

UNITED STATES ARMY IN WORLD WAR II

The Technical Services

THE CORPS OF ENGINEERS: TROOPS AND EQUIPMENT

by
Blanche D. Coll, Jean E. Keith
and
Herbert H. Rosenthal



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This volume, one of the series UNITED STATES ARMY IN WORLD WAR II, is the first to be published in the group of four Corps of Engineers volumes in the subseries THE TECHNICAL SERVICES. All the volumes will be closely related, and the series will present a comprehensive account of the activities of the Military Establishment during World War II. A tentative list of subseries is appended at the end of this volume.

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History of

THE CORPS OF ENGINEERS

Troops and Equipment

Construction in the United States

The War Against Germany

The War Against Japan

. . . to Those Who Served

Foreword

The world-wide operations of the U.S. Army in World War II involved an enormous amount of construction and the performance on a comparable scale of many other missions by the Corps of Engineers.

This is the first of four volumes that will describe the participation of the Engineers in the war and the contribution they made toward winning it. Better known to the public in peacetime for its civil works, the Corps by the time of Pearl Harbor had turned almost its full attention to military duties. At home the Engineers took over all military construction, and prepared hundreds of thousands of Engineer troops for a variety of tasks overseas. These tasks included not only construction but also a number of other duties more or less related to engineering both in rear areas and in the midst of battle. In performing these duties in World War II the Army Engineers gained a proud record in combat as well as in service. This first volume tells how the Corps organized and planned and prepared for its tasks, and in particular how it trained its troops and obtained its equipment. The volumes still to be published will describe the huge program of military construction in the United States, and Engineer operations overseas in the European and Pacific areas.

One of the objectives of the technical service volumes of the Army's World War II series is to capture the point of view of the service concerned. In doing so the authors of the present history, by thorough research and diligent solicitation of assistance, have also brought to their story a broad perspective, and they have told it with a felicity that should make their work a valuable guide to the Army as a whole, to the thoughtful citizen, and to the Engineers who served and who continue to serve the nation in war and in peace.

RICHARD W. STEPHENS
Maj. Gen., U.S.A.
Chief of Military History

Washington, D. C.
10 July 1957

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Preface

This volume relates how the traditional tasks of American military engineers changed and new ones developed in response to the tactical and logistical demands of World War II, and how the Corps of Engineers organized, equipped, and trained its troops in the United States to carry out these tasks overseas. The book is necessarily concerned with machines as well as men because the modern Corps which emerged during this period was an organization that increased its capacity for work to the fullest extent possible by the adoption of power machinery. Dependence upon complicated machines, delicate instruments, and complex rather than simple engineering techniques was a natural accompaniment of world-wide military trends, but the situation nevertheless challenged those charged with plans and preparations to a full display of intelligence and adaptability.

More than half a million Engineer officers and enlisted men were in the armed forces by the spring of 1945, comprising about 8 percent of the Army. Most of them were building or rebuilding hangars and barracks and offices at a multitude of military bases, laying down or repairing the strips at innumerable airfields, and enlarging or improving the endless network of roads and culverts and bridges. Some were installing and operating miles of petroleum pipeline. Combat engineers were clearing mine fields. Still other engineers were manning boats and ships, making maps, purifying water, forging and shaping steel, or running sawmills. In all areas of conflict, from battle front to rear bases, with ground and air forces, engineer troops were justifying the years of planning and preparation at home.

The day-to-day problems involved in readying engineer troops for such duties overseas may have appeared simpler to the participants than to the historians who reviewed the whole record later. The files are heavily weighted with the burdens of daily frustrations; successes account for much less space. We have been granted complete freedom to evaluate and interpret, and to present a full and frank appraisal.

Many persons, both within and without the Corps of Engineers, have helped to supplement and clarify the written record. The list is so long indeed that we have had to be content in most cases to let the footnotes be our only acknowledgment. To those who read and commented upon the entire volume—Maj. Gen. Clarence L. Adcock; Col. William W. Bessell, Jr.; Col. William W. Brotherton; Col. Edward H. Coe; Brig. Gen. Miles M. Dawson; Col. Joseph S. Gorlinski; Richard M. Leighton; Lt. Col. David M. Matheson; Lt. Gen. Eugene Reybold; Maj. Gen.

Julian L. Schley; Brig. Gen. John W. N. Schulz; and Lt. Col. Eugene J. White—go our special thanks. Joseph A. Logan of the Office of the Comptroller of the Army conducted a comprehensive review of statistical matter.

Kent Roberts Greenfield, Leo J. Meyer, and Stetson Conn of the Office of the Chief of Military History and our colleagues in the Engineer Historical Division, especially Lenore Fine and Jesse A. Remington, gave us the benefit of their criticism and greatly encouraged us by their understanding and support. David Jaffé and Loretto C. Stevens edited the volume with care and patience. Margaret E. Tackley selected the photographs.

Among the many typists who worked on the manuscript, Dorothy Washington, Elizabeth M. Ralston, Daisy G. Shield, Johanne R. Daggett, and Bettie J. Hazell earned our particular gratitude for their preparation of the final copy. Gerald N. Grob relieved us of many chores in checking and proofreading.

Librarians and clerks in the various records depositories proved untiring in their efforts. To mention Eva Holt, Geraldine Jewell, Mary K. Stuart, and Mae E. Walker is to shorten a long list of persons who rendered this type of service with admirable efficiency. Gladys Z. McKinney answered repeated inquiries about Engineer officers.

Research by Stuart W. Bruchey, Barbara B. Garner, Curtis W. Garrison, Keith Glenn, and Harry E. Ickes has proved helpful in the writing of the book. Useful drafts on mapping, camouflage, and intelligence were prepared by Kenneth J. Deacon and on procurement of equipment before Pearl Harbor by Doris M. Condit. Edna E. Jensen worked up much of the material on procurement of supplies during the later war period.

As to the division of labor among the authors themselves, Miss Coll concentrated primarily upon equipment; Mr. Keith, upon training; and Mr. Rosenthal, upon organization of troop units. Since a number of the chapters are the work of more than one of the authors, and since in some cases we invaded each other's field, there appears to be little advantage in attempting to assign more specific authorship credit. An assumption of collective responsibility best expresses the way in which we have shared in the final product.

BLANCHE D. COLL
JEAN E. KEITH
HERBERT H. ROSENTHAL

Washington, D. C.
25 February 1957

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The illustration on page 10 is from the National Archives; the illustrations on pages 43 and 46 are from the International News Photos; all others are from the files of the Department of Defense.

CHAPTER I

Engineers in the New Army

Those who have attempted to describe in a simple phrase the tactics of the most complex war in history refer to World War II as "an air war," "a mechanized war," "an amphibious war," and most inclusively, "a mobile war." Because its military campaigns accented movement, whether by air, by sea, or by land, and because the primary combat mission of the Corps of Engineers is to aid or impede movement, World War II has also been called "an engineer's war." [1] The far-flung deployment of American troops and the global nature of the conflict placed a premium on logistics. As a consequence the engineer mission of building military bases and routes of communication took on added significance. Although arrogating to the engineers an exclusive title to the war would indeed be to lose perspective, merely noting that the claim was made attests to the importance of the engineer role.

During World War II engineer troops built airfields, camps, depots, and hospitals for the invasion build-up in Britain. They overcame German destruction in Italy by clearing the ports and roads of rubble and by throwing bridges across the rivers. They cleared the beaches at the Normandy landings and rolled the supplies across them. Working under heavy fire, they threw pontoon bridges across the Rhine, making certain that troops and supplies would continue to push onward after the bridge at Remagen collapsed. Engineer troops opened new supply routes into China, constructing airfields on either side of the "Hump" and pushing the Ledo Road and the longest pipeline system in the world through the mountainous jungle. In the long fight from Australia to Tokyo, engineers manned landing craft which delivered invading troops on island after island and converted those islands into operating bases. The foundation of this contribution to victory overseas was laid at home in the development of doctrine and equipment, the refinement of troop organization, and the training of citizen soldiers.[2]

The Engineer Mission

The Corps of Engineers has a long history of service to the nation in war and peace. In 1950 it celebrated its 175th an-

[1] On his return from a tour of the Southwest Pacific theater the Chief of Engineers quoted General Douglas MacArthur: "Reybold, this is an air and amphibious war; because of the nature of air and amphibious operations, it is distinctly an engineer's war." Maj. Gen. Eugene Reybold, "Engineers on Our War Fronts," *Concrete,* III (April, 1944), 33. See also, Lt. Gen. Eugene Reybold, Engineers in World War II, A Tribute, pamphlet [1 Nov 45], p. 1. EHD files.

[2] For the history of the Corps of Engineers overseas, see Ralph F. Weld, Abe Bortz, and Charles W. Lynch, The Corps of Engineers: The War Against Germany, and Karl C. Dod, The Corps of Engineers: The War Against Japan, volumes in preparation for the series UNITED STATES ARMY IN WORLD WAR II.

niversary, thus honoring the date when Richard Gridley was appointed Chief Engineer of the Revolutionary forces. Congress established a Corps of Engineers in 1779, only to disband it in 1783. An act passed 16 March 1802 established the present Corps and provided that it should be "stationed at West Point . . . and shall constitute a Military Academy . . . ." Although the faculty at West Point was but for a short time predominantly "Engineer," the Corps remained in charge of the school until 1866. The Corps of Engineers had meanwhile been singled out to perform tasks which have been variously known as "non-military," "civil works," or "rivers and harbors." In 1824, Congress authorized the President "to cause the necessary surveys, plans, and estimates, to be made of the routes of such roads and canals as he may deem of national importance, in a commercial or military point of view, or necessary for the transportation of the public mail" and "to employ two or more skillful engineers, and such officers of the corps of engineers, or who may be detailed to do duty with that corps, as he may think proper . . . ." Thereafter Army engineers were in the vanguard of westward expansion. They improved the navigation of the Mississippi and Ohio Rivers, selected the route of the Chesapeake and Ohio Canal, superintended the construction of the National Road, and surveyed the routes of many railroads.[3]

The Army engineer is no less proud of the military history of his Corps than of its peacetime accomplishments. Although his unique contribution is as a technician, the engineer soldier is a fighter as well. The exploits of the Union Army's Engineer Battalion at Antietam illustrate his versatility:

The night before the battle of Antietam the Battalion rendered three of the fords of Antietam Creek passable for artillery, by cutting down the banks and paving the bottom with large stones where it was too soft. During the battle the Battalion guarded and kept open these fords. The night after the battle, the Battalion, at the request of its commander, was ordered to report to Gen. Porter to act as infantry and in that capacity supported Randall's battery of the First Artillery in the advance to Shepherdstown. After the arrival of the army at Harper's Ferry it built one bridge over the Potomac and another over the Shenandoah and was busily engaged on the fortifications during the month it remained there.[4]

During World War I, the Corps of Engineers grew from 256 officers and about 2,220 enlisted men to 11,175 officers and about 285,000 men. In France its most important job was keeping open the routes of communication but, as in the Civil War, engineer soldiers were prepared to act as infantry in combat, and their service at Belleau Wood and during the German offensive of March 1918 contributed much toward the Allied victory.

During the period between World War I and II, the military duties of the Corps of Engineers remained the same. If war came, its troops were to clear the way and build;

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[3] Historical sketches of the Corps of Engineers are found in (1) Lt. Col. Paul W. Thompson, *What You Should Know About the Army Engineers* (New York: W. W. Norton & Company, Inc., 1942); (2) W. Stull Holt, *The Office of the Chief of Engineers of the Army, Its Non-Military History, Activities, and Organization* (Baltimore: The Johns Hopkins Press, 1923); (3) Engr Sch, History and Traditions of the Corps of Engineers (Fort Belvoir, Va.: Engineer Center, 1949); (4) Engr Sch, *The News Letter*, II (May, 1950); (5) EHD, The Corps of Engineers Historical Index (1943).

[4] Quoted in 1st Lt. C. A. Youngsberg, *History of Engineer Troops in the United States Army, 1775–1901* (Washington Barracks: Press of the Engineer School, 1910), Engr Sch Occasional Papers 37, 1910, p. 11.

to survey and map; to supply water and electricity; to develop materials and techniques for camouflage; to operate railroads. With the exception of railroad operation, transferred to the newly created Transportation Corps in November 1942, these were the jobs for which the engineers prepared and which they carried out during World War II.

Probably because of the broad scope of engineer responsibilities both in peace and war, the Corps had become accustomed to expecting the cream of the West Point graduating class to elect service with it. When the top man in the class of 1941 failed to select the Corps of Engineers, the head of the Engineering Department at the Military Academy undertook to cushion the Chief of Engineers for the shock:

> You will probably have to take a bit of joshing over the fact that the No. 1 man chose the cavalry. . . . This man, who is a very fine one, was 'crazy' about horses when he entered. . . . This love . . . has stayed with him and, since the cavalry is the only branch that has many horses left, he was consistent in choosing the cavalry.[5]

Actually, this particular Chief of Engineers remained sanguine when top men failed to choose the Corps. He thought that a different choice tended to silence protests from other branches that they also needed men who showed outstanding promise and tended to have a sobering effect upon those Engineer officers who regarded the Corps as an exclusive branch, different from, and perhaps superior to, the other branches. Insofar as exclusiveness aided *esprit*, he welcomed the sentiment; insofar as it posed a threat to teamwork, he deplored it. But whether this loss by the Corps of some of the top men of West Point was a cause for embarrassment or for silent congratulation, such occasions were rare. In 1940, the Engineer quota of 40 was filled from the first 67 men in a class of 445; in 1941, its quota of 50 was filled from the first 69 in a class of 427. The Engineers were indeed fortunate. Such men were accustomed to working hard and to succeeding. They were proficient in book learning—an indispensable tool in the mastery of a technical profession.[6]

Accustomed to outstanding qualities in its West Point graduates, the Engineers sought to set a similar high standard among appointments made from civil life. As one Engineer officer expressed it, the Corps "should not be satisfied with anything less than 'A' No. 1 cracker jack ring-tail elephants to whom you can give a job, forget about it, and know that you will get one hundred per cent results." [7] The Engineers looked to the construction industry, whose ranks were filled with graduates of technical colleges, to furnish many such officers in an emergency. Contacts with this "reserve" were assured through the civil works activities of the Corps and through mutual membership in the Society of American Military Engineers and other national engineering societies.

The *esprit de corps* created by the belief among Engineer officers that they constituted a select group and that they were the heirs of many years' service to the nation led Lt. Gen. Brehon B. Somervell, commanding

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[5] Ltr, [Lt Col Thomas D.] Stamps, Dept of Civil and Mil Engr, USMA, to CofEngrs, 23 May 41. 210.3, Engrs Corps of, Pt. 17.

[6] (1) *Ibid.* (2) Memo, TAG for CofEngrs, 23 Apr 41. 210.3, Engrs Corps of, Pt. 16. (3) Incl, n.d., with Ltr, Maj Gen Julian L. Schley to C of EHD, 4 Jun 52. EHD files. (All letters to the chief of the Engineer Historical Division are in Engineer Historical Division files.)

[7] Ltr, Brig Gen Dan I. Sultan, CO Ft. Logan, to C of Opns and Tng Sec, 28 Feb 39. 210.1, Engrs Corps of, Pt. 6.

the Army Service Forces—himself an Engineer officer—to declare that "the sentimental angle . . . was probably stronger in my own Corps than in any other in the Army. . . ." [8] Sentimentality was exemplified by the cherished Engineer button, different in design from the standard Army button and to be seen only on the uniforms of members of the Corps of Engineers. Confidence marked the Engineers' tendency to translate its motto, *Essayons*, as "Let us succeed" rather than "Let us try." [9]

Except at the very top, the Corps of Engineers always maintained a clear-cut administrative division between its civil and military functions. The Chief of Engineers was the only person charged with both activities. In carrying out his civil works duties, he reported directly to the Secretary of War. On the military side, he was responsible to the War Department's Chief of Staff for the development of doctrine, the selection of equipment, and the training of troops. Once trained, the majority of Engineer officers and enlisted men were removed from his control except in technical matters. The Chief of Engineers was in direct command only of such troops as were not assigned to a territorial commander or were not part of a tactical unit containing other branches. In the fall of 1940 most engineer troops were assigned either to overseas departments, to one of the nine corps areas into which the United States was divided, to one of the four armies which took over tactical command of ground troops under Army General Headquarters in October of that year, or to the GHQ Air Force. Despite the limited nature of his command functions, the Chief of Engineers exercised a continuing influence on engineer troops. Although he could not order them to throw a bridge across a particular river, they built it with the equipment and according to the methods he had approved. Thus, in both a civil and a military way the Chief of Engineers was the arbiter of all Engineer policy and was in the final analysis answerable for the technical performance of engineer troops in the field and of officers and civilians employed on civil works.[10]

When World War II broke out in Europe in September 1939, the Chief of Engineers was Maj. Gen. Julian L. Schley. Fifty-nine years old at this time, he was midway in his four-year term, having been appointed on 18 October 1937. General Schley thus began his service as Chief during the period when the Army was beginning to expand in size and to modernize its tactics and equipment. His retirement came just prior to Pearl Harbor. Before becoming Chief of Engineers General Schley had had the usual distribution of assignments, about evenly divided between military duties and civil works. The two main administrative divisions of the Office of the Chief of Engineers (OCE)—Civil Works and Military—formed a staff of advisers to prepare tentative plans and policy recommendations, to set approved policies in operation, and to supervise their execution. Each was headed by an assistant to the Chief of Engineers who passed recommendations up to the Chief but also approved without reference to him many

[8] Quoted in John D. Millett, *The Organization and Role of the Army Service Forces*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1954), p. 406.

[9] (1) Thompson, *op. cit.*, pp. 18–19. (2) *The News Letter, op. cit.*, pp. 3–4. (3) Samuel T. Williamson, "Fighting Handymen on Every Battlefront," *New York Times Magazine*, April 11, 1943.

