 1 to Hq SOS CBI, 20 Jul 44. Engr Br File, Constr Serv Files.

[104] Romanus and Sunderland, *Stilwell's Command Problems*, pp. 194–96.

at the site of the mining, and the capture of the city was only a matter of time.[105]

On 3 August the Japanese lost Myitkyina, and their forces retreated southward. The fall of the city doomed the enemy hold on northern Burma. A turning point had been reached in the long American struggle to help China. The rest of Stilwell's Chinese troops now came out of the Mogaung Valley to assemble at Myitkyina in preparation for the next phase of the offensive—down the road toward Bhamo. General Pick began moving in engineer and other service troops to convert Myitkyina into the key Allied base for the final drive to open northern Burma; at the same time he took back from Stilwell his decimated engineer combat battalions, which had suffered nearly 500 casualties, and flew them to Ledo for recuperation.[106]

With the collapse of enemy resistance, Col. Manuel J. Asensio, Tenth Air Force engineer, prepared to carry out Stratemeyer's plan for a ring of airfields around Myitkyina, capable of making this area a vital hub for transport and air combat operations.[107] The existing airfield at Myitkyina, with a plane landing or taking off every two minutes, was already the busiest in the theater.[108] By 1 August the engineers had extended the second four-inch line from Digboi to Ledo. To provide the all-important petroleum installations for the air and ground efforts to come, Colonel MacIsaac launched District 22 on a strenuous effort to extend the first of the 4-inch pipelines into Myitkyina by 1 October.[109] With the coming of dry weather in the fall, engineer work could once more be undertaken in earnest.

The CBI Is Cut Back

The Decision to Reduce the Engineer Effort

Since the fall of 1943 Anglo-American planning circles had been increasingly reluctant to give their support to extensive military undertakings on the Asian mainland. Many factors in late 1943 and in the first months of 1944 had encouraged a shift of interest toward operations in the Pacific. Among them were China's interminable delay in reforming its military forces, British aversion to campaigning in the Burmese jungles, the victory over the Japanese in the Gilberts in November, the Russian promise at Tehran in December to attack Japan after the surrender of Germany, and a growing desire in the spring of 1944 to avoid frittering away military resources that might be needed in the coming invasion of the Philippines or Formosa.[110]

Such was the feeling when General Stilwell asked the War Department on 21 April 1944 for additional service

[105] Ltr, with Incls, ExecO Theater Engr Sec USAF CBI to OCE, 11 Oct 44. 370.2 CBI.

[106] (1) Anders, "The Engineers at Myitkyina," *The Military Engineer*, XLV (November-December, 1952), pp. 449–50. (2) Hist of the 209th and 236th Engrs.

[107] Engr Sec Tenth AF, Burma Diary, 25 Jun 44. Air Univ Lib, Maxwell AFB.

[108] Ltr, Godfrey to O'Connor, 31 Jul 44. O'Connor Ltr File, Constr Serv Files.

[109] Hq Constr Serv, Status Rpt, Pipelines, 7 Sep 44. (2) Hq Engr Div 2, Constr Serv, Status Rpt, Pipelines, 30 Sep 44. Both in Opns Br File, Constr Serv Files.

[110] (1) Romanus and Sunderland, *Stilwell's Command Problems*, pp. 79–82. (2) Craven and Cate, eds.,*Guadalcanal to Saipan*, pp. 495–97. (3) Churchhill, *Closing the Ring*, pp. 560–61.

troops, including fourteen engineer construction battalions. He regarded these reinforcements as vital if he was to carry out the War Department's known desires for moving supplies by truck into China and expanding deliveries by air to 20,000 tons a month by early 1945. Many in the War Department strongly opposed meeting Stilwell's requests.[111] Arguments as to whether the Ledo Road should be finished raged back and forth. General Somervell fended off proposals from the Air Forces and the British mission in Washington that the road should be extended no farther than Myitkyina. In July 1944 the Operations Division proposed that the road be completed to Myitkyina; beyond that point work should be limited to repairing and maintaining the existing one-way road which ran from that city through Bhamo to Mong Yu, where it joined the Burma Road. Trucking into China should be restricted to carrying military equipment that could not be sent by air. The Air Forces and the British heartily indorsed this view. They maintained, furthermore, that the Ledo Road could not be completed in time to support the final phases of the war against Japan; worse than that, it would constitute a logistical drain on these operations.[112]

General Somervell was determined to preserve intact the planned overland line of communications to China. On 24 July he warned the Operations Division that if the optimistic assumptions regarding the early defeat of Japan proved unwarranted, everyone would be thankful that there was a Ledo Road to enable the Allies to support the Chinese locked in battle with Japan's mainland armies. He discounted arguments that continued construction of the road would cut deeply into resources needed elsewhere. Seventy percent of the material approved for the road had already been shipped. A major proportion of the troops deemed necessary for construction and operation would still be needed to patrol and maintain the airfields at Myitkyina, the pipelines, and the existing road from Myitkyina through Bhamo to China.[113] Somervell's arguments were of no avail. The Operations Division stood its ground and prevailed upon Marshall to reduce the scope of the Ledo project. On 23 August 1944 the War Department directed Stilwell to limit construction beyond Myitkyina to a one-lane, all-weather road to make possible sending supplies by truck to China and helping the construction forces pushing the pipelines through to Kunming. Work in the theater continued at a fairly high rate after August, but it became increasingly obvious that a cutback was on the way.[114]

Work Resumes on the Ledo Road

During August and September there was no letup in the controversy over whether the Ledo Road should be routed east from Myitkyina through the mountains on the China-Burma border to the

[111] Memo, ACofS OPD for CG ASF, 9 May 44. OPD 400, Case 122.

[112] Memo, Logistic Group ASF for OPD, 16 Jul 44. (2) Memo, ACofAS (Plans) for ACofS OPD, 27 Jul 44. Both in OPD 400, Case 122.

[113] (1) Memo, Somervell for Handy (OPD), 24 Jul 44. (2) Memo, Actg CofS ASF for OPD, 29 Jul 44. Both in OPD 400, Case 122.

[114] Rad, Marshall to Sultan, 23 Aug 44. Theater Engr Policy File, Constr Serv Files.

Chinese city of Teng-chung or continued south through Bhamo. Despite the enthusiasm of the engineers in China and of General O'Connor for the undertaking, Pick insisted that the Ledo Road should go 116 miles south by way of Bhamo and then east to connect with the Burma Road at Mong Yu.[115] Aware of the developing controversy, Stilwell late in August approved construction of both routes. The Chinese would build a road over the 135 miles from Teng-chung to Myitkyina; at the same time, Pick's engineers would build the road via Bhamo.[116] Pick's reconnaissance party, sent out in the summer, returned early in September and confirmed his original adverse opinion of the Teng-chung project by singling out the paucity of timber and gravel in some sections and the need for excessive excavation in others.[117]

As the end of the monsoon season approached, Pick redoubled preparations for resuming work on the road. During the summer months he had moved up heavy equipment and stockpiled it in the Hukawng Valley. In August Colonel Hirshfield began building a supply depot at Myitkyina not only for the road but also for combat, using men from engineer units in the area together with several thousand Burmese laborers recruited by the British. By the end of the monsoon, Pick had approximately 14,000 engineers ready for work on the road. He felt he at last had enough troops to meet any demands which might be made on him.

In the first week of October, work began once more. Elements of the 330th Engineers and of the 1304th Construction Battalion, together with the Chinese 12th Engineer Regiment, started to build a dry-weather road along the trail leading southward from Mile 178 to Myitkyina, to make possible sending trucks into the town as soon as possible. At the same time the Chinese 10th Engineer Regiment began to clear the right-of-way of the Ledo Road itself beginning at Mile 178. Behind the Chinese were grading parties of the 330th to do finished grading, surfacing, and maintenance. The 1304th was responsible for bridge building. On 10 October it began work on a 560-foot Bailey bridge over the Mogaung River, using materials supplied by British depots in India. In mid-October, with the opening of the offensive by Chinese troops from Myitkyina into eastern Burma, the 209th and 236th Combat Battalions began to repair the road running east of the Irrawaddy from Myitkyina to Bhamo.[118]

The Burma Road

The Burma Road engineers, commanded by Colonel Seedlock after Colonel Dawson left for the United States in September, got ready to help the Highway Administration build the road from Teng-chung to Myitkyina. On 2 October Seedlock set up Burma Road Engineer Division 2, with head-

[115] (1) Ltr, Covell to Sultan, 28 Aug 44. (2) Ltr, CO Adv Sec 1 SOS to Farrell, 28 Aug 44. Both in Engr Br File, Constr Serv Files.

[116] Ltr, Farrell to Pick, 1 Sep 44. Engr Br File, Constr Serv Files.

[117] Rpt, Maj James H. Kaminer to Pick, 9 Sep 44. Engr Br File, Constr Serv Files.

[118] (1) Progress Charts, Ledo Rd., 1 Oct, 1 Nov 44 in Plng Div ASF, The Ledo Road, app. C. (2) Hist of the 209th, 330th, and 236th Engrs.

quarters at Teng-chung, and Division 3, with headquarters at Sadon, just inside the Burma frontier, some forty miles east of Myitkyina.[119] Seedlock used most of his 257 engineers as supervisors and equipment operators. He kept a small force to maintain the Burma Road east of the Salween and another to make emergency repairs on the road immediately behind the Chinese XI Group Army. The dark spot in the picture, as autumn came on, was the unexpected stalling of Governor Lung in conscripting the 120,000 laborers who were to work under Seedlock. All that Seedlock could do during September and October was to push surveying, accumulate some equipment, and organize such forces for construction as he had.[120]

The Pipelines

When Myitkyina fell on 3 August, Stilwell's headquarters again turned its attention to the second 4-inch pipeline, which by then had almost reached Pangsau Pass. Stilwell's deputy, Maj. Gen. Daniel I. Sultan, stressed the urgency of extending this line to Myitkyina in time to support the coming autumn offensive in eastern Burma. Sultan set MacIsaac's completion date as 1 October, and MacIsaac made use of every available resource to meet his deadline. The Tenth Air Force flew 1,500 tons of pipe to Myitkyina, and drivers of the 778th Petroleum Distribution Company hauled thousands of tons more from Likhapani down the Ledo Road into Burma. Two of Kinsolving's petroleum distribution companies, the 709th and 776th, joined the six already working on the line.[121] "We have pipeline people," Pick wrote to Covell, "road troops, ponton outfits, Pioneer Indian Labor, Nepalese Porter Corps people, a battalion of Chinese, and a herd of elephants working on it." [122] Because the pipeline left the route of the road in some localities, it was often necessary to construct cableways to ferry pipe across rivers. Sometimes the men had to carry pipe by hand through the hip-deep water of the flooded lowlands. Despite such obstacles, together with the snakes, leeches, and malaria, the engineers strove to "get it through." [123] On 27 September Pick radioed Farrell that the line was completed to Myitkyina. Mountbatten wired his congratulations to Covell and to Pick "and all his men who were responsible for putting the pipeline through from Tinsukia to Myitkyina in record time under monsoon conditions." Covell, forwarding Mountbatten's message to Pick, observed, "Our team is going strong." Col. Birney K. Morse, former chief engineer of the Susquehanna Pipeline Company, who had succeeded MacIsaac on 22 September, took over the job of pushing the line on to China. There was no advance of the other 4-inch line beyond Tingkawk Sakan. It was already operating to capacity just to support construction and trucking along the Ledo Road.[124]

Plans made at QUADRANT had called

[119] Ltr, Seedlock to Div 2 Engr, 2 Oct 44. GED File, CTSOSEF.

[120] (1) Ltr, ExecO Burma Road Engrs to Neyland, CO Adv Hq 1, 18 Oct 44. GED File, CTSOSEF. (2) Hist of Burma Road Engrs. CTO 611 BRE.

[121] Hq Constr Serv Progress Rpts, Pipelines, 7 Sep, 30 Sep, 6 Oct 44.

[122] Ltr, Pick to Covell, 27 Sep 44. Covell Ltr File, Constr Serv Files.

[123] Hist of the 706th, 707th, 776th, 778th, and 780th Engrs.

[124] Plng Div ASF, The Ledo Road, app. E.

for two 6-inch pipelines from Calcutta to Assam.[125] The first, built entirely with invasion-weight pipe, had been in operation since the last week of August. Kinsolving planned to start work in October on the second, to be standard-weight throughout. A heavier line could be operated at greater capacity to meet the great demand for aviation and truck gasoline in upper Assam. Since the line would pass through heavily populated areas, it would, like the first, have to be put underground. The improving tactical situation in Burma in the late summer of 1944 enabled Kinsolving to shift the southern terminus of the second line from Calcutta to the Burmah Oil Company's port facilities at Chittagong, 180 miles to the east across the Ganges estuary. The Chief's Office in July 1944 expressed misgivings about this move, pointing out that construction and operation in the rugged lands north of Chittagong would require a much larger number of troops. Besides, Chittagong's shallow harbor would necessitate building a costly offshore mooring together with a submarine unloading line. But Farrell and Kinsolving knew that the eastern route would require 180 miles less pipe, would obviate crossing the Ganges and the Brahmaputra, and would lessen the dangers implicit in concentrating so many storage facilities at Calcutta. By mid-October, Kinsolving had the 777th and the 138th Petroleum Distribution Companies at work along the railway from Chittagong to Tinsukia. Three thousand Indian laborers were clearing the route and digging the ditches.[126]

Airfields

By the fall of 1944 few airmen set a very high value on the advantages of the MATTERHORN airfields to the American war effort. Between June and October the B–29's made four raids on steel and aircraft plants on the Japanese island of Kyushu, three attacks on a major steel plant in Manchuria south of Mukden, one on an aircraft factory on Formosa, and another on an oil refinery on Sumatra. It was logistically impossible to increase the rate of attack beyond an average of two sorties monthly for each B–29. The craft could not be supplied with sufficient gasoline to make their sorties profitable. Gasoline and munitions for each strike against Japan had to be flown to Cheng-tu by transports or by B–29's working overtime.[127] On 3 October 1944 Secretary of War Stimson observed that the drain of transports to CBI ". . . bids fair to cost us an extra winter in the main theater of war." [128] It was expected that the B–29 fields being built in the Marianas, much closer to Tokyo, would soon be ready. After a few more raids on Formosa and Kyushu in support of the American drive in the

[125] The early planning papers place the northern terminus of the 6-inch lines at Dibrugarh, a barge landing on the upper Brahmaputra connected by a short stretch of meter-gauge railway with the Digboi refinery and the Ledo Base. By the spring of 1944 Construction Service planning had changed the terminus to a tank storage "farm" under erection by engineer troops at Tinsukia, a key railway junction just west of Digboi.

[126] (1) Memo, ACofS OPD for CG ASF, 10 Jul 44, with Inds, 14 Jul and 19 Jul 44. 678 CBI. (2) Theater Engr Staff Journal 26 Jun, 4 Aug 44. Admin File, Constr Serv Files. (3) Hq Constr Serv, Progress Rpts, Pipelines, 6 Oct, 6 Nov 44.

[127] Craven and Cate, eds., *The Pacific—Matterhorn to Nagasaki*, pp. 94–118.

[128] Stimson and Bundy, *On Active Service*, p. 538.

Philippines and after several strategic bombing missions in southeastern Asia, the B–29's in CBI prepared to transfer to the Pacific. By late 1944 the main engineer job on the fields in India and China was maintenance only.[129]

The airfields now of most concern in CBI were those around Myitkyina. While the siege was still in progress, Colonel Asensio's men had begun work on the runways there. According to plans which had been worked out with Godfrey's representative in June, Asensio was to complete by 1 October 1944 a 6,000-foot all-weather field at the original Myitkyina airstrip, now called Myitkyina South. A similar field was to be built just above the town—Myitkyina North. Ten miles south of Mogaung, Asensio was to build a fair-weather strip by 15 November to support the British offensive rolling southward toward Mandalay. At the same time, six miles southwest of Myitkyina, he was to have a fair-weather runway capable of taking B–29's. Finally, to support the Chinese advance into eastern Burma, there was to be a fair-weather strip, just across the Irrawaddy, to be known as Myitkyina East, and to be finished by 1 January 1945. During July the Tenth Air Force flew in the 1888th aviation engineers so that they would be ready to begin work on Myitkyina North as soon as tactically feasible. When, after capture of Myitkyina, it became clear that the Ledo Road would not reach the town before November, Asensio began bringing in by air the rest of his units and their equipment. The 930th and 1877th engineers arrived during September and October. By the latter month, Asensio's projects were well under way.[130]

The Tactical Situation

After their victories on the Manipur Plain and at Myitkyina, the Allies made fairly steady progress along their fronts. The Japanese were being constantly forced farther south in Burma. In September General Sultan, having taken the field as Stilwell's deputy, sent the British 36th Division on a long, southward drive along the Burma Railway from Mogaung to Mandalay. At the same time the newly organized and American-trained Chinese Sixth Army moved out of the Mogaung area and pushed southward over hills and through jungles toward a crossing of the Irrawaddy west of Bhamo. In mid-October the Chinese 1st Army advanced from Myitkyina along the road to Bhamo. The military picture in Burma grew constantly brighter for the Allies.

But it was darkening in eastern China. Disaster had begun in the spring of 1944, as the Japanese bestirred themselves to seize the airfields that the Fourteenth Air Force was using in its strikes against enemy shipping. A major Japanese drive had begun on 26 May with a thrust in the direction of Changsha. On 18 June the Chinese abandoned the city. Before the end of the month the Japa-

[129] Craven and Cate, eds., *The Pacific—Matterhorn to Nagasaki*, pp. 126–30.

[130] (1) Engr Sec Tenth AF, Burma Diary, Oct 44. (2) Ltr, Godfrey to Byroade, 23 Aug 44. AAF 312.2 CTO. (3) Ltr, Godfrey to Stratemeyer, 8 Oct 44. O'Connor Ltr File, Constr Serv Files. (4) Hist of the 930th, 1877th, and 1888th Engrs.

nese had reached Heng-yang, where they at last encountered a Chinese force determined to hold. After a staunch but hopeless defense that lasted nearly two months, the Chinese surrendered the city on 8 August. At the beginning of September the invaders started their advance from Heng-yang. While one column moved westward out of the valley toward the bomber field at Shao-yang, the main body advanced toward Ling-ling. Meanwhile, a Japanese expedition, moving west from Canton, threatened the bomber fields in the region to the south of Kweilin. As Stilwell had feared, the Chinese armies in the eastern provinces were incapable of stemming the enemy's drives. It became the painful duty of Chennault's engineers to undertake the task of destroying the airfields which would soon be overrun by the enemy. On 4 September the resident engineer at Ling-ling applied the torch and dynamite to the field there, four days before the Japanese arrived. On 14 September the field at Shao-yang was destroyed.[131]

As the Japanese were advancing rapidly along the 100-mile road from Ling-ling to Kweilin, the Americans had to decide quickly what to do about the major airfields clustered around the latter city. Stilwell himself went to Kweilin on 14 September to canvass possibilities for holding the area. He found that the Japanese were only seventy miles away. Equally ominous was the fact that the local commander had strict orders from Chungking to employ the classic but futile stratagem of retiring within the city's walls. This news convinced Stilwell that Kweilin was destined to become "another rat trap." [132] He gave the order that afternoon to destroy the three heavy bomber fields near the city. The engineers complied during the night. They buried and detonated bombs in the taxiways and runways, while air force personnel burned the buildings. Eleven days later the process was repeated 120 miles to the south at Tanchuk, just before a Japanese column from Canton arrived.[133]

The loss of airfields in eastern China created a need for new ones in the central and southern part of the country. Leaving some of his planes in the eastern pocket around Kanchow and Sui-chuan, Chennault planned in October to redeploy the bulk of his force to fields along a north-south axis running through Chungking.[134] Thus Byroade, who returned to Washington in September, bequeathed to Col. Austin W. Betts, the new Fourteenth Air Force engineer, the task of beginning construction and improvement of several fields north and east of Chungking and east of Kunming. During October Betts arranged with the Chinese to build a medium bomber base 180 miles northwest of Kweilin and another 400 miles west of that city, together with several fighter fields in these areas.[135]

[131] (1) Romanus and Sunderland, *Stilwell's Command Problems*, pp. 371–73, 399–401, 405, 433. (2) Fourteenth AF Hist, pp. 433, 456–60. (3) Rad, CO Kweilin Air Base to Hq China Air Serv Area Comd, 6 Sep 44. Air Engr Files, CTO.

[132] CBI Hist, pp. 198–99.

[133] Ltr, Resident Engr, Li Chia Chen, to Dist 3 Engr China Air Serv Area Comd, 1 Oct 44. Air Engr Files, CTO.

[134] Chennault, *Way of a Fighter*, pp. 81–82.

[135] Ltr, Betts to Godfrey, 13 Nov 44. AAF 312.2 CTO.

Reorganization of CBI

The deterioration of the military situation in eastern China intensified the long-standing animosity between Chiang and Stilwell. The bitterness became obvious after President Roosevelt, seeking to stave off a total collapse of the Chinese front, had proposed in July that Stilwell assume unified command of all Nationalist and Communist military forces in China. On 25 September Chiang formally demanded Stilwell's recall, and on 18 October the President complied.[136] Within a week, CBI was split into two theaters. China Theater was headed by General Wedemeyer, who was to "advise and assist the Generalissimo in the conduct of military operations against the Japanese" and to "carry out air operations from China." India-Burma Theater was commanded by General Sultan, whose main mission was to "support the China Theater" by assuring the "establishment, maintenance, operation, and security" of overland communications with China. To the extent specified by the Combined Chiefs, Sultan was to support Mountbatten's operations in southeast Asia.[137]

Wedemeyer organized his theater with a forward echelon at Chungking and a rear echelon at Kunming. There were three major engineer offices—one for the theater at Chungking, one for the air forces at Kunming, and a third for the Services of Supply, also at Kunming. Almost no changes were made in the engineer setup in the India-Burma Theater.[138]

Road, Pipeline, and Airfield Projects in Late 1944

General Pick, with a relatively large force of engineers and a substantial amount of machinery under his command, made rapid progress on the Ledo Road during the fall of 1944. On 10 November the 330th General Service Regiment and the 1304th Construction Battalion, with the aid of the Chinese 12th Engineer Regiment completed work on the dry-weather trail from Mogaung to Myitkyina. Early in December the leading bulldozer reached the west bank of the Irrawaddy, some twenty miles downstream from Myitkyina.

The outstanding feature of the work on the road in late 1944 and early 1945 was the building of several major bridges. From 10 October to 14 January, the 1304th engineers alone built 104 spans, totaling 5,105 feet. Among their more noteworthy accomplishments were the building of a 164-foot Bailey over the Mogaung, and the construction of three H–20's, totaling 788 feet in length.[139] On 6 December the 75th Light Ponton Company completed a 1,200-foot ponton bridge across the Irrawaddy at Myitkyina to facilitate supply of the Chinese troops marching southward to join the Y-Force.

[136] Romanus and Sunderland, *Stilwell's Command Problems*, ch. XII, *passim*.

[137] Rad, JCS to Wedemeyer and Sultan, WARX 51593, 25 Oct 44. Theater Engr Policy File, Constr Serv Files.

[138] (1) Hq SOS CBI, Hist of SOS China-Burma-India, 11 Jun 42–24 Oct 44, app. 1, p. 37; sec. II. OCMH Files. (2) Ltr, Covell to Somervell, 10 Dec 44. Somervell Routine Corresp File, Constr Serv Files.

[139] (1) Plng Div ASF, The Ledo Road, app. C. (2) Hist of the 209th, 236th, 330th, 1304th, 1880th, 1883d, and 1905th Engrs. (3) Hq SOS CBI, Hist of SOS CBI, I, 454.

This bridge was apparently the third longest ponton structure built by U.S. Army Engineers up to this time.[140]

After the engineers had completed the first 4-inch pipeline to Myitkyina on 27 September, emphasis turned to running the line through to Kunming. Parties worked toward each other from these two points. On 26 October Colonel Morse established an advanced headquarters at Yunnanyi and assigned to it the 779th, 780th, and 1381st Petroleum Distribution Companies; a fourth unit, the 1382d, arrived in December. Pipe was flown in from Assam. Lt. Col. Frank H. Newnam, Jr., SOS engineer in the China Theater, making an inspection on 27 November, was favorably impressed with the work of the "well-equipped, well-manned, and efficient" units. Meanwhile, two petroleum distribution companies, the 709th and the 775th, were laying pipe out of Myitkyina. The two groups were expected to meet in 1945. Three other companies were operating the lines from Tinsukia to Myitkyina. On 19 November the second 4-inch line was complete to Myitkyina, eleven days ahead of schedule.[141]

Work continued in eastern Bengal and Assam on the second 6-inch line. Taking advantage of the proximity of the pipeline's right-of-way to the railroad from Chittagong northward, Colonel Kinsolving made up work trains for his men. Each train, with cars for troops, equipment, and supplies, moved forward as needed from siding to siding. From the outset his work was hampered because much of the salvaged British pipe made available under reverse lend-lease had been seriously damaged in transit from the Middle East. As was the case with the first 6-inch line, Kinsolving had to change specifications while construction was in progress. Despairing of getting enough new standardweight pipe from the United States in time to complete the project on 1 April 1945, he decided in late December to convert the northernmost 150 miles to invasion-weight, which would mean a reduction in the line's capacity from 13,000 to 10,000 barrels a day. For the northern reaches of the line he used some of the pipe intended for the 6-inch line across Burma. At times, Kinsolving had difficulty in getting cargo space on British vessels operating between Calcutta and Chittagong, and the scarcity of workmen was a problem at first. One obstacle appeared well out of the way by Christmas; the Indian Navy had by then agreed to install the offshore mooring at Chittagong's harbor, and the Burmah Oil Company had agreed to connect this mooring to its tank farm with two underwater unloading lines.[142]

[140] It was exceeded in length by the bridge laid by Lt. Gen. Ulysses S. Grant's engineers across the James River in June 1864 and by the demonstration bridge put across the Rhine by Third Army engineers in 1919. See James A. Huston, "Grant's Crossing of the James," *The Military Engineer*, XLV (January-February, 1953), 18–22, and the *R.O.T.C. Manual, Engineers* (Harrisburg, Pa., 1941), vol. III, pp. 347–48.

[141] (1) Hq Constr Serv Progress Rpts, Pipelines, 6 Nov and 9 Dec 44, 28 Jan 45. (2) Plng Div ASF, The Ledo Road, app. E. (3) Ltrs, Covell to Somervell, 18 Oct, 20 Nov 44. Admin File, Constr Serv Files. (4) Hist of the 706th, 709th, 776th, 779th, 780th, 1381st, and 1382d Engrs. (5) Memo, Newnam for Maj Gen Gilbert X. Cheves, 25 Nov 44. GED File, CTSOSEF.

[142] (1) Hq Constr Serv Progress Rpts, Pipelines, 6 Nov, 6 Dec 44, 9 Jan 45, 6 Feb 45. (2) Ltr, Welling to Farrell, 27 Dec 44. Specs File, Constr Serv Files. (3) Ltr, Kinsolving to Mgr Burmah Oil Co, 26 May 45. Opns Br File, Constr Serv Files.

Colonel Asensio pushed work on the airfields around Myitkyina. Additional engineer troops and equipment came in by air from India during November. Between July and November the Tenth Air Force had flown in 149 2½-ton trucks, 66 tractors, 32 scrapers, 30 motorized graders, 27 rollers, 9 power shovels, 4 cranes, and great quantities of lesser equipment. Impressed by the ingenuity of Asensio's subordinates in preparing so much heavy machinery for air transportation, General Stratemeyer declared on 5 October that it was impossible to "give too much publicity" to this significant operation. The opening of the Ledo Road's cutoff near Mogaung made it possible to bring into Myitkyina the aviation engineers' 12-yard Tournapulls, D–8 tractors, and 4-ton trucks during November. Asensio's work was now in high gear. He strove not only to meet the operational target dates for all fields but also to bring them to all-weather standards before the next monsoon.[143]

With regard to the Teng-chung Road, the Chinese displayed their usual mixture of enthusiasm and procrastination. The Central Government held back the first allotment of funds until mid-November; Mr. Kung, director of the Highway Administration, then made a concerted effort to organize his laborers and to get hand tools. Work began in earnest in the latter part of the month, but prospects for rapid construction were not encouraging. Governor Lung delayed a full month before conscripting labor in large numbers. Parties working eastward from Myitkyina were showing encouraging progress. They were comparatively well supplied with machinery. Pick's depots had sent them 4 D–7 bulldozers, 4 motor graders, 4 air compressors, and 4 trucks; during the latter part of November, the Air Transport Command flew in additional machinery. Still, by early December it was obvious that the target-date for completion of a one-lane, surfaced road would have to be moved back from 15 January.[144]

Work was going ahead on the Ledo Road, although Japanese forces were still astride the route in eastern Burma. Until mid-December work east of the Irrawaddy was designed primarily to maintain a supply line for the troops besieging Bhamo. Thereafter, the 1875th Aviation Battalion moved across the river to begin in earnest the construction of a military highway. While Company C built a 14-mile, all-weather link eastward from the Irrawaddy crossing to the dry-weather track to Bhamo, the major part of the battalion undertook regrading, widening, and surfacing of the track south of its projected junction with the Ledo Road. The 209th Combat Battalion worked on fixed bridges; the 71st Light Ponton Company erected and maintained ponton bridges

[143] (1) Asensio to Godfrey, n.d., Rpt of Movement by Air of Heavy Engr Equip. Air Univ Lib, Maxwell AFB. (2) Engr Sec Tenth AF, Burma Diary, *passim*. (3) Hist of the 1891st Engrs.

[144] (1) Memo, Seedlock for CO Adv Sec 1 SOS CBI, 16 Sep 44. Engr Br Files, Constr Serv Files. (2) Rad, Maj Gen Thomas G. Hearn, CofS CBI, to Covell, 5 Oct 44. Engr Br File, Constr Serv Files. (3) Memo for Rcd, C Engr SOS China Theater, 25 Nov 44. GED, CTSOSEF. (4) Rad, Cheves to Hq USF 1 BT 19 Dec 44. Engr Br File, Constr Serv Files.

over the many streams. By January the 236th Combat Battalion, working closely behind the advancing Chinese infantry, was improving the 72-mile blacktop road from Bhamo to its junction with the Burma Road at Mong Yu. The work consisted mostly of widening the road, putting in culverts, and repairing the bridges.[145]

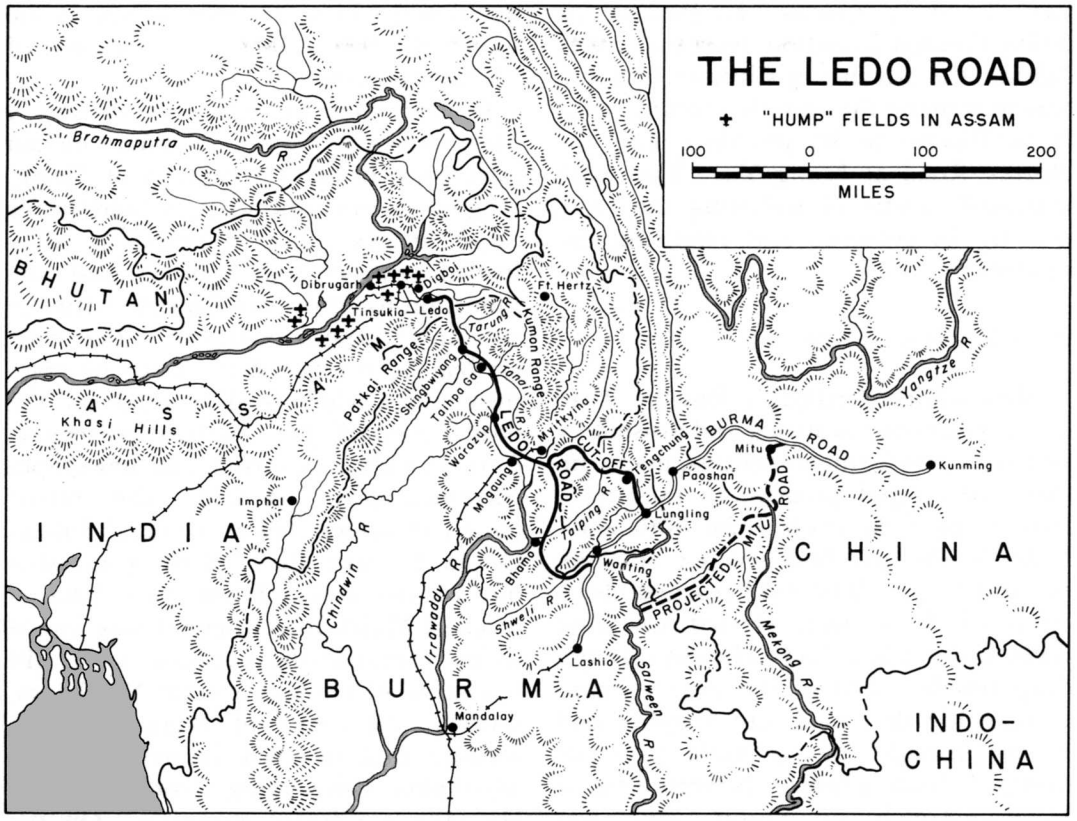
Two Roads to China

Meanwhile, Seedlock's Burma Road engineers, now 500 strong and assisted by nearly 12,000 Chinese laborers, made unexpectedly rapid progress in pushing a road along their route from both ends. Initially the job had seemed an "impossible" one. The road reached elevations of 8,500 feet, skirted towering cliffs, and in places had to be cut through deep jungle; parts of the area were so inaccessible that food and supplies had to be brought in by mule pack or dropped from planes. Nevertheless, a 100-mile-stretch of virgin trail was pushed through in 60 days. In the belief that the road to Teng-chung would soon be open, China Theater on 6 January approved the departure from Myitkyina of a "convoy" consisting of two trucks and an 11-ton wrecker; in command was 1st Lt. Hugh A. Pock. On 20 January Seedlock's engineers met in the mountainous frontier region. (*Map 22*) A one-lane, unsurfaced track was open from Myitkyina to China. Pock's convoy continued on to Kunming and reached the city on the evening of 22 January. The Southeast Asia Command and China Theater flashed to the world the news that the blockade of China was broken.[146]

General Pick had his own plans for a "first convoy." Early in January he had assembled at Ledo a caravan of "jeeps, weapon carriers, ambulances, [and] heavy cargo trucks"—113 vehicles in all—loaded with enough artillery and ammunition to equip two Chinese batteries and one weapons company. The drivers had been selected from all the engineer units which had worked on the road. Among the civilian passengers were 65 radio, magazine, and newspaper correspondents. At Ledo, the convoy passed in review before General Sultan. On 12 January, Pick led the procession out of the city. Three days later it reached Myitkyina, where it was forced to halt because the Japanese were still in control of the area around Namhkam, seventy miles east of Bhamo. While waiting, Pick received the news that the Myitkyina–Teng-chung Road was open. He gave it a frosty reception. On the 23d the convoy resumed its forward movement. When it reached Namhkam three days later, it had to halt again because of the fighting near Mong Yu. The next day, the Chinese drove the Japanese from the city. Company B of the 236th Combat Battalion rushed to Mong Yu to connect the Ledo and Burma Roads; at the same time, the 71st Light Ponton Company hastily put a 450-foot ponton bridge across the Shweli at

[145] Hist of the 71st, 209th, and 236th Engrs.

[146] (1) 1st Ind, Seedlock to Offs and Men of the Burma Road Engrs, 28 Jan 45, on Ltr, Cheves, CG SOS China Theater, 23 Jan 45. CTO 611 BRE. (2) Ltr, Seedlock to Covell, 14 Mar 45. Covell Ltr File, Constr Serv Files. (3) Romanus and Sunderland, *Time Runs Out in CBI*, p. 140.



MAP 22

Wanting on the Chinese border. On the 28th Pick's convoy left Namhkam and soon covered the 40 miles to Wanting, where T. V. Soong, the Chinese Minister of Foreign Affairs, welcomed the Americans in a brief ceremony. On 4 February the caravan reached Kunming. A series of celebrations culminated in a banquet given by Governor Lung in Pick's honor. Pick sent a congratulatory message to his command, in which he described the Ledo Road as a "major contribution to the war effort" and expressed to his troops his "sincere appreciation" and "pride" in their achievement.[147]

Overland communications with China had been restored, but much still remained to be done. For the engineers, months of hard work lay ahead to bring the Ledo Road to all-weather standards, improve the Burma Road, and extend

[147] (1) Hq Constr Serv, Status Rpt, Ledo Road, 6 Feb 45. Admin File, Constr Serv Files. (2) Ltr, Pick to Covell, 16 Feb 45. Covell Corresp File, Constr Serv Files. (3) Hist of the 330 Engr GS Regt. (4) Hq Adv Sec 3 SOS India-Burma Theater, Daily Bull No. 29, 29 Jan 45. Engr Sec File, LAC Files.

the 4-inch pipeline to Kunming. Now that the major engineer missions in Asia were certain of fulfillment, a policy of retrenchment, particularly in the India-Burma Theater, was well under way. Some units were transferred to China. The organization in India-Burma was reduced, and a number of officers returned to the United States. General O'Connor and General Farrell left in December; in January, Col. Alvin C. Welling was given the triple responsibilities of Theater Engineer, SOS Engineer, and Commanding Officer, Construction Service. Work continued much as before, and all construction projects related to the supply of China remained in full force. Additional troops and equipment arrived at Calcutta to insure the earliest possible completion of the line of communications across India and Burma. Nevertheless, the favorable progress of the war against Japan in other theaters meant a decline in the importance of CBI.[148]

[148] *Time Runs Out in CBI*, chs. I, IV. For a brief resumé of engineer activities in China, Burma, and India in 1945 to the end of the war, see below, pp. 662–66.

CHAPTER XII

The Drive Across the Central Pacific

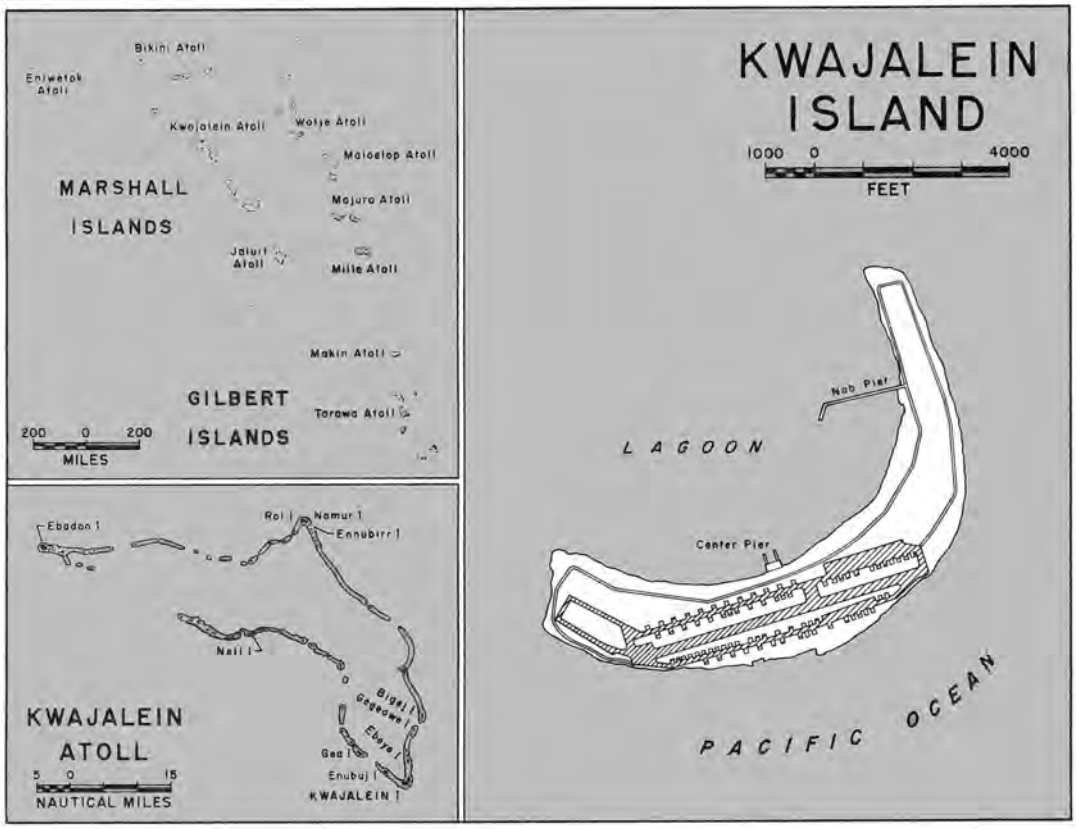
Having seized the Gilberts, American forces were in a position to continue the major drive across the Pacific. Four thousand miles still separated them from Tokyo. There was but one way to reach the goal—seize enemy-held islands and build airfields and bases on them to provide support for the next assault farther west. But building airfields and bases would be a major construction job, especially when the work had to be done on isolated islands, 1,000 miles from the nearest supply base. A strategy that looked almost hopeless at the time of Pearl Harbor now held great promise of success. Many seemingly insurmountable problems in amphibious warfare of the type required in the Central Pacific had been solved. Naval transports and landing craft, particularly LST's, LCM's, and Dukws, made possible the rapid loading and unloading of troops, supplies, and heavy construction equipment on distant islands where no docks or wharves existed. To expedite landings in shallow water, floating steel ponton cubes that could be bolted together to form piers of various lengths and widths, were developed. Equipment for distilling sea water, lacking before the war, and without which the maintenance of bases on waterless coral islands would have been impossible, was now available. Engineer construction had been simplified. Crossed runways and huge parking aprons were a thing of the past. Plentiful supplies of coral and landing mat made possible the expeditious construction of landing strips. Safety factors were kept to the minimum. The use of prefabricated buildings was widespread. Engineering had been adapted to amphibious warfare.[1]

The Marshalls

Plans and Preparations

The first objective in 1944 was the Marshall Islands. Two thousand five hundred miles southwest of Honolulu and 500 miles northwest of the Gilberts, the Marshalls consisted of more than thirty atolls. (*Map 23*) According to information available at the time, Kwajalein Island, in the atoll of the same name, was well suited for airfield construction. A crescent-shaped coral island, it was 3 miles long and a mile wide. To the north, in the same atoll, were two islets, Roi and adjacent Namur, large enough for a base and an airfield. The Japanese had been active in the atoll. They had built an airstrip, a pier,

[1] Col. George E. White, Jr., "From Pearl Harbor to Tokyo," *The Military Engineer*, XXXVIII (January, 1946), 1–8.



MAP 23

and warehouses on Kwajalein and had constructed an airfield on Roi and a pier and warehouses on Namur. On 20 July 1943 the Joint Chiefs directed Nimitz to begin planning for an assault on the Marshalls to be made the following January. On 1 September they set the date for the initial attack as 1 January; this was postponed in October to 31 January. Kwajalein was to be taken first. Thereafter, Majuro, in the southeastern part of the Marshalls, and Eniwetok, in the northwestern part of the archipelago, were to be captured. The attack on Kwajalein atoll would be a joint Navy-Army affair. The Army component, made up of elements of the 7th Infantry Division under Maj. Gen. Charles H. Corlett, was to seize Kwajalein Island. The 4th Marine Division would take Roi and Namur.[2]

Extensive engineer planning was necessary for operations in the Marshalls. Most of it was required for Kwajalein

[2] (1) Crowl and Love, *Seizure of the Gilberts and Marshalls*, pp. 166ff. (2) Lt Gen Robert C. Richardson, Jr., Rpt, Participation in the Marshall Islands Opns by USAFICPA, Jan–Feb 44 (cited hereafter as USAFICPA, Marshall Islands Opn), p. 27. 98–USF3–0.3 (23498). (3) *Building the Navy's Bases*, II, 322.

Island. Three combat units were assigned to the assault phase and their functions clearly defined. The 13th Engineer Combat Battalion, under Lt. Col. Harold K. Howell, as the divisional engineer unit, would go in with the 7th Division. Each of the battalion's three lettered companies was attached to a regimental combat team; in turn, each platoon was attached to a battalion landing team. Engineers and infantry of the battalion landing teams were trained to work together in special assault groups. Each engineer platoon was broken down into three provisional squads, each of which, including specially attached personnel from platoon headquarters, had about fifteen men. A squad supported a reinforced rifle company. Equipped with explosives, flame throwers, and hand tools, the engineers were to give close support to the infantry in the reduction of enemy strongpoints; since this would probably be their only function, they were to bring in no machinery except bulldozers during the first days. The 50th Engineer Combat Battalion, under Lt. Col. Leonard L. Kingsbury, if not needed in combat, was to turn at once to shore party work. In reserve was Company B, less one platoon, of the 102d Combat Battalion of the 27th Division, which was to be ready for either combat or shore party work.[3]

To garrison the island, the same type of organization was set up as had been employed on Makin. Two Army defense battalions were organized—the 3d and the 4th. Company D of the 34th Combat Regiment was assigned to the former; the 1st Battalion of the 47th General Service Regiment, the 854th Aviation Battalion, and a provisional engineer headquarters, to the latter. If necessary, elements of the garrison force engineers were to go in with the assault troops and help the 50th engineers with shore party work.[4]

The troops spent considerable time in training. Combat engineers received training in assault landings and coordination with the infantry. The men assigned to the garrison force got instruction in removing mines, operating equipment, installing refrigeration, using water distillation units, and fighting fires. Much attention was given to planning for the air base on Kwajalein. The engineers of Headquarters, Seventh Air Force, and in General Kramer's office prepared most of the layouts. Those of the air engineers called for facilities for four medium bomber squadrons and their servicing units. Final plans were based on standard drawings modified to fit the conditions expected. The commanding officer of the 4th Defense Battalion spent much time and effort in helping to put plans for base construction in final shape. Engineer supply required a great deal of effort. Kramer's staff prepared detailed lists of materials which were then reviewed by unit engineers and the base commander's staff. Three shipping priorities were set up. The first included 221 prefabricated portable buildings, mostly kitchens and

[3] (1) USAFICPA, Marshall Islands Opn, pp. 85ff. (2) Maj C. N. Shaffer, Rpt on the Kwajalein Opn (cited hereafter as Shaffer Rpt). EHD Files. (3) Ltr, Kramer to Reybold, 13 Apr 44. 98-USF3-20.0 (2590)M. (4) Memo for Rcd, Col Wayne C. Zimmerman, 17th Inf, n.d., sub: The Infantry-Engineer Team. (2687) 9-1.2405/44.

[4] USAFICPA, Marshall Islands Opn, pp. 87-88.

mess halls, to be shipped with the assault forces. The second and third included, for the most part, materials for building warehouses, shops, and hangars.[5]

The Assault on Kwajalein

During the last week of January a task force of more than sixty vessels was on its way to the Marshalls. An engineer observer, Maj. C. N. Shaffer, aboard one of the transports loaded principally with engineers, infantrymen, and tankers, reported that "the trip . . . was uneventful, the morale of the men was noticeably high, and their spirit on the evening prior to D-Day . . . was at a peak." Dawn of the 31st found the armada six to ten miles west of its objective. The four islets to the northwest of Kwajalein were attacked first, and, by midday, the two outermost ones were secured. Few Japanese were found on them. At the same time the two islands nearest Kwajalein were under assault. The first waves of infantry and elements of the 13th engineers, expert with rocket grenades, explosives, flame throwers, and wire cutters, had come ashore soon after 0900. Major Shaffer, landing on one of the islands shortly before noon, found the assault had met with no resistance. The fifty or so enemy soldiers had been evacuated the night before. The first waves of landing craft had crossed the coral reefs without mishap, but several of the later waves had a hard time. By early afternoon a number of boats were stuck and were forced to unload supplies and equipment some sixty yards short of the beach. It was especially difficult to get jeeps, trucks, and trailers to shore. Bulldozer operators helped pull the vehicles to the beach and then went to work to clear positions for the artillery. By 1600 the job was finished, and soon thereafter the 105's had completed their registration fires.[6]

Soon after 0800 the next day, the landing craft lined up in waves for the assault on Kwajalein. Infantry and engineers clambered down the ships' nets to their boats and, protected by a powerful naval bombardment, sped toward the beaches in orderly formations. There was little enemy fire aside from a few antiaircraft shells. At 0930 the first troops came ashore. The preliminary bombardment had been effective. Fortifications near the water's edge had been pounded into rubble; a seawall under construction had been smashed. The plan of attack called for two regimental combat teams to land abreast and move up the length of the island. Protected by a heavy naval and air bombardment, the landing teams advanced inland for 150 yards before meeting resistance. Then, amidst piles of rubble, they came upon a few small pillboxes, which the infantry-engineer teams, in their first test on such installations, easily eliminated.[7]

Soon after the first elements had landed, the first shore party engineers came in with Col. Brendan A. Burns, the

[5] (1) USAFICPA, Marshall Islands Opn, pp. 85, 93. (2) Ltr, Kramer to Reybold, 13 Apr 44.

[6] (1) Crowl and Love, *Seizure of the Gilberts and Marshalls*, p. 223. (2) Shaffer Rpt.

[7] (1) Crowl and Love, *Seizure of the Gilberts and Marshalls*, pp. 235ff. (2) Samuel Eliot Morison, "History of United States Naval Operations," vol. VII, *Aleutians, Gilberts, and Marshalls* (Boston, 1957), pp. 257ff. (3) S. L. A. Marshall, *Island Victory* (Washington, 1945), pp. 48ff. (4) Shaffer Rpt.

shore party commander. Organizing two beaches for receiving supplies on the island's western shore, the men collected supplies brought in by LVT's and Dukws and put them in a dump about 50 yards inland. Meanwhile, the combat engineers had fewer problems than expected, and some of them joined the shore party engineers. With their bulldozers they smoothed the rough ground from the beach to the western section of the highway skirting the island and repaired part of the highway. When darkness fell, the front lines crossed the island at a point more than one-fourth of the distance from the landing beaches to the northeastern tip. The next morning the advance continued past great mounds of rubble. Again, enemy resistance was slight. The infantry-engineer assault teams knocked out some pillboxes; the wrecked airfield was captured. By nightfall of the second day half of the island was in American hands.[8]

On the morning of the third day the troops, expecting to capture all of Kwajalein by nightfall, prepared to advance against the enemy holed up in the mile-long tip of the island. Japanese prisoners and natives warned that enemy defenses were strong. As the men advanced, they found them far stronger than had been anticipated. Amidst rubble and mounds of twisted wreckage were numerous defensive installations, many of them largely intact. Most common were air-raid shelters that had been converted into pillboxes; a considerable number were built of concrete, heavily reinforced with steel; some were constructed of coconut logs and sand. Nearly all of the latter were near the shore. Some of the shelters were occupied by as many as 75 men. Next in order of frequency were the pillboxes. Usually of concrete and hexagonal in shape, they had walls from one to one-and-one-half feet thick, but only a few had enough vents to permit all-around firing. In addition, there were circular cisterns, about seven feet high, apparently so constructed that, if necessary, they could be used as pillboxes, but their concrete walls were thin. The enemy troops in all these defenses were ready to resist to the death.[9]

The engineer-infantry teams were now put fully to the test. While the infantrymen shot at the apertures of the enemy strongpoints, the engineers ran forward with flame throwers, explosives, and bangalore torpedoes, then crawled to within inches of the structures, which they would prepare for destruction. The best procedure was to put a charge through an opening and let concussion do the rest. If a charge could be exploded in a pillbox, probably all the occupants would be killed. Flame throwers were effective if the men could get close enough to put one burst inside. Bangalore torpedoes, used rather infrequently, were poked through machine gun slits or pushed down ventilator pipes of the larger structures. The infantry-engineer teams had the support of tanks in the destruction of the more massive defense works. The tanks preceded the troops by about 150 feet, firing their

[8] Crowl and Love, *Seizure of the Gilberts and Marshalls*, pp. 253ff.

[9] (1) Crowl and Love, *Seizure of the Gilberts and Marshalls*, pp. 262ff. (2) Marshall, *Island Victory*, pp. 77ff. (3) Shaffer Rpt.



A JAPANESE PILLBOX, KWAJALEIN

75-mm. guns point-blank at the installation under attack, thus enabling the engineers and infantry to close in on it.

Though barbed-wire entanglements were rare, the infantry-engineer teams had been trained to deal with them also. If the advancing troops were held up by small arms fire aimed at the barbed wire from a pillbox, the infantry "buttoned up" the pillbox while the engineers ran or crawled to the wire, placed bangalore torpedoes, and withdrew. The ensuing explosion, with its noise and smoke, was the signal for the infantry to rush through the opening in the obstacle. Once safely past, the infantry again placed fire on the pillbox while the engineers moved forward with satchel charges and flame throwers. In some cases, the occupants of an installation, only stunned, would come to hours later and reman their guns. Infiltrators would reoccupy some of the pillboxes that had been left intact. After the second day on Kwajalein, clean-up details were organized to reduce all fortifications to rubble.[10]

The engineer shore parties were carry-

[10] (1) Shaffer Rpt. (2) Ltr, Kramer to Reybold, 13 Apr 44. (3) Engr an. to G-3, USAFICPA, Rpt on Kwajalein Opn. 307-20 (3492). (4) Memo for Rcd, Zimmerman, The Infantry-Engineer Team.

ing on equally important if less dramatic work. As his staff, Colonel Burns had a provisional group headquarters of sixty-two officers and men. Under his command were the 50th Battalion, one battalion of the 47th General Service Regiment, and one company of the 34th Combat Regiment. Each company supported one battalion landing team. At the two original beaches on the western and southern shores of the island, reefs interfered considerably with unloading. Engineers making a reconnaissance of the lagoon side of the island discovered an excellent place for bringing in supplies, and by noon of the second day all shore party activities had been diverted to it. Rather slow at first, unloading speeded up on the third day, when cranes, trucks, and bulldozers were brought in. The shore parties were soon handling supplies faster than landing craft could transport them. About 300 yards inland, the engineers set up supply dumps and cut roads to them from the unloading sites. They constructed eight causeways in the lagoon to unload the heavier supplies and equipment. Enemy interference was slight. After the third day work went on without interruption even at night on the brightly lighted beaches.[11]

By the morning of 4 February more than three-fourths of Kwajalein was in American hands. The enemy, bottled up in a litter-strewn area 1,000 yards long and 400 yards wide, was in a hopeless position. But this part of the island abounded with defenses—shelters, pillboxes, machine gun emplacements, earth and log bunkers, and barricades against tanks—all of them still formidable even though they had been heavily pounded by naval guns, artillery, and aerial bombardment. Enemy resistance was tenacious; the fighting, savage. To the troops the action seemed "indescribably chaotic; it was like trying to fight your way across the landscape of a nightmare." [12] Nevertheless, the advance continued. At four in the afternoon General Corlett radioed Rear Adm. Richmond K. Turner, commander of the Joint Expeditionary Force: "All organized resistance . . . has ceased." [13]

Majuro

The assault on Majuro, in the southeastern Marshalls, made on 31 January, began with the disembarkment on the atoll of a battalion landing team of the 106th RCT, 27th Division. Two engineer units went in with the assault forces—the 2d platoon of Company B of the 102d Combat Battalion to support the infantry, and Company B of the 104th Combat Battalion to do shore party work. The BLT commander with a special staff, including the commander of Company B of the 104th engineers, went ashore on the major island of the atoll for a reconnaissance. The party found large quantities of construction supplies and explosives, including many 5-inch and 8-inch naval shells. There were no booby traps or mines. Japanese installations were

[11] (1) Shaffer Rpt. (2) Ltr, Capt John S. Hassell, Prov Hq Engr Combat Group, to Kramer, 21 Feb 44. Engr AGF PAC.

[12] Marshall, *Island Victory*, p. 93.

[13] Crowl and Love, *Seizure of the Gilberts and Marshalls*, p. 289.

fairly extensive, but only one enemy soldier was found. The engineers destroyed the unexploded naval shells, began clearing away the wreckage, and prepared to rehabilitate the facilities of the island.[14]

Eniwetok

Some 325 miles northwest of Kwajalein, Eniwetok atoll consisted of about thirty islets arranged in an almost perfect ring, twenty miles in diameter. Plans called for an assault by Army and Marine units on three of the islets, Eniwetok and Parry in the south and Engebi in the north, and the subsequent construction of a naval base. After the unexpectedly rapid capture of Kwajalein, Admiral Nimitz decided to move up the assault on Eniwetok, originally scheduled for about 1 May. Begun on 3 February, preparations for the stepped-up attack were completed twelve days later and the assault force set out for its destination; exact planning in this short time had not been possible.[15]

The marines came ashore on Engebi on 17 February. Two days later the 106th Regimental Combat Team, less a battalion landing team, arrived off Eniwetok. Company B, less one platoon, of the 102d Combat Battalion, provided combat support, and the 104th Combat Battalion, less one company, served as shore party. The 102d engineers, most of them organized in squads of sixteen men, had been teamed with infantry platoons as on Kwajalein and equipped with flame throwers and demolitions. Progress was slow against such enemy pillboxes and fortifications as remained after the bombardment. Eniwetok was one of the highest islands in the Marshalls. Because underground defenses were deep and "well-recessed," few of them had been detected on aerial photographs. Infantry-engineer teams again destroyed pillboxes, emplacements, and dugouts with demolitions and flame throwers. Operations on Parry Island, to the northeast of Eniwetok, were similar. Parry was cleared in one day.[16]

Shore party work was carried on as on Kwajalein. The 104th Battalion went in early on Eniwetok. Company C, the first unit to hit the beach, came ashore six minutes after the initial wave of infantry landed; it was quickly evident that the engineers had arrived too soon. Since the Japanese were putting up unexpected resistance in back of the beaches, congestion of troops and supplies at the landing points was marked. Only after more than two hours had passed was any cargo brought in for the shore party to handle. The engineers cut ramps through the high banks in back of the beaches so that tanks and trucks could move inland more easily. They set up water points, collected discarded equipment, and buried enemy dead. On Parry Island, Company C of the 104th performed similar duties.[17]

[14] (1) 104th Engr Combat Bn, Jnl, 5 Jan–14 Nov 44. ENBN 104–0.7. (2) Memo for Rcd, Capt Raymond W. Beggs, CO Co B 104th Engr Combat Bn, sub: Opn: SUNDANCE, 31 Jan–28 Feb 44. Engr AGF PAC. (3) *Building the Navy's Bases*, II, 318ff.

[15] Crowl and Love, *Seizure of the Gilberts and Marshalls*, pp. 333ff.

[16] Hist of the 102d Engr Combat Bn. (2) 104th Engr Combat Bn, Jnl, 5 Jan–14 Nov 44.

[17] Ltr, Lt Col John R. Sharp, CO 104th Engr Com-

Base Construction—Kwajalein, Eniwetok, Majuro

With the end of organized resistance on Kwajalein, the commander of the garrison force took over and directed that work on the airfield and base facilities begin. The most important job—the building of the airfield—was the mission of the 854th Aviation Battalion. The unit had arrived off the island on 30 January. Two days later Lt. Col. Herbert E. Brown, Jr., the commanding officer, with members of his staff and four survey crews, came ashore to make initial surveys for the runway. The best site they could find was the one the Japanese had selected for their field. The runway was a heap of rubble, littered with live shells and grenades. "We experienced some close calls from sniper fire and random shots from the direction of the battle, but suffered no casualties," wrote Colonel Brown, "and surveying proceeded with little interruption." When the first equipment operators came ashore with their bulldozers on 2 February they headed straight for the airfield, cleared away debris, and filled in bomb craters. Most of the battalion did not come ashore till 6 February. The next day around-the-clock operations began. The strip was to be coral surfaced not only because the Air Forces preferred this to steel plank, but also because coral was plentiful. The main problem was to locate satisfactory deposits. The aviation engineers found coarse coral and sand in the center of the island, which they scooped out with a dragline. A more difficult job was locating satisfactory material for surfacing. After days of reconnoitering, the men found a satisfactory layer about one foot thick, some five feet underground. Carryalls placed it on the runways. To determine the bearing qualities of the material, a strip seventy-five feet long was constructed with two layers of well-compacted coral rock, topped with a lighter surface layer. The engineers tested the strip with a 20-ton crane loaded with steel mat, the closest approximation to a B–24 that could be obtained with the material and equipment on hand. Even after the crane had passed 150 times over the compacted strip, the latter showed no visible deflection. The adjoining subgrade showed a deflection of three-fourths of an inch for the same number of trips. On 12 February a Navy plane landed on the runway and took off without difficulty. By 17 February, a 5,000-foot strip had been cleared, graded, and surfaced sufficiently to be suitable for all types of aircraft then in the Central Pacific. On the 21st, heavy bomber squadrons began carrying out regular tactical missions from Kwajalein. During their first month on the island, the aviation engineers built seventy-six acres of runways, taxiways, aprons, and hardstands.[18]

Although Eniwetok atoll was to be primarily a naval base, Army engineer units helped build it. The engineers did most of their work on Engebi. The 3d

bat Bn, to Kramer, 6 May 44. Engr AGF PAC, 319.1.

[18] (1) Hist of the 854th Engr Avn Bn, 1 Oct 43–31 Mar 44. (2) Ltr, Brown to Col George Mayo, Air Engr Hq AAF, 16 May 44, in Rpt of Opns of 854th Engr Avn Bn, Kwajalein. Engr 854-HI, 1944-45. Air Univ Lib Maxwell AFB.

Defense Battalion, the garrison force for the island, included the 1st Battalion of the 47th Engineers, numbering about 1,800 men. They were to start work on the airfield and continue with the job until relieved by a naval construction battalion. The Japanese airstrip, with a reinforced concrete runway four inches thick, was repaired, and by 25 February a 3,000-foot fighter strip was usable. Progress was not as rapid as it might have been for a number of reasons. The engineers had to remove a large number of unexploded bombs because ordnance personnel was lacking. There was also a serious shortage of supplies, partly because of a difference of opinion over who should supply the island—one of the consequences of the speed-up in operations.

After a naval construction battalion reached Eniwetok, some of the 102d and 104th engineers remained to help construct the naval base. They were at first used in an inefficient manner. Their main jobs were to straighten out supply dumps for the infantry and bury enemy dead. The engineers pointed out to the naval commander that little work was being done on the naval base and that they could help in base construction with their heavy equipment. The atoll commander agreed, and the combat engineers set out to help the Seabees. Early in March they began an extensive construction program on an around-the-clock basis with 12-hour shifts, erecting Quonset huts, clearing areas for runways, taxiways, and roads, blasting coral for surfacing, and building revetments. The naval commander gave the engineers tentage and lumber to enable them to build a semipermanent camp for themselves, including screened mess halls, kitchens, latrines, and a floor for each tent.[19]

On Majuro, meanwhile, the engineers continued to be busy. They helped the infantry unload supplies, cleared and repaired a road running from the north to the south of the island, and, within a few days, had established supply dumps, waterpoints, and camps. They then aided the Seabees in building a minor base. They remodeled and repaired a Japanese pier, resurfaced roads with coral and sand, built causeways between a number of islands, and helped in the construction of the airfield. The Army engineers left Majuro at the end of February for Oahu; the base was henceforth operated by the Navy.[20]

Kwajalein Island remained the scene of greatest activity. On the lagoon side near the northeast end of the island, the engineers rebuilt Nob Pier, 1,600 feet long, where five LST's and numerous smaller craft could unload at one time. They also rebuilt a small pier, 250 feet long, near the center of the island on the lagoon side. By June 1944 they had provided storage for 800,000 barrels of gasoline, extensive camps, numerous administrative buildings, and hospitals. A network of coral-surfaced roads crisscrossed the island.

Construction was not carried on without some difficulties. Engineer plan-

[19] (1) Memo, Kramer for Richardson, 16 Mar 44. Engr AGF PAC. (2) Memo, Kramer to DC/S-R, 20 Apr 44. Engr AGF PAC. (3) *Building the Navy's Bases*, II, 324ff.

[20] (1) Memo for Rcd, Beggs, CO Co B 104th Engr Combat Bn, sub: Opn: SUNDANCE, 31 Jan–28 Feb 1944. Engr AGF PAC. (2) *Building the Navy's Bases*, II, 318ff.

ning had been incomplete, and changes made in plans by higher headquarters after construction began complicated the construction effort. It had not been anticipated that so many tons of rubble would have to be cleared away before work could begin. Engineer supplies were not received rapidly enough, and unloading was not always in accordance with priorities that had been established. The Air Forces insisted on having tons of its supplies moved across the beaches before badly needed engineer construction equipment was brought in, even though the air supplies could not be used until the airfield was operational.[21]

Logistical Support From Hawaii

Organization

In Hawaii, during the first months of 1944, the dual engineer organization of department and district under General Kramer continued to provide support for the combat zones of the Central Pacific Area. Colonel Wimer continued to be in charge of the district office; Colonel Brown, of the department office. Colonel Brown's staff was principally engaged in planning; the district office supervised construction in Hawaii and furnished supplies. The building program, while tapering off, was still considerable. Some of the work was now being done under lump-sum contracts; by 1 July there were fourteen such contracts in effect. Engineer troop units, responsible to General Kramer, were being used more and more to replace civilian labor.[22]

Construction

In the first months of 1944 quite extensive work was still required on airfields because of the anticipated expansion of the Air Forces in the Central Pacific. In February the airmen proposed far-reaching improvements to fields on Oahu and the outlying islands. Some required more housing; most needed additional parking aprons. Much construction was required aside from that for the Air Forces. Still extensive was the need for warehousing and refrigerated storage space. During April the engineers provided 491,360 square feet of the former and 46,800 cubic feet of the latter. By the end of that month the demands for cold storage space were met for the time being, but the engineers were scheduled to provide an additional 954,968 square feet of warehousing during the next three months. Because of the steadily increasing quantities of cargo arriving at Honolulu, more piers were needed at Kapalama Basin, and construction of the piers at the basin continued. More hospitals were urgently needed. Three of the largest schools in Honolulu were still being used as hospitals, two of them as units of Tripler General, the largest Army hospital in the islands, which was filled to overflowing. Tripler itself, because of its age and design, was no longer satisfactory. The engineers had begun preliminary surveys for a new structure in 1943, and Kramer was now convinced that the time had come to begin long-range planning for a new Tripler Hospital and for other hospitals as well. The War Department did not approve the construction of new hospitals, but directed that planning could

[21] USAFICPA, Marshall Islands Opn, pp. 97–98.
[22] Rpt of Kramer Conf, 4 Mar 44. Engr AGF PAC.

begin. A continuing problem was the deterioration of the roads in the islands, particularly at Oahu. Conferences were held, but, as before, little or nothing was done to improve the roads.[23]

The Hawaiian Constructors

Negotiations between the Honolulu District and the Hawaiian Constructors to arrive at a final settlement of the contract dragged on. By late 1943 the Engineers had been able to show additional progress. In mid-October, agreement had been reached as to the completion status of the work on 31 January 1943 and the estimated cost of the projects not covered by the contract. In January 1944 substantial agreement was reached on the estimated cost of the changes made in the basic contract and the first forty-three supplemental agreements. Still a bone of bitter contention was the fee. The contractors continued to feel they were entitled to special compensation because the government had terminated the contract just when they were making strenuous efforts to fulfill their obligations. The engineers, particularly Kramer and Wimer (the contracting officer), thought their demands unreasonable. In mid-February, negotiations reached an impasse.[24] The contractors believed they were not being treated fairly and voiced their complaints to General Richardson, stating they had "not been able to obtain from the Contracting Officer a satisfactory explanation of his actions, which appear to be direct and clear violations of the original contract, the change orders and supplemental agreements approved by the War Department in Washington, D.C. . . ." The contractors went on to say that, in their opinion, ". . . the action of the Contracting Officer is so arbitrary and obviously erroneous that we must construe it as an act of bad faith motivated by bias and prejudice and intended to injure the contractor." [25] General Richardson expressed the view that ". . . it would appear that there does not obtain between the respective parties that degree of mutual confidence which is deemed essential to an early settlement of the contract." He directed Kramer to confer with the contractors' representatives and, having done so, explain why settlement of the contract was "so unduly prolonged." The contractors were permitted to tell their side of the story at the meetings held early in March. Late that month the Office of the Chief of Engineers, at General Richardson's request, sent two experts in cost-plus-a-fixed-fee contracts—Harry W. Loving, head of the Price Adjustment Branch, and Col. Clio E. Straight, chief of the Contract and Claims Branch—to Hawaii to review the Hawaiian Constructors' contract.

On their arrival in Honolulu, one of Loving and Straight's first jobs was to examine the records in the Hawaiian offices of the inspector general, the judge advocate, the Federal Bureau of Investigation, and the Military Governor. General Kramer had voiced the sus-

[23] (1) Memo, AirO Seventh Air Force, to D/C CPA, 18 Feb 44. Engr AGF PAC. (2) Interstaff Routing Slip, Richardson to CofS HD, 19 May 44. Engr AGF PAC.

[24] Ltr, Kramer to Richardson, 14 Mar 44. Engr AGF PAC 160, Contracts, vol. 1.

[25] As quoted in Ltr, Richardson to Kramer, 22 Feb 44. Engr AGF PAC, 160, Contracts, vol. 1.

picion that the contractors might have been guilty of fraud, having arrived at this view because cost estimates for many jobs, for no apparent reason, had been increased by 10 and sometimes even 20 percent. Loving and Straight immediately and thoroughly studied the possibility of fraud but found no evidence of it. On 5 April Kramer, Wimer, Loving, and Straight held a meeting. "We have come to the conclusion," Loving and Straight reported, "that the situation here is not extraordinary, not entirely unusual in that a lot of fixed fee contracts were confused [and] disagreements resulted . . . the contractor in many such cases comes to the conclusion that the contracting officer has acted in bad faith, . . . contractors many times, not having previously worked under fixed fee contracts, don't always understand their rights and there is sincere disagreements on all sides." [26] Loving and Straight spent several weeks more in their investigations. Early in April, they went to Canton and Christmas with Capt. C. D. Baker to inspect the work which had been done on those islands. Early in May, they flew to Port Moresby, New Guinea, where they talked with Sverdrup and Robinson and learned of the difficult conditions the contractors had had to contend with in Hawaii. Meanwhile, progress was made toward a settlement. In May, the Engineers and the Hawaiian Constructors reached a final agreement. The total cost of the work was set at $112,031,375. The fixed fee was $1,215,597, plus a supplementary fee of $1,060,000 resulting from termination. Purchases of equipment by the government were considered binding. The contract was exempted from renegotiation.

By this time interest in the contract of the Engineers with the Hawaiian Constructors had become nationwide. It was touched on by a number of governmental committees delving into the background of the Pearl Harbor attack. It was thoroughly reviewed by the Army Pearl Harbor Board, the principal members of which were Lt. Gen. George Grunert, then commanding general of the First Army and Eastern Defense Command; Maj. Gen. Henry D. Russell, an infantry commander; and Maj. Gen. Walter H. Frank, of the Army Air Forces. From 20 July to 20 October, members of the Army board heard testimony from civilians and officers in Washington, San Francisco, and Hawaii. Colonel Wyman, then commanding officer of Cherbourg Base Section in France, testified at Fort Shafter on 14 September and Col. Bernard L. Robinson, who had flown in from Hollandia, was heard the next day. Many others who had worked in the Honolulu District were questioned.[27]

The Army board, in its report made public after the war, did not deal gently with Wyman as Honolulu District engi-

[26] (1) Min of Mtg Held in . . . U.S. Engr Off Honolulu . . . at 1930, 5 Apr 44, p. 4. (2) Memo for Rcd, Robinson, 5 May 44. (3) Contract No. W-414-engr-602, Supplemental Agreement No. 53, 17 May 44. All in Engr AGF PAC, 160, Contracts, vol. 1.

[27] (1) Min of Mtg Held in . . . U.S. Engr Off Honolulu . . . at 1930, 5 Apr 44, p. 4. (2) Memo for Rcd, Robinson, 5 May 44. (3) Contract No. W-414-engr-602, Supplemental Agreement No. 53. 17 May 44. All in Engr AGF PAC, 160, Contracts, vol. 1. (4) *Pearl Harbor Hearings,* Testimony of Col Theodore Wyman, Jr., pts. 28-29, pp. 1735, 1742.

neer, nor with the Hawaiian Constructors. It charged Wyman with poor administration, with causing inexcusable delays in construction, and with showing favoritism toward the grossly inefficient Hawaiian Constructors. Much was made of the fact that Hans Wilhelm Rohl, president of the Rohl-Connolly Company when the original contract was signed, was a German alien and did not become an American citizen until a few weeks before Pearl Harbor.[28] Additional investigations and a judicious review of the evidence raised doubts that the charges of the board could be substantiated. Secretary Stimson stated that nothing indicated "that any conduct on the part of Colonel Wyman or of Rohl or of any of the other contractors in Hawaii contributed in any way to the Pearl Harbor disaster." It was not illegal to give a defense contract to a firm, one or more of whose officers was an alien; the law merely prohibited showing secret plans and specifications to an alien. No evidence was adduced that Rohl ever saw such plans or specifications before he became a citizen. There was no convincing proof that Wyman had shown undue favoritism to the Hawaiian Constructors or had awarded them contracts against the best interests of the United States. There was no evidence of fraud. The confusion, waste, and slowness in defense construction that existed before and after Pearl Harbor could not be blamed on one arm or service, much less on one man. Stimson conceded that Wyman was guilty of indiscretion, adding that there was "creditable evidence" that the social and personal relationship of Rohl and Wyman was quite close, and that "Colonel Wyman acted unwisely in permitting this close association to continue during the progress of the work." This, together with Wyman's undiplomatic handling of some people, unnecessarily added to his difficulties, which would undoubtedly have been only a fraction of what they were had they occurred in an inconspicuous place or at a less critical time.[29] Many in the Army considered Wyman a capable officer. In 1942 he was recommended for the Distinguished Service Medal for his services in Hawaii and subsequently he received the Legion of Merit for his services in Europe.

[28] Rpt of Army Pearl Harbor Bd, ch. V.

[29] WD, Bureau of Public Relations, Press Br, Statement of the Secretary of War Relative to Colonel Theodore Wyman, Jr., Corps of Engineers, for release Saturday a.m., 6 Oct 45. Copy in EHD Files.

Maps

Mapping units had an increasing work load in 1944. "We have been putting out a tremendous number of maps here lately . . . ," Kramer wrote in late 1943 to Col. Herbert B. Loper, head of the Military Intelligence Division of the Chief's Office. "Both the 64th Engineers and the old Department reproduction plant are sorely taxed." Still, with only small islands to be mapped, the Central Pacific did not require a great number of mapping units. Late in 1943, Kramer had asked for a GHQ topographic battalion, a type of unit which had substantial amounts of equipment and could produce and reproduce large quantities of maps. The Corps had only four such units and could spare none for the Central Pacific. Loper

suggested that Kramer take one of the Army topographic battalions instead. These units, with less equipment, some of it mobile, produced fewer maps, but they had recently been reorganized to meet more adequately the demands of modern war. Their photomapping platoons had been expanded into companies and the survey companies cut to platoons. The Office of the Chief of Engineers decided the 651st Topographic Battalion, Army, would best meet the needs of the Central Pacific. Kramer wanted the 651st to merge with the 64th Topographic Company and take the latter's number because of the 64th's fine record. The 651st arrived in Honolulu in April and was thereupon absorbed into the 64th, which was then reorganized as a battalion. The new and enlarged unit of 451 men, under the operational control of Brig. Gen. Joseph J. Twitty, chief of J–2 of the Joint Staff, went to work on maps of the Marianas and the Carolines.[30]

In February 1944 Colonel Loper suggested that the 29th Topographic Battalion, GHQ, stationed at Portland, Oregon, help make maps for the Central Pacific. He believed this unit could be of substantial aid in the preparation of some of the badly needed large-scale maps of the Marianas and Carolines. The Navy would supply the photographs. Kramer thought Loper's suggestion an excellent one. It proved, moreover, timely. The troops on Kwajalein had just found a fairly complete set of maps of all Japanese-held islands in the Central Pacific, mostly at a scale of 1 to 50,000, containing a wealth of hydrographic and topographic detail. These maps could be compared with aerial photographs of the Marianas, particularly of the islands of Saipan and Tinian, just coming in. The 29th was given the job of making maps for the Central Pacific. Using aerial negatives received from Hawaii, the men compiled preliminary topographic maps of the islands of the Central Pacific, then sent the drafts to the 64th Topographic Battalion, which put them in final form, making use of the latest intelligence data. The engineers could do little to determine what specifications would be used for aerial photography, since Navy squadrons took practically all the pictures. But the engineers and naval fliers did try to work out a plan whereby photographs would be available for maps sufficiently far in advance of scheduled assaults to ". . . insure the availability of adequate detailed maps for planning, as well as for operations." [31]

Training

By 1944 training schedules for engineer units in Hawaii were rather extensive. Since the troops in the Islands might be sent to any part of the western Pacific, all divisional engineer units received a week's training in jungle warfare. Included were scouting and patrolling, working with dogs, close-

[30] (1) Ltr, Kramer to Loper, 5 Nov 43. Engr AGF PAC, 016. (2) Ltr, Loper to Kramer, 8 Oct 43. Engr AGF PAC, 370.09 (Mapping). (3) Hist of the 64th Engr Topo Bn.

[31] (1) Ltr, Loper to Kramer, 4 Feb 44. Engr AGF PAC, 370.09 (Mapping). (2) Ltr, Kramer to Loper, 13 Feb 44. Engr AGF PAC, 061. (3) Ltr, Kramer to Loper, 8 Mar 44. Engr AGF PAC, 061.01.

quarter fighting, stream crossing, and placing and deactivating mines and booby traps. Two officers, who as naturalists in civilian life had studied the islands of the Pacific, gave the men pointers on how to live in the jungle. Their basic idea was that the jungle, far from being something to be feared, should be regarded as the "friend and protector of man," since it could be made to provide shelter and food. Exercises were held in areas of the Hawaiian Islands where heavy tropical growth existed and could provide a realistic background. At the Waianae Amphibious Training Center on Oahu, most engineer units were given a week's refresher course in amphibious landings. Included were exercises in embarkation, debarkation, and swimming with equipment. Training was completed with a battalion exercise at night on the beach with live ammunition. There were, in addition, many specialist schools to provide instruction in such subjects as mine clearance, water distillation, refrigeration, and the operation of mechanical equipment. The mine clearance school, surprisingly enough, by the fall of 1944 had more than forty hard-to-get Japanese mines and various types of fuzes—enough to lay a small mine field for the trainees to practice on. The school's commanding officer explained that having long and unsuccessfully tried to get Japanese mines through official channels, he had finally gotten some by trading his liquor ration for souvenirs brought back by the troops from the combat areas.[32]

Reorganization

When General Richardson visited Washington in February, he was successful in obtaining War Department approval for a major reorganization of his headquarters. What he had wanted was an "integrated communications zone command." He planned to have General Kramer as his theater engineer; Kramer would plan for and exercise technical supervision mainly over engineer operations in the combat zone. At the same time a chief engineer would be needed to provide technical supervision over engineer work in the communications zone. In response to Richardson's request of 29 March for Loper, Reybold released him for assignment to the Islands. In May Kramer consolidated the two offices of district and department engineer, which henceforth were designated the Office of the Engineer, CPA. Late in May, Kramer returned to the United States because of poor health. In June Colonel Loper arrived and became Kramer's replacement. On the 29th of that month the logistics organization Richardson had wanted was established with the activation of the Central Pacific Base Command (CPBC). But for the time being, no change was made in the engineer organization in the Hawaiian Islands, and no engineer was appointed to exercise technical supervision over engineer work in the Central Pacific Base Command.[33]

[32] (1) Engr USAFICPA, Tng Directive, n.d. Engr AGF PAC. (2) McMeekan, British Army Staff, Rpt on Visit as Engr Observer to Central Pac, Aug-Sep 44. (3) Hist Review, CE, U.S. Army, Covering Opns During World War II, POA, pp. 819A–C.

[33] Ltr, Richardson to Reybold, 29 Mar 44. Engr AGF PAC, 160, Contracts, vol. 1.

The Marianas

Plans and Preparations

In mid-January 1944 Admiral Nimitz released the general plan of campaign approved by the Joint Chiefs of Staff for the latter part of the year. The main Japanese bastion to be seized was Truk, one of the Caroline Islands, and the target date for the assault was 15 June. After Truk had been taken, three islands in the Marianas—Saipan, Guam, and Tinian—were to be captured. These islands, 3,800 miles west of Hawaii, were a most important objective. They would provide a site for an advance naval base for the Fifth Fleet, thus enabling it to attack and destroy Japanese warships and transports and eventually gain control of the rest of the Central Pacific. Air bases in the Marianas would help isolate and neutralize the remaining enemy-held islands in the central Carolines. Most important of all, the Marianas, only 1,500 miles from Tokyo, would be ideal sites for airfields for the B–29's, now coming off the production line in quantities. Capture of the Marianas was scheduled as the concluding phase of the 1944 campaign. Initial planning centered almost entirely around Truk, a base that had to be captured in order to safeguard the American flank in an assault on the Marianas. In a series of powerful carrier thrusts in February, the Navy exposed the vulnerability of that enemy bastion. Truk could be bypassed. The Joint Chiefs, in a directive sent to Nimitz and MacArthur on 12 March, directed that the attack on the Marianas begin on 15 June. On 20 March Nimitz issued a staff study for FORAGER—the code name for the conquest of the Marianas—and detailed planning soon got under way in full force for the capture of Saipan and Tinian, the main Japanese islands in the group, and for the recapture of Guam. D-day for Saipan was to be 15 June; for Guam, 18 June. The V Amphibious Corps, consisting of the 2d and 4th Marine Divisions, with the Army's 27th Infantry Division in reserve, was to take Saipan and Tinian. The III Amphibious Corps, made up of the 3d Marine Division and the 1st Marine Provisional Brigade, with the 77th Infantry Division in reserve, was to take Guam. Marine Lt. Gen. Holland M. Smith was to have tactical command of all troops ashore on the three islands until the tactical phase was completed, and he would be directly responsible to Vice Adm. Richmond K. Turner, who commanded the joint Army-Navy-Marine task force. The Army would have primary responsibility for base development on Saipan. The Army and Navy would be jointly responsible for base construction on Guam. The Navy was to be responsible for base construction on Tinian.[34]

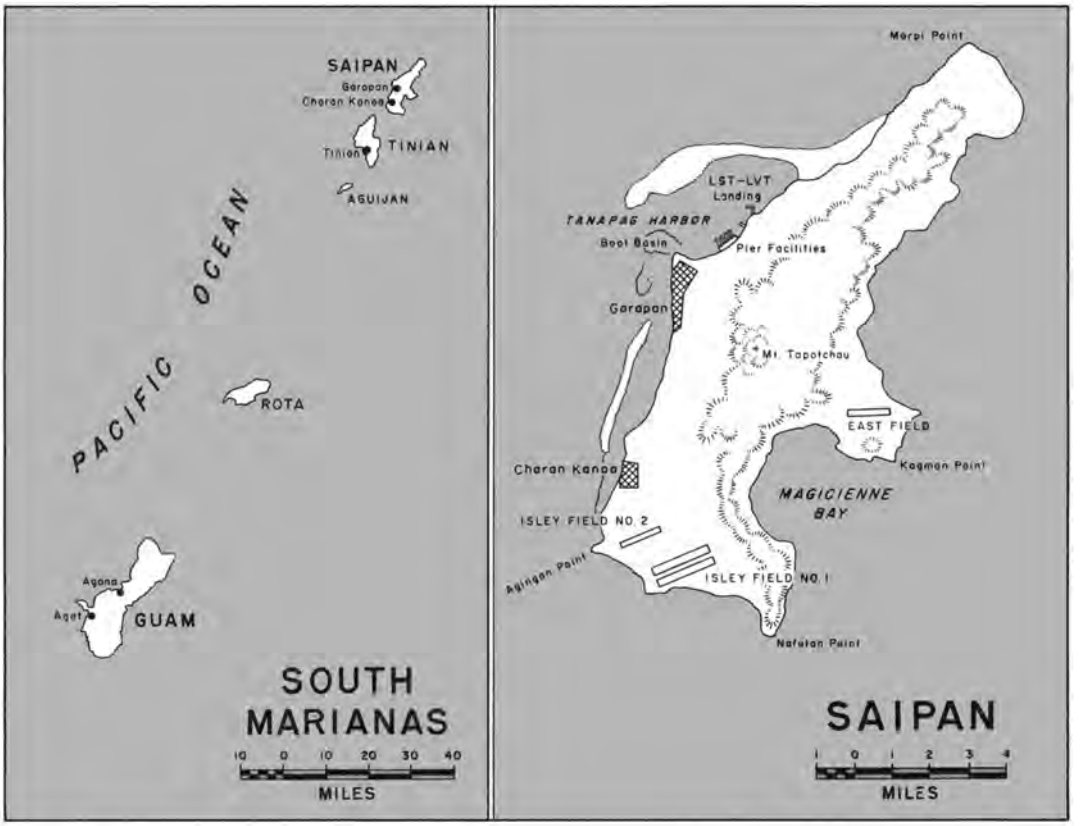
The Engineers had begun long-range planning for operations against Truk in January. When the decision was made to bypass that atoll, they concentrated their studies on the Marianas, directing most of their attention to Saipan. That island, like others of the Marianas, ex-

[34] (1) Participation in the Marianas Opn by USAFICPA, Jun–Sep 44 (cited hereafter as USAFICPA, Marianas Opn), p. 63. (2) Crowl, *Campaign in the Marianas*, pp. 33ff. (3) Samuel Eliot Morison, "History of United States Naval Operations," vol. VIII, *New Guinea and the Marianas* (Boston, 1953), pp. 8–10. (4) Holland M. Smith, *Coral and Brass* (New York, 1949), pp. 152ff.

cept Guam—a U.S. possession since 1898—had been held by the Japanese since World War I. Information about Saipan was meager. No aerial photographs were to be had. The engineers studied German maps made before World War I, when the Marianas (except Guam) were a German possession; they analyzed information found in the records of the Japanese Diet; and they interviewed people who had lived on Guam, since it was known that the terrain features of Guam and Saipan were similar. Unlike the flat coral islands to the east, the Marianas were of volcanic origin. Saipan, about twelve miles long and five wide, was mountainous, with a line of low peaks running in a north-south direction. (*Map 24*) The highest, Mount Tapotchau, near the center of the island, rose to an altitude of 1,554 feet. The eastern side of the island had steep wooded hills bordering the ocean. On the western side, the high points sloped gradually to level areas cultivated principally with sugarcane. On the western coast were two major towns, Garapan, the capital, to the north, and Charan Kanoa, to the south. The western side of the island was most promising for an amphibious assault. In late February the first photographs of Saipan, taken from carrier planes, came in. They were rather poor because many of the features were obscured by clouds and the flight lines were irregular.[35]

The most important construction mission in the Marianas was the building of airfields for the B–29's. On Saipan and Guam, the engineers were to construct six runways for the long-range bombers. On Tinian, Navy engineers were to build six more with materials furnished by the Army. Runways were to be 8,500 feet long and surfaced with asphalt. Planning was involved and time consuming. After the planners in Hawaii had determined airfield requirements, they began estimating other construction needs, such as camps, hospitals, and warehouses. Kramer's staff prepared construction annexes for the base development plan for Saipan, with layout plans showing the tentative location of all major installations to be built. Because of the few aerial photographs of the islands, the engineers had to make their layouts somewhat flexible. After Kramer's engineers had completed their work on the Base Development Plan, they turned it over to Colonel Burns, who had served as head of the shore party on Kwajalein, and was to be garrison force engineer on Saipan. His staff prepared detailed designs and layout maps and computed supply requirements. Civilians from the Honolulu District office, aided by a special staff of officers, worked on the extensive engineer supply needs. The effectiveness of the Joint Staff had increased constantly; the Marianas operation was the first in which its new procedures were to be fully applied. For one thing, ships carrying supplies from the United States were to bypass the Hawaiian Islands and go directly to the Marianas. The engineers planned to send 150,000 ship tons to the islands by 1 October 1944 and 350,000 tons more by the following April. If supplies

[35] (1) USAFICPA, Marianas Opn, pp. 63ff. (2) Building Saipan, the Engineer Mission, 20 Jun 44–2 Sep 45 (cited hereafter as Rowland, Building Saipan), prepared for the 2233d Engr Constr Serv Sec by Maj James C. Rowland, 98–USF4–0.3.0 (30757).



MAP 24

were sent directly from the United States, requisitions would have to be submitted to the ports of embarkation at least three months before the date the items were to be delivered. Very important was proper echeloning of the shipments. The engineer liaison officer at the San Francisco Port of Embarkation had the authority to load engineer cargo for each base as he thought necessary in order to fill engineer tonnage allowances. Meeting supply needs in the Marianas would not be easy because construction deadlines would require great quantities of materials at an early date. One weakness in planning persisted: task force commanders, after receiving their final directives, had too little time to finish their own planning and found that when they needed additional supplies, the items were almost impossible to get.[36]

Engineer troop requirements for Saipan were similar to those for Kwajalein. Although Saipan was considerably larger and enemy forces stationed there were estimated to total many thousands, Army troop requirements were not so

[36] (1) USAFICPA, Marianas Opn, pp. 75ff. (2) Ltr, Leavey to C EHD, 21 Jun 61. EHD Files.

great as originally expected because the marines were to participate in the assault. As part of the 27th Division, the 102d combat engineers, under Lt. Col. Harold F. Gormsen, their experiences on Makin and Eniwetok behind them, were scheduled to take part in the attack. Headquarters and Headquarters Company of the 1165th Combat Group, recently split off from the 34th Engineers when that unit was converted to a battalion, and commanded by Col. Horace L. Porter, was to supervise the shore party work of three combat battalions—the 34th, 1341st, and 152d; all shore party personnel were attached to the 27th Division. After the assault phase of the operation, the shore party was to be transferred to the Saipan Garrison Force. It was believed that the terrain which would be encountered and the nature of the operation did not require bridging, topographic, depot, or maintenance units during the combat phase. Army engineer units of the garrison force would be directly under the Headquarters of the 1176th Construction Group, which had been formed from the 47th General Service Regiment when that unit was converted into a battalion. Colonel Burns, commander of the 1176th, was to be responsible to Maj. Gen. Sanderford Jarman, commander of the garrison force. Engineer units assigned to Burns's command were principally aviation and construction battalions and elements of supply and maintenance companies.[37]

While headquarters staffs were engaged in planning, troop units were undergoing intensive training. The 102d engineers were alerted for FORAGER in the latter part of February. They were given considerable training in attacking fortified positions; some of the men attended specialist schools. The three battalions selected for shore party operations were familiarized with unloading and storing supplies and in using demolitions; classroom instruction was followed by rehearsals at the beaches. Units assigned to the garrison force were trained in their specialties by working on construction jobs. The men worked with well-drilling rigs, hot-mix asphalt plants, and quarrying equipment; some got additional training in civilian shops and factories in Honolulu. To insure around-the-clock operations in the Marianas, extra operators were selected and trained on earth-moving and other construction equipment. Plans for base development could be prepared with greater accuracy in April, when B–24's operating from the newly constructed airfields in the Marshalls obtained complete photographic coverage of Saipan. By early May the base development plan was complete.[38]

The Assault on Saipan

Late in May a task force with the 2d and 4th Marine Divisions and the 27th Division sailed from Hawaii for the Marshalls. Somewhat earlier a similar force carrying the III Amphibious Corps, including the Marine 3d Division and the 1st Provisional Brigade, had left Guadalcanal for the same destination.

[37] (1) Hist of the 1165th Engr Combat Group. (2) Hist of the 1176th Engr Constr Group. (3) USAFICPA, Marianas Opn, p. 67.

[38] USAFICPA, Marianas Opn, pp. 68ff.

The two fleets met near Kwajalein, the staging base for the operation. FORAGER was by far the largest assault yet undertaken in the Central Pacific. For Saipan alone, plans called for transporting 78,000 men and 100,000 tons of supplies from Hawaii. The Fifth Fleet, commanded by Admiral Raymond A. Spruance, was the largest American naval force so far assembled in the Pacific. The combat engineers spent their time en route to the fighting zone in listening to orientation lectures, doing physical exercises, practicing loading and unloading supplies and equipment, and just relaxing. Meanwhile, planes and warships were pounding the island. "Saipan was smoking when we arrived. . . ." wrote General Holland Smith.[39]

On 15 June the 2d and 4th Marine Divisions landed near Charan Kanoa. Enemy troops and defenses near the beaches were few. But the Japanese, skilfully using the guns they had emplaced on hills and in ravines farther back, put enough fire on the landing forces to hold them to a half-mile deep beachhead during the day. Early on the morning of the 17th, two regimental combat teams—the 105th and the 165th—of the 27th Division landed to the south of the Marine positions. Company A of the 102d engineers came ashore with the 105th; Company C, with the 165th. Again combat engineers and infantry had been organized into fighting teams. Each RCT came ashore with its company of engineers, part of which had been formed into assault groups, each consisting of one noncommissioned officer and five men. Three of the men carried satchel charges, one had a Browning automatic rifle, and one carried a flame thrower. The groups remained at or near company headquarters to be assigned to rifle platoons as needed. Engineer company and platoon headquarters had the job of bringing in reserve supplies of tools, equipment, explosives, Bangalore torpedoes, mine detectors, and liquid for flame throwers.

From the engineer standpoint, the beach defenses of southwestern Saipan were poor. They consisted for the most part of hastily constructed trenches and foxholes and a few log obstacles to stop tanks. In the advance toward the airfield, named Aslito, the combat engineers had to destroy only a few pillboxes, caves, and dugouts. Their biggest job was to find their supplies and equipment, dumped indiscriminately on the beaches and "hopelessly scattered." [40]

One of the first tasks of the shore party engineers was to make a reconnaissance of the beaches. On the third day of the landing, at 0830, three officers and two enlisted men from headquarters of the 1165th Group set out on a survey of one of the beaches and its offshore coral reef to determine if it would be possible to unload palletized supplies from LCM's and LST's, move them across the reef, and then have Alligators haul them from there to the beach. Ninety percent of the cargo and supplies of the 27th Division had been palletized. The reconnaissance party had a rough time. Caught in an enemy air raid and unable to return to their ship, the group had to

[39] Smith, *Coral and Brass*, p. 158.

[40] (1) Hist of the 102d Engr Combat Bn. (2) Crowl, *Campaign in the Marianas*, pp. 99ff. (3) McMeekan, Rpt on Visit as Engr Observer to Central Pac, Aug–Sep 44.

spend the night in an LCVP. "With our tow boat, we floated about until a Jap plane came into view and began strafing various boats around us," the men reported in their diary. "We hopped into the tow boat and dodged about until the plane had gone, then returning to our own LCVP. There was much confusion and firing. Whenever one boat would open up at some target, fancied or otherwise, every other would join in and bullets were thick in the air." Unloading began as planned but could be carried out only with difficulty. Dukws and Buffaloes, clambering over the reef, brought in the first supplies; landing craft with stores for all three divisions used a single narrow channel in the reef.[41]

Shore party operations in the 27th Division area were entirely under engineer control. The engineers were responsible for organizing the beachhead, selecting sites for dumps, hauling supplies to the dumps, and providing security. Men from other arms, naval beach parties, members of the Signal and Medical Corps, and other troops in the shore party area were subject to engineer shore party command. The plan was that supplies of all the arms and services would be landed at the appropriate beaches, near their dumps. But unloading was haphazard from the first. For the engineers it was almost disastrous. Units searched for days for their equipment; some items were never found. The chances were that construction on the airfield would not get started on time.[42]

The Japanese had begun too late to build up the island's permanent defenses. At the time of the American landing, their program was only about 25 percent complete. "We found coastal defense guns up to 200 mm. crated, or uncrated and not installed, and large quantities of equipment and materiel waiting to be used," General Smith wrote.[43] The Japanese had, however, set up strong makeshift defenses by cleverly exploiting the natural features of the island. Artillery and mortars had been placed in advantageous positions in the mountains and trained on the roads and defiles leading inland. Army and Marine units pushed forward against stubborn and sometimes skilfull resistance. Yet the defensive positions with which the engineers had to deal were few. The troops came across a number of pillboxes with sides of palm logs and roofs of sheet metal topped with sand. There were some blockhouses, generally with walls of weak concrete, 2½ to 4 feet thick, usually with 4 ports and mounts for 20-mm. guns. Most of the emplacements were either just finished or under construction. The combat engineers, sometimes with the help of shore party engineers, knocked out cave emplacements and pillboxes with demolitions and flame throwers. The few mines that were found revealed a "complete lack of thought" with regard to their

[41] (1) Diary of the 1165th Engrs in Saipan Opn. Engr AGF PAC. (2) McMeekan, Rpt on Visit as Engr Observer to Central Pac, Aug–Sep 44. (3) Hist of the 152d Engr Combat Bn. (4) Hist of the 1341st Engr Combat Bn. (5) Hist of the 34th Engr C Bn.

[42] 1165th Engr Combat Group, FORAGER Opns, Questions and Answers on Shore Party Opns as requested by Hq V Amphib Corps. EHD Files.

[43] Smith, *Coral and Brass*, p. 159.

placement, concealment, and tactical use.[44]

By 18 June Aslito airfield, together with the southern part of the island except a pocket at Nafutan Point, was in American hands. The next day the 4th Marine Division reached Magicienne Bay on the eastern side of the island. The 2d Marine Division was north of Garapan. The two divisions re-formed their lines and advanced northward. Despite the makeshift Japanese defenses, it was apparent that the capture of Saipan would take longer than anticipated. Naval and military commanders held a conference on shipboard and decided to prepare for a three weeks' campaign.

After Aslito airfield was captured, it was renamed Isley in memory of a naval aviator[45] killed during one of the preliminary strikes on the island. On 19 June a naval construction battalion reached the field and began filling in craters and smoothing one of the runways. The next day a strip 4,500 feet long was usable. At this time the 804th Aviation Battalion, under Maj. John W. Paxton, arrived, having been delayed two days because of the unfavorable tactical situation and the haphazard unloading. The three LST's carrying the battalion had beached on a coral reef, partly submerged at high tide, about 600 feet from shore. Heavy dozers were unloaded first. A roadway was smoothed over the reef and through shallow water to the bluff at the water's edge; a blasting crew charged the bluff's 50-foot-high face with dynamite. After blasting, dozers and carryalls completed a road up to the plateau of the island; construction equipment and personnel poured ashore "through chest-deep water." The aviation engineers took over from the Seabees and continued improving the airfield for fighters. The men graded the shoulders and approach zones to make the strip safe for fighters and provided parking facilities for four squadrons of planes. They then began work on storage for aviation gasoline.[46] The 804th engineers were the first of the units assigned to the 1176th Construction Group to reach Saipan. The advance echelon of group headquarters arrived on the 25th, and, under Colonel Burns, who had landed a week before, set up camp just west of Isley.[47]

As the Americans advanced northward, they came upon a series of cliffs and deep ravines, pitted with caves, from which the Japanese fought back stubbornly. The enemy, astride Mount Tapotchau, had a full view of the battlefield, which gave him a considerable advantage. Company B of the 102d Combat Battalion was active around Mount Tapotchau. The men had a rough time. They had to reduce innumerable machine gun positions and neutralize a large

[44] (1) Hq 1165th Engr Combat Group, Hist Rcd. (2) Diary of the 1165th Engrs in Saipan Opn. (3) Hist of the 1341st Engr Combat Bn. (4) Hist of the 34th Engr Combat Bn. (5) 1165th Engr Combat Group, FORAGER Opns, Questions and Answers on Shore Party Opns.

[45] Comdr. Robert H. Isely. For reasons unknown, the spelling of the aviator's name and that of the field differ.

[46] (1) Hq 804th Engr Avn Bn, Rpt on Air Base Constr, Saipan, Mariana Islands, 3 Feb 45. Engr AGF PAC. (2) Ltr, Paxton to Air Engr Hq AAF, 22 Nov 44. Engr 804-SU-RE Mar 44. Air Univ Lib Maxwell AFB.

[47] (1) Hist of the 1176th Engr Constr Gp. (2) USAFICPA, Marianas Opn, p. 454.

number of enemy caves. They used their bulldozers to close the mouths of caves which were so located that the machines could be used effectively. Sometimes the operators pushed dirt and other material down a slope over a cave entrance or inched their machines along a shelf of the hillside to the cave's mouth. When the Japanese fired at approaching dozers, they aimed, as a rule, at the driver, protected by his armored cab and raised blade, instead of at the vulnerable parts of the engine. The engineers could reach some caves located in sheer cliffs only by following goat tracks on which enemy weapons were trained. They usually demolished these hideouts by lowering satchel charges from above, putting them in place in accordance with directions from observers stationed at a distance. After the explosion, the infantry went in with rifles, grenades, and flame throwers. Sometimes large charges were set off above the cave, causing the roof to collapse. The Japanese had laid their mine fields clumsily, without plan, and did not cover them with fire. A field of about seventy-five mines was discovered alongside a road near Mount Tapotchau. These mines, apparently laid in haste, were easily rendered harmless. A few booby traps were found near a radio station; poorly concealed, they were quickly deactivated.[48]

Base Construction on Saipan

As the enemy was being forced back, the work of transforming the island into a major base began. In General Jarman's words, "I knew the primary job was to push the very long-range [bomber] program as rapidly as possible. There were three things we had to do. First, we had to build the strips for the Superfortresses; second, we had to have docks to unload the equipment to build the airstrips; third, we had to have the roads from the docks to the fields to bring the equipment. Everything else was secondary." [49]

Work began first on the B–29 runway, to be 8,500 feet long and surfaced with asphalt. It was to be built at Isley. On 20 June, when the original Japanese runway was rehabilitated sufficiently to take fighters, work began on the B–29 runway. Survey parties of the 804th made experimental profiles to determine runway directions, sometimes under rifle fire. Intelligence reports had indicated the topsoil was about two feet deep, but it turned out to be only a few inches. Underneath was hard coral rock, which required much blasting. The aviation engineers used about five tons of dynamite a day. During the first week and a half, work was slowed by Japanese bombers overhead, usually at night. The engineers were forced to impose blackouts and all work stopped.[50]

Base development plans called for putting in a fighter field north of Charan Kanoa, where the Japanese had been at work on an airfield. Late in June the

[48] (1) Hist of the 102d Engr Combat Bn. (2) McMeekan, Rpt on Visit as Engr Observer to Central Pac, Aug–Sep 44.

[49] As quoted by Clinton Green, "Our B-29 Base: An Epic Job," *New York Times Magazine*, December 10, 1944, p. 8. Brackets are in the original quotation.

[50] Of of the Air Engr AAF POA, Avn Engrs Build B–29 Bases in the Marianas. AAF Central Files, Misc Papers.

805th aviation engineers, just in from Panama, surveyed the site. They regarded the area as unsuitable because of the strong cross winds and operational hazards. The local air force commander decided to build a field on the eastern side of the island at Kagman Point. On 3 July, when the enemy was cleared from the area, construction began. The engineers used their earth-moving equipment on a 24-hour basis, and on 8 July, they put the first coral from a nearby pit on the runway. Rapid progress had meanwhile been made on storage of aviation gasoline on Saipan. On 1 July the 804th Aviation Battalion began the rehabilitation of the Japanese storage facilities. Materials were beginning to arrive for the additional tanks to be constructed.[51]

The Japanese were being slowly forced back to the northern tip of the island. On 30 June a platoon of Company A, 102d Combat Battalion, was attached to BLT 3 of the 105th Regimental Combat Team and continued the attack, using flame throwers and dynamiting caves and dugouts. Fighting was savage. U.S. troops suffered 25-percent casualties. The Japanese commander on Saipan ordered a last desperate counterattack for the night of 6–7 July. At 0300, the enemy attacked just north of Tanapag harbor. Armed with rifles, grenades, and knives, several thousand Japanese advanced shoulder to shoulder. They overran and wiped out two American infantry battalions and a number of field artillery units. "They came along the road adjacent to the beach about 1000 yards above the Tanapag seaplane base," the 102d Combat Battalion historian reported, "and kept pushing in and in. All the weapons of the BLT's were used to stop them, and as a last resort flamethrowers were used." The attack lasted for two and a half hours. The first platoon of Company A, hit hard, lost several men killed and wounded in action. Some of the engineers, after firing their last rounds, escaped by swimming out to destroyers in the harbor. Many of the surviving Japanese committed suicide, as did the commander of the enemy garrison on the island. On 9 July organized resistance came to an end. There had been twenty-four days of fighting. A large number of Japanese had retreated to the caves and jungle of northern Saipan, where mop-up operations continued for months.[52]

With the island secure, work on airfields and base facilities progressed at a more rapid pace. Additional units of the 1176th Construction Group arrived. Progress continued on the B–29 runway, but more slowly than had been expected. In some places the engineers had to cut coral down to a depth of fifteen feet; in others they had to fill as much as twenty-two feet. Good coral rock for the base course came from a quarry about two miles away. To speed up work, the men built a road from quarry to runway, to be used only by trucks hauling coral; stoplights at intersections gave the trucks the right of way at all times. To build this road, the engineers discontinued work on the runway for four days, but in about two days the increase in the amount of coral hauled made up for the

[51] (1) Hist of the 805 Engr Avn Bn. (2) Rowland, Building Saipan.

[52] Hist of the 102d Engr Combat Bn.

time spent on constructing the road. In building the runway, the engineers placed a coral base from twelve to eighteen inches deep. Asphalt for surfacing was produced at two plants located near the field. The rehabilitated Japanese runway crossed the B–29 strip near the middle. In order not to interfere with the flights of the fighter planes, the men worked on the two ends of the B–29 runway and left the fighter strip untouched in between. Heavy rains in July slowed construction somewhat. Drainage required little attention. The runways were constructed to drain to the shoulders, and from there the water percolated down through the coral. Early in July the 804th engineers began rehabilitation of the Japanese aviation gasoline fueling system. They had one of the tank farms in operation by the 12th; work on a second was under way.[53]

Working conditions on Saipan were not ideal. "Tropical downpours drenched the men, the heat was intense, water was scarce," wrote war correspondent Clinton Green. "The flies pressed unmercifully against sweaty bodies and had to be pried from one's eyes, ears, and nostrils. Yet the work went on—twelve to eighteen hours a day." There were heavy, almost continuous rains from the middle to the end of July, but by this time enemy air raids were becoming less frequent.[54]

The Army and Navy were jointly responsible for rehabilitating ports and harbors. The Army was charged with building piers and clearing areas for storing cargo; the Navy, for removing sunken ships and debris offshore and doing dredging. Saipan had one well-developed port—Tanapag, on the west coast, north of Garapan. A 200-foot-wide channel, 22 feet deep, led to three piers. The 47th engineers, organized as a construction battalion in April 1944, were slated to carry out the Army's responsibilities at Tanapag. The unit arrived on 25 June and bivouacked in a cane field near Isley. Early in July, it moved to a hillside near Tanapag, prepared to work on docks and storage areas. Harbor facilities were a shambles. The three piers were wrecked. The 47th would have to repair them as quickly as possible. The northernmost one, an L-shaped structure built of large concrete blocks, with 200 feet of water along its northern face, appeared best suited for immediate repair. The other two were in water too shallow for American transports. The engineers could make all three suitable by lengthening them with floating piers. They began work by clearing debris from the L-shaped pier; the plan was to lengthen it to 570 feet and provide berthing facilities on both sides. The center pier could be similarly extended for about 460 feet. The third pier was to be improved with the construction of an 800-foot-long marginal pier, from which four floating finger piers were to be extended. When the engineers went to work, they found Japanese riflemen still present in the area. On the 10th of July guards posted by the 47th engineers on a dredge in Tanapag harbor found seven Japanese soldiers in the boiler room, and that same day two enemy soldiers were caught prowling in the 47th's camp area. The presence of enemy soldiers, while some-

[53] Rowland, Building Saipan.

[54] Clinton Green, "Our B–29 Base: An Epic Job," *New York Times Magazine* (December 10, 1944), p. 38.

what nerve-racking, did not slow construction.[55]

Saipan was to be not only an important air base but also an important supply, staging, and rehabilitation center. The number of installations was increased so many times that the original base development plan had to be drastically revised. Extensive covered storage was required. Because of the danger of an enemy landing, the engineers at first built only small frame warehouses; some of this construction was done by troops from other arms and services, supplied with materials and supervised by the engineers. The larger warehouses, built later, were standardized structures 304 feet long, 100 feet wide, and 16 feet high, designed to withstand winds with velocities up to 60 miles an hour. At the same time the engineers began work on hundreds of hardstands and igloos for ammunition. The main housing area for the troops was placed on the narrow coastal plain south of Isley. Pup tents or pyramidal tents with floors provided the first living quarters for the troops; these gradually gave way to prefabricated barracks and Quonset huts. The first hospitals, also, were in tents. Operating rooms were put in Quonset huts. Station and general hospitals of Quonset huts and prefabricated buildings were built around these operating rooms. Added later were water, sewer, and electric systems, air conditioning, asphalt roads, and concrete sidewalks. By the beginning of September, 6,000 beds were in Quonset huts or prefabricated buildings; 3,000 were still in tents.[56]

The roads on Saipan were in deplorable condition. The Japanese had built about fifty miles of roads, many of them not much better than oxcart trails. The one highway that could support American military traffic was the 20-foot-wide thoroughfare from Garapan to Charan Kanoa. During the fighting the roads almost disappeared. "Under the milling of thousands of feet and hundreds of heavy-tracked vehicles, the dirt roads had disintegrated into a fine, penetrating dust," General Holland Smith observed, and added, possibly with some exaggeration, "a passing jeep could put up a smoke screen more effective than our chemical services could produce and blot out the sun. . . ." "When it rained," General Smith continued, "jeeps became amphibians caught in quagmires that had been roads a few hours before." [57] The engineers found it more profitable to build a new system of roads than to try to rehabilitate the old one. They built a perimeter road along the shores of the island and put in three main cross connections. They made most of the main roads thirty-two feet wide and paved them with coral. An unusual job was rehabilitating the railroad. A narrow-gauge line, which the Japanese used mainly for hauling sugarcane and military supplies, circled the island. The shore party engineers, soon after landing, went to work on it. They put one diesel and three steam locomotives back in use and repaired 100 flatcars. The 1398th Engineer Construction Battalion operated the railroad and by the end of July was hauling 350-ton miles a day on it.[58] Since the railroad was not,

[55] Hist of the 47th Engr Constr Bn.

[56] (1) USAFICPA, Marianas Opn, p. 460. (2) Rowland, Building Saipan.

[57] Smith, *Coral and Brass*, pp. 182–83.

[58] (1) Hist of the 1398th Engr Constr Bn. (2)

on the whole, a practical form of transportation, the tracks were taken up and a road built along the right of way. Two of the locomotives made excellent sterilizers for garbage cans.

The all-out effort on the airfields continued. By 6 August the engineers had extended the heavy bomber strip at Isley to 6,000 feet and had lengthened the B–29 runway to nearly 7,000. The hard coral, which required so much blasting, was still the principal hindrance to rapid construction. Heavy rains in August added to the problems. It had been hoped initially that a second B–29 field could be built on the west coast to the north of the field the Japanese had been building. The site looked good on aerial photographs, but it proved to be unsuitable because of extensive marshes; part of the area was below sea level. Reconnaissance indicated the second B–29 field could be built northwest of Isley. Construction was authorized, and the 1878th Engineer Aviation Battalion got the job of building the field. Storage tanks for aviation gasoline were being completed rapidly. The first job, the erection of four 5,000-gallon tanks, was finished on 12 July. The second—the erection of twelve 1,000-barrel tanks, begun on 10 July—was finished on 7 August. It would still be some time before the B–29 base would be completed.[59]

The Assaults on Guam and Tinian

While the Japanese were being mopped up on Saipan and airfield and base construction was well under way, preparations went ahead for the capture of Guam and Tinian. Plans had originally called for an assault on Guam on 18 June; when it was learned late on the first day of the landing on Saipan that a Japanese task force was headed for the Marianas, the assault was postponed indefinitely. After the defeat of the Japanese force in the Battle of the Philippine Sea, 19–24 June, preparations for Guam were further delayed by the stubborn resistance on Saipan. With the end of fighting on that island, preparations for the attack on Guam, and Tinian as well, were resumed.[60] Plans now called for an attack on Guam on 21 July and on Tinian three days later. Marine units were to be mainly responsible for combat on both. The 3d Marine Division, the 1st Provisional Marine Brigade, and the Army's 77th Infantry Division, including the 302d Engineer Combat Battalion, were to take Guam. The 2d and 4th Marine Divisions would capture Tinian. Engineer combat and shore party units were to go into Guam, but only engineer shore party units would take part in the assault on Tinian.

The 77th Division arrived off the west coast of Guam on 21 July; the marines had already secured beachheads to the north and south of Orote Peninsula. (*Map 25*) Early in the afternoon the 305th RCT, with part of the 302d Combat Battalion, began to debark; the remaining elements of the division completed their landing by dusk. A lettered company had been attached to each of the division's regimental combat teams. The landing was unopposed, since the preliminary bombardment had driven

Comments by Col Brown on draft of this chapter, EHD Files.

[59] Hist of the 1878th Engr Avn Bn.

[60] Crowl, *Campaign in the Marianas*, pp. 314–15.



MAP 25

the Japanese away from the beaches. Some of the enemy returned during the night and attacked the American perimeter at a point held by a platoon of engineers. In hand-to-hand fighting, 18 Japanese and 3 engineers were killed. A combat group headquarters with three combat battalions, the 132d, 233d, and 242d, arrived for shore party operations. Unloading of supplies and equipment was routine. The main hindrances were shortages of unloading gear and the troublesome fringing reef. Fortunately the Japanese made no determined attack at night when the beaches were flooded with light. The shore party engineers were subjected to only occasional enemy fire and had little contact with the enemy, though engineer and Japanese patrols sometimes clashed over water points.[61]

The plan of campaign called for uniting the two beachheads by capturing Orote Peninsula and then splitting the enemy forces with a drive eastward across the island to Pago Bay. As the troops moved inland, enemy resistance stiffened noticeably, but the Japanese could not stop the advance. After five days Orote Peninsula was captured. The 3d Marine Division and the 77th Division then drove eastward to Pago Bay, getting possession of the one road across the island by 31 July. The 1st Provisional Brigade mopped up enemy positions on southern Guam.

The main job of the engineers on the southern part of the island was to keep the supply roads open. The terrain was rugged; beyond the beaches the ground rose in a series of hills and ridges; the soil, a reddish clay, was sticky when wet. Guards posted at critical points protected the work parties. The rapid advance of the infantry across the island made almost impossible the maintenance of the narrow existing roads with their thin surfaces of crushed coral. In building new roads, a route was first selected on foot or by jeep, a D–6 dozer leveled a two-lane width, and the excess dirt was then shoved aside. If time permitted and the tactical situation was sufficiently

[61] (1) Lt. Col. Leigh C. Fairbank, Jr., "Division Engineers, Part 1, Guam," *The Military Engineer*, XXXIX (January, 1947), 1–3. (2) Memo for Rcd, 302d Engr Combat Bn, 8 Sep 44. 377–Engr–3 (28973)M. (3) Ltr, Hq 132d Engr Combat Bn to TAG, 17 Sep 44. Engr AGF PAC.



GUAM LANDING

stable, coral and rubble were hauled in for surfacing.[62] "It is readily seen," the 302d engineers reported, "that the above system violated good road building practice. The road was in general below the surrounding ground, and side drainage was not provided for. As the road rutted, bulldozers shoved off the mud until a firm base was found farther down." [63] This system, apparently the best one possible in the deep clay of southern Guam, assured rapid supply of the division. The low parts of the road had to be filled in with logs or rocks.

The Japanese, as they withdrew to the northern plateau, put up a strong and skillful resistance. The 3d Marine Division was on the right, the 77th Division on the left. The enemy concentrated his forces at the two peaks of Mount Santa Rosa and Mount Barrigada. Northern Guam was a limestone plateau about 400 feet above sea level. Except for Mount Santa Rosa and Mount Barrigada, it was gently rolling and offered excellent sites for airfields. On this part of the island, the combat engineers were engaged mainly in maintaining old roads and trails and building new ones. Here their task was somewhat easier than in the south because only about a foot of clay covered the

[62] Fairbank, "Division Engineers, Part 1, Guam," *The Military Engineer*, XXXIX (January, 1947), 2–3.

[63] Memo for Rcd, 302d Engr Combat Bn, 8 Sep 44. 377–Engr–3 (28973)M.

limestone. The jungle was heavy, but there were no streams. An engineer bulldozer operator, protected by his armored cab and closely supported by riflemen, usually moved ahead of each infantry column, opening a passageway through the dense growth. A second dozer, behind the first, widened the trail to 20 or 30 feet. Little work was needed on surfacing because the limestone base held up under all kinds of weather. Maintenance required only filling in shell craters and potholes, shaping up the crown, and, if necessary, constructing drainage ditches.[64]

Assault of fortified positions was a negligible task for the 302d engineers on Guam. The only instance of demolition work was the destruction of an elaborate Japanese underground headquarters, which required three-quarters of a ton of TNT. On 10 August all organized enemy resistance was at an end. Mopping up continued, however, and for many months it was necessary to search for enemy troops entrenched in caves and in isolated mountain areas.[65]

On 24 July at 0730 the 2d and 4th Marine Divisions made the assault on Tinian. The 1341st Engineer Combat Battalion, assigned to shore party work, landed in Alligators and Buffaloes in the third and subsequent waves. While the beach was still under heavy enemy fire the men carried on their tasks, partly protected by coral ledges. Their main job was to gouge out exits from the beach for tanks. The men removed mines and filled in craters on the right flank of the beach. Working about an hour with bulldozers, they had cleared the beach sufficiently to permit tanks to land at any point. Soon the entire unit was engaged in typical shore party activities. The engineers selected dump areas in accordance with prearranged plans; by 1500 they had completed access roads to them, and soon supplies were coming in on amphibious trucks and LVT's. On 6 August, the 1341st reverted to the control of the 27th Division, and the next day returned to Saipan. Seabees were responsible for base construction on Tinian.[66]

Meanwhile, on Guam, Seabees and Marine engineers had begun building three airfields. Marine engineers, helped by Seabees, extended the 4,500-foot runway at Orote field another 1,000 feet. From early August on, the field was in constant use. A 5,000-foot strip which the Japanese had almost completed near Agana was lengthened to 7,000 feet, and on 23 August, the first plane landed on this strip. To the north of Agana Field, the Japanese had completed clearing for a third runway. This location was chosen for Depot Field, which was to be used for the repair of B–29's. The engineers were not to begin work on the big B–29 fields until fall.[67]

1944 Draws to a Close

The last months of 1944 saw great progress made in the Central Pacific. The theater was reorganized in prepa-

[64] Fairbank, "Division Engineers, Part 1, Guam," *The Military Engineer,* XXXIX (January, 1947), 3–4.

[65] *Ibid,* p. 4.

[66] Hist of the 1341st Engr Combat Bn.

[67] Lt. Col. Herbert E. Brown, Jr., "Aviation Engineers on Guam," *The Military Engineer,* XXXVII (October, 1945), 398–99.

ration for the final drive against Japan, and the engineer setup was likewise geared for the last stages of the war. Work in the Marianas moved ahead. Islands in the western Carolines were seized. In Hawaii, the engineers continued their efforts in support of operations in the forward areas. It all meant unrelenting pressure against the enemy.

Reorganization

On 1 August U.S. Army Forces in the Pacific Ocean Area (USAFPOA) was set up as a theaterwide Army command under General Richardson, who was directly responsible to Admiral Nimitz. General Richardson appointed Colonel Loper as his engineer. Central Pacific Base Command became a logistical organization of USAFPOA. In the South Pacific Area, USAFISPA was reconstituted as a second logistical command with the designation South Pacific Base Command (SPBC). Few changes were necessary to transform USAFISPA into a logistics organization; the South Pacific Area was now of diminishing importance, and most of its troops were being transferred to the Southwest Pacific. Since the Central Pacific Base Command was a new organization, a considerable effort was necessary to set it up. On 10 August an Engineer Section was organized and designated the Construction Service. Headed by Colonel Wimer, it was authorized 106 officers and 62 enlisted men. Wimer was responsible for construction in the base command area, procuring and distributing supplies, providing maps, furnishing intelligence data, and acquiring real estate.

The new logistical command was expected to have about 10,000 engineer troops, together with 12,000 civilians, assigned to engineer projects. To provide Wimer with a staff, the district organization, which had been part of the Office of the Engineer, Central Pacific Area, since August 1943, was transferred to the new command. At the same time the department engineer organization, likewise part of the Office of the Engineer, CPA, since August 1943, was transferred to USAFPOA, where it constituted the major part of Colonel Loper's office.[68]

Construction—Hawaii

The construction still required in the Hawaiian Islands was of a minor nature. On 28 June General Richardson stated that the most important jobs of the engineers were to ready troops for combat and construction in the forward areas, make minor improvements at John Rodgers, Hickam, and Mokuleia airfields, complete the depot for the Seventh Air Force, finish the underground airplane repair shop, and construct camps for prisoners of war. Other work was secondary. The Construction Service let a few lump-sum contracts, which it awarded on the basis of competitive bidding. New construction, almost entirely of a minor nature, included mainly barracks, warehouses, and shops. The biggest construction project, still to be undertaken, was the building of the new Tripler General Hospital. The engi-

[68] (1) U.S. Army Forces, Mid Pac and Predecessor Comd, vol. 3, pp. 436ff. (2) Hist Review Covering Activities of Constr Serv, CPBC, 1 Jul 44 Through 15 Sep 45 (cited hereafter as CPBC, Hist Review), p. 1. Engr AGF PAC.

neers began planning for this installation in August 1944.[69]

Despite so many efforts made to reduce it, minor and miscellaneous construction was still so extensive that warnings again had to be issued. In October General Richardson informed the Commanding General, CPBC, that Colonel Wimer had numerous projects on his books, which, when they were finished, would be of little, if any, value to the war effort. As before, he warned, "It is the intention of this headquarters that the construction effort shall be directed to the completion of those facilities which have an immediate, as well as a permanent, value to military operations in POA. . . ." [70] Specifically, this meant adequate facilities for the supply services, training and recreational facilities for the troops, and the repair and improvement of utilities at the permanent installations.

Supply

Now that combat forces based on Hawaii were engaged in operations as far west as Saipan, supply became more complicated. At the end of June, the Supply Division of the Office of the Engineer, CPA, included two major subdivisions: the War Plans Branch, responsible for long-range planning and determining general supply needs, and the Engineer Depot, charged with requisitioning and distributing stocks. When the Construction Service was set up, the depot was transferred to it; the War Plans Branch went to the engineer office in Headquarters, USAFPOA.

Long-range planning, while simpler than in some other theaters, was no longer the easy thing it had been earlier. This was in large measure the result of the limited quantities of supplies in the United States, and the consequent need to ration them to meet the heavy demands from overseas theaters. The greatest difficulties by far were encountered in allocating Class IV stocks. Ever since overseas construction had first begun in 1939, a number of systems had been successively set up to deal with this troublesome problem. In peacetime, requisitions had been prepared for the Class IV supplies needed for a particular project and the items then purchased in the open market. Early in the war, supply requisitions were prepared for all projects to be constructed by a particular task force being sent overseas and the items purchased. In 1943 the War Department instituted the operational project system under which each theater was required to plan its construction one year ahead, estimate the amount of supplies it needed, and forward to Washington a tabulation of its requirements, together with construction plans of the various projects. This system was unsatisfactory because theater planners found it impossible to determine with sufficient accuracy what projects would be built during the coming year. In 1944 the War Department instituted the quarterly estimates. Under this procedure, theater engineers estimated their supply needs five quarters in advance but were not required, in order to justify their supply needs, to give as much detailed information regarding their

[69] (1) Memo, Engr to G–4 USAFICPA, 28 Jun 44. Engr AGF PAC. (2) CPBC, Hist Review, p. 47.

[70] Ltr, Richardson to CG CPBC, 10 Oct 44. Engr AGF PAC, 600.12.

proposed projects. Both the operational project and the quarterly estimate systems required too much meticulous long-range planning by theater engineer staffs and neither could be carried out as intended. What the planners usually did under the quarterly estimate system was to calculate approximately how much construction would be required to support the operations planned for the coming year and how much could be accomplished with the number of men and the amount of equipment likely to be available. Striking a balance between these two estimates, they tried to arrive at a reasonable figure as to the amount of supplies needed.[71]

By mid-1944 the Central Pacific had set up a well-functioning system of requisitioning and distributing supplies and equipment. Engineer units sent their requests directly to the engineer depot in Honolulu, which requisitioned supplies from the United States, or, if possible, secured them by purchase in the Islands. The depot stored its supplies in seventeen base yards in and around the city. Insofar as possible, all items of one kind were stored in one yard—one had electrical materials, another, plumbing supplies, and a third, lumber. The engineers reviewed supply levels for the theater each month and reset them every three months.

Supply units were noticeably short by mid-1944. A need existed especially for depot companies to handle the steadily increasing numbers of items arriving from the mainland. During the summer of 1944, because of the shortage of such units the Class II depot on Oahu was being operated by the 1399th Construction Battalion, an understrength organization, made up largely of Japanese Americans, many of whom were experienced in construction, but few of whom knew anything about supply or spare parts. Maintenance units were noticeably lacking. In July Wimer informed Loper that 2 heavy shop companies and 2 maintenance companies were attempting to meet the needs of some 50 combat, construction, aviation, and general service battalions and a civilian construction force of 15,000. On the basis of one maintenance company for 200 pieces of heavy engineer equipment, the theater should have had 17 maintenance companies.[72] Small wonder that 500 pieces of engineer equipment were deadlined.

By 1944 the Central Pacific was beset by most of the troubles in spare parts supply which had plagued other theaters, particularly the Southwest Pacific, almost from the start of the war. There were too few units to store and distribute spare parts, together with too few men trained or experienced in spare parts supply; shipments were not received from the mainland until months after

[71] (1) Engr CPA, Periodic Rpt, Quarter Ending 30 Jun 44. (2) Engr CPBC, Periodic Rpt, Quarter Ending 30 Sep 44. Both in Engr AGF PAC. (3) Memo for Rcd, Harry F. Kirkpatrick, 20 Dec 45, sub: Development of Sup Plng for Engr Class IV Sups. EHD Files. (4) Memo, Lt Col Joseph Matson, Jr., Asst to Honolulu Dist Engr, to Kramer, n.d., sub: Notes on Sup Matters Pertaining to Requisitioning Against HD Projs Engr AGF PAC, 400.

[72] (1) Memo, MIL Amph Tng to MIL ExecO CPA, n.d., sub: Use of 1394th Engr Constr Tr Assigned to Engr Depot. Engr AGF PAC, 370. (2) 1st Ind, Wimer to Loper, 15 Jul 44, on Ltr, OCofEngrs to Loper, 21 Jun 44. Engr AGF PAC.

requisitions were sent in from Hawaii; diverse makes of equipment required unnecessarily large quantities of parts; inefficient and careless equipment operators further increased the need for scarce parts; and stock control was inadequate. In 1944 construction of a spare parts depot at Schofield Barracks and the transfer to it of the spare parts stored in the base yards on Oahu made for better stock control and improved distribution, but the shortage of trained personnel remained. The spare parts depot was manned by the parts supply platoon of the 452d Depot Company, helped occasionally by details from construction battalions. In October 1944 two parts supply platoons (separate) were assigned; the two units had only one officer and one enlisted man with any experience in spare parts supply.[73]

Maps

When Colonel Loper arrived in the theater in June, he found that his mapping duties required more than merely making and supplying maps for the Army. The Navy and Marine Corps had no adequate map-making units; consequently, the engineers had to "take on the lion's share of production for those arms as well." This continued to be the case. When the Construction Service was set up and responsibilities for map production for forces in the theater were transferred to it, Colonel Wimer's mapping section was charged with conducting surveys, making and reproducing maps, and distributing copies to units in the field. Fortunately for the map makers, General Twitty, J–2 of the Joint Staff, continued to handle policy matters and priorities for the theater. He had the theater photographic officer under his "immediate control" and maintained close liaison with Colonel Loper. This partly explains why photographic units of the Navy and Air Forces were gaining a better understanding of the needs of the map-making units and accepted the fact that "Photographic coverage is never obtained by procrastination." A major problem had at first been the great distance from the Hawaiian Islands of the areas to be photographed. In the early days, the engineers were heavily dependent on naval planes based on carriers. With the Marianas under American control, land-based aircraft could reach most of the islands of the western Pacific, and more systematic photographic coverage was possible. Because of clouds over the islands, oblique pictures were sometimes the best the airmen could provide. During the summer the 64th Topographic Battalion was busy making maps of the western Carolines and the Palau Islands, working on a two-shift, 24-hours-a-day basis. With the B–29's about to take off from the Marianas, most of Japan would soon be within range of the cameramen.[74]

[73] Ltr, EngrO AFMIDPAC to CofEngrs, 17 Oct 45, sub: Engr Spare Parts Sup in the Mid Pac Theater. SWPA File M13.

[74] (1) Hq CPBC, Rough Draft of Circular, Aug 44, sub: Engr Mapping Functions. Engr AGF PAC. (2) Hist of the 64th Engr Topo Bn. (3) Memo, Engr CPBC, for G–4, G–2, and G–1 CPBC, 19 Aug 44. Engr AGF PAC. (4) Memo for Rcd, Lt Col H. E. Thomas, Of of C Engr GHQ SWPA, 25 Oct 44. Engr AGF PAC, 061.20 Intel Rpts. (5) Ltr, Col John Donoghue to Col Herbert Milwit, 20 Jan 45. Engr AGF PAC.

Construction in the Forward Areas—Saipan

Meanwhile, work on Saipan was proceeding apace. By late September one of the runways at Isley, 7,000-feet long, could take medium bombers. After construction got under way on the second B–29 field to the northwest (Isley No. 2), fill requirements were found to be so great that higher headquarters directed that the B–29 runways be built on Tinian instead, and that Isley No. 2 be developed only as a medium bomber and transport strip. Construction of the smaller field was fairly easy because the coral was comparatively soft; only one-third of the cuts required blasting. Most of the coral needed for the base course was quarried from the field itself; the engineers hauled additional material from a pit three miles away. In September they began work on a second parallel B–29 runway south of Isley No. 1. Construction problems were similar to those at Runway No. 1. Much blasting, rock removal, and filling of ravines was required. Here the deepest cut was 14 feet; the highest fill, 23.[75]

Work went ahead on the piers. Using floating ponton cubes, the engineers constructed unloading facilities rapidly. They built all six piers on Saipan in a similar manner. With angle irons, they combined the cubes, each five by seven feet, into floating strings, twelve cubes long. The first strings, already assembled, were brought in on the sides of LST's or cargo vessels. Later on, strings were brought in on barges from Oahu or were assembled in Tanapag harbor itself. With fasteners and tie rods, these floating strings were fastened together into pier sections, twelve cubes wide. As sections were completed, they were floated into place and tied to dolphins. The sections were hinged together at the top, the flexibility so provided making it less likely that the piers would be broken up by storms. In September the commander of the naval base gave General Jarman plans for expanding facilities considerably. In October Seabees arrived to begin construction. The engineers continued work on Tanapag harbor.[76] Jarman congratulated the 47th engineers on their expeditious work on the floating extension to Pier B. "I noted with pleasure that two full size cargo ships tied up to the pier on 1 October 1944, which was the date set for completion," Jarman wrote to Maj. Richard P. Sauer, commanding officer of the unit. "A well done to your 47th Engineer Battalion which completed an excellent job . . . in scheduled time." [77]

The Army engineer organization set up to carry on construction on Saipan was well designed for its task. Colonel Burns was General Jarman's staff engineer, and, at the same time as garrison force engineer and commander of the 1176th Construction Group, he was in charge of construction on the island. His original group staff was augmented on Saipan with officers from Hawaii together with two additional ones from each unit in the group. In October 1944 his staff was redesignated Head-

[75] Hist of the 1878th Engr Avn Bn.

[76] Rowland, Building Saipan.

[77] Ltr, Jarman to Sauer, 4 Oct 44. Incl to Hist of the 47th Engr Constr Bn.



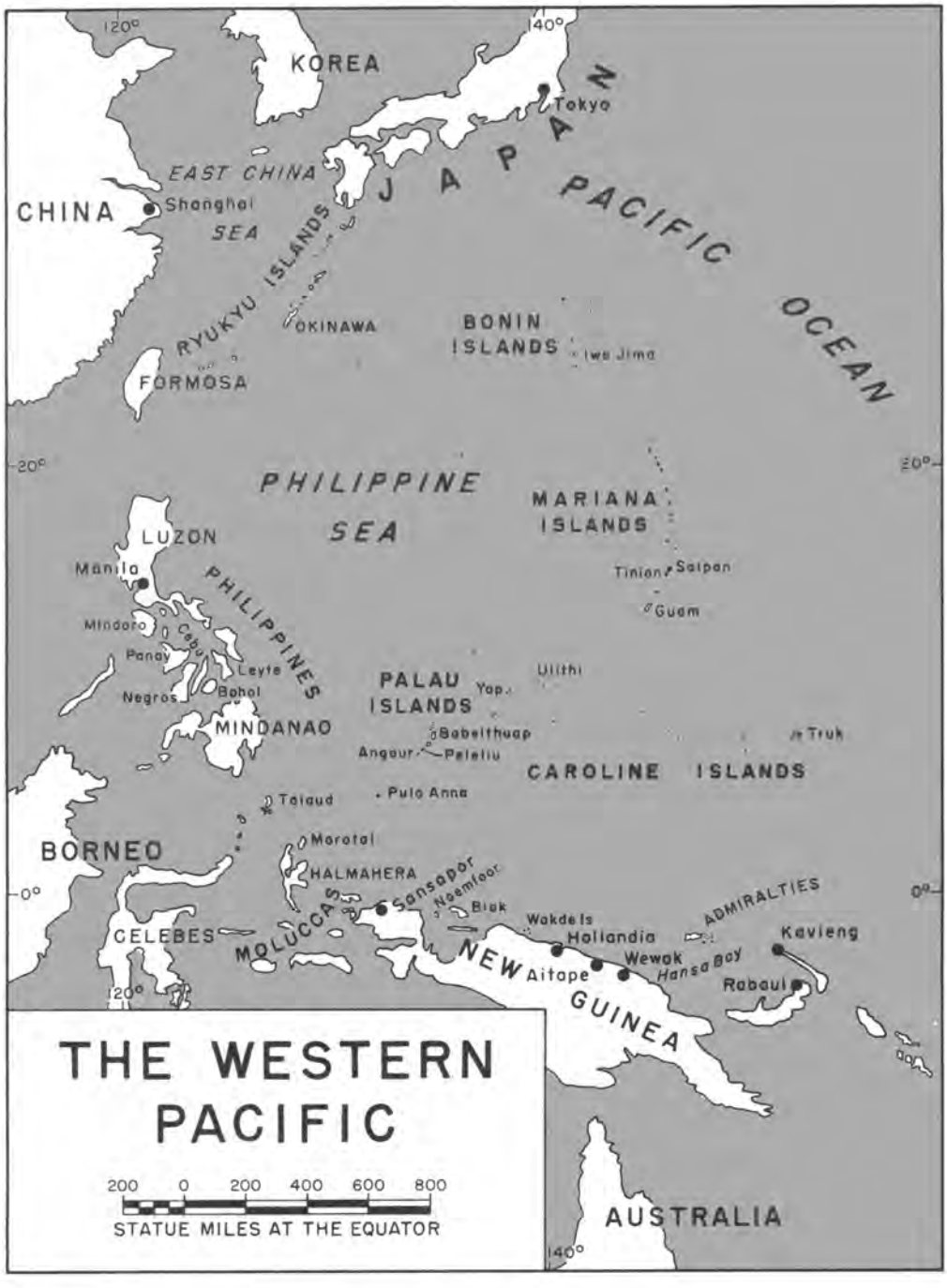
FLOATING PONTON PIER, SAIPAN

quarters, 1st Provisional Engineer Brigade. By November the brigade had 5 aviation, 3 construction, and 3 combat battalions, a heavy shop company, a maintenance company, a parts supply platoon, and a camouflage company which operated dump trucks. These units were organized into groups, the commanders of which were directly responsible to Colonel Burns. Three naval construction battalions assigned to the brigade worked on projects of special interest to the Navy. The effectiveness of this organization was due, at least in part, to the fact that Colonel Burns, while a staff engineer, at the same time had full command of the engineer units on Saipan. He, in effect, headed a construction command.[78]

The Assault on the Western Carolines

One island barrier remained on the road to the Philippines—the western Carolines. Farthest west in this group were the Palaus, about 550 miles east of Mindanao. (*Map 26*) The Japanese had

[78] (1) Memo for Rcd, Thomas, 10 Nov 44. Engr AGF PAC, 061.20, Intel Rpts. (2) Brown Comments on draft of this chapter.


120°
140°
KOREA
Tokyo
JAPAN
EAST CHINA SEA
CHINA
Shanghai
RYUKYU ISLANDS
OKINAWA
BONIN ISLANDS
Iwo Jima
PACIFIC OCEAN
FORMOSA
20°
PHILIPPINE SEA
MARIANA ISLANDS
LUZON
Manila
PHILIPPINES
Tinian
Saipan
Guam
Mindoro
Cebu
Panay
Leyte
Negros
Bohol
PALAU ISLANDS
Yap
Ulithi
MINDANAO
Babelthuap
Truk
Angaur
Peleliu
CAROLINE ISLANDS
Pulo Anna
Talaud
BORNEO
Morotai
HALMAHERA
0°
Sansapor
Noemfoor
Biak
ADMIRALTIES
Wakde Is
Hollandia
Kavieng
CELEBES
MOLUCCAS
NEW GUINEA
Aitape
Wewak
Hansa Bay
Rabaul
20°
THE WESTERN PACIFIC
200 0 200 400 600 800
STATUE MILES AT THE EQUATOR
AUSTRALIA
140°

MAP 26

important naval and air bases in the Palaus. American forces would have to seize them or at least neutralize them before beginning an invasion of the Philippines. In addition to capturing the Palaus, Admiral Nimitz planned to seize Ulithi atoll and Yap, as well as a number of other islands in the western Carolines. Atolls and islands not seized would be isolated and neutralized through bombing attacks. The Army's 81st Infantry Division, together with Navy and Marine units, was assigned to operations in the western Carolines. Little was known about these far-off places. It was assumed their terrain was similar to that of the other coral atolls or volcanic islands of the western Pacific. Plans were made to capture Babelthuap and Peleliu, the two major islands in the Palaus; both had airfields which could probably be rehabilitated quickly. Subsequent studies showed that both were almost completely surrounded by a dangerous barrier reef; to make matters worse, mountainous Babelthuap was believed to have a sizable Japanese garrison. Angaur, six miles south of Peleliu and outside the barrier reef, and with an area of three square miles, could probably be taken fairly easily. In the plan of campaign which was finally developed, Angaur was substituted for Babelthuap. Two regimental combat teams of the 81st Division were scheduled to seize Angaur; the marines, supported by elements of the 81st Division, were to take Peleliu.[79]

On 17 September the 321st and 322d Regimental Combat Teams of the 81st Division landed on Angaur. Divisional and shore party engineers went in with the landing forces. The 306th Engineer Combat Battalion had combat missions; the 1138th Combat Group, including the 52d and 154th Combat Battalions, was responsible for shore party work. The assault troops landed at two places on the eastern side of the island. Company A of the 306th came ashore with the second and third waves of the 321st RCT to the south; Company B, with the 322d RCT, to the north. The southern beach had firm sand which held up well under vehicles. The northern one, narrow and steep, was flanked by limestone cliffs; here the engineers first had to cut a road from the water's edge to high ground. Moving inland, the troops found the bombardments had turned the island's jungle into an almost impenetrable tangle of broken trees and debris. The combat engineers' main job was to clear roads through the wreckage.

The next day Company C and Headquarters Company of the 306th landed. They cleared a center line so that the surveyors could plot the airstrip, constructed a perimeter road on the western side of the island, and manned beach defenses. Meanwhile, the shore party engineers were unloading supplies and establishing supply dumps. During the first night the Japanese put beaches and storage areas under small arms and mortar fire, causing some casualties among the shore party.

With the retreat of the defenders,

[79] (1) App. 2 to An. B, Intel to Accompany FO No. 7, 81st Inf Div, 5 Aug 44. 381-32.1 (8958). (2) Robert R. Smith, *The Approach to the Philippines*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1953), pp. 452ff. (3) Hq Western Pac Base Comd Status Rpt on Angaur Island, an. A. 98-BC5-0.3.0 (19843)M.

after a few days, into the rugged northwestern part of the island, the primary mission of the combat engineers was that of working with the infantry in destroying fortifications. The Japanese had hollowed out numerous caves and had built many pillboxes; the latter, constructed of reinforced concrete, coconut logs, coral, or earth, were of various sizes and shapes. Caves and pillboxes were, as a rule, mutually supporting and expertly camouflaged. The 306th was heavily engaged in assaulting these positions. The men advanced under covering fire, using flame throwers and demolitions. Once again, the D–8 bulldozer with armored cab was a most valuable piece of equipment. This machine could be used on many projects subject to sniper fire. The engineers also used it to ram dugouts and pillboxes or to cover them with earth.[80]

About 300 miles east of the Palaus was Ulithi, one of the atolls in the western Carolines scheduled for capture. The island was to be provided with a fleet anchorage, a seaplane base, and an airfield. Capture of the atoll and initial construction were assigned to the 323d Regimental Combat Team, the engineer component of which included the 155th Combat Battalion and a detachment of Headquarters and Headquarters Company, 1138th Combat Group. On 21 September the advance echelon of the 323d RCT reached the island; two days later, the rear echelon arrived. No enemy troops were found. The men of the 155th, landing on a number of islets, helped with unloading and did shore party work. Part of them prepared to begin work on the airfield. Apparently the most suitable site was on Falalop Island in the eastern part of the atoll.[81]

Construction in the Western Carolines

By late September the engineers were building airfields on Angaur and Ulithi. Plans for Angaur called for a long-range bomber runway of 6,000 feet, to be lengthened eventually to 8,000 feet. The site selected ran in a northeast-southwest direction on the eastern side of the island. Construction was delayed because advance elements of the two aviation battalions, the 1884th and the 1887th, could not disembark until three days after the assault began because the harbor facilities had been destroyed. The men, moreover, arrived without their equipment. Borrowing two bulldozers from the combat engineers, they hacked out a center line for the airfield through the tangled jungle, which had trees up to 90 feet high. Enemy interference during the first ten days made night work impossible. By 15 October a 4,500-foot runway, coral surfaced, was ready, and the next day the first plane landed. The men completed the remaining 1,500 feet during the next five days. The original intention was to surface the strip with steel mat, but this

[80] (1) 81st Div, Opn Rpt, Ulithi Atoll and Other Western Caroline Islands. 381–33.4 (21579) 21 Sep 44–4 Jan 45. (2) 154th Engr Combat Bn, Opns on Angaur and Peleliu Islands. (3) 52d Engr Combat Bn, Opns Rpt, Angaur Island. (4) Ltr, Capt Donn H. Wagner, C.E., Observer, Angaur Opn, to Richardson, 23 Oct 44. Engr AGF PAC.

[81] 81st Div, Opn Rpt, Ulithi Atoll and Other Western Caroline Islands.

turned out to be unnecessary because the coral provided a satisfactory surface.[82]

On Ulithi, construction of the airfield was complicated by a number of factors. The map of Falalop, based on aerial photography, indicated there was ample room for a 3,500-foot runway, but the island turned out to be smaller than expected. Reconnaissance on the ground indicated the map was in error by as much as 6 percent. The runway would have extended over the eastern and western beaches. Much of the island was swampy, with a spongy vegetation about five feet high; the terrain, together with the heavy rainfall, made proper drainage highly important. The 155th Combat Battalion started to put a narrow road through the swamps of the airfield site. Using power saws, the men cut down the trees on either side of the road and dynamited the stumps; bulldozers pushed trees, stumps, and brush to one side or the other. With coral obtained from nearby pits, the men widened and lengthened the road, gradually transforming it into a runway. Probably their major problem was to extend the strip over the eastern beach, awash at high tide. To hold back the strong waves, the men built a protective wall of coconut logs in a series of cribs, which they filled with coral.[83]

Much additional work was done on Angaur and Ulithi. Since the preliminary bombardment had destroyed the piers on Angaur, extensive reconstruction was necessary. At first, unloading facilities were provided on both the eastern and the western shore. Subsequently, a landing pier for LCT's was built on the eastern side. On the western side, the engineers constructed a floating dock 350 feet long, held in place by steel piles. The men of the 1887th deepened and widened the harbor channel, completing this job in seven days, even though they had had no experience in underwater demolitions and were not properly equipped for such work. On 9 October the 52d and 306th Combat Battalions took over harbor development. They continued dredging and constructed a causeway over 500 feet long. Additional work included building storage for 32,000 barrels of gasoline and a camp for the troops, maintaining a network of coral-surfaced roads, and rehabilitating a narrow-gauge railway. On 14 October the 57th Naval Construction Battalion landed on Ulithi and took over most of the work on the airstrip and other facilities from the 155th Combat Battalion. The latter continued work on the cribbing and taxiways until 26 October, when it left for Peleliu. The next day the first plane landed. In general, the 155th engineers had been handicapped by a shortage of personnel and of heavy equipment.[84]

A number of additional atolls and islets in the western Carolines were seized, including Ngulu, Pulo Anna, Kayangel, and Faie. Elements of the 155th, 52d, and 306th Combat Battalions

[82] (1) Army Garrison Force Hist, APO 264, Angaur Island. World War II Rcds Div. (2) 1887th Engr Avn Bn, Hist of Opns on Angaur Island. (3) Hist of the 1884th Engr Avn Bn. (4) Ltr, Wagner to Richardson, 23 Oct 44.

[83] Hist of the 155th Engr Combat Bn.

[84] (1) Army Garrison Force, Hist, APO 264, Angaur Island. (2) Hist of the 1887th Engr Avn Bn. (3) 52d Engr Combat Bn, Opns Rpt, Angaur Island. (4) 306th Engr Combat Bn, Rpt on Angaur and Peleliu Opn, 10 Oct 44. 381-43.2 (21135).

took part in these landings, which were under way from mid-October on. These operations had various purposes: to find sites for naval anchorages, to establish loran stations, or simply to reconnoiter the islands and destroy any enemy troops thereon. Not many troops were found. Only on Pulo Anna were any installations erected. Here, following the initial landing made on 20 October, one company of the 52d constructed a loran station, together with defensive installations.[85]

Construction on Guam

The Army's base development plan called for two B–29 fields on Guam's northern plateau. On 7 October the 854th Aviation Battalion disembarked, its officers and men recent veterans of Kwajalein. Before turning to the B–29 fields, the aviation engineers helped the Seabees, who were having difficulty in meeting their completion dates on Depot Field; providing repair facilities for the big bombers was urgent, since many would undoubtedly be damaged during the attacks on Japan. From 9 October on, most of the battalion was engaged in building facilities at this field. Although the site was in a cultivated and fairly thickly populated part of Guam, Japanese riflemen were still a menace to the construction crews.[86]

Work soon began on the first B–29 field. On 15 October the 854th's entire engineering section, including three well-armed survey parties, went to the northern part of the island to start the arduous task of surveying the sites. When the men reached the area selected for North Field, they found a small clearing with a barbed-wire enclosure in which a radio signal detachment was already established. They welcomed this addition to their reinforcements. A drafting room was built within the enclosure and the initial development of the new airfield was under way. Each of the three survey parties was equipped with a D–8 bulldozer to clear a pathway; each had two submachine guns and a half-track for protection.[87] Building the airfield was not going to be easy. "Mother nature made this construction job a hard and gruelling grind in the sticky heat . . . together with the ever-present dengue-infested mosquitoes," wrote Colonel Brown. ". . . the northern part of Guam was still a . . . mystery to the engineering world. Aerial photographs that were on hand failed to show contours or even the few native trails obscured by thick tropical growth."[88] Meanwhile, one company with about a third of the battalion's heavy equipment had started on 12 October to build six miles of access road to the new airfield from the existing one-way island thoroughfare. Road construction went on twenty-four hours a day.[89]

[85] 81st Div, Opn Rpt, Ulithi Atoll and other Western Caroline Islands.

[86] (1) Hist of the 854th Engr Avn Bn. (2) Brown, "Aviation Engineers on Guam," *The Military Engineer*, XXXVII (October, 1945), 398. (3) *Building the Navy's Bases*, II, 351–52.

[87] Hist of the 854th Engr Avn Bn.

[88] Ltr, Brown to *Time* Magazine, 30 Aug 45, sent to CG AAF WD, for forwarding, in Rpt of Opns, 854th Engr Avn Bn, Kwajalein and Guam. Air Univ Lib Maxwell AFB.

[89] Brown, "Aviation Engineers on Guam," *The Military Engineer*, XXXVII (October, 1945), 398ff.

B–29's Take Off From Saipan

On 12 October the first B–29 landed on the still unfinished runway at Isley, and in a little over a week additional Superfortresses came in from the United States. The time had come to blast Tokyo. On 24 November the first bombers took off for the Japanese capital and made a successful raid. Retaliation was to be expected. On the 27th Zeros bombed Isley during daylight hours. The 804th engineers claimed they shot down one enemy plane as it was strafing their bivouac area. During the night of the 29th, the Zeros returned. This foray caused considerable damage. Brig. Gen. Haywood S. Hansell, Jr., commander of the XXI Bomber Command, in a letter to General Arnold, gave an eye-witness account of the attack. He and his party were coming up a hill near Isley at about 0115 as the B–29's were being loaded for their takeoff at 0515. The Japanese scored a lucky hit on one of the bombers. "There was the most violent explosion I have ever seen. . . ." General Hansell wrote. "There were bombs all over the place, and the ground was covered with small antipersonnel fragmentation bombs dropped by the Japanese planes." The engineers, General Hansell went on to say, moved in with bulldozers and scoops to keep the fires from spreading. They piled the still burning wreckage into two heaps, which they partially covered with earth, and then drove their bulldozers over the flaming mounds. "The flames came up through the tractors and all around the drivers but it didn't stop them . . . ," General Hansell continued. "All of this when most of us were expecting any moment that another set of bombs would let go from the . . . adjacent hardstands due to the intense heat." By 0230 the fires were under control, and the engineers "were cleaning up the mess." [90]

The B–29's were soon pounding Japan with growing strength, and reconnaissance planes from Saipan were taking photographs of south central Honshu for maps to be used for the invasion of the Japanese home islands. Saipan was being developed into the most powerful base in the Pacific. The whole appearance of the island was being changed. "Saipan," wrote Clinton Green, who had landed with the first Army troops along the beaches south of Charan Kanoa, ". . . is something out of an engineering dream book." [91]

From January to October 1944 forces of the Central Pacific had advanced to a point 4,800 miles west of Honolulu. The Palaus, only about 550 miles from the Philippines, had been captured. On all the captured islands, base and airfield construction was progressing rapidly. In the Marianas, B–29 fields were being built from which the Japanese home islands would shortly be subjected to crippling air raids. In the Central Pacific, as in the Southwest Pacific, engineer base construction was vital to the westward advance and required the major share of the Engineer effort. To support the movement across the Central Pacific, a growing Army force was available. Army troop strength in the Cen-

[90] (1) Craven and Cate, eds., *Matterhorn to Nagaski*, pp. 546–48, 558. (2) Ltr, Arnold to Reybold, 21 Dec 44. Engr AGF PAC, 330.1.

[91] Clinton Green, "Our B–29 Base: An Epic Job," *New York Times Magazine* (December 10, 1944), p. 8.

tral Pacific rose from 389,706 on 1 January to 412,618 on 1 October. During the same period, the number of engineer troops in the Pacific Ocean Areas, even with the dwindling strength in the South Pacific, rose from 31,547 to 46,714 men.[92]

[92] AGO, Statistical and Accounting Br, Strength Rpts of the U.S. Army.

CHAPTER XIII

Amphibious Warfare and Base Construction in the Southwest Pacific

The Advance to Biak

Expanding Operations

During the first eight months of 1944 the engineers of the Southwest Pacific were engaged in the kind of amphibious warfare which had been well developed in the latter part of 1943. Briefly, the pattern for seizing areas from the enemy was: air bombardment, naval bombardment, landing of assault forces, defeat of enemy troops in the area, and construction of airfields and base facilities. General MacArthur's strategy was so planned that enemy strongpoints and sizable concentrations of troops along the New Guinea coast and on nearby islands were bypassed. The campaign was highly successful; by the end of September Allied forces in the Southwest Pacific had advanced 1,500 miles.

A similar pattern had been followed in the South Pacific, but by 1944 combat had almost ceased in that theater. Under MacArthur's general direction, South Pacific forces in 1944 were engaged mainly on Bougainville, an island actually in the Southwest Pacific Area. The number of engineers in the South Pacific, totaling 15,261 at the beginning of the year, was steadily declining. Colonel Beadle continued as Engineer, USAFISPA, and Colonel Murrow, as Engineer, SOS, but with progressively fewer duties. Preparations were under way during the first months of 1944 to move large numbers of men and supplies to the Southwest Pacific.[1]

In the Southwest Pacific theater, engineer activities were expanding constantly. On 1 January, engineer troop strength totaled 42,285 and was increasing. Major engineer headquarters during the first months of the year remained at Brisbane. General Casey's office was steadily being enlarged. Late in 1943 Colonel Teale, Chief Engineer, USASOS, returned to the United States; Col. Lewis T. Ross took his place; under Colonel Ross, the office continued to carry out its basic logistic missions with regard to engineer construction, supply, and training. The USASOS field organization in Australia was gradually being liquidated as installations were being moved to New Guinea. The Sixth Army Engineer Section under Colonel Sturgis was located on Goodenough Island. These various engineer offices were busily engaged in making

[1] AGO, Statistical and Accounting Br, Strength Rpts of the U.S. Army.

preparations to support the drive along the New Guinea coast. Additional units were arriving from the United States; among them was the 3d Engineer Special Brigade, under Brig. Gen. David A. D. Ogden, which reached Milne Bay soon after the first of the year. The elements of the brigade began a period of orientation, and some participated in reconnaissance missions or in minor landings on the coasts of New Guinea and New Britain in preparation for a major assault.[2]

It was the engineers of Sixth Army who were to play a most crucial part in the move up the New Guinea coast. They would be responsible both for combat support and for starting work on new airfields and bases. Task force commanders would have immediate responsibility for these two major missions at various points along the route of advance. One of the most important duties Colonel Sturgis and his staff had to assume was the selection of a capable task force engineer for each operation. As regards engineer organization within a task force, there was little in the way of experience to go on except what had been learned in the operations of the previous year. There were no standard tables of organization and equipment or standing operating procedures (SOP). Each task force engineer would have to try to organize his staff in the way best suited to carry out his particular mission. Nor were there any rules to indicate how many units should be assigned to a particular operation. One of the most pressing problems of a task force commander and his engineer was how best to carry on combat support and undertake base construction at the same time. This was true even though procedures for construction in the combat zone had been fairly well standardized. Responsibility for construction within a specified area was usually assigned to the task force commander. GHQ SWPA, through channels, furnished him with a layout map, construction requirements, and specifications. The task force engineer's staff prepared detailed layout plans, established priorities, and prepared plans for using engineer construction units assigned to the task force in the most effective manner. The task force commander was responsible for the initial phases of base development. GHQ SWPA determined the final extent of construction. Though directives and procedures might be clear enough, whether or not they could be carried out in the midst of combat was a question not so easily answered. Casey worked closely with Sturgis in these operations. He passed on information through technical channels and consulted with Sturgis ". . . even to the extent," Casey wrote later, "that we both sometimes trod on Command prerogatives." [3]

The Admiralty Islands

The Admiralty Islands were the scene of the first major assault of 1944. About

[2] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 115–20. (2) Brig Gen Lewis T. Ross, Personal Recollections of the CE (MS). (3) 3d ESB, Our Business Is Beachheads. Both in SWPA Files.

[3] (1) Engr Sec Sixth Army, Engr Hist, ch. XI (Draft MS). Sturgis File 32. (2) Ltr, Casey to Sturgis, 14 Aug 50. SWPA Files.

200 miles northeast of New Guinea and 350 miles northwest of Rabaul, they were of great strategic importance. On 13 February MacArthur directed Krueger and Halsey to seize them and the enemy base at Kavieng on the northern tip of New Ireland about 1 April. Krueger would be responsible for seizing the Admiralties; Halsey, for capturing Kavieng. Using Navy construction battalions and Army engineer units furnished by Halsey, Krueger was to begin work on a major naval base in the Admiralties and improve two Japanese-built airfields there. General Krueger selected the 1st Cavalry Division, reinforced, designated the Brewer Task Force, for the assault. A square division of two brigades, the 1st Cavalry had been dismounted and reorganized to fight as infantry. Its engineer component was the 8th Engineer Squadron under Lt. Col. Marvin C. Ellison. Each of the two brigade combat teams had an engineer troop, supplied with additional equipment, including 7 bulldozers, 6 carryalls, 2 road graders, a crane, and a sawmill. Troop A supported the 1st Brigade Combat Team; Troop C, the 2d. In reserve were Troop B and Headquarters and Service Troop. Since the Navy was especially interested in developing airfields and a base in the Admiralties, Krueger assigned airfield construction initially to naval construction battalions. An Army engineer, Col. William W. Wanamaker, was named task force engineer.[4]

The Admiralties included one large island—Manus—about sixty miles long from east to west and twenty miles wide. (*See Map 27.*) To the east, separated from Manus by a 1,000-foot wide strait about three miles long, was small Los Negros Island, whose irregular coast line enclosed two bays, Seeadler Harbour on the northwest, and Hyane Harbour on the east. The northern part of Los Negros, known as Mokerang peninsula, had numerous coconut plantations and swamps. In a flat stretch south of Hyane Harbour, the Japanese had built Momote airfield. The southern part of the island was hilly and densely wooded. Jungled Manus, never thoroughly explored, appeared from aerial photographs to have little more than native villages and a few trails. On the northern shore, the Japanese had built a landing strip near the village of Lorengau. The plan was to have two combat teams land on D-day—one on Los Negros on the west side of the Mokerang peninsula and the other on Manus near Lorengau.[5]

By mid-February, as signs became fairly numerous that Japanese air strength in the area around the Bismarck Sea was weak, General Kenney pressed for moving up the attack. In the last week in February MacArthur, acting on Kenney's suggestion, decided to change his plans. In place of a full-scale amphibious assault on the islands on 1

[4] (1) Miller, *CARTWHEEL: The Reduction of Rabaul*, pp. 316–17. (2) 8th Engr Squadron, Hist of Activities in the Admiralty Campaign (Brewer Task Force). 901–ENG–0.3 (2997)M 29 Feb–18 May 44. (3) Col William N. Leaf, Task Force Engr Rpt, Opns at TEACUP, 13 May 44. Sturgis File 39. (4) USAFFE Bd, SWPA Rpt 18, Opns of Divl Engrs, Admiralties Campaign (cited hereafter as USAFFE Bd Rpt 18). World War II Rcds Div, 4–2/118/114.

[5] (1) Historical Division, War Department, *The Admiralties; Operations of the 1st Cavalry Division*, (Washington, 1946), pp. 4–7. (2) USAFFE Bd Rpt 18.

April, he directed that a reconnaissance in force be made at Hyane Harbour not later than 29 February. If the reconnaissance group found Momote inadequately defended, an all-out amphibious assault was to be launched immediately. MacArthur's change in strategy required Sixth Army, including the engineers assigned to the task force, to make some changes in plans, since the initial landing was now to be made at Hyane Harbour east of Momote. The 8th Engineer Squadron had two days to make necessary revisions. Because of the sudden change in plans, detailed diagrams for loading engineer equipment on LST's could not be prepared. But on the whole, planning was readjusted without difficulty.[6]

The reconnaissance in force met slight resistance. During their first hours ashore, elements of the 1st Cavalry Brigade pushed across to the western edge of Momote airfield. The small detachment of the 8th engineers, which had gone in with the second wave, destroyed an enemy bunker, carried on reconnaissance, and disposed of duds. General MacArthur, deciding to launch a full-scale invasion, directed Brewer Task Force to send reinforcements. A reinforced platoon of the 8th engineers and a regimental task group of the 2d Special Brigade disembarked at Hyane Harbour on 2 March. The beachhead extended inland as far as the eastern edge of the airfield, a distance of some 300 yards. The amphibian engineers, bringing in supplies and equipment, found the landing area, consisting of hard coral topped with a thin layer of humus, ideal for unloading; even trucks were able to move inland easily. Since the beachhead was so small, the unloading of supplies was frequently interrupted by enemy infiltrators and by mortar and artillery shells; to screen some of their operations, the amphibian engineers used smoke pots. Meanwhile, the 8th engineers supported the cavalrymen in their efforts to drive the enemy away from the other side of the airfield, using bulldozers to clear fields of fire and knock down trees in front of artillery and antiaircraft guns. The engineers found no mines or obstacles. Though the Japanese at times fought stubbornly, they were forced to retreat into the jungles of southern Los Negros.[7]

On 2 March part of the 40th Naval Construction Battalion and detachments of three other battalions reached Hyane Harbour. The Seabees were to improve Momote sufficiently to make it operational for fighters. Since Americans and Japanese were still locked in battle near the airfield, the Seabees spent most of their first two days ashore in building pillboxes, preparing dugouts, and manning part of the perimeter. When, on 4 March, they began to repair Momote they found the task more onerous than had been expected. The runway was rough and much of it overgrown with grass; the Japanese had not

[6] (1) Miller, *CARTWHEEL: The Reduction of Rabaul*, p. 321. (2) *General Kenney Reports*, p. 359. (3) USAFFE Bd Rpt No. 18.

[7] (1) 8th Squadron, Hist of Activities in the Admiralty Campaign. (2) Rpt, 2d ESB, 6 Mar 44. SWPA File 72. (3) 2d ESB, Monthly Hist Rpt of Opns, Mar 1–31, 44. SWPA File E-20-3. The monthly reports of the engineer special brigades contain after action, as well as routine and miscellaneous, reports of the various elements of the brigades.

removed the humus before putting down the coral surfacing. The Seabees scraped the foot-deep top soil from the solid coral underneath and, with excellent coral from a nearby pit, resurfaced the entire runway. In a few days planes were operating from it. By 6 March beachhead and airfield had been secured. The enemy was being forced farther back into the jungle.[8]

With the beachhead under control, the 12th Cavalry, with two platoons of engineers, set out for Red Beach on the west side of Mokerang peninsula, the site originally chosen for the first landing. The troops advanced along a road leading from Momote airfield. Enemy resistance failed to materialize. The only obstacle was a pit, the width of the road, from 3 to 4 feet deep and 15 feet long; canvas stretched over a framework of poles had been placed over the top and covered with sand to resemble the road's surface. This crude trap was easily detected, and an engineer with his angledozer quickly filled in the hole. That same day, the troops reached their objective. At the same time other elements of the 8th Engineer Squadron landed at Red Beach, the amphibian engineers bringing in some of the men. The 8th Engineers' job was to construct and improve the coral-surfaced roads. By mid-March organized enemy opposition on Los Negros had come to an end.[9]

The next objective was the Japanese positions on Manus, especially those near Lorengau airfield. The attackers first set out to destroy enemy forces which might be located on a number of small islands in Seeadler Harbour, especially Hauwei and the Butjo Luos. The amphibian engineers took part in these assaults. No Japanese were found on the Butjos, but on Hauwei enemy troops, cleverly concealed, drove off the cavalrymen brought in by the amphibian engineers. A second landing was necessary to take this island. On 15 March the 2d Cavalry Brigade Combat Team landed about two miles west of Lorengau airstrip. Boat and shore elements of the 2d Engineer Special Brigade and Troop C of the 8th Engineer Squadron took part in this assault. The amphibian engineers used about 40 landing craft. This was a shore-to-shore operation—men and supplies were moved from Los Negros across Seeadler Harbour to Manus. Despite some machine gun fire from the shore, the landing was made successfully. The shore engineers came in with the third wave and began unloading the LST's as soon as the latter arrived. As the shore engineers' equipment had been placed well forward on the decks, unloading proceeded rapidly; in half an hour, the empty LST's pulled away from the beaches.[10]

Many of the Japanese were holed up in bunkers and pillboxes. The 8th engineers used their bulldozers to ram some of these structures; most were quickly demolished, the men inside crushed in the rubble. In three days, cavalrymen and engineers, using tanks, bulldozers, artillery, and dynamite, destroyed 340 enemy bunkers and pill-

[8] (1) USAFFE Bd Rpt No. 18. (2) *Building the Navy's Bases*, II, 295.

[9] (1) USAFFE Bd Rpt 18. (2) 8th Engr Squadron, Hist of Activities in the Admiralty Campaign.

[10] Brig. Gen. William F. Heavey, "Amphibian Engineers in Action," *The Military Engineer*, XXXVII (July, 1945), 253–54.

boxes. Advancing toward the airfield, the men easily overcame the weak resistance. The Japanese had installed more obstacles on Manus than on Los Negros; they had sown the beaches near the landing area with antiboat mines and had erected barbed wire entanglements. But these hindrances were not in the path of the advancing troops. On the whole, the principal engineer jobs were clearing jungle, building roads, and laying corduroy.[11]

To relieve congestion on the airfields in New Guinea and to provide runways for bombers to support operations farther west, MacArthur directed in mid-March that the scope of airfield and base development in the Admiralties be considerably enlarged. Instead of one fighter field, two heavy bomber fields were to be built. To meet the new requirements, Colonel Wanamaker proposed extending Momote runway so that it could take heavy bombers. Since the condition of the Lorengau runway made rehabilitation impracticable, he proposed constructing the second bomber field in a coconut plantation on Mokerang peninsula. Colonel Sturgis and Colonel Sverdrup, who went to the Admiralties on an inspection trip, approved these suggestions. Additional Army Engineer and Navy units were sent in. A detachment of Headquarters, 931st Aviation Regiment, was flown in in mid-March; at the end of the month, the 836th Aviation Battalion and the 617th Base Equipment Company disembarked, and the 104th Naval Construction Battalion arrived on 1 April. The 931st Engineers designed Mokerang airdrome and supervised its construction. The 40th Naval Construction Battalion began work on this field and had removed about 300 feet of coconut trees when the 836th engineers took over. The latter cleared a space for a 7,500-foot strip. They blasted and rooted the solid coral, graded and compacted it to a depth of six inches, then surfaced it with cutback bitumen.[12]

Colonel Wanamaker did not have an easy job in the Admiralties. Most of his troubles were the result of poor organization and interservice rivalries. From the first, he did not have an adequate staff. The assumption had been that the naval construction battalions would do most of the construction, but the battalions were not definitely placed under Wanamaker and consequently would not take orders from him. He could give orders to the Seabees only through the headquarters of the 17th Naval Construction Regiment. Sometimes his orders were passed on; sometimes there was debate as to whether they should be carried out or not. Generally, the naval units did not take kindly to suggestions. All four were put on airfield construction in an attempt to meet the optimistic deadlines that had been set; this was resented by the naval commanders who had their own construction to do on naval facilities and were

[11] (1) 8th Engr Squadron, Hist of Activities in the Admiralty Campaign. (2) Lt. Col. Marvin C. Ellison, "Engineers in Attack on Lorengau Airdrome," *The Military Engineer*, XXXVI (September, 1944), 290–92.

[12] (1) Rad, MacArthur to Marshall, 7 Mar 44. SWPA Files. (2) Col. John H. Dudley and Maj. William G. Staggs, "Engineer Troops on Airdrome Construction," *The Military Engineer*, XXXVII (October, 1945), 385–86. (3) 836th Engr Avn Bn, Hist Narration for 1944. (4) *Building the Navy's Bases*, II, 295–96.

unable to do it. There was confusion even over the administration of Army units.[13] "Upon arrival this station the usual existed," the chronicler of the 836th reported. "We knew not to whom we were assigned."[14] Early in April the construction battalions were placed directly under the operational control of the task force engineer. Conditions improved greatly. Confusion and delays in getting orders to construction units were noticeably reduced. A considerable source of friction was the slowness of the Seabees in getting started on construction. Sverdrup reported, "The 104th . . . spent the first 9 days after arrival in unloading their gear and equipment and setting up their camp. In contrast . . . the 836th went to work immediately upon arrival, and 36 hours after the ship arrived at Seeadler Harbour, the entire unit was working on a 24-hour basis."[15]

Bougainville

Meanwhile, in the Solomons, the engineers continued to be heavily engaged on Bougainville, both in combat and in base construction. On 15 December 1943 responsibility for combat on the island had passed from the Marines to the Army's XIV Corps. That same day the Army had organized a service command for base construction and logistic support. Elements of the 131st Engineer Combat Regiment landed from 15 to 21 December. On the 25th the advance echelon of the 57th Combat Battalion arrived; the last elements came in on 9 January 1944. Part of the 131st and all of the 57th joined the 117th Combat Battalion in supporting the infantry. The men cut roads and trails through the heavy jungle, built timber bridges, and strengthened perimeter defenses. Part of the 131st Engineers went to work in the service command area. This site was a tangle of jungle interspersed with swamps; the growth was so dense that the first clearing had to be done by hand and drainage ditches dug to lower the water table. Engineers with bulldozers then moved in and took out more growth. Others followed with clamshells, which dug wider and deeper drainage ditches. After the ground had been cleared and drained, construction of the major projects began. The engineers started work on supply dumps for all sections of the command. The largest jobs by far were the storage areas for quartermaster, ordnance, chemical warfare, and air forces units.

By early March, the signs were unmistakable that the Japanese were preparing an all-out counterattack. The 57th engineers increased the number of guards, strung barbed wire, and mounted machine guns in the bivouac area. On the 8th, enemy artillery opened fire; the counteroffensive was on. The 117th and part of the 131st engineers were heavily engaged in combat duties. On 11 March two companies of the 57th were committed as infantry to be used in case the enemy attacked in their sector. On the 12th regular engineer work was suspended by the remainder of the battalion and the men put to work carrying ammunition, rations, and water, and evacuating the wounded. The enemy

[13] Leaf, Task Force Engr Rpt, Opns at TEACUP, 13 May 44.

[14] 836th Engr Avn Bn, Hist Narration for 1944.

[15] Memo for Rcd Sverdrup, 21 Apr 44. SWPA File 164. It should be noted that it was SOP for the Seabees to build their camps first.

attacks, continuing for two weeks, had spent themselves by the end of the month. The engineers' main task henceforth was base construction.[16]

Hollandia—Planning

With the Admiralties captured a month ahead of schedule, the campaign in the Southwest Pacific could be speeded up. On 12 March the Joint Chiefs directed General MacArthur to cancel the attack on Kavieng and accelerate base and airfield construction in the Admiralties. In line with suggestions previously made by MacArthur, they further directed him to bypass Hansa Bay and Wewak and seize Hollandia, 200 miles west of Wewak. Bombers taking off from fields at Hollandia would be able to reach western New Guinea and the Palau Islands, and thus could strike at bases deep in enemy-held territory. MacArthur, anticipating the Joint Chiefs' directive, had, a few days before its arrival, ordered his staff to discontinue preparations for the attacks on Hansa Bay and Wewak and plan instead for an assault on Hollandia. The attack was set for 22 April. Simultaneously, there was to be a landing near Aitape, some 100 miles to the east, to forestall any overland attack by enemy forces bottled up at Wewak and other points along the New Guinea coast.[17]

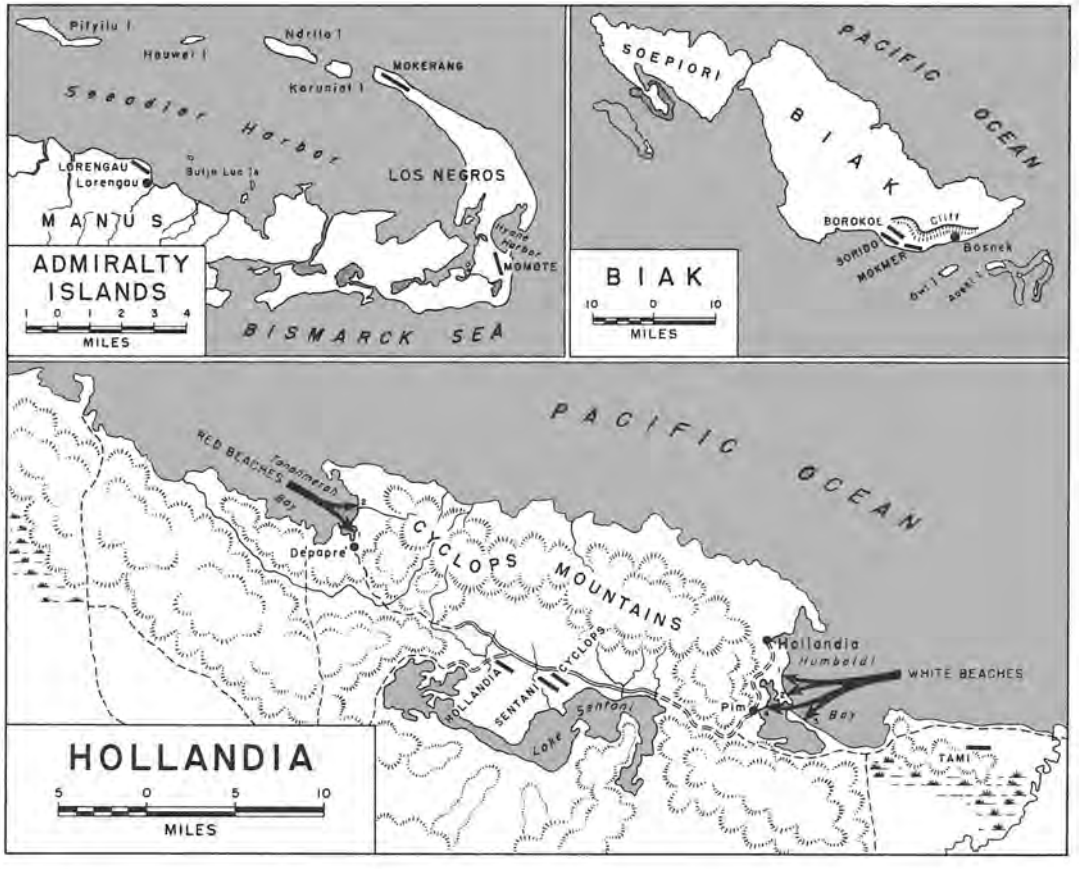
Hollandia, the name of a small settlement on the northern shore of New Guinea, also denoted an area just west of the Netherlands New Guinea boundary, extending about 50 miles along the coast and stretching inland for some 40 miles. (*Map 27*) Here were two large bays—Humboldt in the east and Tanahmerah, 25 miles to the northwest. Extending along the coast was the Cyclops Range, a lofty chain, the dominating feature of the region. South of the mountains was a fairly level, well-drained plateau, in the center of which was Lake Sentani. Except for the area around the lake, the terrain was rugged. According to intelligence information, there were good, if small, landing beaches at Humboldt and Tanahmerah Bays. Plans called for transforming the Hollandia region into a sizable air base and a supply base, the latter to handle 180 days of supply for 200,000 men. Required would be six airfields, an air depot, about four million square feet of covered storage, 200 miles of road, tanks for 118,000 barrels of gasoline, 16 Liberty ship docks, and numerous camps and administrative buildings. At Aitape, the coastal area seemed fairly level, and there appeared to be no obstructions to hinder movement inland. A landing could probably be made easily; base construction would be minor.[18]

Since the Hollandia operation was to be the most extensive so far undertaken in the Southwest Pacific, preparations for the assault and base construction began well in advance. In mid-February, two

[16] (1) 57th Engr Combat Bn, War Diary–Jnl, 1 Jan–31 Mar 44. (2) Hist of the 131st Engr Combat Bn. (3) Serv Comd APO 706, Final Unit Hist. 98-SC10-0.1 (16478)M 23 Dec 43–Dec 44. (4) Miller, *CARTWHEEL, The Reduction of Rabaul,* pp. 358ff.

[17] Smith, *Approach to the Philippines,* pp. 9–12. The Joint Chiefs' directive also contained instructions to Admiral Nimitz with regard to operation in the Central Pacific. See above, p. 492.

[18] (1) RECKLESS Task Force, Hist of the Hollandia Opn, p. 2. (2) RECKLESS Task Force, an. 4 to Admin Order 1, Engr Plan, 5 Apr 44. Both in SWPA File A141.



MAP 27

small engineer staffs had started planning for an amphibious attack at Hansa Bay and construction of a base there. One, made up of Sixth Army engineers, working in Sixth Army headquarters at Finschhafen under Colonel Robinson, the task force engineer, was engaged in planning for the assault and initial base construction; the other, working in USASOS headquarters at Brisbane, was preparing more elaborate plans for base construction. Soon after word was received on 10 March that the objective area was changed to Hollandia, the two staffs were consolidated at Sixth Army headquarters and continued work there; subsequently some of the planners worked at nearby I Corps headquarters under General Eichelberger, who had been chosen task force commander. Additional men were added from time to time. Just before D-day, the task force engineer staff totaled ninety-one officers and men, most of them taken from USASOS engineer units. This was a most logical arrangement; transfer of the base after the combat phase from Sixth Army to USASOS would be rela-

tively easy.[19] The importance of the Hollandia operation from the engineering standpoint is shown by the fact that GHQ operations instructions for that operation, issued on 28 March, included a separate engineer annex. Previously, engineer requirements for an operation had been contained in the G–4 annex.[20]

The task force engineers made elaborate calculations to determine how units assigned to base construction might be employed most effectively. They tried to estimate not only when each facility would be required, but also the type and number of units needed to finish it on schedule. Calculations along these lines could now be made with some degree of accuracy because Sturgis' staff had prepared tables setting forth the construction potential of experienced engineer units, based on their records in the theater. A fully manned and equipped aviation battalion was taken as the standard construction unit. "Fully manned and equipped" meant that the work force of the battalion totaled approximately 500 men, working eight hours a day, six days a week, on a 3-shift basis. The amount of work the battalion could do in a month was called a battalion month and its work potential was arbitrarily rated as 1. An experienced general service regiment was rated as 1.2; a newly arrived construction battalion, 0.8; a combat battalion, 0.6; a naval construction battalion with three months' experience, 1.2. The planners set up construction schedules for the thirty-three units to be assigned to the operation. Equally detailed was planning for supply. After the engineers had completed construction schedules, they calculated supply needs, then broke them down into priorities for shipment to Hollandia.[21]

Hollandia—Assault

RECKLESS Task Force, together with its supporting Allied naval and air units, constituted the largest assemblage of ships, planes, and men organized for any operation in the Southwest Pacific up to this time. Commanded by General Eichelberger, and assigned the mission of seizing the Hollandia area and initiating construction of Base G, RECKLESS Task Force included the 24th and 41st Divisions (the latter less the 163d RCT) and twenty-eight attached combat and service units, totaling approximately 60,000 men. The engineer component amounted to about 41 percent, the highest for an amphibious operation so far conducted in the Southwest Pacific; most of this percentage represented construction units. By mid-April, preparations for the assault were complete. The 24th Division staged at Goodenough Island, 1,000 miles from Hollandia; the 41st Division, at Finschhafen, 700 miles from the objective area. The naval convoys carrying these two divisions and their

[19] (1) USAFFE Bd SWPA, Rpt 31, Engr Opns, RECKLESS (Hollandia) Task Force (cited hereafter as USAFFE Bd Rpt 31). World War II Rcds Div, 4–2.131/44. (2) RECKLESS Task Force, Hist of the Hollandia Opn, p. 52.

[20] Ltr, Casey to Sturgis, 14 Aug. 50. SWPA Files.

[21] (1) USAFFE Bd Rpt 31. (2) Comments by General Sturgis on draft chapter. SWPA Files. (3) Ltr, Lt Col Leonard L. Haseman to Staff Br, 28 Nov 50. SWPA Files. (4) Of C Engr GHQ SWPA, developed slightly different percentages for engineer unit capabilities. See Of C Engr GHQ AFPAC, Admin Hist, 6 Apr 45–31 Dec 46, p. 11. SWPA Files.

supporting units sailed for the Admiralties, which they reached the first night; thereupon, the combined task force turned westward.[22]

On the morning of 22 April under excellent sea and weather conditions, the assault was made as scheduled. The 2d Brigade's support battery was active. Besides its 4 rocket LCVP's, 4 rocket Dukws, and 2 flak LCM's, the battery had 43 Buffaloes to carry troops across reefs and shallow waters near the beaches. The battery's craft were about equally divided for the two assaults. When the naval bombardment ceased, rocket LCVP's and Dukw's and flak LCM's moved to about 100 yards from shore and loosed their barrages on the beaches. Waves of landing craft brought in troops and supplies.[23]

The 532d Boat and Shore Regiment, less two companies, landed men and supplies for the 41st Division on the three White Beaches at Humboldt Bay. Only a few of the amphibian craft, upon approaching shore, were hit by enemy rifle fire; most of the Japanese had fled inland. Ships had to be unloaded on D-day so that they could get away that night; stacked higher and higher on the beaches, supplies were in a vulnerable position. At Tanahmerah, the 542d Boat and Shore Regiment helped land the 24th Division on Red Beaches 1 and 2. Except for random rifle fire, enemy interference was lacking. As at Humboldt Bay, complications began when supplies piled up on shore. As intelligence reports had indicated, the beaches were narrow; to the rear were mangrove swamps, some of which had not shown up on aerial photographs because of the dense growth of trees in the water. Exits were far more restricted than had been anticipated. Red Beach 2 had such an extensive swamp in back of it that moving supplies into the interior was out of the question; during the first night, large amounts were shuttled across Tanahmerah Bay to the other beach. Nor did everything go smoothly at Humboldt Bay.[24] A lone Japanese plane coming over on the second day dropped a number of bombs near an ammunition dump. For three days explosions rocked the area, and fires raged out of control. The amphibian boatmen, bringing their craft close to shore, rescued many of the men trapped on the beaches by the flames.

Soon after the first landings, the combat engineers began to advance inland with the infantry. The 116th Combat Battalion (less Company A) of the 41st Division came ashore at Humboldt Bay on D-day. Enemy resistance was negligible. The men widened the trail leading from the beaches to the native village of Pim, making it passable for trucks. They then began to improve a Japanese-built road running from Pim to the airdromes. This road, which intelligence sources had indicated was in fair condition, turned out to be little better than a trail, which at most could take 2½-ton trucks in dry weather. In swampy areas

[22] (1) RECKLESS Task Force, Hist of the Hollandia Opn, pp. 5–6. (2) Maj R. M. Little, 1st Aust Corps, Rpt on Engr Opns at Hollandia and Aitape, Dutch New Guinea, 22 Apr–4 May 44. SWPA File 128.

[23] 2d ESB, Monthly Hist Rpt of Opns, Apr 1–30, 44. SWPA File E–20–4.

[24] (1) 532d EBSR, Unit Rpt No. 5, 15 Mar–7 Jun 44. SWPA Files. (2) RECKLESS Task Force, Hist of the Hollandia Opn, p. 54. (3) Heavey, *Down Ramp!*, pp. 116–17. (4) Ltr, Heavey to Reybold, 30 Jun 44. SWPA File 73.



ENGINEERS OF THE 1881ST WITH FULL JUNGLE EQUIPMENT *move along a Hollandia beach.*

it became a quagmire largely because of the heavy, continuous traffic. The 116th engineers, helped by the 79th Combat and the 1881st Aviation Battalions, had to make a major effort on this road.[25]

At Tanahmerah Bay the 3d Combat Battalion (less Company B) of the 24th Division landed on D-day. The effort required to support the infantry in the advance to the airdromes was more laborious than at Humboldt Bay. The trail leading inland was too narrow and steep even for jeeps. For days, the men had to carry supplies forward. Added to these difficulties were the rains, which began on the second day of the landing, the lack of gravel or rock for surfacing, the inadequate number of hand tools, and the small number of natives in the region willing to work. The most favorable element was the ineffectual enemy resistance. By 26 April the three airdromes were in American hands.[26]

[25] Rpt, Col Herbert G. Lauterbach, CO 116th Engr Combat Bn, to Krueger, 28 Jun 44. SWPA Files.

[26] (1) Tanahmerah Bay Landing Force, Hist Rpt. SWPA Files. (2) 3d Engr Combat Bn, Hist Rpt, an. 1. (3) USAFFE Bd Rpt 31.

As soon as the infantry reached the airfields—named Sentani, Cyclops, and Hollandia—the engineers began the job of rebuilding them. The three runways, satisfactorily located, considering the terrain, were poorly constructed; they were of earth, and drainage was inadequate. The subbase at Sentani was so poor that the Japanese had placed the runway surfacing on bamboo matting. Allied bombings had damaged the fields heavily. Four aviation battalions, working under the direction of headquarters, 931st Aviation Regiment, began the job of reconstruction. The aviation engineers' main job was to find a suitable material for surfacing. In nearby streams they came upon sufficient quantities of rock and gravel. They graded the Sentani and Cyclops runways and placed crushed rock to a depth of about six inches; after rolling the rock into a compact layer, they dampened it slightly and topped it first with an asphalt cutback and then with a coat of pure asphalt and limestone chips. They surfaced the Hollandia runway with iron ore which they took from a nearby deposit, mixing the ore with equal parts of sand. The most troublesome job was providing adequate drainage. The water table was high because of the many swamps and streams. The men dug three-foot deep ditches, which helped considerably to lower the ground water level. On the whole, the work of making the airdromes serviceable progressed rapidly, despite the terrain, which was poorer than expected. By 29 April 4,000 feet of the Cyclops runway was ready for dry-weather use by transports, and by 3 May the Hollandia strip had been completed to 5,000 feet and a squadron of fighters was stationed there.[27]

The unsatisfactory roads in the Hollandia area made it hard to get supplies to the airfields and the area around them where the base was being constructed. Japanese-built Tami airfield near the coast southeast of Humboldt Bay, if improved, could be used to airlift supplies into the interior. Accordingly, General Krueger directed the engineers to lengthen the grass runway at Tami to 4,000 feet and surface it with steel mat. By 3 May the engineers had improved the strip sufficiently to make landings and takeoffs by C–47's possible. In the next few days C–47's made almost 500 trips from Tami to the fields at Hollandia, bringing in gasoline, supplies, and troops. Useful in the early days of the Hollandia operation, Tami was not further developed because of its swampy location.[28]

Aitape

The assault at Aitape by PERSECUTION Task Force resembled the one at Hollandia, but on a reduced scale. Naval and aerial bombardment killed or drove away most of the Japanese in the beachhead area; the troops on landing met only occasional rifle fire. This was the first major landing in which units of General Ogden's 3d Engineer Special

[27] (1) Dudley and Staggs, "Engineer Troops on Airdrome Construction," *The Military Engineer*, XXXVII (October, 1945), 386–88. (2) *Engrs of SWPA*, VI, 230. (3) Eichelberger, *Our Jungle Road to Tokyo*, p. 113.

[28] (1) Craven and Cate, eds., *Guadalcanal to Saipan*, pp. 609–10.

Brigade participated. The 593d Boat and Shore Regiment, less two boat companies, furnished the boat and shore teams. Despite the exposed beach with its heavy surf, the amphibian engineers carried on more or less routinely their tasks of unloading LST's and establishing supply dumps. Moving inland, the 27th Combat Battalion and Company A of the 116th Combat Battalion encountered no Japanese, mines, or obstacles. The combat engineers worked mainly on roads and bridges, the 27th widening the road leading to the enemy-built airfields and the 116th constructing roads along the beach. Since the light Japanese-built bridges and culverts would not hold up under M4 tanks, the troops constructed temporary spans of coconut logs and put in culverts made of gasoline drums covered with sand, which proved to be satisfactory expedients.[29]

With sizable enemy forces at Wewak and Hansa Bay, construction of airfields at Aitape was urgent. Three mobile works squadrons—the 5th, 6th, and 7th—of the Royal Australian Air Force and two American airborne aviation battalions—the 872d and 875th—had the mission of rehabilitating the three Japanese-built runways at Aitape, known collectively as Tadji Drome. The units were to work under the supervision of Wing Comdr. William A. C. Dale, the task force engineer. A few hours after the landing, Dale and members of his staff investigated the strip nearest the beach. It was 400 feet long, fairly well graded, and almost entirely overgrown with kunai grass. The Australian units, all three of them ashore by D+1, worked around the clock with motor graders, dozers, and sheepsfoot rollers. On 24 April, before 1000, the first fighter plane landed. Soon the heavy rains turned the runway into a quagmire, unusable except in emergency. The Australians then set out to cover the strip with pierced plank; they finished this job on the 28th. The field was again serviceable but not altogether satisfactory because of its poor drainage. To the south lay the enemy-built bomber runway, in the same state of neglect as the fighter strip and pitted with bomb craters. On the third day of the landing, the Australians began filling in the craters but were not able until the 28th to transfer any equipment from the fighter strip. The two American airborne aviation battalions, arriving on 4 May, joined the Australians working on the bomber strip. Poor terrain slowed construction. Coral surfaced, the runway was ready for fighters on 27 May, but not for bombers until early in July.[30]

A Smaller Base at Hollandia

Problems had developed at Hollandia. Although the engineers were able to reconstruct the airfields fairly rapidly for fighters and transports, they could not

[29] (1) Task Force Engr Rpt on PERSECUTION Opn. SWPA File A165. (2) 3d ESB, Hist Rpt, 3–30 Apr 44. SWPA File E–32–1.

[30] (1) Little, Rpt on Engr Opns at Hollandia and Aitape, Dutch New Guinea, 22 Apr–4 May 44. (2) Memo for Rcd, Sverdrup, 25 Apr 44, sub: Inspection at Aitape. SWPA File 511. (3) Task Force Engr Rpt on PERSECUTION Opn. (4) Hist of the 872d Airborne Engr Avn Bn. (5) Hist of the 875th Airborne Engr Avn Bn.

readily develop runways for heavy bombers because of the swampy terrain. Representatives of the major commands, making a survey of the Hollandia area, concluded that construction of a base of the size outlined in GHQ's operations instructions would be impracticable. The unfavorable terrain, the poor roads, and the impossibility of developing adequate harbor facilities at either Tanahmerah or Humboldt Bay within a reasonable time were all hard facts that militated against building a base large enough to support 200,000 men. Maj. Gen. James L. Frink, commanding general of USASOS, advised construction of a smaller base. General Kenney canceled plans for an air depot and directed the building of minimal air facilities only. Over-all plans for base and airfield construction were revised. MacArthur reduced the number of airfields to be built from six to three, cut covered storage from four to three million square feet, and directed that supply facilities be built for 140,000 instead of 200,000 men. Despite these reductions, construction needs were still tremendous, and would necessitate a sustained effort by all engineer units assigned to the operation.[31]

Wakde

Even before the assault on Hollandia and Aitape, plans and preparations for amphibious strikes against points farther west were well along. MacArthur's planning staffs were concentrating on two places in particular: the Wakde Islands together with the nearby New Guinea coast, about 125 miles northwest of Hollandia, and the island of Biak, some 200 miles still farther west. After the detailed survey of the Hollandia area had shown conclusively that the development there of heavy bomber fields was not advisable, the capture of Wakde and Biak was all the more compelling. Until adequate fields could be built on these islands, heavy bombers would have to operate from the Admiralties, over 400 miles east of Hollandia. On 27 April MacArthur issued operations instructions calling for an assault on 15 May on the Wakde Islands and a 25-mile stretch of the nearby New Guinea coast from Sarmi to Toem. The 41st Division was to make the landings. The division's 163d Regimental Combat Team was to capture the Wakde Islands; the remainder of the division, the area along the coast. The attack on Biak was tentatively scheduled for early June; the precise date would be determined later. While plans and preparations for the assault on Wakde were being made, aerial photographs coming in of the coastal area indicated that it was a poor place for airfield construction and that concentrations of Japanese troops near Sarmi might make the job hazardous as well. MacArthur decided to revise his strategy, and on 10 May issued new operations instructions. The 163d RCT was to seize the Wakde Islands and a smaller nearby coastal strip, while the remainder of the 41st Division would prepare for the assault on Biak. The landing at Wakde was now scheduled for 17 May; the one on Biak, ten days later.[32]

[31] (1) Craven and Cate eds., *Guadalcanal to Saipan*, pp. 608–09. *General Kenney Reports*, pp. 394–95. (2) USAFFE Bd Rpt 31.

[32] (1) TORNADO Task Force Engr Rpt. Sturgis File

About two miles off the New Guinea shore line, the Wakde Islands included Insoemoar, usually called Wakde by the American troops, and smaller Insoemanai. Relatively flat Insoemoar, about one and three-fourths miles long, had limestone cliffs and terraces along its southeastern edge. The Japanese-built airstrip extended almost from the western to the eastern tip of the island. Insoemanai was too small for base development. Colonel Sturgis had little time to organize a task force engineer section and assemble units for the assault. Nevertheless, Lt. Col. Sherwood E. Liles, Jr., the task force engineer, and his staff of four officers and twenty-one enlisted men from Headquarters, 1112th Combat Group, after being briefed on the operation, and making a fairly detailed study of terrain reports, aerial photographs, and maps of the objective areas, were able to piece together quite an accurate picture of the airstrip, the nature of the soil, the conditions at the beaches, and the extent of the road net on the Wakde Islands and the mainland. Before D-day, Colonel Liles and his staff had prepared a layout of the runway, taxiways, and dispersal areas to be constructed on Wakde. Eight engineer units, hastily assembled from bases on the New Guinea coast, were assigned to the task force for airfield and base construction.[33]

TORNADO Task Force arrived at its objective area at dawn on 17 May. After the bombings, the assault waves made their landings on the New Guinea coast. The amphibian engineers consisted of the shore battalion of the 593d Boat and Shore Regiment and Company A of the boat battalion of the 542d Boat and Shore Regiment. Shallow water and heavy surf were the main obstacles; both were so troublesome that a major effort was necessary on the landing jetties. The shore engineers, using their bulldozers, had the beach in fair condition in about an hour. Enemy resistance was slight; apparently the Japanese had not expected a landing at this point. The combat engineers, including the 27th Combat Battalion and Company A of the 116th, veterans of the recent Aitape landing, had as their initial mission unloading LST's. After finishing this task, two companies of the 27th improved the coastal road and repaired the Japanese-built bridges. One of the companies supported the infantry in its drive westward toward Japanese-built Maffin Drome, some six miles from the landing beach. As the troops moved forward, enemy resistance stiffened noticeably; the engineers frequently had to repair roads and bridges under fire or while harassed by enemy patrols and, at times, had to fight as infantry to ward off attacks.[34]

Meantime, a major amphibious assault was under way against the Wakde Islands. In the initial landing, on 18 May, Company A of the boat battalion of the 542d Boat and Shore Regiment and the shore battalion of the 593d Boat and Shore Regiment went in with the infantry. The amphibian engineers ran

42. (2) Craven and Cate, eds., *Guadalcanal to Saipan*, p. 620.

[33] TORNADO Task Force Engr Rpt.

[34] (1) TORNADO Task Force Engr Rpt. (2) 3d ESB, Our Business Is Beachheads. (3) 3d ESB, Hist Rpt, 1–31 May 44. SWPA File E32–2.

into surprisingly strong enemy resistance. Despite the preinvasion bombardments and the shelling from guns emplaced on the mainland the day before, many of the defenses, particularly those in the limestone cliffs, were not severely damaged. The Japanese had fortified the beaches skilfully. They had even taken turrets from disabled planes and partially buried them in the sand, with the guns trained on the shore. The amphibian craft on approaching the island ran into heavy fire. No infantrymen were wounded until the ramps were lowered, but many of the boatmen, who had to stand in exposed positions as their craft neared the beach, were hit; three were killed. Still, every boat reached shore. One LCVP showed the marks of more than sixty bullets and shell fragments. For its part in this landing, Company A received the Distinguished Unit Citation.[35]

The shore engineers, also, had a hard time. The beach was littered with debris. Strong enemy resistance and artillery and rifle fire hampered the men in clearing areas for supply dumps. By the end of the first day, the beachhead, 200 yards wide, extended inland only 300 yards. During the next two days, enemy infiltrators set fire to ESB machinery, trucks, and gasoline, and slashed truck tires with bayonets. The combat engineers—Company A of the 27th Engineers—functioned almost entirely as infantry during their first two days on Wakde. Many of the island's defenders were holed up in caves from which they could not easily be dislodged. Combat engineers and infantrymen attacked the hideouts with hand grenades, bazookas, and flame throwers and lowered explosives through the cave entrances. Most of the enemy not destroyed by the grenades and flame throwers were killed by the concussions of the demolition charges. The Japanese fought stubbornly from caves, foxholes, pillboxes, and concrete emplacements. Every strongpoint had to be reduced.[36]

Construction began soon after the first troops landed. While Wakde was under bombardment, the transport carrying the 836th Aviation Battalion arrived offshore; the men, lined up along the ship's rails, watched guns and planes pound the island. Disembarking while fighting was still in progress, the aviation engineers came under fire, and several men were wounded. During the afternoon of their first day ashore, the troops, digging in along the beach and setting up their perimeter defense, could plainly hear the sounds of battle; fighting was going on only 900 feet away. The next day, with the end of organized resistance, the men began repairing the airfield, which though badly torn up by the bombing and fighting, proved to be an excellent, coral-surfaced strip. Within forty-eight hours the runway was ready to take American planes. Thereafter, the Japanese did not interfere with work on the airfield, except for occasional night bombings, which caused little

[35] (1) 2d ESB, Monthly Hist Rpt of Opns, May 1–31, 44. SWPA File E–20–5. (2) Heavey, "Amphibian Engineers in Action," *The Miliary Engineer*, XXXVII (July, 1945), 256.

[36] (1) 3d ESB, Our Business Is Beachheads. (2) 3d ESB, Hist Rpt, 1–31 May 44. (3) TORNADO Task Force Engr Rpt. (4) Of C Engr GHQ SWPA Engr Tech Info Bull No. 1, 10 Aug 44. SWPA File M163.

damage. On 25 May the last pocket of enemy resistance was destroyed.[37]

Biak

One of the Schouten Islands, situated in Geelvink Bay, Biak had an area of about 950 square miles. (*See Map 27.*) A coral island, partly of volcanic origin, it was rugged, with no streams of any size. Roughly paralleling the southern coast, from a few hundred yards to 2 miles inland, was a coral cliff, rising in some places to a height of 300 feet; largely a series of precipitous ridges and terraces and heavily forested, it was honeycombed with caves and tunnels hollowed out by the action of water. Between the cliff and the beach was a coastal shelf, 10 to 50 feet above sea level. Offshore were dangerous coral reefs. The Japanese had built a number of installations on the island, most of them in the coastal area between cliff and sea. Aerial photographs showed that Mokmer airfield, about 300 yards from shore, had a runway about 4,500 feet long, with an extensive dispersal area. Two other fields, Borokoe and Sorido, were not operational in early May 1944, but apparently the Japanese were working on them. On the southern coast, extending from the shore to the outer edge of the coral reef, were four jetties, which presumably could take barges, probably only at high tide. What appeared to be an excellent motor road followed the coast from the native village of Bosnek west to the airfields, a distance of 10 miles.[38]

The 41st Division, reinforced, less the 163d RCT, originally scheduled to seize the New Guinea coast off Wakde, was designated the HURRICANE Task Force for the Biak operation. With the three Japanese airstrips the initial objective, the tactical plan called for a landing near Bosnek, the point closest to Mokmer where the cliff rose sufficiently far back from the beach to give the landing forces fairly adequate room to maneuver. Upon landing, the troops were to move westward on the coastal shelf and seize the airstrips. The rather abrupt change of the task force's assault area from Toem-Sarmi to Biak gave Colonel Lauterbach, the task force engineer, and his staff, assembled during the first week of May, little time for planning. Studies of Biak's terrain indicated that bringing in supplies and equipment over the coral reefs would probably be a complicated matter. Even though Biak appeared to have a sizable Japanese garrison, no unusual problems were anticipated in combat support. More difficult was planning for base development, largely the responsibility of Col. David W. Heiman, commander of the 1112th Combat Group, and assistant task force engineer in charge of construction. Eight officers and forty-three enlisted men in group headquarters (all those who had not been assigned to Colonel Liles and the Wakde operation) worked with Colonel Heiman on plans for the airfields and the base. Information on what to build was vague. MacArthur's operations instructions of 10 May had

[37] (1) 836th Engr Avn Bn, Hist Narration for 1944. (2) TORNADO Task Force Engr Rpt.

[38] (1) Hq 162d Inf, an. 1–a to FO 1 Essential Elements of Terrain, 24 May 44. SWPA Files. (2) USAFFE Bd SWPA, Rpt 49, Rpt on the Defense of Biak, 29 Aug 44. (Cited hereafter as USAFFE Bd Rpt 49). World War II Rcds Div, 4–2, 149/44.

no engineer annex. On 17 May Colonel Heiman learned at Sixth Army headquarters at Finschhafen that he was to construct two airdromes, one for fighters and another for bombers, and that he would receive additional instructions later. Eventually Biak was to be expanded into a major air base. Heiman's staff prepared tentative plans for airfields and base facilities, using aerial photographs as a guide in locating installations. Eight engineer service units, including three aviation battalions, were scheduled to go in during the first days, to begin work on the airfields and the base as soon as possible.[39]

On the morning of the 27th HURRICANE Task Force arrived off the southern coast of Biak. After the usual naval and aerial bombardment, the launching of landing craft began. The 542d Boat and Shore Regiment (less the boat company at Wakde) and the support battery of the 2d Brigade were on hand. Because of a haze and the smoke of the bombings, which obscured the shoreline, and because the ocean current was stronger than expected, the naval assault vessels imperceptibly drifted westward and by the time of the initial landing were about two miles beyond their proper location; the first waves came ashore to the west of the designated beaches. Buffaloes of the support battery were among the craft coming ashore at that point. Luckily, there was no enemy opposition. The subsequent landings were made at the scheduled places. The beach was about one mile long and 1,000 feet deep; to the rear was the almost vertical cliff, 200 feet high. Though the area was a shambles from the bombing, the amphibian engineers found the two coral jetties satisfactory for unloading. Helped by the 116th combat engineers, they pushed coral over the reef and quickly provided new temporary landing areas and at the same time began the construction of additional jetties. Before long the beachhead was well organized. The Japanese, intrenched in positions in the cliff, made little effort to interfere; the amphibian engineers reported the enemy did no more than fire a few shots.[40]

Soon after the landing elements of the 162d Infantry began to advance along the coastal road toward Mokmer. Company C of the 116th Combat Battalion furnished engineer support. In fair condition, the road required a minimum amount of work. There were a few scattered mines and ineffectual obstacles. At one point, the Japanese had buried, at random, twelve antitank mines, each with an extra charge of two blocks of picric acid. Nearby were two 100-kilogram bombs and two 25-pound naval shells placed nose-up so as to be detonated by pressure from a vehicle. This was the first time since the Admiralties operation that the engineers were called upon to deal with enemy mines. They removed them easily. By the next

[39] (1) Seventh Amphib Force, Rpt of Biak Opn. SWPA File 73. (2) Task Force Engr Rpt on Biak Opn. Both in SWPA File 73. (3) Hq, HURRICANE Task Force, an. 12 to FO 1, Engr. SWPA Files. (4) GHQ SWPA, OI No. 51/1, 10 May 44, with ans. 1–4. SWPA File A288. (5) Ltr, Heiman to Staff Br, 13 Oct 50. SWPA Files.

[40] (1) Seventh Amphib Force, Rpt of Biak Opn. (2) 2d ESB, Monthly Hist Rpt of Opns, May 1–31, 44. SWPA File E–20–5. (3) Rpt, Capt Wallace M. Mulliken, Adj 542d EBSR, to Krueger, 29 Aug 44. SWPA File 73. (4) USAFFE Bd Rpt 49.

morning the infantry had reached the eastern end of Mokmer. Enemy resistance was so strong the troops were forced to withdraw a distance of about half a mile, where they were pinned down by machine gun and mortar fire and harassed by enemy infiltrators. Repeated Japanese frontal attacks were repulsed with heavy losses to the enemy.[41]

On 30 May the 864th Aviation Battalion, under Lt. Col. E. L. Griggs, Jr., arrived at Mokmer. The men were to reconstruct the strip as a fighter, and eventually, a bomber field. The Japanese, entrenched in various places in the coral cliff, were able to prevent any kind of work from being done. Since the Americans had been ashore for three days and still had no airfield and slight prospects of getting one soon, another location had to be found. General Krueger thought a field might be built in the interior of the island north of Bosnek, but engineers sent out on reconnaissance reported it would take at least three weeks to construct one there. Several small islands off Biak's southern coast were a possibility. Engineers, airmen, and naval personnel, surveying the islands during the first days of June, agreed that Owi offered a good site. Construction was urgent. It was rumored that the Japanese were planning to send in reinforcements and that an enemy fleet "had been sighted five hours off Biak." [42] Meanwhile, the one aviation battalion on the island, unable to work on Mokmer, was building jetties, widening the road along the beach, unloading ships, carrying water to the infantry, and maintaining trails to the front lines. On 6 June, General Fuller, commander of the 41st Division, directed construction of a field on Owi. That same day Company B of the 864th was sent over to begin work. The remainder of the battalion arrived during the next five days.[43]

General Fuller had meanwhile decided to capture Mokmer by an enveloping movement. He directed the 186th Infantry, at that time in the Bosnek beachhead, to drive westward along the top of the coral cliff. On 1 June Company B of the 116th Combat Battalion was attached to the infantry for support. As the infantry advanced, the engineers built a road in the rear to bring up supplies; from the 2d to the 5th of June, they completed seven and one-half miles. The advance met strong resistance. At night, the engineers bivouacked within the infantry perimeter; but during the day, unable to maintain continuous contact with the infantry, they had to furnish their own protection. On one occasion, a group of Japanese attacked a working party, tried to cause panic by "screams and fiendish laughter," and killed one man and wounded three. A few days later, a Japanese threw an explosive charge at the windshield of a moving truck, the driver stepped on the accelerator, and the charge bounced off, exploding harmlessly.

[41] (1) Rpt, Co C 116th Engr Combat Bn to CO 116th Engr Combat Bn, 18 Aug 44. (2) Rpt, Hq 116th Engr Combat Bn to CG 41st Div, 20 Sep 44. Both in SWPA Files.

[42] Hq 864th Engr Avn Bn, Narrative Rpt of Biak and Owi Islands Opn, Covering Period 11 May–20 Aug 44, dtd 31 Aug 44.

[43] (1) Hq 1112th Engr Combat Group, Hist Rcd of Opns at Biak Island, 7 May–15 Jul 44. (2) Memo, Sturgis for Casey, 12 Sep 44. SWPA File 73. (3) Rpt Mulliken to Krueger, 29 Aug 44.

A severe handicap was the shortage of water, unusual in the Southwest Pacific, where, as a rule, sources were plentiful. Each man of Company B was allowed one canteen daily for drinking; there was none for washing or cooking. A drenching rain on 6 June kept operations from coming to an almost complete standstill. The men were so eager to get water that they spread their ponchos to serve as catch basins to direct water into their helmets. On the 7th the infantry descended on the coral ridge to the north of Mokmer. The Japanese were forced to retreat westward.[44]

On 8 June two aviation battalions, the 860th, under Lt. Col. Benjamin E. Meadows, and the 863d, under Lt. Col. Raymond J. Harvey, landed at Bosnek. The former was scheduled to help the 864th engineers on Owi; the same day Company B went to the island; Companies A and C followed shortly. The mission of the 863d was to make Mokmer operational within a day and a half.[45] The big problem was getting the men to Mokmer. General Fuller and Colonel Heiman, discussing the matter, agreed the most expeditious way would be to transport them by LCT.

During the night of 9–10 June Company A set out from Bosnek. Colonel Heiman helped bring in the first elements near the airfield. The landing was made across a coral reef, 200 yards wide, before dawn, under blackout conditions, with the continual threat of Japanese mortar and artillery fire opening up, should the enemy become aware of what was going on. A 6-foot tide came in so rapidly that nearly all equipment was swamped; it had to be pulled ashore and left to dry out. "We had to work fast and in the darkness on a strip of beach that was strange to all of us," Colonel Heiman wrote. "We were lucky." [46]

The situation at Mokmer had not improved. Engineers, making a reconnaissance of the field soon after dawn, came under enemy machine gun fire; during the remainder of the day shelling was so heavy that no work could be done. The next day conditions were just as bad. Since improvement of the airfield was impossible, most of the aviation engineers were assigned to providing combat support for the infantry driving westward toward Borokoe. On 12 June, when fire on Mokmer slackened considerably, some of the aviation engineers once more began to work on the field. This time their efforts were not seriously interrupted, and by nightfall they reported to Colonel Lauterbach that the runway could receive fighter planes. But during the next two days enemy fire on the field was again so strong that little could be done. Most of the aviation engineers were again put to work supporting the infantry.[47]

A major job was destroying the enemy in the caves and tunnels in the coral cliff. Helping the infantry blast the enemy out of their hideouts was one of the most strenuous tasks of the 116th Combat Battalion. On one occasion, a

[44] Rpt, Co B 116th Engr Combat Bn to CG 41st Inf Div, 10 Jul 44. SWPA Files.

[45] (1) Ltr, Meadows to Krueger, 28 Aug 44. SWPA Files. (2) 863d Engr Avn Bn, Rpt on Biak Campaign.

[46] Ltr, Heiman to Staff Br, 6 Oct 50. SWPA Files.

[47] (1) Task Force Engr Rpt on Biak Opn. (2) Hq 864th Engr Avn Bn, Narrative Rpt of Biak and Owi Islands Opns.

voluntary detail from Company C went into the caves near the airfields and spent two days cleaning out enemy troops. With rifles, grenades, bazookas, and flame throwers, infantry and engineers entered the intricate network of caves and tunnels. In some cases they lowered explosive charges into cave entrances and detonated them. The engineer-infantry teams considered the flame thrower especially useful, since it either burned the Japanese or drove them out of the cave so that they could be dealt with by rifle fire. Combat, amphibian, and aviation engineers at times helped the infantry. Destroying the Japanese not only in the cliff but also in other areas of the island was a laborious task and required three weeks of continuous effort.[48]

On 15 June General Eichelberger temporarily took command of HURRICANE Task Force. Three days later reinforcements, requested before he took over, reached Biak. Eichelberger followed the tactical plan already in effect. The Japanese withdrew from the two westernmost airdromes and at the same time retreated northward from the coral cliff. Interference with work on Mokmer lessened noticeably. On 18 June the 863d Aviation Battalion had a runway, 5,000 feet long, in excellent shape for fighters; the same day a 4,500-foot coral strip, finished on Owi, was able to take several P–38's, which made forced landings, and a B–25. Three days later planes began using Owi regularly, and on the next day P–40's began operating from Mokmer. Work was coming along well on Borokoe and Sorido, and plans were being prepared for the construction of base facilities. The airfields on Biak had fallen behind schedule, mainly because of enemy interference. On Owi, enemy action was limited to air attacks which caused little damage, but a major concern was scrub typhus. The 864th had 64 cases; one officer and two enlisted men died of the disease. Many were sick of fevers, the exact cause of which was unknown.