[10] AR 100–5, 28 Nov 33, 26 Jun 42.

matters within established policy which were not routine. (*Chart I*)

In addition to the Civil Works Division in Washington, the Corps of Engineers maintained an extensive field organization, the Engineer Department, for on-the-spot supervision of its rivers and harbors projects. For this purpose the United States was divided geographically into eleven divisions, each made up of several districts. For example, the North Atlantic Division included eight district offices, seven in the United States and one in Puerto Rico; the Lower Mississippi Valley Division, three district offices.[11]

The relative importance of civil works and military activities varied according to whether the nation was at peace or at war. When, in the years following World War I, the military activities of the Corps of Engineers were, in common with those of other branches of the Army, afflicted by paucity of funds and other frustrations, the spirit of the Corps' officers was kept high through assignments to rivers and harbors duty and to various public works sponsored by the federal government. While Army officers in general struggled with outmoded equipment and small-scale training exercises, many Engineer officers found themselves in the center of New Deal pump-priming. Some in this group were loaned to various New Deal agencies; others were assigned to work within the Corps itself. No matter where they went they found challenging jobs, supervising the building of vast networks of roads and the construction of such huge installations as the Bonneville and Fort Peck dams. The Engineers maintained that such experience did more than build morale. Typical of their attitude was the enthusiastic agreement of an Engineer officer with a congressman's summation



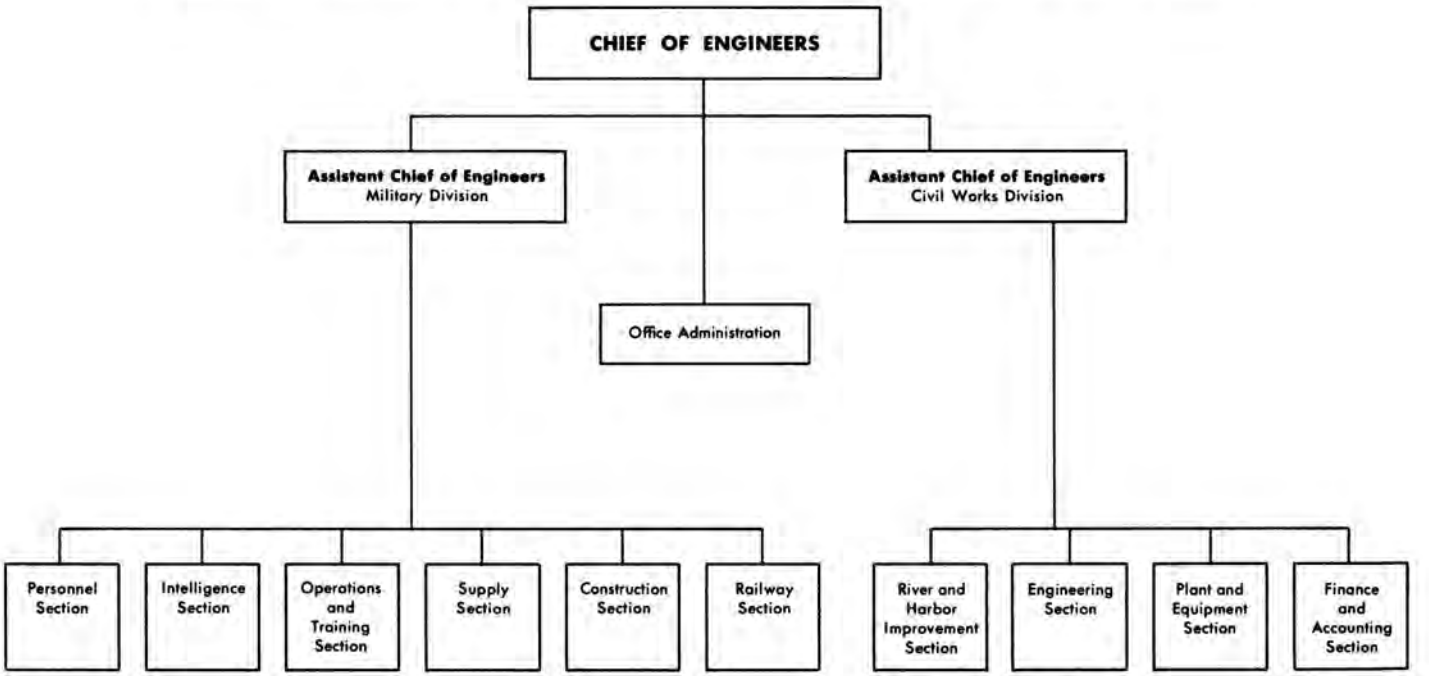
MAJ. GEN. JULIAN L. SCHLEY,
Chief of Engineers from October 1937 until October 1941.

that "while their jobs may have to do with engineering projects which have no immediate military connection, such assignments do equip them in the best possible way to tackle the problems which would confront them in time of war." [12] The unique combination of civil works and troop duty, the Corps was convinced, produced something more than the pioneer infantryman who served as the engineer of other armies. The Engineer officer was a soldier with a knowledge of civil engineering. Tours of duty with civil works afforded him an opportunity to learn about the latest construc-

[11] Orgn Charts OCE, 1 Sep 39, 1 Aug 40, 27 Feb 41. EHD files.

[12] *Military Establishment Appropriation Bill for 1941, Hearings before the Subcommittee of the Committee on Appropriations,* HR, 76th Cong, 3d Sess, p. 657.

CHART 1—ORGANIZATION OF THE OFFICE OF THE CHIEF OF ENGINEERS: SEPTEMBER 1939



tion techniques and equipment and to gain experience in organizing the work of large groups of men. Yet on the whole, the relationship of the Civil Works Division and its field offices to the wartime mission of the Engineers was an indirect one.

Developing fighting engineers was the job of the Military Division. During the period when Schley was Chief of Engineers, Brig. Gen. John J. Kingman was his assistant in charge of the Military Division. Kingman's division was composed of six sections: Operations and Training; Personnel; Supply; Intelligence; Construction; and Railway; and of two field agencies—the Engineer School and the Engineer Board—located nearby at Fort Belvoir, Virginia. Central to them all was the Operations and Training Section (O&T) which had the task of over-all planning both for the proficiency of personnel and the efficiency of equipment. O&T prepared tables of organization (T/O's) which outlined the structure of each troop unit and tables of basic allowances (T/BA's) which listed the types and amounts of equipment to be issued. O&T also supervised the training of all officers and enlisted men, drawing up general educational programs, determining specific curricula, and preparing training literature. The Personnel Section decided whether officers would be assigned to troop units, to schools, to civil works, or to other duties. The Supply Section computed the quantities of equipment needed, bought it, saw that it was delivered when and where needed, and supervised the development of new types. The other two sections of the Military Division in Washington had more specialized duties. The Intelligence Section had charge of all military mapping, including supervision of the Engineer Reproduction Plant, and was consulted on the development of new techniques and equipment for map making. This section also investigated new applications of engineering skills in the light of changing military tactics. During peacetime years the principal job of the Construction Section was the provision and maintenance of seacoast defenses. While this work continued and even increased for a time, the section's other responsibilities—the preparation of designs for structures and installations in theaters of operations and the preparation of plans for the management of public utilities there—eventually overshadowed it.[13]



BRIG. GEN. JOHN J. KINGMAN, *Assistant Chief of Engineers, Military Division.*

For advice in theoretical and technical matters all sections of the Military Division looked to Fort Belvoir, the Engineer center for the training of men and the development

[13] OCE Mil Div Manual, Duties and Procedure, 1937 (Rev).



MAJ. GEN. THOMAS M. ROBINS,
Assistant Chief of Engineers, Civil Works Division. (Photograph taken 1943.)

of new equipment. Here the Engineer School conducted advanced courses for officers and for enlisted men, prepared extension and conference courses for National Guard and Reserve officers, and wrote training literature. In this quasi-academic atmosphere, Engineer doctrine and methods of training were critically examined and recommendations for revision forwarded to the Chief's office. The Engineer Board carried on a similar function in regard to equipment. In the course of its investigations the board engaged in theoretical studies and performed experiments and tests in order to place more efficient tools and equipment in the hands of engineer troops.[14]

Until mid-1941 the Chief's office and its agencies at Fort Belvoir constituted a small organization. Everyone knew everyone else and business was carried out in an informal, personal atmosphere. Co-ordination, recalled one Engineer officer, "was a matter of going next door, or walking down the hall" to ask the advice of friends.[15] For his part, Schley met regularly and often daily with Kingman and Brig. Gen. Thomas M. Robins who was his assistant in charge of the Civil Works Division. General Kingman visited Fort Belvoir frequently and encouraged his subordinates to follow his example. He and Schley also made many trips to engineer units stationed in the field. These visits, with the opportunities they afforded to exchange ideas with those closest to engineer troops, were supplemented by a series of Information Bulletins through which OCE sought to keep the field abreast of developments in military engineering at home and abroad.[16]

The administrative organization of the Military Division provided a comprehensive framework readily adapted to meet an emergency situation. It was not until mid-1941 that the military activities of the Corps began to compel the attention accorded to civil works activities in peacetime. The importance of civil works was well defined by the chairman of a Congressional committee when he remarked to General Schley: "We do not have much opportunity to discuss with you the military side of your responsibility, because, nor-

[14] ARs 350–300, 19 Oct 38, 15 Jun 42; 100–30, 26 Jan 32, 14 Aug 42.

[15] Interv, Col Gerald Galloway, 12 Sep 50. See also similar remarks by Col. Miles M. Dawson in Interv, 20 Sep 50, and Ltr, Col William M. Bessell, Jr., to C of Mil Hist, 16 Jan 54. (All interviews and all letters to the Chief of Military History are in Engineer Historical Division files.)

[16] (1) Incls, n. d., with Ltrs, Schley to C of EHD, 4 Jun 52, and 26 Jun 52. (2) Interv, Brig Gen Claude H. Chorpening, 10 Jul 50.

The series of Information Bulletins began in 1933 and extended through 1943. A set is on file in the OCE Library.

mally, by far the larger part of the funds we appropriate to your branch are for nonmilitary functions." [17] Most congressmen thought of the Corps of Engineers in relation to improvements that would be made to the rivers and harbors adjacent to their home communities. Conscious of this personal interest, Schley felt "it was the part of wisdom to be present" at the hearings on the appropriation bill for civil works, even though he had perfect confidence in the ability of Assistant Chief of Engineers Robins to make the presentation. The Chief of Engineers felt no such compulsion to appear in defense of the military budget and, unlike the chiefs of other arms and services, did not do so. General Kingman usually represented the Corps at such hearings.[18]

For the fiscal year 1938, Congress appropriated but $599,400 in military funds, $234,465,300 in civil funds to the Corps of Engineers; in 1939, $4,358,380 in military funds, $201,885,800 in civil; in 1940, $3,044,340 for military activities, $279,364,000 for civil works. By 1941, however, military funds began to comprise a significant portion of the budget. For that year the Engineers received a military appropriation of $66,405,955 as against a civil works appropriation of $214,878,310. Another $200,000,000 came to the Corps early in fiscal year 1941 for the construction of military airfields, a program hitherto under the jurisdiction of the Quartermaster Corps.[19]

The transfer of the supervision of Air Corps construction from the Quartermaster Corps was the first of two steps in the consolidation of all military construction in the Corps of Engineers. Vital as was the construction program to military preparedness, responsibility for its execution perpetuated the split personality of the Corps, for the military construction program, like the civil works program, had little direct bearing on the creation of engineer soldiers. Schley was confident of the Corps' ability to carry out civil and military construction as well as prepare its troops for war. Normally, he explained, between one third and one quarter of the Regular Army officers were assigned to civil works. Most of the personnel engaged in civil works were civilians. It was possible therefore to transfer officers from civil to military duty without danger to the functioning of the organization, and this was done beginning in the fall of 1939. A similar policy, he promised, would govern the supervision of military construction.[20]

This transfer of officers was but one aspect of the shift from a peace to a war footing. During the period 1939–41 the number of engineer enlisted men increased from somewhat under 6,000 to almost 70,000.

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[17] Statement of Congressman J. Buell Snyder, 20 March 1941, in *War Department Civil Functions Appropriation Bill for 1942, Hearings before the Subcommittee of the Committee on Appropriations,* HR, 77th Cong, 1st Sess, p. 23.

[18] (1) *Hearings on Military Establishment Appropriation Bill* and *Hearings on War Department Civil Functions Appropriation Bill,* 1940, HR, 76th Cong, 1st Sess; 1941, HR, 76th Cong, 3d Sess; 1942, HR, 77th Cong, 1st Sess. (2) Incl, with Ltr, Schley to C of EHD, 4 Jun 52.

[19] Incl, Appropriations for Mil and Civil Functions CE, with Memo, C of Budget and Programs Div OCE for C of EHD, 6 Jun 55. During the fiscal years 1938–41 the Corps of Engineers also received approximately $14,886,600 for construction of seacoast defenses.

For the military construction program, see Lenore Fine and Jesse A. Remington, The Corps of Engineers: Military Construction in the United States, a volume in preparation for the series UNITED STATES ARMY IN WORLD WAR II.

[20] (1) *Hearings on War Department Civil Functions Appropriation Bill,* 1942, HR, 77th Cong, 1st Sess, 20 Mar 41, pp. 23–24. (2) Testimony of Col Stuart C. Godfrey, 11 Mar 40, in *Hearings on Military Establishment Appropriation Bill,* 1941, HR, 76th Cong, 3d Sess, p. 657.



1ST DIVISION ENGINEERS WORKING ON A MUDDY ROAD, *Ardennes, France, November 1918.*

Concurrently with the reception and training of these citizen soldiers the Corps of Engineers adjusted to the radical changes in weapons, structure, and tactics that distinguished the new from the old Army.

Engineers in the Old Army

The United States Army of the twenties and thirties was largely a product of World War I. Trench warfare characteristic of that conflict had left a deep impress on military organization and tactics. The basic unit of the old Army was the square infantry division which took its name from the four infantry regiments it contained. Tied to a clumsy combination of foot soldiers, horses, and motor vehicles, the square division lacked mobility, and its planned wartime strength of 22,000 men would have made it difficult to maneuver. The Army of the thirties was too small to permit the organization of echelons higher than a division, but in case of emergency, the War Department planned to group divisions and supporting units into corps, armies, and a general headquarters.[21]

Engineer functions in these echelons of command conformed to experiences winnowed from World War I. The major task in that war had been repair and maintenance of the muddy roads of France, and the Engineers expected that road and other work to keep the routes of communication open would account for seventy-five percent

[21] For a detailed discussion of the reorganization of the Army, see 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).

of their efforts in a future conflict. Next in the order of engineer jobs during World War I had been the preparation of defensive works, the erection of obstacles, and the construction of shelters and other buildings. The Engineer Field Manual of 1932 reflected that experience. Most of its space on field fortifications was devoted to trench construction. There were few pages on antitank obstacles, and there was little appreciation of the value of antitank mines. Construction of airfields was given but limited coverage.[22]

The engineer units which evolved as a result of World War I were classified either as general or as special units. General units included the engineer combat regiment of the infantry division, the engineer squadron of the cavalry division, and the general service regiments and separate battalions which were distributed among corps, army, and communications zone. The combat regiment did any temporary engineering work required for the accomplishment of the division's mission—repairing and building roads and bridges, creating obstacles, assisting in the organization of defensive positions, constructing advance landing fields for the Air Corps, maintaining the division's water supply, providing maps, and building troop shelters. While the combat regiment was supposed to fulfill only immediate front-line needs, its work was conditioned by the slow-moving character of the division. The engineer squadron, being part of the more mobile cavalry, emphasized hasty road repair and reconnaissance but performed the same general tasks within the limits of its personnel and equipment.

According to Engineer doctrine in the nineteen-thirties one sixth of an Engineer force in a theater of operations would have been composed of these divisional units. The bulk of engineer troops, nearly two thirds, would have been located in general service regiments and separate battalions for duties behind the front. For the more extensive and permanent work required in the rear areas the general service regiment was equipped with a variety of tools and specially trained soldiers. With its large pool of unskilled labor, the separate battalion was designed to support other units as well as to undertake missions of its own.

Special units, intended to comprise one fifth of an Engineer force, were organized to perform particular tasks. They included light ponton companies and heavy ponton battalions for the care and transportation of bridging equipage, topographic units to make and supply maps for army and general headquarters, water supply battalions to deliver water in areas where the local supply was inadequate, dump truck companies to transport construction materials, depot companies to handle engineer supplies, shop companies for the general maintenance of engineer equipment, and camouflage battalions to supervise camouflage and supply special materials.[23]

Although mobilization plans called for all these organizations, they constituted merely a paper classification. In September 1939 the Regular Army had only twelve active engineer units. Eight were combat regiments or parts of regiments down to a company; one, a squadron minus a troop; another, one troop of a squadron. The other two were topographic battalions. The small size of the peacetime Army coupled with the necessity for a core around which to form an

[22] (1) Info Bull 34, 27 Oct 39, Hist of CE. (2) Military Handbook for National Guard and Reserve Engineers (Engr Sch, 1937), p. 153. (3) Engineer Field Manual (2 vols., Washington, 1932), *passim.* (Cited hereafter as EFM.)

[23] EFM, I, Engineer Troops.

initial protective force had dictated this concentration of enlisted men within combat units.[24]

Reorganization of Division and Corps Units

Shortly after General Malin Craig became Chief of Staff in 1935 he ordered a reexamination of the organization and tactics of the Army. The aim was an increase in mobility; the means, the use of mechanical power to the utmost and a reduction in the size of troop units. The period between the two wars had been marked by great improvements in motor vehicles, tanks, and airplanes, which made the adoption of new tactics imperative, while advances in the design of weapons made cuts in personnel feasible without a loss of fire power. In the case of the infantry division, still further reductions could be made by relegating personnel and equipment needed only under certain contingencies to corps.

With these guiding principles the Army embarked in 1936 on a reorganization of the infantry division. The new triangular division that resulted contained three instead of four infantry regiments. Reductions in other elements reduced the planned wartime strength of the division from 22,068 to 13,552 men. The engineers shared in the general cut. The combat regiment of 868 officers and men was changed to a battalion of 518. But in relative numbers the engineer component remained about the same—3.8 percent of the division's strength. By way of indicating what could be done to reduce auxiliary units, Craig had mentioned the possibility of eliminating the engineers from the division entirely. The committee which specified the organization of the triangular division rejected that idea, possibly because of the expectation that increased dependence on motor vehicles would mean increased dependence on roads and bridges, but more likely because of the desire to avoid so drastic a change prior to testing. At any rate the new engineer battalion retained substantially the same functions as the old regiment.[25]

After the triangular division was tested in 1937, its officers recommended further cuts. For the engineers this meant a drastic reduction to a single company of 175 officers and men, only 1.7 percent of the division's strength. Proper reconnaissance, the argument ran, would enable the division to detour around blown bridges and other obstacles in the movement that preceded actual combat. Once the battle was joined, the division would require only emergency repair of roads, while other engineer tasks such as demolitions and roadblocks could be executed quickly. There seemed therefore to be little organic need for divisional engineers in open warfare. In the following months this viewpoint was to meet strong opposition from the Corps of Engineers.[26]

Responsibility for expounding the opinions of the Corps of Engineers on organizational matters rested with the Chief of Engineers, and more specifically with the

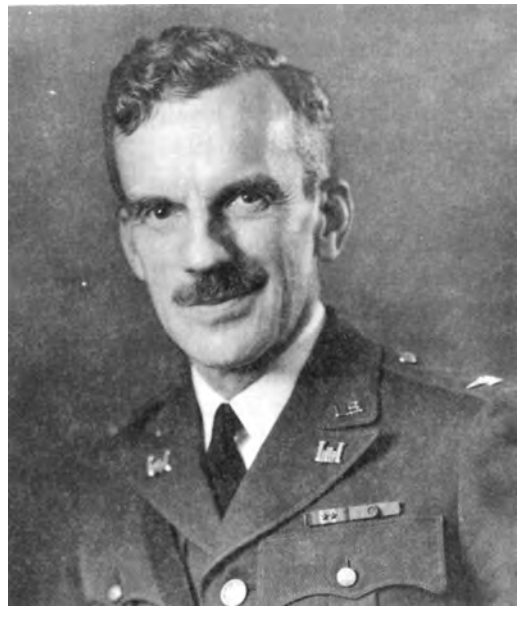
[24] (1) Annual Report Covering Military Activities of the Corps of Engineers for the Fiscal Year Ending June 30, 1939. (Cited hereafter as Ann Rpt OCE. These reports are in EHD files.) (2) The Engineer Protective Mobilization Plan, 1939 (Tentative), 15 May 39. EHD files. (3) Mark Skinner Watson, *Chief of Staff: Prewar Plans and Preparations*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1950), pp. 26–30.

[25] (1) O&T Office Study 131. EHD files. (2) Lecture, Col S. C. Godfrey, The Streamlined Division and Its Engineer Component, 9 May 38. 350.001, Pt. 10. (3) Military Handbook for National Guard and Reserve Engineers, pp. 24–25.

[26] Rpt of Fld Sec Test of Proposed Inf Div, App. A, 21 Mar 38. McNair Papers.

Operations and Training Section. From 1937 to 1941 O&T was headed by Col. Stuart C. Godfrey, who had served overseas during World War I. Thereafter, he had had tours of duty as an instructor at the Command and General Staff School, as a troop unit commander, and as a District Engineer. Among his assistants, Maj. Louis J. Claterbos, who became his executive officer, Capt. Gerald E. Galloway who headed the organization and equipment subsection, and Maj. Kenner F. Hertford, who succeeded Galloway, were particularly concerned with the organization of engineer units. These men did the spade work in preparing the arguments with which Schley and Kingman forcefully promoted the Engineers' point of view.[27]

The O&T Section obtained some of its arguments in turn from the Engineer School and the Engineer Board, and from units in the field, but the Chief's office was often guided by different considerations from those of these subordinate organizations. O&T had to face the practical problem of not making impossible demands on the General Staff. The proposals that went forward, therefore, were usually limited to requests which would not be considered unreasonable. At the same time the Engineers tried to assure themselves a sympathetic hearing by making a concerted effort to place able officers from the Corps in positions of responsibility on the General Staff itself.[28] "I believe," Godfrey advised General Schley in February 1939, "that the most effective way to ensure full consideration of our needs, for men and equipment, is to secure a larger representation on the General Staff. Major Wood's detail to G–4 has already been very helpful in this connection. The present opportunity to recommend an Engineer for detail in the important Mobilization Section of G–3 should, in my opinion, be taken advantage of, even at the expense of some other activity." [29] In mid-1939 there were five Engineer officers assigned to the General Staff, which at this time numbered about one hundred. In the fall of 1940 there were six, one of whom, Maj. Gen. Richard C. Moore, was deputy chief of staff for supply and transportation, and another, Brig. Gen. Eugene Reybold, the G–4. Many of the letters and memoranda addressed to the General Staff were delivered personally by Schley or by Kingman, who, on these occasions and others, sought to keep themselves posted on



COL. STUART C. GODFREY, *Chief of Operations and Training Section from 1937 to 1941.*

[27] Orgn Charts OCE, 1937–41. EHD files.

[28] (1) Incl, n. d., with Ltr, Schley to C of EHD, 4 Jun 52. (2) Interv, Maj Gen Clarence L. Adcock, 27 Dec 51.

[29] Memo, ExO Mil Div for CofEngrs, 21 Feb 39. 475, Engr Equip, Pt. 1.

the staff's point of view as well as to present that of the Engineers.[30]

The Engineers' views were naturally motivated in part by branch loyalty. Thus, one unit commander wrote in 1938: "If we are not careful, such organizations as Reconnaissance Squadrons will beat us to the punch in providing their own means for what should be our work." [31] But the basis of their arguments was usually a carefully reasoned estimate of what a given situation would require of military engineers. In the reorganization of the infantry division the Engineers were faced with a current of opinion which would have diminished their position and they fought to maintain it, convinced that the military situation had been inadequately evaluated.

While the Engineers were acutely conscious of the new mobility, it was the vulnerability of vehicles to obstacles which they emphasized and on which they based their criticisms of the proposed cuts. They insisted that the growing use of motor transport demanded more, not less, road work—a fact that had not been apparent in the 1937 tests where there had been no mud and no shelling. Predicting that the enemy would attempt to blow every bridge along a line of retreat, the Engineers foresaw a need for more bridge building, which would be complicated by the necessity of supporting heavier trucks and tanks. To impede the movement of the enemy, on the other hand, roadblocks, antitank mines, and demolitions along possible avenues of attack had become increasingly important.[32] In support of their position the Engineers pointed to the proportion of engineers found in British and German divisions and to the remarks of a non-Engineer military attaché in Germany who wrote:

> I have become very much struck in recent months here by the enormously increased importance which the German Engineers are receiving. . . . The reason for this increased importance is the motorization and mechanization now taking place in all armies in the world. I do not take issue with such mechanization and motorization, but desire to point out that there are disadvantages as well as advantages thereto, and that no unit of the army is better designed to take advantage of the weaknesses of motorization than an engineer unit.
>
> . . . . . .
>
> . . . By all means motorize a part of our army, but by all means also, along with this motorization, give to the engineer corps that increased importance which is rightfully theirs through the sensitiveness of motor transport to the demolition and obstruction of routes of communication.[33]

The General Staff did not accept the 1937 tests as conclusive and scheduled more extended ones in 1939. For these the engineer component in the division consisted of a battalion of 11 officers and 269 enlisted men. This was the peace strength of the unit; its war strength was 15 officers and 393 men, about 3.7 percent of the whole division. As set up the battalion was responsible for reconnaissance, hindering

[30] (1) Ray S. Cline, *Washington Command Post: The Operations Division,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1951), pp. 23–24. (2) Ann Rpts OCE, 1939, 1940. (3) Longhand notations on memos for CofS. 320.2, Pt. 22.

[31] Ltr, Maj Henry Hutchings, Jr., CO 8th Engrs, to Godfrey, 13 May 38. O&T Office Study 114, EHD files.

[32] (1) Memo, CofEngrs for CofS, 2 May 38, sub: Engr Component of the Inf Div. Loose Papers O&T Sec, EHD files, Orgn of Inf Div. (2) Lecture, Godfrey, The Streamlined Division and Its Military Component, 9 May 38. 350.001, Pt. 10.

[33] Extract from a letter from an authoritative military observer in Germany, November 1937, Incl, with Ltr, ACofEngrs to CofCav, 16 May 38, sub: Div Units for Cav Div (Mecz). O&T Office Study 114, EHD files.

enemy movements, improving road and stream crossings, taking measures for defense against mechanized attack, and helping to organize defensive positions. Road building, map reproduction beyond simple sketching, and emergency bridging were cut out so far as divisional engineers were concerned. When the Office of the Chief of Engineers objected to the elimination of floating bridge construction from the battalion's functions, the War Department pointed out that absence of streams in the testing area would prevent experimentation! While the Engineers had succeeded in securing almost as much relative strength in this division as in the one tested in 1937 they still felt there was a strong sentiment in favor of reducing their strength to a company.[34]

In September 1939, before the War Department announced new tables, Schley presented his views to the General Staff once again. He proposed that the engineer battalion be organized with a peace strength of 350 men and a war strength of 520. Although these numbers were considerably less than the 800-man battalion recommended by the Engineer Board and the Engineer School around the same time, or the 642-man battalion recommended by Schley himself in 1937 when he was commandant of the Engineer School, their acceptance would have raised the wartime strength of the engineer component to 4.3 percent of the division. In support of this recommendation, Schley stressed again the unrealistic nature of the 1937 and 1939 tests, where favorable weather and lack of destruction had minimized the need for engineer troops, and called attention to the reserve of fire power which the engineers could supply. He also noted a new factor—the experience of the German Army in Poland—and observed that its rapid advance against obstacles "must have demanded a great amount of engineer work." [35] The General Staff was not persuaded. In September 1939 the War Department authorized a peace strength battalion of 300 enlisted men. Shortly thereafter the battalion's war strength was set at 420 enlisted men, or 3.5 percent of the division. The relative strength of engineers in the triangular division was thus to be .3 percent less than in the square division, but this was a far cry from reduction to a company.

The outbreak of war in Europe had meanwhile led the President to increase the Regular Army by 17,000 men. However inadequate the expansion of the Army, it made possible the formation of four more triangular divisions and of a few corps and army units. In its search for mobility the War Department had considered the composition of army corps along with the infantry division but no firm conclusions had been reached. The authorization of more manpower and a definite decision on the infantry division brought the question up again. Under the old Army organization, engineer units had been allotted on the basis of one general service regiment, three separate battalions, one depot company, and one light ponton company to a corps. Since under the reorganization many functions formerly performed by divisions had been relegated to corps, Schley proposed to change the character and strength of the corps' engineer component. The new organization which he recommended in Sep-

[34] The preceding paragraph and the discussion following are based upon: (1) Corresp in 320.2, Pts. 22, 23; (2) Loose Papers O&T Sec, EHD files, Orgn of Inf Div; (3) O&T Office Study 131, EHD files.

[35] Memo, CofEngrs for CofS, 12 Sep 39, sub: Engr Component of Inf Div. 320.2, Pt. 22.

tember 1939 consisted of a corps combat regiment with 700 men in peace and 1,120 in war, a general service regiment of the same strength, and a light ponton company. The combat regiment was to reinforce the divisional engineer battalion in such operations as river crossings. The general service regiment, with its heavier equipment, was to be responsible for combat-support bridging, maintenance of roads and railroads, and general construction. The ponton company was to maintain a pool of bridging equipment and boats for assault crossings.

Although it accepted the strength of the general service regiment, the War Department eliminated the light ponton company and reduced the war strength of the combat regiment to 782 men. In explanation, the War Department laid down the principle that, as in the case of the division, corps troops were to maintain the same ratio to over-all strength in war that they had in peace, 6.3 percent. This seemed reasonable to the General Staff in light of the fact that less than half of the 11 percent of engineer troops in the American Expeditionary Force had been assigned to corps.

In the weeks that followed the engineers continued to contend for more troops in division and corps—centering their attention on proposed war strengths which would not have required any immediate increase. While acceding to the elimination of the ponton company from the corps, OCE suggested that it be replaced by a topographic company to compensate for the reduced mapping potential of division engineers. Schley and Kingman wrote repeatedly of the need for more Engineers. They questioned the use of percentages in settling the matter and, particularly, the percentages used by the War Department. Engineer work could not be measured solely by the decrease in numbers of divisional troops. The area to be covered must be taken into consideration, and, with greater mobility, the area would probably be larger than before. When it suited their purposes, the generals used World War I experience, but more and more they stressed the current European war and the fact that the engineers were fighters as well as technicians. On 3 October 1939, Schley wrote caustically: "The Germans believe that the modern trend toward motorization and mechanization demands a *much larger* proportion of Engineer and other technical troops with the combat troops than formerly. We seem to be moving in exactly the opposite direction." [36]

The General Staff capitulated under the weight and persistence of these arguments. By December the War Department had approved the topographic company, and a war strength of 520 for the engineer battalion and 1,100 for the combat regiment. Engineers now composed 4.3 percent of divisional and 8.0 percent of corps strength. Thus a relative gain had been made—a gain the Engineers had insisted was essential to meet the demands of modern warfare.[37]

Formation of Armored and Aviation Units

Important as it was, the reorganization of infantry units was but the first step in the tactical reorganization of the Army. In 1939 the Engineers began to find their place in the units that were being evolved to exploit the power of the tank and the bomber. In general, armored units were to embody the

[36] Memo, CofEngrs for ACofS G–3, 3 Oct 39, sub: Orgn of Div and Corps Engr Units. 320.2, Pt. 22.

[37] (1) Ltr, AGO to CofEngrs, 11 Dec 39, sub: Div and Corps Engrs. 320.2, Pt. 23. (2) T/O 5–187, 1 Nov 40.

classic cavalry doctrine of mobility, fire power, and shock action.

During the thirties the Army had organized the 7th Cavalry Brigade (Mechanized) to develop the special techniques of tank warfare. Repeatedly, the Chief of Cavalry and the Chief of Engineers had recommended the attachment of an engineer unit to the mechanized brigade. This was the only way, the Chief of Cavalry pointed out in April 1937, to gain practical experience in how to increase the mobility of mechanized cavalry. Lack of funds was the main reason for the War Department's disapproval of this proposal.[38]

The most the Engineers could get at this time was the assignment of an observer to the Cavalry training center at Fort Knox. After a short time in this capacity Capt. Robert E. York came up with rather moderate proposals. While he boldly insisted that engineer troops would play an important role in support of mechanized cavalry, he was clearly under the spell of armor's potential mobility and was hard put to find specific tasks for his own service. The mechanized brigade would move so fast that only minor road repairs could be executed. Construction of shelters and other buildings would be unnecessary in a tactical movement. Mapping would probably be limited to preparing and reproducing sketches and overlays from aerial photographs. Reconnaissance would be confined to obtaining information about obstacles. The removal of roadblocks, mine fields and other deliberate obstacles, if necessary by demolitions, would constitute the main task. But he doubted there would be much, if any, need for bridging. Detours could in almost all cases be made in less time than it would take to construct a bridge. But despite the nebulous nature of these tasks the mechanized cavalry insisted on the need for assigning engineer troops immediately. Delay in attaching an engineer unit, wrote the commanding officer of the mechanized brigade, would "retard development of the full capabilities of mechanized cavalry with respect to its chief characteristic, mobility." [39]

At this time OCE's Military Division was recommending a squadron whose main functions would be reconnaissance, mapping, stream crossing, and the removal and construction of obstacles. The following May, Kingman also urged the organization of a squadron, though he conceded that shortages of personnel might not permit a unit this large. In January 1939 the Military Division, at the War Department's request, submitted a T/O for a troop, a unit that Kingman considered adequate for peacetime, but too small to function effectively in war. Despite all this counseling, another year slipped by before the War Department approved the activation of the 47th Engineer Mechanized Troop with a contingent of 128 men. Its functions, which Brig. Gen. Adna R. Chaffee, the new commander of the mechanized brigade, wholeheartedly endorsed, included demolitions, hasty repairs to bridges, and the provision of emergency crossings for small streams. The important fact was that the Chief of Cavalry and the Chief of Engineers now had the opportunity they had so long sought—the opportunity to arrive at conclusions from actual experience.

Whereas the Engineers had long been conscious of the need for engineer mecha-

[38] The discussion of the formation of engineer armored units is based upon (1) O&T Office Studies 114 and 155, in EHD files, and (2) Corresp in 320.2, Pt. 23.

[39] 4th Ind, ExO 7th Cav Brig to CofEngrs, 15 Oct 37, on Ltr, York to TAG, 24 Aug 37, sub: Engr Component of Cav Brig (Mecz). O&T Office Study 155, EHD files.

nized units, it was not until 1939 that they realized that similar provision would have to be made for the Air Corps. To be sure there had been some co-operation on camouflage and aerial mapping, but the construction needs of the Air Corps had scarcely been considered.[40] The initiative came from the War Department, which, in September 1939, asked the Engineers to submit T/O's for engineer units of the GHQ Air Force (the Air Corps' operating arm). In replying, Kingman made a distinction between the construction of landing fields in forward areas and the more permanent bases in the rear. For the first, he proposed the creation of an engineer aviation regiment of three battalions with a total peace strength of 43 officers and 1,050 men. It was to be trained with the GHQ Air Force and to concentrate on "hasty methods of utilizing existing facilities for landing fields, or improvising new ones." For the more extensive and deliberate construction in the rear Kingman recommended use of the general service regiment, which would be equal to the task after receiving special training and equipment. The ultimate size of the engineer component of the GHQ Air Force was left open pending experience, but Kingman recommended that one unit of each type be constituted.[41] These units were needed to work out new methods of emergency runway construction, camouflage, and bomb and fuel transportation, as well as for the supply of power, water, and other utilities. "There is so much for Engineer troops to do to make the GHQ Air Force more effective on M-day," Maj. Gen. Delos C. Emmons, commander of the GHQ Air Force, wrote in February 1940, "that there can be no question as to the immediate need for the units above recommended. Much of this necessary development has been neglected because of the lack heretofore of Engineer troops with the Air Corps." [42] The Engineers decided to convert a general service regiment into an engineer aviation regiment after the April–May 1940 maneuvers.[43]

The Impact of the German Blitzkrieg

The maneuvers of 1940 and 1941 were to form the basis for further changes in engineer organization and equipment. But in the spring of 1940 the lessons to be learned from maneuvers were overshadowed by the German blitzkrieg. The fall of France and the Low Countries and the retreat of the British to their island caused an explosive reaction in American thought. The United States was jarred into an expansion of its military forces that overwhelmed previous planning. By the end of June Congress had authorized a Regular Army of 375,000 men, and before the summer was out had provided for calling up the National Guard and for the unprecedented institution of a peacetime draft.

Whereas the Polish campaign in the fall of 1939 had reinforced the arguments of those who predicted a return to open warfare, the retirement behind fortified positions which characterized the "phony war" the following winter had caused some to pre-

[40] (1) Memo, ExO Mil Div for CofEngrs, 21 Feb 39. 475, Engr Equip, Pt. 1. (2) Ltr, Lt Col J. A. Dorst to Lt Col L. E. Atkins, 6 May 39. 210.3, Air Forces, Pt. 1. (3) Ltr, Atkins to Dorst, 17 May 39. Same file.

[41] 1st Ind, 16 Oct 39, on AG Ltr 320.2 (9–19–39) P (c) to CofEngrs, 21 Sep 39, sub: T/Os. 320.2, Pt. 22.