Progress by Midyear

By the end of June the Allied forces were solidly entrenched at various points on the New Guinea coast and nearby islands as far west as Biak. Combat was largely over. In the Admiralties, the combat phase had ended on 18 May, when the Navy took over responsibility for airfield and base construction. Although Hollandia and Aitape were to remain under Sixth Army control until late in August, construction was now the only concern there. Early in June, Japanese resistance was broken at Toem, and Maffin Drome fell into American hands. Wakde and Biak were still under Sixth Army, but there was no fighting on Wakde and little on Biak; on these islands, the major tasks were airfield and base construction. In the South Pacific, where combat was a thing of the past for U.S. forces, troops were being transferred to more active theaters. The only area where fighting still seemed likely was to the east of Aitape along the Driniumor River. Here a Japanese build-up was in progress and an enemy drive westward seemed probable. For

[48] (1) Ltr, CO Co C 116th Engr Combat Bn to CO 116th Engr Combat Bn 18 Aug 44. SWPA Files. (2) Ltr, Co E 542d EBSR to CG 2d ESB, 17 Aug 44. SWPA Files.

the engineers there had been little difference between the combat phase and the logistics phase of operations; from the start, their major tasks had been building airfields and bases.

Logistical Support

Combat Versus Construction

"As usual, the Engineers up here are way out in front," Colonel Sturgis had written on 13 September 1943. "That's what makes this war so different." [49] This statement was equally true of the campaign along the New Guinea coast in 1944. The struggle in the South and Southwest Pacific was a war of bases. The engineers had to devote by far their greatest efforts to building logistic facilities as quickly as possible in one of the world's most underdeveloped regions. The rugged terrain of Netherlands New Guinea and the nearby islands was similar to that of Papua, Northeast New Guinea, and the Solomons. On practically every island where the engineers had to build, the interiors were mountainous; the narrow coastal areas, jungled and swampy. Construction had to start from scratch and be carried forward with all possible speed. The progress of the Allied forces toward Japan was to a large extent dependent on the rapidity with which the engineers could build bases and airfields, which meant that extensive construction had to be done during the combat phase of operations. Task force commanders of Sixth Army, responsible for combat missions, were at the same time responsible for starting work on air and supply facilities. Conditions in the South and Southwest Pacific, especially in the latter theater, were thus greatly different from those in the European theater of World War I, upon which much of the pre-World War II concepts and planning had been based.[50]

In both theaters tasks of the combat engineers were surprisingly light. In the operations along the New Guinea coast, divisional engineers landed, as a rule, in the third and fourth waves, prepared to meet strong resistance, but in the first six months of 1944, tenacious enemy opposition had been encountered only in the Admiralties and on Wakde and Biak. At most landing places, the overpowering bombardments had driven the Japanese away from the beaches. Such defenses as were found were not formidable, with the exception of those on Wakde and Biak. Many were demolished or made useless by explosives. Engineers, with bulldozers, destroyed numerous pillboxes and roadblocks. The Japanese rarely used mines, and when they did, it was in an incompetent manner. The engineers themselves seldom laid any because the advance was so rapid and the enemy rarely counterattacked. There was little need for bridging, either temporary or permanent. River crossings were infrequent because of MacArthur's strategy of leap-frogging along the New Guinea coast and across the nearby islands. When overland movements were made, bridging opera-

[49] Ltr, Sturgis to Mr. H. B. Deal, H. B. Deal Constr Co, 13 Sep 43. Sturgis File, Personal Corresp, 1943–44.

[50] (1) Ltr, Lane to C Staff Br, 28 Jul 47. SWPA Files. (2) Col Girard B. Troland, Notes on Army Engr Opns in SWPA. SWPA File 104.

tions had to be restricted. The sudden heavy rains of the region quickly produced swollen streams and rivers, in most cases precluding the use of ponton bridges. The only noteworthy instance of such bridging up to this point had been the Australian crossing of the Markham River near Nadzab. There were no American bridging units in the South or Southwest Pacific. One estimate was that in the campaign along the New Guinea coast, combat support made up only 10 percent of the effort of the divisional engineers.[51]

In contrast, construction tasks during the combat phase were heavy; by the time USASOS took over, a vast amount of work had already been accomplished. Task force engineers faced numerous problems. Their staffs were generally too small to handle extensive construction missions adequately. They frequently found it difficult to assemble adequate staffs because task force commanders, as a rule, did not think in terms of base construction being done during the combat phase of operations. Even when staffs were adequate insofar as numbers were concerned, time was usually too short to build up an efficient organization or to plan carefully. Partly because of the shortage of shipping, task force engineers found it hard to get enough men and equipment early in an assault. No definite rule existed as to whether the task force commander or his engineer should command the engineer units of the task force. Commanders generally expected their staff engineers to direct the work of the engineer units, and, as a rule, staff engineers did exercise command functions. The fact that so much heavy construction had to be performed in the combat zone and sometimes in the midst of fighting necessitated resort to numerous administration procedures that were hardly orthodox according to prewar planning. Yet there seemed to be no other way of doing the construction quickly.[52] Giving to task force commanders the responsibility for initiating base construction was, in Casey's opinion, ". . . definitely the correct procedure under the conditions which prevailed in the Southwest Pacific." [53]

The New Bases

Engineer work went on apace, whether under Sixth Army or USASOS. By mid-1944, work in the Admiralties was far along. After the friction between Army engineers and Seabees had been eliminated early in April with the reorganization which placed the Seabees directly under the task force engineer, operations were much improved. On the 21st of the month Sverdrup, after a visit to the islands, had reported that Momote and Mokerang were operational. "Meeting the deadlines, is in my opinion the finest construction achievement yet accomplished in SWPA," Sverdrup wrote. "It was accomplished by a tremendous amount of

[51] (1) Ltr, Maj John E. Brewer to The Comdt The Engr School Ft. Belvoir, 30 Sep 44. EHD Files. (2) Of C Engr SWPA, Engr Tech Intel Bull, 20 Sep 44. SWPA File M163.

[52] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 122–23. (2) Ltr, Brewer to The Comdt The Engr School Ft Belvoir, 30 Sep 44. (3) Ltr, Sturgis to C Staff Br, 7 Aug 50. SWPA Files.

[53] Ltr, Casey to Sturgis, 14 Aug 50. SWPA Files.

energy and drive. . . ." [54] By mid-May, the Army engineers had built two docks, camps for American and Australian troops, a pipeline jetty, and had almost finished putting up storage tanks for 40,000 barrels of gasoline. The naval construction battalions were continuing with work on the naval base. Work was going ahead rapidly at Hollandia—Base G—where, by mid-June, the engineers were developing the largest base in northwest New Guinea. The camps at Hollandia were extensive enough to house a community of 35,000 people. The engineers had provided three airfields. They had built three jetties and one floating dock, and had started work on a pile dock. They had installed four 2,000-barrel tanks for gasoline, had put in 13 miles of pipeline, and had completed 70 miles of road through swamps and over mountains. Army engineer units and RAAF works units were working on the lesser base at Aitape. On Wakde, construction was shaping up well, and by early June the runway had been extended to 7,000 feet. Additional facilities constructed were minor. In June Colonel Liles, the task force engineer, was directed to construct tanks for aviation gasoline and a jetty, and, later that month, the engineers were making preparations to build a hospital and a liberty ship dock on the nearby New Guinea mainland. The island of Biak—Base H—was being transformed into the second largest base in northwestern New Guinea. By the latter part of June, the engineers had two bomber runways there in excellent condition. Work on a third—Borokoe—was under way. Under Colonel Heiman, the engineers prepared to do extensive work on Biak and build, in addition to the three airfields, a complete array of facilities, including two jetties, eight LST slots, a floating dock, storage for gasoline, a staging area with camp facilities, tented hospital facilities, and some 13 miles of road, all scheduled to be completed in early August.[55]

Bougainville

While work was going on along the New Guinea coast, the development of a huge supply base in the service command area of Bougainville was progressing. A principal task of the 131st Engineers, one of the first units on the scene, was clearing the jungle for camps and storage areas. One of the largest projects was the ration dump for the Quartermaster Corps. Four hundred men with hand tools, 6 bulldozers, 2 clamshells, and 20 dump trucks worked for two months "before any semblance of order" was brought out of the swampy jungle. The cleared area was equal in extent to four large city blocks. The storage platforms were erected on man-made elevations, 375 by 60 feet. Each platform, 60 by 30 feet, was designed to support 100 tons of rations. The 131st Engineers used their sawmills to prepare lumber from coconut logs, and by the end of April, the men had built about ten platforms on each elevation. Sup-

[54] Memo for Rcd, Sverdrup, 21 Apr 44. SWPA File 164.

[55] (1) Task Force Engr Rpt, Opns at TEACUP, 13 May 44. Sturgis File 39. (2) USAFFE Bd Rpt 31. (3) TORNADO Task Force Engr Rpt. Sturgis File 42.



HOLLANDIA DEVELOPMENT, 1944. *Above, General MacArthur's quarters. Below, a water purification unit.*



plies were covered with canvas without framing. While canvas was easy to provide, it was not altogether satisfactory because of the fungus growth which spread over it rapidly, causing it to rot; roofing paper would have been preferable. Fruits and other items likely to be pilfered were kept within a barbed wire enclosure 400 feet square. Also within the enclosure was a tin hut for storing flour. The engineers built seven bakeries capable of producing 15 tons of bread daily. They cleared 2.5 square miles of jungle and here erected hundreds of small isolated bays for storing ammunition for ordnance units. An area of 4.5 square miles was cleared for gasoline storage tanks. The chemical warfare dump covered an area of about one square mile. Camps and hospitals were under tents. In all cases, simplicity of construction was the rule. Because of the high seas, it was almost impossible to build piers and wharves. Landing craft lightered supplies to a beach 600 feet long which had been selected as the main unloading area. Here sand was piled up to a height of 10 feet above the breakers at high tide. The amenities were not forgotten. Ten men with bulldozers worked for a week to clear an area 375 by 600 feet. The engineers then erected ten buildings to house such organizations as the Red Cross and the chaplain's section. They built a theater, called Loew's Bougainville, constructed three tennis courts, two of them with concrete surfaces, and laid out a baseball diamond.[56]

[56] (1) Serv Comd APO 706, Final Unit Hist. 98-SC10-0.1 (16478)M 23 Dec 43-Dec 44. (2) Hist of the 131st Engr Combat Bn.

Decline of Older Bases

At the older bases in the two theaters construction declined, and at some it ceased altogether during the first six months of 1944. The principal bases of 1942 and 1943 in the Southwest Pacific —Port Moresby, Milne Bay, and Oro Bay—were no longer of strategic importance. Port Moresby was the first to be discontinued. Milne Bay was still being developed. Here by early 1944 the engineers had completed 14 docks for Libertys and had three more still under construction as well as several docks for small ships. A ponton assembly plant, finished by mid-1944, was turning out 1,800 ponton cubes a month to be used for floating piers or barges. At Oro Bay, some berths for Libertys and other facilities were finished early in the year, but by mid-1944 Oro Bay had greatly declined. Lae had been developed mainly as a support and supply base for construction and operations at Nadzab; as air activity moved away from the Markham Valley, Lae lost its importance and was little used. Base F at Finschhafen, established officially 15 November 1943, was the largest base in New Guinea during the first half of 1944. Most transports going to that island docked at this port, where base facilities extended for 35 miles along the coast. By the end of April, the engineers had constructed 12 Liberty ship docks, 2 small ship docks, 2 oil jetties, almost 2,000,000 square feet of storage, 12 hospitals, 4 main staging areas, camps for two divisions, and 75 miles of roads and bridges. In the South Pacific, only Bougainville was an extensive base by mid-1944. The bases at New Caledonia,

Espíritu Santo, and Guadalcanal were being dismantled.[57]

Troop Shortages and Reorganization of Units

Still one of the most critical problems in the building of bases was the chronic shortage of engineer units, particularly those needed for heavy construction. Many Sixth Army engineers considered the inadequate number of construction units as their most frustrating problem. Various ways were devised to get the work done. The policy of not giving the Army Air Forces exclusive control of the aviation battalions was now showing its worth; task force commanders put the battalions on many types of work urgently needed in the forward areas. Many units, such as combat battalions, with no jobs to do for which they were trained, were assigned to construction projects. A number of nondivisional combat battalions and camouflage companies were reorganized as construction units. Engineer units, no matter of what type, were often put on any job which needed doing. "Aviation battalions have built docks," Major Brewer wrote, "combat battalions . . . airdromes, and Seabees have built army headquarters." [58]

As exasperating as the shortage of units was the failure to receive enough replacements to bring the depleted units up to authorized strength. To fill the gaps, men were transferred to engineer units principally from the infantry and artillery; but until they were at least partially trained for their new assignments, they could do little to speed up construction. One hopeful sign during the later phases of the New Guinea Campaign was that gradually a proportionally greater number of engineer construction units and replacements were arriving in the Southwest Pacific.[59]

The "nontraditional" kind of warfare in the Southwest Pacific necessitated changes in the organization of some types of engineer units. The combat battalions, in particular, seemed to stand in need of changes in organization. These units were called upon to do a great deal of construction; in fact, generally speaking, their primary mission was construction. The battalions were inadequately organized and equipped for their tasks. To make them really effective units they needed a substantial amount of additional equipment. At Casey's request, MacArthur asked the War Department for more machinery for the battalions, but no action was taken in Washington. In 1944 the theater assigned additional personnel and equipment to the battalions. Certain types of construction units also needed changes in organization to make them more suitable for the theater. As has been seen, the units early found unsuitable for the far-flung operations of the Southwest Pacific were the general service regiments. They were of unwieldy size and inadequately equipped for construction jobs at widely separated places in a

[57] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, I, 196. (2) Of C Engr GHQ SWPA, Annual Rpt for 1944 (Draft MS). SWPA Files.

[58] (1) Ltr, Brewer to The Comdt The Engr School Ft. Belvoir, 30 Sep 44. (2) Engr Sec Sixth Army, Engr History, ch. XI.

[59] Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 120ff.

fast-moving campaign. It was often necessary to split them into battalions, companies, and detachments. In 1943 the War Department had organized the construction battalion. This unit, with some 900 officers and men, was the equal of an aviation battalion in earth-moving capacity and of a naval construction battalion in equipment and grades for enlisted men. After 1 April 1944 the War Department sent only construction battalions to the Southwest Pacific. The theater converted a number of its general service regiments into construction battalions. Airborne aviation battalions, successfully used in the Markham Valley, subsequently proved to be impractical in the Southwest Pacific because their equipment was too light. Elements of an aviation or construction battalion flown to an assault area with regular equipment could accomplish far more. Late in 1944, the airborne battalions in the Southwest Pacific were converted into aviation battalions or aviation service companies.[60]

As the scope of base construction along the New Guinea coast increased, a need became apparent for some kind of engineer headquarters to function under the task force commander and be responsible for planning engineer work and supervising the activities of engineer units in a newly seized area. The task force engineer's staff was too small and sometimes too preoccupied with combat duties to be able to give sufficient time to supervising construction units under the task force commander's control. Even at rear bases, there was a need for some kind of engineer headquarters to direct the activities of the often large numbers of units charged with construction. The engineers had no organization higher than a regimental headquarters to command construction units. They had, however, adopted the brigade type of organization for amphibious operations. Other arms and services had likewise adopted this type of organization for supervising a number of units engaged in similar activities. Casey and others believed that engineer construction units should be similarly supervised to make possible better direction and control. In March 1944, MacArthur requested the War Department to authorize the activation of two construction brigades. The War Department informed MacArthur that he could activate the two units, and in June two were organized—the 5201st and 5202d—the former under Colonel Robinson and the latter under Col. Orville E. Walsh. Each brigade headquarters would have 21 officers and 88 enlisted men; for operations in a forward area, engineer units would be assigned to a brigade as needed. The plan was to use the brigades for the first time in the coming campaign in the Philippines.[61]

Construction Standards

Construction in the Southwest Pacific continued to be on a hand-to-mouth basis. A great deal of it was required quickly, and there were relatively few troops, meager amounts of materials, and inadequate quantities of equipment with which to do it. "Military engi-

[60] Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 143ff.

[61] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 144-46. (2) Ltr, Lane to C Staff Br, 28 Jul 47. SWPA Files. (3) Memo, Klinke for Casey, 12 May 44. SWPA File 42.

neering, as opposed to engineering in civil life," Colonel Sturgis wrote, "must assume certain risks in the all-important and prevailing interests of speed of construction and lack of materials." [62] In no theater involved in the war with Japan was military engineering put to a greater test than in the Southwest Pacific. To meet theater needs, the engineers in Casey's and Colonel Ross's offices had developed "standard" designs for many types of construction to meet the special requirements of the theater. Equally valuable were the calculations made as to the work potential of the different types of engineer units. By 1944 the units which had been longest in the theater had acquired considerable experience in building in the Southwest Pacific so that, even without "standard" plans, they often knew the best way to proceed. As before, a basic precept was to make as much use of expedients as possible. On the whole, the engineers carried out their missions successfully.[63] "The pressure for speed of construction from all sources, GHQ, Air Force, and hence by this headquarters," Sturgis informed Maj. Gen. Lucius D. Clay, one of Somervell's assistants in Headquarters, Army Service Forces, "has, due to its being the entire key to the advance, been indescribable. I can say that in spite of this green hell we have not failed yet. . . ."[64]

By the time of the New Guinea Campaign, specifications for airfields and procedures for their construction were fairly well standardized. The task force engineer and the local air force commander were, as a rule, the ones who actually selected the site at a forward base. A field usually consisted of one strip or two parallel strips together with hardstands, alert areas, and minimum operational facilities. If the engineers put in only one strip they almost invariably built a parallel taxiway alongside it. New Guinea and the adjacent islands had two types of terrain best suited for airfields: the lowlands near the sea and the "benchlands" a little farther inland. In the lowlands, the most satisfactory places were in the coconut groves, which, as a rule, had been planted in the best drained areas. The "benchlands" were usually fairly well-drained, level stretches, overgrown with kunai grass. By cutting the grass and removing the boulders, the engineers could quickly provide a strip on which transport planes could land. A more substantial runway would then be constructed for fighters with the base course and surfacing of rock, gravel, and sand, which were usually found in quantities in the stream beds nearby. Since the richest gravel deposits frequently contained quantities of large stones, rock crushers were at a premium. Bombers required more substantial surfacing. Usually this was bitumen. The method of construction that the engineers had developed in Australia and Papua during the first year of the war—two or more coats of bitumen, thinned with diesel oil, on a well-compacted base of sand and gravel—proved adequate for the fields along the New Guinea coast. Runway failures during heavy rains were now rare because the men had learned from experience the importance

[62] Memo, Sturgis for Col George H. Decker, CofS Sixth Army, 16 Jan 44. Sturgis File 25.

[63] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, 425ff. (2) Troland, Notes on Army Engr Opns in SWPA.

[64] Ltr, Sturgis to Clay, 19 Aug 44. Sturgis Files, EHD.

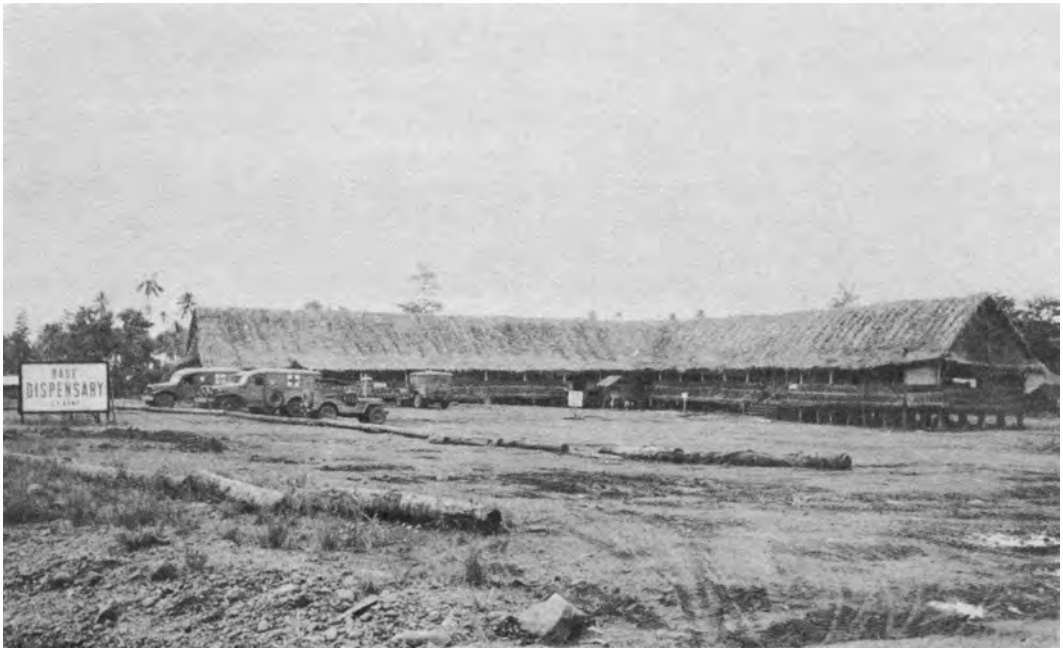
of adequate drainage. Coral, while plentiful in most coastal areas, was not as extensively used as in the Central or South Pacific. At some fields, the engineers laid steel mat. Most often it would be a field that needed some kind of surfacing quickly or was so located that it was difficult to send in materials and equipment. If steel mat was used, the field would in all likelihood be a temporary one and would not be developed further. In most of the areas seized along the New Guinea coast, the Japanese had already built one or more fields at the most favorable sites, but these fields were so poorly constructed that they could seldom be used without being extensively rebuilt. The runways were too short, and their substructures not solid enough for heavily loaded planes. If practicable, the engineers would improve the runways. Pursuit planes could usually land on a captured field in two or three days, but at least two weeks of additional work would be required before a plane heavier than a C–47 could safely land.[65]

At a new base, supplies were initially stored in the open or under canvas. Later they were transferred to newly erected prefabricated warehouses, most of them of the standard widths of 20, 44, or 88 feet, and all of light construction. Since winds in the combat zone of the Southwest Pacific seldom exceeded 15 miles an hour, such buildings were adequate. Considerable quantities of lumber were needed for the sides of the warehouses. To cut down on the amount, several of the smaller structures would be combined and interior posts used to support the roof—one large warehouse would, of course, require less siding than a number of small ones containing the same amount of space. Roofs were of corrugated iron or sisalcraft; floors were usually graveled. Excellent as shop buildings were native-type structures, their framework lashed together with vines and their roofs and sometimes their sides covered with kunai grass or sago palm. Because of the fire hazard, such structures were not much used as warehouses.

Hospital wards were at first usually under canvas or in native-type buildings. The latter had wide, overhanging eaves and no sides. Sago palm was generally used for roofing. Kunai was not suitable because it contained quantities of grit and sometimes not a few insects including ticks that transmitted typhus. The 20-foot-wide prefabricated buildings were used as surgeries, clinics, messes, and warehouses. As soon as possible, wards were transferred to prefabricated buildings.

Construction of piers followed uniform procedures. Design had been standardized. At a new base, the Navy's ponton floating wharves would at first be used. Meanwhile, the engineers would construct timber wharves as rapidly as possible so that the ponton structures could be moved forward. Specifications for Libertys, for example, called for a pile structure, 300 by 30 feet, parallel to the shore. Sets of materials, including piling, were shipped from rear bases. If the troops building a

[65] (1) Troland, Notes on Army Engr Opns in SWPA. (2) Ltr, Haseman to C, Staff Br, 28 Nov 50. SWPA Files. (3) Ltr, Kenney to Arnold, 24 May 44. AAF, RG–501, Central Files, 312. 1–J. (4) Ltr, with Incls, Casey to Col B. M. Harloe, C Engrg and Development Div, Of CofEngrs, 17 Apr 44. SWPA File 104.



DISPENSARY IN NATIVE-TYPE BUILDING, MILNE BAY

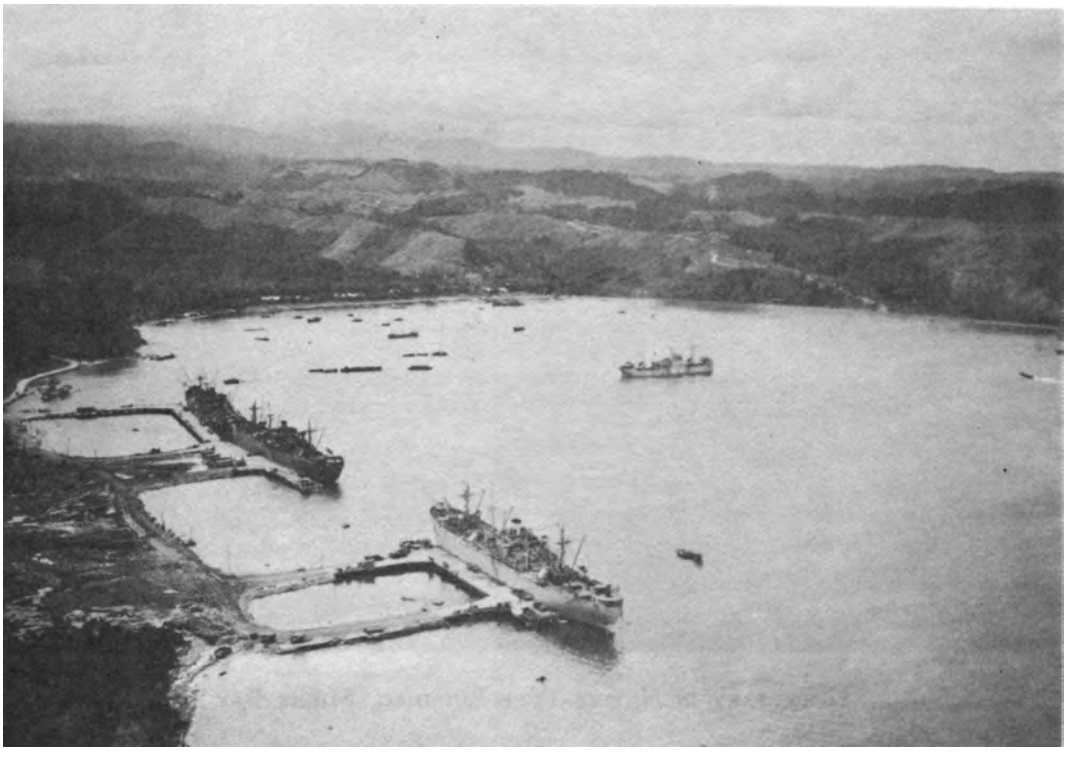
dock had a sawmill, they could easily supply additional materials from local timber. Besides docks for Libertys, the engineers built jetties and crib wharves for barges and smoothed out landing points for LST's and LCT's.

Bridges were for the most part needed in the areas where base construction was under way. Spans were invariably of wood and usually fashioned from trees found nearby. Because of quickly rising streams during the New Guinea rainy season, stringers and decking had to be securely fastened to the piling. Abutments often had to be bolstered with large rocks.[66]

[66] Troland, Notes on Army Engr Opns in SWPA.

Maps and Intelligence

Requirements for maps and intelligence differed greatly in the two theaters by 1944. In the South Pacific, the demand was dwindling rapidly; in the Southwest Pacific, it was becoming constantly greater and more difficult to meet. General Casey's Intelligence Section, with its two major subsections, Maps and Charts and Research and Reports, had a growing work load. The number of men increased, but not enough to keep up with demands. Authorized on 1 January were 65 men; the section had 35. In April 5 officers and 8 enlisted men were added; in June, 6 civilians arrived from the United States.



LIBERTY DOCKS, ORO BAY

By 1 July, the number of personnel had risen to 54.[67]

Under the operational control of GHQ SWPA and subject to the technical supervision of the Intelligence Section was the 648th Topographic Battalion, which continued operations in Melbourne. Under the 648th's technical supervision were all military map-making organizations in the Southwest Pacific, including the Australian topographic units. By 1 July, there were in the theater, besides the 648th, the 650th Topographic Battalion and five topographic companies. The 650th, which had arrived at Finschhafen in May, was placed under Sixth Army and began to produce maps for planning and combat. The topographic companies, engaged primarily in producing hasty maps for combat, were moved as far forward in the fighting zones as conditions would permit. The 648th still produced most of the maps for the theater. To give the troops a better idea of the terrain they would encounter, models of the objective areas were needed. In April, a model-making detachment of one officer and twenty-one enlisted men arrived at Brisbane, was placed under the Intelli-

[67] The information in this and succeeding paragraphs, unless otherwise indicated, is from Office of the Chief Engineer, GHQ SWPA, Annual Rpt for 1944, Intelligence Section.

gence Section, and installed on the second floor of a warehouse. The men, most of whom were commercial artists in civilian life, began to fashion terrain models, using information gleaned from aerial photographs.[68]

The air forces continued to supply photographs to the map-making units. The system, in effect at the beginning of the year in the Southwest Pacific, whereby the photographic squadrons maintained direct liaison with the 648th Topographic Battalion in order to make engineer requirements better known to the airmen, was continued. The difficulties that earlier plagued the photographic squadrons remained. A new problem developed in the course of the New Guinea operations. In the great leaps forward scheduled for the combat forces, photographic aircraft could not reach an objective area, on an average, until two and one half months before a planned assault was scheduled. In the short time remaining, getting satisfactory photographs and preparing adequate maps was well-nigh impossible.

Mapping units in SWPA continued to have trouble getting topographic supplies. Units which should have been receiving them from engineer bases were either making purchases in Australia or working with reserve stocks they had brought from the United States. Since there were some 35,000 items of topographic supply, efficient requisitioning was of the utmost importance. One of the missions of the Topographic Supply Unit of Casey's Intelligence Section was to gather data on the status of topographic supply in the theater. It advised the Chief Engineer, USASOS, of immediate supply needs and probable future requirements. At the same time, the section suggested ways of improving equipment, packing fragile instruments, and storing supply items properly. Better co-operation between topographic engineers in GHQ and USASOS resulted in improved supply in 1944. As Sverdrup noted, ". . . certain old abuses of critical items have ceased through education; zinc plates are no longer used for roofing sheets, press blankets are not cut into seat pads or laid as flooring, and sensitized paper is not opened in daylight to effect a physical sheet count." While major "abuses" had seemingly been fairly well eliminated, numerous minor ones, caused in the main by "ignorance in the identification, handling, and care of topographic supplies" remained.[69]

The map depots were heavily taxed. The 1604th Map Depot Detachment, responsible for the automatic distribution of all maps, was stationed in Brisbane. It transshipped maps produced by the 648th in Melbourne. The 1603d, located at Finschhafen, distributed maps to task forces. Organized on 26 May, the 1608th Map Depot Detachment was scheduled to begin operations in July at Hollandia, and from there it would distribute maps to units in western New Guinea. The depots shipped out increasing quantities of maps; between 1 January and 1 July, 139 tons went by air from Melbourne to Finschhafen alone. Distribution over ever greater distances

[68] 648th Engr Topo Bn, Interim Rpt, 10 Oct 43–31 Dec 44. SWPA File 15.

[69] Memo, Sverdrup for Ross, 20 Oct 44. SWPA File M168.

posed numerous problems. For maps to reach units as scheduled, officers responsible for distribution in the map depots had to follow up on shipments constantly; at times, even hourly checks were necessary. Still, many shipments went to the wrong places. Partly responsible were the "unbelievable apathy and carelessness" of the personnel handling the shipments.

Since there was a growing need for more information on the terrain of the New Guinea coast and the offshore islands, the Research and Reports Subsection had increasing responsibilities. More men were needed to interpret aerial photographs, now by far the principal source of information on enemy-held territory. A great deal of data was required on landing areas and airfield sites. The civilian specialists who arrived in June were from the United States Geological Survey; they were experts in geology, soil analysis, and the structure of coast lines and beaches. The data supplied by aerial photographs and information brought back by men, including the geologists who had been on reconnaissance in forward areas, were analyzed and written up in a variety of reports.

Supply

Engineer supply gave rise to more and more problems despite the fact that the War Department adopted a somewhat more realistic policy with regard to supply levels. In January 1944 it reduced the requirements for Class II and Class IV items for the South and Southwest Pacific from a 90-day operating level and a 90-day reserve to a 30-day operating level and a 120-day reserve. In the Southwest Pacific, few engineer stocks could be built up as prescribed. As before, fortifications materials were plentiful. Hand tools were up to about 80 percent of demand. Landing mat was ample, since sufficient amounts were arriving from the United States and much of the mat at the older airfields was being taken up, reconditioned, and shipped forward. Australia continued to be an important supplier of cement, lumber, construction materials, prefabricated buildings, and certain types of equipment. During 1944 about 25 percent of the stocks the engineers received came from Commonwealth sources. But numerous items needed for construction remained in chronically short supply. The most severe shortages were in corrugated iron, lumber, electric and welding supplies, nails, and bolts. As before, shortages were partly the result of the lack of shipping from the United States. On 1 May the backlog of engineer cargo awaiting shipment from the United States totaled about 300,000 ship tons. Backlogs piled up in the theater also; by the end of May, 32,000 ship tons had accumulated in Australian ports, and the amount was increasing. These developments were partly the result of inadequate docking and unloading facilities at many of the New Guinea ports for handling the quantities of supplies now arriving from the United States and Australia. One encouraging sign, during 1944, was the increase in the amounts of supplies in the theater. Gradually engineer depots were becoming better stocked.[70]

[70] Of C Engr GHQ AFPAC, *Engrs of SWPA*, VII, 124ff., 129ff.



SECTION OF THE MAP DISTRIBUTION AREA, FINSCHHAFEN

With increasing shipments from the United States and the continued forward movement of the Allied forces, problems of distribution became acute in the Southwest Pacific. As has been seen, the engineers had no central supply depot in the theater. Up to 1944 units requisitioned from various USASOS engineer depots. One of the chronic shortcomings of this system was the lack of stock control. No engineer office had over-all knowledge of what items were in the theater, how many there were, or where they were. Shortages of supplies and the enormous distances within the theater made distribution all the more difficult. In the opinion of many engineer officers, a central depot was necessary. "Stock records, location of stock and inventories must be kept by a centralized agency," Col. Charles H. McNutt, executive officer of the Chief Engineer, USASOS, stated. "No depot can know what the others may have from day to day and in any case cannot handle supply distribution." [71] During the first half of 1944 efforts were made to improve procure-

[71] 1st Memo Ind, McNutt to Casey, 3 Sep 44 on Memo for Rcd, Of C Engr GHQ SWPA, 30 Aug 44. SWPA File 223.

ment in the theater and provide better stock control. On 1 January General Frink set up the Procurement Division at Sydney. It was to co-ordinate the purchase of all supplies in Australia. Its Engineer Branch at first had seven officers and one enlisted man. On 1 February General Frink established the Distribution Division at Sydney and Distribution Branch, Base A, at Milne Bay; these two offices would supervise the distribution of supplies in the theater. The Engineer Branch of Distribution Division, with a staff of about thirty, including military and civilian personnel, began operations in February; the Engineer Section at Milne Bay, with an initial staff of fifteen, began work at about the same time.[72]

New theaterwide procedures for requisitioning and distributing were established. Henceforth, all requests for supplies from engineer units went to the Engineer Branch of the Procurement Division. The branch prepared lists of items that might be purchased in Australia and forwarded them to the general purchasing agent for submission to the Australian Government. Supplies not available in Australia were requisitioned on the United States. More troublesome than requisitioning was getting supplies to the units. The engineers of the Distribution Division began the monumental task of setting up a file of stock control cards for all engineer items in the theater. Once a month, they sent out questionnaires to the engineer supply depots for information as to the quantities of items on hand.[73]

It took time to get things organized. Col. Charles R. Bathurst, who upon his arrival in the theater in December 1943 became Casey's supply officer, visited the Engineer Branch of Distribution Division late in March. He reported that the organization, with 20 officers and 89 civilians, was "understaffed and overworked." Many of the civilians were inexperienced, and considerable effort had to be made to train them. In the two months since it began work, the branch had sent out 60,000 inventory and requisition forms, and it had organized a file index of some 15,000 stock control cards. Estimates were that 200,000 cards would eventually be required and that a force of 240 civilians would be needed.[74] The small section at Milne Bay did not really get started with its work until 15 April, when it settled down to furnish engineer supplies for Base G at Hollandia. This first major project could be accomplished only by extraordinary efforts because the organization was new and the staff too small. "The Engineer supply requirements for operation G," General Casey wrote to the Deputy Chief of Staff, USAFFE, on 21 April, "will virtually deplete all available resources in this theater. . . . if requirements for immediate subsequent operations are to be provided, special action must be taken to procure and ship engineer construction materials

[72] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 64. (2) Ltr, Engr Br Distr Div USASOS to Dir Distr Div USASOS, 26 May 44, sub: Hist Rpt, Period Covered 1 Feb 44–31 Mar 44. World War II Rcds Div.

[73] (1) *Ibid.* (2) Hq INTERSEC USASOS Distr Br Engr Sec, Sec Diary, 17 Feb–30 Jun 44, 17 Jul 44. World War II Rcds Div.

[74] Memo, C. R. B[athurst] for Casey, 22 Mar 44. SWPA File 163.

and equipment aggregating a very large quantity in tonnage." [75] In order to have supplies within a reasonable time, the chief of the Engineer Section at Milne Bay was getting ready to take the requisitions to the United States and follow through in person.

Steady progress was made. Stock control cards at Milne Bay increased from 3,000 in mid-March to over 6,000 by 1 July. By this time requisitions had been processed for 150,000 ship tons of supplies and equipment for Hollandia, Wakde, and Biak. There were interruptions to the work, however. Late in June the Milne Bay Distribution Branch was moved to Oro Bay. Since USASOS installations still in Australia were soon to be moved to New Guinea, plans now called for moving Distribution Division from Sydney to Oro Bay and consolidating it with Distribution Branch. Such a move would mean the loss of the Australian civilians, who had now become settled in their jobs, since the Australian Government would not permit them to go to New Guinea. Operations of the branch would suffer.

Task force engineers were fortunate if they received supplies on time and in sufficient amounts. Procedures for securing supplies had been standardized. A task force engineer sent a list of his needs to the Sixth Army Engineer Section, where it was edited and, if approved, was forwarded to the engineer depot at Finschhafen. That depot supplied as many stocks as it could and sent a request for the remainder to the Distribution Branch at Milne Bay. As a rule, one platoon of a depot company went in with a task force to store and distribute supplies. A common complaint was that supplies were sent forward without adequate ships' manifests. At Wakde, the only means of locating certain materials was dependent on the memory of the ship's crew that unloaded the materials. Changing needs at some bases, as, for example, Biak, made it hard to analyze supply requirements. Shipping bottlenecks further slowed deliveries. The supply situation at Hollandia appeared to be an exception.[76] There, Casey reported, ". . . the urgency and importance of the priority for unloading engineer supplies required for port facilities is fully understood by the Task Force Commander." Colonel Robinson, the task force engineer, Casey continued, " . . . has had most detailed information as to where all Engineer supplies and equipment are and when they may be expected." The chief engineer went on to say that this was due solely to the "excellent work" of Colonel Sturgis and his staff, who secured detailed data on where engineer supplies were loaded on ships bound for Hollandia and sent it promptly to Colonel Robinson.[77]

Spare Parts

The spare parts situation remained extremely critical. Requirements continued to be exceptionally high and shipments from the United States meager.

[75] Memo, Casey for Dep CofS USAFFE, 21 Aug 44. SWPA File 104.

[76] (1) Memo for Rcd, Of C Engr GHQ SWPA, 1 Sep 44. SWPA File 105. (2) TORNADO Task Force Engr Rpt.

[77] Memo for Rcd, Casey, 26 May 44. SWPA File 164.

It was repeatedly stated that the many makes of equipment in the theater only made a bad situation worse. An added aggravation was the chronic shortage of men trained in stocking and distributing the many types of parts. There had been no parts supply companies in the theater throughout 1943. The first one arrived in January and went to Milne Bay, where it began the job of processing about 8,000 cases of spare parts and storing them in the recently completed warehouse. In April, a second one arrived and went to work on setting up a spare parts depot at Finschhafen. A survey made in the Southwest Pacific in May showed that spare parts were completely lacking for pipeline pumping stations, airborne equipment, refrigeration equipment, jungle warfare equipment, and over forty other major items. Stocks were much too low for twenty-three additional important items. "The statement that parts for all important items . . . are critically short or nonexistent is not an exaggeration," Casey wrote on 6 June to Brig. Gen. Raymond F. Fowler, Assistant Chief of Engineers for Supply. "It is not a question of keeping stocks within prescribed levels but of reaching and maintaining a satisfactory operating level." [78]

The shortages of parts and the enormous distances within the theater rendered efficient distribution of utmost importance. Distribution was normally accomplished by water, but in emergencies air shipments were sometimes made. During June 1944, for example, 650 tons of parts were shipped by water and 50 tons by air. Preparations were under way to fit out ships with bins for spare parts, "floating warehouses" as they were called, which would expedite distribution in forward areas; the first was expected to be ready in November.

With the shortage of spare parts, maintaining equipment was no easy task. To make matters worse, during the first six months of 1944 there was still only one maintenance company in the theater, and additional companies were not scheduled to arrive until after the middle of the year. There were three heavy shop companies, generally stationed in rear areas. A heavy burden was placed on engineer construction units, especially those in the combat zone; most had to do their own third and fourth echelon maintenance.[79]

Efforts were made to better spare parts supply for the amphibian landing craft. In March 1944 the Engineer Branch of the Distribution Division set up a Marine Supply Section. The amphibian engineers henceforth forwarded their requests through channels to this office, and from there the requests were sent to the Navy's spare parts distribution center at Brisbane. Marine supply sections were organized at a number of bases and staffed by amphibian engineers insofar as possible to help expedite the supply of spare parts for landing craft. USASOS organized a special marine supply service of fast nonconvoyed boats which made the run from Milne Bay to Oro Bay, each boat carrying about 300 tons of spare parts. Despite all efforts, shortages remained as severe as ever, and

[78] Ltr, Casey to Fowler, 6 Jun 44. SWPA File 223.

[79] Conf, WD, Washington, D.C., Relative Engr Equip Spare Parts Sup Situation, SWPA, . . . 14 Jun 44. 319.1 SWPA.

numerous craft were deadlined. As before, there were many reasons for this situation—the Navy's Distribution Center at Brisbane was too far from the forward areas where the amphibian engineers were operating; the Navy had underestimated the quantities of spare parts required; production in the United States was inadequate; and distribution to the widely scattered units within the theater was in itself a tremendous task.[80]

Attitude Toward Supply

The serious problems which plagued engineer supply were at least in part the result of the attitude of many officers toward this important responsibility. In the Southwest Pacific, most engineers were apparently not fully aware of the importance of logistic support and of its complexity. Many engineers made determined efforts to avoid supply jobs. "Our best officers," wrote Col. Miles M. Dawson, Casey's supply officer from August 1944 on, "avoided supply duty like poison." Most engineers preferred combat or wanted to be in charge of construction projects where they could point to "tangible" evidence of their work and where the experience gained would probably stand them in good stead later on in the Army or in civilian life. Long hours spent on supply jobs brought little praise. A supply officer was more apt to receive severe criticism. In Colonel Dawson's opinion, supply was frequently on the verge of breaking down, and it was only ". . . the constant effort of a few officers like General Casey . . . and General Sturgis . . . [which] kept the engineer supply situation from becoming a veritable shambles." [81]

Camouflage

Camouflage was of little importance in the South and Southwest Pacific. Higher headquarters never developed an over-all camouflage program since there was no need for one. The troops neglected camouflage almost entirely. By mid-1944 the overwhelming Allied air superiority made concealment seem superfluous even in the most forward areas. Japanese planes came over mostly at night and struck mainly at airfields, which could not be effectively camouflaged in any case. In the Southwest Pacific, a small unit organized initially in the Office of the Chief Engineer, USASOS, subsequently transferred to the Engineer Section in USAFFE and in September 1943 to Casey's office in GHQ, was responsible for formulating the theater-wide camouflage program. It sent literature to the troops, conducted experiments, and supervised the production of camouflage materials in Australia. Three camouflage teams, each consisting of two noncommissioned officers, visited units in the field and advised mainly on camouflaging radar installations and artillery positions. In July two camouflage companies, the 641st and the 642d, each with some seventy officers and men, arrived in the Southwest Pacific and were assigned to Sixth Army. During their first few months in the

[80] Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 142–43.

[81] Memo, Dawson for Casey, 24 Jun 46. SWPA Files.

theater they were engaged mainly in trying to find ways and means of being useful to the combat units.[82]

Training

By 1944 it was increasingly apparent in the Southwest Pacific that some important aspects of engineer training in the United States had not been sufficiently stressed insofar as operations in SWPA were concerned. The most striking deficiencies were found in construction. To begin with, too many officers and men lacked engineering backgrounds, and the few months of training they received in the States did not offset their lack of knowledge. Many officers, too little versed in the principles of earthmoving, compaction, and drainage, could not plan projects properly. Too many enlisted men were not well trained in operating equipment or in how to do their work. Training for combat had apparently been satisfactory, but in the Southwest Pacific it was not the combat units but the construction units which were under pressure. The fact that construction requirements were so much greater than had been considered "normal" undoubtedly explains in part why training deficiencies of the construction units showed up so glaringly.[83] "After World War I," Colonel Lane wrote, "all Engineers were brought up on the histories of divisional Engineers." There was little emphasis on the duties of engineers attached to the Services of Supply and "no real analysis and study of the work of the SOS Engineers" engaged in providing logistic support.[84] Lane's observations were fully supported by other engineer officers in the Southwest Pacific. Unfortunately, the pressure of work in the theater kept the units from receiving additional training. The officers with adequate backgrounds had to help carry those whose engineering backgrounds were deficient.

As in previous years, Australian schools continued to train a small number of specialists. Several new schools were opened. In February 1944 the RAAF opened one in Richmond, New South Wales, to teach maintenance of radar equipment, and assigned a student quota to the engineers. In March and April the LeTourneau Company conducted two schools in Sydney, one of which taught welding, and the other how to operate Tournapulls. Sydney Technical College gave a course in the operation of diesel engines, which fifteen engineers attended. An additional United States Army Engineer school was organized in the first half of 1944 to provide specialist instruction; this was the school in refrigeration mechanics, which opened in Melbourne in February to teach specialists how to operate and repair the various types of refrigerators being used in the theater. Two technical colleges in Melbourne provided facilities and instructors. Payment was by reverse lend-lease. The bomb disposal school at

[82] (1) Engr Sec Sixth Army, Engr History, ch. XI (Draft MS). (2) Memo for Rcd, Col Emil R. Klinke, Opns Of C Eng GHQ SWPA, 7 Sep 44. (3) Memo for Rcd, Of C Engr GHQ SWPA, 1 Sep 44. Last two in SWPA File 105.

[83] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 151. (2) USAFFE Bd SWPA, Rpt 28, Comments on Tng of Engr Units. SWPA File 86. (3) Of C Engr USASOS, Tech Memo, 17 Jun 44. SWPA File 14.

[84] Ltr, Lane to C Staff Br, 28 Jul 47. SWPA Files.

Bonegilla was discontinued in the spring because it was believed a sufficient number of men had been trained to meet theater needs by this time. Small detachments of American personnel, known as mobile bomb disposal schools, traveled from unit to unit and gave refresher courses in bomb disposal. By midyear, plans were under way to open two additional schools, one at Oro Bay to teach equipment maintenance and another at Finschhafen to continue the work of the soils mechanics school set up at Port Moresby the year before.[85]

Specialist schools could train relatively few men. Commanding officers were frequently averse to sending men away to such schools because they believed they needed all available hands in their units. General Casey was of the opinion that it would be best to combine the various specialist schools into one, to be set up at a central location in the theater. The engineers of the lower echelons agreed that a theater school that would provide an adequate program in specialist training for all units would be desirable but were of the opinion that provision of sufficient students, staff personnel, and equipment was beyond the resources of the theater if operations were to be supported to a maximum degree. Since deficiencies in training were becoming more pronounced, the question of whether to organize a school to teach specialists was one which would have to be resolved soon.[86]

[85] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 152–53. (2) Of C Engr GHQ SWPA, Annual Rpt for 1944 (Draft MS).

[86] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 209. (2) Memo, L[eif] J. S[verdrup] for G–3 GHQ SWPA, 11 Nov 44. SWPA File 52.

Western New Guinea and the Moluccas

The remaining operations along the New Guinea coast, while important in the drive toward the Philippines, were of a minor nature insofar as engineer operations, especially combat support, were concerned. Additional areas had to be captured in order to bring MacArthur's air forces within striking distance of the Philippines. The same procedures were followed as before against steadily weakening enemy resistance. Capture of enemy areas was followed by the construction of fighter and bomber fields and the development of minor base facilities.

Noemfoor

Since mid-May MacArthur's planners had had under consideration an assault on Noemfoor, an oval-shaped, coral island, about 15 miles long, located in Geelvink Bay, some 90 miles west of Biak. Seizure of the island would be followed by the construction of airfields and minor base facilities. General MacArthur ordered an amphibious assault for 2 July. The attack was to be made by CYCLONE Task Force, made up of the 158th Regimental Combat Team and supporting units, including the 27th Engineer Combat Battalion. Australian Group Capt. William A. C. Dale was task force engineer. Two aviation battalions and three RAAF airfield construction squadrons were assigned for work on the base and airfields. Enemy troops on the island were believed to total around 3,000. While its terrain was not as rugged as Biak's, Noemfoor was densely

forested and had coral terraces. The Japanese had built three airfields, which could probably be improved without much effort.[87]

The landing was made as scheduled on the northwestern shore near Kamiri airstrip. Units of the 2d and 3d Special Brigades, including the shore battalion of the 593d Boat and Shore Regiment, a boat company of the 543d Boat and Shore Regiment, and the 2d Brigade's support battery took part in the landing. Operations were routine. The only interference from the Japanese was light rifle fire. All troops were transported in Buffaloes and Dukws until naval demolition crews blasted passageways through the wide coral reef fringing the beach. The shore engineers reported no unusual hindrances. About 800 yards long, the beach was a fairly smooth coral ledge which, about 150 yards inland, rose abruptly to a bank from 6 to 8 feet high. Because the landing was made at the site of the airfield, it was not necessary to build roads. The shore engineers transferred supplies to dumps easily. Flak LCM's patrolled the coastal waters, strafed beaches where the Japanese might be lurking, and launched rockets into the interior of the island.[88]

In the advance along the northern coast, the 27th engineers found about 400 mines. Most were aerial bombs which the Japanese had buried with the nose fuses even with the surface of the ground. The mines, though numerous as compared with the quantities found at other landings in the Southwest Pacific, had no effect on the operation. Most were not armed, and the Japanese had marked the location of many with sticks, so that little probing was required. Demolition teams of American and Australian engineers quickly deactivated and removed the mines. Eastward of Kamiri, along the shore, the infantry found pillboxes, caves, and barbed wire entanglements designed to repulse landings and prohibit movement along the coast; these defenses were not manned. Few Japanese were in evidence. Most had retreated into the jungles of the central and southern parts of the island. On only two occasions were the 27th engineers called on to use flame throwers to flush the enemy out of caves and dugouts. While there were isolated instances of fanaticism, Japanese resistance on Noemfoor was negligible.[89]

The first job of the engineers was to rebuild Kamiri. Requirements called for a runway 5,000 feet long. On the first day of the landing, with the field still under intermittent enemy rifle fire, the men of the 27th Battalion, dragging lengths of Japanese rails behind trucks, filled in bomb craters and smoothed the runway. The 1874th Aviation Battalion and the 5th Airfield Construction Squadron arrived within a few days and set out to rehabilitate the strip. They

[87] (1) Smith, *Approach to the Philippines,* pp. 397ff. (2) Craven and Cate, eds., *Guadalcanal to Saipan,* p. 642. (3) Hq Sixth Army FO 19, an. 3, 21 Jun 44. SWPA File A290. (4) Task Force Engr's Rpt on TABLETENNIS Opn. Sturgis File 44. (5) Seventh Amphib Force, Rpt on Noemfoor Opn. SWPA File 74.

[88] (1) 3d ESB, Hist Rpt, 1–31 Jul 44. SWPA File E–32–4. (2) 2d ESB, Monthly Hist Rpt of Opns, Jul 1–31, 44. SWPA File E–20–7.

[89] (1) Rpt, Hq 27th Engr Combat Bn to CG U.S. Forces APO 704, 31 Aug 44. SWPA Files. (2) Rpt Hq 27th Engr Combat Bn to CG U.S. Forces APO 704, 17 Jul 44. SWPA Files.

finished putting in the coral base in about two weeks. On 20 July the runway and minimum facilities were ready to base one fighter squadron. Higher headquarters wanted Kamiri lengthened an additional 500 feet, but this could not be done because both ends of the runway were too close to the sea. To the east, the engineers improved a partially finished field called Kornasoren. Here they built two bomber strips 7,000 feet long. The first was usable on 25 July; the second, early in September. A third strip was started at the site of Namber field, but work was discontinued because the location did not permit extending the runway to more than 4,500 feet. Namber was used only for emergency landings. In addition to the airfields, the engineers built tanks for gasoline, a fueling jetty, and a pipeline sufficient to support air operations.[90]

Sansapor

From the time he first planned to advance along the New Guinea coast, MacArthur had reasoned that one or more airfields would have to be built on the Vogelkop Peninsula at the western end of the island to provide adequate air support for an attack on the Philippines. During late 1943 and early 1944 MacArthur's planners had centered their attention on the Japanese base at Sorong, on the western coast of the peninsula. Along with Sorong, MacArthur planned to seize Waigeo Island, sixty miles to the northwest, and develop an air base there. He also planned to seize the oil fields at Klamono, thirty miles to the southeast of Sorong, and develop them to provide fuel and thus cut down on requirements from the United States. Casey's staff did considerable planning for the development of the oil fields. In the United States, the Army Service Forces, with the approval of the Joint Chiefs of Staff, likewise did a good deal of planning, and by April some 2,000 Engineer troops were being trained and supplied with equipment for operations at Klamono. With the speedup of the campaign after the bypassing of Wewak and the landing at Hollandia in April, MacArthur revised his schedule for the advance along the New Guinea coast and called for an acceleration of operations. In July the plan of developing the oil fields at Klamono was abandoned, since they could not be made to produce soon enough. Air reconnaissances made that same month indicated there were few if any suitable sites on Waigeo Island for an air base. MacArthur's planners then directed their attention to the northern coast of the Vogelkop Peninsula—the Sansapor-Mar area. A reconnaissance group sent out by Sixth Army reconnoitered the area, including two offshore islands, Amsterdam and Middleburg, during the last week in June. They found no enemy troops. The beaches were good, but poor terrain might make the construction of airfields anything but easy. On 30 June MacArthur directed Krueger to seize the Sansapor-Mar area on 30 July.[91]

[90] Task Force Engr's Rpt on TABLETENNIS Opn.

[91] (1) Smith, *Approach to the Philippines*, pp. 425–28. (2) Seventh Amphib Force, Rpt on Sansapor Opn. SWPA File 74. (3) Hq, Sixth Army FO 20, an. 3, 10 Jul 44. SWAP File A 291.

To seize the area, Krueger organized the TYPHOON Task Force, made up of the 6th Infantry Division, reinforced, less one regimental combat team. The 6th Engineer Combat Battalion would provide combat support; eleven additional engineer units were assigned, their work to be supervised and directed by Headquarters, 1112th Engineer Combat Group, under Colonel Heiman, the task force engineer. The 836th, 1881st, and 1897th Aviation Battalions, the 43d Construction Battalion, and the 96th General Service Regiment were the most important construction units. They were to build two airfields, one for fighters and one for bombers, the first to be ready in twenty days; the second, in thirty-five. Colonel Heiman's staff, after studying the data available on the target area, including the information brought back by the reconnaissance party, concluded that combat operations would probably be negligible; the construction of airfields, difficult. The site for an airfield on the mainland chosen by the air forces was in a narrow coastal rain forest in back of which was a swamp. Amsterdam was too hilly. Middleburg was flat, but possibly too small for an airfield; long enough for a fighter strip, it was only 240 acres in area. Colonel Heiman recommended that the fighter runway be built on the latter island, small as it was, because completing such a strip on the mainland on schedule would be impossible. The airmen agreed that construction should proceed as Heiman suggested, if a reconnaissance made after the landing showed his assumptions regarding terrain were correct. The engineers prepared layout plans for the airdromes accordingly and assigned engineer units on a tentative basis.[92]

Since all indications pointed to no combat but much construction at Sansapor, the engineers at all command levels stressed the importance of sending men and equipment to the objective area as soon as possible. At a planning conference with MacArthur and Krueger, Casey urged sending in engineer troops and machinery at the earliest possible time. A schedule for shipping engineer equipment forward was finally agreed upon. Eight LST's of supplies for the task force were to go in with each echelon up to D plus 28. The engineers were given 5 of those scheduled to go in on D-day, 4.6 of those scheduled for D plus 2, and 5 of those scheduled for D plus 4. The engineers put major emphasis on moving equipment forward. The units themselves would arrive "piecemeal." Half of the 6th Combat battalion, 30 percent of the 836th Aviation Battalion, and 10 percent of the 617th Engineer Base Equipment Company were to come in on D-day. On D plus 2, another 10 percent of the 6th Combat Battalion, 60 percent of the 836th Aviation Battalion, and 20 percent of the 617th would land. Some units would arrive in as many as five echelons. It was believed that the advantage of getting the equipment to Sansapor early would more than offset the piecemeal arrival of the units.[93]

The assault, made as scheduled, en-

[92] Task Force Engr Rpt, GLOBETROTTER Opn. Sturgis File 45.

[93] (1) Task Force Engr Rpt, GLOBETROTTER Opn. (2) 836th Engr Avn Bn, Narration for 1944. (3) Smith, *Approach to the Philippines,* pp. 434, 446. (4) Hist of the 1112th Engr Constr Group.

countered no enemy opposition. If there were any Japanese in the area, they remained out of sight. The skies were clear and the seas tranquil. The first landing was made on the New Guinea coast; subsequently, troops were put ashore on Amsterdam and Middleburg. Operations of the 543d Boat and Shore Regiment, less two boat companies, the only amphibian unit participating in the assault, proceeded smoothly. Enemy air attacks began the next day but never seriously interfered with amphibian activities. The combat engineers were soon at work on roads and bridges. Colonel Heiman with three members of his staff arrived on D-day. His executive officer, Lt. Col. I. K. Hearn, and a number of airmen, including Brig. Gen. Earl W. Barnes, who was to command the air forces based on Sansapor, went to Middleburg Island to make a survey, while Colonel Heiman and the two other engineer officers went to the New Guinea coast to reconnoiter that area. Engineers and airmen agreed, after a thorough discussion, that the fighter strip should be constructed on Middleburg and the bomber runway on the mainland. On 2 August the 836th Aviation Battalion, by now 90 percent disembarked, and with plentiful amounts of equipment, began construction on Middleburg. Because of the sandy soil, the men were mainly concerned with finding suitable material for the base course on which to lay the pierced plank. They solved the problem by dredging coral from the ocean, placing it on the runway area, and compacting it to a thickness of four inches. Work progressed rapidly, and by 17 August the field, called Klenso, was operational. Good weather had favored the engineers. The small amount of rain which fell only helped to compact the coral. Enemy air raids were not as severe as had been expected; raiders came over only at night and did not interfere with the work.[94]

Meantime, progress was being made on the bomber strip called Mar Drome, after a nearby native village on the New Guinea coast. The 1881st and 1897th Aviation Battalions, the 43d Construction Battalion, and the 96th General Service Regiment labored on this field, carving the runway out of the rain forest. To lower the water table, they drained a swamp between the runway and the beach. The loose, sandy soil added to compaction difficulties. The men nevertheless made steady headway, and by early September the field was in service. The strip on Middleburg was ready one day ahead of schedule and Mar Drome on the day it was supposed to be operational. The meeting of the deadlines was in great part due to the careful planning. The equipment and units had arrived as scheduled; in fact, the task force engineer reported that most of the equipment arrived at Sansapor sooner than expected. Since combat was not anticipated, the engineers could send in equipment early. During the operation the 1112th Combat Group headquarters was redesignated a construction group headquarters, a title which more accurately indicated what its real duties

[94] (1) 3d ESB, Hist Rpt, 1–31 Aug 44. SWPA File E–32–5. (2)3d ESB, Our Business Is Beachheads. (3) Hist of the 6th Engr Combat Bn.



DREDGING CORAL FOR RUNWAY CONSTRUCTION

were.[95] "At Sansapor," Colonel Heiman wrote, "we had the advantages of intensive planning, good units, good equipment, fairly good weather and minimum enemy air interference." [96]

Morotai

The airfields at Sansapor, 600 miles from Mindanao, were too distant to furnish sufficient air cover for the first operations in the Philippines. MacArthur had for some time planned to seize one additional site somewhere to the west or northwest of New Guinea. He selected the small island of Morotai, one of the Moluccas, and about 300 miles northwest of the tip of New Guinea. D-day was set for 15 September. Morotai was mountainous and heavily wooded; along the southern coast was a narrow coastal plain, one of the few areas where airfield and base construction would be practicable. Here the Japanese had begun work on a runway but had abandoned the project. Surf was heavy along Morotai's southern

[95] (1) Task Force Engr Rpt, GLOBETROTTER Opn. Sturgis File 45. (2) Ltr, Sturgis to Casey, 13 Oct 44. SWPA File 74.

[96] Incl with Ltr, Heiman to C Staff Br, 6 Oct 50. SWPA Files.

coast, and the many coral reefs made navigation hazardous. The Gila Peninsula, jutting out in a southwesterly direction, helped protect the beaches on Morotai's western coast from high surf. On the basis of available information, the western shore near the base of the Gila Peninsula appeared to be the best place for a landing.[97]

For the assault, General Krueger organized TRADEWIND Task Force, including Headquarters, XI Corps, the 31st Infantry Division, and the 126th RCT of the 32d Division, together with a large number of supporting troops—all told, about 40,000 men. The engineer component included twenty-six units. Assigned were a headquarters and headquarters company of an aviation regiment, three aviation battalions, a headquarters and headquarters company of a construction group, two construction battalions, and two RAAF airfield construction squadrons. For the first time, elements of the 4th Engineer Special Brigade were to take part in a major assault. The brigade, headed by Colonel Hutchings, had reached the Southwest Pacific the previous March. At Morotai, the 544th Engineer Boat and Shore Regiment, less one boat company, and a shore battalion of the 534th Boat and Shore Regiment were to handle boat and shore missions. Colonel Bathurst, the task force engineer, reported that while he and his staff had ample time for planning, a major problem was assembling the various task force engineer units, widely scattered along the New Guinea coast and on nearby islands.[98]

Unexpectedly, the landing was one of the most difficult in the Southwest Pacific. What had appeared on aerial photographs as beaches of white sand or coral proved to be gray mud three feet deep. The shallow water forced LST's to unload far out from land; many of the men had to wade to shore in water up to their necks. Particularly troublesome were submerged coral heads and potholes in the ocean floor. The men could not get much of their equipment to the beach; on the day of the landing, the 534th's shore battalion managed to bring in only three of its eight bulldozers. Conditions improved after the shore engineers built ramps and piers out into the water. The excellent loading plan which the 534th had worked out and put into operation helped save the situation in these first days. It was fortunate that the Japanese did not interfere with the landing. Combat engineer tasks were light. The 106th Engineer Combat Battalion was occupied mainly with sweeping the beaches for nonexistent mines, clearing jungled areas for tactical units, building supply roads, and reconnoitering. Since the island's coral surface held up well under traffic, road construction was easy. There were no mines or obstacles. Most of the Japanese had retreated a good distance into the jungle.[99]

[97] Rpt, Brigadier R. N. L. Hopkins, Austr Liaison Off with Seventh Force, sub: INTERLUDE Opn, Morotai Island, 15 Sep 44. SWPA File B192.

[98] (1) Task Force Engr Rpt, INTERLUDE Opn. Sturgis File 46. (2) 4th ESB, Monthly Hist Rpt, Sep 44. SWPA File E-45.

[99] (1) 4th ESB, Monthly Hist Rpt, Sep 44. SWPA File E-45. (2) Hopkins Rpt, "INTERLUDE Opn," Morotai Island, 15 Sep 44. (3) Rpt, 106th Engr Combat Bn to Engr XI Corps, 20 Oct 44, sub: INTERLUDE Opn.

MacArthur had directed the construction of three runways on Morotai—one for fighters to be ready as soon as possible and two for bombers, the first to be usable by the 10th and the second by the 30th of October. Since the partially completed Japanese strip near the landing beaches was unsuitable for rehabilitation because of poor drainage, the engineers began work on a fighter strip in the coconut groves near the southern coast. The three aviation battalions and the RAAF units were assigned to the construction of Wama Drome, as the strip was called. Despite heavy underbrush and tree roots which extended several feet underground, they made fairly rapid progress. Wama received a 6-inch coral base and was surfaced with landing mat. On 3 October the 5,000-foot runway was operational. Reconnaissance had shown that just to the north was an area well suited for the construction of the two bomber runways. Two of the aviation battalions and a construction battalion went to work, clearing the trees, stripping the top soil down to the coral substratum, cutting and filling where necessary, and then compacting. Surfacing was pierced plank. The first runway, named Pitoe, was ready for operations on 17 October.[100]

The engineers were not able to provide airfields on Morotai as rapidly as MacArthur's operations instructions had specified. This delay was the result of various causes—the existing Japanese field could not be rehabilitated so that entirely new construction was required, securing an adequate amount of suitable coral had taken longer than expected, rains had to some extent slowed construction, the shortage of spare parts had deadlined much equipment, and, lastly, the schedules set by planning staffs had undoubtedly been somewhat optimistic. Yet, within forty days three engineer aviation battalions and two RAAF construction squadrons had constructed a fighter runway and a bomber runway and had completed 90 percent of the work on a second bomber strip. They had provided, in addition, storage for 40,000 barrels of aviation gasoline, together with a fuel jetty, and were rapidly completing storage for another 40,000 barrels. They had installed two floating wharves capable of taking three Liberty ships and had almost completed work on a pile dock. Construction on camps, covered storage, hospitals, and access roads was complete.[101]

The South Pacific

While the forces in the Southwest Pacific made giant strides toward the Philippines, the dwindling forces in the South Pacific were reorganized. As already indicated, on 1 August USAFISPA was redesignated South Pacific Base Command and made subordinate to the newly activated United States Army Forces in the Pacific Ocean Area. SOS SPA was inactivated and its personnel transferred to SPBC. There was no change in the mission of Army forces in the South Pacific, except that responsi-

[100] (1) Task Force Engr Rpt, INTERLUDE Opn. Sturgis File 46. (2) Hq, 931st Engr Avn Regt, Opns Rpt—INTERLUDE. SWPA File, M15. (3) 836th Engr Avn Bn, Hist Narration for 1944. (4) Ltr, 841st Engr Avn Bn to CG XI Corps, 14 Oct 44. SWPA File M15.

[101] (1) Hq, 931st Engr Avn Regt, Opns Rpt—INTERLUDE. (2) Ltr, Col J. H. Dudley to C Staff Br, 19 Jul 50. SWPA Files.

bilities for training were discontinued. SPBC henceforth had only the two primary missions of providing logistic support for operations in the Central and Southwest Pacific and rehabilitating and staging a number of divisions assigned to those two theaters.

As engineer operations declined in scope, the engineer organization in the South Pacific was changed to conform with the over-all reorganization of the theater. The Engineer Sections of USAFISPA and SOS were combined as the Engineer Section, SPBC. Colonel Beadle and Colonel Murrow had returned to the United States; Col. Peter P. Goerz became the engineer of the South Pacific Base Command. Engineer missions remained much as before. They included principally technical supervision of Engineer units, formulation of policies, planning, and furnishing technical advice to the commanding general of the South Pacific Base Command. Engineer troop strength, which had reached a peak in April 1944, of some 20,000 men out of approximately 245,000 US Army troops, had by July dropped to 11,000.[102] Engineer work now consisted mainly in helping the Seabees to maintain the base installations still remaining on New Caledonia, Espíritu Santo, Guadalcanal, and Bougainville. Colonel Lane, after a visit to the South Pacific in July, wrote to General Godfrey, "New Caledonia and Espiritu Santo are well developed and comfortable rear bases and of little interest to Engineers." Guadalcanal was being used as a major supply base despite the shortage of harbor facilities. Bougainville was "well developed" and at the same time was a good example of "the essential simplicity of Army construction." On the whole, Lane considered the ". . . general aspect of the SOPAC area" a "tribute" to the Seabees, but added that he found the commanders of the aviation engineer units, in particular, ". . . very weary of trailing the Construction Battalions and doing housekeeping work for the Air Force." They were ". . . anxious to come to SWPA where, although not under Air Force control, they [would] be employed on essential construction in the front lines." [103]

Progress by 1 October

From the end of February to the middle of September 1944 Allied forces in the Southwest Pacific had advanced from the Admiralties to Morotai and were within striking distance of the Philippines. By 1 October American engineers in the Southwest Pacific Area numbered 100,000 in a total troop strength of 700,000; U.S. Army engineers in that theater totaled 54 percent of all American engineers in the theaters engaged in the war against Japan. Engineer units had been moving forward continuously; one-third of the total were now in Netherlands New Guinea, including the staffs in GHQ, USASOS, and Sixth Army, which had moved to Hollandia in August and September. Long before the conclusion of the New Guinea campaign, these staffs and numerous engineer units had begun preparations for the recapture of the Philippines.

[102] AGO, Statistical and Accounting Br, Strength Rpts of the U.S. Army.

[103] Ltr, Lane to Godfrey, 20 Jul 44. SWPA File 74.

CHAPTER XIV

Return to the Philippines

Leyte and Mindoro

General MacArthur's staff had begun preliminary planning for the recapture of the Philippines early in 1943. This early planning was repeatedly revised in accordance with changing tactical developments and instructions from the Joint Chiefs of Staff. By March 1944 the war in the Pacific was going well for the Allies. The Marshalls had been seized and were being converted into a powerful forward base. The Admiralties were under attack, and the weak Japanese resistance indicated that capture of these islands was merely a matter of time. On 12 March the Joint Chiefs directed MacArthur to prepare detailed plans for an attack on Mindanao, southernmost of the major islands of the Philippines, tentatively setting 15 November 1944 as the date for the first landing. In mid-June MacArthur issued his plan for a return to the islands. He called for a small-scale attack at Sarangani Bay, on the southern coast of Mindanao, on 25 October and construction of a minor air base there as soon as possible. On 15 November a major amphibious attack would be launched against Leyte in the central Philippines and an extensive base built on that island to support an attack on Luzon.[1]

Engineer Planning

The first assaults on the Philippines were assigned to Sixth Army. In many respects, operations would be similar to those in New Guinea. The objective areas would be softened up through aerial and naval bombardments, amphibious landings made, the Japanese destroyed or driven away from the beaches, and airfield and base construction begun. Early in July, Sturgis and his staff, recently moved from Finschhafen to Hollandia, were briefed on the KING or K series of operations, scheduled for the southern and central Philippines. At this time, little up-to-date information was to be had on those areas. The photography of Sarangani Bay was far from complete and ". . . as for Leyte . . . , there was no photography at all from which local conditions could be determined and construction plans based." [2]

A most important matter was the weather. While temperatures in the Philippines varied little, most of the islands had two pronounced seasons, a dry and a wet, determined to a large extent by the prevailing winds, the

[1] M. Hamlin Cannon, *Leyte: The Return to the Philippines*, U.S. ARMY IN WORLD WAR II (Washington, 1954), pp. 1–3.

[2] Samuel D. Sturgis, Jr., "Engineering Operations in the Leyte Campaign, Part I," *The Military Engineer*, XXXIX (November, 1947), p. 458.

northeast monsoons, lasting from October to April, and the southwest monsoons, which continued from May to September. This pattern of winds brought rain to the eastern parts of the mountainous islands during the northeast monsoon and to the western parts during the southwest monsoon. Southern Mindanao had no pronounced wet or dry season. MacArthur's plans called for a landing on Leyte during the rainy season. October and November were, moreover, the months of strong winds and typhoons. Since a great deal of construction would have to be done, the adverse weather, together with the inadequate number of engineer units and the short time in which to do the work, would create almost insuperable problems.[3]

An Army Service Command

During the New Guinea Campaign the need for an efficient construction and logistics organization in a task force area in the first days of an operation had become apparent. Hastily assembled task force engineer staffs had often not been able to meet satisfactorily the numerous and frequently unforeseen problems which arose. The need for a construction and supply agency in the combat zone in the early phases of a major assault in the Philippines would be even more critical, since such an operation would be more extensive in scope than any undertaken previously. A solution to the problem would be for USASOS SWPA to organize a construction and logistics agency, and before the scheduled assault, transfer it to Sixth Army, which would move it forward as soon as possible during the combat phase, so that no time would be lost either in providing combat support or in beginning base and airfield construction. When Sixth Army subsequently transferred the newly built base to USASOS, much of the organization, particularly the part needed for base operations, would go back to USASOS. With this procedure, there would be a minimum of dislocation when the transfer was made.[4]

In line with this reasoning, USASOS activated the Army Service Command (ASCOM) at Brisbane on 23 July 1944. Casey, now a major general, and on detached service from GHQ, was placed in command; Sverdrup became MacArthur's acting chief engineer. During August Casey organized his headquarters, obtaining most of his staff from units of USASOS, particularly the headquarters of the 5201st Construction Brigade. Colonel Robinson, head of the brigade, became Casey's engineer. The ASCOM staff prepared standing operating procedures and began to requisition supplies for the construction of a base at Sarangani Bay and another on the east coast of Leyte. Since the building of airfields and bases was to be one of ASCOM's major functions, a large number of engineer units were scheduled for temporary transfer to the new command. Part of the men assigned to ASCOM headquarters were to make plans and preparations for constructing a particu-

[3] Cannon, *Leyte,* pp. 35–36.

[4] (1) Ltr, Casey to CG USASOS, 12 Feb 45, sub: Rpt on the "K" Opns. SWPA File 109. (2) Of C Engr GHQ AFPAC, *Engrs of SWPA,* II, 158–60.

lar base, and part of them, transferred to ASCOM later on, were to be responsible for operating it. The latter, together with a number of units, would return to USASOS when the combat phase was over and the base passed to USASOS. As soon as a base was a going concern, those responsible for planning would begin to make plans and preparations for the next one. A hindrance to early planning was that ASCOM was at Brisbane and Sixth Army headquarters at Hollandia. Co-ordination was difficult.[5]

On 27 August MacArthur announced a schedule of operations which called for attacks on dates later than those he had set in his plan of mid-June. There was to be an assault on the Talaud Islands, half-way between Morotai and Mindanao, on 15 October; on Sarangani Bay on 15 November; and on Leyte on 20 December. While the later scheduling of operations would give the engineers more time for planning, they would still have to build the extensive base on Leyte during the rainy season. Planning was moving ahead satisfactorily. Since construction and logistic support were expected to be generally of far greater importance than combat, Casey's staff had to do comprehensive planning. Early in September ASCOM moved to Hollandia, where major theater headquarters were located, and better co-ordination, particularly with Sixth Army engineers, was possible. By the second week of the month, planning was practically complete. Requisitions for all classes of supplies and equipment had been submitted to USASOS. On the 15th ASCOM was transferred to Sixth Army, where it was placed on a corps level; Casey would be directly responsible to General Krueger.[6]

The Assault Schedule Revised

From the 10th to the 14th of September Admiral Halsey's carrier fleet made a number of strikes against the central and southern Philippine islands. The weak resistance his flyers encountered was quite convincing evidence that Japanese strength in those parts of the archipelago was fairly well depleted. Halsey informed Nimitz that the area was "wide open." On the 14th he recommended that the operations planned against Yap, Talaud, and Sarangani Bay be canceled and that Leyte be seized immediately. Nimitz radioed Halsey's suggestion to the Joint Chiefs of Staff, then meeting with the British Chiefs of Staff at the OCTAGON Conference in Quebec. Marshall immediately asked MacArthur for his views regarding the speeding up of the attack schedule; MacArthur replied two days later, agreeing to cancellation of the operations as Halsey recommended. The Joint Chiefs at once instructed MacArthur to move directly against Leyte and set the 20th of October as the day for the attack.[7]

Intensified Planning for Leyte

Concentrating henceforth on planning for the Leyte (K–2) operation the engi-

[5] (1) Ltr, Casey to CG USASOS, 12 Feb 45. (2) Hist of ASCOM From 23 Jul to 26 Dec 44. SWPA File A155.

[6] (1) Cannon, *Leyte*, pp. 7–8. (2) Ltr, Casey to CG USASOS, 12 Feb 45. (3) Hist of ASCOM.

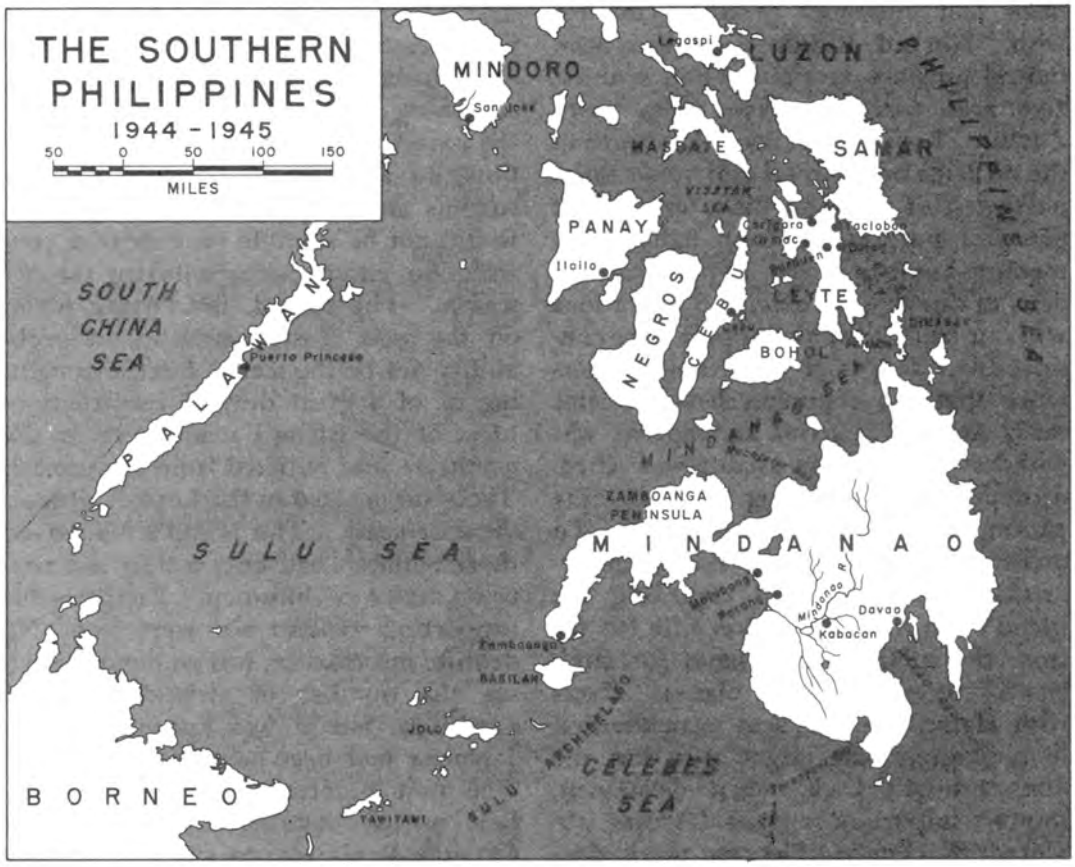
[7] *Biennial Report of the Chief of Staff of the United States Army, July 1, 1943, to June 30, 1945, to the Secretary of War*, p. 71.

neers had numerous problems to deal with. Not only had the target date been moved up sixty days but the new objective area was some 350 miles more distant. Leyte, about 600 miles north of the airfields on Morotai and 1,000 miles northwest of those on Biak, was, for all practical purposes, beyond fighter and medium-bomber range. The risks incident to carrying on extended operations without land-based air support were considerable. It was of the utmost importance that the engineers have airfields ready as soon as naval air support was withdrawn; since the assault was scheduled for the beginning of the rainy season, this might not be easy. To make matters worse, only sketchy information was to be had regarding the island's terrain. Leyte was still too far from the most forward bases for land-based reconnaissance planes. Flyers with Halsey's carrier fleet were the first to photograph the target area, but the films brought back, when developed, showed important terrain features obscured by clouds. Pictures taken during the subsequent weeks were not much better.[8]

Fortunately, a considerable amount of information was available in topographic studies made before the war; the United States Coast and Geodetic Survey had prepared hydrographic studies of beach areas which contained especially valuable data. The eighth largest island of the archipelago, Leyte was some 115 miles long, 43 miles wide at the north, and 16 miles wide at the center. (*Map 28*) Mountainous and, for the most part, heavily wooded, it had two principal lowlands. The first, Leyte Valley, stretching across the northeastern part of the island from Leyte Gulf on the east to Carigara Bay on the north, had many streams and numerous rice paddies; it would not be suitable for extensive construction, except perhaps during the dry season. The second, the Ormoc plain, on the west coast, would in all probability not be the scene of decisive fighting or of a great deal of construction. Most of the island's roads were in the northeast, and radiated from the capital, Tacloban, located in the Leyte Valley on the east coast. The island's few paved thoroughfare's had only a thin and narrow surface of bitumen. Facilities for supporting modern war were few. No definite information was on hand regarding the number of airfields or their condition, but it was known that the Japanese had been working on several. The most important, Tacloban, a 5,000-foot prewar commercial field on the Cataisan Peninsula, two miles southeast of the capital, was undoubtedly operational. In central Leyte, located near the dirt road running west from the coastal town of Dulag to Burauen were four fields—Dulag, San Pablo, Bayug, and Buri. San Pablo, overgrown with weeds, was not in use; the other three seemed to be operational. There were apparently additional fields but little was known about them. Most of the island's population lived on farms or in small villages, called barrios.[9] Even Taclo-

[8] (1) Sturgis, "Engineer Operations in the Leyte Campaign, Part I," p. 459. (2) Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, 286.

[9] (1) Sturgis, "Engineer Operations in the Leyte Campaign, Part I," pp. 459–60. (2) Cannon, *Leyte*, pp. 10–13, 124. (3) Sixth Army, Rpt of the Leyte Opn, 20 Oct 44–25 Dec 44, p. 231. 106-0.3 (20430).



MAP 28

ban, according to Sturgis was ". . . merely an overgrown village with a few dilapidated warehouses and public buildings and limited berthing facilities for two Liberty ships." [10]

Neither combat nor service engineers had enough time for adequate planning. Insofar as combat was concerned, a major obstacle arose from the fact that XIV Corps, assigned to operations on Leyte, had to be kept on Bougainville for mop-up operations. The Central Pacific's XXIV Corps, scheduled for the assault on Yap and already en route to its destination, was diverted to Leyte. The engineer units of that corps, prepared for a landing on a small Pacific island, had to be supplied with more equipment, and eventually more engineer units would have to be sent in to support XXIV Corps. A second matter of importance was bridging. Combat on Leyte, unlike that on New Guinea, would probably require numerous stream crossings, since the American

[10] Sturgis, "Engineer Operations in the Leyte Campaign, Part I," p. 460.

forces would most certainly have to move inland to destroy the Japanese. There were not enough bridging units or sufficient amounts of bridging equipment in the theater to support an extensive overland advance. On hand were one heavy ponton battalion—the 556th—and three light ponton companies—the 506th, 510th, and 530th—and all four had only a minimum of equipment. Of these units, the 556th and 530th were assigned to Sixth Army; the 506th, to X Corps. The 510th was already committed to support the operations on Morotai. Bailey bridging, ideal for semipermanent fixed spans, was in short supply; only a few hundred feet of it were in New Guinea. Most of this was collected and loaded on Leyte-bound vessels which happened to be handy. Sturgis believed that the ponton units, at least part of the time, would have to be put to building fixed bridges on Leyte so that floating equipment could be moved forward as rapidly as possible to support the advance of the infantry.[11]

ASCOM engineers were likewise pressed for time for adequate planning. Their immediate responsibility was the all-important one of building the critically needed airfields. They were to construct four. One runway, 5,000 feet long, was to be ready for fighters within 5 days after the first landing. But airfields were only one of many responsibilities. ASCOM was to build a base to provide logistical support for 200,000 air and ground troops, including port facilities, warehouses, hospitals, and headquarters for various commands. Port facilities were to include floating docks for four Libertys, to be ready within 30 days. Eventually, ASCOM was to complete six fixed wharves for Libertys, each to take two ships; the first wharf was to be ready within 45 days. Seventeen lighter jetties were to be built. ASCOM was to provide 12,000 hospital beds, most of them in tents. Initially, gasoline was to be furnished by barges anchored offshore; meanwhile, ASCOM was to build two small fuel jetties and begin work on bolted tanks of 2,000-barrel capacity each. Northern Leyte and southern Samar Island were, in addition, to be the site of an extensive naval base. To accomplish his construction program, Casey had a sizable number of engineer units. He had, among others, 15 aviation battalions, 3 construction battalions, 2 port construction and repair groups, and 7 dump truck companies. Of the 43,183 men assigned to ASCOM, 21,097, or approximately 47 percent, were engineers. Supply posed one of the most vexing problems. There was less than a month left to finish planning for Leyte, submit requisitions, and load the supplies on transports. Many items scheduled for Talaud and Sarangani Bay had to be diverted willy-nilly to Leyte, whether needed there or not.[12]

Amphibious Operations—Planning

Of all the amphibious assaults made in the Pacific, the Leyte operation was the only one in which both the engineer special brigades of the Southwest Pacific

[11] (1) Sturgis, "Engineer Operations in the Leyte Campaign, Part I," pp. 459. (2) Sturgis, "Engineer Operation in the Leyte Campaign, Part II," *The Military Engineer*, XXXIX (December, 1947), p. 518.

[12] (1) Ltr, Casey to CG USASOS, 12 Feb 45. (2) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 159.

and the shore party organizations of the Central Pacific were to be used. Two major landings were planned for the island's east coast—one just below Tacloban, the other, some fifteen miles farther south near the town of Dulag. The 2d Special Brigade, less one boat and shore regiment, was to help land the 1st Cavalry Division and the 24th Division of X Corps near Tacloban. General Heavey made arrangements with VII Amphibious Force to transport 290 LCM's, 57 LCVP's, and 38 auxiliary craft to the target area; 130 LCM's and 42 LCVP's were to participate in the A-day landings. This was to be by far the largest movement of small craft in any operation made in the Southwest Pacific up to this time. At Dulag, two combat group headquarters with three combat battalions each were to do the shore party work for the 7th and 96th Infantry Divisions of XXIV Corps.[13]

The Assault

On 19 October two naval task forces of the Third and Seventh Fleets approached the east coast of Leyte. Three islands in Leyte Gulf had been occupied a few days before and rather extensive mine sweeping operations carried on to make the offshore waters safer for amphibious operations. As already indicated, the tactical plan called for the landing of two corps on the east coast. X Corps, comprising the 1st Cavalry Division and 24th Division (less one RCT), was to land on the three miles of beaches south of the Cataisan Peninsula and north of the Palo River. XXIV Corps, made up of the 7th and 96th Divisions, was to come ashore near the town of Dulag. One RCT of the 24th Division was to land at Panaon Island southeast of Leyte and secure the narrow strait to enable motor torpedo boats to proceed into Sogod Bay and the Mindanao Sea. The major assaults were to be made on beaches near the two airdrome areas—the early capture of Tacloban airdrome and the four fields in central Leyte was essential.[14] The plan of campaign called for X Corps to advance northwest towards Carigara Bay and thence southward through the mountains toward Ormoc on the west coast. XXIV Corps was to drive across the narrow waist of the island and then advance northwest toward Ormoc to link up with X Corps.

On the morning of the 20th the assault began as scheduled. The weather was ideal. The sea was calm, with the surf between one and two feet high. In the X Corps area, landings were made at White Beach to the north and Red Beach to the south. No mines or underwater obstacles were encountered. Japanese opposition was unexpectedly light, the principal interference being fire, at times fairly heavy, from five 75-mm. guns emplaced in jungle southwest of Red Beach. Four LST's received direct hits and a fifth was set on fire; shell fragments damaged four engineer LCM's.

It was soon evident that Red Beach was poor, with water so shallow that only

[13] (1) Ltr, Heavey to Krueger, 13 Dec 44. SWPA File 75. (2) 1st Lt G. J. Pavia, Constr Serv CPBC, Observers Rpt on Leyte Island Opn. Engr AGF PAC, 319.1.

[14] (1) Cannon, *Leyte*, pp. 31–34. (2) Krueger, *From Down Under to Nippon*, p. 150. (3) Seventh Amphib Force, Rpt on Leyte Opn. SWPA File 75.

one LST could get close enough to make unloading practicable. Hydrographic charts of the Coast and Geodetic Survey, used extensively in planning, had clearly indicated shallow water, as well as swampy terrain between the shoreline and Highway 1, which paralleled the coast. But the tactical plan, which called for X Corps to advance northwest from the beaches, required a landing north of the Palo River; obstacles at the beaches would simply have to be overcome in one way or another. The Navy, also aware of the unsatisfactory conditions offshore, had planned to build ponton causeways but could not get the ponton cubes in time to transport them to Red Beach; plans were then made to transfer cubes from the Dulag area, if necessary. To add to the confusion, naval beach parties, reconnoitering offshore the day before the landing, had erroneously reported the water deeper than it was. Ponton cubes, urgently requested from Dulag on the morning of A-day, did not arrive until that evening. Early the next morning, 21 October, unloading began over the floating piers, but only one LST was able to unload that day. Some transports were transferred to White Beach, where all vessels had unloaded and retracted by the end of the second day. Others proceeded to the beaches on the Cataisan Peninsula, where they unloaded thousands of tons of supplies, which the shore parties piled up on the airstrip.[15]

The shore parties at Red and White Beaches had a hard time moving supplies off the beach. Inland, 100 to 300 yards, was a series of swamps, and between them the Japanese had constructed antitank ditches. These obstacles, together with the lack of roads from the beaches, caused not a little congestion. Work was, moreover, interrupted by frequent air raids and alerts, as the Japanese mustered their dwindling air strength in a determined effort to disrupt the landing. The raids caused no serious damage, but the many alerts meant lack of sleep and near exhaustion for the shore parties. Some of the men were ordered to support the combat troops, which put an added burden on those remaining on the beaches. A major problem was getting a road through from Red Beach to Highway 1. Under orders from the corps commander, the 339th Construction Battalion was attempting to build one across a swamp 600 feet wide, beyond which lay a mile of flooded rice paddies. Going ashore on A plus 1, Sturgis, recently promoted to brigadier general, found bulldozers and other equipment stuck in mud and water. Making a quick reconnaissance with the S–3 of the 339th, he found a fairly dry though somewhat longer route a short distance to the south. He had the unit transferred to this location, where it built a 3-lane road to the highway in a few days.[16]

Despite the obstacles, unloading schedules were satisfactorily met, including those for Green Beach on Panaon Island, where no difficulties were encountered.

[15] (1) Ltr, Heavey to Krueger, 13 Dec 44. (2) Krueger, *From Down Under to Nippon*, p. 150. (3) Seventh Amphib Force, Rpt on Leyte Opn. (4) Samuel Eliot Morison, vol. XII, *Leyte*, "United States Naval Operations in World War II" (Boston: Little, Brown and Company, 1958), pp. 134–35.

[16] (1) Ltr, Heavey to Krueger, 13 Dec 44. (2) Hist of the 339th Constr Bn. (3) Comments by General Sturgis on draft of this chapter. SWPA Files.

When they hit their full stride on the Leyte beaches, the amphibian engineers were unloading approximately 100 tons of cargo an hour, probably a record for SWPA up to that time. On the average, they unloaded an APA (transport, attack), which carried some 1,300 troops and 450 tons of supplies, in four and one-half hours; the unloading of some Libertys, with their larger cargoes, took considerably longer.[17]

Efficient operations were in part the result of steadily improving teamwork of the engineers and the Navy. The apprehensiveness with which Navy men had regarded amphibian engineer operations when the 2d Brigade first arrived in the theater a year and a half earlier was by now largely a thing of the past. "The 7th Amphibious Force and 2d Engineer Special Brigade," wrote Rear Adm. Daniel E. Barbey, commander of VII Amphibious Force, "have been associated in numerous amphibious operations . . . complete understanding has been achieved through this close association and was reflected in the smoothness with which the Leyte landing progressed." [18] General Heavey was of the same opinion. He pointed out that the successful results at Leyte could at least in part be ascribed to "the fact that this Brigade has been associated with Seventh Amphibious Force in numerous preceding operations and knew its methods and many of its beach personnel . . . ." [19]

Responsibilities of naval and amphibian engineer units assigned to task forces had become more clearly defined as the result of lessons learned in the course of actual landings. In all assault operations, the amphibious brigades had been under the control of Seventh Fleet. Landing craft operated by Navy personnel usually carried the first waves of infantry to shore. In the long forward movements, the Seventh Fleet transported the amphibian engineers' craft. The fact that the amphibian engineers brought in part of the troops and subsequently engaged in resupply missions along the shore or from island to island was of distinct advantage to the Navy. Probably the major benefit was that the Seventh Fleet could withdraw its assault forces from a forward area at a relatively early time.[20]

At Dulag, also, the weather was fair and the seas calm on A-day. Demolition crews easily removed the few underwater obstacles found along the beaches. There were no coral reefs, and offshore slopes were steep enough to permit expeditious unloading—LST's, LCM's, LCVP's, and Dukws carried men and supplies from ship to shore with little or no trouble. Firm sandy beaches held up well under truck traffic. Japanese opposition was lacking at the beaches, but here, as at Red and White beaches, congestion became something of a problem. Because of the danger of air attacks, the Navy wanted its ships unloaded and out of Leyte Gulf as soon as possible; at the same time, the infantry, beginning to meet stiff resistance inland, was not able to advance as rapidly as had been hoped. Nevertheless, work proceeded satisfactorily. Dozers of the shore party battalions, landed early in the operation,

[17] Ltr, Heavey to Krueger, 13 Dec 44.
[18] Seventh Amphib Force, Rpt on Leyte Opn.
[19] Ltr, Heavey to Krueger, 13 Dec 44.
[20] Ltr, Lane to C Staff Br, 28 Jul 47. SWPA Files.

were used to cut trails from the beaches and prepare dump areas. One company from each combat battalion provided security for the battalion as far as 800 yards inland. Neither occasional enemy rifle fire nor rainy weather later on interfered seriously with the work of the shore parties. The shore party battalions of the 7th and 96th Divisions, in the words of one observer, "worked at such speed and efficiency that all passenger ships were unloaded of their equipment in 25 hours and all cargo ships were unloaded in 44 hours, enabling them to leave Leyte Gulf." [21]

ASCOM—Initial Operations

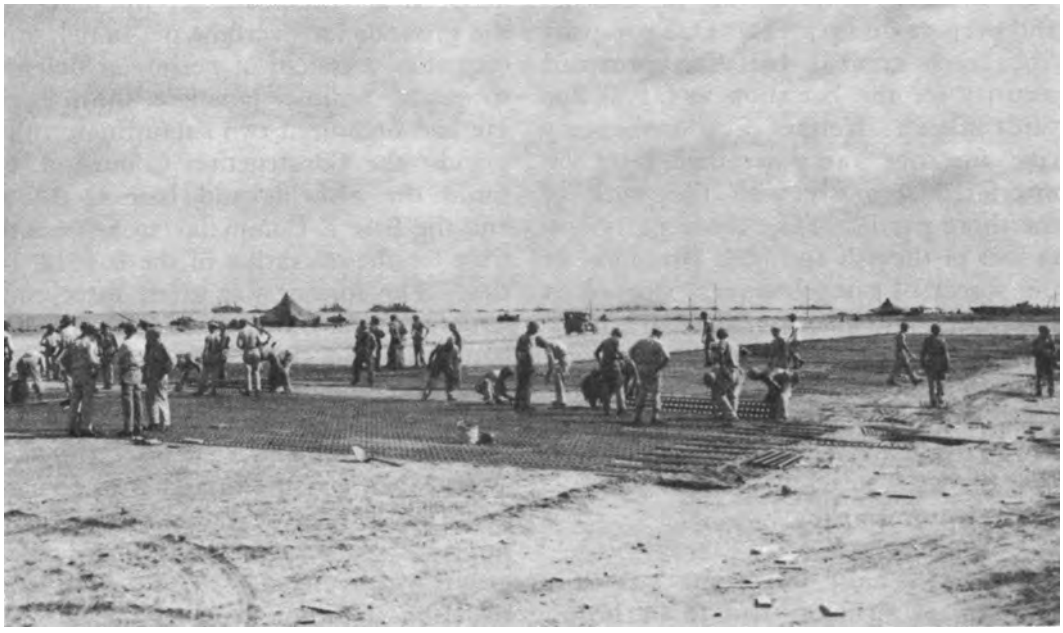
ASCOM's most important task—the building of airfields—had to be begun as soon as possible in view of the fact that the American forces on Leyte were without land-based air support and the Japanese fleet was known to be operating in Philippine waters. Urgently needed were four all-weather fields. The one at Tacloban and the three in central Leyte were to be improved as quickly as possible. All, except Tacloban, would require much work to bring them up to minimum standards.

ASCOM personnel and units arrived early in the operation. Casey with some members of his staff came ashore on A-day; two days later the advance echelon of ASCOM headquarters arrived. Since the Japanese at this time still held the area at Palo allocated to headquarters, Casey installed his staff in a large house near Tacloban, set up tents on the grounds for overflow personnel, and organized a system of perimeter defense to guard against Japanese infiltrators. He had organized two subordinate commands: the Construction Command, to build the airfields and base facilities, and the Base K Command, to be responsible for the operation of the base facilities. The former was given three construction areas on eastern Leyte—Tacloban, Palo, and Dulag—in each of which a construction group headquarters was to supervise the work. As many native workers as possible were to be recruited.[22]

Tacloban was the first field to receive attention; orders were that it was to be improved sufficiently to take a fighter group within five days. The 46th Construction Battalion reached the site on A-day. On narrow, mile-long Cataisan Peninsula, the strip would have to be realigned about 10 degrees if it were to be lengthened eventually to 6,000 feet for bombers; realignment alone would require a considerable additional construction effort. Doing any work on A-day was next to impossible because of the great quantities of supplies and equipment being dumped on the runway from LST's transferred from Red Beach. Strenuous efforts to get supplies off the runway caused such congestion of traffic at the neck of the peninsula that the engineers could haul little or no coral from the nearby pits, and work on the runway was set back at least two days. On A plus 3 the 1881st Aviation Battalion and part of the 240th Construction Battalion joined the 46th; the three units bivouacked on the peninsula alongside

[21] (1) Maj Douglas F. Thomson, Of of Engr Tenth Army, Rpt [Observer's Rpt on Leyte Opn]. Engr AGF PAC. (2) Pavia, Observer's Rpt on Leyte Island Opn.

[22] Hist of ASCOM.



LAYING PIERCED STEEL PLANK (MARSTON MAT) ON TACLOBAN AIRSTRIP

the runway to be near their work, despite the exposed position. They strove to put down a coral base solid enough to support steel mats. By the fifth morning after the landing, the situation was critical. Enemy bombings were frequent; there were about twelve attacks that morning alone. "The sky was notably devoid of our own fighters," Sturgis wrote, "but Zeros and Bettys were whizzing down from the low overcast like hornets. . . ." Rumors were abroad of a giant naval battle off Leyte, as the Japanese fleet made a last desperate gamble to destroy the American task force and drive the Americans from Leyte. Many U.S. planes came in for crash landings; most cracked up on the loose coral and sand of the runway. The pilots explained that their carriers had been sunk or disabled during the battle with a Japanese naval force off the southeast coast of Samar. The engineers dozed some twenty-five wrecked planes into the ocean. That night, between alerts, they worked continuously on the brilliantly lighted runway. By evening of the next day, it was ready for fighters.[23]

Meanwhile, ASCOM units under Colonel Heiman of the 1112th Construction Group had begun work on the airfields in Central Leyte. The Dulag strip was captured on the second day of the landing; the other three, during the next five days. San Pablo was to be developed into a bomber field; the others were to be improved to take fighters and transports. Men sent out on reconnaissance by Sturgis and Casey reported that work

[23] (1) Sturgis, "Engineer Operations in the Leyte Campaign, Part I," pp. 462–63. (2) *General Kenney Reports*, pp. 453–56.

on the fields, located in the midst of rice paddies and swamps, would be laborious enough during the dry season and wellnigh impossible in wet weather. Supply would be an almost insuperable problem, since the fields were near the one-lane road which ran from Dulag to Burauen and which was already choked with traffic to support the combat units.

Work began first on Dulag. The 808th Aviation Battalion, landing on the morning of 23 October, headed straight for the field, captured two days previously. It was about 300 yards south of the Dulag-Burauen road and parallel to it. The Japanese had hauled gravel in pushcarts from a nearby stream and spread it over the runway to a thickness of about one inch. The 808th, working around the clock, smoothed the runway and built roads to the river to enable trucks to haul gravel.[24] Two days later, at about 0930, the men ". . . were surprised to see a couple of strange looking planes circling the field. . . ." They turned out to be Navy fighters, which could not return to their carriers. About fifty planes landed; several cracked up. The dry weather of the next few days made a good deal of progress possible on the runway. On the 27th, the 821st Aviation Battalion joined the 808th. Heavy rains at the end of the month turned the whole area into a sea of mud. The fields in central Leyte could not be made operational within a predictable time.[25]

The news had come on the morning of the 26th that the Japanese fleet had been defeated. The forces at Tacloban had had a narrow escape; a study of the battle reports indicated that if just one of the Japanese warships, only a short distance away, had sailed into Leyte Gulf, it could have shot up the naval transports and the beachhead and caused incalculable damage. Kenney agreed to take over responsibility from the Navy for air support on A plus 7, even though he had no planes on Leyte because there were no adequate fields on which to base them. He was apparently not greatly concerned since he was already convinced that the Japanese air force could no longer do any serious damage; at the most, it could merely delay the American advance.[26] Nevertheless, the lack of American air power on Leyte enabled the Japanese to send in sizable reinforcements via Ormoc, including two complete divisions and parts of three more in the hope of making a decisive stand on the island. In return, the Americans committed the reserve 32d and 77th Infantry Divisions, the 11th Airborne Division, elements of the 38th Infantry Division, and the 112th Cavalry RCT. Despite the lack of sufficient air cover, the campaign on Leyte developed generally as planned. Enemy opposition was light, although stubborn pockets of resistance developed in some areas. While the Japanese reinforcements did not alter the planned strategy, they did prolong the fighting.[27]

Combat Engineers—Roads and Bridges

Although the fighting on Leyte was more or less in the nature of a conven-

[24] Hist of the 808th Engr Avn Bn, p. 513.

[25] (1) *Ibid.*, p. 514. (2) Sturgis, "Engineer Operations in the Leyte Campaign, Part II," p. 515.

[26] *General Kenney Reports*, p. 461.

[27] Cannon, *Leyte*, p. 306.

tional overland advance, combat support was much like that in New Guinea in that road and bridge construction and maintenance accounted for almost the entire effort. Roads required the most work by far. The island's thoroughfares disintegrated rapidly under military traffic. To make matters worse, five days after A-day, heavy rains began—the first of the season. In both corps areas, long stretches of road became morasses. During the first three weeks, X Corps had only three combat battalions to maintain roads in the Leyte Valley; they could not cope with the rapid disintegration of the supply routes. The amphibian engineers saved the situation by moving supplies along the northern coast. The combat engineers continued to have trouble with roads in the valley. Since most of the roads were built above the surrounding rice paddies, they were extremely difficult to restore, once they broke down. After the troops got out of the valley, conditions were just as critical. The advance through the mountains from Pinamopoan on northern Leyte to Ormoc came almost to a standstill because of the poor roads. In some places, the troops had to be supplied by air drop or by native carriers because constructing roads into these regions was virtually impossible. The few combat battalions on northern Leyte had to maintain long stretches of supply routes; a single battalion might be responsible for as much as thirty or forty miles. Many routes could not have been kept open had it not been for the help of native workmen. In the XXIV Corps area in central Leyte, the 13th and 321st Engineer Battalions of the 7th and 96th Divisions were especially concerned with the road leading west from Dulag to Burauen, the main corps supply route. This thoroughfare, which passed through a number of low, swampy areas, required a great deal of corduroy. The constant stream of traffic made any real job of improvement or even maintenance almost impossible. The combat battalions in both parts of the island had an especially heavy burden with regard to road construction because of the insufficient number of corps engineer troops. Some shore party engineers were put on road work in the XXIV Corps area and a number of ASCOM units were sent to both corps, but few such men or units could be spared.[28]

The main roads on Leyte had about 300 bridges, some 30 of which could be regarded as of critical importance. Were the Japanese to destroy any one of the latter, the main supply routes might be blocked for days. The astonishing thing is that the Japanese left all the principal bridges intact. They did destroy a number of minor structures, most of them built of wood, and guerrillas had wrecked an additional number of smaller spans. Neither Japanese nor guerrillas destroyed bridges in an expert manner; as a rule, they left piers and abutments in place, so that the combat engineers could easily replace most spans with timber trestles. Bailey bridging, scarce on Leyte, was especially valuable in areas of extensive rice paddies, where little timber was available. The 556th Heavy Ponton Battalion was directed to establish a "bridge park" where all

[28] (1) Sixth Army, Rpt of the Leyte Opn, p. 232. (2) Sturgis, "Engineer Operations in the Leyte Campaign, Part II," p. 518.

Bailey parts were concentrated. From the miscellaneous tonnages shipped to Leyte, a total of some 600 feet of double-lane Bailey bridging was assembled and distributed as an Army-controlled item.[29]

Mines, Fortifications, and Obstacles

Japanese mines, fortifications, and obstacles played an insignificant role in the Leyte Campaign. The troops encountered a few antitank obstacles, which were not effective. The enemy had erected no fortifications in any real sense. Mines were found in a number of places, some near the landing beaches. The Japanese had hurriedly mined Tacloban airstrip by burying about 100 bombs with the nose fuzes flush with the surface. More mines were found in the interior of Leyte, where the Japanese had time to lay them after the American forces landed. In the central part of the island, a considerable number, including bombs, yardsticks, porcelain, and tape-measure mines, were found along the roads and around the airfields. Too poorly concealed to be effective, they played no appreciable part in the campaign. In a warehouse in Tacloban, the engineers came across a number of coconuts. Each had been cut in half and cleaned out; a grenade with nails fastened to it had been placed inside. Each coconut had then been wired together again, apparently to be booby-trapped so that the grenade would explode when the coconut was picked up. As it was, no use was made of these devices.[30]

ASCOM—Airfields and Base Construction

Charged with both airfield and base construction, ASCOM had heavy responsibilities. It was the airfields that remained of vital concern. Tacloban was coming along as well as could be expected, but the almost complete lack of progress on the fields in central Leyte was cause for alarm. The heavy rains of late October and early November practically put an end to the work. Casey, after a conference with Sturgis and representatives of Fifth Air Force and GHQ, suggested that better sites be found near the landing beaches, and, if none were acceptable to the air forces, that the construction effort be restricted to Tacloban and Dulag. The air forces insisted on the completion of all four fields in central Leyte, but their wishes could not be met. Bayug and Buri, repaired for dry-weather use, became completely unserviceable soon after the rainy season began, and the roads leading to San Pablo became such impassable sloughs that the field had to be abandoned in mid-November. Dulag finally became operational on 18 November, when 4,100 feet of landing mat was in place.[31]

Colonel Heiman, sector engineer at

[29] (1) Sixth Army, Rpt of the Leyte Opn, p. 232. (2) Sturgis, "Engineer Operations in the Leyte Campaign, Part II," p. 518.

[30] (1) Sixth Army, Rpt of the Leyte Opn, pp. 232–33. (2) Thomson, Rpt [Observer's Rpt on Leyte Opn]. Engr AGF PAC.

[31] (1) Sturgis, "Engineer Operations in the Leyte Campaign, Part II," p. 515. (2) Sturgis, "Engineer Operations in the Leyte Campaign, Part III," *The Military Engineers*, XL (January, 1948), pp. 17–18.

Dulag, was firmly of the opinion that meeting the construction deadlines for the fields in central Leyte was out of the question. Shortly before Thanksgiving Day, he met with Generals Kenney and Whitehead at the Dulag strip. They wanted to know when a parallel taxiway would be ready so that a fighter group could use the runway "with facility." Colonel Heiman later wrote that his reply at the time was, "As long as the rains continue as they have, I can give no estimated dates of completion for the strip, taxiways or hardstands." Heiman explained to Kenney and Whitehead that even if the weather cleared, progress on the airfield would be slow because engineers would have to be diverted from the airfields to keep the important supply roads open. Heiman had informed Colonel Sturgis about the condition of the roads, and Sturgis had directed that additional engineers be put to work on them. General Kenney pointed out that the plans for the Luzon campaign were in jeopardy, and that he needed a date at least for the completion of the Dulag strip. Heiman thereupon asked Kenney and Whitehead to take a ride with him on the Dulag-Burauen road. It was so bad they could not get through. They were nevertheless very much concerned about the diversion of engineer strength to the road. On Thanksgiving Day, Heiman recommended that plans for constructing facilities at the three strips west of Dulag be abandoned. Most other engineers were of the same opinion and many had already made similar recommendations. Late in November, work on the three western fields was stopped.[32]

With only two all-weather fields—Tacloban and Dulag—on Leyte, another was urgently needed, even though the Japanese Air Force was no longer the threat it had been. The only desirable sites for additional fields were along the eastern coast. Many miles of flat, sandy beaches extended southward from the Cataisan Peninsula. Eight miles from Tacloban, near the town of Tanauan, was a site, which, from the engineering point of view, was almost ideal. Even in rainy weather construction would not be difficult. From the point of view of the air forces, the area was not very desirable, because any field built there would have the southern end of the runway quite close to a hill some 250 feet high. A further complication was that the site was already occupied by Headquarters, Sixth Army. The engineers nonetheless recommended construction there. General Kenney consented, and General Krueger agreed to move his headquarters. Three aviation battalions began work on 28 November; within two and one half weeks, a fighter runway, 6,000 feet long, surfaced with steel mat, was ready.[33]

ASCOM engineers were providing numerous additional facilities on Leyte. A serious problem from the first was the allocation of sites. Because the maps used in planning had been so inadequate, the areas selected were not what had been expected. Two of Sturgis' engineers, Col. William J. Ely, his executive, and Col. John C. B. Elliott, his operations officer, reconnoitering close behind the advancing infantry, found, in

[32] (1) Ltr, Heiman to C Staff Br, 11 Sep 50. SWPA Files. (2) Sturgis, "Engineer Operations in the Leyte Campaign, Part III," pp. 17–18.

[33] Sturgis, "Engineer Operations in the Leyte Campaign, Part III," p. 18.

Sturgis' words, that ". . . nearly all of the proposed sites for depots were located in rice paddies and swamps. . . . There was very little available space that would not become a quagmire when the rains started. . . ." [34] The situation was aggravated by the fact that so many major headquarters, all in need of space, moved into Leyte in the first days of the assault, and for the most part encamped on the beachhead. At Sturgis' suggestion, Krueger organized a board made up of two officers from each major command—its purpose to allocate space. Meanwhile, about twenty officers and men had the job of traveling about in jeeps in search of dry areas.

In order to do the required construction, ASCOM needed large numbers of native workers. Contrary to expectations, they were at first hard to recruit. Many, having acquired ample stocks of food from looted warehouses, were not much interested in working; large numbers were not eager to go to areas likely to be bombed; and many could not work because there was no transportation from their homes. Gradually, and with the help of local government officials and the encouragement of their priests, the natives began to register for employment. By the end of October, 2,500 had been recruited but their usefulness in the early stage of the program was impaired by the high rate of absenteeism.[35]

The construction of docks had high priority; work was to be completed in sixty days, that is, by 18 December. ASCOM engineers in charge of the project ran into unexpected difficulties. They found that men and materials scheduled for the work had to be diverted to combat areas for road and bridge construction. Also, they encountered unfavorable offshore conditions, such as rock bottoms, precipitous underwater slopes, and, in some places, shallow water. Still, dock and jetty construction completed by late December was impressive. ASCOM had finished a floating and a fixed dock for Libertys and had a second fixed dock about one-third done. Six fixed and four floating lighter jetties were in operation. Construction was continuing. The dredge *Raymond* arrived in the first days of the operation to deepen Tacloban harbor, but because of a shortage of spare parts, the dredge was of little use until the combat phase of operations was almost over. The *Raymond* then pumped sand from the harbor bottom to Tacloban airdrome to make up for the shortage of coral.[36]

ASCOM engineers had many other construction responsibilities. One was to provide storage tanks for gasoline, together with distribution systems at the airfields. At Tacloban, they had in operation by 28 October a temporary system, consisting of a 500-barrel tank on the shore, connected by pipeline with a fuel barge. The permanent system subsequently installed there included storage tanks for 11,250 barrels of aviation gasoline, 5,500 barrels of motor fuel, and 5,500 barrels of diesel fuel, together with pipelines and jetties. At Tanauan, they completed a tank farm with a capacity of 2,000 barrels. Dulag was served by a fuel barge, connected by pipeline with the tank farm at the airfield.

[34] Sturgis, "Engineer Operations in the Leyte Campaign, Part II," p. 515.
[35] Hist of ASCOM.
[36] Ltr, Casey to CG USASOS, 12 Feb 45.

Included among ASCOM's accomplishments was provision for 13,500 hospital beds in tents. A major job was to widen and keep roads in usable condition; about 100 miles of thoroughfare were maintained and improved. Some projects fell behind schedule because of too few supplies, a shortage of some kinds of engineer troops, the diversion of others to support the combat forces, and, finally, the heavy rains—thirty-five inches fell in the first forty days, about twice the average amount.[37]

The End of the Leyte Campaign

The struggle for Leyte, prolonged by the ability of the Japanese to land reinforcements on the west coast near Ormoc, nevertheless moved toward its inevitable end; the enemy was gradually compressed into the western part of the island and destroyed. On 25 December, Sixth Army turned control of operations on Leyte and Samar over to Eighth Army. Organized at Hollandia in September 1944 under General Eichelberger and up to this point engaged in destroying or neutralizing the remnants of the Japanese forces in New Guinea and on nearby islands, Eighth Army was well prepared to participate in more extensive operations in the Philippines. Eighth Army continued mopping-up on Leyte and Samar until May 1945.

Mindoro

As a prelude to the landings on western Luzon, the seizure of the lightly held island of Mindoro and development of airdromes near the city of San Jose on the southwestern coast held a prominent place in early planning. In mid-October MacArthur had directed Sixth Army to seize the San Jose area. The target date was set for 5 December. Company C of the 161st Engineer Parachute Battalion and Company B of the 3d Combat Battalion were assigned combat missions; a RAAF airfield construction squadron and three engineer aviation battalions had the job of airfield construction. The 532d Boat and Shore Regiment was to land supplies and equipment. At the beginning of December American land-based air units still had only a precarious hold in the Philippines. Leyte had two operational fields; additional ones were urgently needed. Sites tentatively selected on Mindoro would be ideal because they were on the western side of the island, at that time of the year in its dry season. Since enemy resistance on Leyte was so stubborn and airfield construction so far behind schedule that adequate air cover for forward operations was impossible, the assault was postponed for ten days.[38]

On 15 December the landing was made near San Jose without opposition. No preinvasion bombardment was necessary, and the objectives of the initial assault were quickly reached. The building of airfields on Mindoro was easy. On the first day of the landing the engineers began to rehabilitate the two strips near San Jose. Within five days, Hill Field, a 5,700-foot dry-weather runway for fighters, had been completed.

[37] (1) *Ibid.* (2) Sixth Army, Rpt of the Leyte Opn, pp. 234, 231.

[38] Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, 314.

On 28 December, seven days ahead of schedule, the 7,000-foot San Jose dry-weather strip was ready for use. On 1 January Eighth U.S. Army took over operations on Mindoro. Engineer tasks continued. The aviation engineers began work on two additional all-weather fields, which would be needed when the rainy season set in. The fields on Mindoro assured more adequate air support for the planned invasion of Luzon.[39] "The success of the work at Tanauan and the ease (logistics not considered) with which the dromes at Mindoro were shaped accelerated the loss of interest in Leyte," Colonel Heiman wrote later. "By New Years, 1945, it was evident that Leyte would soon be a backwash." [40]

Luzon: The Drive to Manila

Tactical

Once Leyte and Mindoro had been secured, Luzon was to be attacked. The struggle for this island would be a crucial one. The plan of campaign for the MIKE series of operations, which were scheduled for Luzon, included a landing at Lingayen Gulf, a drive down the Central Plains toward Manila, seizure of the capital, capture of the fortified islands in Manila Bay, and then a mop-up of the Japanese who had retreated to the outlying parts of Luzon. Probably the most critical part of the campaign would be the drive down the Central Plains. From a military point of view, the plains, with a maximum width of 40 miles and extending 100 miles from Lingayen Gulf to Manila, were the most vulnerable part of the predominantly mountainous island. It was down them that the Japanese had launched their major attack in 1941. The campaign of 1945 would be the campaign of 1941 in reverse, with the Americans the attackers and the Japanese the defenders. The initial assault, the drive down the Central Plains and the capture of Manila —the M–1 operation—was to be the responsibility of two corps: I Corps, with the 6th and 43d Infantry Divisions, and XIV Corps, with the 37th and 40th Infantry Divisions. The 158th Regimental Combat Team, the 13th Armored Group, and the 6th Ranger Infantry Battalion were to provide additional support as needed. In reserve were to be the 25th Division and the 1st Cavalry Division. The Luzon operation was at first scheduled to begin on 20 February 1945, but the date for the landing was later moved forward to 20 December 1944, and then back to 9 January.[41]

Engineer Planning: Sixth Army and ASCOM

Engineer long-range planning required for M–1, the most extensive overland campaign in the Southwest Pacific, in which some 250,000 men were to be engaged, was considerable. Every possible angle of terrain intelligence had to be

[39] *Ibid.*, pp. 315ff.

[40] Ltr, Heiman to C Staff Br, 11 Sep 50. SWPA Files.

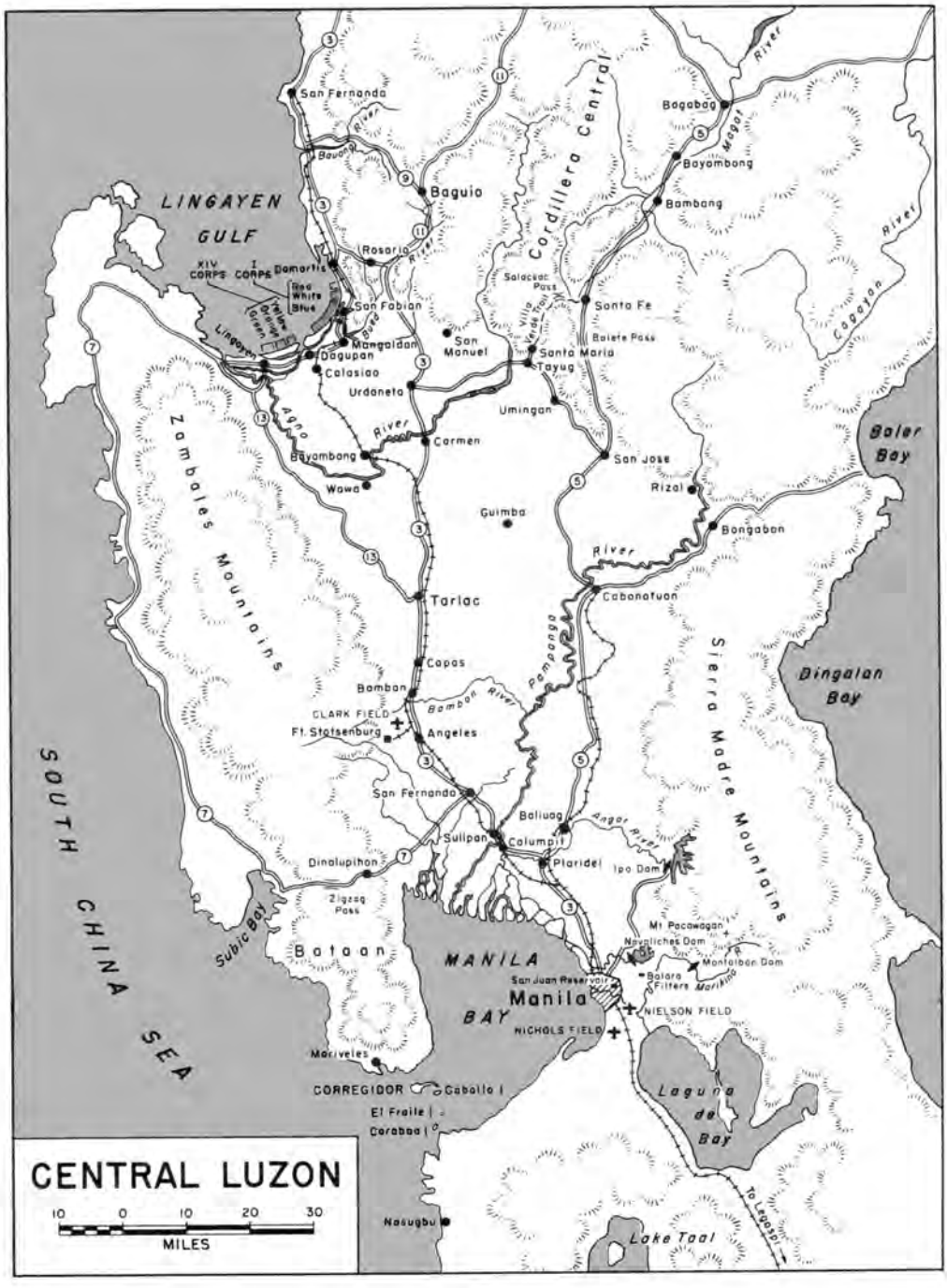
[41] (1) See Robert Ross Smith, *Triumph in the Philippines*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1963), Chapter II, for a discussion of the over-all plan of the invasion of Luzon. (2) Engr, Sixth U.S. Army, Rpt, Luzon Campaign, p. 1. SWPA Files.

studied; maps, and especially aerial photographs, had to be scrutinized with great care. The fact that the Philippines had been an American possession was a decided advantage. But almost all the engineers who had firsthand knowledge of the terrain of Luzon were prisoners of the Japanese. Except for Casey, Sturgis, and a few others who had served in the Philippines before the war, Luzon was unknown country to the men who had to plan and prepare for the coming drive to Manila.

Members of the Engineer Section, Sixth Army, assisted by a number of men from Col. Orville E. Walsh's 5202d Construction Brigade, began preliminary planning on 19 September for a landing at Lingayen Gulf and a drive down the Central Plains. A study of the Lingayen Gulf area indicated that the best beaches by far were on the eastern shore to the south of San Fernando. But behind them was a narrow coastal plain, and, in back of it, stood precipitous mountains. (*Map 29.*) Not only could that part of the gulf be easily defended, but also an invading force would have great difficulty in maneuvering on the plain, which at its southern end narrowed to a width of less than a mile. Farther south, near the town of San Fabian, the beaches appeared to be less desirable but still fairly adequate. LST's could probably make dry landings at a number of points. Southwest of San Fabian, the beaches were poor. Aerial photographs showed waves breaking from 300 to 500 feet from shore, indicating either that shoals existed or that the surf was heavy. The western shores of Lingayen Gulf could not be considered as possible sites because of reefs, poor beaches, and rocky terrain close to shore. All things considered, the most favorable landing area, from the tactical point of view, included that part of the gulf which stretched from San Fabian to the mouth of the Agno River. The beaches had drawbacks, but these were more than offset by the fact that intelligence information indicated the Japanese would probably offer little resistance to a landing made there, whereas they would almost certainly make a determined stand along the eastern shores of the gulf.[42]

For the engineers, the plan of assault had advantages and disadvantages. The beaches from San Fabian to the mouth of the Agno, the most favorable from the tactical point of view, had decided drawbacks, the most serious of which were shallow water and heavy surf. The terrain in back of the shoreline was hardly more promising. Inland, for a distance of from two to five miles, were meandering rivers, tidal estuaries, rice paddies, fish ponds, and swamps. But once past these hindrances and on dry ground, an invading force would encounter few natural obstacles on the way to Manila. On the western side of the central Luzon range, the Central Plains had their dry season from November to mid-May. The engineers would not have to contend with excessive rains as on Leyte; if anything, dust would be a nuisance. Lines of communications, while not plentiful, were probably adequate. Highway 3, a two-lane, all-weather road, partly concrete and partly asphalt, as well as a number of one-lane, dry-weather, graveled roads, led from the gulf to the

[42] Engr Sixth Army, Rpt, Luzon Campaign, pp. 7–8.


CENTRAL LUZON
10 0 10 20 30
MILES
LINGAYEN GULF
SOUTH CHINA SEA
MANILA BAY
Zambales Mountains
Sierra Madre Mountains
Cordillera Central
Baler Bay
Dingalan Bay
Laguna de Bay
Lake Taal
San Fernando
Baguio
Bagabag
Bayombong
Bambang
Rosario
Damortis
XIV CORPS
I CORPS
Red
White
Blue
Yellow
Orange
Green
San Fabian
Mangaldan
Dagupan
Calasiao
San Manuel
Salacsac Pass
Santa Fe
Balete Pass
Santa Maria
Tayug
Urdaneta
Umingan
Carmen
Bayombong
Wawa
Guimba
San Jose
Rizal
Bongabon
Tarlac
Cabanatuan
Capas
Bamban
CLARK FIELD
Ft. Stotsenburg
Angeles
San Fernando
Baliuag
Sulipan
Calumpit
Plaridel
Ipo Dam
Dinalupihon
Zigzag Pass
Subic Bay
Bataan
Mt Pacawagan
Novaliches Dam
Montalban Dam
San Juan Reservoir
Balara Filters
Manila
NIELSON FIELD
NICHOLS FIELD
Mariveles
CORREGIDOR
Caballo I
El Fraile I
Carabao I
Nasugbu
To Legaspi
Agno River
Pampanga River
Bamban River
Angat River
Magat River
Cagayan River
Baua River
Agno
Lingayen
Baua
Asingan-Tayug Road

MAP 29

capital. While these thoroughfares undoubtedly had deteriorated during the Japanese occupation, they could probably still take military traffic. Some twenty-five airfields were in the Central Plains, but only one—Clark Field—had well-developed runways; the others were landing strips with little or no surfacing, and on the whole, were suitable for dry-weather use only. Like the Japanese in 1941, the Americans would have to cross two large rivers—the Agno, flowing into Lingayen Gulf, and the Pampanga, which emptied into Manila Bay. The remaining streams in the plains could probably be fairly easily forded at a number of places during the dry season, especially if the campaign began after the season was well along. On the whole, the plains would probably present fewer natural obstacles to the U.S. Army with its superior equipment than they had to the Japanese.[43]

While combat engineer requirements would probably not be unusually heavy, a major concern for the first time—more so than for Leyte—was bridging. Two problems loomed: how to get the Army across the numerous water barriers in back of the beaches, especially in the western half of the assault area; and how to get the troops across the principal rivers farther down in the Central Plains. How many bridges would be intact or but slightly damaged was uncertain. If Japanese demolitions were as inept as heretofore, numerous structures would probably still be serviceable or could be quickly repaired; however, it was known that many spans wrecked in the retreat in the last weeks of 1941 had not been restored and that some of those rebuilt could not carry more than 10-ton loads. It could also be assumed that quite a few spans still intact would be destroyed by U.S. bombers before the assault landings at Lingayen Gulf began.[44]

Sturgis was especially concerned over the shortage of bridging units and equipment. He still had only the heavy ponton battalion and the three light ponton companies which had been on hand for the Leyte operation. Urgently needed were additional units, including at least one with treadway bridge equipment. Since indications were that the number of bridging units would be too small, Sturgis planned to make intensive use of what was likely to be available. To cross rivers which emptied into Lingayen Gulf, infantry support rafts and LCM's would be used as ferries. In addition, the Engineer, Sixth Army, planned to have the decks of all cargo ships loaded with Navy ponton cubes, to be assembled, if necessary, into 240-foot rafts. Each engineer battalion, combat as well as construction, was to have 150 feet of double-lane Bailey and 200 feet of timber trestle bridging, both types combat-loaded. As Sixth Army advanced down the Central Plains, repeated use was to be made of the floating bridges on hand. Sturgis planned to replace them with semipermanent structures as soon as possible and leap frog the floating equipment forward. This would mean constructing fixed bridges

[43] (1) Engr Sixth Army, Rpt, Luzon Campaign, p. 8. (2) Sturgis, Speech Made at Engr School, Ft. Belvoir, 4 Apr 47, (MS). SWPA File M346. (3) Lt. Col. James B. Lampert, "Combat Engineering—Lingayen to Manilla," *The Military Engineer*, XXXVIII (April, 1946), 143-44.

[44] Sturgis comments on draft of this chapter.

in "half the usual minimum time." Sturgis believed this procedure would serve to get the Army across the Agno, but thereafter engineer units would be under considerable strain to replace floating bridges with semipermanent bridging fast enough to keep up with the advancing infantry. Matters would become especially critical when the troops reached the Pampanga and the major rivers beyond it; a severe shortage of floating bridging might easily develop. Sturgis asked Krueger to request more bridging units from the United States. Sixth Army engineer plans called for one light ponton company assigned to each corps and one heavy ponton battalion, together with one light ponton and one treadway bridge company, assigned to army; eventually, more units would be needed. MacArthur requested additional units, but it was realized the chances were they would not arrive for three or four months and then perhaps without their equipment. The insufficient number of bridging units and equipment, the delay in airfield construction on Leyte, and the Navy's request for more time to make preparations were the principal reasons for the postponement of M–1 from 20 December to 9 January.[45]

ASCOM began planning for M–1 at Hollandia on 25 September, when a number of Leyte planners were reassigned to the new operation. They were scheduled to remain at Hollandia, in order to continue work on M–1 after the rest of ASCOM left for Leyte. General Casey directed that planning was ". . . to conform generally" with that "employed for the K–2 operation. . . ." On 6 October ASCOM sent Sixth Army a "tentative plan outlining [ASCOM] responsibilities in the operation." [46] Sixth Army approved it with slight modifications. Thereafter, planning was largely a matter of filling in the details. ASCOM was to be responsible at Lingayen Gulf for the construction of Base M, which was to support the drive of the combat forces to Manila. The base's operations would be of short duration; after the capital city was taken, a more permanent base would be built in the Manila Bay area.[47]

A question arose with regard to the 5202d Construction Brigade. Casey wanted it assigned to ASCOM, as the 5201st had been on Leyte; Sturgis believed it would be advantageous to have the brigade with its numerous construction units assigned to army, so that it could be used in direct support of a rapid drive on Manila. Since Base M, in any event, was soon to be superseded by the Manila base, construction requirements for the former would probably not be so extensive as for Base K on Leyte. Asked to decide the matter, Krueger placed the 5202d under army.[48] With the Japanese Air Force already in a seriously weakened condition, airfield requirements, in particular, were less. On Leyte, ASCOM had been charged with building four all-weather fields. At Lingayen, it was to have a temporary runway, 5,000 feet long, ready six days after the landing, and it was to have two

[45] (1) *Ibid.* (2) Smith, *Triumph in the Philippines,* ch. II, pp. 12–14.

[46] 1st Lt John Mussachio, CAC, Hist of ASCOM, 26 Dec 44–13 Feb 45, pp. 2–3. SWPA File A154.

[47] *Ibid.,* p. 3.

[48] Engr Sixth Army, Rpt, Luzon Campaign, p. 7.

all-weather strips finished in fifteen days. Dock construction requirements, likewise, were less than on Leyte. Because needs were less, ASCOM's organization for M–1 was smaller than for K–2 and it had fewer engineer units assigned to it. ASCOM had fifteen aviation battalions for Leyte, but only nine for Lingayen Gulf. Still, the number of aviation battalions available for M–1 was no less than for K–2, since the battalions ASCOM lost had come under Sixth Army control along with the 5202d Construction Brigade.[49]

Engineer amphibious operations at Lingayen Gulf were to be the most extensive so far carried out in the Southwest Pacific. They were assigned to the 4th Special Brigade, which was reinforced with two boat and shore regiments from the 3d Brigade. Each boat and shore regiment, supporting one division or independent regimental combat team, was to function under the direct control of the unit to which it was attached. The amphibian engineers made arrangements with the Navy for the shipment of engineer landing craft aboard assault vessels to the target area for arrival on S-day; 69 craft were allotted to I Corps, 84 to XIV Corps, and 25 to the 25th Division and other units of the reinforcement group. During the landings, Colonel Hutchings, commander of the 4th ESB, was to act as a special staff officer to General Krueger and as such was to be mainly responsible for keeping a close check on unloading operations and apportioning landing craft to the beaches in such a way that the discharge of cargo would be expedited to the greatest degree possible.[50]

Assault

The assault was made as planned on 9 January at Lingayen Gulf on a series of beaches fifteen miles long. The 37th and 40th Divisions of XIV Corps landed on the right; the 6th and 43d Divisions of I Corps on the left. The remaining units of the attacking force, standing by, were to come ashore within the next few days. As the troops in their landing craft neared shore, there was singularly little enemy opposition—only sporadic artillery fire and occasional aerial attacks. Sturgis, aboard one of the vessels of the convoy, saw only two enemy aircraft, one at dusk on S-day, making an unsuccessful suicide attack on the landing fleet, and another two days later, engaged in reconnaissance.[51]

Amphibious Operations

As planned, the amphibian engineers landed troops of XIV Corps on the right. The 544th EBSR, supporting the 37th Division, brought its first infantrymen ashore at H plus 10 at Yellow Beach, farthest to the east in the XIV Corps area. The weather was fair, but the seas were rough and the beaches poor. Thirty-five feet in back of the low water line was a dune up to ten feet high,

[49] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 165. (2) Sturgis comments on draft of this chapter.

[50] 4th ESB, Monthly Hist Rpt, 1 Dec 44–31 Jan 45. (2) Ltr, Krueger to Hutchings *et al.*, 23 Nov 44. Both in SWPA File E48.

[51] (1) Barbey, Rpt of the Lingayen Opn—San Fabian Attack Force, 12 Feb 45, pp. 16–17. SWPA File 82. (2) Sturgis comments on draft of this chapter.

which made the construction of roads inland difficult. On the second day, the seas became so heavy that a number of LCVP's were broached and the unloading of landing craft became almost impossible. The beach was so unsatisfactory that a new one had to be found; after some reconnoitering, the 544th discovered a likely site along the banks of the nearby Dagupan River and transferred its unloading operations to that point.[52]

To the west was Orange Beach. Here the 594th EBSR landed the 40th Division. Some random rifle fire was received from the shore and during the first night several air raids occurred in the course of which enemy planes dropped a few bombs. More hampering than the enemy was the surf. LST's could get no closer than 200 feet from shore. Causeways of ponton cubes placed from the LST's to the beach made dry landings possible, but the seas became so rough that the causeways could not be kept in place. Orange Beach was abandoned and the 594th sent its landing craft to discharge cargo along the banks of the Calmay River, which paralleled the coast about two miles inland. On the far right of the XIV Corps landing area was Green Beach, which was reserved for service units and the unloading of bulk cargo such as landing mat. On the second day two companies of the 594th came ashore and began unloading LCM's and LCVP's, but shallow water made the job hard. The amphibian engineers at this beach were handicapped by their lack of ponton cubes for causeways and bulldozers for the building of ramps.[53]

In the I Corps area, the problems were of a somewhat different nature; the surf was not so high, but the water, in most places, was too shallow for satisfactory unloading. On the right were Blue Beaches 1 and 2. Here the 543d EBSR brought in the 6th Division. The Japanese at first did nothing to oppose the landing except to put some ineffectual rifle fire on the beach. Shallow water prevented LCM's from coming close to land; most were grounded about 300 feet offshore. The Japanese Air Force went into action and strafed the beach, inflicting some casualties among the amphibian engineers. On the second day the seas became rough, with waves up to six feet high, and many landing craft floundered. During the succeeding days, as the surf subsided, supplies could be brought ashore in large quantities.

To the left, at White Beaches 1, 2, and 3, the 533d and 543d ESBR's found landing conditions favorable except on the right. Attempts to land LST's and LSM's here were futile because of the shallow water and fairly heavy surf. Unloading had to be shifted to the left part of the beach. Japanese resistance was more in evidence at the White Beaches. On the first day a number of boats were hit by mortar shells, and during the following days the enemy laid down mortar and 75-mm. and 240-mm. artillery fire, in the course of which the

[52] (1) 4th ESB, Monthly Hist Rpt, 1 Dec 44–31 Jan 45. (2) Heavey, "Down Ramp," *The Military Engineer,* XXXVIII (December, 1946), 519–25. (3) Rpt, Engr Sixth Army, Luzon Campaign, pp. 22, 28.

[53] Heavey, "Down Ramp," *The Military Engineer,* XXXVIII (December, 1946), 519–25.

shore party suffered a number of casualties. Because of the rough seas in the XIV Corps area and at the Blue Beaches, a considerable amount of shipping was diverted to the White Beaches. Some confusion and delays resulted, but not of sufficient importance to affect subsequent operations.[54]

The amphibian engineers assisted in the landing of one additional unit. On the far left, the shore battalion of the 534th EBSR helped bring in the 158th RCT on Red Beach on S plus 2. The Japanese offered more resistance here than on any of the other beaches, placing heavy artillery fire on the men coming ashore, and causing numerous casualties. The enemy also used small suicide boats filled with explosives, but these did little damage. The 25th Division, the 13th Armored Group, and the 6th Ranger Battalion came ashore on White and Blue Beaches on S plus 2 in landing craft operated by the Navy.[55]

On the whole, enemy opposition had been surprisingly light. The amphibian engineers had fewer casualties than had been the case at Leyte, Biak, or Wakde. Japanese air strength was noticeably weak—the high surf and shallow water gave the most trouble. In the days after the first landings, the amphibian engineers continued unloading supplies and gave increasing support to the logistical development of the Lingayen Gulf area. They helped construct unloading facilities and built roads and supply dumps. They extended the scale of these activities when they passed from the control of corps and divisions to ASCOM on 19 January.[56]

Combat Engineer Support

In the egress from the beaches and the subsequent drive down the Central Plains, combat engineer support was furnished by the divisional combat battalions and by engineer units assigned to the two corps and to the 5202d Engineer Construction Brigade under Sixth Army. Five divisions, an RCT, and an armored group took part in the initial advance. XIV Corps with the 37th and 40th Divisions was on the right; I Corps with the 6th, 43d, and 25th Divisions, the 158th Regimental Combat Team, and the 13th Armored Group was on the left. XIV Corps, scheduled to advance directly on Manila, was to bear the brunt of the drive. I Corps, responsible for protecting the left flank, was to drive across the island in a southeasterly direction toward Dingalan Bay. General Krueger believed that the Japanese, having expected a landing on the eastern shores of Lingayen Gulf, would have strong positions in the mountains to the northeast of the Central Plains, a view already partly substantiated by enemy interference with the landings on the far left, and to be still further substantiated by the stubborn resistance which I Corps was to meet in a number of places as it drove ahead. Krueger's great concern was that XIV Corps should not advance so rapidly in the face of comparatively light resistance that it would outrun its

[54] 4th ESB, Monthly Hist Rpt, 1 Dec 44–31 Jan 45.
[55] *Ibid.* (2) Off C Engr GHQ AFPAC, *Engrs of SWPA*, IV, 542–43.
[56] (1) Ltr, Heavey to Trudeau, 30 Jan 45. SWPA Files. (2) 4th ESB, Monthly Hist Rpt, 1 Dec 44–31 Jan 45.

supply lines or expose itself to a flank attack.[57]

On the far right, the 40th Division, supported by the 115th Combat Battalion, was scheduled to advance south from Lingayen Gulf to Highway 13 and thence to Highway 3, which led directly into Manila. Resistance to the landing was completely lacking. The movement from the beach was easy; the combat engineers broke down a bank, about three feet high, beyond which roads led to the town of Lingayen, where the streets, but slightly damaged, easily carried military traffic. Within a distance of two miles south of the town, two major rivers had to be crossed—the Calmay and the Agno; the bridges over both had been destroyed. The combat engineers took the troops over in assault boat ferries constructed by Companies A and B and in landing craft borrowed from the 594th EBSR. Within three days most of the division was across the Agno and advancing down Highway 13. Great expanses of wet rice paddies forced the troops to stay close to the road. Since smaller bridges, though usually intact, could seldom take more than 3-ton loads safely, the 115th engineers strengthened them to take thirty-five tons. Only one large bridge on Highway 13—at San Clemente—was completely destroyed. On Highway 3, a most important bridge —the one over the Tarlac River—had twenty spans, two of which were partly demolished; they were repaired in two hours. Complete destruction of this bridge would have seriously slowed the division. Within two weeks the 40th Division had reached the town of Bamban, sixty miles from Lingayen Gulf and somewhat more than halfway to Manila.[58]

On the left in the XIV Corps area, the 117th Combat Battalion supported the 37th Division in its drive southeast from Lingayen Gulf to Highway 3. The first major obstacle again was the Calmay, about a mile south of the landing area. The river did not prove the hindrance it might have been. The bridge which the division was to use, some 600 feet long, had 3 spans of 150 feet each and one span of 120 feet, the latter on the near shore. The first troops to reach the site found the Japanese had destroyed the 120-foot span but had left the other 3 intact. The combat engineers on 13 January easily replaced the missing span with a Bailey bridge. The 37th Division was scheduled to cross the Agno some twelve miles to the south at Bayambang, where the 300-foot railroad bridge over the river was only slightly damaged. The engineers on 14 January repaired the piers and placed decking on the bridge so that it could take 15-ton wheeled traffic. Two days later the 117th battalion constructed a ponton bridge capable of taking 13-ton loads. During the night of 15 January seventeen men of the 530th Light Ponton Company and twenty-five men of the 117th engineers put a ponton bridge to take 8-ton traffic across the Agno at Wawa. Construction was difficult; the men had no time for a reconnaissance, and it turned out that a sandbar in the

[57] Krueger, *From Down Under to Nippon*, pp. 226–28.

[58] (1) Hist of the 115th Engr Combat Bn. (2) Engr Sixth Army, Rpt, Luzon Campaign, p. 28.

middle of the river forced the engineers to put up two bridges.

From the Agno to the Pampanga, bridging for the 37th Division was fairly easy. The troops used fords extensively. Where necessary, the combat engineers, using local material, repaired or constructed timber trestle spans to carry loads up to sixteen tons; this work, they reported, constituted up to 75 percent of their effort during the first two weeks. The men built some bridges at night, using lights, sometimes as much as ten miles ahead of the main line of resistance, and without infantry protection. Very little effort was required on roads. Highway 3 had many holes but was usable for all military traffic. The combat engineers expended time and effort on developing a two-lane graveled road east of Highway 3 into a parallel secondary route.[59]

It was much the same story in the I Corps area. The 6th Combat Battalion, supporting the 6th Division in its advance from the beaches to the town of Urdaneta on Highway 3, had no trouble at first, even though, as maps and aerial photographs had correctly indicated, the beachhead was something of an island. To the south was the Binloc River, lined with fish ponds, to the east the Bued, to the west the Dagupan. LVT's carried the assault troops across the waterways. For the supply and support of the troops the 6th engineers had to bridge the rivers in the line of the advance. They constructed a 150-foot Bailey across the Binloc, a major problem being the marshy ground near the river's banks. The next big job was getting the troops across the Agno on Highway 3 near Carmen. Here was the bridge of thirteen spans, each 160 feet long, one of which the retreating American and Filipino forces had demolished during the withdrawal of 1941. The Japanese had replaced the destroyed span with a timber structure; American bombers sweeping over Luzon before the Lingayen Gulf landing had destroyed more or less completely four of the concrete spans. To get the first troops across the river, the engineers hired about 250 Filipinos to build bamboo rafts; the natives put 70 together, but none were needed because the Japanese did not oppose the crossing. The 506th Light Ponton Company and one platoon of the 6th engineers got the job of putting a ponton bridge across the river and preparing the approach roads. Before construction began, Japanese forces reached the opposite bank and held up work for about twenty hours. As at Wawa, a sandbar in the middle of the river bed required the men to build two floating bridges. The advance elements of the 6th Division crossed over on 20 January. Beyond the Agno, the most important jobs were improving and maintaining the roads as far as the towns of Guimba and Cabanatuan.[60]

Farther to the east, the 118th Combat Battalion of the 43d Division reported that it had little trouble. The roads from the beach crossing swamps and ponds were "intact." Farther inland, the main roads were in "excellent condition." The bridges were too flimsy to take division loads, but railroad bridges

[59] Hist of 117th Engr Combat Bn.

[60] (1) Hist of the 6th Engr Combat Bn. (2) Hist of the 506th Light Ponton Co.

and embankments, almost everywhere in excellent shape, were quickly prepared to take all traffic, and fords were easily found. The engineers had no difficulty developing and maintaining an adequate, even if heavily traveled, road net. The men, called upon to destroy occasional obstacles such as pillboxes and barbed wire entanglements, some of them mined and boody-trapped, dealt with them handily. Sometimes enemy infiltrators tried to disrupt work by planting mines at the job sites. "The Japs would come in at night and lay a few mines at random on a portion of road just constructed and aside from the harassing effect accomplished little," the 118th reported.[61]

On the far left were the 65th Combat Battalion, supporting the 25th Division, and the 186th Combat Battalion, supporting the 13th Armored Group; both combat battalions landed on S plus 2. The 158th RCT, which came ashore the same day, had no engineer unit. The 65th engineers were active in the San Manuel–Santa Maria–Umingan area at the northeast edge of the Central Plains. They developed about 100 miles of new roads and trails and strengthened about fifteen timber bridges. The men spanned the Agno, no more than a small stream in this area, with an infantry support bridge 150 feet long and prepared a ford 400 feet wide nearby for heavier loads. Since fords were readily found at all streams, road maintenance was a far more time-consuming task than bridging.[62]

The 186th engineers, in landing, encountered more opposition from the Japanese than any other combat battalion. The unit came ashore at 1830 on 11 January; about 8 hours later the enemy began shelling the ships as the troops were unloading them. Six men of the 186th were killed and two wounded; enemy fire was so heavy that unloading had to be postponed till morning. Since the 13th Armored Group moved into bivouac, the 186th engineers had no immediate combat missions. They improved and maintained some roads near their bivouac area and spanned a nearby stream with a Bailey bridge.[63]

The combat battalions had an additional construction task which at times was of considerable importance—the building of temporary landing strips needed by artillery liaison planes for courier service and by transports for the evacuation of casualties. The men prepared most of these strips with bulldozers. Since the Central Plains had many level, cleared areas, little earthmoving was required. Large expanses of dry rice paddies offered the best sites. In a short time, the troops leveled off irrigation dikes and prepared a smooth surface. "Dry weather airdromes across rice paddies," Sturgis wrote to Somervell, "was the easiest thing that we have had fall in our lap in the last two years. . . ." [64]

Mines and Obstacles

The troops found few mines at the beaches or on the routes leading inland to the main highways of the Central

[61] Hist of the 118th Engr Combat Bn.

[62] Hist of the 65th Engr Combat Bn.

[63] Hist of the 186th Engr Combat Bn.

[64] (1) Engr Sixth Army, Rpt, Luzon Campaign, pp. 79–80. (2) Ltr, Sturgis to Somervell, 28 Jan 45. Sturgis File 84.

Plains. No units except the 118th engineers reported encountering any in quantities. It was only after the troops had advanced far down the Central Plains that they ran into fairly large numbers of mines in some areas. Quite a few were found near Clark Field and Fort Stotsenburg. At Clark, the 117th engineers had to deal with approximately 1,300 buried aerial bombs, buried just deep enough to put the nose fuze even with the ground. Locating these mines was easy; not only were the shipping boxes scattered about in the mined area but also the plugs were on the ground nearby. In a few instances, the mined areas were covered by enemy fire. In that event, the infantry-engineer-tank teams went into action. Fire from the infantry and tanks covered the engineers probing for mines. The men, as a rule, disarmed the aerial bombs by hand. They turned down the arming collar on the fuze spindle, unscrewed the nose fuze, and inserted the bomb plug in the nose-well. Using an **A**-frame or truck winch, they pulled the bomb out of the ground. In the few cases where the detonaters were jammed, the bombs were blown in place with explosives. Troops in the foothills on the east side of the Central Plains found a number of mines, including artillery shells, flower pot and tape measure mines, and some improvised box mines made of wood or tin. None were placed in any identifiable pattern, and most were so poorly camouflaged that they were easily detected.[65]

The combat troops ran into only a few roadblocks or similar obstacles, and most of these, almost invariably consisting of logs or wrecked equipment, had been hastily put in place. Some machine gun emplacements covering strategic road intersections or bridges had been constructed, but they were not manned. On the whole, the obstacles encountered on the Central Plains were ineffectual. In the hills west of Fort Stotsenburg, the Japanese had built well-entrenched positions. They had constructed elaborate defensive installations, including caves, many of them blasted in vertical cliffs and interconnected by tunnels. These positions were extremely difficult to reduce. Since they were located on the flank of the route to Manila, they had more of a nuisance value than anything else and did not slow down the advance to the capital.[66]

ASCOM

The first elements of ASCOM came ashore on S plus 1. General Casey, scheduled to land on S-day, was delayed until the next afternoon because the destroyer on which he was aboard had to escort a crippled transport. Upon landing, he went to Lingayen airstrip, situated between the town of Lingayen and the sea, where he met Col. Reginald L. Dean, chief of ASCOM's Construction Section. Aircraft carrier support was to be withdrawn seven days after the first troops hit the beach; this meant an airfield would have to be ready within 5

[65] Memo for Rcd, 117th Engr Combat Bn, 2 Feb 45. SWPA File B78.

[66] Engr Sixth Army, Rpt, Luzon Campaign, p. 79.

days; immediately required was a 5,000-foot runway.[67]

Special efforts had been made to prevent the confusion that had arisen at Tacloban, where the thousands of tons of supplies dumped on the runway had made rapid rehabilitation of the airstrip impossible. Kenney had prevailed on MacArthur to call a special conference shortly before the convoy set sail from Leyte for Lingayen Gulf. Among those present were Kenney, Krueger, Casey, and Sturgis. The conferees agreed that three fast supply ships loaded with steel mat were to accompany the assault echelon and land as close to Lingayen airstrip as possible on S-day, that one construction battalion scheduled to land on White Beach 2 was to be shifted to Orange Beach near the airstrip, that a group of ASCOM engineers assigned to the leading assault wave was to go at once to Lingayen airfield and stake out the construction area, and, finally, that the commanding general of XIV Corps was to see to it that troops, vehicles, and supplies were kept away. These arrangements were for the most part being carried out. However, landing conditions, the nature of the soil at the airstrip, and the degree of enemy resistance that might develop were unknown factors; how rapidly construction would progress was, at least partially, dependent on them. If soil conditions were not satisfactory, four additional days might be needed to make the strip operational.[68]

Making a quick reconnaissance of Lingayen, Casey and Dean found the turf runway badly torn up by the pre-invasion bombings. Because of delays in unloading and congestion on the beaches, work on the strip could not begin until the second day of the landing. At that time 400 Filipino civilians went to work to remove bomb fragments and fill craters with sand from the beach. Three days later one company of the 836th Aviation Battalion began work; the next day, the remainder of the unit, two companies of the 1879th Aviation Battalion, and a number of men from the 43d Construction Battalion arrived with a few pieces of heavy equipment. Little earth-moving was required. As soon as troops and civilians had smoothed the surface of the runway, they covered it with palm fronds and placed steel mat on top of these. Since the strip was to be used only temporarily and the subgrade was sand, no drainage system was installed. Seven days after the landing, a 5,000-foot steel mat runway, with undispersed parking areas, was in use. Without the help of the Filipino civilians, the target date could not have been met.

On 13 January Filipino civilians, supplied with hand tools, began work on a second runway about two miles south of Blue Beach near the town of Dagupan. The next day the 828th and 864th Aviation Battalions disembarked and, while waiting for their equipment to be unloaded, did some work by hand on the strip. Two days later, with all their machinery at the site, the men began construction in earnest. It was soon evident that a high water table, together with spongy soil, made the location undesirable, even for dry-weather opera-

[67] Unless otherwise indicated, this account of ASCOM activities in the Luzon Campaign is based on History of ASCOM, 26 December 1944–13 February 1945.

[68] Sturgis comments on draft of this chapter.

tions. A reconnaissance team found a better site west of the town of Mangaldan. The 1876th Aviation Battalion began work here on the night of 17 January. With no specific instructions from higher headquarters as to how to proceed, the unit went ahead on its own. Since the water table was only eighteen inches below the western end of the runway, the men were careful not to disturb the surface of the rice paddies, except where necessary to remove dikes and pull out shrubs and small trees. The dry clay made a firm, hard surface. By the time the runway was operational, the tactical situation was so much better than had been expected, and the weather outlook was so favorable, that the original directive calling for two all-weather airfields was replaced by one calling for two dry-weather runways only. The uncompleted strip at Dagupan, 4,500 feet long, was satisfactory for cub planes and transports.[69]

A most important responsibility of ASCOM was the erection of storage tanks for gasoline. During the first days of the landing, all such installations were to be of a temporary nature, their function to supply airstrips at Lingayen and Mangaldan and the needs of the troops in the beachhead area. Plans called for fourteen barges to discharge bulk petroleum fuel through temporary lines to 500-barrel tanks on shore. Because of the heavy surf, the only possible site for such tanks with their pipelines was on the Dagupan River near the town of the same name, but even here problems arose because the surf, together with a sandbar, slowed the movement of barges into the river. Nevertheless, within nine days, a temporary system consisting of one 500-barrel tank for aviation gasoline, connected by pipeline with a barge anchored in the Dagupan River, was supplying Lingayen Drome. A second pipeline was under construction from the Dugupan River to Mangaldan Drome.

From 16 to 31 January ASCOM engineers began construction of more permanent facilities at a number of places in the Lingayen area. Undertaking repair of a marginal wharf in the Dagupan River, they had it ready for use by 24 January. Because of the heavy surf and the lack of suitable sites, they did not try to build small-ship docks or lighter jetties (other than fuel) at Lingayen Gulf. ASCOM engineers maintained and improved more than forty miles of roads and rehabilitated thirty-five miles of railroad in the Base M area. The many ASCOM projects were built without undue delay, despite such major obstacles as poor unloading conditions. Equally annoying was the improper loading of ships. Many urgently needed items were at the bottom of the holds, many crates were broken and great quantities of supplies were damaged. Ten thousand pipeline couplings arrived from the United States without bolts. The Sixth Army engineer reported that "more difficulties with respect to unloading bulk petroleum supplies were encountered during this period than ever before in the theater." Nevertheless, ASCOM managed to finish a number of projects on time and some ahead of schedule. The rapid advance of the troops down the

[69] (1) Hist of the 1876th Avn Bn. (2) Engr Sixth Army, Rpt, Luzon Campaign, p. 29.

Central Plains and the imminent capture of Manila were sufficient indication that Base M would not be needed long. For 28 days, ASCOM functioned as the construction agency of Sixth Army. On 13 February it was transferred to USASOS and redesignated Luzon Base Section. Casey returned to his post of Chief Engineer, GHQ.[70]

Army and Corps Engineers

A substantial number of engineers were assigned to army and the two corps —about 8,100 to army and 8,000 to each of the corps. The primary mission of army and corps engineer units was to provide facilities of a more substantial nature than those supplied by divisional combat battalions. Corps units followed closely behind divisional units, improving such construction projects as was necessary, thereby enabling divisional units to move on in direct support of their combat elements. Since corps engineer staffs were small, the two corps engineers, Col. W. D. Smith of XIV Corps, and Col. Herbert G. Lauterbach of I Corps, were each given an engineer group headquarters to function as an operations section staff. To help get the troops across rivers, each corps had been given a bridging unit: XIV Corps, the 530th Light Ponton Company, and I Corps, the 510th Light Ponton Company. As soon as possible, army units took over from corps units, thus enabling the latter to keep up with the divisions. In the army area, construction units were under Colonel Walsh's 5202d Engineer Construction Brigade. Assigned to the brigade were three bridging units —the 556th Heavy Ponton Battalion, the 506th Light Ponton Company, and the 1011th Treadway Bridge Company —and five aviation battalions, the latter units responsible for building both runways and fixed bridges. Lauterbach and Smith were to ask for army engineer support if needed; they kept abreast of general developments through their liaison officers in the army engineer section. In the first days of the M–1 operation, Colonel Walsh sent reconnaissance parties into the corps areas to get intelligence information, locate construction brigade units as they landed and issue orders to them, and co-ordinate the distribution of floating bridge equipment. Since important engineer information was frequently not sent in time over the Sixth Army radio net, Sturgis had arranged to have the Signal platoon of the 4th Special Brigade set up its own radio net and operate it to secure data promptly from corps and divisions—an arrangement which was to prove highly advantageous. In the rapid advance down the Central Plains, most of the more complicated jobs, particularly bridging, begun under corps direction, were soon transferred to army. Increasing numbers of Filipino civilians were hired to help the troops, particularly in the army area, where the most extensive construction was necessary. "Between the corps rear boundary and the Army Base boundary is where the big slug of work on the communication lines, roads, bridges, and railroads lies," Sturgis wrote Brig. Gen. Francis K. Newcomer in late January.[71]

[70] Engr Sixth Army, Rpt, Luzon Campaign, p. 34.

[71] (1) Engr Sixth Army, Rpt, Luzon Campaign, pp.

A most important mission of the bridging units, whether army or corps, was to put floating bridges across rivers to take the heavier divisional loads and the great quantities of supplies needed to support the advance of the combat units. Requirements were especially heavy in the maze of rivers in the Lingayen Gulf area; two waterways in particular needed more substantial bridges—the Calmay and the Agno. With the arrival on 10 January of the 1011th Treadway Bridge Company, though without most of its equipment, more rapid forwarding of ponton bridging was possible.

One of the longest floating bridges to be constructed was the 396-foot steel treadway across the Calmay south of Lingayen, where the 40th Division had crossed on rafts and ferries. Company A of the 556th Heavy Ponton Battalion was given this job on 11 January. The bridge was open to traffic at 0930 of the 13th. On 17 January the battalion was ordered to put a heavy ponton bridge across the Agno at Wawa, where the 37th Division had crossed. Company B completed it at 1600 of the next day; 240 feet, the ponton bridge was connected to a trestle bridge 60 feet in length. Meantime, the railroad bridge across the Agno at Bayambang, one span of which the 117th Combat Battalion had repaired to enable the division to cross, was not satisfactory for heavy loads. On 18 January the 556th received orders to put a treadway across the Agno near the railroad bridge. To get material, the men dismantled the recently completed treadway across the Calmay and transported it thirteen miles to the new site. Begun just before noon on 20 January, the new bridge, with the help of Company A of the 1011th Treadway Company, was completed at midnight on the same day. The 863d Aviation Battalion began work on 22 January on an unusual floating bridge across the Agno—one made up of Navy ponton cubes. This bridge, really a floating causeway, consisted of three sections of thirty pontons each, floated into place, with the two end sections anchored to clusters of piling driven into the north and south banks of the river. The men finished this floating causeway, together with its approaches, on 27 January. The structure, while generally satisfactory, required continuous maintenance because of the hinges breaking in the center. The process of taking up bridges and moving them forward was well under way by 20 January, when Sverdrup reported, "Treadway bridging is replacing floating bridging as rapidly as possible and the floating bridge material is being brought forward." [72]

Meantime, army engineer units were repairing wrecked bridges and putting in semipermanent spans to speed the forward movement of both ponton and treadway bridging. Semipermanent fixed bridges, capable of carrying loads up to thirty-five tons, were provided in several ways. Since Japanese demolitions were usually not expert, the most common way was to repair the partially demolished concrete or timber structure.

7, 232–33. (2) 5202d Engr Constr Brigade, M–1 Opn. SWPA File B95. (3) Ltr, Sturgis to Newcomer, 28 Jan 45. Sturgis File 84.

[72] (1) Hist of the 556th Heavy Ponton Bn. (2) Hist of the 863d Avn Bn. (3) Check Sheet, Sverdup to CofS *et al.* GHQ SWPA, 20 Jan 45. SWPA File M203.

Most bridges required one or more new spans. If a concrete structure had been but slightly damaged, the engineers, as a rule, restored the abutments, realigned the piers, if necessary, and poured new slabs, utilizing as much of the reinforcing steel as possible. Little concrete was used because of the lack of time and a shortage of cement. More often the engineers replaced missing spans with wooden trestles; a standard design for a 35-ton timber trestle span had been developed before the M–1 operation began. Since the Central Plains had practically no trees, materials consisted generally of timbers salvaged from the wrecked structures or taken from local stocks. Most wooden bridges required additional bracing. Bailey bridging was preferred on long narrow spans, where the height of the bridge or the condition of the stream had made the use of piling uneconomical. Bailey bridging was very effective and made for "great economy of time and effort." The troops had no serious trouble launching such bridging, even though most of them had had no experience with it except in training. Since the Japanese frequently destroyed a highway bridge, but left a nearby railroad bridge intact, numerous railroad bridges were reconstructed or repaired with additional decking to permit both trucks and trains to cross within a short time.[73]

The five aviation battalions assigned to the 5202d Construction Brigade were mainly responsible for building semipermanent bridges or repairing demolished structures to permit them to take loads up to thirty-five tons. The aviation engineers often repaired smaller bridges with timber trestle spans; for the larger structures they used Baileys to replace the demolished sections. In some instances, they built entirely new timber trestle bridges. The 1876th Engineer Aviation Battalion from 14 to 18 January put in a new 274-foot long pile-trestle bridge across a waterway between San Fabian and San Fernando, using salvaged timbers and coconut logs cut on the spot; the 340th and 118th Combat Battalions furnished the pile drivers. More often, however, the engineers repaired, as quickly as possible, the partially wrecked bridges left by the Japanese. The 841st Aviation Battalion, for example, repaired two large structures on Highway 3, one north, the other, south of Bamban. The battalion restored the bridge across the Cutcut River north of the town by putting in two 75-foot trestle approaches and erecting a 90-foot Bailey; south of the town, it spanned the Bamban River with a 410-foot Bailey, making use of the piers, which had been left in place. North of Angeles, the 841st Engineers repaired existing concrete spans and constructed a 350-foot H–20 bridge.[74]

One of the major jobs was the reconstruction of the badly damaged bridge across the Agno near Carmen, the longest in the Philippines, which the 6th Division had bypassed. The 1876th and 1913th Aviation Battalions got the task on 21 January; the 1913th was assigned the northern half, the 1876th, the

[73] Engr Sixth Army, Rpt, Luzon Campaign, pp. 55, 63.

[74] (1) Hist of the 1876th Avn Bn. (2) 5202d Engr Constr Brigade, M–1 Opn, pp. 54–55. SWPA File B95.

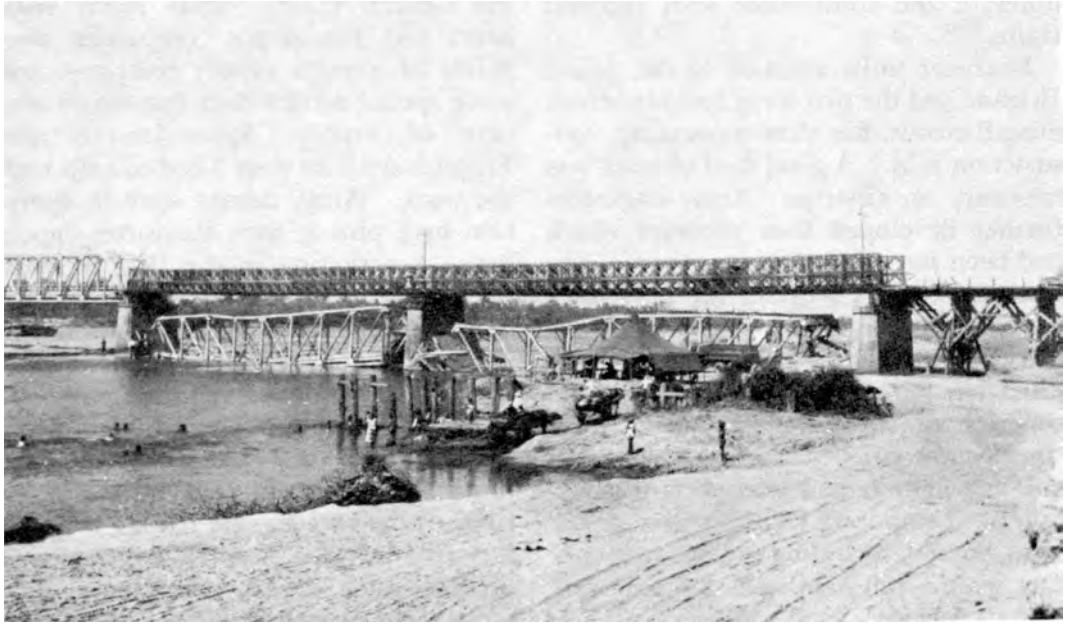
southern. Plans called for a good deal of work. The four demolished spans were to be replaced with Baileys, and the pile-bent span was to be reinforced to carry thirty tons. Eight of the other spans needed new members welded in and old ones reinforced. One cracked pier had to be strengthened; the severely damaged concrete decking had to be repaired. The 1876th and 1913th first salvaged as many parts of the bridge as possible and sent out parties to scour the countryside for additional material; they found some as far as forty miles away. The four fallen spans posed a considerable problem, because, partly in the way, they prevented the launching of the Baileys. Short of oxygen and acetylene for their blow torches, the engineers used explosives to remove the wreckage; the flying debris endangered the pneumatic floats of the nearby ponton bridge. Preparing to do extensive blasting one night, the men disconnected the 273-foot long floating bridge from its abutments and let the current carry it 600 feet downstream; the next morning, they returned it to its original position. In the meantime the obstructing wreckage had been blasted away. To fill the two gaps left by the wrecked spans, the men launched two Baileys, each 330 feet long and supported on a center pier. Repair of the damaged truss members was a complex undertaking; 74 of the truss members, including 20 stringers, had to be replaced, and 32 needed major repairs. The 1913th engineers reinforced the cracked pier by wrapping a ¾-inch cable around it. Much work was required on the decking. The men cleaned out the holes and filled them with new concrete. The 1876th reinforced the timber trestle span with additional bracing; the chief bottleneck here was getting the timbers. Repairs were completed on schedule on 4 February, and the ponton bridging was immediately sent forward.[75]

Another of the bigger jobs assigned to army engineer units was the restoration of bridges on the Manila Railroad. "Demolitions accomplished by our own air force bombers during the earlier days of the campaign were very effective, especially in the destruction of railway truss bridges," the 117th Combat Battalion reported. Rehabilitation of the main line and the restoration even of partial traffic would help relieve congestion on the overtaxed highways. ASCOM, assigned this mission initially, had to limit its efforts, because of high priority construction at Base M, to repairing bridges on feeder lines near Lingayen Gulf, but it put a railroad company to work to restore the tracks from Lingayen Gulf to Manila.[76]

Aviation engineer units assigned to the 5202d restored most of the bridges on the main line of the Manila Railroad. The retreating Japanese had left many of the short spans intact but had partly demolished the larger structures. A bridge that required a substantial effort was the one across the Agno at Bayambang, which the 117th Combat Battalion had quickly repaired on 14 January to take fifteen tons. The 841st Aviation Battalion began work on this structure

[75] (1) Col. John H. Dudley, "Bridge Repairs on Luzon," *The Military Engineer*, XL (October, 1948), pp. 456–58. (2) Hist of the 1876th Avn Bn. (3) 931st Engr Constr Group (Avn), Rpt, Use of Sixth Army Engr Trs on M–1 Opn. SWPA File B88.

[76] (1) Hist of the 117th Combat Bn. (2) Engr Sixth Army, Rpt, Luzon Campaign, p. 80.



REPAIRS ON THE CARMEN BRIDGE OVER THE AGNO RIVER

seven days later. A pier, consisting of two concrete columns, had been severely damaged. One of the columns was cracked below the water line; the other badly sheared. The aviation engineers constructed coffer dams of sandbags around the damaged columns and poured in reinforced concrete. They strengthened damaged girders by welding steel plates to them. Trains began crossing the bridge on 30 January. A second large structure needing repair was some thirty-five miles to the south over the Cutcut River near the town of Capas. Here Company A of the 1879th Aviation Battalion on 29 January began the job of replacing three 60-foot wrecked spans with timber trestles. Company B took over on 5 February and finished the work a week later. Five miles to the south, the bridge at Bamban required considerable effort. The Japanese had destroyed three spans at one end of the structure but had left the piers and the abutment intact. The 841st replaced one of the spans with a Bailey and the other two with a timber trestle structure, 144 feet long. The hardest task was driving the piles into the rocky stream bed. The work on the railroad bridges and tracks produced results. By 29 January the railroad was open from Lingayen Gulf to Tarlac. "The most the railroad has gotten behind is about thirty miles where we had a bad bridge job over the Agno River which required repairs to the piers and foundations," Sturgis wrote to Newcomer on 28 January, ". . . tomorrow this work will be completed and we will be up within five

miles of the front lines with railroad trains." [77]

Engineer units assigned to the 5202d Brigade and the two corps had numerous miscellaneous, but time-consuming, construction jobs. A good deal of work was necessary on airstrips. Army engineers further developed four runways which had been started by divisional engineers; intended for dry weather use only, they required no drainage or crowned surfaces. Probably the major airfield rehabilitation job was the restoration of the concrete runway at Clark Field. This runway was patched up and made suitable for fighters and transports in short order. Temporary facilities were developed nearby, including a 7,000-foot runway with a soil-stabilized subgrade and asphalt surface. One aviation battalion completed this job in ten days. As far as possible, construction in the army area was held to a minimum. Extensive road repair was not necessary, and tents and existing buildings were widely used, so that little new construction was necessary. Civilian workmen were employed in increasing numbers.[78]

Supply for Combat

One of the important responsibilities of army and corps engineers on Luzon was getting supplies to the engineer units. In contrast to most previous supply operations, this responsibility was fairly well handled in the drive down the Central Plains. Sixth Army engineers had two depot companies, two-thirds of a parts supply company, and some special service detachments to take care of supply. Approximately 400 Filipino civilians were hired to help with the work. Army dumps were in operation by S plus 4; soon thereafter depots began functioning in the Base M area. Each depot, covering an area of around 600 acres, received, stored, and issued about 1,500 tons of supplies daily. Each advance army depot required some 75 acres. The average distance from army supply points to regiments and smaller units was about fifty-six miles. As a rule, trucks and trailers hauled supplies forward, but the Manila Railroad was used to some extent. Sections or platoons of depot companies moved forward by truck. Stocks in depot areas were dispersed but not camouflaged. While organization was much improved and stocks were more adequate, deficiencies in training were still pronounced, being especially noticeable with respect to handling large quantities of supplies, loading heavy materials, and planning space requirements. For the tasks assigned, the number of parts supply platoons was inadequate.[79]

Maps for Combat

Providing enough satisfactory maps for combat on Luzon was even more difficult than providing them for operations in New Guinea, a situation partly explained by the comparatively extensive overland advance which was now neces-

[77] (1) Engr Sixth Army, Rpt, Luzon Campaign, p. 80. (2) Hist of the 1879th Avn Bn. (3) Ltr, Sturgis to Newcomer, 28 Jan 45. Sturgis Files.

[78] (1)Engr Sixth Army, Rpt, Luzon Campaign, pp. 79–80. (2) Check Sheet, Sverdup to CofS *et al.* GHQ SWPA, 20 Jan 45. SWPA File M203.

[79] Pacific Warfare Board Rpt, No. 33, 13 Aug 45. SWPA File E123.

sary. The number of map-making units was not increased for operations in the Philippines but remained what it had been in mid-1944. The 648th, the one base topographic battalion in the Southwest Pacific, continued to produce maps at its plant in Melbourne. It was scheduled to move to Luzon in April. Sixth Army had an army-type topographic battalion—the 650th—for the hasty production of maps. It had, in addition, a survey liaison, a map depot, and a model-making detachment. Each corps had its topographic company for hasty photomapping and map production in the field. Both army and corps units had enough stocks of equipment to permit them to produce maps from negatives supplied by the base map plant.[80]

From a theoretical standpoint, the mapping organization in the Southwest Pacific was adequate, but the war was being fought in an unusual manner. Even though working under great pressure, map-making units in the theater fell considerably short of meeting their requirements. As in the New Guinea Campaign, one of the major difficulties was the short time available for making maps before the date set for an attack. It was still the case that aerial photographs could not be obtained in time. As a rule, a mapping unit, after receiving aerial photographs, needed from four to six months to produce accurate maps in sufficient quantities for target areas as large as those in the Philippines. For the Leyte operation, aerial photography was not received until thirty days before the initial landing; the same was true for the assault landing at Lingayen Gulf.[81]

To help provide maps for the drive down the Central Plains, the Army Map Service (AMS) in Washington sent reproduction material based on prewar surveys. Theater mapping units, since they had so few aerial photographs, could do little in the way of producing more up-to-date maps. Almost all maps which Sixth Army used in its drive to Manila were supplied in one form or another by Army Map Service. Mapping units in the theater were engaged chiefly in preparing maps from material furnished by AMS or in reprinting existing sheets. Many of the maps furnished to combat units were more or less inaccurate because of changes in vegetation, in the areas under cultivation, and in the courses of streams. Still, the maps the Engineers provided proved to be adequate for the first thirty days of the Luzon Campaign.

By early February the fighting was taking some of the forward elements out of the Central Plains and into mountainous areas, many of which, particularly on northern Luzon, had not been mapped. "Much of the heaviest fighting is now in blank areas on the AMS 1:50,000 series, and the trend of operations is toward other unmapped or incompletely mapped areas . . . ," Lt. Col. H. E. Thomas of Casey's Intelligence Section wrote on 7 February to Col. Ernest A. Dunbar, chief of the section. Mapping units of Sixth Army worked assiduously to make hasty overprints of the blank areas to show topography, streams, roads, and trails in red, but this was admittedly only

[80] Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 199.

[81] *Ibid.*, p. 198.

a stopgap procedure which did not result in good maps. Sixth Army was faced with the prospect of stopgap maps all the way to the northern shores of Luzon. "To say that we have been disturbed, perturbed and alarmed over the Luzon mapping picture would be a most modest statement," Dunbar wrote on 11 February to Maj. Harold F. Drury, commander of the 1679th Engineer Survey Liaison Detachment. By this time mapping units in the theater, working under great pressure to compile maps from aerial photographs to support imminent operations in the Visayas and Mindanao, could devote little time to the preparation of adequate maps of the more remote parts of Luzon. At the same time there were too few depot detachments to distribute the great quantities of maps the troops needed.[82]

In the Philippines campaign, mapping units were asked to accomplish missions they could not fulfill. By late 1944 the inadequate number of maps and the poor quality of some, together with instances of unsatisfactory distribution, prompted Brig. Gen. George H. Decker, General Krueger's chief of staff, to write to General MacArthur about the state of affairs. MacArthur did not regard the situation as critical. General Sutherland in a letter to Krueger explained, "The Philippines campaign, and the New Guinea campaign before it, were planned with a full realization of the inadequacy and unreliability of existing maps of the operational areas." He went on to say, "In each operation where insufficient time was allowed for compilation of adequate maps from aerial photography, there have been obvious tactical advantages in early attack, which have outweighed the unsatisfactory mapping situation." [83]

Landings at Subic Bay and Nasugbu

To support Krueger's Sixth Army drive down the Central Plains, MacArthur directed Eichelberger's Eighth Army to make two landings on western Luzon, one at Subic Bay, northwest of Bataan Peninsula, and the other near the town of Nasugbu, about forty miles southwest of Manila. The purpose of the landing at Subic Bay was twofold: to cut off the Japanese troops already on Bataan Peninsula and to prevent those on central Luzon from retreating to that area. The landing at Nasugbu was to be diversionary; it would draw off enemy troops from the defense of the northern approaches of Manila and at the same time pose a threat from the south for the Japanese troops in the city. Both operations, to be planned and initiated by Eighth Army, were to pass to Sixth Army control soon after they got under way.[84]

Units of XI Corps—the 38th Infantry Division and the 34th RCT of the 24th Division, together with supporting troops—made the landing at Subic Bay. The 592d EBSR provided amphibian support. On 29 January, at 0800, the

[82] (1) Memo for Rcd, Thomas, 18 Feb 45. SWPA File I15. (2) Ltr, Thomas to Dunbar, 7 Feb 45. SWPA File I16. (3) Ltr, Dunbar to Drury, 11 Feb 45. SWPA File I15.

[83] (1) Ltr, Decker to MacArthur, 24 Dec 44. SWPA Files. (2) 1st Ind on above, Sutherland to Krueger, 18 Jan 45.

[84] (1) CG Eighth Army, Rpt on the Nasugbu and Bataan Opns, p. 1. SWPA Files. (2) Smith, *Triumph in the Philippines*, pp. 222, 313.

first troops hit the beach. There was no opposition. The only obstacle was a sandbar, which the boatmen negotiated by ramming their craft into it at full speed and sliding over it. The beaches, about 100 feet wide, were poor, and most wheeled vehicles had to be pulled across because of the loose sand and steep banks. After the vehicles got beyond the beaches, they had no trouble reaching Highway 7, at this point only a few hundred feet from the coast. The next day, when control of the operation passed to Sixth Army, the troops were already well on their way to ZigZag Pass to the east, where it was believed the major enemy defensive installations would be encountered. This view was correct. In the formidable terrain of the pass area, the Japanese had for months been preparing their positions, which proved to be expertly sited, carefully concealed, and well supplied.[85]

To drive the enemy from these positions would take prolonged, bitter fighting. Japanese resistance was exceptionally stubborn. The 113th Engineer Combat Battalion had to reduce an unusually large number of defensive positions, including hundreds of caves, scores of pillboxes, and innumerable wooden box and magnetic mines and bombs used as mines. The combat engineers were so overburdened with the reduction of fortifications that a construction battalion and a dump truck company had to be placed on combat missions. All bridges except a few of the concrete culvert type had to be strengthened or replaced. Highway 7, the main supply route, required a great deal of maintenance. Eventually, in the first days of February, the enemy positions at ZigZag Pass were bypassed, and the troops of XI Corps headed for Dinalupihan, six miles to the east and near Manila Bay.

The landing at Nasugbu was the mission of the 11th Airborne Division, reinforced by a small number of service troops. Organic to the 11th was the 127th Engineer Airborne Battalion. Though airborne troops participated in the assault, the landing actually was an amphibious one. On the morning of 31 January the assault troops came ashore unopposed on the beach at Nasugbu. Though the men found no mines or obstacles, the landing was difficult because the beaches were so poor. Initially grounded on a sandbar in from 5 to 12 feet of water, the LST's, by repeatedly retracting and ramming the beach, finally managed to get to within 50 feet of shore, where sand ramps were dozed out to them. Since no amphibious engineers were assigned to this operation until five days later, the division engineers had the mission of unloading supplies. The 127th Battalion, less one company, did this work, providing dumps and exit roads as planned.

As the troops advanced toward Manila, they encountered an increasing number of mines, obstacles, and pillboxes. One stretch of road had five heavy barricades made of steel roof trusses and wooden posts about ten feet high; each barricade extended across the road and about 100 yards beyond on either side to join up with buildings. The five obstacles were entangled and interlaced with discarded

[85] This account of the operations at Subic Bay and Nasugbu is based on the Report, Engineer Sixth Army, Luzon Campaign, pages 86–101, unless otherwise indicated.

equipment and barbed wire, and adjacent areas were mined. The engineers reduced the obstacles under fire by winching the discarded equipment to the side of the road and using explosives to cut off the steel and wooden posts even with the ground. The closer the troops came to Manila, the greater the number of mines. Most were either buried aerial bombs or antiboat mines with acid vial electric detonators. As was almost invariably the case with Japanese mine fields, camouflage was poor. In fact, the enemy had made no real effort to conceal the mines. Removing them was easy, but patrolling the fields was an arduous task, because Japanese infiltrators tried to place additional mines. Even though the Japanese had demolished most of the large bridges, no serious road or bridging problems occurred. No portable bridging was required. If a bridge was out, a ford could usually be found; it was more often the case that the ineptly wrecked structures could be quickly repaired and traffic routed across. The 127th airborne engineers quickly prepared two cub strips by marking off sections of highway and removing nearby telephone and electric wires. The operation continued under Eighth Army control until 10 February.[86]

Approaching Manila

The rapid advance down the Central Plains continued. By 31 January the 37th Division had occupied Calumpit, and its patrols were well beyond that town. An additional unit had been committed to action—the 1st Cavalry Division, a veteran element of Sixth Army, "its leaders indoctrinated with the concept of sweeping maneuver and aggressive attack." Debarking at Lingayen Gulf on 26–27 January, the division had moved to Guimba, where Krueger held it in reserve, planning to commit it when the time came to make a quick thrust into Manila. That time arrived when the 37th Division was crossing the Pampanga at Calumpit. The 1st Cavalry Division, farthest to the left in the XIV Corps area, was directed to make a rapid advance down Highway 5. Meantime, the I Corps divisions were advancing toward the southeast in an effort to capture San Jose and secure the line Cabanatuan-Bongabon-Rizal. On the right flank of the XIV Corps area, the 40th Division was attacking enemy positions in the Zambales Mountains west of Fort Stotsenburg. On 2 February patrols of the 1st Cavalry and 37th Divisions met at Plaridel. Beyond this point, the 37th Division, driving ahead along Highway 3, was slowed by the many demolished bridges, but the 1st Cavalry Division continued south rapidly on the east flank.[87]

In this final dash to Manila, the tasks of the 117th Combat Battalion of the 37th Division were particularly heavy. The rapid advance brought the capture intact of several bridges south of Bamban, but it was more often the case that the bridges were, at least in part, destroyed. As the 37th Division neared Calumpit, it was stopped by an

[86] Hist of the 127th Airborne Engr Bn. SWPA File B33.

[87] (1) Sturgis comments on draft of this chapter. (2) Krueger, *From Down Under to Nippon*, pp. 239–44.

unexpected waterway not shown on any maps. Intelligence information available showed a drainage ditch at this point with pools of stagnant water, spanned by a double-tracked railroad bridge. According to the maps, Highway 3 crossed to the east of the railroad bridge. The new uncharted waterway was spanned by a bridge carrying both a highway and a single-track railway line. Apparently, the Japanese during the occupation had diverted water into the drainage ditch and rerouted Highway 3 across the previously double-tracked railroad bridge. Two of the spans had been wrecked. Something would have to be done to get the troops across the Sulipan Canal—the name soon given to this new obstacle. Company B of the 556th Heavy Ponton Battalion was assigned the job. The heavy ponton bridging which spanned the Bued River near Lingayen Gulf was sent for and arrived at the Sulipan Canal at 0100 on 2 February. The next morning at 1030, a ponton bridge, 240 feet long, was open to 16-ton traffic. Two days later the 1879th Aviation Battalion arrived to begin work on a semipermanent bridge. Plans called for repairing the slightly damaged span and replacing the 160-foot center with Bailey bridging for the highway half of the bridge and for the building of a timber trestle structure for the railroad half.[88]

A few miles to the southeast, Highway 3 crossed the Pampanga at Calumpit. Here were the two bridges Colonel Skerry's engineers had blown up early on New Year's Day in 1942. They had not been repaired. To get the first troops and supplies across the river, men of the 1279th Combat Battalion in the afternoon of 1 February constructed an M–3 raft of 18-ton capacity and built a dock on the far shore, 75 feet out into the shallow water. Later that afternoon they constructed four infantry support rafts and built two docks on the near shore and two more on the far shore. The five rafts, while efficient, could take only lightly equipped troops. Heavy traffic was stalled. XIV Corps staff engineers rounded up as many cargo trucks as possible to haul the treadway bridge spanning the Agno at Bayambang to the Pampanga, a distance of about ninety miles. The first trucks inched their way across the ponton bridge over the Sulipan Canal while the bridge was still under construction. Company A of the 556th meanwhile began work on the treadway from the far shore of the Pampanga. After all the dismantled material had arrived, a check showed it was too short by 24 feet to span the river, even though estimates had indicated there was enough. On 3 February four men of the 530th Light Ponton Company set to work to fill in the 24-foot gap with M–3 light ponton equipage. The men connected the two bridges by submerging the riverward end of the light ponton bridge and placing the extended treadways from the other bridge onto the decking. They placed infantry assault bridge treadways on the ponton bridge, connecting them with the extended treadways to provide a level roadway. They lashed balk, treadways, and rings of the floats together.

[88] (1) Ltr, Robert R. Smith, OCMH, to Col Skerry, 22 May 53. Copy in EHD Files. (2) Ltr, Skerry to Smith, 19 Jun 53. Copy in EHD Files. (3) Hist of 556th Heavy Ponton Bn. (4) Hist of the 1879th Avn Bn.

The shortage of treadway delayed completion of the bridge by thirty-six hours; the combination structure, 480 feet long, was finished at 1030 on 4 February; it could carry loads up to sixteen tons. The mystery of the shortage of the treadway bridging was soon cleared up. In the dismantling of the bridge across the Agno in a blackout, one raft, consisting of two pneumatic floats and 48 feet of treadway, had broken loose and floated downstream to Wawa, where it was not discovered until three days later. As soon as additional treadway bridging became available, it was substituted for the light ponton section. Plans were already being prepared for a semipermanent bridge. The 841st Aviation Battalion got the assignment of building a combination timber-trestle railway-highway bridge, 530 feet long, between the two demolished structures. This construction would require earth fills at both ends and the relocation of about 1,000 feet of railroad track.[89]

Beyond the Pampanga, swampy terrain and a series of rivers prevented a rapid advance. The Japanese had not destroyed as many bridges as expected, but there were many weak and damaged structures. Much of the wreckage had not been caused by the Japanese. A number of bridges had been destroyed by American and Filipino forces retreating to Bataan in 1941; during the occupation, the Japanese had replaced some of the spans with weak timber structures, usually of no more than 10-ton capacity. American airmen had destroyed several bridges as a preliminary to the advance down the Central Plains. The final thirty miles that the 37th Division had to cover from Calumpit to Manila had six or seven rivers, each about 150 feet wide. All bridges had been destroyed. The 530th Light Ponton Company was in close support of the 37th Division over this stretch; with its light bridging equipment, it provided crossings at each stream.[90]

General Krueger had sent the 1st Cavalry Division to Manila by way of the left flank in the belief that it would avoid the swampy terrain of Highway 3 and would cross the shallower reaches of the rivers flowing into Manila Bay or would bypass the rivers altogether. Sturgis had seen to it that the division was amply supplied with bridging units and equipment. Supplies of treadway, which finally had arrived at Lingayen Gulf in late January in response to the urgent requests of the previous September, were given the highest unloading priority and rushed to the 1st Cavalry Division at Guimba. Bridging and heavy construction units were readied to support the division where necessary and the 8th Engineer Squadron was directed to provide immediate support, with bulldozers and bridge timbers, for stream crossings. At this juncture, Maj. Gen. Oscar W. Griswold, commander of XIV Corps, wanted to have the 1011th Treadway Bridge Company with its equipment transferred to the 37th Division, struggling with the rivers in the Manila Bay area, but Sturgis persuaded

[89] (1) Hist of the 556th Heavy Ponton Bn. (2) Hist of the 530th Light Ponton Bn. (3) 5202d Engr Constr Bn, M-1 Opn, p. 55.

[90] (1) Hist of the 117 Engr Combat Bn. (2) Lambert, "Combat Engineering—Lingayen to Manila," *The Military Engineer*, XXXVIII (April 1946), 146–47.

Brig. Gen. Clyde D. Eddleman, Krueger's G–3, to have the unit continue in direct support of the 1st Cavalry Division.

On 1 February, the 1st Cavalry Division crossed the Pampanga on the repaired wooden trestle bridge on Highway 5 two miles north of Cabanatuan. Beyond the Pampanga, the Japanese offered only light and scattered opposition. The troops crossed many streams at fords and captured a number of bridges before the Japanese could destroy them. The one major obstacle was the Angat River at Baliuag. Company A of the 556th Heavy Ponton Battalion was directed to bridge the river with a treadway. The ponton engineers reached the site at 0200 on 2 February and, aided by the 8th engineers, finished the job at 0930. "The entire division is waiting to cross," the company commander reported, adding that the men of Company A had not had any sleep in forty-eight hours. The advance of the 1st Cavalry Division from Cabanatuan to Manila was merely a matter of days.[91]

Preparations were already under way for the rehabilitation of Manila, a task for which Sixth Army engineers were mainly responsible. About a month before the landing at Lingayen Gulf, Colonel Manzano, a survivor of Bataan, and engaged in intelligence activities during the occupation, had been contacted in the Philippine capital and assigned to the personnel section of ASCOM. Late in January he arrived at Sixth Army headquarters at Calasiao, near the gulf, to report on conditions in the city. The Japanese, preparing to make a last-ditch stand in Manila, were expected to turn much of the metropolis into rubble. Buildings, streets, bridges, utilities, and port facilities would be a shambles. Sturgis and his staff began to make plans and preparations to deal with the many problems bound to arise. A special engineer task group, called the construction command, was to be organized. Sturgis conferred with Colonel Walsh, who proposed that his executive officer, Colonel Liles, be put in charge. The construction command could operate as the advance echelon of the 5202d. Sturgis asked Colonel Dean of ASCOM to select first-class units from his organization which might be available. Manzano made his way back to Manila and worked with the American intelligence services to help key employees of the municipal facilities escape from the capital and go to Sixth Army headquarters at Calasiao.[92]

On 1 February Colonel Liles was ordered to Calasiao to take charge of the new command. His staff consisted of 11 officers, 8 enlisted men, and 2 Filipino civilians. Eight engineer units were assigned to him, among them the 43d Construction Battalion, the 1876th Aviation Battalion, the 1504th Water Supply Company, the 963d Maintenance Company, and elements of the 556th Heavy Ponton Battalion. Plans were made to deal with a wide range of jobs which might have to be done, including the installation of floating bridges, clearing and opening the city's main streets, re-

[91] (1) Engr Sixth Army, Rpt, Luzon Campaign, p. 101. (2) Sturgis comments on draft of this chapter. (3) Hist of the 556th Heavy Ponton Bn.

[92] (1) 1st Ind, Krueger to MacArthur, 2 May 45, on Ltr, Liles to Sturgis, 20 Apr 45. Sturgis File 28. (2) Sturgis comments on draft of this chapter.

habilitating and operating the water and electrical systems, furnishing power to refugee centers and hospitals, fighting fires, preparing emergency airstrips, demolishing unsafe structures, and removing mines. Special efforts were to be made to save the key installations in the city's water supply system, especially Novaliches and San Juan Reservoirs to the northeast of the capital, Balara Filters to the east, and the aqueducts and pipes carrying water into the city.[93]

The Capture of Manila and the Islands of Manila Bay

North of the Pasig

The foremost elements of the 1st Cavalry Division reached Grace Park in northern Manila on the evening of 3 February. The Japanese plan of defense was almost immediately apparent. While offering only light resistance in the northern part of the city, the Japanese would withdraw across the Pasig, destroy all the bridges, and make a strong and, if necessary, suicidal stand south of the river in the modern reinforced government buildings and in the old walled section of the city, known as Intramuros. Operations of the Japanese north of the river were therefore only a delaying action, the purpose of which was to enable most of the troops to get across the Pasig. Demolition charges had been placed several weeks before on all bridges and in some important public and commercial buildings.[94] As the American forces approached, the demolitions were set off. By 6 February the 1st Cavalry and 37th Divisions had gained possession of northern Manila up to the river. "[No] . . . sooner had the leading elements of the 37th Division reached the Pasig River," Sturgis wrote, "than the entire town in the general region of the Escolta broke into flames and Jap snipers and saboteurs opened up almost everywhere in North Manila out to Grace Park." [95] The fires were brought under control before extensive damage had been done. Meanwhile, the 11th Airborne Division had entered the capital from the south. It met heavy opposition in the Nichols Field area, but nevertheless pushed slowly forward.

Enemy defenses north of the Pasig were not strong. Mines and obstacles were rare. Hastily prepared, they were, in general, not effective. An elaborate mine field was found in Laloma cemetery. Along the roads and in between the graves, the Japanese had placed about 120 depth charges, twenty to thirty feet apart; they had also mined a road near the cemetery in the same way. Resembling an ashcan, each of the improvised mines, with about 250 pounds of explosives, had a fuze in a tube in the center and an improvised pressure plate of wood directly in contact with the firing pin mechanism. The weight of a man would be sufficient to set the charge off. Some of the mines were camouflaged with sod, burlap, or earth. To cover the mine field, the Japanese had erected pillboxes armed with 25-mm.

[93] (1) Ist Ind, Krueger to MacArthur, 2 May 45, on Ltr, Liles to Sturgis, 20 Apr 45. (2) Ltr, Liles to Sturgis, 20 Apr 45.

[94] See Smith, *Triumph in the Philippines*, Chapter XIII, for a discussion of the Japanese plans to defend the city.

[95] Ltr, Sturgis to Tyler, 4 Mar 45.

naval guns and had emplaced larger guns in various strategic positions. The pillboxes, expertly blended with their surroundings, were hard to detect. Some of them, resembling mounds of earth, were even sodded and had flowers growing on them and a few were mounted with crosses. There were many trenches within the cemetery; dugouts and mausoleums were filled with quantities of ammunition. Expertly constructed, these various strongpoints were of no value because they were not manned. Deactivating the mines was no problem. The engineers disarmed them by removing the wooden pressure plates, taking out the striker through the well opening, and then lifting out the firing mechanism and detonator. The 11th Airborne Division, entering Manila from the south, had similar experiences. In the Nichols Field–Fort McKinley area, in particular, mines were numerous, though most of them were placed in no pattern. Only one regular mine field was encountered, about 300 by 1,000 yards in area, but the mines were easily deactivated.[96]

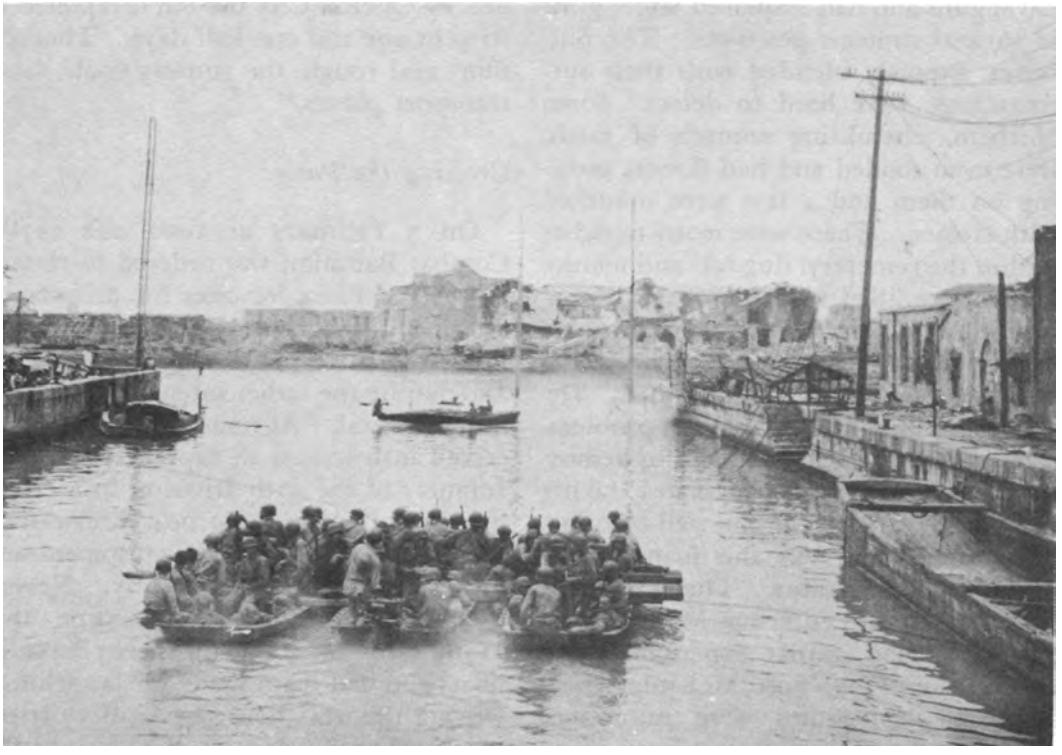
The combat engineers were concerned not only with demolitions, but also with construction and rehabilitation of airstrips. The first engineers to enter the Manila metropolitan area went to work to rehabilitate existing strips and ready new ones as quickly as possible. As soon as the 1st Cavalry Division had taken Grace Park airstrip, elements of the 8th Engineer Squadron began work on it to make it usable for C–47's. In nearby Quezon City the 8th completed a strip in one and one half days. Though short and rough, the runway could take transport planes.[97]

Crossing the Pasig

On 7 February at 1000, the 117th Combat Battalion was ordered to reconnoiter the Pasig for sites for an assault crossing. Reconnaissance parties made numerous attempts to find likely places, and despite the rather intense enemy fire, found several. At noon Company C received instructions to support the 148th Infantry of the 37th Division in a crossing scheduled for 1400 near Malacanan Palace. To get enough equipment on such short notice was not easy. Nevertheless, by the prescribed time the 117th had rounded up thirty assault boats and had them ready for launching. During the next hour the artillery tried to silence enemy guns on the south bank. At 1500, men of Company C ferried the first infantrymen across. In five trips under strong enemy fire, the thirty boats carried the assault troops over. As soon as the first men reached the opposite shore, the engineers built two infantry support rafts powered by outboard motors. The rafts would be in continuous use until a floating bridge could be put across the river. On midmorning of 8 February M–3 ponton material arrived; sixty men from the 530th Light Ponton Company and fifty from the 117th engineers were to put a bridge across the river but were unable to do so because of the enemy's intense mortar and machine gun fire. Construction was

[96] Engr Sixth Army, Rpt, Luzon Campaign, pp. 118, 124. (2) Engr Sixth Army, Engr Info Bull 18, p. 33. SWPA Files. (3) CG Eighth Army, Rpt on the Nasugbu and Bataan Opns, pp. 22ff.

[97] Hist of the 8th Engr Squadron.



INFANTRY SUPPORT RAFTS ON THE PASIG RIVER

again started late that day and work continued under cover of darkness. The bridge was completed at 0100 on the 9th.[98]

By this time the first elements of the 1st Cavalry Division were ready to cross the river. On 9 February the 530th engineers were ordered to construct a footbridge near the Philippine Racing Club to enable the assault troops of the division to get to the south bank. The materials arrived at the site at 1500. The first cavalrymen crossed the river in assault boats on the morning of the 10th. Immediately thereafter construction of the footbridge began. The engineers placed anchor cables and had the bridge partly assembled when Japanese troops suddenly opened up with heavy fire, in the course of which a number of men were wounded and some of the equipment was destroyed. Further work on the bridge was impossible, and the cavalrymen made no more attempts to cross the river that day. The next morning they again crossed over in assault boats. Because of the continued heavy concentration of enemy fire, the engineers made no further attempt to bridge the Pasig at this point.[99]

[98] (1) Hist of the 117th Engr Combat Bn. (2) Hist of the 530th Light Ponton Co. (3) Engr Sixth Army, Rpt, Luzon Campaign, p. 118.

[99] (1) *Ibid.* (2) Hist of the 530th Light Ponton Co.

South of the Pasig

As the troops converged on the Japanese south of the Pasig, they encountered increasingly stubborn resistance. The enemy had built strong defensive positions in the numerous, modern, reinforced concrete government buildings and behind the heavy walls surrounding Intramuros. With sandbags, logs, and steel plates, they had further strengthened the government buildings and the stone ramparts of the old city. Caves were numerous. Some streets were blocked by rows of rails imbedded in concrete and entangled with barbed wire; these obstacles were covered by small arms fire from pillboxes. Mines seemed to be everywhere. Beach mines and depth charges were especially plentiful, perhaps because a large number of the enemy bottled up were naval personnel. So effectively were mine fields laid that tanks, armored vehicles, and heavy construction equipment could not move with safety until engineer troops had first examined the route carefully and cleared the mines.[100]

Destroying the enemy was a slow and tedious job, primarily a mission of the infantry, with close engineer support. Engineer-tank teams were quite effective in reducing a number of enemy strongpoints, especially caves. To seal some of these hideouts, charges of over 250 pounds were required. Each fortified building had to be taken individually. As a rule, the attacking infantry, protected by fire from tanks, began the assault by throwing grenades into the basement or ground floor. The engineers next set off explosive charges. The Japanese almost invariably retreated from room to room until the last man was wiped out. To clear mines and obstacles from the streets, particularly the narrow lanes of Intramuros, a special kind of tank-infantry-engineer team was devised. To eliminate snipers, the infantry occupied the buildings on both sides of the street where the mines were located. Then a tank with tow cable attached moved toward the mines, firing its cannon straight ahead at enemy positions. Behind the tank came a 4-man engineer mine disposal squad. When the tank reached the mine field, it discontinued its cannon fire, but kept up its machine gun fire at enemy positions. One of the engineers ran out in front of the tank, disarmed a mine, attached it to the tow cable, then ran to the rear of the tank. The machine backed away, pulling out the mine. Alternate men were used for each succeeding mine. A well-trained mine disposal man could disarm a mine in from 10 to 15 seconds. This method, used often and with no casualties, was nerve-racking work and required frequent relief for the mine disposal men. "There is no question," an engineer report stated, "that the Japanese defensive installations in South Manila were effective in delaying our occupation of that area and costly to us also." [101]

Manila—Rehabilitation

Meanwhile, the rehabilitation of the capital had begun. On 6 February Colonel Liles and his staff, together with

[100] Engr Sixth Army, Engr Info Bull 21, pp. 13, 19. SWPA Files.

[101] (1) Hist of the 117th Engr Combat Bn. (2) Engr Sixth Army, Engr Info Bull 21, pp. 13, 19.

the 43d Construction Battalion, 963d Maintenance Company, 1504th Water Supply Company, and one platoon of the 439th Depot Company, had moved into the northern part of the city and set up temporary headquarters near Grace Park. Reporting to General Griswold, commander of XIV Corps, Liles presented his plans for rehabilitation; they were approved at once and the engineer troops of the construction command began work.

One of their biggest jobs was rehabilitating Manila's water supply system. A major effort had been made to capture intact the most important installations, all of them located to the northeast of the city. Ipo and Montalban Dams and Reservoirs, farthest from the capital, and in mountainous areas occupied by the enemy, were not taken in the first dash to Manila, but a third reservoir, Novaliches, holding twelve billion gallons, some ten miles southwest of Ipo, while heavily mined, was captured intact. The 13-mile aqueduct from Ipo to Novaliches was running full, which probably meant that Ipo was also undamaged. The water gauge on Novaliches showed 5 billion gallons, enough to take care of Manila through the dry season. Water from these three reservoirs flowed through aqueducts to Balara Filters, which the 1st Cavalry Division took just 30 minutes before the enemy could set off the demolition charges. The filters were dirty but undamaged. From the filters, water flowed into the new San Juan Reservoir, which had a capacity of 56 million gallons. Here an intake and an outlet valve had been blown; estimates were that repair would require about a week. The old San Juan Reservoir nearby, with a capacity of 50 million gallons, and being used as a fish pond, was intact. Tests indicated the water was satisfactory, and although filters would have to be installed, this source could be used and the new San Juan Reservoir bypassed for the time being. The water lines from the reservoirs to Manila were found unimpaired. Japanese infiltrators had not given up trying to damage the installations. Early in the morning of 11 February an enemy group destroyed a small section of the aqueduct running from Novaliches Dam to Balara Filters. Subsequently, two breaks were found in the mains feeding the city from San Juan Reservoir. Repairs were begun promptly. Casey informed MacArthur on 18 February that the repair of the lines from the old San Juan Reservoir to the city would be completed that day, releasing the 20 million gallons remaining in the reservoir.[102]

Since so many water mains within the city had been damaged, distributing water was no easy task. A number of water supply points were set up. By the evening of 11 February, the 1504th Water Supply Company had 3 in operation, each providing some 30 gallons a minute, and plans called for setting up three more immediately. Navy ponton cubes, mounted on 2½-ton trucks, were used to carry water to storage tanks in various parts of the city. By 18 Febru-

[102] (1) Memo for Rcd, Chaffin, 11 Feb 45. SWPA File M175. (2) Memo for Rcd, Chaffin, 12 Feb 45. SWPA File M175. (3) Check Sheet, Casey for MacArthur, 14 Feb 45. SWPA File M203. (4) Of C Engr GHQ AFPAC, *Engrs of SWPA*, VI, 362. (5) Check Sheet, Casey to CofS SWPA *et al.*, 18 Feb 45. SWPA File M179.

ary Manila had 31 water points. Between 400 and 500 employees of the Municipal Water Department were rehired. Manila south of the Pasig posed a most difficult problem, since all mains crossing the river had been wrecked. Fortunately, that part of the city had some twenty artesian wells. A job of first priority was to restore the water mains across the Pasig. The old siphon under the river was being repaired, and some 20,000 feet of 4-inch invasion weight pipe was on order for the repair of the water mains across the river.[103]

Colonel Liles and his men had many other important jobs. The Japanese, in contrast with their ineffectiveness in destroying the water supply system, had almost completely demolished the electrical utilities which supplied light and power to the capital and its suburbs. They had in the words of one report, concentrated on the most "critical units in the best possible manner." The task group set to work to provide temporary sources of power. They rehabilitated the generating units of a brewery to make available some 140 kilowatts and rehabilitated a manufacturing company's generating plants to produce an additional 900 kilowatts. Liles's men rehabilitated those parts of the electrical distribution system which were needed to distribute the power generated by the temporary power plants. Under fire at times, the 556th Heavy Ponton Battalion constructed two treadway bridges over the Pasig, a third over the Mariquina, and a fourth over an *estero* in south Manila. As soon as the section south of the Pasig was secured near the Jones Bridge, two 200-foot Baileys, capable of taking 35-ton loads, were put across the river at this point. Liles's units in addition opened up innumerable roads, cleared some of the dock areas, re-established the city fire department, and helped clear mines and booby traps. Because of the work of the Construction Command, ". . . General Griswold had little to worry in this respect and could devote his energies to the rugged tactical situation." [104] The work of the task force was well in hand by 4 March, when the fighting for the city was virtually over.

Corregidor

The capture of the capital city and its port would mean little unless the islands at the entrance to Manila Bay were under American control. Consequently, soon after the attack on Manila began, the islands came under assault. First to be attacked was Corregidor. Highly developed as a fortress before the war, Corregidor would undoubtedly be strongly defended by its Japanese occupants. Its capture was assigned to XI Corps, already responsible for operations at Subic Bay and on Bataan Peninsula. Troops of the corps were to make an amphibious landing at Mariveles, at the tip of Bataan Peninsula, and, with that point as a base, were to make both an amphibious and a parachute landing on Corregidor. The parachute landing was to be made by a company of the 503d

[103] (1) Memo for Rcd, Chaffin, 12 Feb. 45. (2) Check Sheet, Casey to CofS SWPA *et al.*, 18 Feb 45.

[104] (1) Memo, Sturgis for Sutherland, 23 Apr 45. Sturgis File 28. (2) Of C Engr GHQ AFPAC, Engr Tech Info Bull No. 15, 20 Jun 45, pp. 14–16. SWPA Files.

Parachute Infantry; the amphibious assault, by the 3d Battalion (reinforced) of the 34th Infantry. Engineer support was to be furnished by Companies A and D of the 592d Boat and Shore Regiment, Company C of the 161st Airborne Battalion, and two combat units—Company B of the 113th Combat Battalion and the 3d Platoon of Company C of the 3d Combat Battalion. These units were to support the airborne and amphibious landings and the subsequent combat operations, which would probably be aimed mainly at reducing enemy fortifications.[105]

The XI Corps task force landed at Mariveles on 15 February. The infantry pushed rapidly inland and secured the southern part of the peninsula. That evening in Mariveles harbor, the 3d Battalion of the 34th Infantry embarked on two LCT's and twenty-five LCM's, prepared to cross over to Corregidor. The next morning, at 0900, the first elements of the parachute company dropped on the island. Two hours later, the first amphibious landing began on the southern shore. The craft encountered no underwater obstacles or mines, but enemy machine gun fire was intense. All engineer craft were hit; nevertheless, all made successful landings. Completing their missions, they returned to Mariveles, except six assigned to resupply runs. As had been expected, enemy defenses on Corregidor were formidable. The landing beach was heavily mined and several vehicles attempting to cross it were wrecked. A group of engineers, assisted by an infantry mine platoon, rapidly cleared a passageway through this mine field, which contained about 130 antiboat mines. The Japanese had apparently prepared this field some time before the landing, but as was usually the case, had made little or no attempt to camouflage the mines. A similar field of no discernible pattern was found on the west side of North Harbor; none of the mines were armed. On the beaches, along the trails, and near Kindley Field, antiboat mines were scattered about, some of them armed. In general, all were ineffective. Of the many types of mines found on the island—magnetic and lunge mines, shaped charges, yardsticks, and Molotov cocktails—most were still in packing crates; only the antiboat mines had been tactically emplaced. Because of the large numbers of shell fragments on Corregidor, mine detectors could not be used effectively; but, fortunately, the vast majority of the boat mines were so poorly camouflaged that it was easy to locate them. They were dealt with in one of two ways; they were disarmed and removed by hand or they were blown in place with TNT.[106]

Destroying enemy caves was a different matter. This was a slow process requiring three weeks of effort by the infantry and engineers. In the first days of the assault, the parachute engineers sealed caves for the airborne infantry. Subsequently, the combat engineers were called forward as needed. The terrain

[105] (1) Engr Sixth Army, Rpt, Luzon Campaign, p. 146. (2) 3d Platoon Co C 3d Engr Combat Bn, Encounter Rpt (for the Corregidor Opn). SWPA File 82.