[42] Memo, CG GHQ Air Force for CofAC, 6 Feb 40. 320.2, Pt. 24.

[43] (1) 3d Ind, Actg CofEngrs (Kingman) to TAG, 21 Feb 40, on memo cited n. 41. 320.2, Pt. 24. (2) Info Bull 45, 13 May 40, Changes in Orgn of Engr Units.

dict a repetition of World War I tactics. In March 1940 Godfrey had written: "No development in recent warfare has been more striking than the renaissance of deliberate land fortifications. The Maginot Line and the West Wall have rendered quiescent the threat of an offensive on the West Front." [44] The German attack in the spring of 1940 banished this idea once and for all. But to the Engineers the blitzkrieg meant more than the triumph of mobile warfare. To them the blitzkrieg, in which German engineers took a prominent part, offered sure and final proof of their claim to an enhanced combat role.

The person who did most to publicize this conviction was Capt. Paul W. Thompson, who had been in Germany as a military observer shortly before the outbreak of the war. In May 1940, Godfrey recommended that Thompson be called to OCE to analyze reports from abroad.[45] The analysis of the blitzkrieg which Thompson made from German published sources received widespread attention throughout the Army. His first article appeared in the September–October 1940 issue of the *Infantry Journal*. By April 1941 the editor of the magazine considered Thompson "one of the wheelhorses of the corps of Journal authors," and within the next eight months published five articles under Thompson's name. At the same time Thompson was writing extensively for *The Military Engineer,* the journal of the Society of American Military Engineers. In the January–February 1941 issue he began to publish a series called "Engineers in Battle." In September, the editor of *The Military Engineer* remarked on the popularity of the articles, and upon the publication of the last one in December announced that the series would be issued in book form.

In writing for the two periodicals Thompson tailored his presentation to his audience. Most of his articles in the *Infantry Journal* were general descriptions in which engineer troops were mentioned only incidentally. He did, however, call attention to matters which were the particular concern of engineers—the character of the terrain, the road net, the rivers and canals.[46] His "Engineers in Battle" series was naturally concerned almost exclusively with the role of engineers.

Typical of Thompson's descriptions of the exploits of German engineer troops was his "Engineers in the Blitzkrieg," which was published in the *Infantry Journal.* In this article Thompson stressed particularly the contribution of German engineers to the fall of Fort Eben-Emael. The capture of Eben-Emael in Belgium was a crucial point in the German plan of attack. Considered by the Allies almost impregnable, the fort had been effectively neutralized and forced to surrender in well under forty-eight hours. As Thompson described the action from the sources available to him an initial heavy bombardment had been followed by penetration by engineer parachute troops. An engineer battalion, reinforced with infantry, arrived on the outside of the fort and established contact with the parachutists within. After this, in Thompson's words:

> The AA guns went into battery, firing direct at the ports of individual works. The infantry prepared to repulse any sorties or counterattack. The engineers crawled forward, concentrating on certain individual works. They carried their explosives, grenades, smoke

[44] Memo, C of O&T Sec for CofEngrs, 7 Mar 40, sub: Land Defenses. 660, Harbor Defense (S).

[45] (1) *Infantry Journal,* XLVII (September–October 1940), 521. (2) Memo, C of O&T Sec for CofEngrs, 24 May 40, sub: Engr Intel. 091, Germany, Pt. 6.

[46] Thompson articles in the *Infantry Journal,* XLVII, XLVIII, XLVIX (September 1940–February 1941) and in *The Military Engineer,* XXXIII (1941).

candles, flame-throwers, poles, and other equipment. . . . Finally, they reached the outer walls of the works themselves.

Here the scene must have been one of terrifying action. Flame-throwers are playing against ports, grenades are bursting, projectiles from the AA guns are ricocheting, and engineer soldiers are hugging the dead spaces, throwing and placing their charges. With their explosives they are attacking the sensitive parts of the work, the ports, the turrets, the hinges.[47]

In a number of respects Thompson's report on the capture of Fort Eben-Emael was in error. The parachutists arrived before the bombers; the defenders held out longer than he believed. But he did not overestimate the decisive part played by German engineers in their employment of explosives.[48]

In expounding the role played by engineer troops in the capture of Fort Eben-Emael, Thompson and other Engineer commentators were aware that in the American Army assault of permanent fortifications was fundamentally an infantry mission. They were aware as well of other differences between the German engineer and his American counterpart. The German engineer was trained as an infantry soldier first and as a technician second. His main job was combat engineering. Road building and other construction (except for emergency bridging) was left to the semimilitary Arbeitsdienst (Labor Service) and the Organization Todt. Thompson warned against blindly accepting German doctrine, noting particularly that it had been developed to meet a specific enemy in a specific theater of operations:

We must ourselves keep in mind the possibility of operating under widely varying conditions—conditions where water supply might be more important than assault tactics, where labor battalions from the interior might not be available on call, or where our own air superiority might not be such as to make of camouflage a superfluous art.

But he continued:

There is one conclusion . . . which is incontestable (and obvious). It has to do with the intimate coordination which must exist between members of the combat team. The German blitz campaigns have demonstrated this fact more forcibly, perhaps, than it ever before has been demonstrated. And as a corollary fact, the campaigns have demonstrated that the engineers are now an elite member of the team.[49]

An elite member of the combat team—it was a refrain repeated over and over, and not merely by the Engineers themselves. A report of the Military Intelligence Division of the War Department General Staff had this to say:

The results of the two recent major campaigns, Poland and the West Front, are eloquent testimonials to the importance of combat engineers. Formerly it was the infantry and the artillery team that was all important, but in the light of recent operations the combat engineers take their place beside the artillery, so essential are their functions to the success of ground troops.[50]

Pointing to German tactics, Schley recommended in July 1940 that the War Depart-

[47] Paul W. Thompson, "Engineers in the Blitzkrieg," *Infantry Journal,* XLVII (September–October 1940), 429. This article was distributed as Information Bulletin 63, 31 October 1940.

[48] A detailed account of the operation, translated from foreign sources, is contained in Hq EUCOM Hist Div, The 7th Infantry Division on the Albert Canal, Pt. 8, "The Battle of Fort Eben-Emael, 10 and 11 May 1940." MS, OCMH.

[49] (1) Paul W. Thompson, "Engineers in the Blitzkrieg," *Infantry Journal,* XLVII (September–October 1940), 432. (2) See also, Address, Maj. Gen. J. L. Schley, The Engineer and National Defense, 18 Sep 40, EHD files, and Rpt, Assault of Defensive Installations, 29 Nov 40, First Research Course, Vol. I, Engr. Sch. Library.

[50] MID WD, Tentative Lessons Bull 9, 5 Jul 40, sub: Preliminary Mil Attaché Rpt From Berlin on West Front Opns, May 40. 091, Germany, Pt. 6.

ment provide for joint exercises with other arms in the attack on fortified positions, but he was told that engineer techniques would have to be perfected first. Before this reply had arrived, the Engineers began to plan a research course which would examine and improve upon the tactics used in the battles of Europe. In the fall of 1940 and again in the spring of 1941 officers from nearly all engineer units and from a number of other branches of the service were brought for several weeks' stay at the Engineer School. After a period of orientation they were assigned to committees to explore designated topics.[51]

These topics reflected, in nearly all cases, the combat rather than the technical aspects of military engineering. Thus eight of twelve subjects studied in the first course were concerned with tactics and techniques of the assault in four different types of operations—against an organized position, against obstacles in barrier zones, against organized river lines, against enemy air bases. But some of the committees accorded more attention to the assault tactics of foreign armies and the duties of engineer troops in defense against them than to the role of engineers in overcoming the defenses of an enemy. This approach was true of the committee on barrier tactics, the committee on obstacles, the committee on deliberate field fortifications, and the committee on what began as the assault on, and became the defense of, air bases. These groups weighed the value of various obstacles in the light of their effectiveness against trucks and tanks, concluding in general that engineer troops should be particularly skilled in laying mine fields (for mines were the most effective obstacle for hasty defenses), and that the construction of large-scale fortifications was unnecessary in the continental United States and would be impossible to execute in an overseas theater.[52]

Several committees proposed a radical change in the doctrine on assault. Instead of being restricted to the removal of barbed wire, mines, and roadblocks, the American engineer, like the German, should also be charged with the duty of reducing concrete and steel emplacements. In a river crossing, engineer troops should be integrated into the assault team after they had delivered it to the enemy-held shore. In ship-to-shore amphibious landings, engineer soldiers would assume the lead in demolishing pillboxes and other fortifications. A representative of the field artillery registered vigorous dissent:

> Engineers have always been charged with duties involving "watermanship" and will presumably always conduct or supervise river crossings but, to imply that they should conduct assaults after a river is crossed is no more proper than it is to conclude that they are fitted to drive a tank because they have ferried it across a stream. . . . As respects the essential skills it is obvious that engineers are more competent in the employment of explosives than infantrymen and that infantrymen are normally more thoroughly trained in combat firing and scouting and patrolling. . . .

The choice, it seemed to him, was to train a very few infantrymen in the art of demoli-

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[51] (1) Ltr, CofEngrs to CofS, 24 Jul 40, sub: Assault Opns, with 1st Ind AG 370.2 (8–24–40) M–C to CofEngrs, 13 Sep 40. Sup Sec Rqmts Br Gen Staff (G–4). (2) 2d Wrapper Ind, Comdt Engr Sch to CofEngrs, 12 Aug 40, on AG Ltr 352.01 (7–26–40) M–C to CofEngrs, 31 Jul 40, sub: Courses at Special Sv Schs. 352.11, Engr Sch, Pt. 9.

[52] The foregoing and following discussion of the research courses is based upon the reports in: (1) Info Bull 71, 2 Jan 41, sub: Mission, Duties, and Tng of Div Engrs; (2) First Research Course, 21 Oct–30 Nov 40, Vol. I; (3) Second Research Course, 1 Feb–1 Mar 41, Vols. I and II. The Research Courses are in the Engineer School Library.

tions or to train many engineer soldiers in the art of shooting.[53]

The committees which defined the mission of infantry and armored divisional engineers followed much the same pattern. Although they believed the need for building permanent roads and bridges had been underestimated as a result of the blitzkrieg, they agreed that divisional engineers could not be expected to carry out this work. Divisional engineers would be much too busily occupied in emergency work on roads and bridges, removal of mines and roadblocks, reduction of organized defenses, and construction and defense of mine fields and other such hasty offensive and defensive measures.

In addition to the many pronouncements about Engineer doctrine, the committees had much to say about methods of training and about the development of new equipment—so much so that the O&T Section felt that many officers had been carried away by their enthusiasm. The demands for new equipment were "excessive." The ideas on the training of Air Corps units were unsound as were the recommendations on the construction of deliberate fortifications and the proposals for giving radios to engineer units when wave lengths were already jammed.

But the enthusiasm created was not to be lightly dismissed. Thinking had been stimulated and confidence reasserted. Once back with their units the officers who had attended the research course shared their experiences. Moreover, many of the reports were published for circulation within the Corps, and some of the recommendations found their way into field manuals.[54] When Kingman submitted the two volumes of reports to the Chief of Staff he pointed out that they contained no radical departure from existing doctrine—merely modifications to meet demands for speeding up operations—and concluded with the premise on which the course had been given in the first place: "A fresh emphasis was placed upon the combat function of engineers." [55]

Changes in General Units After the Blitzkrieg

Insofar as the blitzkrieg in the West had served to quicken the interest in the role of engineer troops its effect was vital but at the same time intangible. Insofar as the blitzkrieg led to a large-scale expansion of American military strength its effect was both decisive and practical.

The spring 1940 maneuvers had provided engineer troops with a better opportunity for demonstrating their usefulness than had the earlier tests of the infantry division. There were streams to bridge and there was some rain. Commanders made extensive use of simulated roadblocks. It became standard practice to attach a platoon of the engineer combat battalion to each of the division's three combat teams. Engineer officers came away from the maneuvers convinced the exercises had shown that the engineer component of the

[53] Minority Rpt, Assault of Defensive Installations, 29 Nov 40. First Research Course, Vol. I, p. 25.

[54] (1) Memo, ExO O&T Sec for Godfrey, 17 Jan 41, sub: Atchd Recommendations, with Incl. (2) Ltr, AC of O&T Sec to Godfrey, 25 Mar 41, sub: Info Bull based on First Research Course. (3) Memo, Engr GHQ Air Force for Maj Joseph S. Gorlinski, 26 Feb 41, sub: Rpt of Research Comm, Defense of Air Bases. All in 352.11, Engr Sch, Pt. 10.

[55] Memo, ACof Engrs for Cof S, 29 Jan 41, sub: Rpt on Special Research Course on the Technique of Assault Opns at Engr Sch. 352.11, Engr Sch, Pt. 10.

infantry division was too small and they were satisfied that this fact had been impressed upon infantry officers as well.[56]

The Military Division sought immediately to capitalize upon these feelings, but was at pains to stay within the limits of what the General Staff might be willing to approve in view of the then small size of the Army. Thus Maj. Clarence L. Adcock, OCE's executive officer, suggested early in May that the Corps recommend an increase in the headquarters detachment from 30 to 60 men. By June, however, the success of the German blitzkrieg in the West was pointing to further expansion of the armed forces. Godfrey, viewing the expected increase as an opportunity to make bolder recommendations, asked the Engineer School to review the entire subject afresh. Toward the end of June, Col. Creswell Garlington, speaking for the school and the Engineer Board, recommended a minimum battalion strength of 600 to 700 men both in peace and in war. If it was felt this request would be turned down, he proposed that the increases be made under the following priorities—first, increase the headquarters and headquarters detachment to 80; second, increase the squad from 10 to 12; third, add a third platoon to each company; and fourth, add a fourth lettered company to each battalion. For the present he suggested that peace strength be at least 400 and war strength a minimum of 700.[57]

In July OCE forwarded a table of organization to the General Staff calling for a peace strength of 480 and a war strength of 720. Soon thereafter the promise of men from Selective Service permitted the War Department to plan for further revisions in the triangular division and to use one strength for both peace and war. As a result, the engineer combat battalion was reorganized in October into a headquarters company and three lettered companies of three platoons each. The total strength of the battalion was fixed at 18 officers and 616 men. The fourth company was disapproved, largely because of the opposition of Brig. Gen. Lesley J. McNair, then Chief of Staff, General Headquarters, and formerly an advocate of a single company for division engineers. The present engineer battalion, McNair argued, was already almost as large as the engineer regiment of the old square division, and unless the pressure from Engineers and other branches was resisted, the triangular division would become as unwieldy as the organization it had replaced.[58]

The successes of the German panzer divisions in the spring of 1940 added spectacular support to those who were advocating a separate mechanized force within the United States Army and led to the creation of the Armored Force in July. Two armored divisions were activated with an engineer battalion in each. When advance notices indicated that the strength of the engineer

[56] Various reports of maneuvers are in 354.2 and 354.2, Bulky. See Information Bulletin 51, 26 July 1940, Third Army Maneuvers, April–May 1940, for key extracts from the reports of Engineer officers.

[57] (1) Memo (with atchd routing slip), ExO OCE for Kingman, 8 May 40, sub: Rpt on IV Corps Maneuvers at Ft. Benning. 354.2, Pt. 7A. (2) Memo, C of O&T Sec for Comdt Engr Sch [Jun 40], sub: T/O for Increased Strength for Div Engr Bn. 320.2, Pt. 24. (3) Ltr, Comdt Engr Sch to CofEngrs, 27 Jun 40, same sub. 320.2, Pt. 25.

[58] (1) Memo, C of O&T Sec for ExO OCE, 5 Jul 40, sub: Résumé of Activities O&T Sec, 28 Jun–5 Jul 40. 025, Pt. 1. (2) Memo, ACofS G–3 for CofEngrs, 10 Aug 40, sub: T/Os. 320.2, Pt. 25. (3) AG Ltr 320.2 (8–31–40) M (Ret) M–C to COs All Corps Areas, 10 Sep 40, sub: Reorgn of Triangular Div. 320.2, Pt. 25. (4) Memo, Col J. C. Mehaffey, I Corps Engr, for Adcock, 24 Mar 41, sub: Orgn of Engr Bn (Combat) Triangular Div. 320.2, Engrs Corps of, Pt. 14. (5) T/O 5–75, 1 Oct 40. AG 320.2 (7–19–40) (2).

armored battalion would be only 281, General Schley protested that German breakthrough tactics involved the extensive use of engineers. The panzer division had an engineer battalion consisting of three large companies plus a bridge train. For the engineer element in the American armored division OCE suggested a peace strength of 473 and a war strength of 620. Although the War Department explained that the battalion's initial strength would be limited by the availability of personnel in a 375,000-man army, the first battalions were activated under tables of organization calling for 466 men in a battalion made up of three lettered companies and a headquarters company.[59]

Shortly thereafter men became available through the draft. The Armored Force then proposed a revision that not only increased the battalion to 712 men but, like the German panzer division, included a bridge company as well as three lettered companies. Although the inclusion of the bridge company was criticized later, its presence in the engineer armored battalion was logical in view of the expectation that armored divisions, unlike infantry, would usually operate at some distance from corps troops.[60]

During the summer of 1940 the composition of corps engineers changed too. Under the T/O's for combat and general service regiments there had been little difference between the two units in peacetime strength and equipment. The general service regiment had been made similar to the combat regiment by eliminating skilled men for heavier types of work in concrete, railroad, and road construction and by adding assault boats and mines. The major differences between the two units were the greater capacity and weight of the power shovel in the general service regiment and its larger number of skilled men. The Engineer School had argued that it would be preferable to have two combat regiments in a corps and keep the old general service regiment for heavier work in rear areas. In reviewing these tables, the War Department also noted their similarity and suggested one table for both. While OCE recognized this fact, it had wished to postpone a change until both organizations had been tested. After the April–May 1940 maneuvers, in which the units were used indiscriminately, Kingman agreed that the two engineer regiments in the army corps should be combat regiments, the general service regiment to be relegated to rear areas for heavy work. As the Army obtained more men, both the combat regiment and the general service regiment followed the combat battalion in converting to single strength tables and in securing increases in the number of enlisted men. By the end of the year both regiments had T/O's calling for over 1,220 men each—about 100 more than Schley had called for in September 1939.[61]

Like the combat battalion, the armored battalion, and the combat regiment, the engineer aviation regiment was classified as a

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[59] (1) History of the Armored Force, Command and Center (AGF Hist Sec Study 27, 1946), pp. 7–8. (2) Memo, CofEngrs for ACofS G–3, 22 Jun 40, sub: Engr Component for Armd Div. 320.2, Pt. 24. (3) 1st Ind, AG 320.2 (6–22–40) M (Ret) TAG to CofEngrs on same memo, 16 Jul 40. 320.2, Pt. 25. (4) Memo, C of O&T Sec for ExO OCE, 5 Jul 40, sub: Résumé of Activities O&T Sec, 28 Jun–5 Jul 40. 025, Pt. 1. (5) 10th Ind (basic missing), CG Armd Force to TAG, 22 Oct 40, Incl, with Ltr, Capt Bruce C. Clarke to Godfrey, 22 Oct 40. 400.34, Armd Comd.

[60] (1) Ind and ltr cited n. 59 (5). (2) Greenfield, Palmer, and Wiley, *op. cit.*, p. 278. (3) Col. Lunsford E. Oliver, "Engineers With the Armored Force," *The Military Engineer*, XXXIII (September, 1941), 397.

[61] (1) 320.2, Pts. 23, 24. (2) Info Bull 85, 18 Apr 41, sub: Road Work in Theaters of Mil Opn. (3) T/O 5–21 and T/O 5–171, 1 Nov 40.

general unit, designed for general engineer work. The Engineers considered it a combat unit, not a service unit. Although its primary mission was to build airfields, the Engineers anticipated that the unit would generally operate without support from other ground troops. Aviation engineers would be called upon to defend airfields from enemy attack and to clear surrounding areas of enemy resistance.[62]

During the months following activation of the first engineer aviation regiment, Lt. Col. Donald A. Davison served as Engineer, GHQ Air Force. He and his executive, Capt. Rudolph E. Smyser, Jr., pioneered in studying the organization and equipment of aviation engineers. As in the case of other general engineer units, the aviation regiment's authorized strength was revised upward as its officers gained experience and the Army increased in size. In March 1941 its T/O called for 2,153 enlisted men. Even in an expanding Army it was difficult to allot men in such numbers. In October 1940 the GHQ Air Force recommended one engineer aviation regiment for each of four air districts and one for GHQ reserve but limitations on personnel allowed for an allotment of only 2,898 aviation engineers in all. Consequently, requirements for aviation engineers at overseas bases and in the various air districts had to be met by the assignment of separate companies. Nevertheless, both the GHQ Air Force and the Corps of Engineers continued to think in terms of regiments in their plans for expansion.[63]

Finally, in March 1941, the General Staff saw its way clear to authorize an expansion of aviation engineers to 6,300. About this time Smyser, just returned from a tour of observation in the British Isles, recommended the organization of separate engineer aviation battalions instead of regiments, pointing out that the battalion was sufficiently large to build one airfield in a reasonable time. Accordingly, the plan submitted by Kingman for the projected expansion provided for a regiment in GHQ reserve, a battalion for each of four air forces (formerly air districts), and battalions, where possible, for overseas bases. Since the battalion was not equipped to perform the topographic, camouflage, and supply functions handled by regimental headquarters, a headquarters company for each air force was to be organized.[64]

Just as construction requirements determined that the aviation battalion would be the basic engineer aviation unit, they also fixed the place of engineers in the Army Air Forces. In the fall of 1941 each air force was organized so that all activities dealing with air bases and services, including the engineers, were placed under a service command, a step which caused Godfrey to comment:

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[62] (1) Ltr, ACofEngrs to TAG, 21 Jun 40, sub: Issue of U. S. Rifle Cal .30 M1 for Engr Regt, Avn. 400.34, Pt. 36. (2) Info Bull 74, 13 Jan 41, sub: Defense of Air Bases.

[63] (1) Ltr, CofS GHQ Air Force to TAG, 24 Oct 40, sub: CofEngr Sv with GHQ Air Force. 320.2, GHQ Air Force. (2) Memo, O&T Sec for Kingman, 21 Dec 40, sub: Equip and Orgn of Avn Cos. 320.2, Pt. 26. (3) 1st Ind, 4 Mar 41, on Ltr, ExO Plans Div Office of CofAC to CofEngrs, 15 Feb 41, sub: Rev Basis of Allot, Engr Trps With Air Corps. 320.2, Pt. 27. (4) T/O 5-411, 20 Mar 41. (5) Conf, 22 Nov 40, sub: Increases in Avn Engrs. OCofS, Notes on Confs (S).

[64] (1) Memo, ACofEngrs for ACofS G-3, 27 Mar 41, sub: Increase in Avn Engr Strength. 320.2, Engrs Corps of, Pt. 14. (2) Memo, Actg ACofS G-3 for CofEngrs, 17 Feb 41, sub: T/Os Avn Engr Units. 320.2, Air Corps, Pt. 2. (3) Info Bull 74, 13 Jan 41, sub: Defense of Air Bases. (4) Ltr, Col Rudolph E. Smyser, Jr., to OCMH, 24 Dec 53. (5) Wkly Rpts O&T Sec, Feb-Apr 41. EHD files. (6) Col. Stuart C. Godfrey, "Engineers With the Army Air Forces," *The Military Engineer*, XXXIII (November, 1941), 487-91.

At first thought, it is somewhat unpalatable for us to think of aviation engineer troops as part of a service command. The Corps of Engineers is an arm, not a service. However, I think we cannot quarrel with the logic of this set-up as far as an Air Force is concerned. In case of a large program of new construction, a separate construction organization seems to be indicated.[65]

Godfrey's distaste for the service classification of engineer troops is understandable in view of the emphasis on combat units in the pre-Pearl Harbor years. Yet on the whole the Engineers could look back with some satisfaction to their success in adapting their organization to new demands from the Air Forces, the Armored Force, and the Infantry. Though they had to fight to maintain their position the Engineers were able to convince the Army that mobile warfare did not decrease the necessity for engineers, but rather emphasized their importance. Not all engineer units had achieved a desired reorganization and there was a lack of harmony between theory and practice, but by Pearl Harbor the basic adjustment to a war of movement had been made.

The emphasis on combat organizations which dominated Engineer thought in the prewar years delayed consideration of special units. During the first nine months after the outbreak of war in Europe only a few of these had any real existence, but as the Army expanded in 1941 the Engineers were able to activate camouflage, ponton, water supply, dump truck, depot, shop, and additional topographic units. Changes in doctrine and organization then became subject to practical test and will be discussed in connection with the development of equipment with which the special as well as general units were so intimately connected.

[65] Ltr, Godfrey to Maj Lee B. Washbourne, 805th Engr Bn (Avn) (Sep), 26 Sep 41. 320.2, 805th Engrs.

CHAPTER II

The Revolution in Equipment

The vigor displayed by the Engineers in arguing their case before higher echelons was equally evident in exhortations toward members of the Corps itself. The Engineer mission had not diminished but had gained in importance. Engineer techniques must match the tempo of the new tactics, ran the message of an Information Bulletin issued in July 1940. Engineer work must be carried out "at top speed." [1] The way troops were organized and the thoroughness with which they were trained would go a long way in support of this objective. But as basic to the creation of a new Corps of Engineers as to the creation of a new Army was the adoption of modern equipment. Since the Engineers were most concerned about their adjustment to the new tactics of infantry, armor, and air they were particularly interested in improving means for hasty road repair, emergency bridging, and construction of airfields. But no phase of engineer activity—whether in front lines or in rear areas—was left untouched by the revolution in equipment which occurred during the experimental years before Pearl Harbor.

The Process of Selection

Most of the steps in the selection of new equipment were carried out by the Engineer Board at Fort Belvoir, yet all sections of the Military Division were involved in the process to some extent. The Operations and Training Section determined the military need for each item. The Intelligence Section advised the board on mapping equipment. The Supply Section gave its views on sources of production. The group which worked most closely with the Engineer Board, the Development Branch, Supply Section, considered whether or not a particular line of development was feasible, offered technical guidance to the board's staff, and passed upon the recommendations made.

Other helpful sources existed outside the Military Division. Much was learned from industry and the professions serving industry because most engineer equipment was either a standard commercial product or a modification of something already on the market. Other arms and services, particularly the Engineer officers serving with them, contributed concrete suggestions as well as complaints which spurred the Engineer Board to attempt improvements. The advice of the Navy and Marine Corps was sought in connection with camouflage, landing boats, and water purification. The Bureau of Standards conducted tests from time to time. After the organization of the National Defense Research Committee in June 1940, the Engineers utilized its facilities. Persons with something to sell, inventors, and just plain citizens offered their bit. Nevertheless, most suggestions about new

[1] Info Bull 50, 18 Jul 40, Mobility—and the Engineer.

equipment originated in the Military Division in Washington or with the Engineer Board at Fort Belvoir. These agencies sought out new ideas in domestic and foreign technical magazines, sent representatives to meetings of technical societies, and scanned numerous patents. Particularly after the German advance into France, intelligence reports and general news items were studied intensively. As the ties with Britain were strengthened, Engineer officers were sent abroad to exchange information.

Memoranda, letters, and reports about new work to be undertaken and work already under way at the Engineer Board came to the "IN" box of Maj. Claude H. Chorpening, the chief of the Development Branch. Five and a half years at Fort Peck Dam, Montana, had taught him much about construction machinery. Chorpening gradually filled out his staff so that by summer 1941 it consisted of fourteen civil, electrical, and mechanical engineers, five of whom he had worked with at Fort Peck.

The close link between the Engineer Board and the Military Division was one way of assuring unity in doctrine, training, and equipment. Another was provided by drawing together the Engineer Board and the Engineer School. The Engineer Board in the formal sense consisted of a group of seven officers. By custom its president was the commandant of the Engineer School and at least two of its members were on that faculty. Two others might be on duty at OCE or at the school. Only two members, its executive officer and his assistant, were on the board's operating staff. The formal board of seven officers came together for two purposes—to witness demonstrations and tests of equipment, and to pass upon recommendations.

Although the president of the Engineer Board exercised general supervision in matters of policy, it was the executive officer who was the active head and general manager. From 1936 until his death in October 1939, the executive officer was Capt. James M. Young, who came to Fort Belvoir after supervising a number of New Deal construction projects in the west. Captain Young's successor, Capt. William C. Baker, Jr., had been assistant executive officer since July 1938.

During Young's tenure at the board funds were meager, part of its physical plant was run down, and its staff was small. During the fiscal year 1939, for example, Young had less than $100,000 at his disposal. Much of it went into patching up the World War I barracks, where offices and drafting rooms were located, and the two sheds and two warehouses, which also dated from 1918. By contrast, the shop and laboratory building, finished in 1935, took little from the budget. It was modern and sufficiently spacious for the experimental work of the six officers and forty civilians at the board in 1939. With so few employees, specialization was out of the question. As a consequence, the board's organization was loose and the work performed by most personnel ranged over several subjects. In addition to his administrative duties Young carried a heavy load, working on bridging, construction machinery, and demolitions.

Money to add more officers, hire more civilians, and provide more suitable facilities was forthcoming after the fall of 1939. The funds available in 1939–40 jumped to over $300,000, the year following to over $2,000,000. By June 1940, Baker was directing a staff of 5 officers and 100 civilians. By June 1941 there were 453 civilian employees and 38 officers on full-time duty,

including one each from Field Artillery, Ordnance, and Air Corps.

The increase in funds for salaries and equipment gradually created an opportunity to specialize and to carry out a thorough program of study and tests. By 1 July 1941, the jobs assigned the board had been broken down and employees given specific duties in the many administrative units created. At this time 35 percent of the personnel were in the Engineering Division where the development program was concentrated, 44 percent in the Operations Division whose main job was the manufacture of searchlight mirrors, and 21 percent in the Administrative Division.

As personnel was hired and the board overflowed into another old barracks and a portable building, Kingman and Chorpening sought means of providing a modern plant. With $2,800,000 allotted from the President's Emergency Fund they contracted for the construction of twenty-four permanent buildings, including three for offices, two for general storage, a central heating plant, and numerous special shops and laboratories. Begun in July 1941, none of the buildings was finished until after Pearl Harbor. Lack of suitable facilities plagued the board's personnel before and throughout the defense period.[2]

Despite shortages of personnel and lack of facilities much was accomplished, particularly in the year and a half before Pearl Harbor. In the period May 1930–May 1940 only 34 single items and sets were added to the organizational equipment of engineer troop units. Between May 1940 and October 1941 the total number of single pieces of equipment rose from 22 to 139 and the number of sets from 40 to 79.[3] Over and above these additions to the table of basic allowances the Engineers tested and selected some equipment to be held in depots for issue as construction projects demanded.

From Hand Tools to Power Machinery

During World War I as throughout the previous century the pick and shovel had been the symbol of the engineer soldier, expressing both the overwhelming importance of construction as an engineer duty and the reliance on manpower. In 1930 hand labor, supplemented by horse- and mule-drawn wagons, road graders, and scrapers, still furnished the basic power for everything from simple clearing at the front to the more deliberate and extensive building in the rear. Nothing could have been more obvious than the fact that manual labor and horsepower were incompatible with the tempo of the new Army.

To a large extent, it was lack of money that had fostered this situation—but not altogether. The type of power employed by the military in 1930 was not appreciably different from that used by the construction contractors. In illustrating the operations at Hoover Dam the magazine *Construction Methods* printed a picture with the appropriate caption, "Grading Operations for railway require forty head of horses and mules pulling fresno scrapers."

[2] (1) Orgn Charts OCE, 1938–41. EHD files. (2) Ann Rpts Engr Bd, 1939–42. ERDL files. (3) Col H. C. C. Weinkauff, Hist of Engr Bd, 15 Jan 42. ERDL files. (4) Min of Mtgs Engr Bd, Jul 38–Jun 39. Rec Sec ERDL. (5) Wkly Rpts Sup Sec, 31 Jan 41, 13 Jul 41. EHD files. (6) Stuart W. Bruchey, Engineer Research and Development: Organization and Administration (typescript), 1951. EHD files.

[3] T/BAs, 14 May 30, 1 Jul 37, 1 Jan 39, 1 May 40, 1 Oct 41.

But other pictures of the work showed power machinery excavating, lifting, and hauling.[4]

Although the application of artificial power to construction operations stretched back a century to the invention of the steam shovel, even this machine did not come into general use until the hectic railroad building of the eighties. The decade of the nineties was remarkable both for the number and the complicated nature of earth-moving and construction projects, and the quantity and variety of the machinery used. Steam shovels, derricks, dredges, cranes, compressors, drills, cars, and locomotives were all familiar to engineers who observed the construction of the Chicago Drainage Canal, but not in such numbers. There were so many machines employed at one time on this project that engineers were forced to think in terms of machinery instead of masses of men as factors in construction. Observers of the canal building were also struck by the introduction of mobility into machinery. At the canal site car trucks and railway tracks were utilized to the utmost to shift machinery that had formerly been moved only after dismantling. An even more striking fact about the Chicago Canal job was that the construction industry had begun to grasp the fundamentals of coordination of machines in train to perform a succession of processes. The result was a "construction plant" having many of the characteristics of assembly-line production. By the turn of the century the construction industry had established modern principles of operation. The following decades were to be notable chiefly for technical improvements.

Most of these improvements sprang from the invention of gasoline and diesel engines and of crawler tracks. The new engines supplied more and cheaper power. Crawler tractors freed construction machinery from dependence upon mule power and railway tracks. Mounting on crawler treads not only did away with the necessity for laying track but made possible the construction of a base wide enough to support a revolving steam shovel. While the evolution of the power shovel was typical of the kind of improvements made in machinery already in use, the first three decades of the twentieth century also witnessed the introduction of a number of new machines and attachments. Outstanding among these was the bulldozer blade. First marketed in 1915 to be pushed by mules, its potentialities were fully realized in 1923 when it was mounted on a tractor.[5]

Closely associated with the vast earth-moving and road-building projects sponsored by the federal government during the twenties and thirties, Engineer officers kept abreast of the latest in construction machinery and techniques. To them it was a foregone conclusion that in any future war construction operations would be "mechanized." But until 1937, when the Army committed itself to a motorized, mechanized force, the Engineers could do little more than make this general assumption.

For one thing, funds were short. For another, so many new machines were introduced during the early thirties that the Engineer Board considered it unwise to make a selection. Nevertheless, the Engineers bought a few machines during this

[4] "Setting the Stage for Building the Hoover Dam," *Construction Methods,* XIII (April, 1931), 40.

[5] (1) "Construction Machinery," *Engineering News-Record,* CXLIII (September 1, 1949), A–18–19. (2) Francis Donaldson, "Mechanization Has Revolutionized Construction Work," *Civil Engineering,* XXII (September, 1952), 56. (3) C. S. Hill, "The Birth of Mechanized Construction," *Engineering News-Record,* CXXXVII (December 12, 1946), 102–05.

period. Air compressors, gasoline shovels, truck-cranes, tractors, road graders, concrete mixers, and asphalt kettles of different makes and models were issued to troop units with requests for comment. The performance reports were duly filed, but when Young took up his duties as executive officer of the Engineer Board in 1936 he became convinced of the necessity for a new start.[6] Attention centered for the most part upon the types of machinery that would be issued as organizational equipment. This preoccupation was partly a result of the general emphasis upon tactical units, partly a result of the Engineers' correct assumption that construction jobs in rear areas would be equipped and organized like any peacetime work of comparable size.

In choosing construction machinery to support the Army's mobility the Engineers had to take into account the dictum of higher authority that mobile troops must travel light. Only what was habitually required should be attached to an outfit as organizational (Class II) supplies and be set down on the T/BA; other supplies essential for carrying out certain operations but not always needed (Class IV) should be held in corps or army depots for issue on demand. There were limits as well on the weight of equipment. Items issued to divisional units could not exceed 7½ tons; for corps and army units, the limit was 15 tons. Although the General Staff placed no maximum on the weight of equipment in the Class IV pool, these supplies were expected to be as light as possible.[7] Since most construction machinery was heavy and specialized and since the heavier and more specialized the machine the greater its capacity and relative efficiency, the Engineers were hard put at times to make a choice. They did, however, include tractors, air compressors, power shovels, road graders, and that characteristic vehicle of American industry, the dump truck, in the T/BA of July 1937. This selection was subject to change as a result of the investigations projected by the Engineer Board.

The tractors listed by the Military Division on the 1937 T/BA were "mechanical mules," intended to replace the four-line mule teams which had been used to pull heavy equipment. They were light, 3-ton units of the type used on small farms—a far cry from the powerful tractors commonly employed on construction projects. These heavier tractors with bulldozers and winches lent themselves to many of the jobs which general engineer units would be called upon to do—clearing debris from roads, digging and filling antitank ditches, clearing sites for construction, pulling heavy equipment out of mud or over steep grades. Officers in command of troop units urged the adoption of such heavier, more versatile machines.