[106] (1) Engr Sixth Army, Rpt, Luzon Campaign, p. 146. (2) Engr XI Corps, Rpt, Fortifications, Mines, Booby Traps, and Demolitions on Corregidor. SWPA File 82. (3) Ltr, Heavey to Trudeau, 20 Feb 45. SWPA Files.

was so rocky and littered with debris that, as a rule, the only weapons that could be used were those the individual soldier could carry. The reduction of caves was a time-consuming process, despite the fact that caves and tunnels, seldom mutually supporting, could be reduced one at a time, and enemy weapons had only limited fields of fire, in most cases but a few feet wide. An effective way to reduce a cave was to fire rockets or grenades into it, which either forced the Japanese to come out or retreat to the rear. The demolition parties would then place the charges at the entrance. Flame throwers could seldom be used to advantage. If the terrain was such that a tank could maneuver in front of the cave, it would fire point-blank into the opening, while a bulldozer gathered a large load of earth with its blade. As soon as the tank stopped firing, the dozer pushed the earth into the mouth of the cave. This procedure was repeated until the mouth of the cave was closed.[107]

Caballo

Two miles south of Corregidor, on small, rocky Caballo Island, was Fort Hughes, occupied by an estimated 350 Japanese. On 27 March elements of the 38th Division, with a platoon of Company B of the 113th Combat Battalion, made an amphibious landing on Caballo, supported by Naval gunfire and land-based artillery. Resistance was negligible; in two days the island was overrun. During the next week the attackers, using flame throwers and explosives, tried in vain to dislodge the Japanese holed up in the underground forts. Most of the enemy appeared to be in what was known as the "mortar pit area," a fortification with a number of guns and several bombproof chambers. The rocky terrain forbade using tanks, and aerial bombing was out of the question because of the danger to the troops. A new plan was tried. The 113th engineers fastened two Navy ponton cubes to an LCM and, attaching a pump with a hose, filled the cubes with diesel oil and gasoline. The amphibian engineers took the LCM to Caballo where, despite mortar fire, they brought it to shore not far from the mortar pit area. The combat engineers laid about 600 feet of 4-inch invasion-weight pipe from the LCM up the cliff and into an opening of the pit. They pumped in some 2,500 gallons of gasoline and fuel oil and set the mixture on fire. The flames continued for two hours; from time to time, small explosions were heard. The next day, as the American troops approached, they came under fire from the pit. Apparently the Japanese had left the pit before the gasoline was ignited and had returned after the fires burned out. The combat engineers laid the pipe to another opening in what was known as the west pit. Before gasoline could be pumped in, enemy small arms fire broke the pipe. It was repaired and gasoline and fuel oil were then pumped in and ignited; fires and explosions lasted for three hours. The next day the Japanese continued to fire from this pit also. The engineers thereupon lowered a 500-

[107] (1) Engr Sixth Army, Rpt, Luzon Campaign, p. 146. (2) Engr, XI Corps, Rpt, Fortifications, Mines, Booby Traps, and Demolitions on Corregidor. (3) Engr Sixth Army, Engr Info Bull 21, pp. 21–22. SWPA Files.



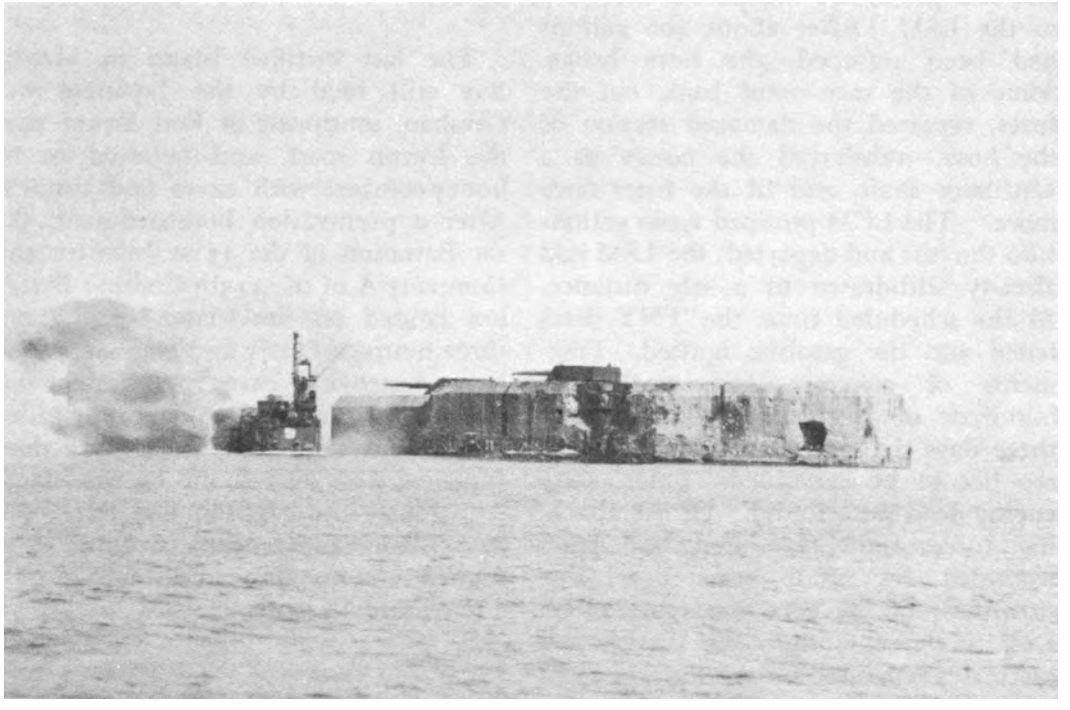
LAYING A PIPELINE TO THE MORTAR PIT, CABALLO ISLAND

and a 250-pound bomb about six feet into a ventilator shaft and put 550 pounds of TNT in the entrance of a railroad tunnel. They pumped diesel fuel and gasoline into both pits. Bombs and explosives were timed to go off when the fuel was ignited. A number of heavy explosions occurred, and small arms fire was heard in the tunnels, probably ammunition exploding in one of the magazines. There was no further sign of enemy activity on the island, yet weeks later an American officer was killed by a Japanese sniper.[108]

Fort Drum

Six miles south of Caballo, on El Fraile Island, was Fort Drum. Resembling a battleship, Fort Drum had reinforced concrete sides about 30 feet thick; its top was 18 feet thick. Its "deck" had two turrets, each with two guns; each side had a casemate with two guns. From the standpoint of the attackers, the fort's vulnerable parts were its turrets, casemates, stairwells, and ventilator shafts. It was decided to attack Fort Drum in the same way as Fort Hughes—that is, with TNT and gaso-

[108] (1) Engr XI Corps to Engr Sixth Army, 13 Apr 45, Rpt, Opns on Caballo Island. SWPA Files. (2) William F. Heavey, "Amphibian Engineers in Action", *The Military Engineer,* XXXVIII (February, 1946), 61. (3) Engr Sixth Army, Engr Info Bull 19, pp. 1–2. SWPA Files.



FORT DRUM, JUST BEFORE THE EXPLOSION. *At left, engineers are pulling away from the fort.*

line. The same LCM would be used; in addition, an LSM, equipped with a drawbridge, would be needed; it was to proceed to Fort Drum and swing its drawbridge to the top of the fort to permit the men to cross over. Once on top of the fort, the men were to pack the TNT and insert the pipe into the turrets or other openings in order to pump gasoline into the interior. The Navy furnished an LSM for which the engineers devised a drawbridge. Thirteen men of the 113th Combat Battalion made up an "oil and flame" party, and thirteen more formed a "demolition" party. The 38th Division again furnished the covering force and the 592d Boat and Shore Regiment the crew for the LCM.

The assault was made on 13 April. As the LSM moved up alongside the fort, the drawbridge was swung into place; infantry and engineers crossed over. Occasional small arms fire from the Japanese inside the fort was of no moment. The demolition party placed 600 pounds of TNT in the after starboard stairwell, tamped it with sandbags, and attached a fuze of primacord. The oil and flame party considered the after port stairwell as best for their purpose. The men signaled the LCM to come up alongside the fort. They hauled up the hose and inserted the nozzle in the stairwell, sandbagging it in position. The LCM began to pump gasoline and fuel into the fort. Lighting the fuzes for the mixture

and the TNT, the two parties returned to the LSM. After about 400 gallons had been pumped, the hose broke. Some of the men went back, cut the fuzes, repaired the damaged section of the hose, transferred the nozzle to a ventilator shaft, and lit the fuzes once more. The LCM pumped 2,200 gallons into the fort and departed; the LSM had already withdrawn to a safe distance. At the scheduled time, the TNT detonated and the gasoline ignited. Fragments of concrete and steel shot hundreds of feet into the air. After three days the smoldering fort was still too hot to be examined. Later, sixty enemy dead were found. Of the attacking force, only two men had been wounded by small arms fire. The sturdiness of the fort was remarkable. Despite the explosion, the turrets and casemates remained in position; the sides and top, intact.[109]

[109] (1) Ltr, Engr XI Corps to Engr Sixth Army, 7 May 45, sub: Engr Opns in the Recapture of Fort Drum (El Fraile Island). P.I. SWPA Files. (2) William F. Heavey, "Amphibian Engineers in Action," *The Military Engineer*, XXXVIII (February, 1946), 61. (3) Engr Sixth Army, Engr Info Bull 19, pp. 11–13. SWPA Files.

Carabao

The last fortified island in Manila Bay still held by the Japanese was Carabao, southwest of Fort Drum near the Luzon coast, and believed to be honey-combed with caves and tunnels. After a preinvasion bombardment, the 1st Battalion of the 151st Infantry and Company A of the 113th Combat Battalion landed on the island. For about three hours, infantry and engineers were busy destroying caves. A violent explosion from an unknown cause killed 5 men and wounded 18. Only 2 dead Japanese were ever found on the island. Apparently the garrison had left a few days before the landing, swimming at night to the mainland, a distance of only a few hundred yards.[110]

[110] (1) The Last Outpost in the Bay, Fall of Fort Frank, Carabao Island (Draft MS). SWPA Files. (2) William F. Heavey, "Amphibian Engineers in Action," *The Military Engineer*, XXXVIII (February, 1946), 62.

CHAPTER XV

The Final Months of the War

During the last months of the war, the Allied forces made great strides both in driving toward the Japanese home islands and in liquidating the Japanese conquests made earlier in the war. The destruction of organized resistance in the Philippines and Borneo all but severed the Japanese lines of communication to the East Indies and southeast Asia, while the capture of the islands of Iwo Jima and Okinawa, so close to Japan itself, put the Empire in gravest danger. In southern China, the Japanese forces, which had advanced threateningly in 1944, were, by the spring of 1945, in full retreat. While enemy forces were being destroyed or were in retreat on the islands of the Pacific and on the Asian mainland, the more remote bases were being dismantled and closed out, but an enormous amount of base and airfield construction was still under way, particularly in the Philippines and on Okinawa, for the purpose of supporting an invasion of Japan proper. At the same time, plans and preparations were being made for the invasion itself.

Destruction of the Japanese in the Philippines and Borneo

Over-all Plans

Since the Philippines, particularly Luzon, were to constitute the most important base area to support the coming invasion of Japan, the enemy forces on those islands had to be destroyed or rendered harmless. No time was lost in getting on with the job. While Manila and Corregidor were still under attack, operations were begun against the Japanese who had withdrawn into the outlying parts of Luzon as well as against those still more or less in control of the central and southern islands of the archipelago. On 5 February 1945 MacArthur directed Sixth Army to destroy the Japanese in northern, eastern, and southern Luzon. The next day, he directed Eighth Army to seize certain islands in the central and southern Philippines.

Sixth Army's plan of campaign on Luzon called for the destruction of the enemy by three corps. I Corps would have the mission of capturing Baguio and securing the Cagayan Valley, with the city of Aparri, on Luzon's northern coast. XIV Corps was to begin the task of destroying the Japanese in the Sierra Madre mountains of east central Luzon. After the first few weeks, XI Corps was to take over this mission, while XIV Corps attacked the Japanese in the southern and southeastern parts of the island. Eighth Army's operations in the central and southern Philippines, to be known as the VICTOR operations, were to be amphibious assaults. The first would

be directed against the southwestern islands—Palawan, the Zamboanga peninsula of Mindanao, and the Sulu Archipelago. Thereafter, four of the major islands in the central Philippines—Panay, Negros, Cebu, and Bohol—were to come under attack. These four were part of the Visayan group of islands, two of which—Leyte and Samar—were already under American control. Lastly, the Japanese in the main part of Mindanao would be crushed. Thereupon, the Philippines would be completely under American control.[1]

Engineer Planning

Sixth and Eighth Army engineers began planning after receiving MacArthur's directives. Sturgis' engineer section made a study of the terrain of the more remote parts of Luzon and the highways and trails leading to them. Unlike the amphibious operations along the New Guinea coast or the advance down the Central Plains, the drives into the outlying parts of the island would be, for the most part, through mountainous terrain. After making extensive reconnaissances from the air and on the ground, Sixth Army engineers were convinced that their most important task was the construction and maintenance of roads. Bridging would probably not be a major job until the onset of the rains in May. Japanese mine fields and demolitions would very likely be as crude as before, but in the mountainous parts of the island might be considerably more effective in holding up an advance. Engineer work, unlike that performed in New Guinea, would, as a rule, be done in the conventional manner. Troops under corps and army would undertake major construction in back of and not at the front lines. Since there were not enough engineer units or supplies to support three simultaneous actions in widely separated areas, General Sturgis decided to keep most of his heavy construction troops under army control in or near Manila until developments showed where they could be used to best advantage.[2]

Meanwhile, Eighth Army engineers under Col. David M. Dunne were deep in plans and preparations for the VICTOR operations, of which there were to be five. The various islands of the central and southern Philippines had similar terrain—a narrow coastal belt behind which rose steep and wooded mountains. There was little time for reconnaissance, and map coverage was inadequate. Since the attacks were to be amphibious, they would undoubtedly be carried on in the same manner as the earlier similar operations along the New Guinea coast. Heavy naval and air bombardments would drive the enemy away from the beaches and into the interior of the islands so that, soon after the initial landings, the engineers could begin work on bases and airfields virtually unhampered. The Eighth Army engineers, in making tentative plans for construction in each area, had to devote considerable effort to getting sufficient numbers of troops and adequate amounts of supplies. The relatively few units

[1] (1) Engr Sixth Army, Rpt, Luzon Campaign, p. 159. (2) Robert R. Smith, *Triumph in the Philippines*, chs. XX, XXIII, XXIX. (3) Eichelberger, *Our Jungle Road to Tokyo*, p. 164.

[2] Engr Sixth Army, Rpt, Luzon Campaign, p. 159.

available were so apportioned that each operation would have amphibian and combat units and either aviation or construction battalions.[3]

East Central Luzon

On Luzon the first attack began on 20 February when the 1st Cavalry Division and the 6th Infantry Division of XIV Corps launched an assault against the Japanese who had retreated into the Sierra Madre Mountains in the east central part of the island. In this rugged and inhospitable region, where roads were few, the terrain greatly favored the defenders. Here the Japanese had under their control Ipo Dam, and ten miles to the southwest, Montalban Dam, two important elements of Manila's water supply system which had to be captured intact, if possible. The engineers were in continual demand to support the infantry in the drive through the mountains. Tasks of the 8th Engineer Squadron and the 6th Combat Battalion were similar. Mines were numerous along the narrow and primitive roads. In many places, the Japanese had set up roadblocks and covered them with fire. Some were of the abatis type; others were blasted out of the steep slopes on both sides of the road or path. Engineer demolition teams helped destroy caves, bunkers, and pillboxes in which the enemy were hiding. A major task was building and maintaining roads. Often the infantry had to wait until the engineers could fashion a trail. Steep grades, large outcroppings of rock, and enemy fire all slowed down construction. Maintenance of the roads, most of them unsurfaced and rough, was complicated by the constant traffic.[4]

Northern Luzon

The attack against the Japanese on northern Luzon began on 21 February. By that date, I Corps held a line across the narrow waist of the island from Damortis on Lingayen Gulf in the west to Baler Bay in the east. The Cagayan Valley, a major food-producing area, stretched more than 200 miles to Aparri. Bounded on the east, west, and south by broad and rugged mountain ranges, it had two approaches from the south feasible for military operations: one from Bambang; the other from Baguio, fifty miles to the west. Bambang could be reached by two routes. One was by way of Highway 5 running from San Jose, at the edge of the Central Plains, up the Tulavera River valley to Balete Pass. The enemy positions at the pass were considered the key to the southern defenses of the Cagayan Valley. Once they were taken, the forward movement down the valley would be relatively easy. Another possible route was by way of the Villa Verde Trail, a path for foot travelers and carabao, which began to twist through the mountains 25 miles west of Highway 5 and joined it just north of Balete Pass. Baguio had four approaches. Highway 11, also known as the Kennon Road, was the most direct. From Rosario it ran northeast and then north through the Cordillera Central

[3] CG Eighth Army Rpt on Panay-Negros and Cebu Opns, pp. 4–11, 136–37. SWPA Files.

[4] (1) Hist of the 6th Engr Combat Bn. (2) Engr Sixth Army, Rpt, Luzon Campaign, p. 194.

Mountains. A longer route was by way of coastal Highway 3 and then inland by way of Highway 9. Two trails to Baguio cut through the rough triangle formed by the three roads. From Baguio, dirt roads and trails led eastward through the Cordilleras to the Cagayan Valley. The 25th and 32d Infantry Divisions were to take Bambang; the 33d Infantry Division was to capture Baguio and then assist the other two in the drive up the Cagayan Valley. Progress of the drives through the mountainous terrain of northern Luzon would depend in large measure on the success of the engineers in overcoming natural and man-made obstacles.[5]

The Advance to Bambang

The 25th Division, with its 65th Combat Battalion, moving north from San Jose along Highway 5, got off to a good start. By mid-March, that is, in about three weeks, it was nearing Balete Pass. The engineers kept pace with the infantry, developing the highway, a two-lane graveled road, as the main supply route for the division. Most of the men were engaged in repairing and reinforcing bridges. They cleared three mine fields and spent much time probing for additional mines which the enemy had scattered about in haphazard fashion. Just to the south of Balete Pass, the road ran through a deep defile. The nearer the troops approached the pass, the greater became the enemy's resistance. Since a frontal attack would be costly, the engineers had to put in numerous side roads through the rocky terrain to make possible flank attacks on enemy positions. Because the roads would be abandoned after the troops had won the area, bridges were not put in; the engineers either found fords or constructed temporary crossings of steel culverts. The men had to be continually on the alert for mines. It was standard practice for the enemy to sneak back and replant an area previously cleared.[6]

The Villa Verde Trail

When the 25th Division began its drive toward Bambang, the 32d Division with its 114th Combat Battalion was at the lower end of the Villa Verde Trail at Santa Maria. The infantry was to advance along the trail; at the same time the 114th engineers were to transform the pathway into a combat road. Winding some 25 miles through mountains and over hogback ridges and reaching an elevation of 4,800 feet, the trail connected two points only 11 miles apart by air. The surface was hard-packed clay. Because fairly rapid construction was necessary, the engineers decided to dispense with some of the basic principles of road building. In widening the footpath, which in places clung to the sides of the steep hills, the men began cutting from the bottom of a hill instead of the top. The overhangs sometimes caved in, burying equipment. Dozers, slipping over the precipitous slopes, went down as much as 400 feet and could be recovered only with difficulty; in a number of instances, roads had to be built to

[5] G–3 Sixth Army, Combat Notes. SWPA File M30.

[6] (1) *Ibid.* (2) Hist of the 65th Engr Combat Bn.

them to get them back on the trail. Although the infantrymen were well ahead of the engineers most of the time, the enemy infiltrated the rear areas on several occasions. At Kilometer 19, one of the dozers came under enemy fire; eighteen 47-mm. shells landed near the machine. Shell fragments tore many holes in the blade and body of the dozer, but caused no casualties.

On 5 March the infantry reached Salacsac Pass, where the Villa Verde Trail turned east toward Santa Fe and Highway 5. The Japanese, waiting there, made determined efforts to halt the advance; enemy machine gun fire was so heavy that no progress could be made for days. The Japanese had built numerous caves in the pass area. The engineers brought up armored dozers to prepare firing positions for tanks. Protected by their cabs, the men kept on working despite minor wounds received from bullets that found their way through the portholes. One armored dozer, working its way around a bend, ran into fire from a machine gun about twenty feet away. The operator, slightly wounded, charged the gun with his dozer. The bullets cut the cable and dropped the blade. The operator withdrew to make way for a tank, which proceeded to destroy the machine gun. The cable was quickly repaired and the bulldozer operator resumed work in forty-five minutes. The next day he buried three Japanese in caves. On the whole, working with armored dozers on the precipitous slopes of the Villa Verde Trail was dangerous because the visibility of the operators was so severely restricted. While the infantry vainly attempted to get control of Salacsac Pass, the 114th engineers continued to push forward slowly on the road and to improve the part to the rear. Dreary weeks passed while the enemy continued to hold at the pass.[7]

The Drive to Baguio

Meanwhile, during the first part of March, the 33d Division was advancing on Baguio. Here, also, the work of the 108th Engineer Combat Battalion was largely road construction, but, as elsewhere, many other jobs had to be done. The Japanese had placed numerous mine fields, most of them poorly camouflaged and some so hastily laid that they were wholly ineffective. Still, the combat engineers could not take any chances and cleared twenty-five fields. The Japanese, in retreating, had destroyed most of the bridges. Wherever possible, the engineers located fords or repaired the ruined structures, salvaging such materials as they could. At one point on the Kennon Road, the Japanese had destroyed an 80-foot span over a gorge forty feet deep. The site was at a horseshoe bend, with sheer cliffs on one side, where only a 30-foot horizontal clearance at the abutment was left in which to maneuver. Instead of the usual two hours, the men needed sixteen to swing a Bailey into place.

One of the urgent missions of the 108th engineers was to seize intact the two concrete and steel bridges across the

[7] (1) 32d Inf Div, Rpt After Action, M-1 Opn, an. 8, Engr Rpt. SWPA File A149. (2) 114th Engr Combat Bn, Tech Rpt of Villa Verde Trail, 8 Feb–26 May 45. SWPA File B75. (3) Hist of the 114th Engr Combat Bn.



TRUCKS NEGOTIATE THE VILLA VERDE TRAIL *where Engineer construction is in progress.*

Bauang River near its mouth on the west coast of Luzon. The two spans had to be taken undamaged if the troops were not to be unduly delayed. It was known that the bridges were mined and that the Japanese occupied positions north of the river commanding the structures. At night an infantry battalion, preceded by a platoon of combat engineers and a mine detection detachment, moved to the south bank. The infantry forded the river to attack enemy forces in Bauang. Meanwhile, the engineers crept up to the bridges. One detail removed about 400 pounds of explosives from the stringers of the south span; it had just finished the job when it was attacked by the enemy. One engineer of the platoon was killed in the skirmish in which the Japanese were repulsed. The bridges were captured undamaged. Late in March the 37th Division was sent from its garrison in Manila to relieve the 33d Division in its coastal positions. Everywhere, progress was painfully slow.[8]

[8] (1) 33d Inf Div, Opnl Highlights. Sturgis File 79. (2) Hist of the 108th Engr Combat Bn. (3) WD GO No. 29, 30 Mar 46. SWPA File A80.



FILIPINOS HELP CONSTRUCT A ROAD ACROSS A FORD *in the Santa Cruz River, Luzon.*

Southern Luzon

On 14 March XIV Corps, transferred from the east central front to southern Luzon, began the drive against the enemy in that part of the island. In the vanguard was the 11th Airborne Division, which had been engaged in combat on southern Luzon since its landing at Nasugbu. Enemy resistance south of Manila was weak. The division's 127th airborne engineers constructed and repaired supply and combat roads in hilly terrain, built and repaired bridges, operated ferries, and leveled off rice paddies for cub strips. They also took care of mines and booby traps and removed explosives from several bridges. Mount Macalod, on the southeast shores of Lake Taal, and Mount Malepunyo, ten miles east of the lake, were heavily mined. On the latter mountain, bombs and shells, hung in low trees, were not discovered until a patrol stumbled over the wires. Hampered by a lack of equipment usually furnished a combat unit, the 127th resorted to expedients and maximum use of local materials to perform its missions. In mid-March elements of the 592d Boat and Shore Regiment supported part of the 158th RCT in a series of shore-to-shore opera-

tions that lasted almost a week and that cleared the enemy from Calumpan Peninsula between Balayan and Batangas Bays in southwestern Luzon.

With the transfer of the 1st Cavalry Division from central Luzon to the Bicol Peninsula on 23 March, the 8th Engineer Squadron also transferred its activities to that area. The men carried on their usual tasks. While constructing two ponton bridges, they encountered an unusual problem. Lily pads came floating downstream in such tremendous numbers that they threatened to wreck the bridges. The men stretched cables from bank to bank to catch the pads before they reached the bridges. By the end of March southern Luzon, except the Bicol Peninsula, had been cleared of the enemy.[9]

Corps and Army Engineer Units

Behind the front lines, engineer units assigned to corps and army were at work. Road maintenance, improvement of bridges, elimination of pockets of enemy resistance, and some base construction were the major jobs. Close behind the combat forces moving towards Bambang and Baguio were units of the 1136th Construction Group, working under I Corps. The corps engineers kept supplies flowing to the two fronts near Bambang and Baguio, operated sawmills, and built camps for the troops to use in the coming rainy season. Because the fighting was expected to drag on well into the wet months, the group's principal job was to develop main supply routes for all-weather use. Highway 5, breaking down under heavy traffic, was resurfaced and repaired. In the Baguio area, where Highways 3 and 11 required extensive work, the engineers raised roadbeds above the level of the surrounding countryside, widened one-lane sections, and installed drainage facilities. In east central Luzon, the 1112th Construction Group worked on supply routes and bridges. At the end of March, when most of the group was transferred to Sixth Army for construction in rear areas, responsibility for engineer work in the XI Corps area was transferred to the combat engineers of the two divisions. On southern Luzon, the 1129th Engineer Combat Group under XIV Corps direction furnished support to the combat units. Among its tasks were the repair of the pier at Batangas, rehabilitation of the airstrip at Lipa, and operation of a sawmill and an ice plant.[10]

The Eighth Army Campaign—Palawan

Meanwhile, Eighth Army had begun its campaign in the central and southern Philippines. Palawan was the scene of the first landing. On 28 February a task force, made up mainly of the 186th RCT of the 41st Division, disembarked on the eastern shore of the island. Engineer units included two companies of the 532d Boat and Shore Regiment, elements of the 116th Combat Battalion, and the 1897th Aviation Battalion. The assault waves came ashore at the three desig-

[9] Engr Sixth Army, Rpt, Luzon Campaign, p. 194.

[10] (1) 1136th Engr Constr Group, Opns Rpt, Luzon Campaign. SWPA File B92. (2) 1112th Engr Constr Group, Opns Rpt, 15 Feb–Jul 45. SWPA File B89. (3) Engr Sixth Army, Rpt, Luzon Campaign, pp. 196, 202, 214, 221, 228.

nated beaches, amid some confusion, in the course of which a number of the engineer craft missed their proper landing points; but all of this was not serious, since enemy opposition was nonexistent. The beachhead was quickly consolidated. No real resistance ever developed, and the last Japanese elements were wiped out in about a month. Little combat engineering was required. The 1897th engineers began to rehabilitate the airstrip at Puerto Princesa, badly damaged by bombing, and in 19 days had it ready for fighters.[11]

The Zamboanga Peninsula and the Sulu Islands

After bringing Palawan under control, troops of Eighth Army seized the Zamboanga Peninsula and the Sulu Islands. One hundred and fifty miles long, the peninsula was connected with the major part of Mindanao by a narrow isthmus, and, together with the Sulus, formed a series of steppingstones to Borneo on the southwest. On 10 March a naval task force began a bombardment of the coastal areas east and west of Zamboanga City, forcing the Japanese to abandon their beach defenses. Shortly after 0900, the infantry, assisted by elements of the 543d Boat and Shore Regiment, landed west of Zamboanga City and was ashore in half an hour, encountering only light machine gun fire. Zamboanga City fell the first day. Subsequently, enemy resistance stiffened and a number of bitterly contested battles were fought. Nevertheless, the American forces continually expanded the area they held. Combat engineer operations, the mission of elements of the 116th engineers, were considerable on the peninsula, where well-camouflaged pillboxes, mine fields, barbed wire entanglements, and fortified caves and tunnels were numerous. The combat engineers destroyed about 50 caves and pillboxes and removed nearly 2,000 mines. They built about 50 miles of roads and rehabilitated or constructed 16 bridges, each capable of taking 35 tons.

The 370-odd islands of the Sulus, the southernmost ones in the Philippines, were mostly small, uninhabited, and unimportant. Three were of strategic significance—Basilan, Jolo, and Tawitawi. The campaign began with the landing of elements of the 41st Division on Basilan on 16 March. Other islands were seized later, including the main one, Jolo, where the only enemy resistance worth mentioning was encountered. In these operations, elements of the 543d Boat and Shore Regiment helped land the infantry, and the 116th engineers carried out combat missions. Except on Jolo, little combat support was needed. On that island the engineers destroyed some enemy fortifications, removed mines, repaired and constructed bridges, and built about twenty miles of road. Construction units did additional work in the Sulus and on Mindanao. The 873d Aviation Battalion rehabilitated airfields on the Zamboanga Peninsula and the Sulus, and other engineer units began to rehabilitate numerous local facilities.[12]

[11] (1) CG Eighth Army, Rpt on Palawan and Zamboanga Opns, pp. 114ff. SWPA Files. (2) Ltr, Hq 532d EBSR to Heavey, 3 Mar 45. SWPA File E92.

[12] CG Eighth Army, Rpt on Palawan and Zamboanga Opns, pp. 114–18.

The Visayan Islands

To gain control of the remaining Visayan Islands, McArthur planned two operations, one by elements of the 40th Division, to seize Panay and western Negros, and the other by elements of the Americal Division, to recapture Cebu, Bohol, and eastern Negros. The 2d Special Brigade, the 52d and 57th Combat Battalions, the 865th Aviation Battalion, and the 239th Construction Battalion were to provide major engineer support. The first assault began on 18 March with the landing of elements of the 40th Division near Iloilo, capital of Panay. Eight days later, the Americal Division launched the second assault near Cebu City. These operations were similar to those against Palawan and the Zamboanga Peninsula. The naval and aerial bombardments drove the Japanese away from the beaches and forced them to retreat into the mountainous interiors, from which they could, as a rule, be routed only after long and arduous campaigns.

The most effective enemy defenses were found on Cebu, where the landing forces came ashore just south of Cebu City. Starting across the beach, the troops discovered that the area was heavily mined and expertly camouflaged. Within a few minutes, eight vehicles were blown up. With men continuing to come in, beaches were soon jammed. A disaster would have been inevitable had there been any Japanese opposition besides light rifle fire. The engineers worked frantically to open a path through the mines. In back of the beaches and on the road to Cebu were numerous obstacles, among them antitank ditches, log walls, steel rails, and more mines. The obstacles were not much of a problem because they were not covered by fire. Cebu City, like the other major cities of the central Philippines, was practically deserted. Again, construction of roads and bridge building were by far the most important jobs. The 865th Aviation Battalion on Cebu and the 239th Construction Battalion on Panay and Negros rehabilitated shattered airfields and other facilities.[13]

Mindanao

The only large island in the southern Philippines the Japanese still controlled to some extent at the end of March was Mindanao. A successful campaign by American forces there would mean the end of Japanese power in the central and southern part of the archipelago. The Japanese on Mindanao were already in a precarious position because of the loss of the Zamboanga Peninsula and the increasing harassment of Filipino guerrillas, led since 1942 by Colonel Fertig. In February 1945 Fertig had under his command some 33,000 men, half of them armed. Like the Visayan Islands, Mindanao offered many good opportunities for defense. Much of the island was mountainous, jungled, and swampy. Because of the relatively large size of the island, its few good roads, and its complete lack of railroads, overland operations would be extremely difficult.[14]

Assault planners tried to take advantage of the few favorable terrain features. An invasion of the east coast would be

[13] CG Eighth Army, Rpt on the Panay-Negros and Cebu Opns, pp. 136ff.

[14] (1) Smith, *Triumph in the Philippines*, p. 586. (2) Eichelberger, *Our Jungle Road to Tokyo*, pp. 217–19.

impractical because of the high surf, the rugged shore line, and the almost impassable mountains farther inland. The north coast had many good beaches, in particular at Macajalar Bay, but high ground farther inland would give the defending forces a decided advantage. A major handicap on the southern coast would be inadequate communications with the remainder of the island. On the west coast were many good beaches and anchorages, and from this part of the island the interior was most accessible. Consequently, the initial assault was planned for that coast.

On 17 April two divisions of X Corps, the 24th and the 31st, landed near Parang. The 24th Division, with the help of guerrillas, advanced eastward along the highway leading to Davao. At the same time the 533d Boat and Shore Regiment of the 3d Special Brigade, together with naval units, moved some of the troops up the Mindanao River to secure the Fort Pikit–Kabacan area in the central part of the island, through which ran the Sayre (North-South) Highway. On 26 April elements of the 24th Division reached Davao Gulf, not far south of Davao, turned northward, and occupied their objective on 2 May. Meanwhile, the 31st Division had started up the Sayre Highway to split the Japanese forces in the northern part of the island. On 10 May, at Macajalar Bay, at the northern terminus of the highway, a second amphibious force came ashore and headed south. Everywhere Japanese troops were forced to retreat into the almost impenetrable jungles of the interior.[15]

"The engineer problem on . . . Mindanao began with bridges and ended with roads," said one engineer report. The story of the 3d engineers of the 24th Division, almost from the time they landed until they reached Davao was one of " . . . by-passed bridges, rebuilt bridges and newly constructed bridges, of frantic efforts to get bridge timber and Bailey up forward . . . ." The 106th engineers of the 31st Division likewise were occupied mainly with roads and bridges. Their first job was to improve the road net in the vicinity of the landing area. When the 31st Division started up the Sayre Highway from the Fort Pikit–Kabacan area, the 106th engineers, transferred to the highway a company at a time, furnished increasing support.[16]

In worse shape than the roads were the bridges. Between Kabacan and the first gorge, twelve miles to the north, demolished structures spanning shallow streams were either bypassed or hurriedly repaired to make rapid progress possible. The first real gorge, 120 feet across and 35 feet deep, with the bridge in ruins at the bottom, was a more serious obstacle. Stringing a cableway downstream from the site of the bridge, the engineers got jeeps, ¼-ton trailers, and howitzers across. Heavy vehicles would need a bridge. Because of the depth of the gorge, construction of a timber trestle was not practicable, and erection of a Bailey would be laborious, if not impossible. The men solved the problem in an ingenious way. They blasted out the sides of the gorge at the two approaches; the debris filled the gorge and made a crossing possible. The job was finished

[15] (1) CG Eighth Army, Rpt on the Mindanao Opn, pp. 145ff. SWPA Files. (2) 533d EBSR, Opns Rpt, V–5, 1 Mar–7 May 45. SWPA File E59.

[16] Engr Opnl Hist, Mindanao Campaign (Draft MS). SWPA File A164.

in two days and two nights. The combat engineers had numerous chores in support of the infantry, arising from the fact that the Japanese had fortified strategic points with systems of caves and pillboxes and that enemy camouflage was excellent. Base construction was kept to a minimum, but as elsewhere, airfields and other facilities were rehabilitated.[17]

Borneo

As early as October 1944 the Allies had planned to seize certain areas of Borneo to deprive the enemy of vital oil supplies and to construct bases from which to cut Japanese communications with the Netherlands Indies. Plans called for three attacks, the first against Tarakan Island on 17 May, the second against Brunei Bay on 10 June, and the third against Balikpapan on 1 July. These assaults were assigned to Australian and Dutch troops, supported by American naval forces and elements of the 3d Special Brigade. The 26th Australian Brigade and a company of the Royal Netherlands Indies Army took part in the operations against Tarakan. The first troops were put ashore on 30 April without opposition on Sandau Island off the east coast after withering naval and air bombardment had blasted the main landing area. Engineers and naval personnel went in and breached offshore obstacles in twelve places to permit LST's to land. The Japanese did not try to defend their beach positions, and, after attempting to make a stand about 1,500 yards inland, were driven into the interior. Royal Australian Engineers had combat and construction duties.

At the Brunei Bay landing on 10 June, the task force included units of the 9th Australian Division. After the naval bombardment, landings were made unopposed. In view of the fact that the Brunei Bay landing would sever north-south communications, enemy reaction in this area was remarkably weak, being limited to only a few harassing air raids. The amphibian engineers were hampered somewhat in unloading operations on Labuan Island by the narrow roads and swampy conditions near the beaches. Elsewhere at Brunei Bay, landings were easily made. It was expected that the landing at Balikapan would be equally successful.[18]

The End of Organized Resistance on Luzon

Meanwhile, on Luzon the Japanese were being compressed into smaller and smaller areas. In mid-April the four divisions striving to reach Baguio and Bambang were still stalemated. Those on the Bambang front were tied down at Balete and Salacsac Passes, while in the Baguio area, the 33d's advance had progressed only a few miles up the strongly defended Kennon Road, and the 37th Division was having just as hard a time moving in from the coast. Engineer tasks in support of the infantry were as strenuous as before. The first breakthrough in the Baguio area came on 21 April when the 37th Division cracked resistance on Highway 9 at the Irisan River

[17] *Ibid.*

[18] Of C Engr GHQ AFPAC, *Engrs of SWPA*, I, 290–92, 297.



ENGINEERS USE A JAPANESE TRUCK TO SUPPORT A TEMPORARY BRIDGE *in the Cagayan Valley.*

gorge, and together with the 33d Division, took Baguio five days later. On 5 May the 37th Division was transferred to the Bambang area, where the Japanese were still holding up the 25th and 32d Divisions. The job still requiring the greatest effort was the Villa Verde Trail, where the rains which began in late April compounded the difficulties. In May, the downpours increased in intensity, and work on the trail became impossible. The engineers reported, ". . . dozers dug themselves in as their tracks revolved without traction. . . ." On 13 May the 25th Division finally captured Balete Pass. Reaching Santa Fe twelve days later, it turned west onto the trail and headed toward Salacsac Pass. Meantime, after a 3-month struggle, the 32d Division broke through enemy strongpoints at the pass. On 29 May the two divisions met. Further engineer work on the trail had been halted three days previously, and all effort was henceforth spent on keeping open the part that had been improved.[19]

The stage was now set for the final drive down the Cagayan Valley. The plan was to have the 25th and 32d Di-

[19] 114th Engr Combat Bn, Tech Rpt of Villa Verde Trail.

visions remain at Bambang and most of the 33d Division at Baguio to clear out pockets of resistance. The 37th Division was directed to pass through the 25th Division and spearhead the drive north on the highway. It left Santa Fe on 31 May and made good time, averaging five or six miles a day. The 117th Engineer Combat Battalion had to move forward every two or three days to keep up with the infantry. Highway 5 was in fair condition, but most of the bridges were out. The company farthest forward operated treadway ferries until permanent crossings could be built, put in bypasses and culverts, and made minor road repairs. The next one along made major repairs to bridges, put gravel on bypasses, and occasionally built new bridges. The men put a floating bridge over the Magat River at Bagabag, some twenty miles north of Bambang. The 117th engineers also built several airstrips. At Bayambang, they blocked off a portion of a graveled roadway to serve as a runway; at Bagabag one hundred natives removed grass from an existing strip and filled small shell holes. The engineers were favored by the terrain in the flat, open valley, but the heavy rains were a major hindrance.[20]

To keep the enemy from escaping by way of Aparri, a small group of Filipinos and Americans—called the Connolly Task Force—had been organized to go rapidly up Highway 3 along the western and northern shores to Aparri. Engineer reconnaissance parties learned that much work would have to be done on the highway to permit the convoy of 200 vehicles to reach its goal. Two platoons of the 339th Construction Battalion went ahead of the main force, by road and by LCT, to repair bridges, remove landslides, and widen the road. The engineers also erected two hospital ward tents, built an all-weather airstrip, and installed and operated ferries.[21]

In east central Luzon, the advance was slow. Early in March the 43d Infantry Division replaced the 1st Cavalry Division, which had been transferred to southern Luzon. On the 14th of the month XI Corps assumed command of the operation. An engineer company of the 6th Battalion had an unusual task on Mount Pacawagan, one of the numerous peaks on which fighting took place, and where the only possible route for a trail was along a hogback ridge. The men managed to get motorized compressors up the steep sides to drill holes in rock outcroppings, and then placed explosive charges in the holes to blow up the rock and make a roadway. They used 100 smoke pots to screen their work from the enemy close by.

Early in May the final push began. The 38th Division with the 113th Combat Battalion headed for Montalban Dam, while the 43d was deployed from the rear to take Ipo Dam. Road improvement continued to be the major job in support of the infantry. With the seizure of Ipo Dam on 17 May and the capture of Montalban on the 28th, both of them intact, the campaign in the Sierra Madres was virtually over. The engineers, even though they had not always been able to keep the infantry on the

[20] Engr Sixth Army, Rpt, Luzon Campaign, p. 179.

[21] *Ibid.*, p. 181.

move, had contributed much to final victory.[22]

Fighting continued in southeastern Luzon. On 1 April units of the 2d Special Brigade landed the 158th RCT without opposition at Legaspi, near the tip of the peninsula. Squads of the 1279th Combat Battalion cleared the beach of mines which had not been detonated by the preinvasion air assault. The infantry started inland but was soon halted by the enemy near Daraga, a few miles northwest of Legaspi. While fighting raged, the combat engineers set about reconditioning the airstrip at Legaspi for evacuation of the wounded. Under enemy fire the first two days, the men cut grass, dug drainage ditches, and filled twenty large bomb craters with wreckage from the port. The strip was ready for operations on 6 April. Two days before, the engineers had started rehabilitation of the railroad. About 600 Filipinos, using hand tools supplied by the engineers, restored the shops and replaced tracks while the troops concentrated on bridge construction. On 10 April resistance at Daraga collapsed. The advance continued northwest on the Bicol Peninsula, where there were many well situated but poorly camouflaged mine fields and numerous roadblocks. On 12 April the 158th attacked the main Japanese force in the Cituinan Hills near Camalig; the same day the 1st Cavalry Division entered the Bicol Peninsula from the northwest. On 2 May elements of the 158th RCT and the 1st Cavalry Division met at San Augustin, and on 16 June, the Bicol Peninsula was declared secure.[23]

Before the end of June the Japanese on Luzon were almost completely crushed. On the 8th of that month, with organized enemy resistance in the east central part of the island at an end, the 6th Division, including the 6th Combat Battalion was transferred to the Cagayan Valley. The 6th Division started up the highway behind the 37th. At Bagabag the two divisions turned northwest on Highway 4 toward Kiangan, where remnants of the enemy were gathering. Fighting was approaching an end in northern Luzon. On 21 June Connolly Task Force, which had moved up the west coast, reached Aparri. Reinforced by one battalion of the 11th Airborne Division, it started south on Highway 5 two days later, and on 26 June its patrols met advance elements of the 37th Division at Alacan, twenty-five miles south of Aparri. The two units then started east to search for the enemy in the mountains. There were still some 65,000 Japanese left in northern Luzon, but they were largely unorganized and scattered. On 1 July Eighth Army relieved Sixth Army to carry on mop-up operations. Eighth Army also continued with mop-up operations in the southern Philippines. The operation against Balikpapan was carried out as scheduled on 1 July.[24]

[22] (1) *Ibid.*, p. 188. (2) Hist of the 6th Engr Combat Bn.

[23] Engr Sixth Army, Rpt, Luzon Campaign, pp. 194 and 196.

[24] (1) *Ibid.*, pp. 179–81. (2) Of C Engr GHQ AFPAC, *Engrs of SWPA*, I, 277, 297–8. (3) Smith, *Triumph in the Philippines*, p. 579.

Iwo Jima

Meantime, decisive combat and amphibious operations had been under way closer to the Japanese homeland. The islands of Iwo Jima and Okinawa, the former 800 miles south of Tokyo and the latter 900 miles southwest of the Japanese capital, had come under assault. Both were in the Pacific Ocean Area.

Admiral Nimitz had decided on the capture of Iwo Jima principally for two reasons: to make it impossible for the enemy to use the island as a takeoff point from which to bomb American bases in the Marianas, and to provide B–29 fields which could stage bombers headed for Japan and at the same time enable crippled planes returning from missions to make emergency landings. The capture of the island, and most base construction as well, was assigned to the marines and the Navy. Plans called for building three airfields: a large one with two runways for B–29's in the center of the island, and two fighter fields with 5,000-foot runways north and south of the B–29 field. Most of the work was assigned to Seabee units. One engineer construction unit—the 811th Aviation Battalion —was scheduled to be sent in.[25]

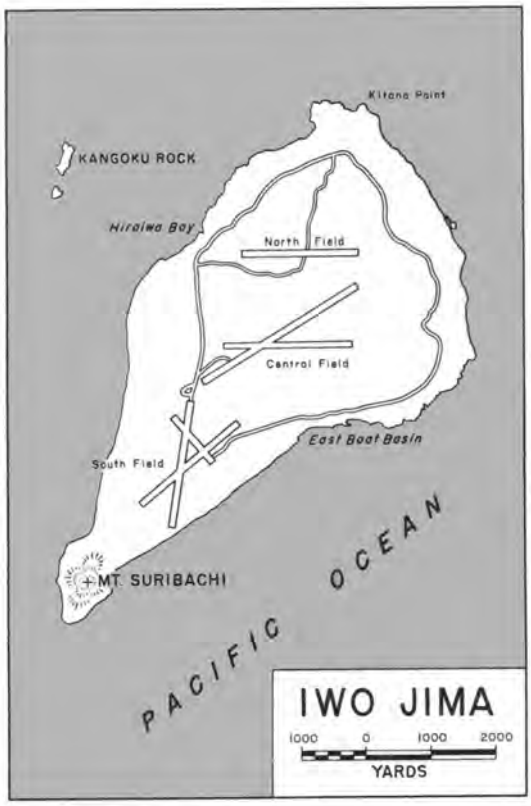
The assault began on 19 February. After three weeks of bitter fighting, the island was secured on 16 March. The 811th engineers, the first Army unit to arrive, landed in mid-April and on the 27th of that month took over construction on North Field from the Seabees. (*Map 30*) The aviation engineers found that Iwo Jima (Japanese for Sulphur Island) was unusual insofar as terrain was concerned. Five miles long and two and one-half wide, it was of volcanic origin. Mount Suribachi, an extinct volcano 550 feet high, formed the southern tip. The northern half of the island was a flattened dome about 400 feet above sea level. Coral, usually found in this latitude, was absent. The surface of Iwo Jima consisted of volcanic ash, in various stages of consolidation, with the hardest resembling soft sandstone. Steam vents were numerous, and just a few feet under the surface, the ground was quite hot. When the 811th engineers took over construction on North Field on 27 April, the runway was operational, but they still had much work to do on the field. Principal tasks included the building of taxiways, parking areas, warehouses, and roads.[26]

Okinawa

Stretching for approximately 600 miles from Kyushu to Formosa was a chain of islands known as the Ryukyus. Almost in the center was Okinawa, some 60 miles long and 3 to 10 miles wide, which the Joint Chiefs had for some time been considering as a site for an amphibious assault. The capture of this island by the United States would have grave consequences for the Japanese Empire. Control of Okinawa would enable American forces to develop airfields and bases from which to deliver crushing attacks on enemy communications and industrial

[25] Craven and Cate, eds., *The Pacific—Matterhorn to Nagasaki*, pp. 577–78.

[26] (1) USAFPOA, Participation in the Iwo Jima Opn, pp. 39–40, 105, 183–91, 287–89. (2) Col. D. A. Morris, "Engineer Operations on Iwo Jima," *The Military Engineer*, XL (May, 1948), 199–200. (3) Hist of the 811th Engr Avn Bn.



MAP 30

centers. If the Japanese lost the island, their lines of communications with southeast Asia and the Netherlands Indies would be cut, whereas Allied communications with China would be secured. With Okinawa gone, the Japanese would not be able to carry on the war much longer.

Terrain

Favorably located from the strategic point of view, Okinawa was not the best site for an amphibious assault. It was a rough, generally mountainous, coral island. (*Map 31*) The northern two-thirds consisted almost entirely of rocky terrain, which aerial photographs indicated was covered by forests and heavy undergrowth. The southern one-third, not so mountainous, consisted in part of gently rolling country broken by ravines and limestone cliffs. About 80 percent of southern Okinawa was under cultivation, mostly in sugar cane and sweet potatoes. Along the coasts were rice paddies. The island's shoreline was precipitous; mouths of streams broke the steep slopes in only a few places. Good landing beaches were scarce, the most likely ones being on the east coast at Nakagusuku Bay and on the west coast between Hagushi and Itoman. In back of these beaches were flat areas consisting principally of rice paddies—a potential hazard to vehicles. Most of the few roads and trails ran along the coast. Because of the rocky nature of the island, stone for road surfacing would in all probability be easy to obtain. Deposits of coral and of slate, conglomerate, and other types of rock were believed to be plentiful. There were small streams but no rivers. Since most of the waterways could be waded, they would scarcely be an obstacle from a military standpoint, and bridging, consequently, would be relatively easy. Rainfall was plentiful and occurred throughout the year, with the heaviest downpours taking place between May and September. From May to November, typhoons could be expected. The only city of any size was the capital, Naha, with a population of about 65,000. The slow reduction of enemy forces barricaded behind stone walls of an extensive urban area, which had been the case in Manila, was not an-



MAP 31

ticipated. However, throughout the island, each house with its outbuildings was, as a rule, surrounded by a dense row of trees and often by a stone wall, ideally suited for defensive fighting. There were numerous burial vaults which would provide advantageous positions for the enemy.[27]

[27] (1) Lt Col W. T. Bradley, Rpt on Engr Opns, ICEBERG. SWPA File B119. (2) Roy E. Appleman, James M. Burns, Russell A. Gugeler, and John Stevens, *Okinawa: The Last Battle*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1948), pp. 7–14.

Engineer Planning

The capture of Okinawa had been assigned to Tenth Army. (*See Map 31.*) Consequently, Brig. Gen. George J. Nold, formerly engineer of the Alaskan Department and since June 1944 Engineer, Tenth Army, was responsible for over-all planning for combat engineering. He and his staff had begun work in mid-October 1944. Since they expected combat support to be largely routine, they did not have to engage in extensive planning. The major concern of the

planners was obtaining enough engineer troops to provide adequate support for the initial amphibious assault and subsequent overland movement. Because only about 70 percent of the units requested were available, some adjustments had to be made.[28]

Planning for base construction on Okinawa was a complex matter. Since both the Army and the Navy wanted numerous facilities, the engineers in Hawaii had to make detailed calculations regarding location and size. The airfield program alone was tremendous. Six B–29 runways were to be built, together with a depot field, for the long-range heavy bombers. Also planned were 6 heavy bomber, 2 medium bomber, and 2 fighter runways, all to be constructed of coral. To support such an airbase storage tanks for about 1,800,000 barrels of gasoline, 6,000,000 square feet of warehousing, 12,500 hospital beds, housing for 375,000 men, 700 miles of road, and extensive harbor facilities at Naha would be needed. Estimates were that ninety engineer units would have to be sent to Okinawa to finish this construction on time. Higher headquarters also considered it advisable to put base facilities on small nearby islands. Those on Ie Shima, about two miles off the northwestern coast of Okinawa, would be the most extensive.[29]

For the assault on Okinawa, two corps were assigned—the Army's XXIV Corps, including the 7th and 96th Divisions, and the Marine Corps III Amphibious Corps, consisting of the 1st and 6th Marine Divisions. In reserve were the 2d Marine Division, afloat, and the Army's 27th Division at Ulithi. The plan of campaign was a model of simplicity. Prior to the attack, Tenth Army's 77th Infantry Division was to seize a number of small islands to the west—the Kerama Islands —where naval anchorages would be provided. Landing on the west side of Okinawa near Hagushi, both corps, the III Amphibious on the left and XXIV on the right, were to drive eastward clear across the island. Then the III Amphibious Corps was to turn north and destroy Japanese forces in the northern part of Okinawa; XXIV Corps would turn south, and drive the enemy forces toward the southern tip of the island until they surrendered or were destroyed. Since the Okinawa operation was to be carried out by Pacific Ocean Area forces, the island command or garrison type of organization for base construction was set up. Engineer units assigned to the garrison force for base construction were scheduled to land early.[30]

Planning for Amphibious Operations

The landings in this assault would differ from those in the Central Pacific Area in that an engineer special brigade organization was to be used. This was the Headquarters and Headquarters Company of the 1st Brigade, redeployed in late 1944 from France, and now under the command of Colonel Talley, for-

[28] (1) Bradley, Rpt on Engr Opns, ICEBERG. (2) Tenth Army, Rpt of Opns in the Ryukyus Campaign, pp. 11–XI–1–30. EHD Files.

[29] USAFPOA, Participation in the Okinawa Opn, I, 77. EHD Files.

[30] Navy Dept Of of CNO, Rpt, Amphib Opns—Capture of Okinawa, 27 Mar–21 Jun 45. 9–1.0001/46 (26670).

merly in charge of construction in Alaska. The 1st Brigade differed considerably from the special brigades of the Southwest Pacific. It was a shore organization only and had been converted from an amphibious-type unit while it was still in England preparing to engage in the 1942 North African campaign. Later, the only part of the brigade to be retained permanently was the Headquarters and Headquarters Company. For each operation, engineer combat battalions, and quartermaster, signal, ordnance, and medical units were attached. The organization of the 1st Brigade thus fitted in well with the Central Pacific's shore party type of organization. The plan was to place the shore parties of XXIV Corps and III Amphibious Corps under the headquarters of the 1st Engineer Special Brigade.[31]

Operations to Mid-April

The Okinawa campaign began on 26 March. On that day, elements of the 77th Division landed on five of the islands of the Kerama group. The 302d Combat Battalion supported the division; a company or a platoon was attached to each of the battalion landing teams. Missions were easily accomplished, including the provision of the usual support for the infantry and the destruction of enemy installations, equipment, and supplies.[32]

On the morning of 1 April at 0830, XXIV Corps and III Amphibious Corps landed on the west coast of Okinawa near Hagushi. Weather and sea conditions were almost perfect. The only obstacle was a coral reef extending along the entire length of the 6-mile-long assault beach. Since the heavier landing craft could not cross over, men and cargo were transferred to LVT's and Dukws, but in some places even Dukws had difficulty crossing the barrier until the engineers prepared passageways with explosives and bulldozers. Japanese resistance was surprisingly light, the enemy laying down only occasional artillery and mortar fire, which caused few casualties and did little damage. As was so often the case elsewhere, infantry intrenchments, pillboxes, and other defensive positions near the beaches were not occupied. About 2,000 posts had been placed along the southern part of the reef; apparently they were to have been strung with barbed wire, but no wire was found and the posts were easily removed. Once more, natural obstacles were more formidable than the enemy. Reefs, bluffs, and seawalls caused the troops to be jammed along the shore. Colonel Talley and his staff, initially using the shore party units of XXIV Corps and others assigned to the Island Command, were soon busily engaged in directing the unloading of supplies and moving them to dumps. Because the organization had too little time to work together as a team, there were some difficulties. Confusion in unloading was the result, in part, of the limited time available for planning and for integrating the organization. There was a noticeable shortage of Dukws and LVT's to haul supplies over the reef.[33]

[31] (1) 1st ESB, Action Rpt, Okinawa Campaign 9 Apr–31 May 45. SWPA File E4. (2) William F. Heavey, "Down Ramp," *The Military Engineer*, XXXIX (February, 1947), 65–66.

[32] (1) Tenth Army, Rpt of Opns in the Ryukyus Campaign, pp. 11–XI–3ff. (2) Hist of the 302d Engr Combat Bn.

[33] (1) Navy Dept Of of CNO, Rpt, Amphib Opns—

Engineer Combat and Amphibian Support

As the troops moved inland, Japanese resistance continued to be light, and by noon of the first day, the troops had captured Yontan and Kadena airfields. By evening, some 50,000 men were ashore. The next day, again in the face of light resistance, the 7th Division reached the east coast. III Amphibious Corps now veered north, and XXIV Corps, south, and began their drives to the tips of the island.

During the next few days, the troops generally made rapid progress. On northern Okinawa, largely because the infantry advanced so swiftly, the major task of the Marine engineers was road repair. Before long, division and corps units were charged with the maintenance and repair of more than 100 miles of concrete highway. More bridging was required than the nature of the terrain had led the planners to expect. The engineers repaired damaged structures, mainly by putting in cribbing and timber supports, and replaced completely destroyed bridges with Baileys. Fords, dikes, and causeways were used whenever possible as temporary expedients. Mines and fortifications were almost entirely lacking. Water supply was sometimes difficult because of the rapid advance of the troops and the few satisfactory sources of water. Rehabilitation of Yontan airfield began on the second day.

On southern Okinawa, also, as XXIV Corps moved southward, division and corps engineer missions were light. Enemy resistance in any real sense did not materialize. The engineers had to give most attention to the roads in the interior of the island, where, narrow and only partly paved, they soon crumbled under heavy traffic. Division and corps engineers improved them with coral and rubble from the buildings of native villages. The 13th Combat Battalion of the 7th Division began rehabilitating Kadena airfield the day after the landing; the next day an aviation battalion took over; four days later the runway was operational. As the troops of XXIV Corps penetrated farther into the southern part of the island, they found increasing numbers of mines. Some were plastic; many were aerial bombs equipped with pressure detonators. Roadblocks, consisting of ditches, felled trees, and junked equipment, became common. The troops also came upon more booby traps. These various obstacles were no great hindrance to the advance of the troops in the first days of the assault.[34]

By mid-April operations on Okinawa were progressing well. All of the northern part of the island was in American hands, except isolated pockets of resistance on Motobu Peninsula. The troops were advancing toward the southern tip, though at a slower pace and against mounting enemy resistance.

Logistical support was proceeding satisfactorily. On the 9th, the 1st ESB had assumed control of all shore party operations in the XXIV Corps area and was scheduled to take over control of all un-

Capture of Okinawa, 27 Mar–21 Jun 45. (2) Island Comd Okinawa, Action Rpt, 13 Dec 44–30 Jun 45. 98-ISCI-0.3(18017). (3) Heavey, "Down Ramp," *The Military Engineer*, XXXIX (February, 1947), 66–69.

[34] (1) Navy Dept Of of CNO, Rpt, Amphib Opns—Capture of Okinawa, 27 Mar–21 Jun 45. (2) Tenth Army, Rpt of Opns in the Ryukyus Campaign, pp. 11–XI–5ff. (3) Hist of the 13th Engr Combat Bn.

loading on Okinawa, including that in the Marine beach areas, on the 20th. The brigade in landing troops and unloading supplies had experienced occasional fire from the enemy. In general, amphibian operations on Okinawa indicated that an ESB headquarters company with temporarily attached units could not operate as efficiently as a complete brigade with permanently assigned boat and shore elements.[35]

Combat Support on Ie Shima

On 16 April two regimental combat teams of the 77th Division landed on Ie Shima. Daily aerial reconnaissance during the two weeks before the assault disclosed so few signs of enemy activity that it was widely assumed the island had been evacuated. When the first assault waves hit the beach, they found Ie Shima anything but abandoned. Enemy resistance was savage; even civilians armed with hand grenades and sticks took part in the fighting. The third regimental combat team, less one battalion, was sent in to reinforce the first assault troops. Elements of the 302d Combat Battalion, attached to their respective combat teams, were busy reducing obstacles, removing mines, and destroying caves and pillboxes, and at times, fighting as infantry in hand-to-hand combat. The island was strewn with all types of mines —antipersonnel, antitank, and antiboat. The two airfields were heavily mined. The enemy made extensive use of aerial bombs, which were buried in the ground with fuzes pointed upward. Improvised mines, consisting of 5-gallon cans of explosives fitted with a pressure-type fuze, were numerous. During the final stages of the campaign in the rugged eastern part of the island, the troops had to destroy hundreds of caves, some of them cut in the sides of cliffs and two or three stories high. The 302d engineers during the fighting on Ie Shima removed about 2,600 land mines, and reduced 560 caves, pillboxes, and dugouts. For the 302d this was the bloodiest fighting of the Pacific war. The battalion suffered 11 men killed and 49 wounded. The island was finally secured on 21 April, but even after that mop-up operations were necessary.[36]

Southern Okinawa

Also on 21 April, three weeks after the initial landing, organized resistance on northern Okinawa came to an end. Fighting was over considerably ahead of expectations. But on southern Okinawa, a different story developed. South of a line running roughly from Kuba to Isa, in terrain admirably suited for defensive warfare and delaying tactics, the Japanese had constructed a defensive system so expertly devised as to be described as "fantastic." Here the enemy, well entrenched in a rocky area honeycombed with caves and studded with pillboxes, blockhouses, and mine fields, put up a tenacious resistance. Not only was opposition on the ground formid-

[35] Heavey, "Down Ramp," *The Military Engineer*, XXXIX (February, 1947), 68.

[36] (1)Tenth Army, Rpt of Opns in the Ryukyus Campaign-pp. 11-XI-11ff. (2) Lt. Col. Leigh C. Fairbank, "Division Engineers, Part IV, Ryukyu Islands," *The Military Engineer*, XXXIX (May, 1947), 198-99. (3) Appleman, Burns, Gugeler, and Stevens, *Okinawa: The Last Battle*, p. 154.

able, but also day and night air raids, including attacks by kamikaze dive bombers, and assaults by suicide boats and even swimmers harassed the American forces. In late April the 77th Division relieved the battle-weary 96th, and the 27th Division relieved the Marine 1st Division. On 8 May the latter returned to the lines and the Marine 6th Division was also sent in. There was now a two-corps front.[37]

Combat engineer tasks on southern Okinawa had been fairly easy up to now, but this was not to be the case henceforth. Only through hard fighting and with constant support of the combat engineers could the infantry make any headway at all. The enemy's defense tactics were among the best encountered so far. One of the principal elements in the defense was cave warfare. On southern Okinawa the Japanese developed this type of fighting to the highest degree in the war. Many of their caves and other fortifications were on the sides of hills and cliffs away from the approaching American forces. The openings from which weapons were fired were so small as to be almost invisible. The enemy placed machine gun and mortar fire on the tops of the hills and ridges over which American troops had to advance to reach the mouths of the caves. Probably the greatest improvement made by the Japanese was to cover cave openings by fire. This was done in various ways. The most successful tactic was to make caves mutually supporting, with the entrance of each cave covered by fire from others located to the front and flanks. Sometimes machine guns, mortars, and even artillery would be emplaced in the open to cover cave entrances. The various weapons were, as a rule, so cleverly camouflaged that they were difficult to find. In the last desperate effort to prevent the destruction of caves by American forces, the Japanese would engage in grenade duels and hand-to-hand combat.

A number of weaknesses in cave warfare remained. For one thing, the small entrances greatly restricted the defenders' field of fire. The lack of communications between caves limited the defenders' ability to maneuver, counterattack, or withdraw. Japanese commanders cautioned their troops not to be trapped in caves. At the proper time at least one-third of the men were to leave and help cover the cave mouth from emplacements. But the defenders had little success in carrying out such orders. The Japanese were aware of the weakness of cave warfare, but had adopted it because of the overwhelming U.S. fire power and because of the chance cave warfare provided for slowing down the advance of the U.S. forces. The Japanese were making every effort to improve cave warfare and at the same time overcome its disadvantages.

The U.S. infantry-tank teams destroyed innumerable caves by using direct fire and flame throwers. The 8-inch howitzers of the artillery, and, at times, bombardment by aircraft proved very effective. The combat engineers were widely used to reduce caves and fortifications that could not be destroyed by direct infantry assault, artillery fire, or aerial bombardment, but had to be eliminated by hand-placed explosive charges. Engineer demolitions person-

[37] Navy Dept Of of CNO, Rpt, Amphib Opns—Capture of Okinawa, 27 Mar–21 Jun 45.

nel were organized in much the same way as in previous assaults in the Central Pacific. Usually a squad of from six to twelve men was responsible for front-line demolitions for an infantry unit as large as a battalion. If intelligence indicated numerous caves, pillboxes, and blockhouses in an area, an entire engineer platoon might be directed to support one infantry battalion. The battalion commander usually kept his engineer demolition teams near his command post in order to have them readily available should the infantry need help. While waiting to be called forward, the men prepared 24-pound satchel charges, which were the ones mainly used on Okinawa. Pole and shaped charges were, as a rule, too unwieldy or too heavy.

Called forward, an engineer squad operated in a more or less standard manner. The man in the lead advanced toward the cave with the charge and phosphorous grenades, followed by one or two others with spare satchels; the remainder of the group took up positions as directed by the squad leader. The infantry was in readiness to deliver protective fire. Reaching the mouth of the cave, the lead man threw in phosphorous grenades to blind the occupants. Next, the satchel charge was thrown in—as far as possible toward the rear of the cave—to get the maximum blast effect. Ten-to-fifteen-second delayed fuzes gave the men a chance to get away from flying debris. The use of multiple fuzes, some of which were dummies, made it difficult for the occupants, already at least partially blinded by the phosphorous grenades, to pull the proper fuze out of the charge before it exploded. Sometimes a second charge was thrown before the smoke of the first had cleared away. The aim was the complete destruction and sealing of the fortification. Moving in rapidly on the target and getting away fast were essential. Operating in this way, the engineers in the support of one front-line infantry battalion often used more than a ton of explosives to destroy about forty pillboxes, caves, bunkers, and ammunition dumps. Casualty rates were high. The Japanese brought intense fire to bear on demolition teams. During one 3-week period, for example, one engineer combat battalion suffered 20 percent casualties.[38]

The defenders of southern Okinawa made extensive use of mines. The American forces found no fields laid in a regular pattern, but standard and improvised mines were scattered about in great profusion. The only new type was the antipersonnel fragmentation mine. All mines, including those that were booby-trapped, were removed by 4-man engineer teams, one team being assigned to each tank platoon. Long demolition "snakes" attached to tanks were used in a few instances to clear paths through mine fields. Armored bulldozers were extensively used to clear roads of obstacles. Booby traps were found in caves and sometimes in abandoned tanks.

Road maintenance in southern Okinawa was an arduous task for the engineers because the poorly surfaced thoroughfares broke down rapidly under the heavy traffic. From 10 to 12 feet wide, most of the main highways were coral surfaced. During the pro-

[38] This account of engineer participation in the reduction of enemy defenses on Okinawa is based on Bradley, Report of Engineer Operations, ICEBERG.

longed rains in May, maintenance became critical; in the XXIV Corps area, the engineers could keep but one main supply route open, and even this was possible only because corps and divisional engineers worked on the route continuously. After the rainy season, maintenance problems on roads were less serious, but bridging remained a major task. Bridges and culverts, almost invariably built of stone or reinforced concrete, and with a capacity of thirty-five tons or more, were adequate for much of the military traffic, but most bridges were only one lane. Baileys, used extensively on southern Okinawa, proved very satisfactory. There was little need for ponton bridges, and only three were put in place.[39]

The End of the Okinawa Campaign

Bitter fighting continued during May, and casualties were heavy as the defenders were pushed back slowly to the tip of the island. In June enemy resistance crumbled more rapidly. By the end of that month the Japanese position was hopeless. As the Americans pressed into the southernmost part of Okinawa, some of the defenders made last-ditch charges against American positions; many committed suicide. On 2 July the Okinawa campaign was declared officially ended.

Base and Airfield Construction for the Assault on Japan

While fighting was still in progress in the Philippines and on Okinawa, the engineers in the rear areas were already building up bases and developing airfields from which U.S. forces were to launch the final assault on Japan. Two theaters, the Southwest Pacific and the Pacific Ocean Areas, were to be jointly responsible for the final assault. The major construction, by far, was being done in the Philippines and on Okinawa. In the meantime, finishing touches were being put on work in Hawaii and other islands of the central Pacific to support the attack on the Japanese home islands. Elsewhere, construction had slackened off greatly or stopped entirely. Some work was still in progress in the CBI theater, but in the South Pacific, the engineers were mainly dismantling bases.

Over-all Organization in the Pacific

Despite changes in the tactical commands, no great modifications were made in the engineer organization in the Pacific in late 1944 and 1945. The greatest changes resulted from the Joint Chiefs' activation of Army Forces, Pacific (AFPAC), on 6 April 1945, under the command of General MacArthur. Henceforth, all Army units in the Pacific, except those of the Strategic Air Forces, were under MacArthur's direction. For the time being, the new command was only a nominal one since no immediate changes in organization were made. In the Southwest Pacific Area, GHQ SWPA continued to function as MacArthur's headquarters for that theater, and MacArthur and Nimitz agreed that U.S. Army units in the Pacific Ocean Areas would remain under Nimitz' control until he released them to MacArthur. Admiral Nimitz did not transfer the first

[39] Tenth Army, Rpt of Opns in the Ryukyus Campaign, pp. 11–XI–9ff.

POA units to AFPAC until 31 August 1945, when MacArthur assumed command of all Army units in the Ryukyus, except those assigned to the Strategic Air Forces.

Engineer Organization— SWPA and AFPAC

When AFPAC was established, the forward echelon of Casey's office was located in the Manila City Hall; the rear echelon was in the midst of moving from Leyte to the Philippine capital. Authorized strength of the office was 65 officers and 114 enlisted men. In April Casey's request for an increase of 50 percent in personnel strength was granted. As Chief Engineer, SWPA and AFPAC, Casey had theoretical technical supervision over all U.S. Army and Allied engineer units in the Pacific. Probably his major task in his new position was to co-ordinate the activities of units insofar as possible in order to prevent duplication of effort. Co-ordination was especially necessary with regard to map-making organizations. In both the Pacific Ocean and Southwest Pacific Areas, they were already at work on or were about to be engaged in an extensive mapping program of the Japanese home islands.[40]

OCE USASOS

The office of General Ross, Chief Engineer, USASOS SWPA, had finished moving from Brisbane to Hollandia in November 1944. By this time, an advance echelon was already at Tacloban, Leyte; thereafter, additional elements moved forward, and by February 1945 the entire office was settled in Leyte. General Ross was now making preparations to move forward again, this time to Manila. An advance echelon, headed by Col. O. N. Rinehart, arrived in the Philippine capital in February. In April Col. Louis J. Rumaggi and the Operations Division, together with supplies and equipment, were flown there. They took over the third floor of one of the buildings of Far Eastern University and in a short time "were carrying on business as usual." That same month OCE USASOS was officially set up in Manila.[41]

Engineer Districts

Since construction in the Philippines was to be so extensive and vitally important, proper organization would be highly essential. Especially in and around the metropolitan area of Manila, an immense amount of construction and reconstruction was necessary. As in Australia and New Guinea, General Frink, the commander of USASOS, organized bases to decentralize operations. He set up five, one on Leyte (Base K), three on Luzon (Base M at Lingayen Gulf, Base X at Manila, and Base R at Batangas), and one on Cebu (Base S). To supervise their operations, he had redesignated the Army Service Command, recently transferred from Sixth Army to USASOS, as Luzon Base Section, made it an intermediate headquarters, and placed it over

[40] Of C Engr GHQ AFPAC, Admin Hist, 6 Apr 45–31 Dec 46, pp 1–3, 5–7. SWPA Files.

[41] Of C Engr AFWESPAC, First Semiannual Rpt, p. 6. SWPA File A201b.

the bases. In April Luzon Base Section was renamed Philippine Base Section. In Australia and New Guinea, where engineer construction had been the responsibility of base section and base commanders, staff engineers exercised only technical supervision over engineer work. In the Philippines, engineer construction, initially the responsibility of the base commanders, was subsequently entirely divorced from their activities. It was assigned to engineer districts, which were similar to such organizations in the United States. To accomplish construction on Leyte, General Frink set up the Leyte Engineer District in February 1945 and made it directly responsible to General Ross. That same month, General Frink organized the Luzon Engineer District (LUZED) under Col. Alexander M. Neilson, placed it under Luzon Base Section, and made it responsible for USASOS construction on Luzon. Both districts differed from similar organizations in the United States in only one major respect—engineer troops and not contracting firms or civilian workers did the actual construction.[42]

The Engineer Construction Command

For some time considerable thought had been given to putting all engineer construction in the USASOS area under one command to be headed by an engineer. Generals Casey and Sverdrup and other members of MacArthur's staff had discussed the desirability of making such a move in late 1944 and early 1945. Such an organization would be in line with the War Department's policy of centralizing control of major technical activities in Headquarters, SOS, rather than delegating control of them to commanders of bases and advance sections, a policy the CBI theater had already implemented early in 1944.[43] Sverdrup, made a major general on 5 January 1945, was especially interested in setting up such a command; it was generally assumed he would head it after Casey returned from the Army Service Command to his position as MacArthur's chief engineer. On 20 February 1945, Sverdrup wrote Casey that it was ". . . rather obvious that a concentration of all construction forces within one organization is advantageous as centralized control properly exercised means far greater efficiency." Sverdrup had in mind a construction command which would have under it various engineer districts. Two were already in existence and Sverdrup thought perhaps three more should be created. All would use troop units or contractors to get the work done. A fourth, organized along similar lines, would make use of Filipino workmen for rehabilitating Manila.[44] A major question was whether to place such a command in GHQ, in USAFFE, or in USASOS. It was finally decided to put it directly under General Frink, since, as commanding general of USASOS, he was responsible for construction in the communications zone.

On 6 March the Engineer Construc-

[42] Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 189–90.

[43] See above, p. 438.

[44] Memo, Sverdrup for Casey, 20 Feb 45. 323.41, SWPA Files, KCRC.

tion Command (ENCOM) was set up under Sverdrup, who was henceforth responsible for co-ordinating and supervising all construction in the Southwest Pacific that was under the control of USASOS. This meant, in effect, responsibility for construction in the Philippines, since the rear bases were by this time being dismantled. Engineer construction responsibilities in the communications zone in the islands were thus placed under one engineer command, which was completely separate from the base organizations. The men for Sverdrup's new headquarters were taken on a temporary basis, mostly from the 5202d Construction Brigade and from a number of aviation and construction battalions. The Leyte and Luzon Engineer Districts were transferred to ENCOM.[45]

The General Engineer District

A new engineer district for ENCOM was soon organized. Its establishment had, in fact, been under consideration since late 1944, when it seemed likely that an extraordinary effort would have to be made to rehabilitate and reconstruct facilities in and around Manila after the Japanese there had been defeated. Colonel Lane, chief of Sverdrup's Operations Division, was one of the first to suggest using a district organization to rehabilitate the Philippine capital. He wrote Sverdrup on 26 November 1944: "In connection with plans for rehabilitation of Manila, it has occurred to me that it may be desirable to establish an Engineer District Office . . . and that the Chief of Engineers could probably furnish a complete District with all personnel for this work. . . ." Lane stated that such an organization should plan to use as many Filipino civilians as possible in order to free the troops for more direct combat support. Since local contracting firms would in all likelihood not be available, large numbers of hired laborers would have to be used.[46] On 5 December MacArthur radioed a request to the Chief of Engineers for an organization similar to an engineer district office in the United States. "The limited number of engineers at my disposal," MacArthur pointed out, "will be fully occupied in direct support of the campaign. . . . This means that the maximum use must be made of civilian labor." [47]

In line with MacArthur's request, Reybold began recruiting men for the new office. Some 150 officers and 300 enlisted men were supplied by division and district offices in the United States. They received a few weeks training at Fort Belvoir and then flew to Manila, arriving in late March. Headed by Col. Robert C. Hunter they were designated the General Engineer District (GENED). It was hoped that at least some of the reconstruction projects could be given to local contractors, but this idea was quickly given up. There were few Philippine construction firms before the war and these were now unable to do any effective work because of the dislo-

[45] (1) Ltr, Ross to Worsham, 4 Jan 45. 323.41, SWPA Files, KCRC. (2) Of C Engr GHQ AFPAC, Admin Hist, pp. 20ff. (3) Ltr, Sverdrup to Staff Br, 28 Aug 50. SWPA Files.

[46] Memo, Lane for Sverdrup, 26 Nov 44. SWPA File 304.

[47] Radio, MacArthur to Reybold, 5 Dec 44. 323.41, SWPA Files, KCRC.

cations caused by the conflict. Colonel Hunter had to rely at first on hired labor. He had the usual difficulties of organizing and supervising such a large work force. Fortunately, many of those hired had been employed by the U.S. Army before the war and so had gained experience for the work they had to do. Because of the vast amount of destruction, however, Hunter, contrary to original plans, soon had to use large numbers of troops.[48]

Construction Corps of the Philippines

Although Sverdrup had considered organizing a number of additional subordinate commands, only one more was formed—the Construction Corps of the Philippines (CONCOR), organized to make further use of Filipino workmen. It was set up on 25 April, under Col. Samuel N. Karrick, to undertake reconstruction in the Philippines, especially in and near Manila. Workmen, recruited on a voluntary basis for a minimum period of six months, would be directed by American and Filipino officers. This type of organization was expected to make possible a more efficient use of the Filipinos by providing better organization and supervision and reducing labor turnover. The workmen were to be organized into labor battalions. At full strength, each would have 92 officers and enlisted men from the U.S. Army, the Philippine Army, and the Philippine Scouts, and 1,037 civilians. A CONCOR battalion had a special table of organization and equipment closely resembling that of the former Civilian Conservation Corps battalions in the United States. Recruitment was slow, and by 1 June, CONCOR had only one battalion. Thereafter, expansion was more rapid, four battalions being activated in June. Including both skilled and unskilled workers, the battalions became quite efficient in all types of construction, except possibly those requiring much earth moving. They built barracks, warehouses, and hospitals, and maintained roads and utilities. Labor turnover was of serious concern at first but became less so as the organization was improved. Though wages were low, many Filipinos were attracted to the organization mainly because it provided meals at cost and permitted employees to buy scarce articles in the Army's post exchanges.[49]

Changes in ENCOM

In the rapidly changing conditions in the Philippines, Sverdrup's staff, and his subordinate commands as well, underwent almost continuous modification. During the first months the number of men in ENCOM headquarters fluctuated greatly. In June the War Department authorized a staff of 114 officers and 652 enlisted men. Meanwhile, Sverdrup found himself directing the construction efforts of a larger and larger engineer force. Late in April, he had acquired an additional unit. This was the Boat

[48] Of C Engr GHQ AFPAC, Admin Hist, pp. 22–23.

[49] Of C Engr GHQ AFPAC, Admin Hist, pp. 23–26. (2) Memo, 2d Lt Warren D. Curtis, Opns Sec Of C Engr GHQ SWPA, for Colonel Lane *et al.*, 4 May 45, with Incl, Staff Study, Constr Corps of the Philippines, 20 Apr 45. SWPA Files M75. (3) Of C Engr AFWESPAC, First Semiannual Rpt.

Building Command, which had been established in mid-1944 at Milne Bay to direct the activities of the boat assembly units in the theater. In early 1945 the command was transferred to Batangas, Luzon, where the men rebuilt their assembly plants and were soon putting landing craft together again. The Luzon Engineer District also expanded rapidly, and by the end of April, Colonel Neilson had about 250 military and civilians on his staff. Within the next few weeks, he had some 30,000 engineer troops and over 20,000 Filipino civilians working on various projects. The General Engineer District likewise grew rapidly. When the Leyte Engineer District was inactivated in May, GENED took over its projects, and it took over LUZED's when that organization was inactivated in July. By then, the General Engineer District had under its control most of the military construction in the USASOS area in the Philippines.[50]

The type of construction organization that many engineers had wanted since the early days in Australia, one headed by an engineer officer, was now a reality. Nevertheless, many of the difficulties previously experienced were still prevalent, undoubtedly because they were too basic to be easily eliminated by a change in organization. Shortages of men and supplies were still the rule, as were the problems generally encountered in coordinating a construction effort over a vast area in a short time. Some felt that ENCOM, directing work formerly handled well enough by base section and base commanders, was merely another headquarters that had to be dealt with. From the standpoint of many engineers, ENCOM had the great advantage that it was an engineer command. Engineer units of such a command were more likely to receive a sympathetic understanding of their problems than they could get from nonengineer base and base section commanders. ENCOM consequently improved the morale and efficiency of engineer units. It further raised morale by giving a number of promotions that could not be granted earlier because of limitations in the tables of organization.[51]

Army Forces, Western Pacific

On 7 June USASOS was redesignated Army Forces, Western Pacific (AFWESPAC) and placed under the command of Lt. Gen. Wilhelm D. Styer. Somewhat expanded in functions over its predecessor, AFWESPAC was to provide logistic support for U.S. Army troops in SWPA and AFPAC as directed by higher headquarters. On 10 June, General Worsham, formerly division engineer of the Northwest Service Command in Canada and Alaska, became Engineer, AFWESPAC. His staff was one of considerable size, by the end of June consisting of 144 officers, 435 enlisted men, and 33 civilians—a total of 612. AFWESPAC had more than 200 engineer units numbering about 65,000 men, and within a month the figure had risen to 90,000. Engineers made up

[50] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 188–89, 196. (2) Ltr, Heiman to Staff Br, 13 Oct 50. SWPA Files.

[51] (1) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 198. (2) Ltr, Sverdrup to Staff Br, 28 Aug 50. SWPA Files.

one-fourth of all the troops under AFWESPAC's command. Worsham's staff was before long concerned primarily with the construction and maintenance of bases needed to support the invasion of Japan and with making plans and preparations to furnish the engineer troops and supplies required for that assault.[52]

Construction in the Philippines

Rehabilitation and construction in the Philippines surpassed anything hitherto attempted by the engineers in the Pacific in a comparable period of time. Airfields had high priority and twenty on Luzon were repaired, improved, or newly constructed during the first six months of 1945. One of the fields which received a great deal of attention was Clark. The engineers first put the two existing runways in temporary operating condition and then began work on two new 7,000-foot runways for bombers. At Porac, eight miles south of Clark and at Floridablanca (formerly Del Carmen), four miles still farther south, they put in new strips for bombers, also. A great deal of effort was necessary to rehabilitate Nichols and Nielson Fields in the Manila area and to provide them with additional facilities such as gasoline storage and hangars. Most other runways on Luzon, rehabilitated or constructed to meet current operational requirements, were not developed to any great extent. The engineers did rather extensive work on a number of fields in the southern Philippines. The one at Puerto Princesa, Palawan, was rebuilt and lengthened to 7,000 feet; on Mindanao, the fields at Zamboanga and Malabang were improved and enlarged; two all-weather fields were built on Mindoro; four were developed in the Visayas. All told, the engineers rehabilitated and newly constructed forty-five runways in the Philippines during the first six months of 1945.[53]

The engineers generally provided new facilities for storing gasoline. At the same time they constructed or rehabilitated fueling jetties and laid more than 500 miles of pipeline. One of the major new storage installations was the large tanker terminal near Mariveles on Bataan, from which pipelines were extended to Clark and nearby airfields; construction progressed rapidly during the spring of 1945, despite unfavorable weather. Before the battle for Luzon ended, storage for 160,000 barrels had been erected at Mariveles and over fifty miles of 6-inch pipeline installed, with aviation gasoline flowing through the line at the rate of 412 barrels an hour. The 40,000-barrel welded steel tanks at Mariveles, the first of which were completed in August 1945, were the largest storage tanks of this type erected in the Southwest Pacific.

In an extensive hospital building program, major installations were erected at Manila, San Fernando in northern Luzon, and Batangas in southern Luzon. One of the largest projects, built on the

[52] Of C Engr AFWESPAC, First Semiannual Rpt, pp. 7–8. (2) *Engrs of SWPA*, II, pp. 176–80.

[53] The information in this and the following paragraphs on the rehabilitation in the Philippines is taken from Office of the Chief Engineer, GHQ SWPA, Annual Report for 1945. (Draft MS). SWPA Files.

site of a Japanese airfield in the Mandaluyong area in southeastern Manila, was the first in SWPA to use prefabricated steel units. The main members were prefabricated; an assembly line was used to preassemble wall panels, floor joists, roof girders, and posts. The steel units, made of special lightweight metal, were 20 feet wide and varied in length from 48 to 240 feet. The floors were made of plywood, the walls and ceilings of beaverboard, the windows of plastic. Some of these units were also erected at Fort McKinley Hospital. The steel units could be dismantled and then re-erected with only a 5-percent loss of material, but re-erection required considerably more effort than putting up the wooden ones.

Warehousing was extensive. Most storage was in the Greater Manila area, where the engineers supplied about 9 million square feet of covered storage and some 34 million square feet of open storage. They made about 2 million square feet of covered storage available by rehabilitating existing buildings. One of the largest projects was the quartermaster depot built on the site of the old Zablan Airfield, just east of the capital. It consisted of 31 prefabricated buildings, each of which, measuring 110 by 405 feet, covered slightly more than an acre, and took about a week to erect. Floors were of steel mat, wood, concrete, or crushed stone, depending upon the type of supplies to be stored. Bases M and R also had fairly large storage facilities.

Port areas had been severely damaged, especially at Manila, where the Japanese had systematically destroyed the prewar berthing facilities, particularly those of South Harbor; none were usable when the Americans captured the dock area. The harbor was cluttered with some 600 sunken vessels. Reconstruction and clearing began on 1 March. Floating ponton piers were again invaluable and the engineers used them extensively at first to provide facilities rapidly, but since these piers required a great deal of maintenance and could be used successfully only in well-protected harbors, the engineers rehabilitated existing facilities and undertook some new construction. They built two new fixed piers, which provided eight additional berths in South Harbor, and lengthened two existing piers. Pier 13 (formerly Pier 7), one of the longest covered piers in the world, was rehabilitated with the help of about 1,800 troops and 2,000 civilians and provided berths for six Libertys. During the reconstruction period, five Army dredges excavated 3,250,000 cubic yards of material from North and South Harbors and the Pasig River. The Navy, meanwhile, was clearing a path through the wreckage in Manila Bay. The port was made serviceable in a relatively short time, the first Liberty docking on 17 March. The engineers also did harbor work at San Fernando, Subic Bay, Mariveles, Puerto Princesa, Zamboanga, and Cebu City.

Along with the reconstruction of Manila Harbor, a major undertaking was the rehabilitation of the city itself. Engineer construction units under ENCOM took over this work from Colonel Liles's command in March. One of the first jobs to be completed was the restoration of the water supply system. With the capture of Ipo and Montalban Dams, the prewar water pressure in north Manila was restored. By putting a 16-inch water main across the Pasig at Ayala Bridge, the engineers

partly restored water service in south Manila. They were at the same time repairing the sewerage system, which was expected to be turned over to the civilian authorities in the fall. The electric power system had been so badly damaged that large-scale reconstruction was necessary. Power resources remained low; for a time a destroyer escort in Manila Harbor was fitted up to provide 3,500 kilowatts for the city. Work on the electric plant and power lines was a time-consuming job. The engineers cleared and repaired about ninety miles of streets. They put temporary bridges across the Pasig to replace the five destroyed during the fighting. They pulled 200 sunken boats out of the harbor. In short, Manila was again made habitable.

Engineer units did much additional construction in various parts of the islands. They provided staging areas for 350,000 troops and replacement depots and disposition centers for 125,000. They successfully carried out railroad rehabilitation, and by 11 March service was restored on the Manila Railroad from Lingayen Gulf to the capital. An engineer combat battalion with the 158th RCT placed sixty-five miles of the railroad on the Bicol Peninsula in operation. Other engineer efforts included quick repair of seventy-four miles of railroad on Panay and a short stretch on Cebu, and attempts to speed up rehabilitation of sawmills and cement plants.

Construction on Okinawa

The organization established on Okinawa for construction was similar to those set up on other islands of the central Pacific. An island command, in Army terms a garrison force, was organized and made responsible for the construction of the base and airfields and for the supply of combat and garrison troops. The island commander on Okinawa was Maj. Gen. Fred C. Wallace. His engineer, a naval officer, was responsible for construction for the Army and the Navy; an Army engineer, with the rank of colonel, was deputy engineer. The Engineer Section was staffed with officers and men from the 1181st Construction Group and from the Naval Construction Office, Tenth Army. Under the command of the island engineer were Army engineer units and naval construction battalions, which were to build the Army's and Navy's projects, respectively. Constructing units, assigned to the Island Command and scheduled for early landings on Okinawa, were attached to XXIV Corps and III Amphibious Corps. The first engineer units of the Island Command landed on D-day. Within the first month, nineteen Army engineer units and naval construction battalions had come in; more arrived in May and June. In late May 16,000 tons of construction materials arrived for the Navy—the first large shipment of such supplies to reach the island. The first large shipment for the Army was unloaded late in June. The slow arrival of supplies, partly caused by the bitter Japanese resistance, delayed airfield and base construction. The unexpectedly tenacious resistance also meant that some of the engineer construction units had to be diverted to army and corps to provide engineer support. Tactical operations within the Island Command area itself involved mainly elimination of snipers and skirmishes with small enemy groups. The

Island Command's area of responsibility was gradually increased until by 30 June 1945 it included all of Okinawa.[54]

As indicated earlier, the construction planned for the island was tremendous. Six runways for B–29's were to be built, the most extensive airfield complex ever designed for an island in the central Pacific. The initial program was not only frequently revised, but also expanded. Early in January 1945 General Buckner had directed that an airfield be built on Ie Shima and that additional base facilities be constructed on small islands near Okinawa. After operations on Okinawa were under way, reconnaissance indicated that there were several additional good sites for B–29 runways. After a conference of major echelon representatives in early May 1945, Nimitz directed that B–29 fields be constructed on Okinawa only; construction on Ie Shima was to be limited to a field for fighters. Plans now called for 6 Army airfields on Okinawa, but only three of them for B–29's. Later, additional fields were required to take care of units of Far East Air Forces which were to be transferred to Okinawa, and, still later, additional facilities were needed for the Strategic Air Forces. By 30 June 22 runways on 13 airfields had been proposed and suitable sites found on Okinawa and Ie Shima; this revised airfield program meant that Army facilities had to be provided for 450,000 men.[55]

Construction of airfields had begun on 3 April with the rehabilitation of Yontan and Kadena. Both fields had been taken almost intact; such damage as was found had been largely caused by American bombings. Within a few days, both fields were ready to take fighters. At Yontan, working from 30 April to 30 June, engineer units under Island Command put in the first American-built runway on Okinawa—a 7,000-foot medium bomber strip. The first B–29 runway was constructed at Kadena and was about 25 percent complete by the end of June. At Bolo Airfield on the western shore of the island, another B–29 runway was under construction and still another B–29 runway was being developed at Futema. On the whole, construction of bomber and fighter runways was progressing satisfactorily until heavy rains in late May and early June slowed down the work. Then much equipment had to be diverted to tactical units to keep supply routes open to the front. Ie Shima was being transformed into a giant airfield. After the enemy runways had been rehabilitated, construction of new ones began, but progress here was hampered by the large number of mines which the Japanese had placed in the airfield area. Because the runways occupied almost the entire island, the civilian population was evacuated. By mid-May, runways, taxiways, and hardstands on Ie Shima were fully operational. By the end of June, five airfields on Okinawa and Ie Shima were operational, and six additional ones were being rehabilitated or newly constructed.[56]

[54] Island Comd Okinawa, Action Rpt, 13 Dec 44–30 Jun 45. 98–ISC1–0.3(18017).

[55] (1) Craven and Cate, eds., *The Pacific—Matterhorn to Nagasaki*, pp. 691–92. (2) USAFPOA, Participation in the Okinawa Opn, I, 167–68.

[56] (1) USAFPOA, Participation in the Okinawa Opn, I, 167–68. (2) Island Comd Okinawa, Action Rpt, 13 Dec 44–30 Jun 45. (2) Bradley, Rpt on Engr Opns, ICEBERG.



AIRFIELD CONSTRUCTION, IWO JIMA

Much other work was undertaken. Repair of existing roads and construction of new ones was vital. By midyear the engineers had built supply roads along both the east and the west coast, as well as down the center. Most of the important thoroughfares were developed to take two-lane traffic. By 30 June 340 miles of all classes of roads were being maintained, 40 miles of the total having been newly constructed. The situation was at its worst during the heavy rains of late May and early June. At one time only one supply road to the front lines was open. The development of harbor facilities began on 30 April with the construction of a 500-foot ponton cube pier for barges at Buckner (Nakagusuku) Bay. By 30 June six temporary ponton piers to take barges were in place, and preparations were well along on the second phase of port development—the construction of permanent piers. Of high priority was the construction of storage tanks for gasoline, the laying of pipelines, and the installation of pumping systems to get the gasoline from the tankers to the airfields. By 25 April gasoline was being pumped through pipelines to Yontan and Kadena; by the end of June tank farms had been erected at the major airfields

then in operation. The building of camps and hospitals was delayed because of the priority of combat and air force construction.[57]

Construction on Iwo Jima

The main reason for taking Iwo Jima had been its importance as an air base site. This volcanic island presented some unusual problems in airfield construction. The fields had to be built on volcanic ash, and a major puzzle was how to bind the hot asphalt mix to the ash. The engineers developed a procedure that proved to be successful. They put down a layer of crushed stone two inches thick and thoroughly rolled it into the ash. When the ash was wet after a rain, it settled, leaving the stones slightly exposed, so that the resultant mixture adhered to the 2-inch asphalt surface. This method was also successfully used in building roads on the island.

A strip of especially hot ground, about 400 feet wide, ran under the runways of the B–29 field and one of the fighter fields. The strip appeared to have the same bearing capabilities as the cooler ground, but after the surfacing had been in place for several weeks, soft areas developed and the runway cracked. The ash underneath had become saturated with water produced by the condensation of the steam trapped by the asphalt surface. The men checked this condition by excavating about sixteen inches below the asphalt surface, filling in 2 to 6 inches of rock, and laying a new surface. As a further precaution, they left breathers at the edge of the stone fill.

After a prolonged rainy period, parts of the asphalt surface of one of the fighter strips became inflated and steam began puffing out. The engineers dug trenches from the side of the runway to the steam vents and laid pipes in them to carry off the steam, which could thereafter be seen hissing at the sides of the runway. They sometimes treated a bulging asphalt surface by driving perforated 1-inch pipes through it, leaving the ends flush with the surface. This expedient solved the problem until the heat caused the asphalt to disintegrate to powder. When that happened, the engineers put down another 1-inch layer of hot-mix asphalt and drove more vent pipes. Little had to be done about drainage because of the porous nature of the volcanic ash.

The construction of storage for aviation gasoline presented the problem of how to reduce the temperature of gasoline standing in the miles of pipe in the hot, volcanic ash—pipes that had to be put underground to get them clear of runways and taxiways. The engineers did not have the time or the materials to provide insulation. In its heated state, sometimes as much as 170° F., the gasoline could not be pumped into the planes. Before the planes could be refueled, the engineers had to erect spare storage tanks into which the gasoline could be pumped about an hour before takeoff. Only in this way could adequate amounts of fuel be cooled. "It was profoundly inspiring," Col. D. A. Morris, engineer of the garrison force on Iwo Jima wrote, ". . . to see hundreds of these mighty bombers coming in to land

[57] Island Comd Okinawa, Action Rpt, 13 Dec 44–30 Jun 45.

or to see two mile-long columns of them . . . lined up for refueling." [58]

Construction in Hawaii

In 1945 General Richardson, commander of USAFPOA, still had many projects to carry out in Hawaii—the completion of seacoast defenses; further development of the port of Honolulu; construction of additional office space for army headquarters; improvement of some of the airfields, particularly Hickam and John Rodgers; the furnishing of housing for approximately 5,000 civilian employees; and the construction of rest and recreational facilities. Many of the projects entailed new construction; others, rehabilitation of old facilities. The most important jobs were the completion of facilities for the Air Forces, Signal Corps, and Ordnance, the building of recreational facilities for the troops, and the construction of the new Tripler General Hospital. Probably the project that had been under way longest of all was the installation of the naval guns from damaged warships. The delay was still mainly due to the great amount of time required to manufacture the many necessary specialized parts, as well as to the lack of two especially important items—the turning gear worm and pinion. The scarcity of technicians forced the Navy to institute a special training program on battleships and in Navy shops. The guns would not be finished in time to be of service during the war. Battery *Pennsylvania* was expected to be completed by September 1945; Battery *Arizona,* by the end of the year.[59]

The South Pacific

There was little activity in the south Pacific by 1945. Construction had ceased, and on 1 December 1944 South Pacific Base Command had directed that all work except that of an emergency nature or necessary to maintain installations be stopped. Engineer units were continuing to move to the central and southwest Pacific. Those still in the area were, for the most part, on New Caledonia, Guadalcanal, and Bougainville and belonged mainly to supply and maintenance units. The roll-up of bases, under way since mid-1944, was accelerated. Efate and Tongatabu were closed out in May 1945. By July, New Zealand was closed out except for a few personnel. It was planned to have New Caledonia serve as the final storage area and transshipment point for the south Pacific. As of midyear, base facilities on that island were still extensive. In June the Engineer Section of the South Pacific Base Command at Nouméa still had 11 officers and 84 enlisted men, whose main job it was to supervise the dismantling and disposal of facilities. A most important part of their task was the return of real estate to the owners—about 85 percent of all leases in the theater were for property on New Cale-

[58] (1) Morris, "Engineer Operations on Iwo Jima," *The Military Engineer,* XL (May, 1948), 200–201. (2) Hist of the 811th Engr Avn Bn.

[59] (1) Ltr, Richardson to TAG, 17 Jan 45. Engr AFG PAC, 600.1 (2) Ltr, Richardson to CG CPBC, 9 Jul 45. Engr AGF PAC, 600.1/6. (3) Memo, Capt H. Perlis, C Special Installations Div Of of Engr USAFPOA, to Loper, 6 Dec 44. Engr AGF PAC.

donia. The number of troops continued to decline. The base command had some 13,000 engineers in January; the number was down to 1,072 by mid-August.[60]

Declining CBI

In Burma and China, engineer work was still considerable, for in early 1945 there was a possibility that fairly extensive operations would be undertaken against the Japanese on the Asian mainland. The military outlook became more favorable in the first months of the year. With the capture of Lashio by the Chinese on 7 March, all of northern Burma was free, and British and Indian troops continued their advance southward. The Chinese armies in Burma began to return to their homeland for a showdown with the Japanese; Wedemeyer hoped to strengthen them sufficiently to enable them to fight their way to the coast by fall. The India-Burma Theater, under Lt. Gen. Daniel I. Sultan, would for all practical purposes function as a communications zone. Major jobs for the engineers on the Asian continent were building additional airfields in China, improving the Ledo and Burma Roads, and completing the system of pipelines. As the war progressed, it became apparent that decisive operations would not take place in China. In the last months of the war, therefore, engineer work was largely of a routine nature.[61]

The logistical build-up in support of the China Theater would be of little avail if the Chinese armies proved too weak to drive the Japanese back. Wedemeyer detailed additional American instructors and liaison officers to Chinese armies and divisions as training activities were stepped up. Meanwhile, Chennault's engineers continued work on a growing number of airfields to replace the eastern ones overrun by the enemy after August 1944. Resident engineers supervised the building or improving of nine fields east of Kunming and seven more north of the Yangtze River and east of Chungking. When fighting broke out between the Japanese and the Chinese in April, Chennault's airmen controlled the skies. In May the Japanese began a general withdrawal, preparatory to the evacuation of southern China. As the Chinese moved eastward in June and July, they recaptured several of Chennault's airfields which the Japanese had demolished. With the recapture of Liuchow at the end of June, Chennault flew in a detachment of the 930th Aviation Regiment to take charge of restoring the heavy bomber field there.[62] At the same time, the engineers were increasingly engaged on a program of road improvement in southern China. Late in April Wedemeyer directed the Burma Road engineers to help their

[60] (1) Hq Constr Serv CPBC, Rpt, Summary of Inspec, SPBC. Engr AGF PAC. (2) (Hist) Rpt, SPBC Engr Sec. 319.1 (Misc) U.S. Army Forces in New Caledonia, KCRC. (3) Ltr, Hq SPBC to CG AFMIDPAC, 18 Aug 45, with Incl, Engr Tr Disposition Rpt, 15 Aug 45. 319.1 U.S. Army Forces in New Caledonia.

[61] (1) Ltr, Col Craig Smyser, Actg Eng IBT to Gen Johns, Of CofEngrs, 29 Jun 45. Theater Engr Ltr File, Constr Serv Files. (2) Charles F. Romanus and Riley Sunderland, *Time Runs Out in CBI,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1959), ch. V.

[62] (1) Chennault, *Way of a Fighter,* pp. 344–45. (2) Hist of the 930th Engr Regt.

Chinese Army counterparts rehabilitate roads in the Anshun-Kweiyang area, and in June SOS, China Theater, detailed the 1880th Aviation Battalion to help improve the 600-mile post road from Kunming eastward to Chihchiang. In June, also, the 858th Aviation Battalion and the 71st Light Ponton Company arrived from Burma to help the Yunnan-Burma Highway Administration improve the Burma Road. Meanwhile, the 191st Light Ponton Company took up ferry operations 260 miles east of Kunming.[63]

Work went ahead on the Ledo Road. It will be recalled that in August 1944 the War Department had authorized construction beyond Myitkyina of a one-lane paved road only. General Pick, convinced that continuous traffic could not be maintained over such a thoroughfare during the monsoon season, set out to widen the Ledo Road to two lanes throughout its length. When General Farrell sounded out the War Department in Washington in January 1945, he learned that the Operations Division would not object to widening the road after all. Somervell started procurement of additional H–20 bridges to make possible two-way traffic beyond Myitkyina.[64] Work progressed, but slowly. Early in April, Lt. Col. W. S. Chapin, of Headquarters, Construction Service, after a personal inspection of the road, wrote Colonel Welling: "The highway from Myitkyina to Bhamo is now two track. A considerable portion . . . from Bhamo to Namhkan is two track and the remaining portion between Namhkan and Wanting is also two track. By 15 June a two track all-weather highway will exist between Ledo and Wanting." [65]

The most spectacular feature of construction on the road in 1945 was the erection of a number of bridges, particularly those over the Irrawaddy, Taping, and Shweli. Pick planned to build a combination bridge over the Irrawaddy to replace the ponton bridge at Myitkyina completed in early December 1944. The new bridge was to be erected some 20 miles downstream from Myitkyina at a point where the river was about 60 feet deep during low water and rose as much as 40 feet during floods. Pick decided to use H–20 girders resting on steel barges to form an 850-foot long center span. Timber trestles would be used for the approaches. The barges, knocked down, were already in the theater, having been sent from the United States to transport gasoline and other supplies on the Brahmaputra. The steel parts for the center span, on order from the United States, were not expected before the end of March, by which time the Irrawaddy would be in flood stage. The only feasible solution was to fabricate steel parts from such scrap metal as could be found in Advance Section. In mid-January 1945 the race against the flood waters began. To assemble and launch the barges, the engineers set up a marine ways on the river a short distance upstream from the bridge site; at the same time, they manufactured on the spot the vital steel parts

[63] (1) Movement Order, Hq Burma Road Engrs, 28 Apr 45. GED, CTSOSEF. (2) Hist of the 71st, 858th, and 1880th Engrs.

[64] Memo, Kaminer, S–3 Adv Sec 3, to Pick, 6 May 45. Engr Sec File, LAC.

[65] (1) Memo, Chapin for Welling, 3 Apr 45. Opns Br File, Constr Serv Files. (2) Work on the Tengchung route was discontinued soon after the opening of the Ledo Road.

needed. On 31 March, about 75 days after work began and two months before the special bridging material arrived from the United States, the bridge was across the Irrawaddy. At its center it had 6 floating spans resting on steel barges, with a distance of about 110 feet between barges. On either side of the floating section were double-hinged spans, each 225 feet long, which permitted the center section to rise and fall with the level of the river. Designed to take a water fluctuation of 40 feet, the two hinged sections were attached to fixed trestles near the banks. This bridge, two lane, had a capacity of 35 tons, and with its approaches was 1,620 feet long.[66]

Beyond the Irrawaddy, all major bridges were Baileys. In view of the difficulties of getting H–20 bridges from the United States, General Farrell in late 1944 had arranged with the British for the procurement of Baileys. The parts had been moved up the Ledo Road in late 1944 and early 1945. In February Company A of the 209th Combat Battalion completed a 400-foot Bailey over the Taping. By 11 March Company B of the 209th had built a similar structure, 450 feet long, across the Shweli.