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[6] (1) Ltr, C of Mil Div to Bd on Engr Equip, 9 Dec 30, sub: Machines For Engr Opns in Fld. 413.8, Pt. 7. (2) Ltr, President Bd on Engr Equip to CofEngrs, 17 Jun 32, same sub. Same file. (3) Ltr, ExO Engr Bd to CofEngrs, 7 Oct 36, same sub. Same file. (4) Ltr, CO Co C 13th Engrs to CofEngrs, 15 Apr 33, sub: Rpt of Air Driven Power Tools, with Incl, n.d. Same file. (5) Ltr, CO 6th Engr Regt to CofEngrs, 19 Apr 35, sub: Tactical Uses of Constr Equip by Engr Trps. 451.2, Pt. 4.

[7] (1) Ltr, AGO to CofEngrs, 13 Apr 38, sub: Rev of T/BA. 400.13, Pt. 34. (2) Ltr, AGO to CofEngrs, 26 Aug 41, same sub. 400.34, Pt. 38. (3) Ltr, AGO to CofEngrs, 5 Nov 41, sub: Reduction of Equip Included in T/BA, 1 Oct 41. 400.34, Pt. 39A. (4) Ltr, ExO Engr Bd to All Concerned, 6 Jan 38, sub: SP 262, Power Shovels, Pile Drivers, and Cranes. Engr Bd Rpt 546, App. F, 20 Sep 38. The Engineer Research and Development Laboratories at Fort Belvoir, Virginia, has a complete file of Engineer Board reports.



BULLDOZER IN OPERATION, *3d Army maneuver area, Louisiana, September 1941.*

In the fall of 1938, a 4½-ton tractor, complete with bulldozer and winch, was purchased from the Cleveland Tractor Company and turned over to the Engineer Board for tests by the 5th Engineers. The unit took it out on a muddy field to "doze," lining up beside it for comparison a mule team and slip scraper operated by two men, and a 3-ton wheel scraper with six operators. The 4½-ton bulldozer with one operator moved sixteen times as much dirt as the animal-drawn scraper and four times as much as the 3-ton scraper. But the 5th Engineers were dissatisfied. They knew a heavier tractor would be even more efficient.

The Cleveland Tractor Company then offered its 7½-ton machine. The extra power in this unit caused the 5th Engineers to pronounce it definitely superior to the 4½-ton tractor. Noting that three other companies—Allis-Chalmers, International, and Caterpillar—could offer similar models, Capt. Gilbert E. Linkswiler of the Engineer Board recommended adoption of the 7½-ton medium dozer as standard equipment.

The increase in the weight of the tractors begot transportation problems. Some officers proposed that they be assigned to depots and brought forward as occasion demanded. Others argued that when dozers were needed they were needed badly, at once, and in quantity. Consequently, they wanted to carry with them enough to meet their maximum requirements at any one time. Linkswiler adopted a middle ground.

Sticking to the rule that troops should carry with them only that "habitually required," he nevertheless found it "hard to imagine" general engineer units "engaged in work which could not be expedited by the use of a small number of tractors." This small number (four to combat and general service regiments; two to squadrons and separate battalions) should be assigned as organizational equipment and with a reserve sufficient to meet emergencies to be held in depots. To carry out large-scale construction in rear areas, he recommended that army and communications zone depots stock 15-ton bulldozers. OCE approved this distribution in September 1939.[8]

Like the heavier tractors, the power shovels selected by the Military Division in 1937 and subsequently studied by the Engineer Board with a view to determining their distribution were multipurpose machines which could be converted into pile drivers or cranes for excavation, hammering, and lifting. Although Engineer officers agreed that such shovels would be needed in the combat zone, they were of different minds as to whether or not they should be issued as organizational equipment. According to the 1937 T/BA, combat regiments and squadrons were entitled to 7½-ton, ⅜-yard shovels; general service regiments and separate battalions to 15-ton, ¾-yard units. Presenting the case for issuing shovels directly to troops, one officer argued that "duties outlined for combat Engineers involve the acquisition, movement and distribution of immense quantities of materials. It is inconsistent to provide dump trucks for movement and distribution and to depend on manpower alone for the procurement and loading." While a good many supported this position, there were more who agreed with the officer who believed that "in warfare of movement, the power shovel has no place in the column," arguing that "division Engineers, to fulfill their front-line mission, must rely on their resourcefulness and ability to improvise, employing simple basic implements of all around usefulness, such as trucks and hand tools." Baker, who weighed these views for the Engineer Board, advocated a reduction in the basis of issue. He favored assigning some 7½-ton shovels to the general service regiment because "the nature of its tasks should provide fairly continuous, profitable employment" for them. Since the need of other troops would be "more or less intermittent," he recommended storing 7½-ton shovels in corps depots; 7½-ton and 15-ton units in army depots; and 15- and 20-ton units in the communications zone.[9]

In contrast to the difference of opinion on whether bulldozers and shovels were needed for the everyday operations of engineer troops, there was unanimity that air compressors were "almost indispensable." The 105-cubic-foot, 7-ton compressor selected by the Military Division in 1937 furnished power for the operation of rock drills, pavement breakers, wood-boring machines, clay diggers, and saws. Although the Engineer Board favored the adoption of a lighter, more mobile compressor, the Development Branch held out for the heavier machines. The "105" was within the 7½-ton limit, was as mobile as any truck in a convoy, and, unlike the lighter machines,

[8] (1) Engr Bd Rpt 547, 3 Oct 38, and 579, 15 Jul 39, sub: Tractors. (The Linkswiler quote is from the latter report.) (2) 1st Ind, 6 Sep 39, on Ltr, ExO Engr Bd to CofEngrs, 29 Jul 39, sub: Rpt 579–SP 264, Tractors.

[9] Engr Bd Rpt 546, 20 Sep 38, sub: Power Shovels, Pile Drivers, and Cranes.

BASIC ALLOWANCES: 1941

Item	*Combat Bn Inf Div*	*Armd Bn Armd Div*	*Sq Cav Div*	*Combat Regt Corps*	*Gen Sv Regt Corps*	*Separate Bn Corps*
Air compressor	3	8	2	8	8	4
Bulldozer	3	3	3	8	8	8
Electric drill	0	1	0	0	0	0
Gasoline hammer	3	7	3	3	2	2
Gasoline saw	9	9	0	18	0	0
Road grader	0	0	0	1	0	1
Shovel, ⅜-yard	0	0	0	1	0	0
Shovel, ½-yard	0	0	0	1	2	1
Welding set	1	3	1	2	2	2
Cargo truck	9	82	8	21	20	15
Dump truck	49	0	37	94	34	16
Prime mover truck	0	6	0	1	2	1
Wrecker truck	0	1	0	0	0	0
Truck-mounted crane	0	2	0	0	0	0

would furnish power for heavier and more varied attachments.[10]

The substitution of power machinery for hand tools, foreseen in the twenties and begun in earnest in the mid-thirties, had, by the fall of 1941, affected all engineer units having construction duties, as shown in table above.[11]

In Godfrey's opinion this was a "fairly large amount" of machinery and trucks at the disposal of general engineer units with a field army. Engineer aviation units, organized in the summer of 1940, were to be equipped with power machinery in even greater number and variety.[12]

Equipping front-line units came first, both in theory and in the practical matter of allocation of funds. Aviation units excepted, the power machinery which engineer troops carried as organizational equipment did not represent the "construction plant" needed to carry out large-scale operations. For such tasks specialized machinery would be stocked in depots for issue upon requisition. The Engineers felt little compulsion to decide just what and how much specialized machinery would be required. Uncertainties inherent in the situation before Pearl Harbor had much to do with this attitude. With the theater of operations a matter of speculation, it was difficult to visualize the type and scale of future construction operations. Perhaps most important, the Engineers were confident they had sufficient knowledge to choose what was proper when called upon to plan for a specific construction operation. Only after Pearl Harbor were funds forthcoming to stock construc-

[10] (1) Hist Staff Engr Bd, History of the Development of Mechanical Equipment, "Air Compressors and Accompanying Tools," (typescript), 21 Jan 46. (Hereafter studies in this series of historical reports will be cited as Engr Bd Hist Study, with subtitle. Reports are in EHD files.) (2) Memo, ExO Engr Bd for Godfrey, 19 Sep 39, sub: SP 260, Air Compressors and Accompanying Tools. ERDL file, ME 260. (3) Interv, Charles G. Perkins, 27 Sep 50.

[11] T/BA, 1 Oct 41.

[12] (1) Stuart C. Godfrey, "Road Work in Theaters of Military Operations," *Civil Engineering*, XI (May, 1941), 284. (2) See below, p. 56.

tion machinery over and above that issued as organizational equipment.[13]

Until power machinery and other engineer equipment began to be bought in quantity the Engineers found it easy to postpone preparations for storage, distribution, service, and repair. It was not until the summer of 1940 therefore that a depot company and a shop company were activated. Their assignment to the technical supervision of the Engineer Board testified to the experimental nature of their organization and equipment. In the reorganization of 1939–40 the number of depot companies with a field army had been cut from four to one, whereas total personnel with a field army had been reduced by only one third. Hoping to bring about a partial restoration of the former balance, the commanding officer of the experimental depot company, with the backing of the Engineer Board, recommended increasing the company from 164 to 255 officers and men and furnishing it with mobile cranes, trucks, and tractors. Even so, the unit's facilities would be insufficient for the servicing of heavy construction machinery. To service such machinery the Engineer Board recommended the formation of a special equipment company, and, in order to co-ordinate supply and maintenance, urged the creation of a park battalion to be composed of depot, dump truck, equipment, and shop companies.[14]

The particular organization proposed for the depot company was not adopted. Instead, in April 1941 the Engineer Board was asked to give the matter further study. The equipment company and the park battalion, approved about the same time, were also assigned to the board for study. Yet none of these units was to undergo as much experimentation as the shop company.[15]

The engineer shop company in the old Army had been charged both with making repairs and with simple manufacturing. In September 1940 1st Lt. Karl F. Eklund, commander of the newly activated 56th Shop Company, suggested that these tasks be handled by two different organizations as in other branches of the Army. He proposed that the repair company "be completely mobile and capable of taking the field as readily as the equipment it will have to maintain." For general overhauling and manufacturing he advocated a less mobile base equipment company.[16]

Although a T/O for a mobile shop company was published in November 1940, OCE issued no other directives to guide the development of its organization and equipment, which continued at the board under the direction of Maj. C. Rodney Smith. Early in 1941 Smith presented a program which called for more funds and the use of the 56th Shop Company as a testing agency. Following approval of the broad outlines of his program, the board intensified research so that by August 1941 Smith had arrived

[13] The Engineer Board did develop a "road-building set," which OCE purchased but which was not tested as planned because units slated to carry out the tests moved overseas. See Engr Bd Hist Study, Road-Building Methods, and Engr Bd Hist Study, Road-Building Equipment.

[14] (1) Ltr, ACofEngrs to TAG, 23 Jul 40, sub: T/Os. 320.2, Pt. 25. (2) Ann Rpt Engr Bd, 1941. (3) Ltr, CO 394th Engr Co to CofEngrs, 14 Nov 40, sub: T/O, with 1st Ind, ExO Engr Bd to CO Ft. Belvoir, 15 Nov 40. 320.2, Pt. 26.

[15] (1) EFM 5–5, 31 Jan 41, p. 370. (2) Ann Rpt Engr Bd, 1941. (3) Memo, ACofS G–3 for CofEngrs, 30 Apr 41, sub: Orgn of Engr Park Bn. 320.2, Engrs Corps of, Pt. 14. (4) Ltr, AG 320.2 (3–21–41) MR–M–C to CG First Army *et al.*, 27 May 41, sub: Orgn of 410th Engr Bn (Park). 320.2, 410th Engr Bn.

[16] 1st Ind, 19 Sep 40, and 2d Ind, Comdt Engr Sch to CofEngrs, 20 Sep 40, on Ltr, AC of O&T Sec to CO 56th Shop Co, 13 Sep 40, sub: T/O for Engr Co, Shop. 320.2, Pt. 25.

at a comprehensive estimate of the maintenance requirements of engineer troops. Heretofore, planning had been based upon one shop company to an army. Conscious of the tremendous increase in mechanical equipment, Smith proposed the assignment of one mobile third echelon shop to each corps, one mobile and one semimobile fourth echelon shop to each army, plus a group composed of both for GHQ reserve. On the basis of four field armies this meant forming twenty to thirty companies. Training of the personnel to fill these units was to be accomplished in factory schools until the spring of 1942, when an Engineer maintenance school with a capacity of 250 to 300 students would open. All this would have cost approximately six million dollars in 1942 and eight million in 1943.

The Engineer Board, while concurring generally in Smith's program, suggested the use of both factory schools and the maintenance school and raised fiscal estimates somewhat.[17] In OCE, Adcock pronounced this a "grandiose scheme" that would require "immediate additional supplemental appropriations, formation of several new units, and additional building construction at Belvoir." Wartime experience was to prove Smith's estimates modest, but it is nevertheless doubtful that approval for carrying them out could have been got from the General Staff and from the War Department Budget Office even had Adcock been willing to fight for them. In no mood to fight, Adcock directed O&T to submit "a suitable modification on a more practicable basis." [18]

Instead of making more plans OCE settled for the time being upon the establishment of a standby organization. In September 1941 Kingman requested the immediate formation of two more shop companies, but even after receiving the War Department's tentative approval the Engineers continued to fix minimum requirements at one mobile shop company per army and two base shop companies in GHQ reserve. There was to be no all-out program for the organization and equipment of maintenance and depot units until after Pearl Harbor.[19]

First things had to come first. It was impossible to accomplish everything at once. Fully aware of this fact, Kingman hailed the advent of a new Corps of Engineers as early as June 1940:

> For years Engineer organizations have had to rely in great part upon man power and hand tools for the performance of their functions. . . . Today we are far more fortunate. Recent appropriations have permitted the purchase of equipment which should enable our units to be modern in every respect. New multi-drive motor vehicles of the latest type are now being furnished our organizations. Up-to-date construction equipment is being supplied to our units, not for inspection but for training and use.

Moreover, he added, "modern bridge equipage is being delivered in quantities that will enable us to discard the type equipment used by General Grant's army in the 1860's." [20]

Strains on the Bridges

The importance of bridging in assuring the mobility of the new Army had been re-

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[17] Corresp in 451.2, SP 104, Feb, Aug 41.

[18] Memo, ExO OCE for Kingman, 22 Aug 41. 451.2, SP 104.

[19] (1) Memo, Actg CofEngrs for Col Raymond F. Fowler, 28 Aug 41, sub: Shop Cos. 451.2, SP 104. (2) Ltr, ACofEngrs to TAG, 9 Sep 41, sub: Changes in Engr Units. (3) Ltr, CofEngrs to TAG, 23 Oct 41, sub: Redesignation of Engr Units. Last two in 320.2, Engrs Corps of, Pt. 14.

[20] Info Bull 49, 27 Jun 40, Equip for Engr Trps.

peatedly stressed by the Corps of Engineers. Reflecting on the blitzkrieg, Godfrey wrote:

> Does an unfordable river block the advance? Perhaps a critical bridge may be seized by the dash of a few motorcyclists while the defenders are still hesitating to destroy it. But suppose the bridge is out, the opposite bank still held by the enemy. Time was when the army waited till night, crossed in the dark by raft or skiff, gained a foothold on the opposite bank . . . later built a bridge. Now it appears that success may sometimes be achieved more speedily,—a crossing accomplished audaciously in fast motorboats, or a bridge built under fire.[21]

At the same time that the Engineers prophesied systematic destruction of bridges by the enemy they were aware of the inadequacy of their own bridging equipage and acknowledged that they were unprepared to keep pace with the enemy's potential destructiveness.[22]

In this sense "keeping pace" meant speedy construction so that a river or ravine could not halt an Army column more than a few hours. To meet this requirement, the components of a military bridge had to be easily assembled. In another sense, "keeping pace" meant new designs to keep up with vehicular developments within the Army. As the Ordnance Department, at the behest of the using services, added weight to tanks, the Engineers had to increase the capacity of bridges. A third concern was with the mobility of the bridging equipment itself, so that ease of transportation became an integral part of design. These determining factors—speed of construction, capacity, and transportability—were often hard to reconcile. As capacity was increased the difficulties of transportation tended to multiply and the time consumed in erection to lengthen.

From one point of view the ideal military bridge was one consisting of parts which could be combined so as to carry either light or heavy loads over water or over ravines. The virtue of this type was that many situations could be met with the same basic structure and that troops would have to learn fewer erection techniques. Its drawbacks were that such a bridge would entail either the handling of unnecessarily heavy parts for a bridge of light capacity, or the use of a large number of light parts for a bridge of heavy capacity. From another point of view, the ideal was a bridge just strong enough to carry the heaviest load normally expected and designed especially for a water or a land crossing. This solution offered a saving in transportation space and construction time under some circumstances, but would result in a multiplicity of bridges.

The bridges the Engineers had to be prepared to provide were of three general types—assault, combat support, and line of communications. Because a floating or ponton bridge can be constructed more rapidly than a fixed bridge, an assault bridge is normally a ponton type. According to orthodox thinking the components of such bridges must be light enough and small enough to be put in place by hand. Fixed or floating, the structure must be capable of supporting the heaviest vehicle accompanying the initial attack. A combat support bridge, erected under less pressure for speed, may be floating or fixed and must be capable of supporting all combat elements. A line of communications bridge, intended to serve as a more or less permanent structure, is commonly a fixed bridge differing little from conventional civilian bridging.

In the summer of 1938, General Staff and

[21] Info Bull 50, 18 Jul 40, Mobility—and the Engineer.

[22] *Hearings on Military Establishment Appropriation Bill, 1940,* HR, 76th Cong, 1st Sess, 1 Feb 39, p. 393.



7½-TON PONTON BRIDGE OVER THE CHATTAHOOCHEE RIVER *near Ft. Benning, Ga., July 1939.*

Infantry officers informed Kingman that light tanks weighing between 10 and 11 tons and medium tanks weighing between 15 and 20 tons were being designed. On the basis of an understanding that light and medium tanks would operate together, bridge designers at the Engineer Board were attempting to develop a ponton bridge of 10-ton capacity which could be reinforced to carry 20. In this way all units of the Army could be served by one ponton bridge.

The Engineer Board did not have to start from scratch to develop a 10-ton ponton bridge. It had merely to modify a 7½-ton bridge which was in turn a modification of a Civil War model. All these bridges consisted of boats connected by wooden beams (balk) over which were laid planks (chess) to form a roadway. At most sites one or two trestles had to be placed inshore to provide supports for the span from the bank to the first boat. The aluminum boats of the 7½-ton bridge were 26 feet long and weighed about a thousand pounds. The modification recommended by the board in January 1938 and approved by OCE in June, brought the capacity of this bridge to 10 tons by enlarging the boats to 28 feet and increasing their weight by 450 pounds.[23]

During the following summer one such boat was tested. Despite its increased weight it proved easy to carry and maneuver. In

[23] (1) 1st Ind, ACofEngrs to President Engr Bd, 14 Jun 38 (basic missing). R&D Div Structures Dev Br, BR 257. (2) Engr Bd Rpt 537, 24 Jun 38, sub: Heavy Ponton Bridge, 23-ton (Model 1924). (3) Engr Bd Rpt 522, 15 Jan 38, sub: Increased Capacity for 7½-ton Ponton Equipage. (4) Engr Bd Hist Study, Light Floating Bridging.

July 1939, meanwhile, eleven more boats were ordered in the expectation of assembling a complete bridge for testing. So certain was the Chief of Engineers that tests of the bridge would prove successful that he directed the Engineer Board "to give priority over every other activity" to finishing up drawings and specifications by Christmas 1939. Money to buy several units was expected in January. The board submitted the specifications on 22 December, and the same day asked the Chief of Ordnance to send a couple of medium tanks to the 70th Engineers who were to test the new bridge. While the commanding officer did not consider the tests altogether conclusive, they proved in general that the bridge would carry loads up to 12 tons provided the balk were strengthened. If reinforced by additional boats the bridge would take loads up to 20 tons. It thus appeared, as Kingman and the board had hoped, that the 10-ton bridge could supply assault bridging to division, corps, and army.[24]

For line of communications bridging the Engineers had for years relied on trestle or pile bridges built from ordinary commercial timbers and steel beams. Although eminently suitable for the rear areas these structures could not be erected in the limited time allowed for construction in combat support, much less during an assault.

The Engineer Board had therefore developed girder bridges with no intermediate trestles. The board did not believe that one fixed bridge should be made to serve both division and army. A light girder bridge would, like a ponton bridge, be used for an emergency crossing, then removed and replaced by a permanent bridge. A heavier girder bridge would be more permanent, spanning those gaps where the time consumed in constructing trestles would be inordinate, or where the piers of a partially destroyed bridge stood far apart. If the components of a light bridge were used to build a heavy one the span would have to be shortened considerably and more girders added, thus lengthening construction time.

Both the H–10 and the H–20 portable steel bridges, as the girder bridges came to be called, were modeled after British bridges. They were so designed at the request of the Engineer Board by the firm of Sverdrup and Parcel of St. Louis, Missouri. The British H–10 bridge was a 64-foot plank roadway, supported by two steel girders formed of latticed box sections. The complete girder, with the aid of a roller and launching beam, was thrown across to the far shore at one time. The American bridge as designed by Sverdrup and Parcel in the spring of 1937 was somewhat heavier and somewhat shorter. There were five 12-foot lattice boxes to a girder, each weighing a little over a thousand pounds.

When the 5th Engineers tested this bridge in June 1938, they reported it stronger than expected—so strong that it could be lengthened to 72 feet by the addition of another section without reducing its 15-ton capacity. Moreover, a longer bridge could be built by adding girders—one for 96, and two for 108 feet. Its parts were sturdy and easily assembled. A crew of one officer and 41 experienced men could erect the normal 60-foot span in one hour, it was reported. This statement of the time required for construction of the H–10 bridge was, like all such estimates, subject to many qualifications.

[24] (1) Study cited n. 23 (4). (2) Ltr, ExO OCE to President Engr Bd, 1 Dec 39, sub: Drawings and Specifications for 10-Ton Ponton Bridge. 417.112, SP 257, Pt. 1. (3) Ltr, ExO OCE to CofOrd, 22 Dec 39, sub: Test Loads for Test of 10-Ton Ponton Bridge. R&D Div Structures Dev Br, BR 257.



H–10 PORTABLE STEEL BRIDGE *being erected by men of the 4th and 5th Training Battalions, Ft. Belvoir, Va., May 1941.*

The length of time consumed in erecting any bridge varies greatly according to the skill of the builders, the character of the immediate terrain, and, for ponton bridges, the velocity of current.

The H–20 bridge had a span of 125 feet and was much like the H–10. It consisted of two girders made up of ten rectangular box sections 12½ feet long and two triangular end sections. Each section weighed 1,728 pounds, about 600 pounds more than a section of the H–10 bridge. Following tests in the summer of 1940 the 5th Engineers reported that the H–20 bridge carried its designed load and more up to 54 tons. Since the H–20 was not an assault bridge, machinery could be introduced into its construction. A crane unloaded the sections from trucks and maneuvered them into position for assembly into girders. The girders were moved into position by means of winches and cables strung through them so they could be pulled to the opposite shore. The 5th Engineers reported that with all equipment at the site an experienced work party could construct 100 feet of H–20 bridging in about three hours.[25]

In May 1940 the Corps of Engineers received some disquieting news. The Ordnance Department, strengthening its long-standing arguments for heavier tanks with

[25] (1) Engr Bd Hist Study, Fixed Bridging. (2) Engr Bd Rpt 552, 5 Nov 38, sub: Long Span (Nonfloating) Bridge for Corps and Army Highway Loads (H–20 Loading). (3) Engr Bd Rpt 511, 30 Oct 37, sub: Portable Single Span (Nonfloating) Bridge Equipage for Division Loads (H–10 Loading). (4) Ltr, 1st Lt Clayton E. Mullins to Engr Bd, 3 Sep 40, sub: An Erection Scheme for the H–20 Steel Port Bridge. ERDL file, SP 267.

current information about the greater weight of German armor, had convinced the General Staff that the 15-ton medium tank was obsolete. The medium tank now projected would weigh about 25 tons. Plans were shaping up for a heavy tank weighing between 50 and 60 tons. The Engineers had been aware of Ordnance's desire to develop heavier tanks. In 1927 they had standardized a 23-ton ponton bridge. The basic design of this bridge was the same as that of the 10-ton ponton; its capacity was greater because its pontons and other structural members were larger. Improvements made in the 10-ton ponton could be applied to the heavier bridge. The Engineer Board had been told to proceed with such improvements in the summer of 1939, provided time and personnel were available. Since time and personnel did not materialize, the Engineers were relatively unprepared when the General Staff gave Ordnance the signal to go ahead.[26]

Capt. Chester K. Harding, the officer most familiar with the 23-ton ponton bridge, believed that with slight modifications it would sustain from 25 to 30 tons and twice that amount when reinforced. On 29 May, Kingman, in conference with Godfrey, Adcock, Harding, and Baker, decided to increase the base capacity of the bridge to 25 tons by enlarging the boats. The board designed a new ponton in two weeks. It was 32 feet 9 inches long and weighed more than a ton, so that a truck-crane had to lift it. Still, no laws had been broken. Mechanical equipment was admissible in the construction of the 25-ton ponton bridge because official doctrine nominated tanks to support the infantry in river crossings.[27] Normally, it was impossible for tanks to accompany the assaulting infantry. With tank support on the near shore, infantry moved across and established a bridgehead. Mechanical equipment could therefore be moved up after the infantry had dug in on the far shore. Once the bridge was erected, tanks would move across, pass in front of the infantry, and lead the assault.

Late in June, Kingman summed up the ponton bridging situation for the Chief of Staff:

> a. The light ponton bridge, while designed for a 10-ton load, will carry a 13½-ton tank under favorable conditions.
>
> b. The light ponton bridge when built "reenforced" (that is, with double the number of boats) is not an adequate bridge to carry a 25-ton medium tank. The bridge suitable for such a tank is our heavy ponton bridge, . . . designed . . . for a 25-ton loading.
>
> . . . . . .
>
> e. As above clarified, the way seems clear, as to bridge capacities, for the development of a light tank not to exceed 13½ tons, and for a medium tank up to 25 tons.[28]

By September the weight of the medium tank was 28 tons, but if Harding's calculations were correct the 25-ton bridge would take it.

OCE ordered eight 25-ton bridges on 29 August, and, five days later, recommended standardization. As yet there had been no tests, but so similar was this bridge to the

[26] (1) OCO ASF, The Design, Development, and Production of Medium and Heavy Tanks (typescript), March 1945. Ord Hist Div files. (2) Engr Bd Monthly Rpts, Aug 39–Apr 40. (3) Engr Bd Rpt 537, 24 Jun 38, sub: Heavy Ponton Bridge, 23-Ton (Model 1924). (4) Engr Bd Hist Study, Medium Floating Bridging.

[27] (1) Memo, Kingman for Maj John M. Silkman, C of Sup Sec, 29 May 40, with Incl, 29 May 40. R&D Div Structures Dev Br, SP 287, Pontons for 23-Ton Bridge, Pt. 1. (2) Engr Bd Monthly Rpt, Jul 40. (3) Engr Bd Hist Study, Medium Floating Bridging.

[28] Memo, ACofEngrs for CofS, 26 Jun 40, sub: Capacity of Ponton Bridge Equipage, As Affecting Design of Tanks. 823, Bridges, Pt. 1, Armd Center, Ft. Knox, Ky.

lighter one that little gamble was involved. Nevertheless, Schley insisted on a thorough workout early in 1941 when deliveries were expected.[29]

The committees assigned to the study of river crossing tactics at the research course conducted at the Engineer School in the fall of 1940 expressed considerable dissatisfaction with the bridging equipage available and urged that much could be learned from German practices. The emphasis on silent execution of the initial crossing should be sacrificed, they argued, in favor of the speed which could be attained by the use of storm boats:

> The few seconds—or even minutes—of additional secrecy after the first wave leaves our shore is of relatively small value. . . . In any case, the first burst of fire, when the enemy first discovers one of our boats, gives away the show; if by the use of fast motor boats we can be down his throat within seconds after he discovers us, we are better off than if we have to paddle laboriously to the shore in the face of fire.[30]

In addition to, or perhaps in place of, storm boats, rubber boats might be adopted.

As early as 1933 the Engineers had seen pictures of German troops using pneumatic floats for assault boats and ferries and in October 1939 C&T had forwarded to the Engineer Board a picture from a German newspaper which showed a raft built of pneumatic floats. It was not until the summer of 1940, however, when such pictures appeared in American newspapers and magazines, that the board was assigned a project to investigate the design and use of pneumatic floats. The advantages of such floats could be readily grasped. Rubber boats would be easier to handle and to move from place to place. In September 1940 the Bridging Section had called in three leading manufacturers of rubber boats, ordering from them models in several sizes, shapes, and materials. As the models were delivered and tested, both Capt. Frank S. Besson, Jr., and Capt. Clayton E. Mullins, who as commanding officer of Company B, 5th Engineers, carried out many tests for Besson, became more and more enthusiastic. They were therefore receptive to the suggestion that a light (5-ton) assault bridge be developed with rubber boats and treadways as its main components.[31]

The treadways were channels just wide enough to cradle the tires or tracks of a vehicle. Substituting them for standard balk and chess was another German idea which the board had begun to investigate and on which the committees urged further work. The committee on river crossing technique, of which Mullins was a member, favored their use in a 10-ton ferry mainly because they would distribute the weight of a vehicle and simplify loading. The committee on river crossing bridge tactics favored a new type of ponton bridge with treadways integrated into a system of trusses or the box girders of the H–10 fixed bridge, estimating that the approximately 2,500 separate operations which went into building the 10-ton ponton bridge would be cut to about 600. As a further contribution to speed, this com-

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[29] (1) Engr Bd Hist Study, Medium Floating Bridging. (2) Memo, Schley for Kingman, 4 Sep 40, with Incl, 20 Jan [40]. R&D Div Structures Dev Br, SP 287, Ponton for 23-Ton Ponton Bridge, Pt. 1. (3) Ltr, ExO OCE to TAG, 7 Oct 40, sub: Tests of 25-Ton Ponton Equipage, with Incl, n. d. 417.112, SP 287, Pt. 1.

[30] Rpt, River Crossing Technique. First Research Course, Vol. I, p. 25.

[31] (1) *Ibid.* (2) Info Bull 1, 14 Feb 33, sub: Extracts From Mil Attaché Rpt on German Maneuvers, 19–22 Sep 32. (3) Incl, with Ltr, C of O&T Sec to ExO Engr Bd, 27 Oct 39. ERDL file, BR 305. (4) Engr Bd Monthly Rpts, Jun, Sep, Dec 40.



GERMAN RAFT BUILT OF PNEUMATIC FLOATS. *This photograph appeared in an American publication in 1940.*

mittee advocated the use of mechanical lifting devices.[32]

The use of treadways with H–10 girders was not favorably received in the O&T Section. Claterbos had seen a movie demonstrating construction of a bridge with H–10 girders and pontons, and the operation had seemed to him "a slow, cumbersome process." Similarly, he believed "the use of trackways would also be slower than a well organized bridge crew using the proper methods of erecting the bridge." [33]

Meanwhile, pressures for changes in river crossing equipment came from Engineer officers attached to the Armored Force, which had been activated at Fort Knox in July 1940. With the ability to strike quickly and forcefully as its reason for being, the Armored Force had come to fear the possibility that frequent or extensive detours around rivers and mine fields might slow its movements. As part of a new organization, Engineer Armored Force officers were anxious to contribute ideas which would advance its future success, and were determined to match or surpass the aid given

[32] (1) Ltr, ExO OCE to President Engr Bd, 9 Jul 40, sub: SP 319, Prefabricated Bridge Sections for Narrow Crossings. R&D Div Structures Dev Br, SP 320, Prefabricated Bridge Sections for Narrow Crossings. (2) Rpt, River Crossing Technique. (3) Rpt, River Crossings, Bridge Tactics, 28 Nov 40. Last two in First Research Course, Vol. I.

[33] Memo, ExO O&T Sec for Godfrey, 17 Jan 41, sub: Atchd Recommendations. 352.11, Engr Sch, Pt. 10.

by German engineers in assuring the forward sweep of armor.[34]

Early in August 1940, Capt. Bruce C. Clarke, acting engineer of the 1st Armored Division, furnished Godfrey with a list of suggested improvements in the equipment of the engineer armored battalion, stressing the inadequacy of the H–10 bridge. All elements of the Armored Force would be engaged in an encircling movement. Since the capacity of the H–10 bridge was insufficient to support the 25-ton tank this bridge would have to be supplanted by a structure that could. Godfrey agreed that the "H–10 portable bridge is certainly not the complete answer to our prayers" and assured Clarke that "the Engineer Board is now working on this problem" (presumably the H–20 bridge.) [35] He also passed Clarke's memorandum along to Kingman, who took this occasion to draw the Armored Force and the Engineer Board closer together. In a letter to the board inclosing Clarke's memorandum, he emphasized the importance of assisting the Armored Force and directed representatives of the board to visit its headquarters at Fort Knox from time to time.

Three days after receiving Kingman's message, Baker, the board's executive, and Leif J. Sverdrup of the designing firm, were at Fort Knox. The engineer armored battalion was authorized one 125-foot unit of H–20 bridge; one 72-foot unit of H–10; 300 feet of portable trestle; one 25-ton ponton bridge; and two portable tank ferries of 30-ton capacity, an extremely long bridge train for a mobile unit. In August 1940, the unit had only the trestle, an H–10, and a 10-ton ponton bridge. Baker found the Armored Force engineers convinced that the bridging authorized was unsuitable and that "perhaps some special bridging equipment would be needed." As they repeated to Baker the complaints contained in Clarke's memorandum and added some others, he sought to reassure them. When asked for portable rafts, he told them to use the 10- and 25-ton ponton equipage, adding that the board was considering the possibility of a special barge. When Clarke expressed the belief that the trestle bridging assigned would not support the medium tank, Baker suggested that it be strengthened with decking and trestles of the 25-ton ponton bridge. Objecting that standard wooden decking was too weak to carry tanks and yet too heavy to handle expeditiously, Clarke suggested that **Z**-irons be used to form a treadway.

The idea of using treadways had occurred also to Maj. Thomas H. Stanley, commanding officer of the 16th Engineer Armored Battalion of the 1st Armored Division, who had gone so far as to work up some rough drawings. Treadways were not new to Baker either, since he was familiar

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[34] Two studies by the Historical Section, AGF, The Role of Army Ground Forces in the Development of Equipment (Study 34, 1946), and The Armored Force Command and Center (Study 27, 1946), on file in OCMH, provided background for the following discussion which is based upon correspondence in: (1) 653, Pt. 3; (2) 400.34, Pt. 38; (3) 320.2, Pt. 25; (4) R&D Div Structures Dev Br, SP 340, SP 257, and Ponton Bridging Equip, Misc; (5) ERDL files, EB 72, EB 83, EB 84, SP 300, SP 305, and Engr Bd Monthly Rpts; (6) upon letters from and interviews with Olive L. (Mrs. Thomas H.) Stanley, Maj Gen Clarence L. Adcock, and Brig Gens Frank S. Besson, Jr., Claude H. Chorpening, Bruce C. Clarke, and Lunsford E. Oliver, and Cols W. Eugene Cowley and Clayton E. Mullins; (7) and on Col. Lunsford E. Oliver, "Engineers With the Armored Force," *The Military Engineer,* XXXIII (September, 1941), 397–401.