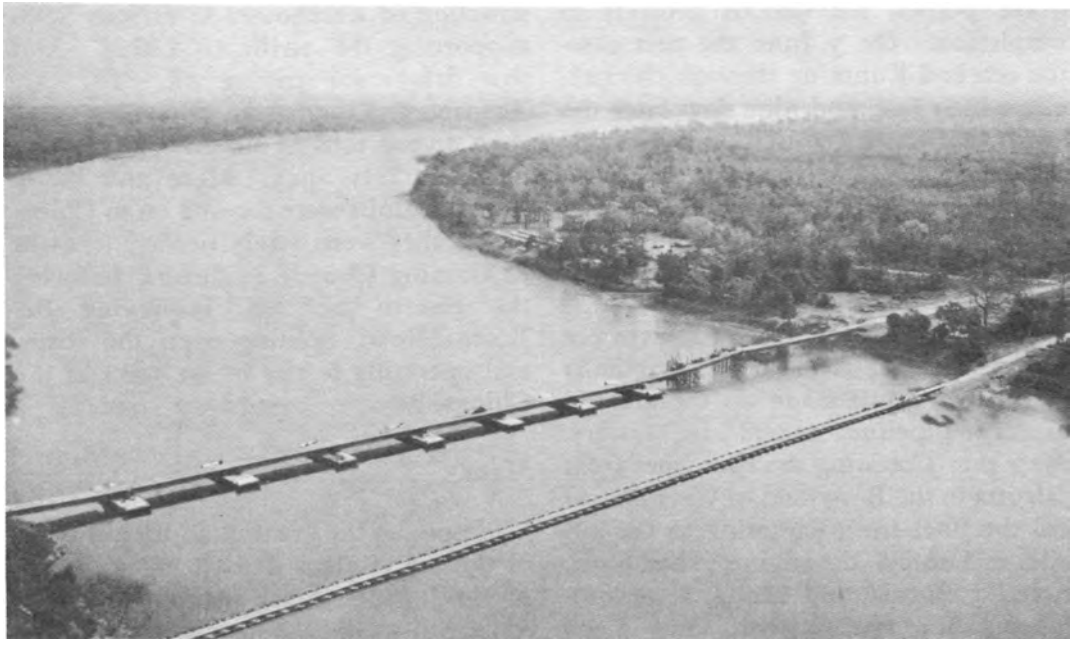
On 21 May General Pick, then in Washington, announced the formal completion of the Ledo Road. Typical of the congratulations he received was the one from Covell, stating that the Ledo Road would "... stand forever as a monument to the unstinting labor, courage, determination and ingenuity of both the living and those who gave their lives in this remarkable accomplishment." [67] But after it was finished the road had far less strategic importance than in the early days of its construction. By 1945 the War Department was no longer interested in the tonnage goals set up at Quebec in August 1943. The Department now directed one-way deliveries of vehicles and munitions only. No more than eighty-eight truck companies would be provided for all operations on the road. To hold the thoroughfare open during the monsoon of 1945, Pick kept 12,000 engineers busy resurfacing the roadway, improving drainage, and repairing bridges.[68]

The plans made at the QUADRANT Conference for the construction of three pipelines to China were cut drastically. On 18 January Pick directed Colonel Morse to complete the 6-inch standard-weight line from Tinsukia as far as Myitkyina. This job was to be finished by 15 July. The 709th and 1382d Petroleum Distribution Companies, reinforced by the 1304th Construction Battalion and elements of four general service regiments, began work on 16 February with pipe supplied by British depots. Sultan, complying with Wedemeyer's request made in mid-April, agreed to stop work on the 6-inch line at

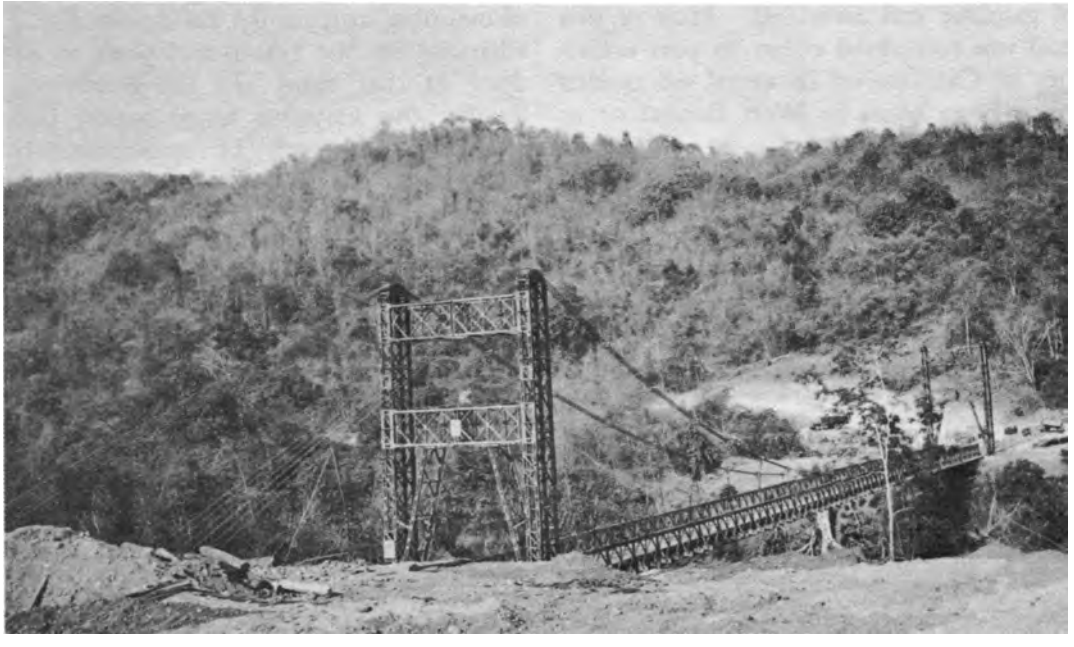
[66] Col. James Truitt, "The Irrawaddy Bridge, Ledo Road," *The Military Engineer*, XXXVII (October, 1945), 406–08.

[67] (1) Ltr, Covell to Pick, 26 Apr 45. Covell Ltr File, Constr Serv Files. (2) Brig. Gen. Paul F. Yount, in addition to commanding the Military Railways, succeeded General Pick as Commanding General, Advance Section, for the summer of 1945, and he in turn was succeeded by Brig. Gen Walter K. Wilson, Jr., who moved up from Mountbatten's headquarters just as the war with Japan drew to a close.

[68] (1) Bykofsky and Larson, *Transportation Corps in World War II: Operations Overseas*, pp. 584–91. (2) Hq IBT, Hist of IBT, app. 10, pp. 6–8. OCMH Files.



THREE EXAMPLES OF BRIDGING IN THE CBI. *Above, the steel barge bridge across the Irrawaddy, with a temporary ponton bridge in the foreground. Below, the Bailey suspension over the Taping River.*



Myitkyina and turn over to the Chinese theater the cargo space thereby released. Morse pushed his various projects to completion. On 7 June the first gasoline reached Kunming through the 928-mile 4-inch line, and nine days later the 6-inch line from Tinsukia to Myitkyina was complete. Twelve of the seventeen pipeline companies in the two Asian theaters were thereafter engaged in pumping and maintaining the lines from Assam to Yunnan.[69]

Although the pipelines built were not as extensive as had been originally planned they still made up the greatest military pipeline system in history. (*Map 32*) Counting the spur lines from Calcutta to the B–29 field in West Bengal and the lines from Kunming to the airfields in Yunnan, the engineers had built, in India, Burma, and China, a continuous pipeline system, with some 3,300 miles of pipe and 148 pumping stations. During the last two years of the war, engineer troops operating this enormous network handled over 15,600,000 barrels of gasoline and diesel oil. Most of this fuel was consumed either in port activities at Calcutta or in aerial operations from B–29 bases in West Bengal or at the transport fields in Assam. The two 6-inch lines delivered some 3,600,000 barrels to the Tinsukia tank farm. From there, about 2,600,000 barrels went to various points along the Ledo Road and approximately 462,000 barrels to points inside China.[70]

By mid-1945, the engineers in India were putting an increasing effort into the maintenance of airfields and the construction of warehouses at various fields supporting the airlift to China. And this drive was paying off. The Air Transport Command delivered more than 70,000 tons of supplies to Chinese fields in July 1945. More and more, engineer units were moving on to China, where they were sorely needed to assist in training Chinese engineers, restoring the eastern airfields, improving the Burma Road, holding open the roads, and operating ferries in the wake of the Chinese advance toward the coast.[71]

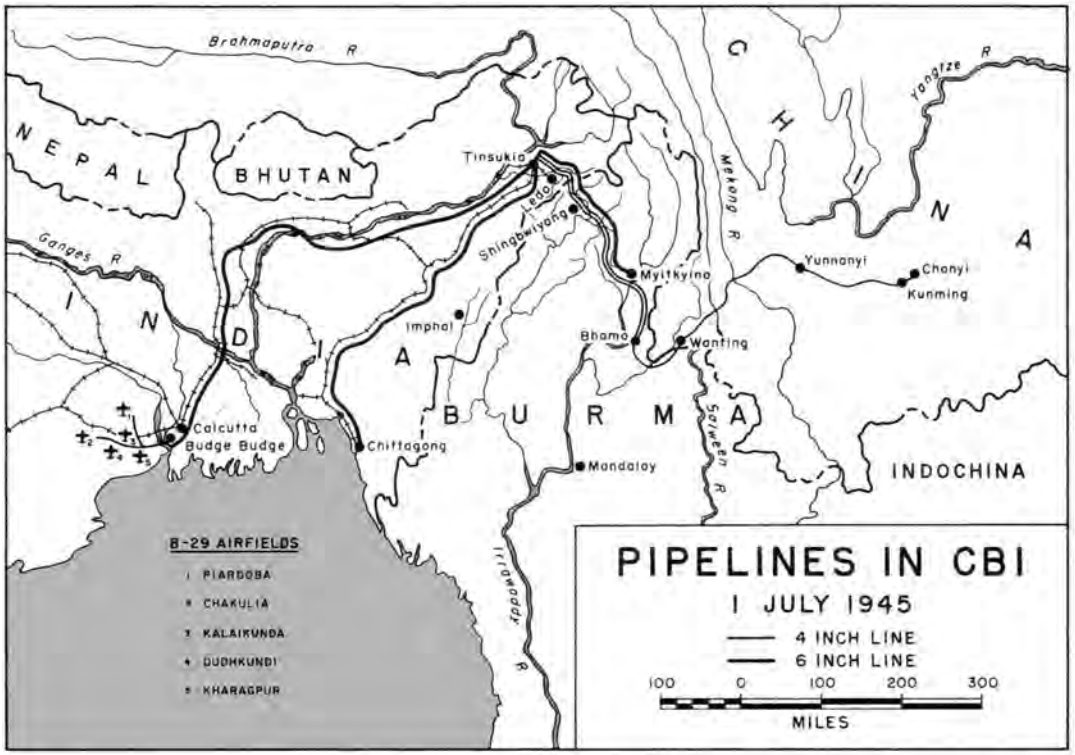
Maps

Supplying the great quantities of maps of the target areas needed for an attack on the Japanese home islands was the responsibility of the engineers of the Southwest Pacific and the Pacific Ocean Areas, the two theaters charged with the final assault on Japan. When AFPAC was formed, in April 1945, the number of mapping units in the Pacific was fairly adequate for the amount of work to be done at that time. In the Southwest Pacific, the mapping organization had reached a strength of approximately 6,000 men. All tactical units had their normal complement of topographic troops, except Eighth Army, which had only a corps topographic company. From mid-February to mid-April, the 648th Topographic Battalion, together with its base map plant, moved from Melbourne to Manila. The battalion was installed

[69] (1) Plng Div ASF, The Ledo Road, app. E, p. 17. (2) Hq Constr Serv Pipeline Progr Rpts, 1 May and 3 Jun 45. 678 (In).

[70] (1) Hq IBT, Hist of IBT, app. 10. (2) Leslie Anders, "American CBI Pipe Lines," *The Military Engineer*, XLV (May–June, 1953), 618–71.

[71] (1) Ltr, Covell to Pick, 26 Apr 45. Admin Br File, Constr Serv Files. (2) G–4, IBT, Weekly Rpts, 29 Jul, 5 Aug, 12 Aug, and 19 Aug 45. (3) Ltr, Welling to Johns, 2 Aug 45. Admin Br File, Constr Serv Files.



MAP 32

in the Aguinaldo Building in downtown Manila in space formerly occupied by a department store. Production of maps resumed full speed early in June. The map depot detachments had been moving to the Philippines as rapidly as the situation permitted.

The 30th Base Topographic Battalion, which had arrived in Hawaii in January 1945, had been put in the huge three-story underground structure originally intended for the Hawaiian Air Depot. The underground chambers, completely air-conditioned and fluorescent lighted, were well suited for the work of the topographic battalion.[72]

With the mapping of the Japanese home islands assuming greater and greater importance after the formation of AFPAC, more mapping units were needed from the United States. MacArthur requested that the 29th Topographic Battalion be sent to the Philippines. Stationed at Portland, Oregon, the 29th had helped on a number of long-range projects for both the Pacific and European theaters. MacArthur's request was granted and the unit was scheduled to arrive in Manila in July.[73]

Late in 1944 seven geologists from the

[72] Hist of the 30th Base Topo Bn.

[73] (1) 648th Engr Base Topo Bn, Interim Rpt, 1 Jan–31 Oct 45. SWPA File I6. (2) Of C Engr GHQ AFPAC, Admin Hist, pp. 62–63.

U.S. Geological Survey had arrived in Honolulu, their job to prepare terrain studies of areas in the Pacific likely to come under attack. Their assignments were similar to those of the teams of geologists who had gone to the Southwest Pacific earlier that year. Responsible to Brig. Gen. Herbert B. Loper, the Engineering and Terrain Intelligence Team, as the group was called, prepared studies as needed by tactical commanders. The first request was for data on the beaches and offshore conditions on Iwo Jima. In preparation for the Okinawa campaign, about twenty-five studies were prepared for Tenth Army. Thereafter the intelligence team devoted its efforts mainly to gathering information on the terrain of southern Kyushu, one of the Japanese home islands. Peak strength of the team was 13 and included 10 geologists, 2 soil scientists, and a highway engineer.[74]

Maps made before the war gave a fairly good coverage of Japan, but the need to bring them up to date was urgent. The most pressing need was to co-ordinate efforts of the photographic units which were bringing back aerial photographs of the Japanese home islands. Numerous sources were supplying photography. The four main ones were squadrons of the Far East Air Forces, based in the Philippines; units of the Strategic Air Forces, which took off from the Marianas and Okinawa; Marine photographic squadrons, which likewise took off from the Marianas and Okinawa; and elements of the Fourteenth Air Force, operating from China. Among the lesser contributors were Navy fliers who obtained photographs while making strikes against the Japanese home islands. Lack of co-ordination among so many sources hampered efforts to secure adequate photographic coverage of Japan proper and to distribute the photographs promptly to the map-making units.

To improve this state of affairs, representatives of the various theaters and of agencies in the United States concerned with mapping held a conference in Hawaii in May. Among those represented were AFPAC, CINCPOA, the Army Air Forces, the Strategic Air Forces, the Office of the Chief of Engineers, and the Army Map Service. Agreements were reached on all important matters, including the areas of Japan to be mapped, the types of maps to be made, the scales to be used, and the priorities in which maps were to be produced. Specifications for aerial photographs were defined. Responsibilities for the compilation, reproduction, and distribution of maps were assigned. MacArthur was to have primary responsibility for the control and co-ordination of the mapping of the Japanese home islands, since he was to be primarily responsible for combat in any invasion. Co-ordination of mapping in the Southwest Pacific and the Pacific Ocean Areas was brought about by making Loper, engineer of USAFPOA, the head of Casey's Intelligence Division.

Meanwhile, the mapping of the Japanese home islands was proceeding satisfactorily. By early June accurate maps of the four main islands, based largely on prewar material, were available. Revisions, based on aerial photography,

[74] (1) Hist of Engrg and Terrain Intel Team. SWPA File 119. (2) Memo, Sherman K. Neuschel, C Geological Surveys Br U.S. Geological Surveys, for C Staff Br, 16 Nov 48. SWPA Files.

were required principally to show new works of man.[75] The conferees in Hawaii had also apportioned the responsibilities of the terrain intelligence teams of the two theaters. The geologists in the central Pacific were to continue with their terrain studies of Kyushu, while those in the Southwest Pacific were to concentrate on studies of Honshu.

In a fast-moving campaign, such as was being undertaken in the Southwest Pacific, map distribution was a most difficult task. During the operations on Luzon, the map depot detachments could not keep up with requirements, even with the additional personnel supplied by replacement depots and labor pools. Topographic supply was improved. During the New Guinea Campaign, a topographic supply depot, consisting of one officer and twelve enlisted men, had been installed on a barge. The barge, of reinforced concrete, arrived in Manila in the spring of 1945, and was used to supply maps to units engaged in combat in the outlying parts of the archipelago.[76]

Supply in the Pacific

The engineers of the Southwest Pacific and the Central Pacific were also the ones with the most pressing supply problems in the last months of the war and would be the ones mainly responsible for adequate enginer supply in the planned invasion. Engineer supply, usually in a rather precarious state, showed signs of improvement in the closing months of the war, but many of the basic problems remained. In some respects there was a trend for the better in the Southwest Pacific, both in the combat zone and in the rear areas. Engineer supply in support of combat, far from satisfactory on Leyte because of the impromptu nature of that operation, was adequate during the remainder of the Philippine campaign. At least in part, this improvement resulted from the fact that the organization for supply was better than for most earlier operations. In the central and southern Philippines, Eighth Army engineers sometimes found supply not very satisfactory, but needs were not so great.

The move to the Philippines inevitably caused a certain amount of dislocation in supply. With the inactivation of the Distribution Division in February 1945, responsibility for stock control was transferred to Luzon Base Section, and later, Philippine Base Section. After ENCOM was established in March, most of the engineer units assigned to bases in the Philippines were engaged in supply work. As construction in the Philippines expanded, difficulties in supply again became conspicuous. Once more in evidence were insufficient long-range planning, poor stock control, careless unloading and storage, especially at the ports, the misuse of supply units, and the inadequate supply training of many officers and men. To provide more efficient supervision of supply, the War Department had organized depot groups which would direct supply more or less as construction groups directed construc-

[75] (1) Check Sheet, Casey for CofS and AG GHQ SWPA, 17 May 45. (2) Ltr, Loper to Casey, 26 May 45. Same File. (3) Of C Engr GHQ AFPAC, Admin Hist, pp. 64ff.

[76] Memo for Rcd, Of C Engr GHQ SWPA, Topo Barge Depot, BCL 306.1. SWPA File M285.

tion.[77] Interest in depot groups was not strong, and few engineers seemed to be aware of their value. "As I have said several times," General Ross wrote to Sverdrup on 19 February, "I am still of the opinion that the Corps of Engineers is not yet supply minded. . . . The need for construction groups, brigades . . . and other supervisory groups is well recognized and pushed . . . the need for supply supervisory groups is even more necessary. . . ." [78]

The distribution of spare parts improved during the Philippine campaign, due partly to the arrival of larger quantities from the United States and partly to better distribution in the theater. To facilitate distribution to units in forward areas, the engineers used ships stocked with spare parts and known as "floating depots." A Liberty ship, the *Robert Louis Stevenson,* the first floating depot to be used by the engineers, was ready in time for the Leyte operation. Three of the holds were assigned to the engineers and two to ordnance. Bins between the decks of the three hatches held loose items and boxed spare parts were stored in the holds. Since there had been little time for remodeling, certain deficiencies were more or less to be expected. There was no ventilating system between decks and no stairwell between the top deck and the section of the ship where the binned parts were kept. All parts had to be handled by ships tackle or an improvised **A**-frame with block and tackle.[79] A second vessel, the *Armand Considere,* a concrete steamship operated by civilians, helped supply Eighth Army engineer units in the southern Philippines. Spare parts were also shipped by air.[80] Two marine spare parts depots were opened—one in Tacloban and another in Manila. The "floating warehouse" system was also used for marine parts. A barge, the *Douglas Fir,* operated by a crew of men from the 2d Special Brigade, supplied spare parts to amphibian units.[81]

The maintenance of equipment improved considerably during the Philippine campaign, mainly because the number of maintenance companies was increased. An engineer "service center" was opened in Manila, where a number of heavy shop and maintenance companies were installed and given the job of putting equipment back in shape. To facilitate repair in the forward areas during operations in the Philippines, a heavy shop company was installed on a concrete barge and did fifth echelon maintenance.[82]

In the central Pacific, most of the difficulties that had plagued the engineers in 1944 continued on into 1945. Although the quantity of stocks arriving from the United States increased, problems of distribution remained. Still all too common, especially in the forward areas, were the shortage of trained personnel and inadequate stock control.

[77] GHQ AFPAC Pac Warfare Bd Rpt No. 33, 13 Aug 45, AGF Questionnaire—Engr Sec. SWPA File E123.

[78] Ltr, Ross to Sverdrup, 19 Feb 45. SWPA File M306.

[79] Memo, Dawson for Sverdrup, 8 Oct 44. SWPA File 166.

[80] Memo, Capt Ralph Hartzler, Sup Div Of C Engr SWPA, for Dawson, 7 May 45. SWPA File M135.

[81] Memo, Sup Div Of C Engr GHQ SWPA for Sverdrup, 9 Dec 44. SWPA File 223.

[82] Of C Engr GHQ, SWPA, Annual Rpt for 1945, Sup Sec. (Draft MS). SWPA File A33.

An engineer officer making an inspection of supply depots on the islands of the western Pacific early in 1945 reported ". . . a rather dismal situation in the forward areas insofar as Engineer stock control and depot operations are concerned." He felt the trouble in large part resulted from "inadequate trained personnel and lack of preplanning." The inexperienced men handling the large quantities of supplies in the depots could not even tell what many of the items they had on hand were used for, which in itself helps to explain why stock control was faulty and distribution inefficient. The supply of spare parts was inadequate and the numerous problems in obtaining and distributing them continued until the end of the war.[83]

Training

During the Philippine campaign, engineer training had further been put to the test. As in New Guinea, training for combat was on the whole adequate, but still a number of senior engineer officers thought certain changes in emphasis would be desirable. They believed more stress should be placed on map reading and the interpretation of aerial photography, and on placing mines and booby traps, as well as on detecting those of the enemy. They also held that, in view of the great importance of amphibious operations in the Southwest Pacific, more emphasis should be put on familiarizing the men with certain details of amphibious operations. With regard to the latter, it was believed especially desirable to teach the men how to recognize the different types of landing craft and to instruct selected personnel in how to waterproof vehicles and remove them from landing craft.

As before, training for construction and supply was noticeably deficient, and also as before, little time was available for additional instruction because of the pressure of work. Units of Sixth Army, Eighth Army, and USASOS carried on training in such subjects as construction operations, equipment maintenance, bridge erection, and mine removal, but the instruction was mainly refresher courses in subjects neglected or not required during the preceding years.[84]

Serious deficiencies in training on the part of many Engineer officers and men in planning and supervising construction and in operating and maintaining heavy equipment, made more and more apparent the need for some kind of central theater engineer school with a technical curriculum. Such a school would have to provide more advanced instruction than could be given in unit on-the-job training or in Australian or unit specialist schools. Casey and Sverdrup, especially, were interested in setting up such a school. Training experts estimated that to be adequate, the school should have approximately 70 officers and 350 enlisted men in attendance. An instructional, administrative, and housekeeping staff of about 50 officers and 180 enlisted men would be required. This require-

[83] (1) Ltr, Capt Don H. Chapman, CE, to CG CPBC, n.d., sub: Staff Visit and Inspec Trip. Engr AGF PAC. (2) Ltr, Col William H. Lewis, ExecO Of of the Engr AFMIDPAC, 17 Oct 45. SWPA File M13.

[84] (1) Ltr, Casey to Worsham, Asst CofEngrs, 29 Mar 45. SWPA File M140. (2) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 207.

ment would mean the withdrawal of men and equipment from active operations, but since the total would be less than 1 percent, the effect on operations would be negligible. The chief engineer of USASOS and the engineers of Sixth and Eighth Armies and FEAF were not in favor of setting up the school because of the pressure of operational responsibilities. They felt it would be preferable to continue the engineer schools already in progress and possibly expand further the Equipment Maintenance School already functioning at Base B as part of the USASOS specialist training center.[85]

General Casey's office, however, began planning in late 1944 for a central theater school. The object was to organize the school in New Guinea as soon as possible and establish it in the Philippines, preferably near Manila. Organization proceeded slowly. A commandant was appointed who prepared a curriculum and obtained instructional material from the United States. By 15 March 1945 a tentative course of instruction had been worked out, and in July a site for the school was found at Clark Field, about fifty-five miles from Manila. Actual instruction did not begin until 3 September 1945. The engineer school was thus a long time in getting under way. The differences of opinion regarding the advisability of having the school, the difficulties in getting qualified instructors and suitable training equipment, and the shortage of facilities to transport the students to the school all had delayed its establishment.[86]

Planning for the Invasion of Japan

Preliminary Planning for Kyushu

Planning for the invasion of the Japanese home islands was first undertaken by the engineers of the Southwest Pacific late in 1944. On 12 December, General Whitlock, MacArthur's G–4, asked Acting Chief Engineer Sverdrup for a preliminary estimate of engineer needs to support a force of more than 500,000 men who would land on Kyushu, southernmost of the four main islands of Japan. After the assault, the engineers would construct three bases on Kyushu to support subsequent operations in the Japanese home islands. No date was set for the assault.[87]

At that time, the engineers had little information on Kyushu aside from what they could get from maps and the sketchy published data on hand. They therefore had to estimate their requirements from the size of the invasion force. The construction required would be the most extensive for any operation in the Pacific so far. Estimates, prepared in about a week, called for eleven runways to support thirty air groups. Exact information on Japanese airfields on southern Kyushu was lacking; the assumption was that existing fields would be almost completely destroyed and that new construction would amount to approximately 90 percent of the total. Two 4,000-foot dry-weather strips for fighters could probably be provided from existing fields in three days; three 6,000-foot

[85] (1) Check Sheet, Sverdrup to G–3 GHQ SWPA, 11 Nov 44. SWPA File 52. (2) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 209–10.

[86] (1) Memo, Sverdrup for AG GHQ and G–3 USAFFE, 26 Jan 45. SWPA File 50. (2) Of C Engr GHQ AFPAC, *Engrs of SWPA*, II, 210–11.

[87] Check Sheet, G–4 GHQ SWPA for Sverdrup, 12 Dec 44. SWPA File T19.

runways for six groups of aircraft, by the end of two weeks. Storage for 576,000 barrels of aviation gasoline could probably be readied in four months. Estimates were that repair and improvement of some 500 miles of roads would be necessary. A port capacity of between 500,000 and 600,000 long tons a month would probably be needed, with port facilities consisting of either wharves or lighter jetties. Widespread destruction would result if the Japanese made their usual suicidal stand; probably few supplies would be available locally and great quantities would have to be shipped in. Perhaps 20 percent of needs could be procured in Japan. USASOS would be responsible for logistic support and would use one or more service commands.[88]

Planning progressed slowly during the winter. On 17 February Casey, just returned to his post as MacArthur's chief engineer, wrote General Whitlock that a terrain study of southern Kyushu was under way, with a view to determining general locations for facilities and the feasibility of construction. The task was difficult since no aerial photography was available and all conclusions had to be based on maps and published data, which, Casey stated, did not ". . . permit accurate location of existing installations or possible sites for construction, particularly with reference to airfields, of which a large number will be necessary. . . ." Although a considerable number of airfields were reportedly in the area, many were believed to be too small to be expanded to the sizes necessary for American aircraft.[89] It appeared that amphibious operations would be moderately difficult on the assault beaches tentatively scheduled for landings near the town of Kushikino on Kyushu's western coast and near the town of Shibushi on Ariake Bay on the island's southeastern coast. Extensive use of floating piers would probably be necessary at both places. Southern Kyushu had few good harbors. Casey recommended that the industrial city of Kagoshima, about 20 miles southeast of Kushikino, and at the head of Kagoshima Bay, be developed to provide a port capacity of about 6,500 long tons a day. Information on roads and railroads was meager, but it was believed the road net would be adequate if it could be maintained. The single-track railroad had many tunnels and would probably be blocked in many places.

Preliminary Planning for Honshu

Two days after reporting to General Whitlock on the engineers' progress in planning for the invasion of Kyushu, Casey received a request for a similar estimate for requirements to support an assault against Honshu in the Tokyo-Yokohama area, the industrial heart of Japan. Tentative plans called for a landing at Sagami Bay, southwest of Tokyo, and on Honshu's Pacific coast east of the capital. The attacking forces would advance northeastward and northwestward, isolate Tokyo, and then drive the Japanese armed forces to the outlying parts of the island, where they would

[88] Check Sheet, Sverdrup for G–4, 20 Dec 44. SWPA File T19.

[89] Check Sheet, Casey for G–4 GHQ SWPA, 17 Feb 45. SWPA File T19.

either have to surrender or be destroyed. The initial landing forces would include 12 infantry divisions, an armored division, and 3 airborne divisions, with 9 infantry divisions in reserve. No target date had been set for the assault.

The engineers spent approximately two months in preparing their estimates. The information they had regarding the Tokyo-Yokohama area was only slightly more adequate than that regarding southern Kyushu. Sagami Bay, on the basis of small-scale hydrographic charts, appeared to be quite shallow and could probably be used only by small landing craft. Casey believed the bay should be used only temporarily, for, with the capture of Yokohama and Tokyo, together with their ports and harbors, there would be adequate facilities for handling the required 40,000 long tons a day. Casey proposed to rehabilitate facilities and do minimum construction at the two cities to provide berths for forty-five Liberty ships. The rest of the cargo would be handled by smaller vessels and lighters. The Tokyo-Yokohama area had an extensive railroad system. Casey recommended that it be fully rehabilitated and be used to the maximum extent. The road net was not satisfactory, and, in view of the heavy traffic it would probably have to carry, would require considerable maintenance. Some fifty airfields existed in the Tokyo area, most of them fighter fields, few of which were near the coast. The area west of Tokyo and Yokohama appeared to have the greatest concentration of airfields and appeared to present the most favorable sites for additional ones. The information was too sketchy to permit pinpointing. The area to the east of Tokyo was expected to present a wide variety of drawbacks. It had relatively few roads and railroads, and rice paddies were numerous, which indicated that desirable sites for airfields would probably be hard to find. For a total assault force of somewhat over a million men, the engineer troops would number approximately 185,000. Combat engineer support, including three special brigades, would total some 98,000 men; service engineers, about 87,000.[90]

Planning Progress

During the spring, planning continued on both proposed operations, but to a far greater extent for the assault on Kyushu, which was given the code name OLYMPIC. Additional information on Kyushu became available and, at the same time, the scope of the operations was extended. The original 31-group air program was increased to 40 and later to 51 groups. Planning could now turn from the general to the specific. On 10 April, shortly after the Joint Chiefs issued their first study for the operation, General Whitlock held a conference to iron out problems of responsibility for logistic support within AFPAC. Casey had too small a planning staff to prepare the basic engineer logistic plan, but he reviewed plans of subordinate commands with regard to engineer matters. At his request, a conference was held on 21 April attended by representatives from Sixth Army, which had been designated to carry out the combat operations, and

[90] (1) Check Sheet, G–4 GHQ SWPA for Casey, 19 Feb 45. (2) Check Sheet, Casey for G–4, 18 Apr 45. (3) Check Sheet, Casey for G–4, 31 Mar 45. All three in SWPA File T20.

by representatives from other interested agencies to co-ordinate engineer planning for the support of a force now grown to over 600,000 men. It was still impossible to set definite figures for the amount of engineer supplies and the number or type of engineer troops needed because the basic concept was still fluid.[91] Casey and Sturgis, especially, had many problems to work out. A conference on 4 May was the first of many that month at which the engineers of AFPAC, USASOS, and Sixth Army met to co-ordinate their thinking on various aspects of OLYMPIC. Engineer troops would, as before, play important roles in combat support, but Casey and Sturgis now gave more thought to base development. At the three bases on Kyushu—one at Kagoshima, another at Shibushi, and a third at Miyazaki, on Kyushu's eastern coast about 35 miles north of Shibushi—construction was to be limited to the minimum essential operating facilities, but the minimum tended to grow. Finding answers for various problems and fitting them into the whole picture continued to keep Casey and Sturgis busy.[92]

Planning for OLYMPIC reached its final stages in June. AFWESPAC submitted estimates of the various types of equipment, materials, and supplies that would be needed for operations and the construction of the three bases. Preparations were made to order supplies and assemble them in the United States. On 14 June the War Department granted MacArthur's request for four additional engineer construction brigades. Frequent conferences were held, sometimes to discuss general problems, sometimes a specific subject, such as the number of bridges needed for roads and railroads, or how extensively prefabricated buildings should be used. A list of engineer troops was made, only to be replaced by another, which, in turn, gave way to a third. On 12 June MacArthur held a conference on construction planning, at which Casey and Sturgis brought up numerous matters for discussion. The conferees reached agreement on several points, such as standards of construction, the loading and shipping of construction materials, phasing of arrival of ships, facilities to be provided, and the number and kinds of engineer troops. It was conceded that very little local labor would be available.[93]

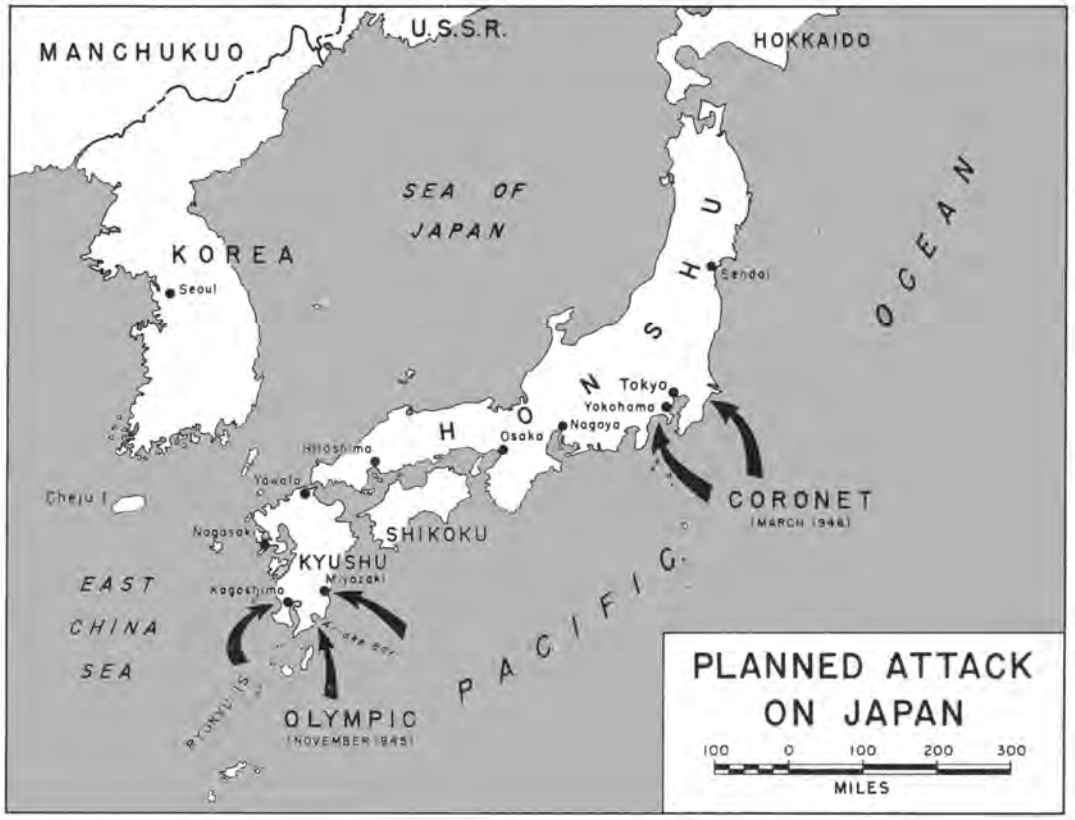
Assault Directives for OLYMPIC

On 20 June MacArthur issued Operations Instructions No. 1 for the OLYMPIC operation. In conjunction with the Pacific fleet, Sixth Army was to carry out the assault, using as its major components three Army corps—I, IX, and XI—together with the Marine V Amphibious Corps. The initial landings were to be made at Kushikino, Ariake Bay, and Miyazaki. (*Map 33*) The ground forces upon landing were to co-ordinate their operations and seize and occupy roughly one-third of Kyushu and establish bases there to support an attack on the "indus-

[91] Memo for Rcd, Whitlock, G–4 GHQ SWPA, sub: Questions and Answers at Conf on OLYMPIC Opn, 0930 hours, 10 Apr 45. SWPA File T19.

[92] Memo, Sturgis for Casey, 9 May 45. OLYMPIC Opn. Sturgis File 63.

[93] (1) Rad, MacArthur to TAG, 11 Jun 45. Sturgis File 63. (2) Memo for Rcd, Col John P. Buehler, C Opns Of C Engr GHQ SWPA, 13 Jun 45. SWPA File T19.



MAP 33

trial heart of Japan." AFWESPAC was to furnish all supplies for Army units mounted from the Philippines; Army Forces Middle Pacific was to supply units mounted from the central Pacific area.[94] AFWESPAC's Logistic Instructions No. 1 for the OLYMPIC operation provided for the organization of an army service command from AFWESPAC personnel who would be transferred to Sixth Army and moved to Kyushu as soon as possible. The date for the operation was set for 1 November 1945.

Estimates called for a sizable engineer force to support OLYMPIC. The engineers were to number 117,570 out of a total assault force of 549,503 men, or about 21.4 percent of the total. Amphibian engineers, including the 2d, 3d, and 4th Special Brigades, and combat engineers would total approximately 50,159 men out of 252,150, or 20 percent of the total combat troops. Service and Air Forces engineers would total 67,408 men out of 297,353, or 22.6 percent of the

[94] (1) USAFPOA was redesignated AFMIDPAC in July. (2) AFWESPAC Logistic Instructions No. 1 for the OLYMPIC Opn, 16 Jul 45. SWPA File T15. (3) Hq AFWESPAC, Engr Base Development Plan, 17 Jul 45. SWPA File T30.

total service troops. These figures were exclusive of the marines.[95]

As far as the engineers were concerned, the most important part of the plan for OLYMPIC pertained to construction of the three bases. Kushikino, to support 400,000 men, was to be the largest. Here the engineers were to build berths for ten Liberty ships, storage for 205,000 barrels of gasoline, 220 miles of roads, 7,500,000 square feet of storage, three hospitals with 13,250 beds, and two all-weather runways. The second largest base was to be at Shibushi, to support 185,000 men; it would have similar but less extensive facilities. The third and smallest base was to be at Miyazaki, to support 135,000 men.[96]

Additional Planning for Honshu

Meanwhile, work was continuing on the plans for the invasion of Honshu, which had received the code name CORONET. A major problem was revising engineer estimates to keep pace with the changing concepts of the operation. In late June plans called for making two landings on the Honshu coast east of Tokyo on Y-day, one by an army, the other by at least two corps. A landing would be made at Sagami Bay thirty days later. For the engineers these changes meant that estimates regarding port construction and reconstruction would have to be revised. An initial attack on the east coast would probably mean that Tokyo and Yokohama would be captured later—possibly not till ninety or more days after the first landing. This would mean that more extensive temporary port facilities would have to be built during the first days of the landing—two artificial harbors might even have to be constructed. With regard to the lines of communication, no great changes were anticipated. Probably only the phasing would have to be altered. The eastern highways and railroads would have to be rehabilitated first, but the effort required would probably not be so great initially because of the fewer roads and railroads east of Tokyo. A larger number of airfields would have to be built east of the capital, and construction problems there would probably be more complicated because of the many rice paddies. More storage would have to be provided in the eastern areas. The total engineer tonnages sent in would undoubtedly remain more or less the same, but the phasing of shipments would have to be radically changed. Three special brigades would take part in the CORONET operation.[97]

On 7 August Casey's planners finished a preliminary draft of the Engineer annex to the CORONET operations instructions. Though estimates were not finalized, an idea of the vast scope of the contemplated program may be derived from a partial enumeration of the planned facilities. Eleven all-weather runways were to be completed in 3 months; 171 lighter berths, seven floating Liberty berths, and 7,800,000 square

[95] (1) Memo for Rcd, Lt Col John H. Ericson, Opns Of C Engr GHQ SWPA, 31 July 45. SWPA File T20. (2) Check Sheet, Casey to G–4 GHQ SWPA, 28 May 45. SWPA File T19. (3) Of C Engr GHQ AFPAC, *Engrs of SWPA, IV*, 692–93.

[96] GHQ SWPA, Basic Plan for OLYMPIC Opn, an. 4, Basic Logistic Plan. SWPA File T18.

[97] Memo, Maj R. S. Kramer, Opns Of C Engr GHQ SWPA for Col Buehler, C Opns, 27 Jun 45. SWPA File T20.

feet of covered storage in 6 months; garrison camps for 500,000 men and hospitalization for 42,750 fixed beds in 5 months; plus camps for 475,000 replacements, POW's, and civilian internees, within an unspecified period. This construction would require 1,016,591 deadweight tons of supplies. The proportion of engineer troops required for the CORONET operation was roughly the same as that for OLYMPIC. Combat engineers, together with three ESB's, totaled 102,427 men out of 555,115 assault troops, or 18.5 percent of the total. Service and air force engineers totaled 133,769 out of 513,925, or 26.1 percent of the total. The over-all figures were 236,196 engineers out of 1,069,040 troops. Despite the extensive construction required, the underlying idea of CORONET differed from previous operations in the war against Japan. This was an operation to vanquish the enemy in the territory being invaded and was not designed to establish bases from which to conduct further operations.[98]

Planning for a Peaceful Occupation

Since late spring Allied leaders had felt there was a possibility of Japan's surrender or collapse before an invasion of the home islands took place. On 14 June the Joint Chiefs had directed MacArthur to prepare a plan for the peaceful occupation of the country. On 25 July MacArthur issued his Basic Outline for the BLACKLIST Operations to Occupy Japan Proper and Korea After Surrender or Collapse. Over-all planning for a peaceful occupation did not require a great deal of effort. It was based largely on the planning already prepared for the assault. Sixth Army would occupy roughly the western half of the Japanese homeland, including the islands of Kyushu and Shikoku and the western half of Honshu; Eighth Army would occupy eastern Honshu, Hokkaido, and the southern half of Sakhalin. Tenth Army was scheduled to occupy Korea. AFWESPAC and AFMIDPAC would provide the logistics.

For the engineers, BLACKLIST would not mean the immense amount of combat support or the construction effort that an armed assault would require, especially an assault against suicidal resistance. Construction would be limited. Existing facilities would be used as much as possible and local resources and labor employed to the maximum extent. On the whole, forces and projects were about the same as were being planned for the assault, but conditions for construction would be far easier.[99]

Meanwhile, the war was moving rapidly to an end. The Japanese position by the summer of 1945 was hopeless. On 6 August the first atomic bomb was dropped on Hiroshima. Two days later Russia declared war on Japan and began a rapid invasion of Manchuria. The next day a second atomic bomb was dropped, this time on Nagasaki. On 10 August the Japanese asked for peace. Five days later, fighting stopped. With the landing of American paratroops at

[98] (1) Draft Annex (Engr) for CORONET Opn. SWPA File T33. (2) Memo for Rcd, Ericson, 31 Jul 45. SWPA File T20.

[99] GHQ AFPAC, Basic Outline Plan for BLACKLIST Opns to Occupy Japan Proper and Korea After Surrender or Collapse. SWPA File T36.

Atsugi airfield on 30 August, the occupation of the Japanese home islands began and the BLACKLIST plan went in effect. Three days later, the official surrender ceremony took place aboard the battleship *Missouri* in Tokyo Bay.

Conclusion

The long war against Japan was over. In few conflicts had military engineers played so important a role as in this one. Engineers of the United States Army had been active in an immense area. From the barren reaches of Alaska to the deserts of Australia, from remote islands of the South Pacific to China and India, they had furnished the engineer combat and logistic support necessary for victory. Thousands of miles from the United States, they had worked and fought in regions consisting for the most part of deserts, jungles, coral atolls, subarctic wastes, and isolated areas cut off from the outside world by lofty mountain chains. They had been an integral and vital part of a complex and far-flung organization.

The story of the engineers in World War II is one of greatly expanded activities and unprecedented growth. In 1939 the Corps had 12 units, 10 of them combat, 2 of them topographic. By mid-1940 the number of units had risen to 25, of which 18 were combat. By the time Japan surrendered, there were, in the Pacific alone, 700 units, totaling 235,764 men in an army of 1,458,911. Many of the new organizations were highly specialized and responsible for missions which new technological developments had made necessary. Alongside the traditional combat battalions and general service regiments were such units as special shop battalions, pipeline operating detachments, model-making detachments, foundry teams, photomapping teams, technical intelligence teams, dredge crews, and port construction and repair groups. But even with the great expansion in personnel and the multiplication of specialized units, there were never enough engineer troops. To do the great amount of work for which they were responsible, the engineers wherever possible used civilians as well as troops. Within the United States and its possessions they engaged contractors and recruited workmen. Overseas, foreign governments employed local contractors and furnished workmen to do the building for the U.S. Army behind the front lines, while the engineers furnished the technical supervision. In some areas natives, scarcely out of the stone age and little acquainted with modern civilization, helped build the facilities the Army needed.

The absence of modern industry in much of the world where the war with Japan was fought, the vast extent of the theaters of operations, and the lack of long-range planning for a struggle in numerous overseas theaters greatly complicated the most important of all engineer tasks—construction. One of the most exasperating problems, particularly in the Southwest Pacific, was the shortage of building materials, a shortage arising from the inadequacy of such supplies in the United States, the shortage of shipping to overseas theaters, and the inadequate amounts of materials in the overseas theaters themselves. In an attempt to make up for deficiencies in the many theaters, the engineers had to use

materials locally available and resort extensively to improvising. Designs were simplified, and flimsier, though still adequate, types of construction were used. More efficient designs were developed for many kinds of installations—runways were not crossed but built in parallel, more suitable oil pumping machinery and pipelines were devised for the combat zones, and, to a greater extent, prefabricated buildings were used. Local materials, some of them little known before the war, were utilized to the greatest extent possible. Coral was a godsend on the islands of the Pacific and native-type thatched roof huts served many a useful purpose. In their battle to furnish the facilities the Army needed not the least of the Engineer tasks was to curb unnecessary and sometimes extravagant construction, which various elements of the Army, for one reason or another, insisted on having.

Of great importance was obtaining the co-operation of other organizations to accomplish the Engineer mission. In the Pacific Ocean Area, for example, a continuing problem was the co-ordination of Army engineer and Navy construction activities, a co-ordination, on the whole, successfully accomplished. Highly important, too, was winning the co-operation of the engineers of the Allied armies, a feat achieved with varying degrees of success. It was easiest to secure by far with the armed forces of the members of the British Commonwealth; more difficult, if the national backgrounds were quite different from the American. Of equally great importance was making the best possible use of the available civilian forces—particularly in rear areas, as, for example, Australia, India, and Burma. This was sometimes a complex matter, calling for a good deal of ingenuity and a better than average understanding of the national background and character. Even with the great technological advances, men were still important; the success of the war effort depended on the co-operation of many millions.

The war was not fought without certain shortcomings, notably in organization, becoming manifest. A continual handicap was the shortage of units, especially in the combat areas, where civilians, even if available, could not be employed to bolster the work force. Shortages of troops existed everywhere, except on the Alcan Highway and possibly in the Hawaiian Islands, during the first two years of the conflict. They were particularly severe in the China-Burma-India theater and in the Southwest Pacific, where a number of engineers cited the continual shortage of troops as their greatest problem. Equally difficult was the getting of individual replacements to bring up to strength the depleted units in the overseas theaters. It was even harder to secure qualified, well-trained replacements. The big cry was for great numbers of well-qualified men and units—a goal difficult, if not impossible, of achievement in modern war.

Since the war against Japan was fought over a much larger area than had been anticipated and in regions where so much unexpected engineer work had to be done, it is hardly surprising that a "balanced" engineer force was seldom attained. There were sometimes too many units of one type and more often not enough of another; on the whole,

there were more than enough combat and camouflage units but far too few construction and supply units. This being the case, units were put on construction and supply jobs, even though not trained for or experienced in such work—this was especially true in the South and Southwest Pacific. A makeshift arrangement, it was the best one possible under the conditions, but did not make for efficient operations.

In a war of rapid movement over great expanses, particularly the kind being fought in the Southwest Pacific from Australia to the Philippines, various problems in organization arose, one of the most important being to achieve flexibility of organization. To provide such flexibility the group type of organization—exemplified by construction brigades, construction groups, and combat groups—was developed and used to an ever greater extent. Each type of group had a headquarters to which units were assigned for a particular task; upon completion of the task some units were transferred out and others were assigned for the next, and somewhat different, task. Such relatively large, stable, and unwieldy units as the general service regiments were not well suited for a war of movement on an extensive scale. In addition to the fluid group type of organization, which could be adapted to the work at hand, the Southwest Pacific made use of the army service commands designed to begin extensive construction and logistical support in the forward areas at any early date; here again service units were assigned to a large and flexible organization for work in a combat zone in accordance with needs.

A matter of continuing controversy in theaters where a great variety of work had to be done was how best to assign engineer units to the various commands; the problem was particularly difficult with regard to the aviation engineer battalions, considered theoretically a component part of the Army Air Forces. Engaged in vital construction as the aviation battalions were, it was sometimes debatable whether they should be assigned to the Air Forces exclusively or to other commands as needed, particularly the Services of Supply. The basic policy, on the whole, was that under emergency conditions, where there was much work with few troops to do it, all engineer units should be utilized and assigned as the theater commander thought best, regardless of the regulations automatically assigning certain types of units to certain commands. Another problem was whether to put engineer construction and supply activities in the field under base commanders and have the engineers exercise only technical supervision or whether to set up a separate engineer construction command as was done in the Southwest Pacific and in part of the China-Burma-India theater. Here a comparison of results appeared to be inconclusive. Having engineer construction and supply in the field carried on under the direction of base commanders seemed to be a satisfactory arrangement, provided such commanders had a broad understanding of their mission and gave adequate support to the construction effort. While a separate engineer command would assure adequate support to construction, it was sometimes difficult to co-ordinate the responsibilities of such a command with those of the base sections and combat elements.

A serious deficiency was the shortage of supplies and supply units. Even more serious was the lack of spare parts, especially for the hard-worked equipment. In the overseas theaters, a serious weakness was the lack of adequate distributing systems for supplies and spare parts, most keenly felt in the Southwest Pacific, where exceptionally large quantities were needed. Much time was lost within theaters in shipping and transshipping stocks. Enormous distances and changing tactical situations militated against setting up an efficient distribution system. Effective, theaterwide stock control was lacking almost everywhere, so that it was difficult to make really efficient use of even the little that was on hand. Two of the greatest needs were, first, personnel well trained in the stocking and distribution of supplies and spare parts, and second, a much larger number of well-stocked and well-managed supply and spare parts depots. A critical situation was made worse by the fact that many Engineer officers were indifferent to supply and seemingly not fully aware of its importance. Of all the problems facing the engineers, those of supply were probably the most serious.

As the war progressed, the inadequate training and insufficient engineering background of many officers and enlisted men, particularly those who entered the Army after Pearl Harbor, came more and more to the fore. Many officers did not have an adequate engineering background to prepare plans for construction, to devise proper methods for undertaking a project, or to supervise the work itself. Enlisted men were poorly trained with regard to many aspects of construction; most glaring, perhaps, was the deficient training in the operation of machinery. The officers themselves, all too often inexperienced in such matters, could not instruct the men of their own units in how a job should be done. Training for combat, generally, had been sound, but in the war in the Pacific, combat support, unexpectedly, did not have the overriding importance it had had in previous conflicts on which planning had been so largely based. Direct combat support had been the engineers' traditional wartime mission; many engineer officers preferred it to other tasks, which partly explains their failure to appreciate the importance of the engineer "service" functions behind the combat zones.

All of these shortcomings might have had more serious consequences had the Japanese not been plagued by far greater deficiencies. Japan had gone to war with only a small part of its military forces assigned to the war against the United States and the British Commonwealth. Of the Japanese Army's 51 divisions, 59 mixed brigades, and 1,500 first-line planes in December 1941, *Imperial General Headquarters* could spare only 11 divisions and 700 planes for operations in the Pacific.[100] Large forces had to be maintained in China to hold the Chinese in check and sizable forces kept in Manchukuo and the home islands as a precaution against a possible Russian attack.

More serious than Japan's shortage of troops was her scant industrial potential. In terms of population, Japan may have ranked as a great power, but in industrial

[100] Kent Roberts Greenfield, ed., *Command Decisions* (Washington, 1960), p. 74.

capacity she was roughly the equal of Belgium. The plan of the Japanese leaders was to wage a limited war. They did not propose to invade the American mainland or even the Hawaiian Islands. It was their intention to destroy the U.S. Fleet at Pearl Harbor, defeat the Allied forces in the western Pacific, get control of the islands there, and transform them into powerful defensive barriers. The Japanese hoped the Allies would not be able to break through the barriers, even after long and bitter fighting. A compromise peace would result. This might have been the course of the war had it not been for the overwhelming technological superiority of the United States, a superiority that became more marked as the conflict continued. The battleship, the aircraft carrier, the airplane, and the bulldozer made Japan's defeat inevitable. Innumerable engineer after action reports stated that the terrain was more of an obstacle than the enemy. From the engineer standpoint, the war was as much a conquest of geography as of the Japanese.

Despite deficiencies, which were more or less unavoidable, the Engineer mission was successfully accomplished. The amount of work done was tremendous. That so much was done was in no small measure due to the courage and skill of all ranks. Morale was generally high; as in the rest of the Army, there was an overriding determination to defeat Japan. Officers and men alike worked long hours, made the best use of the resources at hand, and adapted themselves to new ways of doing things. Once the tide of war had turned at the Battle of Midway in 1942, there was scarcely any doubt as to the outcome of the conflict.

Appendix A

U.S. Army and Army Engineer Personnel Strength in Overseas Theaters 1 January 1942–1 October 1945 [a]

Year and Month	Panama–Alaska–Western Canada	Central Pacific	South Pacific	Southwest Pacific	China–Burma–India
1942 January	62,422	50,708	[b] 0	[c] 4,600	0
	2,988	2,856	0	0	0
April	85,151	71,029	22,961	31,647	100
	7,194	4,805	2,466	3,319	0
July	118,192	111,437	52,455	88,313	7,474
	19,433	5,779	2,745	7,728	14
October	150,491	135,810	65,081	104,113	13,361
	22,309	6,744	3,475	7,684	1,986
1943 January	175,852	131,157	109,979	106,663	16,988
	26,767	7,165	8,770	7,549	1,996
April	184,238	128,441	125,960	135,108	29,026
	25,640	8,550	11,745	18,515	3,546
July	199,987	146,305	145,443	176,254	33,406
	25,719	10,203	13,434	23,909	3,541
October	196,038	171,319	162,323	239,525	60,246
	19,802	11,298	13,815	31,153	8,669
1944 January	188,581	197,404	192,302	307,141	94,560
	18,085	16,286	15,261	42,285	15,817
April	150,346	227,877	244,769	390,535	134,493
	16,662	20,448	19,527	61,167	19,249
July	120,798	255,931	132,617	627,640	138,407
	14,745	29,811	10,908	95,336	22,824
October	108,232	[d] 412,618		689,804	149,014
	10,949	[d] 46,714		99,556	24,153
1945 January	94,424	[d] 408,085		744,373	180,405
	6,521	[d] 49,966		104,130	29,955
April	77,999	[d] 433,370		787,439	197,409
	5,122	[d] 55,353		108,554	30,015
July	73,427	[d] 461,900		866,214	194,558
	5,520	[d] 63,137		115,642	29,249
October	70,767	[e] 1,552,303			181,338
	4,442	[e] 253,421			27,047

[a] The top figure for each month indicates over-all Army strength; the lower figure, Engineer strength. Figures are for the first of the month.

[b] Theaters for which the figure 0 is given may have had some U.S. Army and Engineer personnel, but if so, the number was too small to appear on War Department statistical tables.

[c] Personnel strengths of the U.S. Army and the Engineers in the Philippines on 1 January and 1 April 1942 are not included in the Southwest Pacific figures.

[d] Combined figures for Central Pacific and South Pacific Theaters.

[e] Combined figures for Central Pacific, South Pacific, and Southwest Pacific Theaters.

Appendix B

Types of Engineer Units and Their Functions

Airborne Aviation Battalion

29 officers, 501 enlisted men.[1] Equipped with light machinery, this unit prepared captured airdromes, usually located behind enemy lines, for early use by Army Air Forces. It was sometimes flown in to clear landing strips when regular aviation battalions, because of their heavy equipment, could not be used.

Aviation Battalion

33 officers, 744 enlisted men. The basic engineer construction unit of the Army Air Forces. It was completely equipped to construct an airfield and all its appurtenances. It might also be called upon to camouflage, maintain, and defend airfields.

Aviation Company, Separate

5 officers, 171 enlisted men. Similar in organization to a company of a combat battalion, but with more machinery for runway construction.

Aviation Regiment

66 officers, 1 warrant officer, 2,160 enlisted men. This large unit was organized, trained, and equipped in the early days of the defense build-up. It constructed, repaired, maintained, camouflaged, and defended airfields wherever such work was concentrated in a small area. The battalions of the regiment were the same as regular aviation battalions.

Headquarters and Headquarters Company, Base Depot Group

11 officers, 2 warrant officers, 62 enlisted men. Provided the overhead needed to supervise the operations of an engineer base depot group. Normally such a group was at or near a port of debarkation. The headquarters and headquarters company with its attached troops operated either the engineer section of a general base depot or an engineer base depot. One or more of the following units were attached: base depot company, heavy shop company, base equipment company, parts supply platoon or company, gas generating unit, quartermaster truck company.

Base Equipment Company

5 officers, 168 enlisted men. This unit, usually located at or near an engi-

[1] Since most engineer units underwent reorganization during the war, the strength figures for officers and enlisted men are approximate and are, as a rule, those in effect in the closing months of the war. Information is based on data contained in Engineer Field Manuals FM 5–5, 31 January 1941 and 11 October 1943, with changes; Office of the Chief Engineer, GHQ SWPA, Engineer Estimating Data, 1 June 1945; and TOE's published during World War II.

neer depot, made various types of heavy construction equipment available to engineer units on a loan basis. Skilled operators were sometimes sent with the equipment.

Camouflage Company, Separate

5 officers, 62 enlisted men. Usually assigned to a task force or independent corps, supervised and inspected camouflage work, discipline, and training; experimented with new camouflage methods; and helped troops camouflage their areas.

Combat Battalion

29 officers, 3 warrant officers, 605 enlisted men. This was the Engineer component of the triangular infantry division. It increased the division's combat effectiveness by means of general engineer work, including construction of roads and bridges, the clearing of mines, and the destruction of obstacles. The unit thereby helped make it possible for the infantry to advance, and by laying mines, erecting obstacles, and using demolitions helped the infantry thwart an enemy attack.

Combat Company, Separate

4 officers, 176 enlisted men. Usually employed in improving routes of communication. The amount of work the company could do with its men and tools alone was relatively small.

Headquarters and Headquarters Company, Combat Group

15 officers, 69 enlisted men. The primary mission of this unit was to supervise the operations of corps and army combat engineer troops. The composition of the group was determined by the engineer mission and the units and facilities available.

Combat Regiment

39 officers, 1 warrant officer, 908 enlisted men. The Engineer component of the square infantry division, the combat regiment performed the same engineer work for the square division that the combat battalion performed for the triangular division.

Construction Battalion

29 officers, 2 warrant officers, 869 enlisted men. Organized in 1943, this unit, capable of operating independently or as part of a group, was the equal of an aviation battalion in earth-moving capacity and of a Navy construction battalion in equipment and grades for skilled personnel. It had more heavy equipment and higher grades for its skilled personnel than a general service regiment.

Headquarters and Headquarters Company, Construction Group

13 officers, 1 warrant officer, 80 enlisted men. Organized to supervise the operations of from three to six construction battalions.

Depot Company

7 officers, 202 enlisted men. Its primary mission was the operation of an engineer depot or other engineer supply point in a theater of operations. It

sometimes was a part of a large special engineer depot or the engineer section of a general depot; sometimes it operated as a separate engineer supply unit.

Dredge Crew

Varying from 5 officers, 4 warrant officers, 47 enlisted men to 6 officers, 4 warrant officers, 57 enlisted men, this unit dredged rivers, harbors, and channels.

Dump Truck Company

4 officers, 103 enlisted men. Its principal mission was to assist other engineer units by furnishing transportation for the movement of heavy materials. This unit was usually attached to engineer units engaged in road and railroad construction involving earth moving, clearing, grading, and paving.

Engineer Squadron

14 officers, 441 enlisted men. This unit, the Engineer component of the cavalry division, did work comparable to that performed by the combat battalion for the infantry division.

Headquarters and Headquarters Company, Forestry Battalion

8 officers, 2 warrant officers, 82 enlisted men. The headquarters and headquarters company supervised 3 or more forestry companies (each with 5 officers and 150 enlisted men) whose job it was to supply lumber and other forest products from woodlands in or near a theater of operations. The companies either set up and operated the sawmills with which they were equipped or they used sawmills already in the area.

Foundry Team

1 officer, 16 enlisted men. This team was capable of producing molten metal in the following quantities:

Cast iron—about 108 lbs. per hour
Steel—about 100 lbs. per hour
Bronze—about 132 lbs. per hour

A team was normally assigned to a heavy shop company.

General Service Regiment

39 officers, 11 warrant officers, 1,221 enlisted men. Performed general engineer work—especially that requiring a fair amount of skilled labor—throughout the army service area and communications zone of a theater of operations. A general service regiment, with its large headquarters organization, large number of specialists, and special equipment, plus the fact that it remained a longer time in an area, could undertake extensive and permanent work. General service regiments could be reinforced with other engineer units.

Heavy Ponton Battalion

12 officers, 462 enlisted men. Transported and maintained four units of heavy ponton equipage, 25-ton M1940, with which it constructed bridges and rafts, sometimes with the assistance of other engineer troops. In an extensive river crossing operation, the battalion was attached to a corps to provide a bridge capable of supporting heavier loads.

Heavy Shop Company

6 officers, 165 enlisted men. A semimobile unit, the heavy shop company performed fourth echelon maintenance on all equipment for which the Corps of Engineers had maintenance responsibility. Fourth echelon maintenance included rebuilding a unit's equipment, overhauling the attachments and accessories, doing emergency overhaul of major units, and recovering equipment from the battlefield, reclaiming, and salvaging it.

Light Equipment Company

4 officers, 114 enlisted men. Furnished supplementary equipment with operators to engineer combat battalions and operated as a replacement pool for construction equipment. Light equipment companies were attached to corps or army.

Light Ponton Company

6 officers, 215 enlisted men. Organized and trained to maintain its stream-crossing equipage, to construct floating bridges and rafts, to guard and maintain completed bridges, to regulate traffic thereon, and to dismantle bridges and rafts.

Maintenance Company

6 officers, 185 enlisted men. A mobile unit, the maintenance company had as its primary mission third echelon maintenance of all equipment, including that used by other arms and services, for which the Corps of Engineers had maintenance responsibility. Third echelon maintenance included the making of minor repairs on a unit's equipment.

Map Depot Detachment

1 officer, 11 enlisted men. Received, stored, and issued maps. This unit was adequate to provide map depot facilities for one base section.

Model Making Detachment

1 officer, 18 enlisted men. Constructed scale models of terrain to assist air and ground forces in planning. Normal attachment was to a topographic unit since photo processes were used in model making. The unit was assigned as directed by the commander of the theater of operations.

Parts Supply Company

6 officers, 168 enlisted men. Established and operated an engineer spare parts supply depot and other spare parts supply agencies. This company was a nonmobile unit which operated as part of the engineer depot organization of a base installation. It could not operate as a separate supply unit unless it was furnished with motor transportation.

Petroleum Distribution Company

7 officers, 209 enlisted men. The primary mission of this unit was to design, construct, operate, and maintain military pipeline systems for transporting, distributing, and storing gasoline in a theater of operations.

Pipeline Operating Detachment

1 officer, 24 enlisted men. Organized and equipped to operate a bulk petroleum terminal consisting of 50,000 barrels of tankage with the necessary tanker unloading facilities and a three-pump station pipeline system.

Photomapping Team

2 officers, 78 enlisted men. This team was equipped to perform original topographic mapping from aerial photographs. It was normally attached to a topographic unit having planning, computing, and reproduction facilities; it was sometimes used to increase the capacity of a base topographic battalion.

Headquarters and Headquarters Company, Port Construction and Repair Group

17 officers, 255 enlisted men. This unit, with its attached units, made ready for use the facilities of ports of debarkation in a theater of operations, and performed work required for the improvement or expansion of such ports, exclusive of harbors.

Railway Operating Battalion

18 officers, 803 enlisted men. Operated trains and yards of a railway division, maintained tracks and structures, and repaired equipment. A battalion might also be assigned the operation and maintenance of a large railway terminal or regulating station. Railway battalions were transferred to the newly organized Transportation Corps in November 1942.

Railway Shop Battalion

20 officers, 642 enlisted men. Handled heavy shop work for several railway operating battalions. These units were transferred to the newly organized Transportation Corps in November 1942.

Separate (Labor) Battalion

22 officers, 1,197 enlisted men. Usually assigned to armies or to GHQ, the separate battalion performed general engineer work throughout a theater of operations. It was frequently attached to reinforce other engineer units in whole or in part.

Technical Intelligence Team, Combat Technical Intelligence Team, Research

1 officer, 3 enlisted men; 3 officers, 6 enlisted men. Both kinds of teams operated in a theater of operations. The combat team furnished technical intelligence information for use in the theater; the research team sent information to the zone of interior for further study.

Topographic Battalion, Army

19 officers, 3 warrant officers, 404 enlisted men. This unit had the mission of furnishing adequate map information for tactical and strategical requirements for an army and established and extended horizontal and vertical control for army and corps requirements. It was the organization trained and equipped to prepare and reproduce photomaps, maps of limited areas, over-

lays, and sketches, and to revise and reproduce existing maps.

Topographic Company, Corps

5 officers, 113 enlisted men. Reproduced maps in quantity in forward areas, distributed them to corps troops and to divisions, and established and extended the ground control required for coordination of field artillery fire. When aerial photographs were made available, corps topographic companies used them to prepare photomaps and to revise existing maps. Initial requirements of the corps were met by the corps topographic company, which rapidly prepared and supplied map information, particularly the hasty type of map substitute.

Topographic Battalion, GHQ

29 officers, 767 enlisted men. Its primary mission was the reproduction at the outbreak of hostilities of existing maps of the theater of operations and of such maps, sketches, and drawings of permanent character as might be needed thereafter. Its reproduction functions approached those of a permanent establishment and its equipment was relatively heavy and immobile. It prepared maps by photogrammetrical methods as the situation required. It sometimes reinforced army topographic battalions.

Topographic Company, Aviation

8 officers, 141 enlisted men. Revised, prepared, and reproduced maps, aeronautical charts, navigation charts, target charts, and mosaics for the Army Air Forces.

Treadway Bridge Company

4 officers, 134 enlisted men. Transported, maintained, and constructed bridges with its steel treadway equipage, guarded, maintained, and regulated traffic thereon, and dismantled completed bridges.

Headquarters and Headquarters Company, Water Supply Battalion

10 officers, 2 warrant officers, 112 enlisted men. A headquarters and headquarters company supervised several water supply companies (each with 4 officers and 116 enlisted men), whose principal mission was the procurement, purification, and distribution of potable water to troops in areas where the local supply was inadequate. It might also be charged with the repair of water plants and with developing water supply sources. A water supply company could operate alone or as part of a battalion.

Bibliographical Note

Documentary Sources

The unpublished documentary sources cited in the text, and on which this account of the Engineers in the war against Japan is largely based, are located for the most part in various offices and records depositories of the Department of the Army. The following is a brief description of the sources cited:

1. SWPA Files, located in the Engineer Historical Division, include selected files from the Office of the Chief Engineer, Southwest Pacific Area and Army Forces, Pacific (SWPA and AFPAC), 1942–46, together with letters, memorandums, reports, and comments which Engineer officers who served in the war against Japan sent to the Staff Branch, Office of the Chief Engineer, GHQ, AFPAC and FEC in connection with the writing of the series, *Engineers of the Southwest Pacific*. Most SWPA files have a number; the Historical Division has a list of the numbers with the corresponding titles of the files.

2. The Casey Files, located in the Engineer Historical Division, comprise nine volumes numbered 1 through 9. Numbers 1 through 8 are files of the Office of the Engineer, USAFFE, 1941–42, which survived the Japanese conquest. File No. 9 contains material on the Philippines compiled after the fall of the islands. The titles are:

No. 1, General Casey's Notes, 26 January–28 February 1942.

No. 2, Construction—General, August–December 1941.

No. 3, Landing Fields, 1941–42.

No. 4, Operations, 1941–42.

No. 5, no title; papers pertain mainly to civilians engaged in Engineer operations.

No. 6, Journal File, 1942.

No. 7, Construction, December 1941–March 1942.

No. 8, Philippine Defense, December 1941–January 1942.

No. 9, no title; contains information on the construction of airfields in the Philippines before the outbreak of war.

3. The Sturgis Files, in approximately 100 folders, at present in the custody of the Engineer Historical Division, contain personal correspondence and papers of General Sturgis pertaining to Engineer operations of Sixth Army from 1943 to 1946. The Engineer Historical Division has an index to these files.

4. Engineer Historical Division (EHD) files contain documents and photostatic copies of documents pertaining to Engineer activities in the continental United States and overseas before and during World War II. Also included are letters from and notes of interviews with Engineer officers who participated in Engineer operations during World War II.

5. Canal Zone Files, pertaining to Engineer operations in the Caribbean Defense Command and the Panama Canal Department before and during

World War II, were received from Headquarters, U.S. Army, Caribbean, Fort Amador, Canal Zone, and are at present in the custody of the Engineer Historical Division.

6. Alcan Files include original reports, letters, and various papers or photostatic copies thereof pertaining to the construction of the Alcan Highway, obtained, for the most part, from the Office of the Chief of Engineers. These files are at present in the Engineer Historical Division.

7. Canol Files include original reports, letters, and various papers or photostatic copies thereof pertaining to the construction of Canol, obtained, for the most part, from the Office of the Chief of Engineers. These files are at present in the Engineer Historical Division.

8. The National Archives and Records Service is the depository for unit histories, after action reports of units which served overseas, files of Engineer offices in the United States and the outlying territories, Army Air Forces Central Files, files of the War Plans Division and the Operations Division, G–4, files, files of the Alaska Defense Command, and some files of the China-Burma-India theater (CBI). Material containing file designations but for which no depository is given is located in National Archives Records Service.

9. The Federal Records Center, General Services Administration, Kansas City, Missouri, contains retired files from all types of Engineer offices and units which served overseas and in the United States in World War II. Included are files of the Engineer, Army Ground Forces, Pacific, consisting of the files of the Engineer offices in the Hawaiian Islands, Engineer files of the Southwest Pacific Area which are not in the custody of the Engineer Historical Division, files of G–3, GHQ, SWPA, Engineer files of the South Pacific Area, Engineer files of the Caribbean Defense Command and of Panama and the surrounding areas, and files of the CBI.

10. The U.S. Air Force Historical Division, Maxwell Air Force Base, Alabama, has custody of Army Air Force Unit Historical Reports for the war period.

11. The Office, Chief of Military History, Washington, D.C., has a number of documents and narratives in manuscript form pertaining to Engineer operations overseas during World War II.

12. The Hawaii War Records Depository, University of Hawaii, Honolulu, contains a few documents not found elsewhere pertaining to activities of the Corps of Engineers in Hawaii during World War II.

Published Works

A number of published works which shed light on Engineer operations, particularly their interconnection with other Army and other service activities, have been used in the preparation of this volume. Listed here are those of a special value, but this list is by no means all-inclusive.

1. UNITED STATES ARMY IN WORLD WAR II—various volumes of this series (some of them in manuscript form) dealing with the War Department, the defense of the Western Hemisphere, the war in the Pacific, and the China-Burma-India theater, have been extensively used to furnish background mate-

rial and explanations for Engineer activities. A list of the published volumes in the series can be found on pages 702–04.

2. Bureau of Yards and Docks, *Building the Navy's Bases in World War II* (Washington, 1947). Two volumes.

3. Craven, Wesley Frank, and James Lea Cate (eds.), "The Army Air Forces In World War II," vol. 1, *Plans and Early Operations: January 1939 to August 1942* (Chicago: The University of Chicago Press, 1948); vol. IV, *The Pacific: Guadalcanal to Saipan, August 1942 to July 1944* (Chicago: The University of Chicago Press, 1950); and vol. V, *The Pacific: Matterhorn to Nagasaki, June 1944 to August 1945* (Chicago: The University of Chicago Press, 1953).

4. Office of the Chief Engineer, General Headquarters, Army Forces Pacific, *Engineers of the Southwest Pacific,* 8 vols. Vol. 1, *Engineers in Theater Operations* (Washington, 1947); vol. II, *Organizations, Troops and Training* (Washington, 1953); vol. III; *Engineer Intelligence,* (Washington, 1950), vol. IV; *Amphibian Engineer Operations* (Washington, 1959); vol. VI, *Airfield and Base Development* (Washington, 1951), vol. VII, *Engineer Supply* (Washington, 1949); vol. VIII, *Critique* (Washington, 1951). Vol. V, Engineer Combat Operations, is in preparation.

Various publications of the Congress of the United States dealing with legislation pertaining to or investigations of the National Defense Program contain information on the Engineer effort during the defense build-up and war periods. Among them are:

1. Subcommittee of the House Committee on Appropriations, *Hearings, Military Establishment Appropriation Bill for 1940 and War Department Civil Functions Appropriation Bill, 1940,* 76th Congress, 1st session, and subsequent hearings on appropriation bills.

2. Senate, Special Committee Investigating the National Defense Program, *Hearings, Investigation of the National Defense Program,* 77th and 78th Congress.

3. Joint Committee on the Investigation of the Pearl Harbor Attack, *Hearings, Pearl Harbor Attack,* 79th Congress, 1st and 2d sessions (Washington, 1946).

A number of personal reminiscences and general accounts of the war against Japan or various phases thereof contain information on Engineer operations or provide background material for a better understanding of the Engineer story. Among them are:

1. Allen, Gwenfread, *Hawaii's War Years* (Honolulu: University of Hawaii Press, 1950).

2. Bowman, Waldo G. *et al., Bulldozers Come First* (New York: McGraw-Hill Book Company, 1946).

3. Brereton, Lewis H., *The Brereton Diaries* (New York: William Morrow Company, 1946).

4. Chennault, Claire L., *Way of a Fighter* (New York: G. P. Putnam's Sons, 1949).

5. Eichelberger, Robert L., *Our Jungle Road to Tokyo* (New York: The Viking Press, 1950).

6. Heavey, William F., *Down Ramp! The Story of the Army Amphibian Engineers* (Washington: Infantry Journal Press, 1947).

7. Kenney, George C., *General Kenney Reports: A Personal History of the*

Pacific War (New York: Duell, Sloan and Pearce, 1949).

8. Krueger, Walter, *From Down Under to Nippon: The Story of Sixth Army in World War II* (Washington: Combat Forces Press, 1953).

9. Marshall, S. L. A., *Island Victory* (Washington: Infantry Journal Press, 1944).

10. Morison, Samuel Eliot, "History of United States Naval Operations in World War II," nine volumes dealing with the war in the Pacific (Boston: Little, Brown and Company, 1948–60).

11. Smith, Holland M., *Coral and Brass* (New York: Charles Scribner's Sons, 1949).

12. Stilwell, Joseph W., *The Stilwell Papers* (New York: William Sloane Associates, 1948).

13. Wainwright, Jonathan M., *General Wainwright's Story* (New York: Doubleday and Company, Inc., 1946).

List of Abbreviations

AAF	Army Air Forces
ABDA	American, British, Dutch, Australian
AC	Air Corps
ACofEngrs	Assistant Chief of Engineers
ACofS	Assistant Chief of Staff
ADC	Alaska Defense Command
Adj	Adjutant
Admin	Administrative
Adv	Advance
AF	Air Force
AFB	Air Force base
AFMIDPAC	Army Forces, Middle Pacific
AFPAC	Army Forces, Pacific
AFWESPAC	Army Forces, Western Pacific
AG	Adjutant General
AGF	Army Ground Forces
AGO	Adjutant General's Office
AIF	Australian Imperial Forces
ALF	Allied Land Forces
AMF	Australian Military Forces
AMMISCA	American Military Mission to China
Amphib	Amphibious
AMS	Army Map Service
ANMB	Army and Navy Munitions Board
an.	Annex
APA	Transport, attack
Appns	Appropriations
AreaO	Area officer
Arty	Artillery
ASF	Army Service Forces
ATC	Air Transport Command
ATIS	Allied Translator and Interpreter Service
Aust	Australian
AUS	Army of the United States
AVG	American Volunteer Group
Avn	Aviation
AWC	Allied Works Council
AWS	Aircraft Warning Service
Bd	Board
BLT	Battalion landing team
Br	Branch
C	Chief

CA	Coast Artillery
CAA	Civil Aeronautics Authority
CBI	China-Burma-India
CCC	Civilian Conservation Corps
CDC	Caribbean Defense Command
CE	Corps of Engineers
CG	Commanding general
Chmn	Chairman
Cmte	Committee
CNO	Chief of Naval Operations
CO	Commanding officer
Co	Company
CofAC	Chief of Air Corps
CofEngrs	Chief of Engineers
CofS	Chief of Staff
Com	Communications
Comd	Command
Comdr	Commander
COMINCH	Commander in Chief, U.S. Fleet
CONCOR	Construction Corps of the Philippines
Conf	Conference
Cong	Congress
Constr	Construction
Corresp	Correspondence
COSC	Combined Operational Service Command
CPA	Central Pacific Area
CPBC	Central Pacific Base Command
CPFF	Cost-plus-a-fixed-fee
CQM	Constructing quartermaster
DCofAS	Deputy Chief of Air Staff
DCofS	Deputy Chief of Staff
Dep	Deputy
Dept	Department
DF	Disposition form
Dir	Director
Dist	District
Distr	Distribution
Div	Division
Dukw	2½-ton 6x6 amphibian truck
EBSR	Engineer boat and shore regiment
Ech	Echelon
EHD	Engineer Historical Division
EinC	Engineer in charge
EM	Enlisted men
ENCOM	Engineer Construction Command
Engr	Engineer
ESB	Engineer special brigade

ExecO	Executive officer
FEAF	Far East Air Force
FEC	Far East Command
FO	Field orders
FWA	Federal Works Agency
FY	Fiscal year
G–1	Personnel section of divisional or higher staff
G–2	Intelligence section of divisional or higher staff
G–3	Operations section of divisional or higher staff
G–4	Supply section of divisional or higher staff
GENED	General Engineer District
GHQ	General headquarters
GO	General orders
GS	General Service
H	House
HD	Hawaiian Department
Hist	Historical; history
Hq	Headquarters
HR	House of Representatives
IB	India-Burma
IBT	India-Burma Theater
IG	Inspector General
IGD	Inspector General's Department
Incl	Inclosure
Ind	Indorsement
Inspec	Inspection
Instal	Installation
INTERSEC	Intermediate Section
Interv	Interview
Intl	International
J–1	Personnel Section of Joint Army-Navy Staff
J–2	Intelligence Section of Joint Army-Navy Staff
J–3	Operations Section of Joint Army-Navy Staff
J–4	Supply Section of Joint Army-Navy Staff
JB	Joint Board
JCS	Joint Chiefs of Staff
Jnl	Journal
KCRC	Kansas City Records Center
LCI	Landing craft, infantry
LCM	Landing craft, mechanized
LCT	Landing craft, tank
LCVP	Landing craft, vehicle, personnel
Legis	Legislative
LHQ	Allied Land Headquarters
LST	Landing ship, tank
LUZED	Luzon Engineer District
Maint	Maintenance

MID	Military Intelligence Division
Mil	Military
Min	Minutes
Mtg	Meeting
n.d.	No date
NGF	New Guinea Force
NLF	North Luzon Force
NPD	North Pacific Division
OCAAF	Office of the Chief of the Army Air Forces
OCE	Office of the Chief of Engineers
OCG	Office of the commanding general
Of	Office
Of C Engr	Office of the Chief Engineer
Off	Officer
OI	Operations instructions
OinC	Officer in charge
OPD	Operations Division
Opns	Operations
Orgn	Organization
OUSW	Office of the Under Secretary of War
Pan	Panama
PCD	Panama Canal Department
Pers	Personnel
Phil	Philippine
Plng	Planning
POA	Pacific Ocean Area
PRA	Public Roads Administration
Prelim	Preliminary
Proc	Procurement
Prog	Program
Proj	Project
Prov	Provisional
pt.	Part
PT	Motor torpedo boat
QM	Quartermaster
RAAF	Royal Australian Air Force
Rad	Radiogram
RAE	Royal Australian Engineers
RAF	Royal Air Force
RAN	Royal Australian Navy
Rcd	Record
Rcn	Reconnaissance
RCT	Regimental combat team
Rpt	Report
Rqmts	Requirements
Rqn	Requisition
S–3	Operations and training section of a unit not having a general staff

SEAC	Southeast Asia Command
Secy	Secretary
Serv	Service
sess	Session
SFPOE	San Francisco Port of Embarkation
SGS	Secretary of the General Staff
SLF	South Luzon Force
SOP	Standing operating procedure
SOPAC	South Pacific Area
SOS	Services of Supply
SPA	South Pacific Area
SPBC	South Pacific Base Command
SPD	South Pacific Division
Stat.	Statutes
Sup	Supply
SupO	Supply officer
SW	Secretary of War
SWPA	Southwest Pacific Area
TAG	The Adjutant General
TC	Transportation Corps
Telg	Telegram
TIG	The Inspector General
TM	Technical manual
Tng	Training
TofOpns	Theater of operations
Topo	Topographic
TQMG	The Quartermaster General
Tr	Troop
Twx	Teletype message
USAF	U.S. Air Forces
USAFFE	U.S. Army Forces in the Far East
USAFIA	U.S. Army Forces in Australia
USAFICPA	U.S. Army Forces in the Central Pacific Area
USAFINZ	U.S. Army Forces in New Zealand
USAFISPA	U.S. Army Forces in the South Pacific Area
USAFPOA	U.S. Army Forces in the Pacific Ocean Area
USASOS	U.S. Army, Services of Supply
USFIP	U.S. Forces in the Philippines
USSR	Union of Soviet Socialist Republics
USW	Under Secretary of War
VDC	Volunteer Defense Corps
WD	War Department
WDC	Western Defense Command
WDGS	War Department General Staff
WPA	Work Projects Administration
WPD	War Plans Division
WPO	War Plan ORANGE
Y-FOS	Y-Force Operations Staff

List of Code Names

ARCADIA	U.S.-British conference held in Washington, December 1941–January 1942.
BLACKLIST	General Douglas MacArthur's plan for occupation of Japan.
BOBCAT	U.S. Navy fueling station in Society Islands; first advance base to be established in Pacific after Pearl Harbor.
BOSTON	The Abau-Mullins Harbor area in southeast New Guinea.
CARTWHEEL	Converging drive on Rabaul, New Britain, by force of South Pacific and Southwest Pacific Areas.
CORONET	Assault planned for the island of Honshu, Japan, to take place in March 1946.
CYCLONE	Task force for Noemfoor.
DEXTERITY	Allied operations against Cape Gloucester and Arawe, New Britain, and Saidor, northeast New Guinea.
ELKTON	Plan for seizure of New Britain, New Guinea, and New Ireland area.
FORAGER	U.S. operation to capture Mariana Islands.
GALVANIC	U.S. invasion of Gilbert Islands.
GLOBETROTTER	Allied operation against Sansapor area, Netherlands New Guinea.
HURRICANE	Assault force for Biak, New Guinea.
ICEBERG	Allied invasion of Ryukyu Islands.
INTERLUDE	Allied operation against Morotai Island, Netherlands East Indies.
KING	Plans for U.S. operations to secure initial lodgment in southern and central Philippines and establish bases to support subsequent operations.
MAPLE	Port Moresby, New Guinea.
MATTERHORN	Plan for operating B–29's from Cheng-tu against Japan.
MICHAELMAS	Task force for seizure of Saidor, New Guinea.
MIKE	Plans covering operations for recapture of Luzon.
OCTAGON	U.S.–British conference at Quebec, September 1944.
OLYMPIC	Projected Allied operation to invade island of Kyushu, Japan, in fall of 1945.
ORANGE	Prewar plan of operation in event of war with Japan.
PERSECUTION	Allied task force that carried out operations against Aitape area, New Guinea, to seize and rehabilitate Japanese airstrips.

QUADRANT	First Anglo-American conference, 14–24 August 1943, at Quebec, Canada, attended by President Roosevelt and Prime Minister Churchill.
RAINBOW	Various plans prepared between 1939 and 1941 to meet Axis aggression.
SUNDANCE	Majuro Atoll, Marshall Islands.
TABLETENNIS	Allied operation against Noemfoor Island, carried out by CYCLONE Task Force, 2 July–31 August 1944.
TEACUP	Manus Island, Bismarck Archipelago.
TORNADO	Allied task force under HURRICANE Task Force which carried out operation against Wake Island–Toem, New Guinea, area, 17 May–2 September 1944.
TRADEWIND	Allied task force under ALAMO which carried out Operation INTERLUDE against Morotai Island, Netherlands New Guinea.
TRIDENT	U.S.–British conference held at Washington, May 1943.
TULSA	Early plans for General Headquarters, Southwest Pacific Area, for operations directed at capture of Rabaul, New Britain.
TYPHOON	Task force for Sansapor, New Guinea, operation.
VICTOR	Eighth Army's operations in central and southern Philippines.

UNITED STATES ARMY IN WORLD WAR II

The following volumes have been published or are in press.

The War Department
- *Chief of Staff: Prewar Plans and Preparations*
- *Washington Command Post: The Operations Division*
- *Strategic Planning for Coalition Warfare: 1941–1942*
- *Strategic Planning for Coalition Warfare: 1943–1944*
- *Global Logistics and Strategy: 1940–1943*
- *Global Logistics and Strategy: 1943–1945*
- *The Army and Economic Mobilization*
- *The Army and Industrial Manpower*

The Army Ground Forces
- *The Organization of Ground Combat Troops*
- *The Procurement and Training Ground Combat Troops*

The Army Service Forces
- *The Organization and Role of the Army Service Forces*

The Western Hemisphere
- *The Framework of Hemisphere Defense*
- *Guarding the United States and Its Outposts*

The War in the Pacific
- *The Fall of the Philippines*
- *Guadalcanal: The First Offensive*
- *Victory Papua*
- *CARTWHEEL: The Reduction of Rabaul*
- *Seizure of the Gilberts and Marshalls*
- *Campaign in the Marianas*
- *The Approach to the Philippines*
- *Leyte: The Return to the Philippines*
- *Triumph in the Philippines*
- *Okinawa: The Last Battle*
- *Strategy and Command: The First Two Years*

The Mediterranean Theater of Operations
- *Northwest Africa: Seizing the Initiative in the West*
- *Sicily and the Surrender of Italy*
- *Salerno to Cassino*
- *Cassino to the Alps*

The European Theater of Operations
- *Cross-Channel Attack*
- *Breakout and Pursuit*
- *The Lorraine Campaign*
- *The Siegfried Line Campaign*
- *The Ardennes: Battle of the Bulge*
- *The Last Offensive*

The Supreme Command
Logistical Support of the Armies, Volume I
Logistical Support of the Armies, Volume II
The Middle East Theater
The Persian Corridor and Aid to Russia
The China-Burma-India Theater
Stilwell's Mission to China
Stilwell's Command Problems
Time Runs Out in CBI
The Technical Services
The Chemical Warfare Service: Organizing for War
The Chemical Warfare Service: From Laboratory to Field
The Chemical Warfare Service: Chemicals in Combat
The Corps of Engineers: Troops and Equipment
The Corps of Engineers: The War Against Japan
The Corps of Engineers: The War Against Germany
The Corps of Engineers: Military Construction in the United States
The Medical Department: Hospitalization and Evacuation, Zone of Interior
The Medical Department: Medical Service in the Mediterranean and Minor Theaters
The Ordnance Department: Planning Munitions for War
The Ordnance Department: Procurement and Supply
The Ordnance Department: On Beachhead and Battlefront
The Quartermaster Corps: Organization, Supply, and Services, Volume I
The Quartermaster Corps: Organization, Supply, and Services, Volume II
The Quartermaster Corps: Operations in the War Against Japan
The Quartermaster Corps: Operations in the War Against Germany
The Signal Corps: The Emergency
The Signal Corps: The Test
The Signal Corps: The Outcome
The Transportation Corps: Responsibilities, Organization, and Operations
The Transportation Corps: Movements, Training, and Supply
The Transportation Corps: Operations Overseas
Special Studies
Chronology: 1941–1945
Military Relations Between the United States and Canada: 1939–1945
Rearming the French
Three Battles: Arnaville, Altuzzo, and Schmidt
The Women's Army Corps
Civil Affairs: Soldiers Become Governors
Buying Aircraft: Materiel Procurement for the Army Air Forces
The Empoyment of Negro Troops
Manhattan: The U.S. Army and the Atomic Bomb
Pictorial Record
The War Against Germany and Italy: Mediterranean and Adjacent Areas
The War Against Germany: Europe and Adjacent Areas
The War Against Japan

Index

Abau: 150, 178–80
Abau Trail: 178–80
Abbott, Lt. Col. Ward T.: 112, 135–37, 248
Abel, Cecil: 180
Abel's Landing: 180–81, 192
Adak Island: 284, 290, 294–95, 332
Adelaide: 113–14, 119, 124, 141
Administrative Planning Committee, Australian: 113, 120–22
Administrative procedures
  Australia: 113, 121, 242
  CBI: 453
  Hawaii: 41, 52, 341–42, 353–54, 356–58, 363–64, 370–73, 376, 486–89
  India: 401
  Philippines, 1941–42: 61
  SWPA: 556–57
Admiralty Islands: 521–27, 529, 541–43, 544, 570
Advance Sections, SOS CBI: 395, 396, 415, 418, 439, 452
Advisory Commission to Council of National Defense: 24–25
Aeronautical charts, compilation and distribution: 458
Agana: 506
Agno River: 75–77, 588–91, 595–97, 601–06, 611–12
Agra: 392, 395–96, 399–400, 404
Agriculture and Forestry Board, Hawaii: 346
Aguadulce Airfield: 30, 32
Aguinaldo Building, Manila: 667
Ahioma: 257
Air attacks
  Biak: 538
  Borneo: 636
  Carolines: 514, 516
  Japan: 456, 467–68, 518, 668
  Kwajalein: 479, 482
  Luzon: 596, 599, 604, 612, 639
  New Guinea: 179, 527
  Okinawa: 647, 658
  Philippines, 1944–45: 572, 626, 633–34
  Rabaul: 272
  Saipan: 496
  SOPAC: 542
  SWPA: 542
  Wakde: 536
Air attacks, Japanese
  Alaska: 276, 283–89
  Assam: 400–401
  Borneo: 636
  Central Pacific: 386
  Corregidor: 101–02, 105
  Hollandia: 530
Air attacks, Japanese—Continued
  Lae: 251
  Leyte: 577, 580, 584
  Luzon: 592–93
  Milne Bay: 178
  New Britain: 273–74
  New Guinea: 143, 146, 157, 251, 253
  Okinawa: 647
  Port Moresby: 142–43, 145–46
  Saipan: 497, 499, 501, 518
  SOPAC: 559
  SWPA: 559, 565
  Wakde: 536
Air bases: *See* Airfield construction and repair; B–29's.
Air bases, Japanese: 143
Air commandos: 427–28, 430, 445, 447, 455
Air defense construction. *See also* Aircraft warning stations, construction of; Civilian defense, Hawaii.
  Alaska: 36
  Canal Zone: 50
  Corregidor: 66
  Hawaii: 40–41, 43–44, 344, 361–62, 365
  India: 398, 400
Air defense measures: 66, 125, 249, 344–49, 366–67. *See also* Civilian defense, Hawaii.
Air ferry routes. *See also islands and areas by name.*
  airfield construction and repair: 45–48, 52–53, 161–64, 168–69, 232–33
  to Alaska: 287–88
  alternate routes: 161, 168–69, 171
  become operational: 163–64, 220–22
  climate, effect of: 168
  communications facilities: 161
  defenses, status of: 168
  to Philippines, 1941: 45
  priority rating: 161
  reconnaissance, engineer: 168–69
  shipping shortages: 161
  storage facilities, construction and operation: 164
  to USSR: 288
Air Forces
  Caribbean: 29
  Far East: 71–72, 392, 658, 668, 672
  Hawaiian: 38–39, 342, 346, 348, 354
  Strategic: 649–50, 658, 667–68
  Fifth: 157, 183–88, 230, 242, 248, 583
  Seventh: 361–62, 365, 373, 376, 478, 507
  Tenth: 391–92, 398–400, 416, 428–29, 458, 463, 466, 468, 472
  Eleventh: 282–83
  Thirteenth: 243

Air Forces—Continued
Fourteenth: 417–18, 427–29, 438, 452–53, 458, 468–70, 668. *See also* American Volunteer Group.
Air Forces Service Commands
V: 260–62
X: 429
XIII: 243
Air offensive against Japan: 7–8, 107, 150, 153–54, 387–89, 391–92, 408–09, 417–18, 421, 425, 428, 430–32, 437–38, 463, 467, 561, 563, 566, 573, 581, 586, 587, 598, 674. *See also* B–29's; China.
Air Service Area Command, 5308th: 439, 451
Air Service Command, CBI: 429, 439
Air strength, Japanese: 522, 591, 594
Air strength, SWPA: 234–35
Air strips, construction and repair. *See* Airfield construction and repair.
Air superiority, Allied: 662
Air Transport Command: 324, 431, 452, 454, 472, 666
Air Unit, 5318th: 428
Air units, arrival in China: 431–32
Airborne Division, 11th: 581, 609, 614, 631, 639
Airborne engineer troops. *See* Engineer airborne aviation battalions.
Airborne operations
Arnold and: 428
Burma: 444–46, 454
Corregidor: 619–20
New Guinea: 248–49, 252
Philippines, 1944–45: 619–20
Aircraft, supplied to China: 389, 391–92
Aircraft repair shops, construction: 370, 373–74, 507, 577
Aircraft warning service, Hawaii: 347, 362, 365
Aircraft warning stations, construction of
Alaska: 18, 36–37, 53, 278, 283, 287–88
Bataan: 64, 66
Canal Zone: 20–21, 30–31
Hawaii: 15, 18, 40–42, 51, 53, 346
Ledo Road: 435
Panama: 20–21, 30–32
Philippines, 1941–42: 59, 64, 66
Airfield construction and repair
Admiralties: 521–27, 541–42
air ferry routes: 45–48, 52–53, 161–64, 168–69, 232–33
Alaska: 12, 19, 21–23, 28, 33–35, 37, 50–53, 276–78, 281, 284–89, 291, 296–98, 328–29, 331–34
Alaska Highway: 313
Allied Air Forces and: 182
Arnold and: 430
by ASCOM: 583–84, 591–92, 598–600
Assam: 392, 396–97, 400–401, 416–18, 420, 425, 431, 438–39, 452–53
Attu: 331
Australia: 45–46, 111, 113–20, 123–26, 133–37, 141–45, 147–52, 154–55, 158, 218–20, 223, 239, 260, 549–50
Airfield construction and repair—Continued
Bataan: 61, 64–65, 71, 78–79, 89, 95
Biak: 537–42, 544
Burma: 428, 444–47, 454–55, 459, 463–64, 467–68, 472
Canada: 288, 299
Canal Zone: 29–32
Canol: 321, 324–27
Canton Island: 45–47, 161, 163–64, 385
Carolines: 512–17
CBI: 392, 430, 437
Central Pacific: 381–86, 476, 518
China: 387–89, 392, 397, 402–04, 415–16, 419–20, 425, 429–32, 437, 439–42, 451–53, 456, 468–69, 662–63
Christmas Island: 45–47, 161, 164, 385
coral, uses in: 385–86
Corregidor: 61, 103, 105
Fiji: 45, 48, 161, 163, 171, 232–33, 256
Guadalcanal: 171–72, 206–07, 256
Guam: 493, 506, 517
Hawaii: 28, 38–42, 51, 161, 340–43, 346–49, 361–62, 365, 370, 373–74, 486–87, 507–08
Hollandia: 527–28, 531–34, 543–44
India: 392–94, 396–97, 399–404, 406–08, 416–18, 420, 425, 429–32, 438–42, 455–56, 467–68, 666
Iwo Jima: 659–60
Japan, for assault on: 672–74, 677–78
JCS directives on: 527
Kwajalein: 476–79, 483–85
Lae: 230–31, 234, 244
Leyte: 573, 575, 579–81, 583–84, 586, 590
Luzon: 58–61, 64–65, 79, 590–92, 597, 606, 610, 615, 631–33, 638–39, 655
Manila: 615
Marianas: 592–93, 518
Marquesas: 168
Marshalls: 485–86
Milne Bay: 151–54, 157–58, 174–75, 186, 221, 235–36
Mindanao: 59, 61, 65, 570, 578, 636, 655
Navy's role in: 12
New Britain: 273
New Caledonia: 45, 161, 163–67, 171, 206–07, 221–22, 233, 256
New Guinea: 143–48, 150–59, 174, 180–87, 194, 198–99, 202, 218–20, 230–31, 235–38, 244–49, 251–52, 254, 257–60, 274–75, 533, 549–50, 561
New Hebrides: 170–71, 232
New Zealand: 48
Okinawa: 625, 643, 645, 657–58
Panama: 21, 23, 31–32, 50
Philippine Commonwealth: 59
Philippines, 1941–42: 45, 55, 58–59, 63–66, 71
Philippines, 1944–45: 625–26, 633–34, 655
POA: 380, 640
Port Moresby: 143, 145–48, 151–57, 174–75, 184–86, 188, 220, 236, 259

Airfield construction and repair—Continued
QMC's role in: 12–14, 19
Saipan: 493, 498–501, 503, 511, 518
Solomons: 245, 249–50, 254–55
SOPAC: 232–33, 243, 255–56, 266, 549–50
by SOS CBI: 437–39
SWPA: 218–20, 230–31, 234, 256–57, 266, 549–50, 566–68, 561–66
Wakde: 645–46, 651, 654–55
Airfield construction and repair, Japanese: 477, 550
Airfield defense measures, Hawaii: 348–49, 374
Airfields, Japanese seizure of: 468–69, 662
Airlift operations. *See also* Supply, by airlift.
Admiralties: 525
Burma: 427–28, 468
New Guinea: 180–81, 192, 205
Aitape: 527, 532–34, 541–44
Aitutaki Island: 169, 171, 233
Alacan: 639.
Alaska: 3, 4, 7–8, 11, 12–14, 16–19, 21–23, 27, 28, 33–37, 48–53, 276–98, 305–06, 328–34. *See also* Alaska Highway; North Pacific Area; *islands by name.*
Alaska-Canada Highway. *See* Alaska Highway.
Alaska, Gulf of: 281
Alaska Defense Command: 33, 332–34. *See also* Buckner, Lt. Gen. Simon B., Jr.
Alaska Defense Force: 17–18, 33. *See also* Buckner, Lt. Gen. Simon B., Jr.
Alaska Highway: 276, 299–318, 334, 337, 339
Alaska Railroad: 18–19, 22–23, 34, 287, 289, 295
Alaskan Department: 333. *See also* Alaska Defense Command; Alaska Defense Force; Buckner, Lt. Gen. Simon B., Jr.
Alaskan International Highway Commission: 299
Alaskan Siberian Ferry Route (ALSIB): 288
Albany Race Track, Calif.: 362
Albrook Field: 7–8, 14
Alcan: 312
Alcan Highway. *See* Alaska Highway.
Aleutian Islands: 284–85, 290–98, 364. *See also islands by name.*
Alexandra Falls: 327
Aliamanu Crater: 15, 39–42, 51, 370
Alice Springs: 114, 123, 148, 239, 241
Allahabad: 397
Allied Air Forces, SWPA: 128, 182–83. *See also* Brett, Maj. Gen. George H.; Kenney, Maj. Gen. George C.
Allied Land Forces, SWPA: 128. *See also* Blamey, General Sir Thomas.
Allied Naval Forces, SWPA: 128
Allied Supply Council: 141
Allied Works Council, Australia:
construction machinery and equipment, procurement by: 155, 215–16
and construction program and progress: 141–45, 223–24
Allied Works Council, Australia—Continued
co-operation with SWPA: 120–22, 134–35, 137–38, 140–41, 151–52
and costs of construction: 152, 223–24, 239–41, 260
and hospital construction: 239–40
labor force, mobilizing: 241–42
labor force, strength: 211
road construction and repair: 239
specialist training by: 271–72
Alligators (LVT's): 273, 382, 496, 506
Almirante: 30
Aloha Tower, Honolulu: 346
Altman, Col. Ellis F.: 424
Amberley Airfield: 114–15, 127, 260
Amchitka Island: 288–89
American-Australian Lend-Lease agreement: 141
American-British-Dutch-Australian Command (ABDA): 118, 392
American Military Mission to China: 389
American Procurement Commission, USAFIA: 126
American Red Cross, construction for: 546
American Volunteer Group: 389, 391–92, 415. *See also* Chennault, Maj. Gen. Claire L.; China, China Air Task Force
Ammunition storage facilities, construction of. *See* Storage facilities, construction and operation.
Ammunition storage plan, Hawaii: 367–69
Amphibious Force, VII: 576–78
Amphibious operations. *See also* Engineer special brigades; Landing craft.
Admiralties: 522–23
Borneo: 636
Central Pacific: 476
control of: 227
coral, effect on: 385
Iwo Jima: 640–41
Japan, for assault on: 673–74, 677
lessons gained from: 273, 577–78
Leyte: 575–78
Luzon recovery: 594, 608, 610, 639
Navy's role in: 273, 577–78
New Britain: 272–74
New Guinea: 179, 181, 192, 246–48, 251–54, 272–75, 535
Okinawa: 643–44
Philippines, 1944–45: 619–21, 625–26, 632–35
SWPA planning for: 520–21, 527–28, 534
training program: 271, 330–31, 478, 490–91, 671
Amphibious truck. *See* Dukws.
Amsterdam Island: 563–65
Anchorage: 16–19, 22, 26, 33, 34–35, 37, 282, 284, 289, 290, 295–96, 324–25
Andrews, Maj. Gen. Frank M.: 29–32
Angat River: 613
Angaur Island: 514–16
Angeles, Luzon: 77–78, 603
Ango: 195, 205
Annette Island: 12, 19, 21–22, 35–37, 278, 283, 296

Anshun: 663
Antitank defenses, Japanese: 383, 583, 634
Apamama Island: 381
Aparri: 66, 72–74, 625, 638–39
Appropriations. *See* Congress, defense appropriations by.
Arawe: 272–74
Arayat River: 77
ARCADIA Conference: 107, 164, 390
Archerfield (airfield): 114–15, 127
Argenlieu, Rear Adm. Thierry d': 163–64
Ariake Bay: 675
Arias, Dr. Arnulfo: 21, 32
Arizona: 350–51
Armand Considere: 670
Armies
  Third: 471n
  Fourth: 11, 276
  Sixth: 230, 238–39, 242, 244, 256–57, 520–21, 523, 527–28, 537–38, 541–42, 547, 551–52, 557, 559–60, 563–64, 570–72, 574–75, 584, 586, 588–92, 594–95, 600–601, 606–09, 613, 625–26, 632, 639, 671–72, 674–76, 678
  Eighth: 586–87, 608–10, 625–27, 632–33, 639, 666, 669–72, 678
  Tenth: 642–43, 657, 668, 678
Armies, British
  Eighth: 408
  Fourteenth: 446–47
Armies, Chinese
  First: 468
  Sixth: 468
  XI Group: 466
Armored Group, 13th: 587, 594, 597
Army, Australian First: 196
Army Air Forces (AAF). *See also* Air Forces; Air Forces Service Commands.
  and Alaska Highway: 313
  and China supply: 464
  construction, pressure for: 135–36, 174, 184–86, 354, 365, 397, 401–02, 416–17, 437–38, 486, 549, 583
  construction transferred to: 437–39
  and engineer units, control of: 547
  in India-Burma sector: 428–29
  and Ledo Road: 464
  and map compilation and distribution: 668
Army Forces, Middle Pacific (AFMIDPAC): 675, 678
Army Forces, Pacific (AFPAC): 649, 668, 674–75
Army Forces, Western Pacific (AFWESPAC): 654, 675, 678. *See also* United States Army Services of Supply.
Army Map Service: 188, 290, 458, 607, 668
Army and Navy Munitions Board (ANMB): 48–49
Army Service Command (ASCOM): 571
  airfield construction and repair: 583–84, 591–92, 598–600
  base construction and operation: 584–85, 591
  Base K: 579, 591, 650–51
Army Service Command (ASCOM)—Continued
  Base M: 591, 600–601, 604–06, 650–51
  beach defense construction: 585
  bridge construction and repair: 585
  cargo unloading and distribution: 600–601
  civilians, employment of: 585, 599
  construction, problems of: 584–85
  Construction Command: 579, 619
  dredging operations: 585
  engineer organization: 571–72
  engineer units, arrival: 598–99
  engineer units, control of: 591, 594
  engineer units, shortages of: 586
  engineer units, strength: 575
  Hollandia, transfer to: 572
  hospital construction: 586
  in Japan assault: 676
  land acquisition: 584
  Leyte Campaign: 575, 579, 582–86, 591–92
  Luzon Base Command, redesignation to: 601
  Luzon Base Section, redesignation to: 651
  Luzon Campaign: 591–92, 598–601
  pipeline construction and operation: 585, 600
  port facilities, construction and repair: 585, 600–601
  railroad construction and repair: 600, 604
  road construction and repair: 585–86, 600
  Sixth Army, assignment to: 572, 601
  spare parts shortage: 585
  storage facilities, construction and operation: 585–86, 600
  USASOS, assignment to: 601
Army service commands. *See* Service commands.
Army Service Forces: 429–30, 436–37, 442, 448, 563. *See also* Somervell, Lt. Gen. Brehon B.
Arnold, General Henry H.: 391–92, 418, 428, 430
Arrowsmith, Brig. Gen. John C.: 398–401, 406–12, 415–17, 423–24, 432
Arthur, Col. Joseph D., Jr.: 166
Artillery fire support: 482, 536, 621, 647
Artillery fire support, Japanese: 104–05
Arundel Island: 250
Asensio, Col. Manuel J.: 463, 468, 472
Aslito Airfield: 496–98
Assam: 392, 393–97, 399–401, 404, 405, 409, 413, 416–18, 419, 420, 424, 425, 426–27, 431, 435, 438–39, 441–42, 452–53, 457, 466–67, 471, 464–66
Assam Oil Company: 449
Athabaska, Lake: 324
Athabaska River: 320–22
Atherton Tablelands: 241
Atimonan: 82
Atka Island: 284–87
Atlantic, Gulf and Pacific Company: 60
Atomic bombs, use of: 678
Atsugi Airfield: 679
Attu Island: 276, 284, 290, 322, 329–31, 364
Auckland: 233, 243

Australia: 107, 160, 164, 170, 364. *See also* Australian Army; Royal Australian Air Force (RAAF).
AAF, pressure for construction: 135–36
Administrative Planning Committee, 113, 120–22
administrative procedures: 113, 121, 242
airfield construction and repair: 45–46, 111, 113–20, 123–26, 133–37, 141–45, 147–52, 154–55, 158, 218–20, 223, 239, 260, 549–50
Allied Works Council. *See* Allied Works Council, Australia.
base construction and operation: 112–13, 119, 239
camouflage measures: 219–20, 559–60
civilians, employment of: 112, 120, 142–44, 154–55, 158, 215, 239, 557, 680
construction, control of: 133–39, 651
construction, problems of: 116–17, 119–22, 135, 144, 148–49, 155, 241–42
construction design standards: 120, 139
construction machinery and equipment, procurement: 117, 123–24, 127, 140–41, 144–45, 148–49, 152–53, 155, 241, 554
construction materials, improvised: 125–26, 149, 261–62
construction materials, procurement: 117–18, 120, 124–27, 134–35, 140–41, 155, 213–16, 260–62, 266–67, 554–56
construction programs and progress: 113–22, 133–34, 138–44, 152–53, 214–15, 217, 220, 223, 239, 260
co-operation from: 111–14, 131, 144, 158, 215–16
costs of construction: 152, 223–24, 240–41
demolition operations: 138–39, 216
duplication of effort: 134–35
Economic Cabinet: 215
engineer mission: 111–14
engineer units, arrival and departure: 118, 122–26, 131, 144–49, 152, 190, 228, 247
engineer units, requirements: 133
engineer units, strength: 144
engineers as infantry: 149–50
financial aid from: 112
hospital construction: 114–15, 223, 240
housing arrangements: 114, 217
housing construction: 114–15, 119, 124, 139–40, 223, 260
labor force, mobilizing: 121, 142, 241–42
land clearing operations: 148
and lend-lease: 140–41, 216, 560
maintenance and repair, general: 126, 148–49
map compilation and distribution: 189–91, 551–52
planking, pierced, first use: 125
port congestion: 126–27, 242
port facilities, construction and repair: 110, 113–
port facilities, construction and repair—Continued
15, 240, 260
priority rating: 121–22, 134–35, 137–38, 215–16, 241–42, 260
purchasing, centralized: 126–27
Australia—Continued
RAAF in construction program: 136–38, 154, 158, 560
railroad construction and repair: 241
reconnaissance, engineer: 119–20, 123, 135, 144
resources: 108–09, 140–41, 216
road construction and repair: 122–23, 128, 138, 239–40
shipping: 140, 155, 554
shop construction and operation: 229
Soils Mechanics School: 272, 561
spare parts shortage: 149
specialists, training: 271–72, 560–61
storage facilities, construction and operation: 113–15, 119, 141, 223, 239, 260
supply situation: 126–27, 140–41, 149, 152–53, 155, 556
terrain model construction: 552–53
topographic supplies, procurement: 553
training programs: 122, 124–25, 136, 271
Australian Army. *See also* Royal Australian Engineers.
in Borneo assault: 636
construction policy: 139
Hiring Service: 113
map compilation and distribution: 188–89
in New Guinea: 155, 174–78, 182, 193, 200–02, 204–05, 235, 238, 244, 247–48, 251–54
specialists, training: 271–72
storage facilities, construction and operation. 217–18
Australian Army units
Infantry Brigade, 26th: 636
Infantry Divisions
7th: 174, 178, 193, 252
9th: 251, 636
Australian Chiefs of Staff: 109, 113, 118, 129, 216
Australian Imperial Forces: 108, 118
Australian Military Forces: 109, 133
Australian-New Guinea Administrative Unit (ANGAU): 269
Australian Survey Corps: 189–90, 200
Ayala Bridge, Manila: 656–57

B-17's: 55–59, 63–65, 143, 152, 164, 341, 347, 361–62, 439–40
B-18's: 286
B-24's: 484, 495
B-25's 181, 554
B-29's: 387, 428, 430, 437–42, 449–53, 456, 467–68, 492, 493, 499–501, 503, 506, 510–11, 517, 518, 640, 643, 658, 660, 666
Babelthuap Island: 514
Baccus Marsh: 123
Bagabag: 637–39
Bagac: 86, 89–91
Bagac River: 97
Baguio: 625, 627–32, 636–38

Bailey, Sir Donald Coleman: 448
Bailey bridges: 448, 465, 470
Baker, Capt. C. D.: 47, 163, 165, 488
Baker Island: 380
Bakery construction: 546
Balara Filters, Luzon: 614
Baldwin, Lt. Col. Herbert: 363–64
Baler Bay: 627
Balete Pass: 627–28, 636–37
Balikpapan Island: 636–37, 639
Baliuag: 613
Bamban: 76–77, 595, 604–05, 610
Bamban River: 77, 603
Bambang: 627–29, 632, 636–38
Banga Cave: 81
Bangalore, India: 399
Bangkok: 456
Banzai charges: 500, 592, 594, 647, 649
Barbed wire obstacles: *See* Wire obstacles; Wire obstacles, Japanese.
Barber's Point: 351
Barbey, Rear Adm. Daniel E.: 578
Barge lines. *See* Waterways, development and use.
Barking Sands, Kauai: 39, 349, 361
Barnes, Brig. Gen. Earl W.: 565
Barnes, Brig. Gen. Julian F.: 109, 128, 157. *See also* United States Army Forces in Australia. (USAFIA).
Barracks construction. *See* Housing construction.
Base B: 672
Base K: 579, 591, 650–51
Base M: 591, 600, 604, 606, 650, 656
Base R: 650, 656
Base S: 650
Base X: 650
Base construction and operation
  Admiralties: 524–25, 527, 534, 541–42
  Alaska: 282–83, 289–91, 331–34
  by ASCOM: 584–85, 591
  Assam: 395–96
  Attu: 331
  Australia: 112–13
  Biak: 537–38, 541–42, 544
  Burma: 413, 465
  CBI: 395–96
  Central Pacific: 381, 476, 507, 518
  China: 395–96, 415, 418–21
  Espíritu Santo: 569
  Guam: 492
  Hawaii: 366, 369–70, 380
  Hollandia: 527–29, 533–34, 544, 557
  India: 395–96, 404
  Japan, for assault on: 674–75, 677
  JCS directives on: 527
  Kwajalein: 484
  Lae: 244–45, 258–59, 546–47
  Ledo: 405–06, 409–10, 412, 419, 467n
  Leyte: 570–72, 575, 584–85
Base construction and operation—Continued
  Luzon: 93, 591, 606, 625, 632, 650–51
  Manila: 93, 656, 670
  Manila Bay area: 591
  Marianas: 492
  Marshalls: 478–79, 484–86, 570
  Milne Bay: 236, 245, 257, 556–58
  Mindanao: 572, 636
  New Caledonia: 661
  New Guinea: 236, 238–39, 244, 256–58, 275, 544, 546–47, 557
  Okinawa: 643, 658
  Port Moresby: 174–75, 236, 245, 258
  Saipan: 493–94, 499–503
  Solomons: 245, 250, 527, 544–47
  SOPAC: 255–56, 542–43, 546–47, 649
  by SOS CBI: 395–96, 409, 415, 418
  SWPA: 182–83, 209–10, 256–57, 543–44, 546
  USASOS: 236, 245, 256–59, 262–63, 528
  Wakde: 535, 542
Base construction and operation, Japanese: 512–14
Base General Depot No. 2, SOS CBI: 456
Base Sections, SOS, CBI:
  1: 395–96, 398, 402
  2: 395
  3: 409, 423–24, 431–32, 436, 438, 442
Basilan Island: 633
Bataan Peninsula: 55, 57–58, 61, 64–65, 66, 71, 72–101, 608
Batangas: 84, 632, 650, 655
Batangas Bay: 632
Batchelor Field: 110
Bathing facilities, installation: 266
Bathurst, Col. Charles R.: 556, 567
Battery *Arizona*: 661
Battery *Closson*: 349
Battery *Hatch*: 349
Battery *Pennsylvania*: 661
Battery *Williston*: 349
Bauang: 76, 630
Bauang River: 630
Bauer Airfield, New Hebrides: 232
Bayambang: 76, 595, 602, 604, 611
Bayombong: 638
Bayug Airfield: 573, 576, 580, 583
Beach defense construction: 351–52, 365, 374, 585
Beach defense construction, Japanese: 501
Beach party operations. *See also* Shore party operations.
  Biak: 538
  Carolines: 514
  Kwajalein: 479–82
  Leyte: 576–77
  Luzon: 592–94, 597, 608–09
  Marianas: 506
  Marshalls: 483
  New Guinea: 535
  Okinawa: 644

Beach party operations—Continued
Saipan: 501, 496–97
Wakde: 536
Beadle, Col. Frank L.: 172, 214, 232, 243, 520, 569
Beard, Lt. Col. Cornelius: 222, 233
Beaver Creek: 314
Bechtel, McCone & Parsons: 28
Bedford, Earle: 84
Bellows Field: 39, 45, 51–54, 340, 347–48, 361
Bena Bena Airfield: 244
Bengal-Assam Railway: 449–50, 456
Bengal, Bay of: 405
Bengal Province: 450, 666
Benguet Consolidated Mining Company: 60
Bering Sea: 283, 285, 288, 325
Bermel, Maj. Peter E.: 11
Bethel, Alaska: 295
Betts, Col. Austin W.: 469
Bhamo: 389–91, 405, 430, 460–65, 468, 472–73, 663
Biak Island: 534, 537–42, 544, 557
Bicol Peninsula: 64, 80, 632, 639, 657
Big Delta: 295, 299, 302, 307, 309–10, 312, 315, 334
Big Delta Airfield: 288
Binloc River: 596
Birdum: 110, 148
Bismarck Archipelago. *See islands by name.*
Bismarck Sea: 272, 522
Bissell, Brig. Gen. Clayton L.: 391, 400, 416, 429
BLACKLIST: 678, 679
Blamey, General Sir Thomas. *See also* New Guinea Force.
and Allied Land Forces: 128, 139–40, 182–83, 190
and demolitions operations: 216
and New Guinea Force: 179
in Rabaul offensive: 244–45
Blasting operations
Alaska Highway: 312–14, 317
Luzon: 604, 638
Marshalls: 485
Mindanao: 635–36
Saipan: 498–99, 511
Bloch, Rear Adm. Claude C.: 42, 45
Blueberry River, Canada: 308
Bluemel, Brig. Gen. Clifford: 91, 97
Boat Building Command, USASOS: 653–54
Boatner, Brig. Gen. Haydon L.: 455
Bohol Island: 626, 634
Bolo Airfield: 658
Bomana Airfield: 146, 186
Bomb disposal, training in: 271, 560–71. *See also* Demolition operations.
Bombardment, aerial. *See* Air attacks; Air attacks, Japanese.
Bombardment Group, 9th: 21
Bombay: 396, 411
Bomber Commands
XX: 458
XXI: 518
Bond, Maj. Gen. Richard L. (British): 391–92
Bonegilla: 271
Bongabon: 610
Bonham, Maj. Roscoe: 69–70, 75–76, 87, 92–93, 99–100
Booby traps, Japanese
Leyte: 583
Luzon: 597, 631
Manila: 619
Okinawa: 645, 648
Saipan: 499
Bootless Inlet: 183
Borneo: 118, 633, 636
Borokoe Airfield: 537, 540, 544
Bosnek: 537, 539–40
Bostock, Air Vice Marshal William D. (RAAF): 136–37
Bougainville Island: 234, 254–55, 520, 526, 544–47, 569
Bourake Airfield: 167
Brady, Col. Francis M.: 71
Brahmaputra River and Valley: 427, 431, 450, 467n, 663
Brandt, Col. Carl A.: 261
Breene, Maj. Gen. Robert G.: 214, 232, 256
Brereton, Maj. Gen. Lewis H.: 71, 110, 115, 117, 392–96, 397, 399–400
Bres, Col. E. S.: 136
Bretschneider, Pvt. Karl F.: 149
Brett, Maj. Gen. George H.: 109–13, 115–16, 118–24, 126–28, 135–37, 147–48, 150, 153–54, 392
Brewer, Maj. John E.: 547
Bridge construction and repair. *See also* Ponton bridges; *type by name or model designation.*
Alaska Highway: 307, 312–13, 315–18, 334
by ASCOM: 585
Burma: 444, 458–59
Burma Road: 413, 435
Canol: 328, 337
Fiji: 256
Guadalcanal: 207–08
Ledo Road: 413, 433, 447–49, 457, 465, 470–72, 663–64
Leyte: 574–75, 581–83, 585
Luzon: 76–77, 80–81, 590–91, 595–97, 602–06, 609, 611–13, 616, 626, 628–32, 638–39
Manila: 619, 657
Mindanao: 635–36
New Guinea: 247, 257, 274, 533, 535, 543, 546, 551
Okinawa: 645, 649
Philippines, 1941–42: 64
Philippines, 1944–45: 633–34
Solomons: 249, 255, 526
SOPAC: 542
SWPA: 542, 551, 565
Brisbane: 109–10, 112–13, 114, 115, 119, 122, 138–39, 141, 153, 156, 240, 242, 272, 288, 520, 528, 552–54, 558, 571

Brisbane River: 114
Bristol Bay: 288
British Army
  in Burma: 391, 407–08, 409, 463
  in China: 389, 464, 662
  in India: 392–93, 396, 416–17, 420
  Ledo Road, attitude toward: 407–08, 464
British Chiefs of Staff. *See* Combined Chiefs of Staff.
British Columbia-Yukon-Alaska Highway Commission, Canada: 299
British Infantry Division, 36th: 468
British Royal Air Force: 391
British Royal Engineers
  Assam: 400–401, 416–17, 425, 431, 452
  India: 392–93, 396–97, 400–402, 406, 416–17, 420, 425, 440
  Ledo Road: 409–10, 412–13, 423–24, 450
British Royal Navy: 405–06
Brizay, Mr.: 217–19
Broken Hill Proprietary Company: 140
Brown, Lt. Col. Desloge: 378, 486
Brown, Lt. Col. Herbert E., Jr.: 484, 517
Brown, Col. Rothwell H.: 444
Bruce, Lt. Col. Burton B.: 144
Brunei Bay: 636
Buckner, Lt. Gen. Simon B., Jr. *See also* Alaska; Alaska Defense Command; Alaska Defense Force; Alaskan Department; Armies, Tenth.
  and airfield construction and repair: 34–35, 658
  commands Alaska Defense Command and Force: 17, 33, 333
  and construction, control of: 282
  demands staff engineer: 37
  and radar installations: 283
Buckner (Nakagusuku) Bay: 641, 659
Budge-Budge: 450
Bued River: 596, 611
Buffaloes (LVT's): 273, 382, 497, 506, 530, 538, 562
Bulldog Village: 231, 260
Bulldozers, tactical use of
  Admiralties: 523–24
  Carolines: 515
  Corregidor: 621
  Guam: 506
  Luzon: 628–29
  Okinawa: 648
  SOPAC: 542
  SWPA: 542
Buna: 153–55, 156–57, 173–74, 179–80, 188–89, 192–205
Buna Force: 156
Buna Mission: 193, 196, 198–203
Bunker defenses, Japanese, assaults on. *See* Demolition operations.
Burauen: 573
Bureau of Aeronautics, Philippine Commonwealth: 66
Bureau of Public Works, Philippine Commonwealth: 62–64, 66, 73–74, 76–77, 80–81
Burgin, Maj. Gen. Harry T.: 350, 368
Buri Airfield: 573, 576, 580, 583
Burma: 391–92, 404, 406–08, 413, 415–18, 420–21, 425, 429, 431, 443, 450, 456, 469, 473–75. *See also* China; China-Burma-India Theater; India; India-Burma Theater; Stilwell, Gen. Joseph. W.
  AAF, construction transferred to: 437–38
  airfield construction and repair: 428, 444–47, 454–55, 459, 463–64, 467–68, 472
  base construction and operation: 465
  bridge construction and repair: 444, 458–59
  China-India road, proposed: 405
  civilians, employment of: 465, 680
  climate, effect of: 393
  command and staff structure: 397–98
  construction, control of: 394–95
  construction machinery and equipment, procurement: 430, 472
  construction materials, procurement: 430, 466
  construction programs and progress: 393–94, 464, 661–62
  demolition operations: 445
  Distinguished Unit Citation awarded: 455
  engineer missions: 387–89
  engineer organization: 438–39
  engineer units, arrival: 445, 454–55, 466, 468, 472
  engineer units, diversity in: 427
  engineers as infantry: 444, 453–55, 463
  isolation of: 387–89
  labor force, mobilizing: 465, 467, 471
  and Ledo Road. *See* Ledo Road.
  malaria: 462
  map compilation and distribution: 457–58
  pipeline construction and operation: 390, 426–27, 430, 434–35, 442, 454, 457, 463–67, 471, 666
  port facilities, construction and repair: 467, 471
  railroad construction and repair: 389
  railroad system: 393, 435
  rainfall, effect of: 436, 446, 454–55, 462
  reconnaissance: 445, 454–55
  river crossings: 444, 454–55, 459, 468, 472
Burma Railway: 445–47, 468
Burma Road: 389–91, 404, 405, 406, 408, 413–15, 418–19, 421–22, 425–27, 435–36, 442, 455, 458–60, 464, 465–66, 468, 472, 473–75, 662–63, 666
Burma Road Engineer Detachment: 459
Burma Road Engineer Divisions
  2d: 465–66
  3d: 466
Burmah Oil Company: 467, 471
Burns, Col. Brendan A.: 479–80, 493, 498, 511
Burns Airport: 39, 349
Burt, Maj. R. P., Jr.: 167
Bush flyers: 306, 309
Butaritari Island: 382

Butjo Luos Island: 524
Byroade, Maj. Henry A.: 395–97, 400, 417, 419, 431, 439–40, 451, 469

C–47's: 247–48, 445, 550, 615
C. W. Cunningham Company: 327
Caballo Island: 57, 104, 621–23
Cabanatuan: 66, 75, 77, 596, 610–13
Cabcaben: 79, 93, 95
Cableway construction and operation: 466
Cadwallader-Gibson Lumber Company: 70
Cagayan River and Valley: 73–74, 625, 627–28, 637–38
Cairns Airfield: 143, 235, 240–42, 260
Calasiao: 614
Calcutta: 392, 396–97, 411–12, 416, 424, 427–30, 439–40, 449, 456–57, 467, 471, 475, 666
California Packing Company: 348
Callahan Construction Company: 25, 41, 320, 325, 327
Calmay River: 593, 595, 602
Calumpan Peninsula: 632
Calumpit: 80, 82, 610–12
Camalig: 639
Camouflage
  air ferry routes: 168
  Alaska: 37, 51, 290–91
  Assam: 400
  Australia: 219–20, 559–60
  Bataan: 91
  Canal Zone: 32
  Hawaii: 44–45, 346, 350–52, 361–62, 365
  India: 398–99
  SOPAC: 559–60
  SWPA: 219, 559–60
  training in: 271–72
  USASOS: 559–60
Camouflage, Japanese
  Carolines: 515
  Corregidor: 620
  Luzon: 598, 610, 629, 639
  Manila: 614
  Okinawa: 647
  Philippines, 1944–45: 633–34
Camp Claiborne: 430
Camp Columbia: 115
Camp construction. *See* Housing construction.
Camp Prairie: 321
Camp Seymour: 124–25
Canada: 276, 288, 299, 302–03, 305, 339. *See also* Alaska Highway; Canol.
Canada-Alaska Highway. *See* Alaska Highway.
Canal Zone: 3, 4, 6–15, 20–21, 27–28, 29–33, 48–49, 50, 52, 53. *See also* Panama, Republic of.
Canals. *See* Waterways systems.
Candaba River: 77
"Canec": 367
Canol: 276, 313–17, 318–28, 335–39
Canton, China: 452
Canton Island: 45–47, 16[illegible] 162, 163–65, 385
Capas: 605
Cape Endaiadere: 193–96, 200
Cape Esperance: 209
Cape Gloucester: 272, 274
Cape Muari: 399
Cape Prince of Wales: 22
Cape Spencer: 281
Cape York Peninsula: 109, 134, 143–44, 150–55, 158, 230, 245
Carabao Island: 57, 104, 624
Carcross: 302–03, 310
Card, Lt. Francis C.: 402
Carew, Col. John J.: 194–98, 203
Cargo unloading and distribution
  Admiralties: 523–24
  Alaska: 297–98
  ASCOM: 600–01
  Assam: 400
  Biak: 537–39
  Guam: 504
  Hollandia: 529–30
  Leyte: 577–79
  Luzon: 592–94, 597, 600, 609
  New Guinea: 533, 535
  Okinawa: 644, 646
  Saipan: 496–97
  Solomons: 546
  SOPAC: 214
  SWPA: 212, 562, 567
Caribbean Defense Command: 28
Carigara Bay: 573, 576
Carmen, Luzon: 76–77, 596, 603
Carnegie, Capt. Orris A.: 190
Carney Airfield: 256
Caroline Islands: 489–90, 491–92, 507, 510, 512–17
Carter, Brig. Gen. A. H.: 319, 322
CARTWHEEL: 225, 229, 234, 244, 245, 255, 272, 275
Casablanca Conference: 225, 328, 418
Casey, Maj. Gen. Hugh J.
  and AAF pressure for construction: 185–87
  arrival in Australia: 99, 127
  and base construction and operation: 238–39, 543
  Bataan defense: 86–90, 94, 97–99
  civilians, employment of: 72
  commands of: 57, 63–64, 130, 230, 571, 650
  and construction, control of: 133–40, 220, 229–30, 651
  on construction design standards: 549
  and construction machinery and equipment, procurement: 110, 236, 547, 556–57
  Corregidor defense: 103
  and elimination of nonessential construction: 154, 217
  and engineer units, control of: 147, 187, 230, 548, 591

Casey, Maj. Gen. Hugh J.—Continued
and engineer units, shortages of: 153–54, 186–88, 234–35, 650
and forestry units: 262
and Japan, assault on: 673–75, 677
Krueger, relationship to: 572
Leyte Campaign: 557, 579–81, 583
Luzon, 1941–42: 68, 74–75, 80–82, 84
Luzon, 1944–45: 588, 591, 598–600
and Manila: 618
and map compilation and distribution: 190, 269
mission: 230
and New Guinea offensive: 237–38, 521
and oil field development plans: 563
and port facilities, construction and repair: 148, 254
professional background: 63–64
reconnaissances by: 178–79, 183, 236–37
and Sansapor-Mar operation: 564
and spare parts procurement: 558
and specialists training: 561, 671
and stock control: 557–58
and supply policy: 141, 263–64, 559
Casey, Capt. Patrick J.: 445
Casualties, Allied
Burma: 444–45, 455, 463
Milne Bay: 177
Casualties, evacuation of: 208–09
Casualties, Japanese: 177, 330, 462, 504
Casualties, U.S.
Attu: 330
Guam: 504
Lae: 251
Luzon, 1944–45: 597, 630
Okinawa: 646, 648
Philippines, 1944–45: 622, 624
Saipan: 500
Solomons: 250
Wakde: 536
Cataisan Peninsula: 573, 576–77, 579, 584
Caucasus: 326
Causeway construction and repair
Carolines: 516
Kwajalein: 482
Leyte: 577
Luzon: 593
Marshalls: 485
New Guinea: 183–84, 187
Cavalry Brigades
1st: 522–23
2d: 522, 524
Cavalry Division, 1st: 271, 526, 576, 587, 610–18, 627, 632, 638–39
Cavalry Regiments
12th: 524
112th: 581
Cave defenses, Japanese
Biak: 540–41
Carolines: 515
Corregidor: 620–21
Guam: 506
Luzon: 598, 609, 627, 629
Manila: 617
Mindanao: 636
Okinawa: 646–48
Philippines, 1944–45: 624, 633
Saipan: 499–500
Wakde: 536
Caves, The, Australia: 260
Cavite Province: 84, 94, 104
Cawnpore: 397
Cebu: 634, 650, 656
Cebu Island: 93, 105, 626, 634, 657
Cement plants, rehabilitation of: 657
Central Pacific Area (CPA): 161, 170, 340, 377–86, 476–79, 489–90, 491, 492, 506–10, 511–12, 518–19, 568–69, 669, 670, 671. *See also* Halsey, Admiral William F.
Central Pacific Base Command: 491, 508
Central Plain, Luzon: 73–75, 587–90, 594, 597–98, 600–03, 607, 610, 612
Central Public Works Department, India: 387, 396
Chabua: 400, 458
Chaffin, Capt. Andrew D., Jr.; 123
Chagres River: 32
Chakulia: 416, 450
Chamberlain, Maj. Gen. Stephen J.: 269
Chame Airfield: 30–32, 50
Champagne, Yukon Territory: 317
Chanco, Capt. Antonio P.: 85
Changsha: 428, 430, 468
Chanyi: 415
Chapin, Lt. Col. W. S.: 663
Chaplains' facilities, construction of: 546
Charlie Lake: 310
Charon Kanoa: 493, 496, 499
Charters Towers Airfield: 110, 115, 122, 128, 137, 141, 260
Chemical Warfare Service: 32
Chen Cheng, General (Chinese): 413
Chen Chin-chieh, Lt. Gen. (Chinese): 414
Chengkung: 402–03, 415–16
Cheng-tu: 430–31, 440, 452, 456, 467
Cheng-tu Valley: 440
Chennault, Maj. Gen. Claire L.
and air offensive in China: 408, 417–18, 421, 432, 452–53
and air units, deployment of: 469
and airfield construction and repair: 437
and AVG: 389, 391–92, 415, 425
and China Air Task Force, 402
and demolition operations: 469
and construction, control of: 451–52

Chennault, Maj. Gen. Claire L.—Continued
and Fourteenth Air Force: 417–18
freedom of action by: 429
Chenoweth, Capt. William C.: 80–81, 87–89, 93, 98–100
Chernofski Bay: 280
Chiang Kai-shek, Generalissimo. *See also* China; China-Burma-India Theater; Chinese Army.
and air offensive in China: 428–29
and airfield construction and repair: 415
and Burma offensive: 404–06, 418, 421
and Burma Road: 421
and Chinese troops in India: 403
Combined Chiefs, exclusion from: 390
and Ledo Road: 411, 460–62
and lend-lease: 402
and road construction and repair: 391
Stilwell, relationship to: 397–98, 470
Chichagof Valley: 329–30
Chief of Engineers. *See also* Reybold, Lt. Gen. Eugene; Schley, Maj. Gen. Julian L.
and Alaska Highway: 300, 314
and bridge types: 448–49
and Canol: 319–20, 323
and construction, control of: 282, 360
and construction design standards: 315–16
and construction materials, procurement: 63
and cost-plus-a-fixed-fee contracts: 24–25, 487–88
and Hawaii defenses: 360
and Ledo Road: 448
and map compilation and distribution: 489–90, 668
mission: 6–7
and pipeline construction and operation: 427, 434, 467
and storage facilities, construction and operation: 442
Chief of Staff, U.S. Army. *See* Craig, General Malin; Marshall, General of the Army George C.
Chiefs of Staff Committee, Australia: 113, 121
Chihchiang: 663
Chilkoot Barracks: 8
China: 398–99, 449–50, 473, 625, 682. Chiang Kai-shek, Generalissimo; China-Burma-India Theater; Chinese Army; Stilwell, General Joseph W.
AAF, construction transferred to: 438–39
AAF pressure for construction: 437–38
airfield construction and repair: 387–89, 392, 397, 402–04, 415–16, 419–20, 425, 429–32, 437, 439–42, 451–53, 456, 468–69, 662–63
base for air offensive: 387–89, 409, 417–18, 421, 425, 428, 430–31, 437–38
base construction and operation: 395–96, 415, 418–21
China Air Task Force (CATF): 402
China-India road. *See* Ledo Road.
civilians, employment of: 403, 415, 431, 440
China—Continued
construction, control of: 403, 416, 437–41
construction, problems of: 452
construction design standards: 451
construction machinery and equipment, procurement: 403, 452, 472
construction materials, procurement: 430, 452
construction programs and progress: 419, 425, 431, 440–41, 452, 661–62
costs of construction: 422, 441, 452
demolintion operations: 469
engineer missions: 387–89, 402–03, 416
engineer organization: 395–96, 416, 439–40, 451–52, 470
engineer units, arrival: 438, 475, 663, 666
engineer units, requirements: 408
hospital construction: 419
housing construction: 402–03, 419
labor force, mobilizing: 403, 451, 472
and Ledo Road. *See* Ledo Road.
lines of communication: 387–88, 391, 394, 397, 405–06, 418–19, 425–26, 429–30, 641
map compilation and distribution: 416, 457–58
Military Engineering Commission: 403, 440, 451
mines, installation of: 462–63
Mitu Road Authority: 436
National Military Council: 390
officials, inaction of: 413–14, 415, 421, 436, 472
photography, aerial: 458
pipeline construction and operation: 390, 418, 426–27, 430, 466, 471, 475, 662, 666
POL supply to: 427, 467–68
RAF in supply role: 391
railroad construction and repair: 389
rainfall, effect of: 425
reconnaissance, engineer: 440
river crossings: 663, 666
road construction and repair: 413, 430, 472, 662
road system, enemy control of: 393
and shipping shortage: 408
storage facilities, construction and operation: 402
supply, by airlift: 387, 391–92, 396–97, 400–01, 415, 418, 420, 425, 426, 431–32, 452–54, 464, 467, 472, 666
supply, measurement tons to: 391, 418, 420, 426, 431, 464, 666
supply, overland: 387–88, 391, 404–06, 408–09, 415, 424–25, 432, 464, 470, 474–75
supply system: 425–26, 429–30
technology, lack of: 413
telephone and telegraph, installation of: 419
tunnel construction and repair: 462
U.S. Task Force in: 390
War Ministry: 408, 422
Yunnan-Burma Highway Engineering Administration: 408, 413–15, 421–22, 465, 663
Yunnan-Burma Railroad Authority: 389, 403, 415

China-Burma-India Theater: 387, 389, 390, 392, 393–99, 426, 427–29, 430, 431, 436–39, 442, 453, 456–58, 463–64, 466, 470, 475, 649, 651, 680. *See also* Assam; Burma; Chiang Kai-shek, Generalissimo; China; India; Stilwell, General Joseph W.; Wheeler, Maj. Gen. Raymond A.
China-India road, proposed: 405
Chindits: 427–28, 445–47, 454–55
Chindwin River: 462
Chinese Army. *See also* Chiang Kai-shek, Generalissimo; China.
and Burma offensive: 408–09, 420–21, 442, 453–56, 458–63
and Burma Road: 408, 458–59
German influence on: 403–04
India, troops in: 403, 416
Kunming Training Center: 455
on Ledo Road: 410–12
supply system: 413–15, 421
training program: 403–05, 420–21, 426, 455–56, 463, 662
X-Force: 405
Y-Force: 405, 408, 413–15, 421, 442, 454–56, 458–62, 470, 662
in Yunnan Province: 462–63
Chinese Engineer units: 411, 431, 465, 470
Chittagong: 467, 471
Chittagong-Tinsukia railway: 467, 471
Chorrera Airfield: 31, 50
Christmas Island: 45–47, 161, 162, 164–65, 385
Chungking: 389, 391, 397, 413, 453, 458, 469–70
Churchill, Winston S.
and Alaska defenses: 328
at ARCADIA Conference: 107
at Casablanca Conference: 225, 328
and China as theater: 390
and Germany—first policy: 107
and guerrilla operations: 427
and Rabaul, isolation of: 255
and SEAC: 428
and U.S. role in Pacific: 128
Cituinan Hills: 639
Civil Aeronautics Authority (CAA): 12, 19, 28, 33–34, 37, 39–41, 46, 51, 59, 66, 278, 281, 283, 287, 292, 296
Civil Constructional Corps, Australia: 142–43, 154, 236
Civil disturbances: 398, 400, 404, 431
Civil engineering missions: 5–6, 20
Civilian Conservation Corps: 19, 22, 35, 653
Civilian defense, Hawaii: 342, 344–46
Civilian Defense Director, Hawaii: 342, 345
Civilians, employment of: 679–80. *See also* Labor forces, difficulties with; Labor forces, mobilizing; Labor forces, shortages in; Labor forces, strength.
Alaska Highway: 300–301, 305–07, 310–18, 334
ASCOM: 585, 599
Civilians, employment of—Continued
Assam: 400
Australia: 112, 120, 142–44, 154–55, 158, 215, 239, 557, 680
Burma: 465, 680
Burma Road: 414–15, 422
Canol: 320–25, 327, 335
Central Pacific: 509
China: 403, 415, 431, 440
Fiji: 268–69
Guadalcanal: 208–09
Hawaii: 23–25, 341, 353–55, 369, 486
Hollandia: 531
India: 392–93, 396, 399, 401, 416–17, 440, 680
Ledo Road: 406, 409–11, 424–25
Leyte: 579, 585
Luzon: 596, 599, 601, 606, 638–39
Manila: 651–52
New Guinea: 181, 198, 202, 231, 235–37, 248, 254, 268
in Philippines, 1941–42: 73, 75, 77, 79–82, 101–02
Philippines, 1944–45: 635, 653
POA: 507
Solomons: 235, 268–69
SWPA: 554, 556
USASOS: 268–69, 653–54
Civilians, evacuation of: 163, 165, 285, 658
Civilians, Japanese, in combat: 646
Clagett, Brig. Gen. Henry B.: 115
Clark, Barney: 64
Clark Field: 59–60, 63–66, 72–73, 598, 655, 672
Clatterbos, Maj. Louis J.: 355
Clay, Maj. Gen. Lucius D.: 549
Climate, effect of. *See also* Ice formation problem; Permafrost; Rainfall, effect of; Snowfall, effect of; Temperature, effect of; Weather, effect of; Winds, effect of.
on air ferry routes: 168
Alaska: 291–92
Alcan Highway: 307
Burma: 393
Guadalcanal: 208–09
India: 393
New Guinea: 151, 157–58, 186, 191, 220, 235
Clipperton Island: 8
Cloncurry: 137, 141
Clowes, Maj. Gen. Cyril A. (Australian): 175, 177
Coal mines, operation of: 289
Coast Artillery Brigade, Hawaiian Separate: 23
Coast Artillery Corps: 348–51
Coast defenses construction: 7
Alaska: 287, 291
Canal Zone: 50
Hawaii: 42, 52–53, 346, 349–52, 365–66, 661
naval guns: 349–52, 374, 661
Panama mounts: 58
Philippines, 1941–42: 57
Cochran, Col. Philip G.: 428, 445

Cocos Island: 8
Coen Airfield: 143–44
Cold Bay: 37, 278, 280–81, 283, 287, 329
Cold storage, installation of. *See* Refrigeration plants, installation and operation.
Cold Weather, effect of. *See* Climate, effect of; Weather, effect of.
Cole, Lt. Col. Heston R.: 124
Colombia: 31–32
Columbus Engineer Spare Parts Depot: 375
Combined Chiefs of Staff. *See also* Joint Chiefs of Staff.
  and Burma offensive: 409, 418, 426
  CBI, plans for: 426, 430, 463
  Chiang excluded from: 390
  India-Burma Theater, directive to: 470
  and Leyte: 572
  and map compilation and distribution: 458
  and Pacific offensives: 463
  and pipeline construction and operation: 426–27
  and Rabaul, isolation of: 225
  and SWPA offensive: 225
Combined Intelligence Center, SOPAC: 270
Combined Operations Service Command (SOCS): 182
Command and staff structures
  Burma: 397–98
  CBI: 397–98, 428–29, 437, 470
  Central Pacific: 506–07
  China: 390–91, 397–98, 428–29
  Hawaii: 491
  India: 397–98
  POA: 377–79
  SEAC: 437
  SOPAC: 232
  SWPA: 128
Commerce, Department of: 278
Committee on Aeronautical Affairs, China: 402–03
Committee on Military Affairs, House: 7
Communications facilities
  on air ferry routes: 161
  Alaska Highway: 303–05, 313
  Australia: 155
  Canol: 337
  China: 419
  Luzon: 601
Communications zones: 438, 662
Concrete. *See* Construction materials, improvised; Construction materials, procurement.
Concrete mixers. *See* Construction machinery and equipment, procurement.
Congress
  Alaska Highway, hearings on: 307–08
  Canol, hearings on: 319, 335–36
  cost-plus-a-fixed-fee contracts, hearings on: 23
  defense appropriations by: 7–14, 19, 38, 40–41, 55–59
  and Selective Service Act: 14
  Truman Committee hearings: 335, 362
Connell, Brig. Gen. Carl W.: 260
Constantine Harbor: 289
Construction. *See* Costs of Construction *and by type.*
Construction, control of: 681
  Alaska, 278, 281–82
  Alaska Highway: 301–03, 313–14
  Assam: 394–95, 413
  Australia: 133–39, 651
  Burma: 394–95
  CBI: 394–98, 651
  China: 403, 416, 437–41
  Hawaii: 341–42, 353, 491
  India: 392–94, 398, 438
  Ledo Road: 409, 433–34
  Marianas: 492
  New Britain: 274
  New Guinea: 236, 650–51
  Okinawa: 657
  Philippines, 1944–45: 601, 651–52
  POA: 379
  Saipan: 501
  SOPAC: 242
  SWPA: 229–30, 521, 548, 651–54
  USASOS: 229–30, 257–58, 651–54
  War Department policy: 360
Construction Command, ASCOM: 579, 619
Construction Corps of the Philippines (CONCOR): 653
Construction design standards: 502
  Alaska: 296–98
  Alaska Highway: 305, 315–18
  Assam: 452, 471
  Australia: 120, 139
  Burma Road: 413
  China: 451
  Hawaii: 366
  India: 401–02, 471
  Ledo Road: 409, 433
  Marshalls: 478
  SOPAC: 266–67
  SWPA: 216–20, 266, 521, 548–51
Construction machinery and equipment, diversified: 264–65, 558
Construction machinery and equipment, improvised: 247, 261–62, 329–31
Construction machinery and equipment, maintenance and repair of: *See* Maintenance and repair, general; Spare parts procurement.
Construction machinery and equipment, procurement: 49–50
  Alaska: 278–80, 297–98
  Alaska Highway: 302–05, 310–11
  Australia: 117, 123–24, 127, 140–41, 144–45, 148–49, 152–53, 155, 215–16, 241, 554
  Burma: 430, 472
  Burma Road: 414
  Canol: 321–23
  CBI: 436, 442

Construction machinery and equipment, procurement—Continued
Central Pacific: 476, 510
China: 430, 452, 472
Guadalcanal: 209
Hawaii: 43–44, 343, 355–56, 362–63, 366, 369, 372, 375–76, 488
India: 398, 402, 420, 450
Kwajalein: 482, 484–86
Ledo Road: 406, 409–13, 433, 449, 453–54, 456–57, 465, 470
Marshalls: 478
New Britain: 273
New Caledonia: 212
New Guinea: 151, 155, 202
New Zealand: 47–48
Philippines, 1941–42: 62–63, 69–70
Saipan: 496–98
SWPA: 210–12, 236, 264
War Department policy: 547, 549
Construction materials, improvised
Australia: 125–26, 149, 261–62
Bataan: 93–94
Ledo Road: 663–64
New Caledonia: 165
Construction materials, measurement tons, for Canol: 323
Construction materials, procurement: 49–50, 381–82, 508–09
Alaska: 278–81, 289, 295–98, 333–34
Alaska Highway: 301, 316–18, 334
Assam: 400–401, 424, 441–42, 471
Australia: 261–62, 266–67, 554–56
Bataan: 92–94, 99–100
Burma: 430, 466
Burma Road: 458
Canol: 323–27
CBI: 436
China: 430, 452
Corps of Engineers and: 682
Corregidor: 103–04
Hawaii: 342–43, 353–57, 362–63, 366–67, 375–76
Hollandia: 531–32
India: 397, 399–400, 402–03, 424, 471
Kwajalein: 484–86
Ledo Road: 406, 409, 424, 447, 449–50, 456, 465–66, 471, 664
Leyte: 574–75, 586
Luzon: 602, 612
Marshalls: 478
Milne Bay: 239
New Caledonia: 214
New Guinea: 155, 238, 258, 262–63, 266–67
New Zealand: 213–14, 261–62, 266–67
Okinawa: 657
Philippines, 1941–42: 69–70
Saipan: 496–97
SOPAC: 260–64
Construction materials, procurement—Continued
SWPA: 260–63, 548, 554, 682
by USAFIA: 117–18
Construction missions
Corps of Engineers: 5–6
Quartermaster Corps: 6, 20
Construction problems: 20–21, 679–80
Alaska: 11, 21–22, 35, 280–83, 291–96
Alaska Highway: 308–09, 312
ASCOM: 584–85
Assam: 416–17
Australia: 116–17, 119–22, 135, 144, 148–49, 155, 241–42
Burma Road: 414–15
Canal Zone: 11, 14–15, 20–21, 30–31
CBI: 393–94
Central Pacific: 384
China: 452
Hawaii: 11, 19, 39, 52, 365–66
India: 393–94, 401–02, 417
Ledo Road: 466
Leyte: 585
Luzon: 632
New Guinea: 151, 157–58, 181–82, 257
Philippines, 1941–42: 59–61, 64–65
SOPAC: 542
SWPA: 542
Construction programs and progress
Admiralties: 543
Alaska: 33–37, 50–52, 276–78, 280–81, 283–84, 286–88, 291, 298, 333–34
Alaska Highway: 305–15
Allied Works Council: 141–45, 223–24
Assam: 393–94, 396–97, 399–400, 404
Australia: 113–22,, 133–34, 138–44, 152–53, 214–15, 217, 220, 223, 239, 260
Bataan: 58, 95–96
Biak: 537–38
Burma: 393–94, 464, 661–62
Burma Road: 406, 413–15, 418–19, 421–22, 425–26, 435–36, 442, 458–59, 465–66, 473–75, 662–63, 666
Canal Zone: 29–33, 50
Canol: 321, 325–27, 336–38
Canton Island: 47
Carolines: 515–17
CBI: 431, 649
Central Pacific: 381–82, 476, 506, 511–12
China: 419, 425, 431, 440–41, 452, 661–62
Christmas Island: 47
Corregidor: 58, 65–66, 71, 102–04
Fiji: 242–43
Guadalcanal: 172–73, 208–09, 232, 569, 661
Guam: 517
Hawaii: 38–45, 51–53, 361, 363, 365, 372–74, 486–87, 506–10, 649
Hollandia: 541–42, 544
India: 392–94, 396–97, 399–400, 404, 407–08, 416–17, 438–39

Construction programs and progress—Continued
Japan, for assault on: 675
Lae: 258
Ledo Road: 408–13, 418–19, 422–25, 426, 431–34, 442–49, 453–54, 456–57, 465, 472, 474–75, 662–64
Manila: 650
Manila Bay area: 58
Marianas: 506
Milne Bay: 181–82, 220–22, 238–39
naval construction: 287
New Britain: 273
New Caledonia: 206–07, 569, 661
New Guinea: 133–34, 174–75, 181–85, 220–22, 231–32, 238, 244, 246–47, 258, 541–42, 548
New Hebrides: 569
New Zealand: 222, 233, 661
Okinawa: 649
Philippines, 1941–42: 59–66, 71–72, 86–87
Philippines, 1944–45: 649
POA: 378–79
Port Moresby: 133–34, 181–82, 185, 220–22, 235
Saipan: 497, 499–503, 511
Solomons: 526, 544–46, 568–69, 661
SOPAC: 220–24, 231–32, 242–43, 542–43, 648–49
SWPA: 220–4, 235, 542–43
Wakde: 543–44
Construction Service, CPA: 507–08, 510
Construction Service, SOS CBI: 438, 475, 681
Contact Creek: 314
Contract negotiation. *See* Administrative procedures; Cost-plus-a-fixed-fee contracts.
Cook, Les: 309
Cooktown Airfield: 143–44
Coral: 385–86
Coral Sea, Battle of, 150, 157, 168
Cordillera Central Mountains: 627–28
Cordova, Alaska: 279, 283
Corlett, Maj. Gen. Charles H.: 331, 477, 482
CORONET: 677, 678
Corozal, Post of: 10, 14
Corps, Philippine Army
I: 87–91, 96–97, 99–100
II: 87–91, 97, 99–100
Corps. *See also* Marine Amphibious Corps.
I: 196, 528–29, 587, 592–95, 601, 610, 625, 627, 632, 675–76
IX: 675–76
X: 574–77, 582, 635
XI: 567, 608–09, 619–20, 625, 632, 638, 675–76
XIV: 255, 526, 574, 587, 592–96, 599, 601, 610–12, 625, 627, 630–32
XXIV: 574–76, 582, 643–45, 649, 657
Corps of Engineers, Philippine Army: 66, 68–69
Corps of Engineers, U.S. Army. *See* Engineers, Corps of.
Corpus Christi, Tex.: 326
Corregidor Island: 55, 57, 58, 61, 65–66, 71, 72–80, 93–95, 101–06, 619–21, 625
Cost-plus-a-fixed-fee contracts
Congress and: 23
Hawaii: 353, 363, 371–72, 487–89, 507
Philippines, 1941–42: 61
War Department policy: 24
Costa Rica: 31–32
Costs of construction
Alaska: 278
Allied Works Council and: 152, 223–24, 239–41, 260
Australia: 152, 223–24, 240–41
Burma Road: 414, 421, 435–36
Canal Zone: 50
Canol: 338
China: 422, 441, 452
Hawaii: 52, 342, 353, 355–58, 363, 371–72, 488
Ledo Road: 421
Philippines, 1941–42: 61, 66, 70
Counterattacks, Japanese: 330, 514, 526, 539–40. *See also* Suicide attacks, Japanese.
Couplings, victaulic: 427
Covell, Brig. Gen. William E. R.: 437–40, 456, 466, 664
Craig, General Malin: 7–8
Crow River: 309
Curtin, John: 118, 120–21, 140, 215
Cutcut River: 603, 606
CYCLONE: 561
Cyclops Airfield: 531–32
Cyclops Mountains: 527

Dagupan: 600
Dagupan air strip: 599–600
Dagupan River: 593, 596, 600
Dale, Wing Comdr. William A. C. (RAAF): 533, 561
Dallas huts: 266
Dam construction and repair: 285–86
Damage control, Corregidor: 102–04, 146
Damortis: 76, 627
Daraga: 638–39
Darwin: 45, 109, 110–11, 112–13, 114, 115–19, 122, 123–24, 134, 147–48, 158, 231, 240–41
Darwin Civil Field: 110
Darwin RAAF Field: 110
Davao: 635
Davao Gulf: 635
Davidson, Brig. Gen. Howard C.: 429
Dawson, Lt. Col. Louis Y., Jr.: 408, 413–15, 420–22, 435–36, 458–59, 461–62, 465
Dawson, Col. Miles M.: 559
Dawson Creek: 299, 301, 305, 312, 315, 327, 334
DC-3's: 181
Dean, Col. Reginald L.: 598–99, 613
Decker, Brig. Gen. George H.: 608
Defence Department, Australia: 124, 131
Defense appropriations. *See* Congress, defense appropriations by.
Defense Battalions, Army
3d: 478, 485

Defense Battalions, Army—Continued
4th: 478
Defense battalions, CPA: 381
Defenses, build-up of
Alaska: 7–8, 12–14, 16–19, 28, 35–36, 276–78, 298
Australia: 109–11
Burma: 391
Canal Zone: 6–15, 20–21, 27–28, 32–33
Canton Island: 162, 164–65
China: 387–90
Christmas Island: 162, 164–65
Corregidor: 57, 619–20
Fiji: 162, 164, 232–33
Hawaii: 6–16, 19–20, 27–28, 341–42, 362
New Caledonia: 160, 162, 164–66
New Hebrides: 169–70
Panama: 12, 15
Philippines, 1941–42: 55
SOPAC: 169–71
Del Carmen Airfield: 63–66, 73, 79, 655
Del Gallego: 81
De Longe, Maj. Merrill E.: 270
Del Monte: 61, 65, 71
Demolition operations
Admiralties: 523–24
Australia: 138–39, 216
Bataan: 100–01
Biak: 540–41
Burma: 445
Burma Road: 455
Carolines: 515–16
Central Pacific: 382–83
China: 469
Corregidor: 620–21
Guam: 506
Hawaii: 352–53, 361
Kwajalein: 479–81
Leyte: 578
Luzon: 74–84, 597, 609–12, 627, 632
Manila: 84, 617
Marshalls: 483–85
Mindanao: 106
New Guinea: 146
Okinawa: 646–48
Philippines, 1941–42: 66–68, 74, 596
Philippines, 1944–45: 621–24, 633
Saipan: 496–98, 500
SOPAC: 542
SWPA: 542
Wakde: 536
Demolition operations, Japanese
Leyte: 582
Luzon: 590, 595, 602–04, 610–11, 618, 626, 629, 638
Manila: 613–14, 619, 656
Mindanao: 635
Dengue fever: 186, 517
Denver, Rio Grande and Western Railroad: 389
Department of Interior, Australia: 121
Department of the Interior: 13, 19, 288. *See also* Ickes, Harold L.
Department of Public Works, New Caledonia: 163, 223
Depot construction and operation. *See* Base construction and operation; Base construction and operation, Japanese; Storage facilities, construction and operation.
Depot Field: 506
Derby, Maj. George T.: 112–14, 117, 120
Derra: 115
DeWitt, Lt. Gen. John L.: 276
and air build-up: 276
and airfield construction and repair: 18–19, 22–23, 28, 34–36, 284
and Alaska defenses: 11, 33, 331
and construction, control of: 20, 25–26, 28, 34, 282
and construction programs and progress: 34–37, 276–78
and engineer units, strength: 276–78
and port facilities, construction and repair: 281
and storage facilities, construction and repair: 37, 281
and threat to Alaska: 284
Diamond Head: 351
Dibrugarh: 400, 427, 467n
Digboi: 434, 457, 463, 467n
Dimapur: 446
Dimond, Anthony J.: 299
Dinalupihan: 79, 609
Dingalan Bay: 594
Dinjan: 391, 400
Diseases, effect of: 393, 423–24, 433, 462, 466, 541
Distinguished Unit Citation awards: 455, 536
Districts, SOS CBI: 438–40, 452
Divisions, SOS CBI
1st: 438
2d: 439
Dobodura: 156, 193–96, 198–99, 202–03, 205, 235–38, 245, 257–58
Dock construction and repair. *See* Port facilities, construction and repair.
Dogs, training with: 490–91
Dorn, Col. Frank: 421
Douglas Fir: 670
Drawings, standard. *See* Construction design standards.
Dredging operations: 501, 516, 585, 656. *See also* Port facilities, construction and repair; Port facilities, construction and repair, by Japanese.
Driniumor River: 541
Drury, Maj. Harold F.: 608
Duke River: 311
Dukws: 273–74, 476, 497, 506, 530, 562, 578, 644
Dulag: 573–78
Dulag Airfield: 573–74, 576, 579–80, 584–86
Dulag-Burauen road: 581–82, 584
Dunbar, Col. Ernest A.: 607

Dunn, Col. Beverly C.: 18, 22, 28, 33–34, 37, 49, 278, 280–82, 287
Dunne, Col. David M.: 626
Dutch Harbor: 12, 16–18, 28, 35–36, 276, 278, 284, 287, 288, 290, 308, 322

E. W. Elliott Company: 302, 311
Eagle Farm Air Base: 115, 127, 141, 260
Earth Moving Manufacturers Group: 140, 213
East-West Road, Australia: 114
Eastern Command, British: 440
Economic Cabinet, Australia: 215
Eddleman, Brig. Gen. Clyde D.: 613
Edmondton: 288, 299–301, 311, 313, 321, 324, 327
Efate Island: 169–70, 212, 214, 222, 662
Eichelberger, Lt. Gen. Robert L. *See also* Armies, Eighth; Corps, I.
  and Biak: 541
  in Buna campaign: 199, 201–03
  commands of, 196, 586
  and Hollandia: 528–29
El Fraile Island: 57, 104, 622–24
Electric power plants, installation of. *See* Power plants, installation and operation.
Electrical fixtures: 261
ELKTON plan: 225, 231, 234, 235
Ellice Islands: 380
Elliott, Col. John C. B.: 584
Ellison, Lt. Col. Marvin C.: 522
Ellison, Maj. William J., Jr.: 258
Elmendorf Field: 10, 12, 14, 16–19, 28, 34–37, 278, 283, 287, 296
Ely, Col. William J.: 239, 246, 584
Eman Point: 89
Embessa: 181
Embogo: 195
Embogo River: 202
Emmons, Lt. Gen. Delos C. *See also* Hawaiian Islands.
  and air defense measures: 344, 347–48
  and air ferry routes: 168–69
  and airfield construction and repair: 361
  and ammunition storage plan: 368
  and coast defenses: 350–51
  command of: 161, 344
  and construction, control of: 354, 360–61
  and construction machinery and equipment, procurement: 355, 375
  and construction programs and progress: 361, 365, 367
  and food production: 343–44
  and mines, requisition for: 352
  and naval guns, emplacement of: 374
  and priority ratings: 346
  and road construction and repair: 369
  and storage facilities, construction and operation: 366–67
Empress Augusta Bay: 255
Ende, Capt. Carl F.: 48
Engebi Island: 484–85
Engineer Airborne Aviation Battalions
  871st: 248–49, 252, 254
  872d: 248, 254, 533
  873d: 633
  875th: 533
  879th: 450, 454–55
Engineer Airborne Aviation Company, 900th: 445
Engineer Airborne Combat Battalion, 127th: 609–10, 630–31
Engineer Aviation Battalions
  802d: 36, 278, 286, 290
  803d: 63, 69, 73, 79, 93, 95–98, 100, 103, 105
  804th: 41, 47–53, 162, 340–41, 348, 380–86, 498–500, 518
  805th: 50, 500
  807th: 281, 284, 297, 331
  808th: 122–24, 127, 148, 153, 157–58, 181–182, 187, 235, 258, 267, 275, 581
  810th: 167, 171, 206, 223, 256
  811th: 167, 223, 233, 640
  813th: 283, 289
  821st: 71, 232–33, 256, 581
  822d: 207, 232, 256
  823d: 398, 400, 406, 409–12, 424
  828th: 212, 232, 256, 599
  836th: 258, 526, 536, 564–65, 599
  839th: 264
  841st: 274, 603–05, 612
  842d: 235, 265
  848th: 452
  849th: 433
  853d: 450
  854th: 478, 484, 517
  857th: 235, 258
  858th: 663
  860th: 275, 540
  863d: 275, 539–41, 602
  864th: 264, 274, 538–41, 599
  865th: 634
  930th: 468, 662
  1874th: 562
  1875th: 450, 472
  1876th: 600, 603–04, 613
  1877th: 450, 468
  1878th: 503
  1879th: 599, 605, 611
  1880th: 663
  1881st: 564–65, 579
  1883d: 433, 444, 447
  1884th: 515
  1887th: 515–16
  1888th: 450, 468
  1897th: 564–66, 632
  1905th: 434, 447
  1913th: 274, 603–04

Engineer Aviation Companies
804th: 38, 41
805th: 29, 50
807th: 36, 280–81
809th: 63
Engineer Aviation Regiments
28th: 19, 22, 36n
931st: 525, 532
Engineer Aviation Topographical Companies
955th: 223, 270
958th: 458
960th: 270
Engineer Base Equipment Company, 617th: 525, 564
Engineer Base Shop Battalion, 411th: 229
Engineer Base Topographical Battalion, 30th: 667
Engineer Boat and Shore Regiments
532d: 246, 251, 253, 530, 632
533d: 593, 635
534th: 567, 594
542d: 530, 535–36, 538
543d: 562, 565, 593, 633
544th: 567, 592–93
592d: 608, 620, 623, 631
593d: 533, 535–36, 562
594th: 593, 595
Engineer Brigade, 1st Provisional: 511–12
Engineer Camouflage Companies
639th: 282–83, 291
641st: 559–60
642d: 559–60
Engineer Combat Battalions: 144–45, 547
3d: 43–44, 369, 531, 586, 620, 635–36
6th: 564, 596, 627, 638–39
13th: 328–31, 478–79, 582, 645
14th: 69, 73, 80, 90–91, 94, 98, 100
27th: 533, 535–36, 561–62
34th: 495
50th: 478, 482
52d: 514, 516–17, 634
57th: 167, 170, 207–09, 526, 634
65th: 43, 209, 249–50, 342, 352, 369, 597, 628
79th: 530–31
102d: 381–83, 478, 482–83, 485, 495–96, 499–500
104th: 482–83, 485
106th: 567, 635
108th: 629
112th: 535
113th: 609, 619–24, 638–39
114th: 181, 192, 194–95, 198–203, 205, 271, 274, 628–29
115th: 595
116th: 171, 182, 237, 246–47, 261–62, 271, 530, 533, 535, 538–40, 632–33
117th: 171, 249–50, 255–56, 526, 595, 598, 602, 604, 610–11, 615, 638
118th: 233, 245, 249–50, 596, 598, 603
131st: 212, 223
132d: 503–04
Engineer Combat Battalions—Continued
152d: 381–83, 386, 495
154th: 514
155th: 515–17
186th: 597
209th: 433–34, 448, 454–55, 465, 472, 664
233d: 504
236th: 454–55, 465, 473
242d: 504
302d: 503–06, 644, 646
306th: 514–16
321st: 582
340th: 603
1279th: 611, 639
1341st: 495, 506
Engineer Combat Companies
32d Separate: 17, 33, 36, 278
59th Separate: 246, 251, 273
223d: 332–33
404th: 246
521st: 332–33
Engineer Combat Groups
1112th: 537, 564–65, 580
1129th: 632
1138th: 514–15
1165th: 495–96
Engineer Combat Regiments
3d: 10, 16, 23, 38, 42–43, 342, 352
11th: 10–11, 14, 21, 29
14th: 61, 68
18th: 295, 300, 302–03, 310–17, 331
34th: 41–42, 53, 342, 354, 369, 375, 381, 478, 482, 495
35th: 300–301, 305, 310–16, 326, 335
50th: 328–33
131st: 526, 544
151st: 36, 278–79, 281, 284, 289
Engineer Combat Squardron, 8th: 271, 522–24, 613, 615, 627, 632
Engineer Construction Battalions: 547–48
43d: 564–65, 599, 613, 618
46th: 579
47th: 501–02, 511
239th: 634
240th: 579–80
339th: 577, 638
382d: 434, 440, 450, 456
1304th: 465, 470, 664
1398th: 502
1399th: 509
Engineer Construction Brigades: 548
5201st: 548, 571
5202d: 548, 588, 591, 594, 601, 603–06, 652
Engineer Construction Command (ENCOM): 651–54, 656, 669, 681
Engineer Construction Groups
1112th: 565–66, 632
1136th: 632

Engineer Construction Groups—Continued
1176th: 495, 498, 500–01, 511–12
1181st: 657
Engineer Depot Companies
301st: 153
439th: 618
452d: 375, 510
456th: 411, 418
Engineer Dump Truck Companies
195th: 398, 403
198th: 239
576th: 187–88
Engineer General Service Battalion, 47th: 495, 501
Engineer General Service Regiments: 210, 307, 436
42d: 279, 283, 286–87
43d: 124, 127, 147–48, 158, 175–78, 182, 188, 198–99, 203, 235–38, 261–62
45th: 398–400, 406–07, 409–12, 424, 432–33, 447, 453
46th: 124–28, 144–45, 149–51, 155–56, 158, 175–76, 187, 235, 238–39, 246
47th: 70, 369, 381, 478, 482, 485, 495
91st: 272
93d: 302–03, 310, 317
95th: 305, 310–11, 317
96th: 272, 564–65
97th: 303, 310, 312, 314–15, 317
176th: 292
177th: 287, 289
330th: 411–12, 420, 424, 431–35, 444, 447–48, 465, 470
331st: 287
339th: 239
340th: 303, 310–11, 314–17
341st: 305, 309–11, 316–17
349th: 331
Engineer Heavy Ponton Battalions
89th: 321–22
90th: 321, 326–27
556th: 575, 582–83, 601–02, 611–14, 619
Engineer Heavy Shop Company, 445th: 239
Engineer Hill: 329–30
Engineer Intelligence Section, USASOS, 269
Engineer Light Ponton Companies
71st: 444, 472–74, 663
73d: 302, 312, 317
74th: 301, 312, 317
75th: 470–71
76th: 444, 448
77th: 444
191st: 663
504th: 455
506th: 575, 596, 601
510th: 575, 601
530th: 575, 595–96, 601, 611–12, 615–16
Engineer Maintenance Companies
468th: 290
472d: 213
479th: 411, 433
Engineer Maintenance Companies—Continued
963d: 613, 618
Engineer Map Depot Detachments
1603d: 553
1604th: 553
1608th: 553–54
Engineer missions
Admiralties: 523–25
Alaska: 278, 291, 339
Alaska Highway: 300
Australia: 111–14
Burma: 387–89
Canada: 276, 339
Carolines: 514–16
CBI: 389, 431
Central Pacific: 381–83, 518–19
China: 387–89, 402–03, 416
Guam: 504–06
Hawaii: 340–45, 353, 358, 369–70, 372–73, 507–08
Hollandia: 527–28
India: 396, 404
Japan, in assault on: 674–75, 677–78
Kwajalein: 477–78
Leyte: 574–75
Luzon: 72–85, 587–92, 601–03, 605–06, 610–11, 626–27, 637
Marianas: 493
Marshalls: 477–78
New Guinea: 133–34, 160, 174, 521, 541–42
Okinawa: 642–47
Philippines, 1944–45: 570–71
POA: 507–08
Rabaul: 244
Saipan: 496–97
Solomons: 172–73, 244–45, 249
SOPAC: 275, 542, 568–69
SWPA: 130–38, 275, 520–21, 542
USASOS: 521
Engineer Office, CPA: 377–78. *See also* Honolulu Engineer District.
Engineer organization
Admiralties: 522
AFPAC: 650
Alaska: 281–83, 333
Alaska Highway: 302–05, 313–14, 316–17
ASCOM: 571–72
Assam: 438–39
Australia: 120–21
Bataan: 86–87, 99
Burma: 438–39
Burma Road: 422
CBI: 395–96, 398–99, 429, 431, 437–39, 453
China: 395–96, 416, 439–40, 451–52, 470
Hawaii: 340–42, 353–54, 358, 360–61, 486, 491–92
Hollandia: 527–28
India: 395–96, 398–99, 403–04, 415–16, 429, 438–39
India-Burma Theater: 470, 475
Japan, for assault on: 676–78

Engineer organization—Continued
Ledo Road: 409–10
Leyte: 579, 651
Luzon: 601, 650–51
Marianas: 493–95
New Guinea: 147, 174, 521
Okinawa: 657
Philippines, 1941–42: 66, 69
in POA: 507
Saipan: 511–12
SOPAC: 232, 243, 520–21, 543, 568–69
SOS CBI: 398–99, 438–39
SWPA: 130–31, 230, 235, 243–44, 520–21, 548, 551–52, 556, 571–72, 650–51, 654
USAFIA: 119
USASOS: 243–44, 257, 520–21, 528–29, 571–72, 650–54
Engineer Parachute Combat Battalion, 161st: 586, 620
Engineer Petroleum Distribution Companies
138th: 467
699th: 449
706th: 449, 457
709th: 450, 466, 471, 664
775th: 449, 457, 471
776th: 450, 466
777th: 450, 467
778th: 457, 466
779th: 457, 471
780th: 457, 471
1381st: 471
1382d: 471, 664
Engineer Port Construction and Repair Group, 1052d: 264
Engineer Railroad Battalion, 714th: 287
Engineer Section, SOS CBI: 398
Engineer Separate Battalions
91st: 144–45, 149–50, 155, 178, 182, 235
96th: 144–52, 155, 181, 183, 235, 238
388th: 321, 326
Engineer Special Brigades: 226–30, 246, 578, 644, 646
1st: 643–46
2d: 228, 235, 246, 253, 273–74, 524, 530, 538, 562, 576, 578, 634, 639, 670, 676
3d: 521, 532–33, 562, 592, 635, 676
4th: 252, 567, 592, 601, 676
Engineer survey. *See* Reconnaissance, engineer.
Engineer Survey Liaison Detachment, 1679th: 608
Engineer Topographical Battalions
29th: 23, 33, 278, 290, 302, 306, 490, 667
64th: 489–90, 510
648th: 190–91, 269–70, 301, 306, 552–53, 607, 666
650th: 552, 607
651st: 490
653d: 440, 458
Engineer Topographical Companies
64th: 376–77, 381–82, 490
69th: 190, 200, 270
Engineer Treadway Bridge Company, 1011th: 601–02, 612–13
Engineer Unit Training Center: 430
Engineer units, arrivals and departures
Admiralties: 525
Alaska: 16–18, 279–83, 285–91, 295, 297–98, 331
Alaska Highway: 300–305, 307, 316, 334
ASCOM: 598–99
Assam: 400, 442
Australia: 118, 122–26, 131, 144–49, 152, 190, 228, 247
Biak: 538–40
Burma: 445, 454–55, 466, 468, 472
Burma Road: 459
Canol: 321, 326, 335
Carolines: 514–16
CBI: 430, 436–37
China: 438, 475, 663, 666
Fiji: 171, 263
Guadalcanal: 206–07, 209, 255–56
Guam: 503–04, 517
Hawaii: 369, 375–76, 490, 666-67
Hollandia: 530
India: 398, 411, 430, 440, 450, 458, 475
India-Burma Theater: 475
Kwajalein: 484
Lae: 258
Ledo: 406–09, 457
Ledo Road: 406–12, 432–34, 449–50, 454–55, 457, 471
Leyte: 579–81
Luzon: 599–600, 602, 607, 610–11
Marianas: 506
Marshalls: 485
Milne Bay: 238–39, 521, 558
New Britain: 274
New Caledonia: 164–67, 206, 213, 223
New Guinea: 144–49, 151, 154–55, 157–58, 187–88, 235, 239, 258, 274–75, 533, 551–52, 558
Okinawa: 657
Philippines, 1941–42: 63
Philippines, 1944–45: 666–67
POA: 640
Saipan: 496, 498–501
Solomons: 249, 526, 544
SOPAC: 161, 164–68, 171–72, 226–27, 266, 270, 541
SWPA: 227, 263, 266, 270, 559–60, 564
Wakde: 536
Engineer units, control of: 681
by AAF: 547
Admiralties: 525–26
AFPAC: 649–50
by ASCOM: 591, 594
India: 400
Luzon: 591, 612–13, 626
New Guinea: 174, 182, 187, 202
Okinawa: 657
POA: 649–50

Engineer units, control of—Continued
SOPAC: 243, 543
SWPA: 229–30, 543, 547–48, 649–50
USASOS: 187
Engineer units, imbalance in: 680–81
Engineer units, National Guard: 5
Engineer units, organization: 681
Engineer units, requirements
Assam: 417
Australia: 133
Biak: 538
CBI: 395, 426, 436, 463–64
Central Pacific: 489–90
China: 408
Guam: 503
Hawaii: 16, 342–43, 489–90
Japan, for assault on: 672, 674–75, 677–78
Ledo Road: 406, 409, 423–25, 429, 456–57, 464
Luzon: 590–91
New Guinea: 152–54, 187–88, 244–45
Okinawa: 643
Philippines, 1944–45: 626–27
Rabaul: 234
Saipan: 494–95
SOPAC: 232, 234
SWPA: 231–32, 234–35
Engineer units, shortages of
Alaska: 278–79
ASCOM: 586
CBI: 680
Leyte: 586
New Guinea: 238
Philippines, 1941–42: 59–60
SOPAC: 210–11, 267–68, 680
SWPA: 210, 267–60, 547–48, 680
USASOS: 238
Engineer units, specialized. *See* Specialists, shortage of; Specialists, training.
Engineer units, strength
Alaska: 33, 35–36, 53, 278, 283
Alaska Highway: 307, 680
ASCOM: 575
Australia: 144
Bataan: 88
Burma Road: 466, 473
Canal Zone: 10, 53
Canol: 338
Central Pacific: 519
Fiji: 163
Hawaii: 10, 38, 42, 342, 380, 680
Hollandia: 529
India: 404, 450
Kwajalein: 478, 482
Ledo Road: 432, 442, 454, 456, 465, 664
Leyte: 575
Luzon: 587, 592, 594, 601
Milne Bay: 175, 239
New Caledonia: 256
Engineer units, strength—Continued
New Guinea: 182, 569
Okinawa: 645
Philippines, 1941–42: 61, 68–69
POA: 507, 519
prewar and postwar: 5, 679
Saipan: 512
SOPAC: 210, 243, 275, 520, 569, 661
SWPA: 210, 243, 275, 520, 567, 569, 666
USASOS: 654
Engineer units work potential formula. *See* Work potential formula.
Engineer Water Supply Company, 1504th: 613, 618
Engineering and Terrain Intelligence Team: 668–69
Engineers, Chief of. *See* Chief of Engineers.
Engineers, Corps of
civil engineering missions: 5–6, 20
civilians, employment of: 679–80
construction, problems of: 20–21, 679–80
construction materials, procurement and use: 682
construction missions: 5–6
construction transferred to: 20, 25–26
defense appropriations, share of: 9, 14
engineer units, imbalance in: 680–81
engineer units, strength prewar and postwar: 5, 679
liaison, interservice and Allied: 680
logistical tasks: 5
military engineering missions: 4–5
mobilization plans: 5
spare parts procurement: 682
stock control: 682
supply system, deficiencies in: 682
training, deficiencies in: 682
training missions: 227
and war plans: 4–7
Engineers as artillerymen: 162
Engineers as infantrymen
Attu: 330
Australia: 149–50
Bataan: 87–100
Biak: 539–41
Burma: 444, 453–55, 463
Carolines: 514–15
Guadalcanal: 207
Guam: 503–04
Kwajalein: 480–82
Luzon: 597–98, 609
Manila: 617
Marshalls: 483
New Guinea: 175–78, 205, 252–53, 535, 543
Okinawa: 646
Saipan: 496, 498–500
Solomons: 249–51, 526–27
Wakde: 535–6
Engineers, Office of Chief of. *See* Chief of Engineers.
Eniwetok Island: 477, 483–85
Entrance Creek: 193, 200, 202–03

Equipment, construction. *See* Construction machinery and equipment.
Equipment Maintenance School: 672
Escolta, Manila: 614
Espíritu Santo Island: 171, 206, 214, 221–22, 547, 569
European Theater of Operations: 117, 227
Ewa Marine Air Station: 53–54
Excursion Inlet: 287

F-4's: 270
Faie Island: 516
Fairbanks: 19, 22, 34, 283, 288, 292, 293, 295–96, 313, 315, 325–27, 335–38
Falalop Island: 515–16
Far Eastern University: 651
Farrar, Capt. Willard: 112–14
Farrell, Brig. Gen. Thomas F.: 430, 437–38, 448–51, 456, 462, 467, 475, 663–64
Fasari Airfield: 180–81, 192
Federal Bureau of Investigation: 487
Federal Works Agency (FWA): 317
Ferry operations. *See* River crossings.
Fertig, Col. Wendell W.: 61–62, 65, 71–72, 79, 87, 92, 95, 100, 106, 634
Fiji: 45, 46, 48, 118, 161, 162, 163, 164, 171, 214, 220–22, 232–33, 242–43, 256, 263, 268–69
Finschhafen: 234, 244, 252–54, 258, 272–73, 528–29, 546, 554, 557–58, 561
Fire-fighting: 518, 530
Fischer, Maj. Harry O.: 62, 100
Flame throwers, tactical use: 245, 249, 383, 462, 480, 483, 496–97, 500, 515, 536, 541, 562, 621, 647
Flanders, Maj. Edward A.: 380
Fleets
  Pacific: 232, 675
  Third: 576
  Fifth: 492, 496
  Seventh: 265, 576, 578
Fleming, Maj. Robert J., Jr.: 168
Floating depot concept: 558, 670
Floridablanca: 655
Food production, Hawaii: 343–44, 358
FORAGER: 492, 496
Forestry units, requirements: 262
Formosa: 463, 467
Fort Belvoir: 653
Fort Drum. *See* Carabao Island.
Fort Fitzgerald: 320–22, 324
Fort Frank. *See* Carabao Island.
Fort Hertz: 427, 430, 434
Fort Hughes. *See* Caballo Island.
Fort Kamehameha: 340
Fort Kobbe: 14
Fort McKinley: 61, 64, 66, 84, 615, 656
Fort McMurray: 320–21
Fort Mears: 280
Fort Mills. *See* Corregidor Island.
Fort Nelson: 299, 301, 305–09, 311, 315–17, 334
Fort Nelson River: 309
Fort Ord: 328
Fort Pikit: 635
Fort Raymond: 33
Fort Richardson: 14, 33–34, 36, 282
Fort St. John: 299, 301, 304–10, 312, 315
Fort Shafter: 10, 14, 16
Fort Simpson: 315, 326
Fort Smith: 321–22, 327
Fort Stotsenburg: 45, 598
Fortifications, construction of
  Admiralties: 523
  Bataan: 87–90, 97
  Hawaii: 346, 365, 373
  Solomons: 526
Fortifications, construction of, Japanese
  Biak: 537, 542
  Carolines: 515
  Central Pacific: 383
  Corregidor: 620
  Leyte: 582
  Luzon: 598, 609–10, 627
  Manila: 614–15, 617
  Mindanao: 636
  New Britain: 274
  Okinawa: 642, 644–45, 646–48
  Philippines, 1944–45: 633–34
  Saipan: 496–98
  SOPAC: 542
  SWPA: 542, 562
  Wakde: 536, 542
Fowler, Brig. Gen. Raymond F.: 362, 558
France: 13, 163
France Field: 8
Frank, Maj. Gen. Walter H.: 488
Fraser, Peter: 48, 213
Freight unloading and distribution. *See* Cargo unloading and distribution.
Fremantle: 240
French canal, Panama: 32
Frink, Maj. Gen. James L.: 534, 556, 650–51. *See also* United States Army Services of Supply.
Fritsche, Capt. Frederick L.: 32
Frostbite: 292
Fuel storage construction. *See* Storage facilities, construction and operation.
Fuller, Maj. Gen. Horace H.: 236–37, 539–40
Fuller, Kent: 325
Futema Airfield: 658
Fyzabad: 397

Galápagos Islands: 8
Galena Airfield: 288, 295
Ganges River: 467
Garapan: 493, 498
Garapan–Charan Kanoa road: 502
Garbutt Field: 110, 115, 141,

Garrison forces
Central Pacific Area: 381, 386
Kwajalein: 478, 484
Marshalls: 478, 484–85
Okinawa: 643–44, 657–58
Saipan: 495
Gasoline. *See* POL (petroleum, oil, and lubricants).
Gasoline storage facilities. *See* Storage facilities, construction and operation.
Gaya: 397
Geelvink Bay: 537, 561
Gehr, Capt. Harvey W.: 422
General Engineer District (GENED): 652–53
General Headquarters, India: 392–93, 396, 417, 420
General Headquarters, SWPA: 128, 649. *See also* MacArthur, General of the Army Douglas; Southwest Pacific Area.
General Headquarters, U.S. Army: 5
General Purchasing Board, USAFIA: 126
General Staff Geological Survey, India: 457
Geological surveys
Central Pacific: 669
Iwo Jima: 667–68
Japan: 673
Okinawa: 667–68
SWPA: 554, 669
Germany: 13–14, 27, 35, 107, 210, 326, 403–04
Gertrude Cove: 331–32
Gewald, Capt. Harold T.: 92, 105
Ghormley, Vice Adm. Robert L.: 170–72, 206
Gibson, Col. Herbert D.: 164–65
Gila Peninsula: 567
Gilbert Islands: 164, 377–83, 386, 463, 476
Gili Gili: 238–39, 257
Giru Airfield: 145, 149
Girua River: 194, 205
Gliders: 247, 445, 447, 454
Godfrey, Brig. Gen. Stuart C.: 249, 261, 430, 437, 468, 569
Goerz, Col. Peter P.: 282, 569
Goldie River: 182
Gona: 193, 200
Goodenough Island: 192, 236, 238, 244, 257, 520, 529
Gormsen, Lt. Col. Harold F.: 495
Grace Park, Manila: 614, 618
Grafe, Paul: 41, 327
Graham, Col. James H.: 318–19
Grande Island: 57
Grant, Lt. Gen. Ulysses S.: 471n
Gray, Cpl. Charles H.: 204
Great Slave Lake: 322, 324
Green, Clinton: 501, 518
Green, Lt. Col. Edwin B.: 403
Green, Lt. Col. James E.: 328
Green, Lt. Col. William J.: 433–34, 449
Greenlee, Lt. Col. Harold E.: 454
Grenades, improvised: 352
Griggs, Lt. Col. E. L., Jr.: 539
Griswold, Maj. Gen. Oscar W.: 613, 618–19
Gruening, Ernest: 22, 279. *See also* Alaska.
Grunert, Lt. Gen. George: 55, 58, 488
Guadalcanal Island: 159, 205, 233, 326, 546–47
airfield construction and repair: 171–72, 206–07, 256
base construction and operation: 569
bridge construction and repair: 207–08
civilians, employment of: 208–09
climate, effect of: 208–09
construction machinery and equipment, procurement: 209
construction materials, procurement: 214
construction program and progress: 172–73, 208–09, 232, 569, 661
engineer units, arrival: 206–07, 209, 255–56
engineers as infantry: 207
map compilation and distribution: 188–91
mines, Japanese: 208
road construction and repair: 208–09, 256
topography: 207
Guam: 4, 45, 52, 492, 493, 503–06, 517, 577
Guardia, Ricardo Adolfo de la: 33, 53
Guerrilla operations
Burma: 427–28, 454–55
Churchill and: 427
Leyte: 582
Mindanao: 634
Philippines: 106
Guimba: 596, 610, 612
Gulf Oil Company: 318
Gulkana: 310–11
Gunderson, Maj. Frank N.: 457–58
Gunther & Shirley Company: 25, 41
Gurkha troops: 455
Gurney Airdrome: 257
Gusap Airfield: 254
Guskhara: 399
Guy F. Atkinson Company: 287

H. C. Price Company: 320, 325, 327
H-20 bridge: 447–49, 470
Hagushi: 641, 643–44
Haines: 317
Haleakala: 46
Halsey, Admiral William F. *See also* Central Pacific Area (CPA); South Pacific Area (SOPAC).
and Admiralties: 522
command of: 206, 232
and Leyte: 572
MacArthur, conferences with: 234
offensive plans: 225
and Philippines, 1944–45: 572
and Solomons: 244, 250
Hammond Iron Works: 51
Hangar construction: 217–19. *See also* Airfield construction and repair.
Hankow: 453
Hanna, J. L.: 322

Hannum, Col. Warren T.: 24, 344, 362
Hansa Bay: 527–28, 533
Hansell, Brig. Gen. Haywood S., Jr.: 518
Harbor construction and repair. *See* Port facilities, construction and repair; Waterways, development and use.
Harding, Maj. Gen. Edwin F.: 192–95
Harmon, Maj. Gen. Millard F.: 172, 251
Harris, 1st Lieut. Henry: 98
Harrison, Maj. Gen. Desmond (British): 437, 439–40
Harrison, Lt. Col. Raymond L.: 213, 236
Harvey, Lt. Col. Raymond J.: 540
Hauwei Island: 524
Hawaii Air Depot: 361, 667
Hawaii Island: 348–49
Hawaii National Park: 23
Hawaiian Coast Artillery Command: 350
Hawaiian Constructors: 25, 41–42, 46–47, 51–52, 162, 341–43, 345–49, 353–56, 359–64, 371–72, 487–89
Hawaiian Contracting Company: 353
Hawaiian Department Reproduction Plant: 376
Hawaiian Islands: 3, 4, 6–9, 13–14, 20, 27, 54
  administrative procedures: 41, 52, 341–42, 353–54, 356–58, 363–64, 370–73, 376, 486–89
  air defense construction: 40–41, 43–44, 344, 348–49, 361–62, 365, 374
  aircraft repair shops, construction of: 370, 373–74, 507
  aircraft warning stations, construction of: 15, 18, 40–42, 51, 53, 346
  airfield construction and repair: 28, 38–42, 51, 161, 340–43, 346–49, 361–62, 365, 370, 373–74, 486–87, 507–08
  airfield defense measures: 348–49, 374
  ammunition storage plan: 367–69
  base construction and operation: 366, 369–70, 380
  beach defenses, construction of: 351–52, 365, 374
  blackout control: 341, 343
  camouflage measures: 44–45, 346, 350–52, 361–62, 365
  civilian defense: 342, 344–46
  civilians, employment of: 23–25, 341, 353–55, 369, 486
  coast defense construction: 42, 52–53, 346, 349–52, 365–66, 661
  construction, control of: 341–42, 353, 491
  construction, nonessential, efforts to eliminate: 370–71, 373
  construction, problems of: 11, 19, 39, 52, 365–66
  construction design standards: 366
  construction machinery and equipment, procurement: 43–44, 343, 355–56, 362–63, 366, 369, 372, 375–76, 488
  construction materials, procurement: 342–43, 353–57, 362–63, 366–67, 375–76
  construction programs and progress: 38–45, 51–53, 361, 363, 365, 372–74, 486–87, 506–10, 649
Hawaiian Islands—Continued
  cost-plus-a-fixed-fee contracts: 353, 363, 371–72, 487–89, 507
  costs of construction: 52, 342, 353, 355–58, 363, 371–72, 488
  demolition measures: 352–53, 361
  engineer missions: 340–45, 353, 358, 369–70, 372–73, 507–08
  engineer organizations: 340–42, 353–54, 358, 360–61, 486, 491–92
  engineer units, arrival: 369, 375–76, 490, 666–67
  engineer units, requirements: 16, 342–43, 489–90
  engineer units, strength: 10, 38, 42, 342, 380, 680
  financial problems: 356–57, 363–64
  fortifications, construction of: 346, 365, 373
  hospital construction: 365–66, 374, 486, 507–08, 661
  housing: 366
  housing construction: 38–39, 346, 361, 366–67, 373–74, 486–87, 507–08
  labor force, mobilizing: 23, 342–43, 359–60, 369, 371–73
  labor force, strength: 357, 369
  land acquisition: 40–41, 51–52, 341–42, 346, 355–59, 374
  map compilation and distribution: 376–77, 489–90, 666–69
  mines, improvised: 352–53
  mines, installation and removal: 348–49, 365–66, 377
  mines, number required: 352, 362, 365
  naval guns, emplacement of: 349–52, 374, 661
  Navy, co-operation from: 370, 374, 376, 661
  pipeline construction and operation: 42
  POL rationing: 343, 356, 358
  port congestion: 367
  port facilities, construction and repair: 12, 40, 367, 373–74, 486
  POW camp construction: 507
  power plant installation: 373
  priority ratings: 48–50, 346, 351, 353–56, 369, 373
  prisoners, employment of: 345
  radar station, construction of: 347
  railroad construction and repair: 23
  rainfall, effect of: 371
  reconnaissance, engineer: 16, 51–52, 350, 368, 486
  refrigeration plant installation: 486
  road construction and repair: 23, 43, 346, 350, 369, 374
  roadblocks, construction of: 352
  seaplane base construction: 365, 374
  sewerage installation: 366, 373
  shipping, allocation of: 356
  shipping shortage: 343–44, 355, 362–63
  and SOPAC supply: 171–72
  spare parts procurement: 354–56, 375–76
  specialists, shortage of: 354–55, 375
  as staging area: 366

Hawaiian Islands—Continued
storage facilities, construction and operation: 39–42, 51–53, 350, 365–70, 373–75, 486, 507
telephone exchange installation: 370
temperatures, effect of: 370
transportation facilities: 354, 365–66
trench obstacles, construction of: 344–45
tunnel construction and repair: 350, 368–70, 374
utilities, installation and maintenance: 365
water supply and distribution: 373
waterways, development and use: 342
Hawaiian Pineapple Company: 348
Hay River: 327
Hearn, Lt. Col. I. K.: 565
Heating plants, installation: 297, 316
Heavey, Brig. Gen. William F.: 228–29, 247, 252, 266, 576, 578
Heiberg, Lt. Col. Elvin R.: 112, 121, 126, 130, 137
Heiman, Col. David W.: 537, 540, 564–66, 580, 583–84, 587
Henderson Field: 206, 256
Heng-yang: 469
Hermosa: 79
Herne Bay: 223
Herron, Maj. Gen. Charles D.: 10, 15–16, 20, 26–27
Hickam Field: 8, 38–39, 44, 52, 53, 340, 341, 348, 365, 507, 661
Hicks, Lt. Col. William E.: 435
Highway 1, Leyte: 577
Highway 3, Luzon: 74, 82, 588–90, 595–96, 603, 610–13, 628, 632, 638
Highway 4, Luzon: 639
Highway 5, Luzon: 74, 610, 613, 627–28, 632, 638–39
Highway 7, Luzon: 609
Highway 9, Luzon: 628, 636
Highway 11, Luzon (Kennon Road): 627, 629, 632, 636
Highway 13, Luzon: 595
Highway construction and repair. *See* Road construction and repair.
Highway systems. *See* Road systems.
Hill Field: 586
Hilo: 39, 348–49, 361
Himalaya Mountains: 387, 393, 404, 426, 432, 439, 454, 462
Hiring Service, Australian Army: 113
Hiroshima: 678
Hirshfield, Maj. Robert A.: 399, 407, 410, 417, 465
Hodges, Col. John N.: 10
Hoge, Brig. Gen. William M.: 300–305, 307, 313
Hokkaido Island: 678
Holcombe, Col. William H.: 390–94, 397, 416–17
Holland Park, Brisbane: 223, 240
Hollandia
airfield construction and repair: 527–28, 531–34, 543–44
ASCOM move to: 572
Hollandia—Continued
base construction and operation: 527–29, 533–34, 544, 557
cargo unloading and distribution: 529–30
civilians, employment of: 531
construction materials, search for: 531–32
construction program and progress: 541–42, 544
engineer missions: 527–28
engineer organization: 527–28
engineer units, arrival: 530
engineer units, strength: 529
fire-fighting: 530
housing construction: 527, 544
map compilation and distribution: 553–54
naval construction battalions at: 529
photography, aerial: 530
pipeline construction and operation: 544
port facilities, construction and repair: 527, 544
rainfall, effect of: 531
road construction and repair: 527, 530–31, 544
shore party operations: 530–31
stock control: 557–58
storage facilities, construction and operation: 527, 544
supplies, measurement tons: 557
topography: 527
USASOS move to: 569, 650
work potential formula: 529
Hollandia Airfield: 531–32
Holtz Bay: 329
Homestead, Hawaii: 361
Honolulu: 12, 23, 40, 344–45, 367, 369, 374, 509
Honolulu Engineer District: 10–12, 20, 23, 38–44, 47, 169, 340, 353, 356–64, 367, 369, 372, 377–78, 487–89, 493–94. *See also* Kramer, Brig. Gen. Hans; Wyman, Col. Theodore, Jr.
Honshu Island: 518, 669, 673–74, 677–78
Horn Island Airfield: 143–44, 152, 155, 230
Horowitz, Col. Louis G.: 430
Hospital construction
Alaska: 291
by Allied Works Council: 239–40
by ASCOM: 586
for assault on Japan: 677–78
Australia: 114–15, 223, 240
Biak: 544
China: 419
Fiji: 232, 256
Hawaii: 365–66, 374, 486, 507–08, 661
Kwajalein: 485
Leyte: 575, 586
Luzon: 638
Manila: 655
Marianas: 493
Milne Bay: 257
New Britain: 273
New Caledonia: 220

Hospital construction—Continued
New Guinea: 235, 257, 259, 546
New Zealand: 232, 243
Okinawa: 643, 660
Philippines, 1944–45: 653, 655–56
Port Moresby: 259
Saipan: 502
Solomons: 250–51
SOPAC: 267
SWPA: 267, 550, 568
Wakde: 544
War Department and: 486
House Committee on Appropriations: 8–9
Housing: 114, 217, 366, 410
Housing construction
Admiralties: 543
Alaska: 33, 37, 278, 282–83, 286–87, 291, 296–97
Alaska Highway: 313, 315–16
for assault on Japan: 678
Australia: 114–15, 119, 124, 139–40, 223, 240–41, 260
Biak: 544
Canol: 321
Carolines: 516
Central Pacific: 476
China: 402–03, 419
Fiji: 232–33
Guadalcanal: 208, 256
Hawaii: 38–39, 346, 361, 366–67, 373–74, 486–87, 507–08
Hollandia: 527, 544
India: 396–99, 401–03, 456
Kwajalein: 486
Leyte: 575
Luzon: 632
Marianas: 493
Marshalls: 478–79, 485
Navy's role in: 267
New Caledonia: 167, 223
New Guinea: 184–85, 254, 257–58, 546
New Hebrides: 256
New Zealand: 243
Okinawa: 643, 660
Philippines, 1944–45: 653
Port Moresby: 185
Saipan: 503
Solomons: 544
SOPAC: 256, 266–67
SWPA: 217, 266–67, 568
Howell, Lt. Col. Harold K.: 478
Hoy, C. A.: 121
Hsinching: 440
Hukawng Valley: 442, 444, 446, 465
Humboldt Bay: 527, 530–31, 534
Hump, the. *See* Himalaya Mountains.
Hump airfields: 393, 396–97, 400–401
Hunter, Col. Robert C.: 652
HURRICANE: 537, 538, 541
Hutchings, Brig. Gen. Henry: 252, 567, 592
Hyane Harbour: 522–23
Hyland, Maj. James F.: 416

Iba: 71
I-beam bridge, on Ledo Road: 448
Ice formation problem: 316, 328
Ickes, Harold L.: 279, 299, 322. *See also* Department of the Interior.
Icy Strait: 287
Ie Shima: 643, 646, 658. *See also* Okinawa.
Igloo warehouse: 217–19, 502
Iloilo: 634
Imperial General Headquarters: 179, 682
Imperial Oil Company: 318–25, 335–38
Imphal: 446, 462
Import Procurement Department, Australia: 126
Imus River: 84
India, 389–91, 405, 427–28, 438, 453, 458, 680.
AAF, pressure for construction, 397, 401–02, 416–17
administrative procedures: 401
aeronautical charts, compiling: 458
air defense construction: 398, 400
airfield construction and repair: 392–94, 396–97, 399–404, 406–08, 416–18, 420, 425, 429–32, 438–42, 455–56, 467–68, 666
base construction and operation: 395–96, 402, 404, 406
camouflage measures: 398–99
Central Public Works Department: 387, 396
civilians, employment of: 392–93, 396, 399, 401, 416–17, 440, 680
climate, effect of: 393
command and staff structure: 397–98
construction, control of: 392–93, 398, 404, 438
construction, problems of: 393–94, 401–02, 417
construction design standards: 401–02, 471
construction machinery and equipment, procurement: 398, 402, 420, 450
construction materials, procurement: 397, 399–400, 402–03, 424, 471
construction programs and progress: 392–94, 396–97, 399–400, 404, 407–08, 416–17, 438–39
customs, effect of: 450
diseases: 393
engineer mission: 396, 404
engineer organization: 395–96, 398–99, 403–04, 415–16, 429, 438–39
engineer units, arrival: 398, 411, 430, 440, 450, 458, 475
engineer units, control of: 400
engineer units, strength: 404, 450
housing construction: 396–99, 401–03, 456
India-China road. *See* Ledo Road.
labor force, mobilizing: 393, 400, 471
and Ledo Road. *See* Ledo Road.

India—Continued
map compilation and distribution: 457–58
pipeline construction and operation: 387, 419, 426–27, 439, 442, 450, 457, 466–67, 471, 666
POL supply: 427
port congestion: 396
port facilities, construction and repair: 394, 396, 399
power plants, installation of: 399
priority rating: 401
Public Works Department: 416–17
rainfall, effect of: 392–93, 397, 399
reconnaissance, engineer: 440
refrigeration plants, installation and operation: 399
road construction and repair: 393, 398–99, 403
road system: 393
Royal Engineers in: 392–93, 396–97, 400–402, 406, 416–17, 420, 425, 440
shipping shortage: 471
storage facilities, construction and operation: 394–96, 400, 467, 666
supply, by airlift: 472
supply system: 394–95, 425, 429
training facilities, construction of: 403
transportation facilities: 399–400, 402–03
utilities, installation and operation: 403
wire obstacles, erection of: 399
India-Burma Theater: 470, 475, 662
Indian Navy: 471
Indochina: 452
Infantry Divisions
Americal: 206–07, 209, 634
Philippine: 61, 69
6th: 564, 587, 592–96, 603, 627, 639
7th: 328, 332, 477, 575–76, 579, 582, 643, 645
24th: 23, 43, 529–32, 575–12, 609, 635
25th: 43, 206, 209, 250, 587, 592, 594, 597, 628–29, 637–38
27th: 381, 478, 482–83, 492, 494–97, 506, 643, 647
31st: 567, 635
32d: 118, 124, 156, 178, 192–96, 274, 567, 581, 627–29, 637–38
33d: 628–30, 636–38
37th: 171, 249, 255, 587, 593–95, 602, 610, 612–15, 630, 636–39
38th: 582, 609, 621–23, 638
40th: 587, 592–95, 602, 610, 634
41st: 118, 124, 156, 205, 237, 247, 529–31, 534, 537, 539, 632–33
43d: 233, 245, 587, 592, 594, 596, 638–39
77th: 492, 503, 581, 643–44, 646–47
81st: 512–14
96th: 575–76, 579, 582, 643, 647
Infantry Regiments
34th: 608, 619–20
105th: 496, 500
Infantry Regiments—Continued
106th: 482–83
126th: 567
148th: 615
151st: 624
158th: 561, 588, 594, 597, 631–32, 638–39, 657
162d: 538
163d: 529, 534, 537
164th: 206
165th: 381, 496
186th: 539, 632–33
305th: 503
321st: 514
322d: 514
323d: 515
Infantry-tank teams: 647
Ingalls, Col. Robert D.: 300–301, 305, 309, 314
Inland Passage: 280–81
Insoemanai Island: 535
Insoemoar Island: 535
Inspector General, War Department: 377
Intelligence Center, POA: 376
Intelligence estimates and reports
Hollandia: 527, 530
Luzon: 587–88, 601, 611
Manila: 613
Marianas: 493
by Navy: 284
New Guinea: 156, 158
Saipan: 499
SOPAC: 269–71, 551–52
SWPA: 269–71
International Harvester: 140
Intramuros, Manila: 614, 617
Ioribaiwa: 179
Ipo Dam and Reservoir: 618, 627, 638, 656
Iran, U.S. Military Mission to: 394
Irisan River: 637
Iron Range Airfield: 260
Irrawaddy Plain: 394
Irrawaddy River: 391, 406, 454–55, 465, 468, 470, 472, 663–64
Irwin, Maj. Francis I.: 147
Isa: 647
Isely, Commander Robert H.: 498n
Island Command, Okinawa: 643–44, 657–58
Isley Airfield: 498–99, 501–03, 511, 518
Isurava: 173
Itoman: 641
Iwo Jima: 625, 640–41, 660–61, 668

Jacky Jacky Point Airfield: 155, 230–31
Jake's Corner: 307, 310, 315
James River, Virginia: 471n
Japan: 3–4, 27, 50, 52, 53–54, 71–72, 153, 179, 325, 326, 364, 456, 467–68, 510, 518, 625, 636, 640–41, 649, 650, 654–55, 667–69, 672–79, 682–83

Japanese Combined Fleet: 153
Jaqué: 30
Jarman, Maj. Gen. Sanderford: 495, 499, 511
Jarrett, Lt. Col. Donald L.: 449
Jaure: 178, 192
Java: 118, 392
John Rodgers Airport: 40, 367, 374, 507, 661
Johns, Brig. Gen. Dwight F.: 112, 119–21, 125–27, 136, 140–41, 152, 182–83, 185, 190
Johnson, Col. Alexander L. P.: 114–15
Johnson, Col. Frank M. S.: 302
Johnson, Maj. John P.: 395–96, 399
Johnson, Lt. Col. W. H.: 373
Johnson's Crossing: 327
Joint Army and Navy Board: 10, 14, 17, 35, 39, 51
Joint Chiefs of Staff. *See also* Combined Chiefs of Staff.
  and AFPAC: 649
  and airfield construction and repair: 527
  and Alaska defenses: 284, 288, 328, 331
  and base construction directives: 527
  and Canol: 336
  and Central Pacific offensives: 377–80, 492
  and Japan, assault on: 674
  and Japan, occupation of: 678
  and Kavieng, seizure of: 527
  and Klamono oil fields: 563
  and Leyte: 572
  and Marianas: 492
  and Marshalls: 477–78
  and Mindanao: 570
  and Okinawa: 641
  and Pacific areas, division of: 128
  and Philippines, 1944–45: 570
  and Rabaul: 153, 172, 234
  resources, allocation of: 225, 234
  SOPAC, directives to: 234
  and SOPAC offensive: 170, 172
  SWPA, directives to: 234
Joint Expeditionary Force, Kwajalein: 482
Joint Logistical Board, POA: 378
Joint Planning Committee, Australia-U.S.: 113
Joint Purchasing Board, SOPAC: 171–72, 214
Joint Staff, POA: 378–79
Joint Supply Council, New Zealand: 214
Jolo Island: 633
Jones, Brig. Gen. Albert M.: 82
Jones, Air Marshal George (RAAF): 241
Jones Bridge, Manila: 619
Jorhat: 447
Juneau: 279, 281, 283, 287, 289
Jungle warfare, Saipan: 500
Jungle warfare training: 156, 490–91

K. B. Mission: 238–39
Kabacan: 635
Kadena Airfield: 645, 658–59
Kagman Point: 500
Kagoshima: 673–75
Kahuku: 348, 361
Kalihi Valley: 345
Kamiri air strip: 562
Kanchow: 419–20, 452, 469
Kanchow Construction Company: 419
Kaneohe Seaplane Base: 53
Kansas City Engineer District: 321, 323
Kapa Kapa Trail: 178–79
Kapalama Basin: 40, 42, 367, 374, 486
Karachi: 392, 393, 394–96, 398, 399–400, 402, 404, 406, 417
Karrick, Col. Samuel W.: 653
Katherine, Australia: 123, 149
Kauai Island: 348–50
Kavieng: 522
Kayangel Island: 516
Keehi Lagoon: 40, 365, 367, 374
Kelso Airfield: 145
Kenerson, Lt. Col. Waldo I.: 440, 451–52
Kenney, Maj. Gen. George C. *See also* Allied Air Forces, SWPA.
  and Admiralties: 522–23
  and airfield construction: 174, 184–85, 188, 220, 230, 581, 584
  and airlift operations: 180
  commands of: 157
  construction, pressure for: 184–87
  and engineer units, control of: 187, 229
  and Hollandia base: 534
  in Leyte campaign: 581, 584
  and Luzon: 599
Kennon Road, Luzon. *See* Highway 11, Luzon.
Kerama Retto: 643–44. *See also* Okinawa.
Kewalo Basin: 340–41
Kharagpur: 440, 456
Khasi Hills: 393
Kiangan: 639
Kiangsi Province: 419, 431, 452
Kila Drome: 143, 152
Kimmel, Admiral Husband E.: 347
Kindley Field: 61, 103, 105, 620
King, Maj. Gen. Edward P., Jr.: 62, 99, 101
King, Admiral Ernest J.: 169, 378. *See also* United States Navy.
King, William L. Mackenzie: 300. *See also* Canada.
KING operations: 570, 572, 592
Kingman, Brig. Gen. John J.: 6, 60, 390
King's Wharf, Makin: 382
Kingsbury, Lt. Col. Leonard L.: 478
Kinjaki Barige: 181
Kinkaid, Rear Adm. Thomas C.: 328
Kinsolving, Col. William C.: 439, 449–50, 457, 446–67, 471
Kipapa: 361
Kipapa Gulch: 368, 370, 374
Kiriwina Island: 231, 234, 239, 244, 246, 251
Kirkpatrick, Capt. Harry F.: 415

Kiska Harbor: 331–32
Kiska Island: 33, 276, 284, 286, 290, 322, 328–29, 331–34, 364
Kiunglai: 293
Klamono oil fields: 563
Klenso Field: 565
Klinke, Maj. Emil F.: 130
Kluane Lake: 302–03, 310–11, 316–17
Knox, Frank: 18, 27, 299. *See also* United States Navy.
Kodiak Island: 12, 17, 18, 22, 35, 278, 284, 287, 295–96
Kohloss, Col. Fabius H.: 395, 401, 408, 413–15, 421–22
Kokee: 16, 51
Kokoda Trail: 156–57, 173, 178–80, 192
Kokoda Village: 157–58
Kolombangara Island: 250
Koontz, Capt. Clyde L.: 398
Korea: 678
Kornasoren Airfield: 563
Koromokina River: 255
Koumac Airfield: 171
Kramer, Brig. Gen. Hans: 369–74, 377–78, 381, 478, 486–87, 489, 491, 493
Kromer, Col. Philip F.: 438
Krueger, General Walter. *See also* Armies, Sixth.
  and Admiralties: 522
  and Biak: 539
  and General Casey: 572
  heads Sixth Army: 225
  and Hollandia: 532
  and Leyte: 584–85
  and Luzon: 591, 594–95, 599, 610, 612
  and Morotai: 567
  and New Guinea: 238–39, 244
  and Sansapor-Mar: 563–64
Kuba: 646
Kuluk Bay: 286
Kumon Mountains: 446
Kumpe, Maj. Emil F.: 190
Kung, C. C.: 415, 421–22, 472. *See also* Yunnan-Burma Highway Engineering Administration.
Kunming: 389–91, 395–96, 402–03, 408, 413–15, 419–21, 425, 427, 430, 439, 451, 454, 464, 469–71, 474–75, 662–63, 666
Kunming Training Center: 455
Kushikino: 673, 675, 677
Kuskokwim River: 288, 295
Kwajalein Atoll: 476–82, 483–86, 496
Kwanghan: 440
Kweilin: 418–19, 431, 452, 468–69
Kweiyang: 663
Kyushu Island: 456, 467–68, 668–69, 672–78

La Joya Airfield: 31, 50
Labaun Island: 636
Labor forces, difficulties with
  Alaska: 21–22, 35
  China: 451
  Hawaii: 23, 371–73
Labor forces, difficulties with—Continued
  Ledo Road: 457
Labor forces, mobilizing
  by Allied Works Council: 241–42
  by ASCOM: 585
  Assam: 401, 471
  Australia: 121, 142, 241–42
  Burma: 465, 471
  Burma Road: 466
  Canal Zone: 29, 32–33, 50
  China: 403, 451, 472
  Hawaii: 342–43, 359–60, 369, 373
  India: 393, 400, 471
  Ledo Road: 424–25, 450
  Leyte: 585
  New Guinea: 180–81
  Philippines 1941–42: 69
Labor forces, shortages in: 278–79
Labor forces, strength
  Alaska Highway: 334
  under Allied Works Council: 211
  Burma: 467
  Burma Road: 473
  Canal Zone: 32
  Canol: 335, 338
  Fiji: 163
  Hawaii: 357, 369
  New Caledonia: 163
Ladd Field: 9, 12, 19, 28, 34–37, 278, 287, 288, 291, 293, 296
Lae: 143, 174, 230–31, 234, 244-45, 248, 251–52, 258–59, 546–47
Laguna Province: 84
Lahore: 410
Laiana: 245, 249
Laloki Airfield: 146, 186
Laloma Cemetery, Manila: 614
Lanai Island: 348
Land acquisition and return
  by ASCOM: 584
  Hawaii: 40–41, 51–52, 341–42, 346, 355–56, 358–59, 374
  Leyte: 584
  New Caledonia: 661–62
  Panama: 29–33, 50, 53
  Philippine Commonwealth: 60
  Philippines, 1941–42: 60, 65
  by USAFFE: 60
Land clearing operations: 148, 157–58, 307–12, 314
Landhi: 396
Landing craft. *See also* LCI's; LCM's; LCT's; LCVP's; LSM's; LST's; LVT's.
  Admiralties: 523–24
  Biak: 537–38, 540, 544
  by Boat Building Command: 653–54
  Borneo: 636
  Carolines: 516
  Central Pacific: 382, 476

Landing craft—Continued
concept formulated: 227
Corregidor: 620
Dukw: 476, 497, 506, 530, 562, 578, 644
Hollandia: 529
Kwajalein: 479–80, 485
Leyte: 576–79
Luzon: 588, 590–93, 595–96, 609
Marianas: 506
Navy-operated: 578
New Britain: 273
New Guinea: 533
Okinawa: 644
Philippines, 1944–45: 621–24, 632–33, 638
Saipan: 496–98, 511
Solomons: 546
spare parts for: 265, 558–59
SWPA: 551, 562, 564, 567
Tinian: 506
training with: 671
Wakde: 536
Lane, Col. Albert L.: 305, 560, 569, 652
Lane, Col. Thomas A.: 258–59, 265
Langemak Bay: 258
Larrimah: 123, 239, 241
Larrison, Lt. Col. G. K.: 345
Lashio: 389, 391, 413, 662
Lauterbach, Col. Herbert G.: 537, 540, 601
Layac Junction: 85
LCI's (landing craft, infantry): 251
LCM's (landing craft, mechanized): 228–29, 235, 247, 251, 253, 273, 476, 496, 530, 562, 576, 578, 593, 620–24
LCT's (landing craft, tank): 253, 516, 540, 551, 620, 638
LCVP's (landing craft, vehicle-personnel): 229, 235, 247, 251, 253, 273, 497, 530, 536, 576, 578, 593
Leahy, Flight Lt. Michael J. (RAAF): 180, 231
Leary, Vice Adm. Herbert F.: 128
Leavey, Brig. Gen. Edmond H.: 378–80
Ledo: 391, 405–10, 412, 419, 434, 448–49, 454, 457, 467n, 473, 663
Ledo Road: 387–89, 391, 404–13, 418–19, 421, 422–25, 426, 427, 429, 430, 431–35, 439, 442–50, 453–55, 456–58, 460–62, 463–67, 468, 470–73, 472–75, 572, 662–66. *See also* Pick, Brig. Gen. Lewis A.
Lee, Col. John C. H.: 11, 18, 33
Lee Wen-ping, Dr.: 414, 422
Legaspi: 6, 72, 81, 639
Lehr, Maj. William: 141
Lend-Lease
Act, passage of: 27
Australia: 140–41, 216, 560
China: 389, 398–99, 402–03
India: 392–93, 395, 398–99, 401–02
New Zealand: 213–14, 222
Lenox, Maj. George H.: 167
Lentaigne, Maj. Gen. W. D. A.: 446–47
Leron River: 244
Le Sueur, R. V.: 322
Leyte: 570–88, 590, 591–92, 599, 611, 650, 651, 670
Leyte Engineer District: 651–54
Leyte Gulf: 572, 576, 578–79
Leyte Gulf, Battle of: 580–81
Leyte River and Valley: 573, 582
Liard River: 309, 311, 315
Liberty ship berths. *See* Port facilities, construction and repair.
Libmanan Cave: 81
Likhapani: 410–11, 457, 466
Liles, Lt. Col. Sherwood E., Jr.: 535, 537, 544, 613, 617–19, 656
Lim, Brig. Gen. Vicente: 98–99
Limay: 71, 85, 95, 97
Lines of communication
Alaska: 287–88, 295–96
Assam: 394, 435
Australia: 118, 141, 160, 170, 364
Bataan: 87, 90
Burma: 387, 391, 416, 435–36, 474–75
Canol: 322
China: 387–88, 391, 394, 397, 405–06, 418–19, 425–26, 429–30, 641
Hawaii: 352, 380
India: 391, 394, 397, 405, 426, 429–31, 475
Japan: 625, 636, 640–41, 677
Luzon: 588
New Caledonia: 166
SOPAC: 160, 168
SWPA: 231, 380
Lines of communication, Japanese: 446, 462, 625, 636, 640–41
Lingayen: 595, 602
Lingayen Drome: 598–600
Lingayen, Gulf: 73–76, 79, 587–95, 600–602, 604–07, 610, 612–13, 650, 657
Ling-ling: 469
Lipa: 632
Liuchow: 663
"Loew's Bougainville": 546
Logistical missions, Corps of Engineers: 5
Logistical systems
for assault on Japan: 672–75
POA: 507
SWPA: 209–10
USASOS: 570–71
Logai: 449
Loper, Brig. Gen. Herbert B.: 489–91, 507, 510, 668
Loper-Hotine Agreement: 190
Loran station, construction of: 517
Lorengau: 522, 524–25
Los Angeles Port of Embarkation: 362, 456
Los Baños: 93
Los Negros Island: 522–25
Lovett, 1st Lt. Max D.: 136
Loving, Harry W.: 487–88

LSM's (landing ship, medium): 590, 593
LST's (landing ship, tank): 253, 382, 476, 485, 496, 498, 511, 523–24, 533, 544, 551, 564, 567, 576–79, 588, 593, 609, 636
Lubang Island: 64, 66
Lubricants. *See* POL.
Lumber. *See* Construction materials improvised; Construction materials, procurement; Sawmill construction and operation.
Lung Yun, Governor; 403, 422, 466, 472, 474
Lung-ling: 456, 459, 461
Luzon: 55–57, 62–63, 66–71, 92, 570, 598, 614, 617–18, 636. *See also* Bataan Peninsula; Manila, Manila Bay area.
  airfield construction and repair: 58–61, 64–65, 79, 590–92, 597, 606, 610, 615, 631–33, 638–39, 655
  base construction and operation: 93, 591, 606, 625, 632, 650–51
  Base M: 591, 600, 604, 606, 650, 656
  Base R: 650, 656
  beach party operations: 592–94, 597, 608–09
  blasting operations: 604, 638
  bridge construction and repair: 76–77, 80–81, 590–91, 595–97, 602–06, 609, 611–13, 616, 626, 628–32, 638–39
  bulldozers, tactical use: 628–29
  cargo unloading and distribution: 592–94, 597, 600, 609
  causeway construction and repair: 593
  civilians, employment of: 596, 599, 601, 606, 638–39
  communications facilities: 601
  construction, control of: 601
  construction, problems of: 632
  construction materials, procurement: 602, 612
  demoliton operations: 74–84, 597, 609–12, 627, 632
  engineer district in: 651
  engineer missions: 72–85, 587–92, 601–03, 605–06, 610–11, 626–27, 637
  engineer organization: 601, 650–51
  engineer units, arrival: 599–600, 602, 607, 610–11
  engineer units, control of: 591, 612–13, 626
  engineer units, requirements: 590–91
  engineer units, strength: 587, 592, 594, 601
  engineers as infantry: 597–98, 609
  hospital construction: 638
  housing construction: 632
  map compilation and distribution: 607–08, 668–69
  mines, shortage of: 75
  photography, aerial: 588, 596, 607–08
  pipeline construction and operation: 600
  POL, evacuation and destruction of: 84
  ponton cubes, employment of: 590, 593, 602
  port facilities, construction and repair, 592, 600, 632
  priority ratings: 604, 612
  railroad construction and repair: 596–97, 600, 602–06, 612, 639
  rainfall, effect of: 588, 637–38
Luzon—Continued
  reconnaissance, engineer: 588, 593, 599, 601, 615, 626, 638
  refrigeration plant, construction and operation: 632
  river crossings: 590–91, 595–96, 602, 610–13, 615–16, 630, 638
  road construction and repair: 594, 596–97, 600, 609, 626–32, 637–39
  roadblock construction: 74, 77
  salvage operations: 603–04, 629
  sawmill construction and operation: 632
  storage facilities, construction and operation: 594, 600, 609
  supply system: 606
  wire obstacles, erection of: 82
Luzon Base Command: 601
Luzon Base Section: 651, 669
Luzon Engineer District (LUZED): 651–52, 654
Luzon Force: 99
LVT's (landing vehicle, tracked): 273, 382, 480, 496, 497, 506, 530, 538, 562, 596, 644
Lyman, Brig. Gen. Albert K. B.: 15–16, 23, 38–39, 41–44, 341–44, 348, 350–54, 358–64, 367, 369, 371, 376
Lyons, Lt. Col. F. Russel: 302, 314

Mabatang: 87
Mabatang-Mauban line: 97
Macajalar Bay: 635
MacArthur, General of the Army Douglas. *See also* General Headquarters, SWPA; Southwest Pacific Area; United States Army Forces in the Far East: United States Forces in the Philippines.
  and Admiralties: 521–23
  air build-up by: 150
  and air ferry routes construction: 47
  and airfield construction and repair: 59, 229–30, 525, 563, 566, 568
  and airlift operations: 180
  arrival in Australia: 127
  and base construction and operation: 258
  and Biak: 537–38
  commands of: 57, 99, 128, 649, 650
  and construction machinery and equipment, procurement: 547
  and demolition operations: 216
  and engineer construction brigades: 548, 675
  and engineer districts: 652
  and engineer special brigades: 227–28
  and engineer units, control of: 649
  Halsey, conferences with: 234
  and Hollandia: 527, 534
  and Japan, assault on: 675, 678
  and Klamono oil fields: 563
  and land acquisition: 60
  and Leyte: 571–72
  and Luzon: 591, 599, 608
  and Manila: 618

MacArthur, General of the Army Douglas—Continued
and map compilation and distribution: 608, 667–68
and Marianas: 492
and Mindanao: 570
and Mindoro: 586
and Morotai: 566, 568
and New Guinea: 153, 156–57
and Noemfoor: 561
offensive plans: 129–30, 216, 225, 272–75
ordered to Australia: 99
and Philippines, 1941–44: 57, 80, 82, 87, 89, 92, 98
and Philippines, 1944–45: 570, 572
and Philippines build-up: 55
and priority ratings: 70, 215–16, 260
and Rabaul: 255
and Sansapor-Mar: 563–64
and Solomons: 153
and Southern Philippines: 625, 634
and strategy of isolation: 520, 527, 542-43, 563
and Waigeo: 563
and Wakde: 534
McBride, Brig. Gen. Allan C.: 99
McCandlish, W. L.: 77–78, 81–83
McCarthy, Maj. James A.: 314
MacCasland, Capt. Stanford: 46–48, 163
MacDonald, Thomas H.: 300, 305, 310–11. *See also* Public Roads Administration.
McGrath, Alaska: 288
MacIsaac, Col. Kenneth: 434–35, 449, 457, 463, 466
Mackenzie Mountains: 327
Mackenzie River: 276, 318–21, 324, 327
McNutt, Col. Charles H.: 167, 555
Madang: 234, 244
Madsen, Lt. Col. Kenneth E.: 438–39, 450
Maeda, Lt. Gen. Masami: 79n
Maffin Drome: 535, 541
Magat River: 638
Magicienne Bay: 498
Magnusson, Warren G.: 299
Maintenance and repair, general. *See also* Spare parts procurement; Specialists, shortages of: Specialists, training.
Alaska: 279–80, 290
Alaska Highway: 313, 317–18
Australia: 126, 148–49
Burma: 442
Burma Road: 422
Guam: 517
Ledo Road: 412–13, 433–34
Manila: 670–71
New Guinea: 186, 265–66
Philippines, 1941–42: 62–63
Philippines, 1944–45: 669–70
SOPAC: 264–66
SWPA: 271–72
Majuro Island: 477–78, 482–83, 485
Makin Garrison Force: 386
Makin Island: 381–86, 478
Malabang: 61, 65, 71, 655
Malacañan Palace, Manila: 615
Malaria, incidence of: 151, 238
Malaya: 390
Malicbuy: 81
Malinta Hill and Tunnel: 66, 101–02, 105
Malir: 396, 398–99
Manchuria: 467, 678, 682
Mandalay: 391, 394, 468
Mandaluyong: 656
Mangaldan Drome: 600–601
Manila: 76, 80–85, 92, 93, 587, 591, 604–05, 607–19, 625, 650, 651–53, 655, 656–57, 666–67, 670–71
Manila Bay area: 55, 57–58, 74, 98, 104, 587, 591, 612–13, 656. *See also islands and forts by name.*
Manila Railroad: 74, 77, 81–82, 84, 604–06, 657
Manipur Plain: 446–47, 454, 462, 468
Manipur Province: 450
Manus Island: 522, 524–25
Manzano, Lt. Col. Narciso L.: 75, 77, 82–84, 106, 613
Map compilation and distribution
by AAF: 668
Alaska: 23, 33, 290
Alaska Highway: 305–06
Attu: 290
Australia: 189–91, 551–52
by Australian Army: 188–89
Bataan: 94–95
Burma: 457–58
Canal Zone: 15
Carolines: 489–90, 510, 516
CBI: 457–58
Central Pacific: 381–82, 489–90, 510
China: 416, 457–58
Combined Chiefs directive on: 458
Corregidor: 94–95
Guadalcanal: 188–91
Hawaii: 376–77, 489–90, 666–69
Hollandia: 553–54
India: 457–58
Japan, for assault on: 518, 650, 667–69
Ledo Road: 410, 457–58
Luzon: 607–08, 668–69
Manila: 666–67
Marianas: 489–90
New Caledonia: 269–70
New Guinea: 188–91, 269–70, 553–54, 668–69
Philippines, 1941–42: 94
Philippines, 1944–45: 626, 668–69
POA: 650, 668
Port Moresby: 199–200
Solomons: 188–89
SOPAC: 188–89, 269–71, 551–52, 666–67
SWPA: 188–91, 269–70, 650, 666–69
USAFIA: 189–90
Maps, Japanese, used by U.S.: 490

Mar: 653
Mar Drome: 565
Mareeba: 144
Mariana Islands: 467, 503, 510–11, 518. *See also* Guam; Saipan.
  beach party operations: 506
  construction: 492–93, 506, 518
  engineer mission: 493
  engineer organization: 493–95
  engineer units, arrival and departure: 506
  intelligence estimates and reports: 493
  JCS directive on: 492
  map compilation and distribution: 489–90
  mines, Japanese: 506
  photography, aerial: 490, 493
  planning phase: 492–95
  road construction and repair: 506
  shipping routes to: 493–94
  shore party operations: 506
  supply, measurement tons: 493–94, 496
  training for: 495
Marilinan Airfield: 248
Marine Amphibious Corps
  I: 255
  III: 492, 495, 643–45, 657
  V: 492, 675
Marine Brigade, 1st Provisional: 492, 495, 503–04
Marine Corps photographic squadrons: 668
Marine Corps troops. 153, 173, 205–08, 211, 232, 242, 244–45, 380, 503, 506, 514, 526, 640, 646. *See also* Marine Amphibious Corps; Marine Divisions.
Marine Divisions
  1st: 274, 642, 647
  2d: 209, 492, 495–96, 498, 503, 643
  3d: 255, 492, 495, 504–05
  4th: 477, 492, 495, 498, 503
  6th: 643, 647
Marine Operators Association: 327
Marine raider battalions: 245
Marine Supply Section, USASOS: 558–59
Mariquina River: 619
Mariveles: 71, 92–93, 95, 108, 619–20, 655–56
Mariveles-Bagac road: 95
Mariveles Harbor: 620
Mariveles Mountains: 86, 90, 105
Markham River and Valley: 230, 244, 247–48, 251–52, 260, 543, 546, 548
Marquesas Islands: 168
Marshall, General of the Army George C.: *See also* War Department.
  and air support for CBI: 392
  and Alaska defenses: 18, 35
  and Alaska Highway: 318
  and Australia build-up: 107, 111, 118
  becomes Chief of Staff: 16
  and Burma offensive: 404, 418
  and Canol: 319
  and central purchasing board: 126
Marshall, General of the Army George C.—Continued
  and China air offensive: 409, 418
  and China theater status: 397
  and guerrilla operations: 427–28
  and India airfields: 420
  and Ledo Road: 408–09, 464
  and Leyte: 572
  and Philippines defenses: 57–58
  and priority ratings: 70
  and Rabaul: 255
  and SOPAC defenses: 170
  and Stilwell: 390, 398
Marshall, Brig. Gen. Richard J.: 157, 174, 182, 187. *See also* United States Army Services of Supply.
Marshall Islands: 476–86, 495–96, 570
Marsman and Company: 60
Marston mat: 125, 219
Martin, Maj. Gen. Frederick L.: 39
Maryborough: 260
Mason, Capt. George J.: 403
Massacre Bay: 329, 331
Massacre Valley: 329
Matanikau River: 207–09
Materials, construction. *See* Construction materials, improvised; Construction materials, measurement tons, for Canol; Construction materials, procurement.
Mathison, Jack: 144
MATTERHORN: 430, 438, 441, 449, 450, 453, 456, 467
Matthews, Col. Albert G.: 124–28, 137, 144–45, 147, 174–75, 181–83, 185, 212, 218
Mauban: 87
Maui airport: 39
Maui Island: 6
Mawlu: 446–47
Maynard, Maj. Clarence F.: 94
Mayo Landing: 319
Meadows, Lt. Col. Benjamin E.: 540
Mechanics. *See* Maintenance and repair, general; Specialists, shortages of: Specialists, training.
Medal of Honor award: 253–54
Meeandah: 223, 240
Mekong River: 414–15, 435
Melbourne: 109, 149
  base operation: 112, 153
  construction: 110, 112, 114, 119, 122, 138, 141, 153
  housing arrangements: 114
  map compilation and distribution: 551–52, 607, 666
  specialists, training: 271–72, 560–61
Merauke Airfield: 152, 158, 230
Merrill, Brig. Gen. Frank D.: 405–06, 424, 426, 444
Merrill's Marauders: 444, 446, 454–55
Metlakatla Indians: 19, 22
Mexico, Philippines: 78
Middleburg Island: 563–65
Midway Island: 153, 157, 284, 287, 364, 365, 683
  on air ferry routes: 45, 161

Midway Island—Continued
port facilities, construction and repair: 12
Mielenz, Col. Lloyd E.: 58, 65, 87, 93, 101–04
MIKE: 587, 591, 592, 601, 603
Military aid to China, costs: 389
Military Engineering Commission, China: 403, 440, 451
Military engineering missions, Corps of Engineers: 4–5
Miller, Col. Ernest B.: 78
Millingimbi Airfield: 231
Milne Bay: 179
airfield construction and repair: 151–54, 157–58, 174–75, 186, 221, 235–36
base construction and operation: 236, 245, 257, 556–58
battle of: 175–78
construction materials, procurement: 239
construction program and progress: 181–82, 220–22, 238–39
engineer units, arrival: 238–39, 521, 558
engineer units, strength: 175, 239
hospital construction: 257
ponton cube assembly plant: 546
port facilities, construction and repair: 151, 158, 175, 183, 221, 257, 546
rainfall, effect of: 239
reconnaissance, engineer: 238
road construction and repair: 221, 235
spare parts procurement: 265, 557–58
storage facilities, construction and operation: 257, 265
Minaker River: 308
Mindanao: 72, 105, 608, 626, 633
airfield construction and repair: 59, 61, 65, 570, 578, 636, 655
base construction and operation: 572, 636
blasting operations: 635–36
bridge construction and repair: 635–36
demolition operations: 106
guerrilla operations: 634
photography, aerial: 570
road construction and repair: 635
topography: 634–35
weather, effect of: 570–71
Mindanao River: 635
Mindanao Sea: 576
Mindoro: 64, 586–87, 655
Mine laying, marine, China: 462–63
Mine sweeping, marine, Leyte: 576
Mines, Japanese
Admiralties: 524–25
Biak: 538–39
Burma: 459
Corregidor: 620
Guadalcanal: 208
Leyte: 582–83
Luzon: 597–98, 609, 614, 617, 626–30, 639
Mines, Japanese—Continued
Manila: 614–15, 617, 619
Marianas: 506
Okinawa: 645–46, 648, 658
Philippines, 1944–45: 633–34
Saipan: 497–99
SOPAC: 542
SWPA: 542, 562
Mines
improvised: 352–53
installation in Hawaii: 348–49, 365–66, 377
required for Hawaii: 352, 362, 365
shortage of, Luzon: 75
Mines, marine, Japanese: 183
Ministry of Communications, China: 403, 414
Missouri: 679
Mitu: 413, 415
Mitu Road: 421–22, 435–36
Miyazaki: 675, 677
Mobile Construction Force: 422
Mobilization plans: 5, 43–44, 341
Mogaung: 443–44, 446, 468, 470, 472
Mohanbari: 400
Mokerang Peninsula: 522, 524–25, 543
Mokmer Airfield: 537–41
Mokuleia: 348, 361, 507
Molokai Island: 39, 361
Molucca Island: 566–68
Momote Airfield: 522–25, 543
Mong Yu: 464–65, 473
Monsoons. *See* Rainfall, effect of.
Montalban Dam and Reservoir: 618, 627, 638, 656
Montgomery, Col. Harry A.: 430
Moore, Maj. Gen. Richard C.: 25
Morale
Australia: 149
Corps of Engineers: 683
Ledo Road: 423
New Guinea: 146
SWPA: 654
USASOS: 654
Morobe: 246, 251
Moron: 86–87
Morotai: 566–68
Morris, Col. D. A.: 660
Morse, Col. Birney K.: 466, 471, 664
Morse Field: 39, 348
Motobu Peninsula: 645
Mount Austen: 207–09
Mount Barigada: 505
Mount Bataan: 85
Mount Hagen: 231
Mount Haleakala: 16, 23, 41, 51, 347
Mount Isa: 114, 239, 241
Mount Kaala: 16, 23, 51, 347
Mount Kokee: 347
Mount Macolod: 631
Mount Malepunyo: 631

Mount Natib: 85, 87, 89
Mount Pacawagan: 638
Mount Popomanisu: 207
Mount Santa Rosa: 505
Mount Silanganan: 87, 89
Mount Suribachi: 640
Mount Tapotchau: 493, 498–99
Mountain Engineer Division: 282
Mountbatten, Admiral Lord Louis: 428, 439, 446–47, 455, 466. *See also* Southeast Asia Command.
Mukden: 467
Mullins Harbor: 150
Muncho Lake: 309
Munda: 245, 249, 256
Municipal Water Department, Manila: 619
Murray River: 122
Murrow, Col. Lacey V.: 243, 267, 520, 569
Musa River: 180–81, 192
Musita Island: 193, 200–201, 203–04
Muskeg problem: 35, 293–94, 305, 308
Muskwa River: 309, 313
Myitkyina: 391, 405, 435, 443, 446–47, 454–55, 457, 460–66, 468, 470–73, 663–66

Nabesna Highway, Alaska: 304
Nabesna River: 295
Nadzab: 230, 244, 252, 254, 258, 543, 546
Nafutan Point: 498
Nagasaki: 678
Naha: 641–43
Nakagusuku (Buckner) Bay: 641, 659
Naknek River: 295
Namber Field: 563
Namhkam: 473, 663
Namur Island: 477
Nandi Airfield: 46, 48, 163–64, 222, 233
Nanomea Island: 380
Narewa: 222
Nassau Bay: 246, 273
Nasugbu landing: 608–09, 636
National Guard: 5, 14
National Military Council, China: 390
National Park Service: 41, 51
Nausori Highlands: 256
Naval base construction
  Admiralties: 521–22, 543–44
  Alaska: 16–18, 33, 35, 37, 287
  Carolines: 515–16
  Kodiak: 17
  Leyte: 575
  Marianas: 492
  Marshalls: 483–85
  Samar: 575
Naval construction battalions
  Admiralties: 521–25, 543–44
  Alaska: 287
  Carolines: 516
  Central Pacific: 380–81
Naval construction battalions—Continued
  Guam: 506, 517
  Hollandia: 529
  Marianas: 493, 506
  Marshalls: 485
  Mindanao: 635
  New Guinea: 258
  POA: 640
  Saipan: 498, 511–12
  Solomons: 171–72, 233, 243, 255
  SOPAC: 211, 232–33, 244–46, 569
  7th: 157
  40th: 523, 525
  57th: 516
  104th: 525–26
Naval Construction Regiment, 17th: 525
Naval districts: 36, 42
Naval gunfire support
  Biak: 538
  Borneo: 636
  Carolines: 514, 516
  Guam: 503–04
  Hollandia: 530
  Kwajalein: 479, 482
  New Guinea: 532, 535
  Philippines, 1944–45: 621, 626, 633–34
  Saipan: 496
  SOPAC: 542
  SWPA: 542
  Wakde: 536
Naval guns, emplacement in Hawaii: 349–52, 374, 661
Nawadih: 399
Nawngyang River: 433
Negro troops: 144n
Negros Island: 626, 634
Neilson, Col. Alexander M.: 651, 654
Nenana: 295
Netherlands East Indies: 107, 148, 230, 625, 636, 641
New Britain: 234–35, 272–74, 521
New Caledonia: 118, 234, 652
  airfield construction and repair: 45, 161, 163–67, 171, 206–07, 221–22, 233, 256
  base construction and operation: 661
  construction machinery and equipment, procurement: 212
  construction materials, improvised: 165
  construction materials, procurement: 214
  construction programs and progress: 206–07, 569, 661
  defenses, build-up of: 160, 162, 164–66
  engineer units, arrival: 164–67, 206, 213, 223
  engineer units, strength: 256
  hospital construction: 220
  housing construction: 167, 223
  labor force, strength: 163
  land acquisition and return: 661–62
  lines of communication: 166

New Caledonia—Continued
map compilation and distribution: 269–70
port facilities, construction and repair: 167, 223
power plant, installation and operation: 167
quarry operation: 223
railroad construction and repair: 167
reconnaissance, engineer: 46, 48
road construction and repair: 166, 167, 223
spare parts procurement: 264–65
New Delhi: 395, 397–99, 439, 448, 453, 458
New Georgia Islands: 234, 245, 249–51, 256
New Guinea: 172, 234, 520, 557, 586. *See also towns by name.*
AAF pressure for construction: 184–86
airfield construction and repair: 143–48, 150–59, 174, 180–87, 194, 198–99, 202, 218–20, 230–31, 235–38, 244–49, 251–52, 254, 257–60, 274–75, 533, 549–50, 561
airfield construction and repair, by Japanese: 550
base construction and operation: 236, 238–39, 244, 256–58, 275, 544, 546–47, 557
beach party operations: 535
bridge construction and repair: 247, 257, 274, 533, 535, 543, 546, 551
cargo unloading and distribution: 533, 535
causeway construction and repair: 183–84, 187
civilians, employment of: 181, 198, 202, 231, 235–37, 248, 254, 268
climate, effect of: 151, 157–58, 186, 191, 220, 235
construction, control of: 236, 650–51
construction, problems of: 151, 157–58, 181–82, 257
construction machinery and equipment, procurement: 151, 155, 202
construction materials, procurement: 155, 238, 258, 262–63, 266–67
construction programs and progress: 133–34, 174–75, 181–85, 220–22, 231–32, 238, 244, 246–47, 258, 541–42, 548
demolition operations: 146
engineer missions: 133–34, 160, 174, 521, 541–42
engineer organization: 147, 174, 521
engineer units, arrival: 144–49, 151, 154–55, 157–58, 187–88, 235, 239, 258, 274–75, 533, 551–52, 558
engineer units, control of: 174, 182, 187, 202
engineer units, requirements: 152–54, 187–88, 244–45
engineer units, shortage of: 238
engineer units, strength of: 182, 569
engineers as infantry: 175–78, 205, 252–53, 535, 543
hospital construction: 235, 257, 259, 546
housing construction: 184–85, 254, 257–58, 546
labor force, mobilizing: 180–81
land clearing: 157–58
maintenance and repair, general: 186, 265–66
malaria, incidence of: 151, 238
map compilation and distribution: 188–91, 269–70, 553–54, 668–69
New Guinea—Continued
mines, marine: 183
morale: 146
naval construction battalions at: 258
photography, aerial: 189, 191, 258, 553
pipeline construction and operation: 244, 258
port facilities, construction and repair: 158, 183, 194, 202, 235, 238, 244, 246, 257–58, 544, 546, 554
quarry operation: 152, 188
rainfall, effect of: 151, 156, 186, 247, 252, 258, 274, 533, 549–50
reconnaissance, aerial: 150, 563
reconnaissance, engineer: 150–51, 156, 178–81, 230, 236, 238–39, 258, 521
road construction and repair: 158, 182, 194, 202, 205, 230, 237–38, 244, 246, 251, 257–59, 274, 533, 535, 546
roadblock construction: 205
shore party operations: 533, 535
Soils Mechanics School: 272
spare parts shortage: 186, 265–66
specialists, training: 271–72, 672
storage facilities, construction and operation: 238, 244, 251, 257–58, 265, 546
topography: 178–79, 542
trail clearance: 178–80, 231
weather, effect of: 248
New Guinea Force: 174, 179, 182, 202
New Hebrides: 48, 169–71, 232, 256, 546–47, 569
New Ireland: 522
New Malir: 396
New Zealand: 112, 160, 211
construction machinery and equipment, procurement: 47–48
construction materials, procurement: 213–14, 261–62, 266–67
construction program and progress: 222, 233, 661
hospital construction: 232, 243
housing construction: 243
POL survey: 222, 233, 243
reconnaissance, engineer: 48
storage facilities, construction and operation: 233
New Zealand Chiefs of Staff: 170
Newcomer, Brig. Gen. Francis K.: 416, 453, 601, 605
Newmann, Col. David L.: 305
Newnam, Lt. Col. Frank H.: 471
Ngulu Island: 516
Nichols Field: 58–63, 66, 73, 84, 615, 655
Nielson Field: 66, 84, 92, 655
Night operations: 177, 491
Nimitz, Admiral Chester W. *See also* Pacific Ocean Areas; South Pacific Area.
and Alaska defenses: 288, 331
and B–29 bases: 658
and Central Pacific offiensives: 492
and engineer units, control of: 649–50
and Gilberts: 380
and Hawaii defenses: 350

Nimitz, Admiral Chester W.—Continued
and Iwo Jima: 640
and Leyte: 572
and Marianas: 492
and Marshalls: 477–78
and Philippines, 1944–45: 572
heads POA: 128, 170, 347, 378–79
Richardson, relationship to: 507
and Solomons: 153
Nisutlin Bay: 315
Nob Pier, Kwajalein: 485
Noble Drilling Corporation: 325, 335, 337
Noce, Brig. Gen. Daniel: 265
Noemfoor Island: 561
Nold, Brig. Gen. George J.: 19, 21–22, 35, 37, 278–79, 282, 289–90, 333, 642
Nolting, Maj. John P.: 417
Nome: 33, 278, 288, 325
Norman Wells: 318–27, 335–38
North, Col. Earl: 10–11, 14–15, 21, 29
North Africa campaign: 409
North Burke Airfield: 219
North Drome, New Guinea: 251
North Field, Guam: 517
North Field, Iwo Jima: 640
North Harbor, Corregidor: 620
North Harbor, Manila: 656
North Island, New Zealand: 222
North Luzon Force (NLF): 73–80
North Pacific Area: 170, 276, 328, 333, 339
North Pacific Division: 11, 18, 33, 36
North-South Highway, Mindanao. *See* Sayre (North-South) Highway, Mindanao.
North-South Road, Australia: 114, 239
Northway Airfield: 288, 292, 295
Northwest Division, NSC: 316–17
Northwest Service Command (NSC): 313–14, 316–17
Northwest Staging Route: 288, 299, 313, 318, 338
Norton Sound: 18, 288
Nouméa: 165–66, 212–14, 223, 233, 661
Novaliches Reservoir: 614, 618
Nukufetau Island: 380
Nurse, Lt. Col. Howard B.: 357–59, 372

Oahu Island. *See* Hawaiian Islands; Honolulu.
Oahu Railway & Land Company: 342
Oakes Construction Company: 315
Oakland, Calif.: 362
Obstacles, ground, construction of: 80, 88, 97, 634. *See also* Roadblock construction; Roadblock construction, Japanese; Wire obstacles; Wire obstacles, Japanese.
O'Connor, Brig. Gen. James A.: 304, 307, 309, 313, 325, 453, 458, 461, 465, 475
OCTAGON (Quebec) Conference: 572
O'Donnell Field: 61–64, 71, 73
Offensive plans. *See* MacArthur, General of the Army Douglas; *also areas by name.*
Office of Chief of Engineers (OCE). *See* Chief of Engineers.
Officer candidate schools, SWPA: 272
Ogden, Brig. Gen. David A. D.: 521, 532
Ogelbang Airfield: 231
Ohmer, Maj. John F., Jr.: 37
Oil. *See* POL (petroleum, oil, and lubricants).
Okinawa: 625, 641, 642–49, 657–58, 659–60, 667–68
OLYMPIC: 674–78
On Chong's Wharf, Makin: 382
Ondal: 399
Operations Division, WDGS: 464, 663
Operators, engineer equipment. *See* Specialists, shortage of; Specialists, training.
ORANGE plans: 3–5, 10, 55, 58, 66, 76–77, 89, 92–94
Orani: 79
Orion: 85, 89, 91–93
Ormoc: 576, 581–82, 586
Ormoc Plain: 573
Oro Bay: 194, 202, 221, 236–37, 257–58, 546, 557–58, 561
Orote peninsula: 503–04, 506
Ostrand, Capt. James A., Jr.: 44
Oua Tom Airfield: 233, 256
Owen Stanley Range: 158, 178–80, 192, 198
Owi Island Airfield: 539–41

P–38's: 541
P–40's: 541
Pacific Commercial Company: 70
Pacific Division: 11
Pacific hut: 297
Pacific Ocean Areas (POA): 128, 153, 170, 376, 377–79, 380, 383, 507–08, 518–19, 640, 649–50, 668, 680. *See also* Nimitz, Admiral Chester W.; *islands or areas by name.*
Pacific theater: 27, 49–50, 128, 463, 649–50, 667–69. *See also* Central Pacific Area; Pacific Ocean Areas; South Pacific Area; Southwest Pacific Area.
Paez, Jose: 81
Pagbilao: 81
Pago Bay: 504
Paint, photo-resistant: 44
Palau Islands: 510, 512–14, 518, 527
Palawan Island: 626, 632–33
Pallets, use in unloading: 496–97
Pallikulo Airfield: 206–07
Palmerston North: 222
Palo: 579
Palo River: 576
Palolo Valley: 345–46
Pampanga River: 74, 76–80, 82–84, 590–91, 596, 610–13
Pan American Airways: 47, 163
Pan American Highway: 14–15
Panama, Republic of: 12, 15, 20–21, 23, 29–33, 50, 53
Panama Canal. *See* Canal Zone.

Panama Canal Department. *See* Stone, Maj. Gen. David L.; Van Voorhis, Lt. Gen. Daniel.
Panama mounts: 58, 287
Panaon Island: 576, 577
Panay Island: 105, 626, 634, 657
Pandacan District, Manila: 84
Pandasveswar: 399
Pangsau Pass: 411, 433, 466
Paoshan: 414
Papua: 156. *See also* New Guinea.
"Papuan Aviation Battalion": 181
Parachute Infantry Regiment, 503d: 252, 619–20
Parang: 635
Park, Col. Richard: 33–35, 279, 282
Parker, Maj. David B.: 196, 203
Parker, Brig. Gen. George M., Jr.: 73, 80, 87, 89, 100
Parry Island: 483
Pasig River: 69, 614–17, 619, 656–57
Passage Canal: 18
Patch, Brig. Gen. Alexander M.: 164, 167, 170, 206, 208–09
Patkai Mountains: 405, 411–12, 423
Patnode, Pvt. Jerald F.: 149
Pattee, Lt. Col. Karl M.: 452
Patterson, Robert P.: 24–25, 41, 61
Paules, Lt. Col. Earl G.: 300, 302, 311, 314
Paxton, Maj. John W.: 498
Peace River: 301, 312, 315, 326–27, 334
Pearl City: 374
Pearl Harbor: 53–54
Pearl Harbor Board: 488
Peiping-Hankow railway: 452
Pekoa Airfield: 206–07
Peleliu Island: 514
Pelly River: 337
Pengshan: 440
Pennsylvania: 350–51
Penrhyn Island: 169, 171, 233
Permafrost: 292–93, 309–12
Permanant Joint Board of Defense, Canada-U.S.: 300
PERSECUTION: 532
Perth: 119
Pest control: 308, 501, 550
Peter Kiewit Company: 327
Petroleum, oil, and lubricants (POL). *See* Pipeline construction and operation; POL; Storage facilities, construction and operation.
Philippe, 1st Lt. Hersel E.: 105
Philippine Army
  in CONCOR: 653
  Corps of Engineers of: 66, 68–69. *See also Philippine Army Units by name.*
  mobilization: 55, 57, 68–69, 72–73
  training program: 97–98
Philippine Army Engineer Combat Battalions
  1st: 87
  2d: 87
  11th: 73, 76, 87
Philippine Army Engineer Combat Battalions—Continued
  21st: 73, 76, 87
  31st: 73, 76, 87
  41st: 80, 87–88, 90
  51st: 80, 82, 87, 91, 100
  61st: 105
  71st: 73, 76, 87, 95–96
  81st: 105
  91st: 73, 76–77, 87
  101st: 105
  201st: 88, 100
  202d: 88, 100
Philippine Army Engineer Combat Regiment, 301st: 88, 90
Philippine Army Infantry Divisions
  11th: 89
  31st: 91
  41st: 98
Philippine Base Section: 651, 669
Philippine Department. *See* Philippine Army; Philippines, Commonwealth of; Philippines, 1941–42; Philippines, 1944–45.
Philippine Engineer Depot: 69
Philippine engineer districts: 650–53
Philippine Racing Club: 616
Philippine Scouts: 653
Philippine Sea, Battle of: 503
Philippines, Commonwealth of
  airfields, 1940–41: 58–59
  Bureau of Aeronautics: 66
  Bureau of Public Works: 62–64, 66, 73–77, 80–81
  independence of: 57n
  and land acquisition: 60
Philippines, 1941–42: 4, 52–53, 76, 89, 92–93. *See also* Grunert, Lt. Gen. George; MacArthur, General of the Army Douglas; *islands and areas by name.*
  aircraft warning stations, construction of: 59, 64, 66
  airfield construction and repair: 45, 55, 58–59, 63–66, 71
  bridge construction and repair: 64
  civilians, employment of: 73, 75, 77, 79–82, 88, 101–02
  coast defense construction: 57
  construction, problems of: 59–61, 64–65
  construction machinery and equipment, procurement: 62–63, 69–70
  construction materials, procurement: 69–70
  construction programs and progress: 59–66, 71–72, 86–87
  demolition operations: 66–68, 74, 596
  engineer organization: 66, 69
  engineer units, arrival: 63
  engineer units, shortage of: 59–60
  engineer units, strength: 61, 68–69
  guerrilla operations: 106
  labor force, mobilizing: 69

Philippines, 1941–42—Continued
land acquisition: 60, 65
maintenance and repair, general: 62–63
map compilation and distribution: 94
port facilities, construction and repair: 61, 66, 71
prisoners, employment of: 65–66
railroad construction and repair: 78
reinforcements for: 55–57, 72, 109
road construction and repair: 60–61, 64
spare parts procurement: 62–63
storage facilities, construction and operation: 66
troop units, defense organization: 55, 66–69
tunnel construction and repair: 61, 64, 66, 71
weather, effect of: 61–62
Philippines, 1944–45: 463, 468, 561, 563, 566, 569–70, 572, 586, 619–20, 632, 635, 638. *See also* MacArthur, General of the Army Douglas; *islands or areas by name.*
airfield construction and repair: 625–26, 633–34, 655
base construction and operation: 625–27, 650–51
bridge construction and repair: 633–34
cement plants, rehabilitation: 657
construction, control of: 651–52
construction program and progress: 649
demolition operations: 621–24, 633
engineer districts in: 650–53
engineer missions: 570–71
engineer organization: 650–54
engineer units, arrival: 666–67
engiuer units, requirements: 626–27
flame throwers, tactical use: 621
floating depot concept: 670
fortifications, construction by Japanese: 633–34
hospital construction: 653, 655–56
housing construction: 653
maintenance and repair, general: 669–70
map compilation and distribution: 626, 668–69
pipeline construction and operation: 655
POL, tactical uses: 621–24
ponton cubes, employment of: 621
port facilities, construction and repair: 655–56
railroad construction and repair: 657
reconnaissance, engineer: 626
road construction and repair: 633–34, 653
sawmill construction and operation: 657
snipers, Japanese: 622
spare parts procurement: 669–71
specialists, training: 671–72
storage facilities, construction and operation: 653, 655–56
topography: 626
training, deficiencies in: 671
weather, effect of: 570–71
Photo interpretation: 554
Photo Squadrons
1st: 33
8th: 189–91
Photography, aerial
Admiralties: 522
Alaska: 290
Alaska Highway: 308–09
Biak: 538
Burma: 445
Carolines: 516
Central Pacific: 490, 510
China: 458
Guam: 517
Hollandia: 530
Japan: 510, 518, 668–69, 673
Lae: 252
Leyte: 570, 573
Luzon: 588, 596, 607–08
Marianas: 490, 493
Marshalls: 483
Mindanao: 570
by Navy: 668
New Guinea: 189, 191, 258, 553
Okinawa: 641
POA: 382
Saipan: 490, 495, 503
Solomons: 250
SOPAC: 270–71
SWPA: 271, 552–54, 567
Wakde: 534–35
Photography, trimetrogon: 189–91
Photomaps, compilation and distribution: 376–77, 607. *See also* Map compilation and distribution; Photography, aerial.
Pick, Brig. Gen. Lewis A.: 433. *See also* Ledo Road.
and bridge construction and repair: 444, 448, 663–64
and Chinese, supplies to: 472–73
commands of: 432, 438, 439, 443
completes Ledo Road: 664
and construction machinery and equipment, procurement: 456, 465, 472
and construction program and progress: 434, 453–54, 465–66, 470
and engineer units, diversity of: 466
and engineer units, strength: 465, 664
and engineers as infantry: 444
leads first convoy to Kunming: 473–74
and Myitkyina base: 463, 466, 473
and Myitkyina–Teng-chung road: 473
and pipeline construction and operation: 434, 462, 466, 664
and reconnaissance, engineer: 462, 465
and reinforcements: 457, 463
and road construction and repair: 433, 444, 447, 663–64
and route selection: 460, 462, 465
and spare parts procurement: 442, 456
Pilar: 79, 85–86, 89, 93
Pilar-Bagac road: 90, 93
Pilar-Orion road: 95

Pilar River: 97
Pillboxes. *See* Demolition operations; Demolition operations, Japanese; Fortifications, construction by Japanese.
Pim: 530
Pinamopoan: 582
Pine Creek Airfield: 149
Pineapple Growers Association: 343
Pipe, invasion weight: 426–27, 434, 449–50
Pipeline construction and operation
  Admiralties: 544
  Alaska: 288
  by ASCOM: 585, 600
  Assam: 426–27, 439, 442, 457, 466–67, 471, 664–66
  Burma: 390, 426–27, 430, 434–35, 442, 454, 457, 463–67, 471, 666
  Canol: 320, 323–28, 335–38
  CBI: 436, 466
  Central Pacific: 386
  China: 390, 418, 426–27, 430, 466, 471, 475, 662, 666
  Combined Chiefs directive on: 426–27
  Fiji: 222
  Hawaii: 42
  Hollandia: 544
  India: 387, 426–27, 439, 442, 450, 457, 466–67, 471, 666
  India-Burma Theater: 662
  Lae: 244
  Ledo Road: 427, 434–35, 439, 449–50, 454, 457, 462, 466–67, 471, 475, 664–66
  Leyte: 585
  Luzon: 600
  Manila: 619
  New Guinea: 244, 258
  Okinawa: 659–60
  Philippines, 1944–45: 655
  SWPA: 563
Pitoe Airfield: 568
Plaines des Gaiacs Airfield: 48, 161, 163–67, 222–23, 233, 256
Planking, pierced, first use of: 125, 219
Plaridel: 83, 610
Pleasanton Hotel, Honolulu: 358–59
Pock, 1st Lt. Hugh A.: 473
Poindexter, Joseph P.: 344–45
POL (petroleum, oil, and lubricants)
  deposits, exploration for: 337
  evacuation and destruction of: 84
  rationing: 343, 356, 358
  requirements: 339, 426–27
  shortages: 95, 100
  supply of in CBI: 427, 466–68
  surveys for: 222, 233, 243
  tactical use: 621–24
  as weapon against Japan: 325
Pongani Airfield: 181, 192
Ponton bridges: 444, 470, 471n, 472-74. *See also* Bridge construction and repair; River crossings.
Ponton cubes, employment of
  Central Pacific: 476, 511
  Leyte: 577
  Luzon: 590, 593, 602
  Manila: 618, 656
  Okinawa: 659
  Philippines, 1944–45: 621
  Saipan: 511
  SWPA: 550
Ponton cube assembly plant: 546
Popa, Cpl. Stephen: 253
Porac: 655
Port congestion
  Australia: 126–27, 242, 554
  Hawaii: 367
  India: 396
  Pacific Coast: 343
  San Francisco: 355, 362
  SWPA: 264, 554, 557
Port facilities, construction and repair
  Admiralties: 544
  Alaska: 36, 280–81, 283, 286–89, 291, 297–98, 331, 333–34
  ASCOM: 585, 600–601
  Attu: 331
  Australia: 110, 113–15, 240, 260
  Bataan: 61, 66, 95
  Biak: 539, 544
  Burma: 467, 471
  Carolines: 515–17
  Central Pacific: 476, 511
  Fiji: 222
  Hawaii: 12, 40, 367, 373–74, 486
  Hollandia: 527, 544
  India: 394, 396, 399
  Japan, for assault on: 673–74, 677–78
  Kwajalein: 485
  Lae: 244–45, 258
  Leyte: 575, 585
  Luzon: 592, 600, 632
  Manila: 619, 656
  Marshalls: 485
  Milne Bay: 151, 158, 175, 183, 221, 257, 546
  New Britain: 273
  New Caledonia: 167, 223
  New Guinea: 158, 183–84, 194, 202, 235, 238, 244, 246, 257–58, 544, 546, 554
  Okinawa: 643, 659
  Philippines, 1941–42: 61, 66, 71
  Philippines, 1944–45: 655–56
  Port Moresby: 145, 174, 182–83, 259
  Saipan: 499, 501–02, 511
  Solomons: 245, 249–50, 546
  SWPA: 550–51, 567
  Wakde: 544
  War Department directive on: 287
Port facilities construction and repair, by Japanese: 476–77
Port Heiden: 28, 37, 51, 278, 281, 283, 285, 287

Port Moresby: 118, 142, 150, 173, 546
airfield construction and repair: 143, 145–48, 151–57, 174–75, 184–86, 188, 220, 236, 259
base construction and operation: 174–75, 236, 245, 258
construction programs and progress: 133–34, 181–82, 185, 220–22, 235
hospital construction: 259
housing construction: 185
map compilation and distribution: 199–200
port facilities, construction and repair: 145, 174, 182–83, 259
road construction and repair: 259
Soils Mechanics School: 272, 561
specialists, training: 271–72
Porter, Col. Horace L.: 495
Portland, Ore.: 290
Portland Roads Airfield: 152, 155
Power plants, installation and operation: 167, 373, 399, 502, 619, 657
Prefabricated housing. *See* Housing construction.
Press correspondents: 473
Preventive maintenance. *See* Maintenance and repair, general; Spare parts procurement.
Price, Maj. Charles F. B.: 396, 402, 418–19
Prince George, B.C.: 299
Prince Rupert: 280, 289, 302, 323, 327
Prince William Sound: 18, 287
Priority ratings
air ferry routes: 161
Alaska: 48–50, 279, 282, 289–90
Assam: 416–17
Australia: 121–22, 134–35, 137–38, 215–16, 241–42, 260
Burma: 409
Canal Zone: 48–49
CBI: 436, 456
Central Pacific: 377, 381
Hawaii: 48–50, 346, 351, 353–56, 369, 373
India: 401
Kwajalein: 486
Luzon: 604, 612
Philippines, 1944–45: 70
POA: 379
USAFFE: 242, 260
Prisoners, employment of: 65–66, 345
Prisoners of war: 403, 507
Propaganda broadcast, by Japanese: 146
Prophet River: 308
Public relations, in Hawaii: 358–60, 363
Public Roads Administration (PRA): 21, 278, 300–302, 305–07, 310–17, 334
Public Works Department, India: 416–17
Public Works Department, New Zealand: 233
Puerto Princesa: 633, 655–56
Puerto Rican Department: 6–7, 28
Pulo Anna Island: 516
Punahou Academy: 341–42, 346, 355, 358–59
Pyron, Brig. Gen. Walter B.: 318–19

QUADRANT (Quebec) Conference: 255, 388–89, 425–28, 431, 444, 448, 466–67, 664
Quarry Heights: 14
Quarry operation: 152, 188, 223, 500, 511
Quartermaster Corps: 6, 9, 12–14, 19, 20
Quebec Conferences: 255, 388–89, 425, 426–28, 431, 448, 466–67, 572, 664
Queensland Agricultural College: 114
Queensland Island Defense Road: 239
Queensland Main Roads Commission: 144, 152, 158
Quezon, Manuel L.: 60
Quezon City: 615
Quinauan Point: 96, 103
Quoin Hill Airfield: 232
Quonset hut: 267, 297

R. G. Le Tourneau, Inc.: 140, 272, 560
Rabaul
air attacks on: 272
as air base, Japanese: 143
air support requirements: 153–54
Combined Chiefs directive on: 225
engineer mission: 244
engineer units, requirements: 234
fall of: 118
JCS directives on: 153, 172, 234
offensive, Allied: 150, 153–54, 160, 172, 225, 244, 255, 272, 275
task force concentration, by Japanese: 149
Radar stations, construction of: 250, 283, 347
Radio station, construction of: 315
Ragay: 80
Railroad construction and repair
Alaska: 18–19, 22, 34, 36, 52, 53, 278, 283, 287–89
by ASCOM: 600, 604
Australia: 241
Burma: 389
Carolines: 516
China: 389
Fiji: 222
Hawaii: 23
Japan, for assault on: 677
Ledo Road: 410
Luzon: 596–97, 600, 602–06, 612, 639
Manila: 604–05
New Caledonia: 167
Philippines, 1941–42: 78
Philippines, 1944–45: 657
Saipan: 502–03
Railroad systems
Assam: 393, 471
Australia: 108, 123
Burma: 393, 435
Canada: 302–03, 305
India: 393, 471
Japan: 673–74
Luzon: 74
New Caledonia: 166
Railroads, Japanese control of: 393

Rails, source of: 389
RAINBOW plans: 10, 14, 19
Rainfall, effect of. *See also* Weather, effect of.
  Alaska Highway: 305, 317, 334
  Assam: 393, 400, 416
  Burma: 436, 446, 454–55, 462
  Burma Road: 414
  Carolines: 516
  China: 425
  Hawaii: 371
  Hollandia: 531
  India: 392–93, 397, 399
  Lae: 252
  Ledo Road: 411, 423–25, 432, 453–54, 456–57, 465
  Leyte: 580–84, 586
  Luzon: 588, 637–38
  Milne Bay: 239
  New Britain: 274
  New Guinea: 151, 156, 186, 247, 252, 258, 274, 533, 549–50
  Okinawa: 641, 649, 658–59
  Saipan: 500–503
  Solomons: 249
  SOPAC: 256, 543
  SWPA: 542, 565, 568
Ralph Woolley and Company: 41, 359
Ramey, Maj. Roger M.: 46, 48
Ramgarh: 403–05, 416
Ranger Battalion, 6th: 587, 594
Rangoon: 390–91, 430–31
Rangoon-Lashio railway: 390–91
Rations, shortage of: 96
Raymond: 585
RECKLESS: 529
Reconnaissance, aerial
  Alaska: 283
  Alaska Highway: 306, 308–09
  Burma: 445
  Canol: 323
  Luzon: 626
  New Guinea: 150, 563
  Okinawa: 646
  Solomons: 231
  SOPAC: 231
Reconnaissance, aerial, Japanese: 401, 592
Reconnaissance, combat: 250, 454–55, 482, 522–23
Reconnaissance, engineer
  air ferry routes: 168–69
  Alaska: 12–14, 33–34, 36–37, 283–85, 288–89, 305–06, 331
  Alaska Highway: 300–301, 305–06, 308–12, 314–16
  Australia: 119–20, 123, 135, 144
  Biak: 537, 539–40
  Burma Road: 413–15, 466
  Canol: 325, 327
  Canton Island: 46–47
  Carolines: 516–17
  Central Pacific: 384, 510
  China: 440
Reconnaissance, engineer—Continued
  Christmas Island: 46
  Fiji: 46
  Guam: 517
  Hawaii: 16, 51–52, 350, 368, 486
  India: 440
  Kwajalein: 482, 484
  Ledo Road: 406–07, 409–10, 423–24, 461–62, 465
  Leyte: 577, 580–81, 584–85
  Luzon: 588, 593, 599, 601, 615, 626, 638
  Milne Bay: 238
  New Britain: 521
  New Caledonia: 46, 48
  New Guinea: 150–51, 156, 178–81, 230, 236, 238–39, 258, 521
  New Hebrides: 48
  New Zealand: 48
  Okinawa: 658
  Philippines, 1944–45: 626
  POA: 380
  Saipan: 496, 499–500, 503
  Solomons: 48
  SOPAC: 271
  SWPA: 230, 549, 554, 563–65, 568
  Wakde: 535
Recreation facilities, construction of: 546
Red I Point. *See* Jacky Jacky Point Airfield.
Refinery construction and operation: 326–28, 335–39
Refrigeration plants, installation and operation: 399, 478, 486, 632
Reid River: 125
Reinforcements
  Philippines: 55–57, 72, 92, 109
  SOPAC: 164
Reinforcements, Japanese: 205–06, 581, 586
Rendova Island: 245
Repair of machinery. *See* Maintenance and repair, general; Spare parts procurement; Specialists, shortages of; Specialists, training.
Replacements, requirements for: 547
Requisitions. *See* Administrative procedures.
Reserve Corps: 5
Reserve Force, USAFFE: 73
Reybold, Lt. Gen. Eugene: 42–43. *See also* Chief of Engineers.
  and Alaska Highway: 300, 305, 317, 324
  becomes Chief of Engineers: 45
  and Canol: 319–20, 323–24
  and construction, control of: 354
  and construction programs and progress: 278
  and engineer districts: 652
  and engineer units, shortages of: 342–43
  and maintenance and repair, general: 266
  and specialists: 263–64
  supply policy: 140, 261
Rhine River: 471n
Richardson, Lt. Gen. Robert C., Jr. *See also* Hawaiian Islands; United States Army Forces in the Pacific Ocean Areas.

Richardson, Lt. Gen. Robert C., Jr.—Continued
commands of: 377, 491, 507
and defense battalions: 381
and engineer missions: 507, 661
and Hawaiian Constructors: 487
Nimitz, relationship to: 507
Richardson Highway: 33, 278, 290, 303–04
Richmond, Australia: 560
Riddell-Webster, General Sir Thomas: 426
Rinehart, Col. O. N.: 650
Rio Hato Airfield: 8–9, 11–12, 14, 21, 50
River crossings. *See also* Bridge construction and repair; Ponton bridges
Alaska Highway: 310, 312
Burma: 444, 454–55, 459, 468, 472
China: 663, 666
Ledo Road: 470, 472–73
Leyte: 574–75
Luzon: 590–91, 595–96, 602, 610–13, 615–16, 630, 638
New Guinea: 192
SOPAC: 542
SWPA: 542
Rivers, development and use. *See* Waterways, development and use.
Rizal, Luzon: 610
Rizal Province: 84
Road construction and repair: 16. *See also* Burma Road; Land clearing operations; Trail clearing operations.
Admiralties: 524
Alaska: 36, 50, 278, 283, 288, 291, 295–96, 329–33
by Allied Works Council: 239
by ASCOM: 585–86, 600
Attu: 329–31
Australia: 122–23, 128, 138, 239–40
Bataan: 61, 90–91, 95–97
Biak: 538, 544
Burma: 391, 413, 430, 443, 464
Canal Zone: 20–21
Canol: 321, 325–28, 335–37
Carolines: 514, 516
Central Pacific: 386
China: 413, 430, 472, 662
Fiji: 220–22, 232–33, 256
Guadalcanal: 208–09, 256
Guam: 504–06
Hawaii: 23, 43, 346, 350, 369, 374
Hollandia: 527, 530–31, 544
India: 393, 398–99, 403
Iwo Jima: 660
Japan, for assault on: 673, 677
Kwajalein: 480, 482, 485
Lae: 244, 258
Ledo: 412, 663
Leyte: 577–86
Luzon: 594, 596–97, 600, 609, 626–32, 637–39
Manila: 619, 657
Marianas: 506
Road construction and repair—Continued
Marshalls: 485
Milne Bay: 221, 235
Mindanao: 635
New Britain: 273
New Caledonia: 167, 223
New Guinea: 158, 182, 194, 202, 205, 230, 237–38, 244, 246, 251, 257–59, 274, 533, 535, 546
New Hebrides: 170, 256
Okinawa: 643, 645, 648–49, 659
Panama Republic: 50
Philippines, 1941–42: 60–61, 64
Philippines, 1944–45: 633–34, 653
POA: 380
Port Moresby: 259
Saipan: 498–502
Solomons: 249–50, 255, 526
SOPAC: 256
SWPA: 565, 567–68
Road systems
Australia: 108, 110, 114
Bataan: 85–86
Burma: 393
India: 393
Japan: 674
Leyte: 573
Luzon: 74, 588–90, 627–29
New Caledonia: 166
Roadblock construction. *See also* Obstacles, ground, construction of.
Bataan: 100
Hawaii: 352
Luzon: 74, 77
New Guinea: 205
Roadblock construction, Japanese
Luzon: 598, 609–10, 627, 639
Manila: 617
Okinawa: 645, 648
Philippines, 1944–45: 634
Robb, Col. Holland L.: 369
Robert Louis Stevenson: 670
Robins, Maj. Gen. Thomas M.: 319
Robinson, Col. Bernard L.: 39
and airfield construction and repair: 219
and base construction and operation: 528
and civilians, employment of: 231
and coast defense construction: 351
commands of: 528, 548, 557
and construction machinery and equipment, procurement: 153
and costs of construction: 353
and engineer units, control of: 147
and engineer units, shortage of: 153
and Hawaiian Constructors: 356, 363, 488
and priority ratings: 215
reconnaissance, engineer, by: 47–48, 156
on SWPA staff: 130, 571
Rocket fire support: 273–74, 530, 562
Rockhampton: 45

Rocky Mountain Trench: 299
Rocky Mountains: 308
Rohl, Hans Wilhelm: 489
Rohl-Connolly Company: 25, 489
Roi Island: 476–77
Roome, Maj. Gen. Horace L.: 417
Roosevelt, Franklin D.
  activates USAFFE: 57
  and Alaska defenses: 328
  and Alaska Highway: 299–300
  approves RAINBOW: 14
  and Australia build-up: 118
  authorizes transfer of construction to Engineers: 20
  and B–29 bases: 441
  and Burma Road: 404
  and Canol: 319, 322–23
  at Casablanca Conference: 225, 328
  and China air offensive: 417–18, 428
  and China lend-lease: 389
  and China as theater: 390
  defense planning by: 13–14
  and Germany-first policy: 107, 210
  and hemisphere defense: 7
  and Ledo Road: 409
  orders MacArthur to Australia: 99
  and SEAC: 428–29
  and Stilwell: 398, 470
  and U.S. role in Pacific: 128
Rorona Airfield: 147, 186
Rosario, Luzon: 627
Ross, Brig. Gen. Lewis T.: 520, 549, 651, 670
Roto Airfield: 219
Rowell, Maj. Gen. Sydney F.: 174, 178, 182
Royal Australian Air Force: 136–38, 154, 158, 211, 544, 561–63, 567–68, 586
  Engineer Construction Squadron, 5th: 562–63
  Engineer Mobile Works Squadrons
    5th: 533
    6th: 533
    7th: 533
Royal Australian Engineers: 133, 146–47, 152, 155–56, 158, 211, 231, 271, 636. *See also* Australian Army.
Royal Australian Navy (RAN): 108
Royal Hawaiian Hotel, Honolulu: 358–59
Royal Melbourne Hospital: 114
Royal Netherlands Indies Army: 636
Rumaggi, Col. Louis J.: 650
Russell, Maj. Gen. Henry D.: 488
Russell Islands: 233
Rutledge, Col. Paul W.: 164
Ryukyu Islands. *See* Ie Shima; Kerama Retto; Okinawa.

S. G. Hindes: 367
Sabotage, by Japanese: 536, 614
Sadon: 466
Sagami Bay: 673–74, 677
Saidor: 272–73, 275
Sailor's Home, Melbourne: 114
Saint, Capt. Frederick G.: 73
Saint-Gaudens, Col. Homer: 32
St. Paul Island: 284, 286–87
Saipan: 492–503, 511–12, 518
Sakhalin Island: 678
Salacsac Pass: 628–29, 636–37
Salamaua: 143, 174, 234, 244, 247–48, 251–52
Salt Lake City: 282
Salvage operations: 93, 603–04, 629
Salween Gorge: 397
Salween River: 405, 408, 413, 421, 435, 454–55, 458–62, 466
Samar: 580, 586
Samarai Island: 173
Samboga River: 195
San Agustin, Luzon: 639
San Clemente, Luzon: 595
San Diego, Calif.: 328
San Fabian, Luzon: 588, 603
San Fernando, La Union: 74–75, 588, 603, 655–56
San Fernando, Pampanga: 76–77, 82, 85
San Francisco, Calif.: 52–53, 171–72, 261, 344, 355, 362, 379, 494
San Jose, Luzon: 610, 627–28
San Jose, Mindoro: 586–87
San Juan Reservoirs, Luzon: 614, 617–18
San Juan del Monte: 61
San Manuel, Luzon: 597
San Pablo Airfield: 573, 576, 579–80, 583
Sanananda: 193, 204–05
Sand Island: 367
Sandau Island: 636
Sandvall, Lt. Col. Leslie E.: 454
Sansapor: 564–66
Santa Fe, Luzon: 629, 637–38
Santa Maria, Luzon: 597, 628
Sarana Pass: 329
Sarana Valley: 329
Sarangani Bay: 570–72, 575
Saratoga: 350
Sarmi: 534, 537
Sauer, Maj. Richard P.: 48, 163, 165, 167, 170, 511
Sawmill construction and operation: 433, 544, 551, 632, 657
Sayre (North-South) Highway, Mindanao: 635
Schley, Maj. Gen. Julian L.: 6, 22, 29, 33–34, 36, 42, 45, 63, 70, 389. *See also* Chief of Engineers.
Schofield Barracks: 10, 14, 23, 53, 350, 510
Schouten Islands: 537, 539, 561–63
Schull, Col. Herman W., Jr.: 429
Seabees: *See* Naval construction battalions.
Seacoast defenses. *See* Coast defenses construction.
Seamen's Mission, Melbourne: 114
Seaplane base construction: 365, 374, 515
Seattle: 302, 319, 323
Seattle Engineer District: 11, 19, 28, 34, 36–37, 49, 278–82, 288–91, 296, 333

Secretary of the Navy. *See* Knox, Frank.
Secretary of War. *See* Stimson, Henry L.; Woodring, Harry H.
Seeadler Harbour: 522, 526
Seedlock, Lt. Col. Robert F.: 453, 465–66, 473
Seeman, Col. Lyle E.: 429, 437
Selective Service Act: 14
Semichi Islands: 328
Sentani, Lake: 527
Sentani Airfield: 531–32
Service commands: 214, 676
Services of Supply, CBI
  activated: 394
  advance sections activated: 395–96, 415, 418
  and airfield construction and repair: 437, 439
  base sections activated: 395–96, 409
  China: 470
  Construction Service: 438, 475, 681
  divisions and districts activated: 438–39
  engineer organizations: 398–99; 438–39
  Engineer Section: 398
Services of Supply, SOPAC: 172, 214, 568
Services of Supply, USAFISPA: 172, 214, 568
Seven-Mile Drome: 143, 146, 152, 186–87, 220
Seward: 17, 287, 289–90
Seward peninsula: 283, 288
Sewerage installation: 366, 373, 502, 657
Shaffer, Maj. C. N.: 479
Shao-yang: 469
Sheepsfoot rollers. *See* Construction machinery and equipment, procurement.
Sheldon Lake: 325, 327
Shell Oil Company: 233, 390, 426
Shemya Island: 328, 331, 333
Shepard, O. F.: 358–59
Shibushi: 673, 675, 677
Shield, Maj. John E.: 47, 162, 164–65
Shikoku Island: 678
Shingbwiyang: 405, 411, 424, 433–35, 443, 447, 449
Shipping, allocations: 264, 356, 379
Shipping congestion. *See* Port congestion.
Shipping losses, Japanese: 425, 432, 452, 468
Shipping priorities: 478–79
Shipping routes: 379, 493–94
Shipping shortages
  on air ferry routes: 161
  Alaska: 280–81, 289
  Australia: 140, 155
  Burma: 471
  Canol: 325
  CBI: 436
  China: 408
  Congressional hearings on: 362
  Hawaii: 343–44, 355, 362–63
  India: 471
  SOPAC: 543
  SWPA: 175, 186, 210–12, 543, 554
  USASOS: 186–88
Shop construction: 229
Shore party operations: *See also* Beach party operations; Cargo unloading and distribution.
  Carolines: 514–15
  Guam: 503–04
  Hollandia: 530–51
  Kwajalein: 479–82
  Leyte: 477–79
  Marianas: 506
  Marshalls: 482–83
  New Guinea: 533, 535
  Okinawa: 644–45
  Saipan: 494–97
  Wakde: 536
Short, Lt. Gen. Walter C. *See also* Hawaiian Islands.
  and air ferry routes: 45–46, 161–63
  and airfield construction and repair: 361
  heads Hawaiian Department: 27, 38, 344
  and construction machinery and equipment, shortages: 42–43
  and construction programs and progress: 341–43
  and Hawaii defenses: 27–28, 40
  as military governor: 341, 343
  and priority rating: 49
Shweli River: 473–74, 663–64
Siberia: 326
Sibul Springs: 76
Sierra Madre Mountains, Luzon: 625, 627, 638
Signal Corps: 347, 362
Silhavy, 2d Lt. Robert C.: 80
Silver Star awards: 444
Simemi: 193, 196, 199
Simemi Creek: 193, 196, 200
Sincheng: 419–20, 452
Sincheng Construction Company: 419
Singapore: 118, 390
Sitka: 12, 18, 22, 36, 278, 287
Skagway: 302–03, 319, 323–24, 326, 335, 339
Skerry, Lt. Col. Harry A.: 68, 73–78, 83, 87–88, 91, 96, 98–99, 611
Slana: 304, 312
Slave River: 320, 322
Slim's River: 313
Sloat, Lt. Col. James W.: 407, 409
Smith, Lt. Gen. Holland M., USMC: 492, 496–97, 502
Smith, Col. W. D.: 601
Smoke, tactical use: 523, 638
Smoke screen, use considered: 32
Snipers, Japanese: 484, 614, 617, 622, 657
Snowfall, effect of: 294–95, 309
Society Islands: 168
Sogod Bay: 576
Soil cement: 219
Soils Mechanics School: 272, 561
Soldier's Summit: 315
Solomon Islands
  airfield construction and repair: 245, 249–50, 254–55

Solomon Islands—Continued
bakery construction: 546
base construction and operation: 245, 250, 527, 544–47
bridge construction and repair: 249, 255, 526
civilians, employment of: 235, 268–69
construction machinery and equipment, improvised: 247
construction programs and progress: 526, 544–46, 568–69, 661
engineer mission: 172–73, 244–45, 249
engineer units, arrival: 249, 526, 544
engineers as infantry: 249–51, 526–27
flame throwers, tactical use: 245, 249
hospital construction: 250–51
housing construction: 544
map compilation and distribution: 188–89
naval construction battalions at: 171–72, 233, 243, 255
offensive, Allied: 153, 172, 233–34, 245–46, 249–51, 254–55, 574
photography, aerial: 250
port facilities, construction and repair: 245, 249–50, 546
rainfall, effect of: 249
reconnaissance, aerial: 231
reconnaissance, combat: 250
reconnaissance, engineer: 48
road construction and repair: 249–50, 255, 526
sawmill construction and operation: 544
seizure by Japanese: 165
storage facilities, construction and operation: 526, 544
water supply and distribution: 249–51
Sommerfeld mat: 380
Somervell, Lt. Gen. Brehon B.: 29. *See also* Army Service Forces.
activates India Committee: 429
and Alaska Highway: 313, 318, 324
and Canol: 318–19, 322–26, 339
and CBI supply: 436, 442
and China pipeline: 419
and China supply system: 426, 429–30
and construction machinery and equipment, procurement: 236
and Hawaii base development: 375–76
and Ledo Road: 429–30, 464, 663
and pipeline construction and operation: 436–37
and POA staff: 378–79
and POL survey: 222
and port construction and repair: 281
and road construction and repair: 288
and shipping shortages: 436–37
and TOE: 438
Sookerating: 400
Soong, T. V.: 474
Sorido Airfield: 537, 541
Sorong: 563
South China Sea: 88, 97
South Harbor, Manila: 656
South Island, N.Z.: 222, 233
South Luzon Force (SLF): 73, 79–82
South Pacific Area (SOPAC): 160, 162, 169–70, 173, 214, 244–46, 379, 507. *See also* Ghormley, Vice Adm. Robert L.; Nimitz, Admiral Chester W.
activation: 170
airfield construction and repair: 232–33, 243, 255–56, 266, 549–50
base construction and operation: 255–56, 542–43, 546–47, 649
bridge construction and repair: 542
bulldozers, tactical use: 542
camouflage: 559–60
construction, control of: 242
construction, problems of: 542
construction design standards: 266–67
construction machinery and equipment, diversified: 264–65
construction materials, procurement: 260–64
construction programs and progress: 220–24, 231–32, 242–43, 542–43, 648–49
demolition operations: 542
engineer missions: 275, 542, 568–69
engineer organization: 232, 243, 520–21, 543, 568–69
engineer units, arrival and departure: 161, 164–68, 171–72, 226–27, 266, 270, 541
engineer units, control of: 243, 543
engineer units, requirements: 232, 234
engineer units, shortages of: 210–11, 267–68, 680
engineer units, strength: 210, 243, 275, 520, 569, 661
hospital construction: 267
housing construction: 256, 266–67
maintenance and repair, general: 264–66
map compilation and distribution: 188–89, 269–71, 551–52, 666–67
photography, aerial: 270–71
rainfall, effect of: 256, 543
reconnaissance, aerial: 231
reconnaissance, engineer: 271
reinforcements for: 164
river crossings: 542
road construction and repair: 256
spare parts procurement: 264–66
specialists, shortage of: 263–65
storage facilities, construction and operation: 256, 267
theater missions: 225, 568–69
topography of islands: 542
training program: 271–72
troop units, strength: 210, 243, 569
South Pacific Base Command, SOPAC: 507, 568, 661
South Pacific Engineer Division: 24

South Pacific Force: 244
Southeast Asia Command: 428, 437, 470, 473–75. *See also* Mountbatten, Admiral Lord Louis.
Southwest Pacific Area (SWPA): 107, 128, 153, 156, 174, 175, 186, 225, 380, 522, 527–28, 534, 670. *See also* MacArthur, General of the Army Douglas; United States Army Services of Supply.
activated: 128
airfield construction and repair: 218–20, 230–31, 234, 256–57, 266, 549–50, 561–66
Allied Works Council and: 120–22, 134–35, 137–38, 140–41, 151–52
bases, construction and operation: 182–83, 209–10, 256–57, 543–44, 546
bridge construction and repair: 542, 551, 565
bulldozers, tactical use: 542
camouflage: 219, 559–60
civilians, employment of: 554, 556
combat battalion organization: 547
construction, control of: 229–30, 521, 548, 651–54
construction, problems of: 542
construction battalion organization: 547–48
construction brigade organization: 548
construction design standards: 216–20, 266, 521, 548–51
construction machinery and equipment, diversified: 265, 558
construction machinery and equipment, improvised: 261–62
construction machinery and equipment, procurement: 210–12, 236
construction machinery and equipment, shortages: 264
construction materials, procurement: 260–63, 548, 554
construction materials, shortages: 260–62, 554, 682
construction programs and progress: 220–24, 235, 542–43
construction units, deficiencies in: 560
demolition operations: 542
engineer missions: 130–38, 275, 520–21, 542
engineer organization: 130–31, 230, 235, 243–44, 520–21, 548, 551–52, 556, 571–72, 650–51, 654
engineer units, arrival: 227, 263, 266, 270, 559–60, 564
engineer units, control of: 229–30, 543, 547–48
engineer units, requirements: 231–32, 234–35
engineer units, shortages: 210, 267–69, 547–48, 680
engineer units, strength: 275, 520, 567, 569, 666
flame throwers, tactical use: 562
forestry units, demand for: 262
general service regiment organization: 210, 548
General Headquarters in: 128, 649
geological survey: 554, 669
hangar construction: 217–19
hospital construction: 267, 550, 568
housing construction: 217, 266–67, 568
Southwest Pacific Area—Continued
maintenance and repair, general: 271–272
map compilation and distribution: 188–91, 269, 650, 666–69
photography, aerial: 271, 552–54, 567
pipeline construction and operation: 563
ponton cubes, employment of: 550
port facilities, construction and repair: 550–51, 567
RAAF in construction program: 561–63, 567–68
rainfall, effect of: 542, 565, 568
reconnaissance, engineer: 230, 549, 554, 563–65, 568
replacements, need of: 547
river crossings: 542
road construction and repair: 565, 567–68
sawmill construction and operation: 551
Soils Mechanics School: 272, 561
spare parts procurement: 212, 264–66, 509–10, 557–59, 568
specialists, shortage of: 263–64, 547, 558, 590
specialists, training: 271–72, 560–61, 671–72
storage facilities, construction and operation: 217–19, 220, 267, 550, 562–63, 568
task force organization: 521
terrain model construction: 552–53
topographic supplies, procurement: 553
topography of islands: 542
training program: 271–73, 560–61, 671–72
troop units, strength: 210, 243, 567, 569
winds, effect of: 550
Spaatz, Brig. Gen. Carl: 71
Spare parts procurement
Alaska: 279–80, 290
by ASCOM: 585
Australia: 149
Bataan: 100
Burma: 442
Central Pacific: 509–10, 671
and Corps of Enginers: 682
Hawaii: 354–56, 375–76
for landing craft: 265, 558–59
Ledo Road: 412–13, 434, 456
Leyte: 585
Manila: 671
Milne Bay: 265, 557–58
Navy's role in: 558
New Caledonia: 264–65
New Guinea: 186, 265–66
Philippines, 1941–42: 62–63
Philippines, 1944–45: 669–71
SOPAC: 264–66
SWPA: 212, 264–66, 509–10, 557–59, 568
Specialists, shortages of: 263–65, 354–55, 375, 456–57, 509, 547, 558, 560
Specialists, training. *See by geographic name.*
Specifications, standard. *See* Construction design standards.
Spruance, Admiral Raymond A.: 496

Staging areas: 256, 257, 366, 495–96, 529, 544, 546, 657
Standard Oil Company of California: 320
Standard Oil Company of New Jersey: 318–20, 322, 338
Stark, Admiral Harold R.: 35
State Department: 15
Steel. *See* Construction materials, improvised; Construction materials, procurement.
Steel units, prefabricated: 656
Steele, Maj. Gen. Clive S. (Australian): 131–33, 136–37, 139, 143
Stefansson, Vilhjalmur: 318–19
Stickney, Col. Henry H.: 57, 59–64, 66, 70, 73–74, 79, 82, 86, 93–94, 96, 99–100, 103, 105
Stilwell, General Joseph W. *See also* China-Burma-India Theater.
  activates CBI Air Service Command: 429
  and airfield construction and repair: 430–31
  arrival in Burma: 392
  arrival in China: 391
  arrival in India: 391
  and B–29 bases: 441
  Brereton, relationship to: 397
  and Burma offensive: 404–06, 417–18, 421, 434–35, 436, 442–44, 447, 461–62
  Chiang, relationship to: 397–98
  and China defensive: 469
  and Chinese Army training: 418, 420–21, 426
  and Chinese troops in India: 403
  commands of: 390, 391, 470
  and construction, control of: 394–95, 397, 438, 451–52
  construction, transfers to AAF: 438
  and construction program and progress: 394
  and costs of construction: 441
  and demolition operations: 469
  and Ledo Road: 407, 411–12, 421, 423–24, 433–34, 447, 454, 457, 460–61, 465
  and lines of communication: 394
  Marshall, relationship to: 398
  mission in CBI: 391, 397–98
  Mountbatten, relationship to: 428
  Newcomer, relationship to: 416, 453
  offensive plans: 391
  and pipeline construction and operation: 434
  plans North Africa invasion: 391
  recalled: 470
  as Roosevelt's representative: 398
  and shipping shortage: 408
  and SOS CBI: 438
  supply plans: 391
  and theater status: 397
  and troop units, requirements: 395, 408–09, 463–64
  Wavell, relationship to: 397
  Wheeler, relationship to: 394, 402
Stimson, Henry L. *See also* War Department.
  and Alaska defenses: 35
  anl Alaska Highway: 299
  and Australia defenses: 107
  and Canol: 320, 322, 335–36
  and China supply: 467–68
  and Hawaii defenses: 27
  and Hawaiian Constructors: 489
  selects Stilwell for CBI: 390
Stirling Range: 176
Stock control: 508–10, 555–58, 669–71, 682
Stone, Maj. Gen. David L.: 8, 12. *See also* Panama, Republic of.
Storage facilities, construction and operation
  Admiralties: 544
  on air ferry routes: 164
  Alaska: 37, 276–78, 281, 283, 287–89, 291, 333
  by ASCOM: 585–86, 600
  Australia: 113–15, 119, 141, 223, 239, 260
  Australian Army: 217–18
  Bataan: 95
  Biak: 544
  Burma: 457, 463
  Canol: 323
  Carolines: 516
  Central Pacific: 386
  China: 402
  Hawaii: 39–42, 51–53, 350, 365–70, 373–75, 486, 507
  Hollandia: 527, 544
  India: 394–96, 400, 402, 467, 666
  Iwo Jima: 660
  for Japan, assault on: 673, 677–78
  Kwajalein: 485
  Lae: 244
  Ledo Road: 410
  Leyte: 575, 585
  Luzon: 594, 600, 609
  Manila: 656
  Marianas: 493
  Marshalls: 477–78, 485
  Milne Bay: 257, 265
  New Caledonia: 167, 233–34
  New Guinea: 238, 244, 251, 257–58, 265, 546
  New Hebrides: 256
  New Zealand: 233
  Okinawa: 643, 659–60
  Philippines, 1941–42: 66
  Philippines, 1944–45: 653, 655–56
  Saipan: 498–503
  Solomons: 526, 544
  SOPAC: 256, 267
  SWPA: 217–20, 267, 550, 562–63, 568
  Wakde: 544
Stout-type houses: 297
Straight, Col. Clio E.: 487
Strategic planning, Japanese: 179
"Strategic triangle": 3, 27

Stratemeyer, Maj. Gen. George E.: 428–31, 437, 463, 472
Street fighting, Manila: 617
Strong, Col. Frederick S.: 417, 420, 436–37
Strong, Brig. Gen. George V.: 7
Sturdevant, Brig. Gen. Clarence L.: 300, 305, 310, 313, 322–23, 325
Sturgis, Brig. Gen. Samuel D., Jr.
and airfield construction and repair: 525, 573–74, 580, 583, 597
and base construction and repair: 238–39, 584–85
and bridge construction and repair: 575, 590–91, 605–06, 612
and communications, signal: 601
and construction programs and progress: 548–49, 601
and engineer units, control of: 591, 612–13, 626
and Japan, assault on: 675
and logistical facilities: 542
and Manila, 1944–45: 613–14
and Philippines, 1944–45: 570, 580, 588, 592, 599, 626
and road construction and repair: 577, 584
as Sixth Army engineer: 225, 235, 520
and specialists, shoratge of: 590
and supply system: 263, 557, 559
and task force engineers: 521
and Wakde: 535
work potential formula: 529
Styer, Lt. Gen. Wilhelm D.: 423, 429, 436, 654
Subic Bay: 656
Subic Bay landing: 57, 608–09
Submarine threat to Alaska: 280
Sugar Plantations Association: 343
Sui-chuan: 469
Suicide attacks, Japanese: 500, 592, 594, 647, 649
Sulipan Canal: 611
Sultan, Maj. Gen. Daniel I.: 466, 468, 470, 473, 662, 664–66
Sulu Archipelago: 626, 633
Sumatra: 118, 467
Sung Shan Mountain: 459, 462
Superior Oil Company: 222
Supplies, construction. *See* Construction materials, improvised; Construction materials, procurement.
Supply, by airdrop: 157, 180–81, 582
Supply, by airlift
Assam: 471
Burma: 466, 472
China: 387, 391–92, 396–97, 400–401, 415, 418, 420, 425–26, 431–32, 425–54, 467, 472, 666
Hollandia: 532
India: 472
Ledo Road: 456, 471
SWPA: 558
Supply, daily requirements: 554
Supply, hand-carried: 582
Supply, measurement tons
Alaska: 289
Biak: 557
China: 391, 418, 420, 426, 431, 464, 666
Hollandia: 557
Japan, for assault on: 677–78
Marianas: 493–94, 496
Saipan: 496
SWPA: 212, 556–58
Wakde: 557
Supply, overland: 198, 387–88, 391, 404–06, 408–09, 415, 424–25, 432, 464, 470, 474–75
Supply, by water, SWPA: 558
Supply dumps. *See* Storage facilities, construction and operation.
Supply duty, attitude toward: 559, 682
Supply Mission, New Zealand: 213
Supply systems
Attu: 329–30
Australia: 155, 556
Burma: 466, 394–95, 432, 436, 443, 446
Burma Road: 473
Central Pacific: 508–10, 568–69, 669
China: 425–26, 429–30
Chinese Army: 413–15
deficiencies in: 682
India: 394–95, 425, 429
Leyte: 611
Luzon: 606
Marshalls: 485
Navy's role in: 265
Philippines, 1944–45: 669–70
POA: 378
Port Moresby: 263
SOPAC: 171–72, 214, 233–34, 262–63
SWPA.: 211–14, 262–63, 558, 568–69, 669
War Department directives on: 171–72, 211, 261, 264, 508–09, 554, 669–70
Supply systems, Japanese: 443
Surrender, by Japan: 678–79
Survival training: 491
Sutherland, Col. Edwin M.: 396
Sutherland, Lt. Gen. Richard K.: 179, 187, 234, 608
Suva: 162
Sverdrup, Maj. Gen. Leif J.
and airfield construction and repair: 46–48, 154, 231, 236, 525
becomes SWPA acting chief engineer: 571
and bridge construction and repair: 602
commands of: 130–31, 174, 651–52, 653–54
and construction, obstacles to: 186
and construction deadlines: 543–44
and construction reorganization: 174
and engineer units, control of: 202
forms Construction Corps of Philippines: 653
and Hawaii contractors: 488

Sverdrup, Maj. Gen. Leif J.—Continued
and labor force, mobilizing: 181
and Musita Island action: 204
and reconnaissance, engineer: 48, 168–69, 178–80, 230
and specialists, training: 671–72
and supply discipline: 553
Sverdrup and Parcel, engineering firm: 41, 47–48, 112, 120, 163, 320
Sweeper Creek: 286
Sydney: 109, 114, 126, 134, 136, 138, 141–42, 240, 242, 271–72, 556–57, 560
Sydney Technical College: 560
Szechwan Province: 431, 451

Taal, Lake: 71, 631
Tacloban: 573, 576, 579, 581, 585, 599, 670
Tacloban Airdrome: 576, 579, 583–85
Tactical methods: 77, 82, 91–92, 542
Tadji Drome: 533
Tagish Lake: 312
Tagoloan River: 65
Tagudin: 74
Taipha Ga: 443–44
Talaud Islands: 572, 575
Talley, Col. Benjamin B.: 22–23, 28, 34, 36, 278, 280, 282–84, 288, 292–93, 295, 331, 333, 643–44
Tambu Bay: 247
Tami Airfield: 532
Tanacross Airfield: 288, 307, 310, 315
Tanaga Island: 284
Tanahmerah Bay: 527–28, 531–32, 534
Tanai River: 442–43, 447, 453
Tanana: 288, 325
Tanana River: 295, 304, 310, 312
Tanapag Harbor: 500–501, 511
Tanauan: 584–85, 587
Tanchuk: 469
Tank action, Burma: 444
Tank fire support
Corregidor: 621
Kwajalein: 480–81
Luzon: 598
Manila: 617
New Guinea: 205, 533
Okinawa: 647
Tank-infantry teams, Okinawa: 647
Tanks, control by USAFFE: 78
Taping River: 663–64
Tarakan Island: 636
Tarawa Island: 381
Tarlac: 75, 78, 93, 605
Tarlac River: 75, 77, 595
Tarung River: 435, 443, 447–48
Task forces
2600: 32, 324, 335
Brewer: 522, 524
Task forces—Continued
Connolly: 638–39
CYCLONE: 561
Efate: 171
HURRICANE: 537, 538, 541
New Guinea, organization in: 251
PERSECUTION: 532
RECKLESS: 529
Southwest Pacific Area, organization in: 521
TORNADO: 535
TRADEWIND: 567
TYPHOON: 564
Task forces, Japanese: 149
Tasmania: 137, 216
Tatana Island: 183, 187
Tate, Maj. Ferdinand J.: 398, 400, 410–12
Tawang River: 448
Tawitawi Island: 633
Teale, Col. Willis E.: 151, 153, 158, 213, 215–16, 266, 520
Technology: 413, 682–83
Tehran Conference: 463
Telegraph and telephone installation: 337, 370, 419
Temperature Zone Hospital: 241
Temperature, effect of: 310, 370, 501. *See also* Climate, effect of; Weather, effect of.
Teng-chung: 456, 460–62, 465, 472–73
Teng-chung–Myitkyina road: 472–74
Tennant Creek: 114, 240–41
Tenney, Col. Clesen H.: 381
Terminals, port. *See* Port facilities, construction and repair.
Terowie: 123
Terrain model construction: 552–53
Territorial Airport Contractors: 41, 348
Teslin Lake: 303, 310–12
Teslin River: 303, 312
Thailand: 390
The Caves, Australia: 260
Theodore, Edward G.: 121, 127, 137–38, 141–43, 215, 241–42
Thomas, Lt. Col. H. E.: 607
Three-Mile Drome: 186
Tignuan River: 81
Tiis River: 97
Tingkawk Sakan: 467
Tinian Island: 490, 492–93, 503, 506, 511
Tinker, Maj. Gen. Clarence L.: 348, 361
Tinsukia: 449–50, 457, 466–67, 471, 664–66
Tocumwal Repair and Assembly Depot: 122, 141
Toem: 534, 537, 541
Tojo, General Hideki: 50
Tokyo: 518, 673–74, 677
Tokyo Bay: 679
Tonga Islands: 168–69
Tongatabu Island: 169–70, 661
Tontouta Airfield: 46–48, 161, 163–67, 223, 233, 256
Toobally Lakes: 309, 315

Tools, construction. *See* Construction machinery and equipment, diversified; Construction machinery and equipment, improvised; Construction machinery and equipment, procurement.
Topographical supplies, procurement: 533
TORNADO: 535
Torrens Creek: 125
Townsville: 150, 158
  airfield construction and repair: 45, 110, 115, 119, 125, 127–28, 143, 164
  base construction and operation: 112–13, 153
  port congestion: 243
  port facilities, construction and repair: 110, 115, 128, 240
  reconnaisance, engineer: 46
  road construction and repair: 138
  storage facilities, construction and operation: 260
TRADEWIND: 567
Traffic control and congestion: 316–18, 343, 577, 580, 599, 611, 634
Trail clearing operations: 178–80, 231, 443–44, 447, 470
Training, deficiencies in: 97–98, 330–31, 606, 682
Training centers, in Australia: 271
Training facilities, construction in India: 403
Training missions, Corps of Engineers: 227
Training programs
  amphibious operations: 271, 330–31, 478, 490–91, 671
  Australia: 122, 124–25, 136
  bomb disposal: 271, 560–71
  camouflage measures: 271–72
  Central Pacific: 478
  Chinese Army: 403–05, 420–21, 426, 455–56, 463, 662
  Hawaii: 377, 490–91
  India: 403–04
  jungle operations: 156, 490–91
  with landing craft: 671
  Marianas: 495
  Marshalls: 478
  night operations: 491
  on-the-job: 271–72
  Philippine Army: 97–98
  Philippines, 1944–45: 671
  Saipan: 496
  SOPAC: 271–72
  specialists: 271–72, 560–61, 671–72
  in survival: 491
  SWPA: 271–73, 560–61, 671–72
  USASOS: 671–72
Transporation Corps: 325
Transportation facilities: 320–21, 323–25, 327, 338, 365–66, 399–400, 402–03, 476
Transports, naval, in CPA: 476
Trans-Siberian railroad: 293
Trench obstacles, construction in Hawaii: 344–45
Triangle, The, New Guinea: 196, 200–01
TRIDENT (Washington) Conference: 164, 377, 390, 418–20, 426
Trik, Capt. Carl H.: 355–56
Trinidad Base Command: 28
Tripler General Hospital: 374, 486, 507, 661
Troop assignment methods, USAFIA: 124
Troop units
  Japanese strength: 248, 682
  organization for Philippines defense: 55, 66–69
  shortages of: 509, 670
  strength; 68, 210, 243, 496, 518–19, 567, 569
Trucks, assembling: 400
Trudeau, Col. Arthur G.: 227–28
Truk Island: 492
Truman Committee hearings: 335, 362. *See also* Congress.
Tseng Yang-fu, Dr.: 421
Tsili Tsili Airfield: 244, 248, 252
Tuguegarao: 66
Tulagi Island: 168, 172
Tulavera River and Valley: 627
Tully, Lt. Col. James K.: 51
TULSA plan: 153
Tuna Packers cannery, Honolulu: 340
Tundra: 293–94, 329, 331
Tunnel construction and repair
  Alaska: 283
  Bataan: 61, 71, 95
  China: 462
  Corregidor: 66, 101–04
  Hawaii: 350, 368–70, 374
  Ledo Road: 410
  Philippines, 1941–42: 61, 64, 66, 71
Tunnel defenses, Japanese: 383, 598, 633. *See also* Cave defenses, Japanese.
Tuol River: 97
Turnbull, J. Gordon: 320
Turnbull Airdrome: 257
Turner, Rear Adm. Richmond K.: 482, 492
Twitty, Brig. Gen. Joseph J.: 378, 490, 510
"Two-Ocean Navy Act": 14
Tydings-McDuffie Act: 57n
Tyler, Brig. Gen. Max C.: 6
TYPHOON: 564

Ulithi Atoll: 514–16
Ulupau Head: 351
Umingan: 597
Umnak Island: 28, 37, 51, 278, 280–81, 284, 285, 296–98
Unalaska Island: 37, 281, 285, 296–97
Under Secretary of War. *See* Patterson, Robert P.
Union of Soviet Socialist Republics (USSR): 27, 35, 288, 293, 326, 333, 463, 678, 682
United States Advanced Base, Port Moresby: 174
United States Army, expansion of: 14
United States Army Forces in Australia (USAFIA): 109, 113, 117–18, 119, 124, 126, 156, 171,

United States Army Forces in Australia (USAFIA)—Continued
189–90. *See also* Barnes, Brig. Gen. Julian F.; Brett, Maj. Gen. George H.
United States Army Forces in the Central Pacific Area (USAFICPA): 377
United States Army Forces in the Chinese Theater of Operations, Burma, and India: 390
United States Army Forces in the Far East (USAFFE): 57, 60, 78, 230, 242, 260. *See also* MacArthur, General of the Army Douglas.
United States Army Forces in the Pacific Ocean Areas (USAFPOA): 507, 568. *See also* Richardson, Lt. Gen. Robert C., Jr.
United States Army Forces in the South Pacific Area (USAFISPA): 172, 214, 507, 568
United States Army Services of Supply. *See also* Army Forces, Western Pacific; Frink, Maj. Gen. James L.; Marshall, Brig. Gen. Richard J.; Southwest Pacific Area; Styer, Lt. Gen. Wilhelm D.
AFWESPAC, redesignation to: 654
Army Service Command (ASCOM) activated: 571
ASCOM, assignment to: 601
Australia, transfer from: 557
base construction and operation: 236, 245, 256–59, 262–63, 528
Boat Building Command: 653–54
camouflage: 559–60
civilians, employment of: 268–69, 653–54
construction, control of: 229–30, 257–58, 651–54
Construction Corps of the Philippines: 653
Engineer Construction Command (ENCOM): 651–53, 681
engineer districts of: 650–53
Engineer Intelligence Section: 269
engineer mission: 521
engineer organization: 243–44, 257, 520–21, 528–29, 571–72, 650–54
and engineer units, control of: 187
engineer units, shortage of: 238
engineer units, strength: 654
General Engineer District (GENED): 652
Hollandia, move to: 569, 650
Japan, assault on: 673, 675
Leyte, move to: 650
logistical system: 570–71
Manila, move to: 650
Marine Supply Section: 558–59
mission: 183, 262–63
morale: 654
New Guinea, move to: 557
and shipping shortage: 186–88
specialists, training: 671–72
supply divisions activated: 556, 558–59
stock control: 555–56
training program: 671–72
USAFIA, redesignated from: 156
United States Coast and Geodetic Survey: 94, 376, 573, 577
United States Forces in the Philippines (USFIP): 99. *See also* MacArthur, General of the Army Douglas; Wainwright, Lt. Gen. Jonathan M.
United States Geological Survey: 668–69
United States Navy. *See also* Naval construction battalions; Naval gunfire support.
airfield construction and repair: 12
amphibious operations, role in: 577–78
in construction program: 278, 287, 501, 511–12, 541–44, 657
fleet expansion: 10–11
Hawaii, co-operation in: 370, 374, 376, 661
housing construction: 267
intelligence estimates and reports: 284
at Iwo Jima: 640
landing craft operation: 578
in Luzon, 1944–45: 591–92, 594
in Manila rehabilitation: 656
photography, aerial: 668
and pilots for AVG: 389
POA, liaison in: 680
SOPAC, role in: 160
spare parts procurement: 558
in supply system: 265
war plan: 4
United States Task Force in China: 390
Upolo Field: 348
Urbana Force: 199–201, 205
Urbiztondo: 77
Urdaneta: 596
Utiladors: 292
Utilities, installation and maintenance: 365, 403

Valdez, Alaska: 303
Van Noy, Pvt. Junior N.: 253–54
Van Voorhis, Lt. Gen. Daniel: 15, 20–21, 28–32. *See also* Canal Zone.
Vasey, Maj. Gen. George A.: 193
Vella Lavella Island: 250
Viardo, Capt. Emilio: 68
VICTOR plans: 625
Vigan: 72, 74
Vila: 170
Vila Airfield: 250
Villa Verde Trail: 627–29, 637
Visayan Islands: 72, 608, 625, 634, 655
Visayan-Mindanao Force: 105–06
Viti Levu: 46, 222
Vitiaz Strait: 272
Vogelkop peninsula: 563
Volunteer Defence Corps (VDC): 109

W. A. Bechtel Company: 320, 325, 327
W. E. Callahan Construction Company: 25, 41, 320, 325, 327
Wacol: 115

Waga Waga: 176–77, 238
Wahiawa: 23
Wahiawa Gulch: 368
Waianae Amphibious Training Center: 491
Waiele Gulch: 362
Waigani Drome: 157, 186
Waigeo Island: 563
Waikakalaua Gulch: 40–42, 368, 370
Wainwright, Lt. Gen. Jonathan M.: 73, 75–77, 79, 83, 87, 89, 96, 99, 105, 128
Wakde Island: 534–36, 541, 542, 543–44
Wake Island: 45, 161
Walawbum: 444
Walker, Maj. James A.: 410
Walker, Lt. Col. Nelson M.: 51
Walkway construction: 502
Wallace, Maj. Gen. Fred C.: 657
Walsh, Col. Orville E.: 239, 246, 548, 588, 601, 613
Wama Drome: 568
Wanamaker, Col. William W.: 522, 525
Wanigela Mission: 180–81, 192
Wanting: 474, 663
War Cabinet, Australia: 216
War Department. *See also* Chief of Engineers; Marshall, General of the Army George C.; Stimson, Henry L.; War Department General Staff; War Plans Division, WDGS.
  activates SOS, CBI: 394
  and aircraft for China: 391–92
  and Alaska defenses: 276–78, 299, 333
  and Alaska Highway: 299–300
  and American Military Mission to China: 389
  appropriations, prewar: 9
  and Burma offensive: 404, 409
  and Canol: 318–21, 335–36, 339
  and China, supply of: 423
  and China defenses: 389, 408
  and China theater status: 390, 397
  and Communications Zone organization: 438
  and construction, control of: 360
  construction directives: 25, 281–82, 402, 508
  and construction machinery and equipment, procurement: 547, 549
  and construction units: 547–48, 675
  and cost-plus-a-fixed-fee contracts: 24
  and Engineer Construction Command: 654
  and Hawaii defenses: 16, 342–43, 360–61
  and hospital construction: 486
  and India airfields: 420
  and Ledo Road: 463–64, 663–64
  and pilots for AVG: 389
  and POL surveys: 222, 233
  and port facilities, construction and repair: 287
  and radar installations: 283
  and specialists: 265, 270, 456, 463–64
  supply system and directives on: 171–72, 211, 261, 264, 508–09, 554, 669–70
War Department General Staff. *See also* Marshall, General of the Army George C.; Operations Division, WDGS; War Department; War Plans Division, WDGS.
  Alaska inspection by: 51
  and Alaska Highway: 299
  hemisphere defense plans: 7
  ORANGE plans, changes in: 3–5
  RAINBOW plans, changes in: 10, 14, 19
War Ministry, China: 408, 422
War Office, British: 420
War plans, U.S.: 4–7
War Plans Division, WDGS
  and Alaska defenses: 16, 18, 23, 34
  and Alaska Highway: 299
  and Canol: 318–19
Warazup: 454
Ward's Drome: 186
Warehouse construction and operation. *See* Storage facilities, construction and operation.
Warren Force: 199–200
"Washing Machine Charley": 274
Washington Conference: 107, 164, 377, 390, 418–20
Water purification. *See* Water supply and distribution.
Water seepage problem: 292–93, 316
Water supply and distribution
  Australia: 155
  Biak: 539–40
  Central Pacific: 476
  Corregidor: 103
  Hawaii: 373
  Kwajalein: 483
  Manila: 614, 618–19, 656–57
  Marshalls: 478, 483, 485
  Okinawa: 645
  Saipan: 501–02
  Solomons: 249–51
Waterways, Alberta: 319–27
Waterways, development and use: 288–89, 295, 319, 321–25, 327–28, 342
Waterways systems: 73–74, 312–13, 590, 602, 612–13, 641
Watson Lake: 299, 301–04, 309, 311, 325–26, 328, 335
Watut River: 252
Wau: 231, 260
Wavell, Field Marshal Sir Archibald: 118, 391, 397, 404–05. *See also* General Headquarters, India; India.
Wawa: 77, 84, 595–96, 602, 612
Weather, effect of. *See also* Climate, effect of; Permafrost; Rainfall, effect of; Snowfall, effect of; Winds, effect of.
  Alaska: 281, 283–89, 291–96, 333–34
  Alaska Highway: 315–18
  Attu: 329
  Canol: 324–25, 327–28, 337

Weather, effect of—Continued
Ledo Road: 433
Leyte: 576, 578, 580–81
Mindanao: 570–71
New Guinea: 248
Philippines, 1941–42: 61–62
Philippines, 1944–45: 570–71
Wedemeyer, Lt. Gen. Albert C. *See also* China.
and Burma offensive: 662
Chiang, relationship to: 470
heads China Theater: 470
and pipeline construction and operation: 664–66
and road construction and repair: 662–63
at SEAC: 437
training program: 662
Wehuria Creek: 176–77
Welling, Col. Alvin C.: 301, 475, 663
Wells, drilling in Alaska: 293, 325–27, 335–37
West Construction Company: 34, 36, 278, 287
Western Defense Command: 276
Wewak: 284, 527, 533, 563
Wheeler, Maj. Gen. Raymond A.: 112, 436. *See also* China-Burma-India Theater: Services of Supply, CBI.
and airfield construction and repair: 418, 420, 431
base establishment by: 409, 418
and Burma Road: 405
and construction, control of: 394–95, 397–98, 437–38
and construction program and progress: 397
and engineer units, arrival: 436
heads SOS, CBI: 394–95, 437
and Ledo Road: 406, 409–12, 423–24
lines of communication, operation by: 394
and pipeline construction and operation: 434
at SEAC: 437
Stilwell, relationship to: 394, 402
and supply of Chinese forces: 406, 408
Wheeler, Col. W. J.: 313
Wheeler Field: 8, 28, 39, 44, 51, 53, 340, 347, 361
Whipple, Col. Stephen C.: 303
White, Capt. George E., Jr.: 348
White Pass & Yukon Railroad: 302, 326
White River, Canada: 314–15, 317, 328
Whitehead, Brig. Gen. Ennis C.: 184–85, 229, 584
Whitehorse: 288, 299, 302–04, 307, 309–11, 314–15, 319–20, 322–28, 335–38
Whitlock, Brig. Gen. Lester J.: 178, 672–74
Whittier, Alaska: 287, 289
Wilcox, Maj. H. Case: 395
Wilkinson, Rear Adm. Theodore S.: 225
Williams, Mr.: 104
Willingdon Airdrome: 392, 399
Williwaws: 294–95
Wilson, Brig. Gen. Walter K., Jr.: 437, 440, 664n
Wimer, Col. Benjamin R., 378, 486–88, 507–10
Winds, effect of: 294–95, 550
Wingate, Brig. Gen. Orde C.: 427–28, 430, 444–46
Wire obstacles: 82, 351, 399, 525
Wire obstacles, Japanese: 481, 562, 610, 617, 633
Womeldorff, Lt. Col. Virgil M.: 330–31
Woodbury, Lt. Col. Harry G.: 249
Woodlark Island: 231, 234, 239, 244, 246, 251
Woodring, Harry H.: 7, 18, 20
Woodstock Airfield: 125, 145, 149
Work potential formula: 529, 549
Works Progress Administration (WPA): 38–39
World War I ponton bridge: 471n
Worsham, Brig. Gen. Ludson D.: 317, 327, 334, 655
Wright, Col. Albert: 127, 140
Wyman, Col. Theodore, Jr.: 16
and AAF pressure for construction: 354
and aircraft repair shops: 361
and airfield construction and repair: 39–40, 45–46, 48, 161–65, 168, 348
as Canol director: 316, 320–21, 323, 327
and civilian defense construction: 344–45
and civilians, evacuation of: 345–46
and coast defenses: 349–51
and construction machinery and equipment, procurement: 49, 343
and construction materials, procurement: 49, 343
and cost-plus-a-fixed-fee contracts: 41, 52, 320
and costs of construction: 52, 353
and engineer units, requirements: 38
and food production: 344
and Hawaii defense construction: 38–40, 42, 52, 341, 353
and Hawaiian Constructors: 52, 356, 488–89
heads Northwest Division: 316–17
and land acquisition: 356
and pipeline construction and operation: 42, 325
and POL delivery: 324–25, 343
and priority ratings: 161, 343
and public relations: 359–60
and reconnaissance, engineer: 168–69
and road construction and repair: 325
and staff organization: 340–41
and storage facilities, construction and operation: 41
and supply, by airlift: 324
supply difficulties: 324, 327, 355–56

X-Force, Chinese: 405

Y-Force, Chinese: 405, 408, 413–15, 421, 442, 454–56, 458–62, 470, 662
Y-Force Operations Staff: 421
Yakutat: 12, 22, 35–37, 278, 283, 295–96
Yakutat hut: 297
Yangkai: 403, 415
Yangtze River and Valley: 425, 432, 452, 662
Yap Island: 514, 572, 574
Yawata: 456
Yoder, Lt. Col. Leverett G.: 144, 147, 150–51, 181
Yokohama: 673–74, 677

Yontan Airfield: 645, 658–59
York, Col. Robert E.: 432
Young, Col. Gordon R.: 10, 29, 31–33
Young Hotel, Honolulu: 340
Yount, Brig. Gen. Paul F.: 395, 664n
Yukon River: 288, 295, 309, 325
Yukon Territory: 305, 312
Yunnan-Burma Highway Engineering Administration: 408, 413–15, 421–22, 465, 663. *See also* Kung, C. C.
Yunnan-Burma railroad: 413, 436
Yunnan-Burma Railroad Authority: 389, 403, 415
Yunnan Province: 392, 397, 403–05, 409, 416, 429, 455, 459, 462, 666
Yunnanyi: 415, 421, 471
Yupbang Ga: 435, 442

Zablan Airfield: 656
Zambales Mountains: 610
Zamboanga: 633, 655–56
Zamboanga peninsula: 626, 633–34
Zamboanga Province: 65–66
Zero aircraft: 518
Zigzag Pass: 609

☆ U.S. GOVERNMENT PRINTING OFFICE : 1987 O—190-307