[35] Ltr, C of O&T Sec to Clarke, 15 Aug 40. 653, Pt. 3. Clarke's letter to Godfrey has not been located. That Clarke considered the H–10 bridge unsuitable can be inferred from Godfrey's reply. His reasons for wishing to discard it are stated in Ltr, Brig Gen Bruce C. Clarke to C of EHD, 24 May 51.

with the investigations under way at the Engineer Board. Although doubting their value as a substitute for decking, he readily agreed to ship some treadways to the Armored Force engineers since he believed that "every effort should be made to get a bridge which will be more nearly what they want." [36]

To provide such a bridge for the Armored Force engineers imposed a considerable burden on the Bridging Section at the Engineer Board which already had more projects than employees. Captain Baker unburdened his troubles to Sverdrup on 18 September:

> Seems as if everyone, particularly the armored force people, is demanding longer, lighter, more quickly placed, greater capacity bridges. So we have got to get something out soon or else show them it can't be done. Some of our people have become more enthusiastic about . . . a bridge with longer sections, with special erecting equipment, and which can be more quickly placed than the H–20. (However, we are well pleased with the H–20 and, as I told you, the Chief's Office is going to advertise for some of them as soon as possible.) [37]

Besson, having had more experience with the H–20 bridge, was not so pleased. He noted that it was "considerably heavier and harder to erect than the H–10 bridge," being "a deliberate operation requiring the better part of one day to get it in." It was his "personal opinion . . . definitely not an official Board opinion," that "the H–20 bridge is not suitable for forward combat echelons and is a heavy installation for the supply echelon." [38]

The Armored Force engineers at Fort Knox also remained dissatisfied. During the fall and winter of 1940, Stanley, Clarke, and Lt. Col. Lunsford E. Oliver, Engineer of I Armored Corps, speculated as to how they could improve their bridging. Clarke, in particular, was most anxious to develop faster means of spanning narrow streams and gullys than was possible by use of the timber trestle bridge. To that end he urged that treadways be laid across the stronger prefabricated steel trestles issued as part of the ponton bridge equipage. Experiments with this variation, while not conclusive, were encouraging. Although at the board Baker considered the project important enough to be pushed, he hesitated when it came to "special trestles and special flooring." Yet he promised shipment of about 50 feet of treadway to Fort Knox by the end of January. In the midst of these experiments Clarke was reassigned, but Oliver and Stanley continued to apply pressure on Fort Belvoir.

These two officers were becoming increasingly concerned over the development of a suitable floating bridge because they believed the 25-ton ponton bridge would be too difficult to transport and would take too long to erect. Their opinion was based on observations of the 10-ton bridge, since they had been issued no other, but they knew the same disadvantages would be exaggerated in the heavier structure.

The climax to their dissatisfaction occurred one night early in December 1940 when the bridge company was putting on a night show for *Newsweek* cameramen. After the bridge had been erected a tank was backed on and the photographers took "a few faked 'action' shots." When the driver tried to move forward off the bridge, the

[36] Ltr, ExO Engr Bd to CofEngrs, 30 Aug 40, sub: Rpt of Visit to Ft. Knox, 20–21 Aug 40. 320.2, Pt. 25.

[37] Ltr, ExO Engr Bd to Sverdrup, 18 Sep 40. ERDL file, SP 267.

[38] Ltr, Besson to Capt Alfred H. Davidson, Jr., 10 Feb 41. ERDL file, EB 84.



10-TON PONTON BRIDGE AT FORT KNOX, KY. *Note tank touching curb rail and partial submergence of pontons. This photograph appeared in* Newsweek, *23 December 1940.*

tank stalled. A bulldozer brought to the rescue only succeeded in getting t as far as the hinge span, at which point the end ponton sank to the bottom of Salt River. Stanley hastened off to get a wrecker truck, leaving strict orders to let everything remain as it was. When he returned, he found most of the bridge under water. Another officer had decided to back up the tank. Only in the process of lifting the tank off the bottom of the river did Stanley discover it was not a 9-ton as he had been led to believe, but a new 13-ton model. The added weight, together with the fact that the driver had got off center when he backed up, explained the accident.

This incident determined Oliver and Stanley to pursue Stanley's idea of using steel treadways instead of the standard wooden flooring. On the 27th of December, Stanley wrote Godfrey about the accident, concluding "that the 10-ton bridge should be used for 13-ton tank loads only in an emergency, and then only with every precaution to keep the load centered on the roadway. . . . Perhaps the Engineer Board has already considered this problem," he continued, "but it would seem possible to design treadways for the ponton equipage, both light and heavy." He suggested dimensions for the treadways and a method of joining them together.[39]

The treadways would probably be too heavy to put in place by manpower, but the Armored Force was a completely motorized

[39] Ltr, CO 16th Armd Engr Bn to C of O&T Sec, 27 Dec 40. R&D Div Structures Dev Br, BR 257.

and mechanized outfit and its engineers could see no objection to dependence upon machinery for division bridging as did the Engineer Board and the Military Division in Washington. Oliver and Stanley believed the treadways would speed up construction because fewer parts had to be fitted together, would sustain more weight by distributing the load over more pontons, and would keep the driver on center by means of their channels.

On 2 January 1941, Oliver wrote Besson about the idea and enclosed a rough drawing. When the letter arrived, the board was already prepared to ship the treadways intended as flooring for the trestle bridge. Presumably Stanley could try them out on pontons if he wished. Whatever the reason, Fort Knox heard nothing from Fort Belvoir.

The treadways furnished by the board were modeled closely on the German trackways and were not at all what Stanley had in mind. Conforming to official doctrine, they were light enough to be handled without the aid of machinery. They were flat. Stanley wanted curbs to keep the vehicles from sliding sideways. They were in short 12-foot sections, and were so narrow they offered no leeway for vehicles of different widths.

On 11 February, Oliver, accompanied by Stanley, arrived at Fort Belvoir to witness tests of a ferry which utilized treadways. Again they found fault with the treadways which were similar to those furnished them for the trestle bridge. Again they explained how they wished the treadways designed and expounded their ideas for using them as decking for ponton as well as for trestle bridging. But the two left Fort Belvoir convinced that no one there had the time or the interest to pursue the work with the speed they believed essential. They determined to carry out the entire project at Fort Knox.

Since neither Oliver nor Stanley was free to work up a finished design, they turned the idea over to 1st Lt. W. Eugene Cowley, a motor officer attached to the 16th, who was a mechanical designer by profession. Cowley planned for curbed treads, 15 feet long, 33 inches wide, spaced 39 inches apart, which would accommodate all double tracked vehicles. He evolved a joint for the sections, flexible enough not to overstress the treadways, yet strong and rigid enough so that loads would be distributed over several pontons at once, thus providing the continuous beam action that Stanley and Oliver feared would prove most difficult to achieve.

Although Oliver had money enough to order some treadways fabricated to Cowley's design, he preferred to clear the matter with OCE, explaining his point of view thus to Besson:

> There is a well equipped shop in Louisville which is willing to do the work for us and I believe we can secure much more rapid results than we can if you do it for us, because of the fact that we can quickly carry out tests and can immediately have changes made as indicated. Please do not consider that we are in any way dissatisfied with the work of the Engineer Board for we are not. You are just so far away from us that quick results are difficult to attain, and we know of no more valuable use for the funds I mentioned as available.[40]

The board objected. Admitted that Armored Force engineers knew their own problems better and could concentrate all their

[40] Ltr, Engr I Armd Corps to Engr Bd, n.d. [written sometime between 11 February and 3 March 1941]. ERDL file, EB 83.

The authors have been unable to locate the letter written to Kingman which is referred to in the letter to the board cited here.

time and talent on solving them. Yet it was quite a gamble, the board argued, to transfer responsibility to an officer or command apt to be transient and apt to ignore the interrelationship of plans, specifications, and procurement which the board so well understood. Responsibility for new designs should remain centered in a permanent agency. Baker recommended to Chorpening that Armored Force engineers either submit their designs for approval or detail an officer to Belvoir. The board was not standing still. The old treadways had been redesigned and a test unit would be delivered to Knox by mid-March. At the same time, the board professed itself agreeable to Oliver's buying treadways in Louisville. What it did insist upon was an "opportunity to check . . . work [done at Fort Knox] from the point of view of its broader experience." [41]

On 5 March, before Oliver received any of these objections, he arrived in Washington with Cowley's plans in his briefcase. When Kingman told him he was opposed to surrendering the board's authority, Oliver argued for complete freedom. Was Kingman willing to accept responsibility for failure of Armored Force engineers to carry out their mission for lack of suitable bridges? Kingman finally said no, and gave Oliver permission to go ahead. Arriving back at headquarters, Oliver placed an order with the Louisville firm for enough treadway decking to span Salt River.[42]

It was precisely at this time, when the engineers at Knox had the freest hand in carrying out their ideas, that the engineers at Belvoir did most to help them. The Engineer Board had been pushing the development of pneumatic floats vigorously. In March 1941, before Armored Force engineers had received the treadways from Louisville, the board sent some small pneumatic floats to Knox. Receipt of these floats brought about a radical change in the conception of the Armored Force bridge. On 25 April Oliver wrote Baker:

> I have thought of our assault boats as being superior to the rubber boats, but have changed my mind. . . . As a matter of fact, Stanley and I are ahead of you now and are thinking of the use of the large rubber boats, in conjunction with the treadways we are developing here.

The light, easily transported floats would replace the bulky 25-ton pontons. Oliver asked the Engineer Board to supply larger pneumatic floats, and Cowley was put to work designing "saddles" for the treadways to rest upon.[43]

Early in June, a treadway bridge built with 25-ton pontons and a treadway raft built with floats were demonstrated at Fort Knox. This demonstration settled for all practical purposes the question of bridging for the Armored Force. More treads, floats, and truck cranes to handle the treadways were immediately ordered. On 22 September 1941, OCE recommended that all fixed and floating bridging and the 30-ton ferry be deleted from the Armored Corps T/BA,

[41] (1) Memo, ExO Engr Bd for Chorpening, 24 Feb 41, sub: Col Oliver's Ltr to Gen Kingman re: Design of Port Trestle Bridge. ERDL file, EB 84. (2) Draft of Ltr, Besson to Oliver, 5 Mar 41. ERDL file, EB 83.

[42] (1) Notation in index to ERDL file, EB 83, Ferries, 5 Mar 41. (2) Ltr, Oliver to C of EHD, 31 Mar 51. (3) Interv, Cowley, 7 Mar 51. (4) Memo, Oliver for Col Johns, 23 Jan 47, with Ltr, Dir of Mil Opns to CG Engr Center, 28 Jan 47, sub: Steel Treadway Bridging. R&D Div Structures Dev Br. (5) Interv, Adcock, 27 Dec 51.

The authors have been unable to locate a letter of refusal supposedly already mailed. Oliver recalls in his letter of 31 March 1951 that it set forth "in general" the same arguments as those mentioned in the memorandum from Baker to Chorpening cited in note 41 (1).

[43] Ltr, Engr I Armd Corps to Baker, 25 Apr 41. ERDL file, SP 305.

and the steel treadway bridge be substituted. The bridge train was reduced to five sixths its former size. Furthermore the speed of construction of the treadway bridge as compared with the standard ponton was striking. In December 1941, the 17th Engineer Armored Battalion sponsored a demonstration at Fort Benning, Georgia, setting up uniform conditions for purposes of comparison. A 315-foot pneumatic-float treadway bridge of 30-ton capacity was built across the Chattahoochee River by 154 trained officers and men from the 17th in 2½ hours. It took 245 men of the 87th Engineer Heavy Ponton Battalion 4½ hours to put across a 25-ton ponton bridge 328 feet long.

A wave of triumph swept through the engineer contingent at Fort Knox. The imagination of Stanley, the persistence of Oliver, and the ingenuity of Cowley had been rewarded in full measure. Among the observers from the Engineer Board, Besson and Mullins could point to the pneumatic floats and share credit for the achievement. Yet these two shared also Chorpening's misgiving as he turned and said, "We've adopted something without a real service test." Otherwise the remark was drowned out in the tide of enthusiasm. Less than a year later it was to prove prophetic.[44]

Good as the treadway bridge looked in December 1941 no one suggested that it be universally adopted. The Armored Force had got what it wanted. What it had was not desired elsewhere. This remained true even as armor came to be accepted as an accompaniment of infantry. The treadway bridge was expensive and less durable than standard ponton bridges. Perhaps most important—speedy construction of bridges was not considered as essential by infantry as by armored divisions, for the lightly equipped assault infantry could be ferried across.

By December 1941 the Engineer Board had completed tests of light infantry support rafts and bridging similar to that which had speeded German river crossings. The new equipment was far more efficient for ferrying operations than the standard ponton equipage relied on previously. Constructed of plywood half-boats and treadways or pneumatic floats supporting standard balk and chess, these rafts and bridges had a capacity somewhat under 10 tons and took up relatively little transport space. Their adoption enabled the Engineers to reduce the amount of bridging assigned to the field army and the number of light ponton units from four to two.[45]

Provision of heavier bridges was conspicuously less successful. The long-sustained hopes that the 25-ton ponton would serve were dashed shortly after delivery of the pilot model of the Sherman medium tank. The Sherman weighed 33 tons. Tests of the 25-ton bridge showed it could not carry the new tank unless reinforced, and that the ultimate reinforced capacity of the bridge was about 35 tons. By November the board was working to raise the base capacity of the 25-ton ponton to 31 tons so that medium tanks accompanying divisional units could pass over it.[46]

The increasing weight of tanks was also causing trouble with fixed bridges. While more girders could be added to the H–10 or

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[44] (1) Intervs, Chorpening, 4 Jun 51, and Mullins, 11 Apr 53. (2) See below, pp. 486–89.

[45] Memo, ACofEngrs (Sturdevant) for ACofS G–3, 26 Dec 41, sub: Changes in River Crossing Equip and Ponton Units. 320.2, Pt. 14.

[46] (1) Engr Bd Rpt 647, 1 Dec 41, sub: Interim Rpt on Tests of Medium (25-Ton) Ponton Bridge. (2) Ltr, ExO OCE to Comdt Engr Sch, 4 Nov 41, sub: Character of Floating Bridge Equip. 417, Pt. 11.



PNEUMATIC-FLOAT TREADWAY BRIDGE *built across the Chattahoochee River, December 1941. Medium tank crossing the bridge is an M3A3, weighing approximately 30 tons.*

the H–20 or their spans shortened in order to make them sustain heavier loads, such alterations led to a less efficient piece of equipment. Another general drawback of both these bridges was the heaviness and bulkiness of their components, which made them difficult to transport and, in the case of the H–20, slow to erect.[47]

But more serious than the difficulties the Engineers faced in keeping up with increasing weights was the manner in which they had solved their basic problem, namely, by providing a multiplicity of bridges. The British, by contrast, had been working toward the provision of all-purpose equipage, and by the summer of 1941 were ready to begin production of the Bailey bridge, so called for its designer, Sir Donald Coleman Bailey. The Bailey was strikingly different from any American military bridge because most of its structural members were above rather than beneath its roadway. The Bailey's main support was a continuous truss on either side of the roadway, joined beneath by transoms. Unlike the box sections of the H–10 and H–20, the Bailey's sections which, joined together, formed the truss, were flat panels. They were much lighter—a Bailey panel weighed 600 pounds or about half that of a section of H–10 bridge. Although the Bailey could be handled and transported more easily because

[47] (1) Ltr, ExO Engr Bd to C of Dev Br, 19 Mar 41, sub: Launching Noses for H–10 Bridge. (2) Ltr, ExO Engr Bd to CofEngrs, 28 Apr 41, sub: Rev Specification for H–10 Bridge. Both in R&D Div Structures Dev Br, SP 266.

of its "knocked-down" sections, more parts had to be fitted together before launching than in the H–10 or H–20 bridges. It was reported that a British crew of 53 men built an 80-foot, 21-ton capacity Bailey in 2 hours and 20 minutes, taking slightly more time than for an H–10 and much less than for an H–20. The great advantage of the Bailey was its adaptability to various loads. For example, a certain number of panels fitted together would take 28 tons over a 60-foot span; by adding more panels both alongside and above one another, it would take this weight over a 170-foot span. It could be constructed to carry as much as 78 tons over a 120-foot span. The Americans had no bridge that would take so much weight, let alone one that was capable of meeting such a variety of weights and situations. As a further selling point, there was a great deal to be gained if British and Americans standardized on the same bridge. Because the Bailey could be erected as a single span over narrow crossings, as a multiple span with trestles over wider ones, and because there was good reason to believe that it could be floated on pontons, it appeared an "all-purpose" bridge had been found.[48]

In the summer of 1940 Besson returned from England with working drawings of the Bailey. The Engineer Board asked Sverdrup and Parcel to use them, but to modify the design sufficiently to make the bridge conform to the practices of American rolling mills. Three weeks after Pearl Harbor Chorpening wrote G–4 asking permission to spend $50,000 to buy one Bailey bridge. Tests would show whether the Bailey was versatile enough to replace some or all of the bridges on which the Corps of Engineers had expended so much effort during the prewar years.[49]

Although the design and selection of bridging equipage received most attention by far in the period before Pearl Harbor, the Corps of Engineers was also concerned with the mobility of ponton units and with the question of whether ponton troops, heretofore simply caretakers, should not be charged also with construction of bridges. In the spring of 1940 the advent of heavier tanks made the activation of a heavy ponton battalion imperative. Authorized in June, the heavy ponton battalion was provided with up-to-date trucks and trailers which reduced the length of its train and enabled it to keep up with armored units.[50]

According to doctrine, ponton troops were to deliver bridging equipage and provide instruction and technical advice to the general units which were charged with the actual construction. Ponton units were responsible for maintaining and dismantling

[48] (1) Sir Donald Coleman Bailey, Robert Arthur Foulkes, and Rodman Digby-Smith, "The Bailey Bridge and Its Developments," *The Civil Engineer in War, A Symposium of Papers on War-Time Engineering Problems* (London: The Institution of Civil Engineers, 1948) I, pp. 374–80, 390–98, 401. (2) Engr Bd Hist Study, The Bailey Bridge. (3) Engr Bd Rpt 729, 5 Dec 42, sub: Panel Bridge (Bailey Type), H–10 Bridge and H–20 Bridge. (4) Ltr, Capt R. R. Arnold, CE Mil Obsvr, London, to Besson, 24 Oct 41. ERDL file, BR 341 E. (5) Incl, n. d., with Memo, ExO Engr Bd for Sup Sec OCE, 23 Dec 41, sub: Request for Authority to Procure One Unit of Experimental Port Steel Bridge. ERDL file, BR 341.

See p. 493 for illustration of the Bailey bridge.

[49] (1) Engr Bd Hist Study, The Bailey Bridge. (2) Ltr, C of Intel Sec to Arnold, 24 Nov 41. 653, Pt. 4. (3) Ltr, Asst ExO Engr Bd to C. C. Bell, Tech Advisor (Bridging), Dept of National Defense, Canada, 26 Nov 41. ERDL file, BR 341. (4) Memo, Actg ExO Sup Div for ACofS G–4, 27 Dec 41, sub: Request for Authority to Procure One Unit of Experimental Port Steel Bridge. R&D Div Structures Dev Br, SP 341.

[50] (1) Memo, Actg CofEngrs to ACofS G–3, 17 Jun 40, sub: Engr Trps for Proposed Increase in Army. 320.2, Pt. 24. (2) Memo, ExO OCE for Maj E. H. Brooks, 12 Aug 40, sub: Engr Activities. 025, Pt. 1.

the bridge. After experience in the 1940 maneuvers the commanding officer of the 70th Light Ponton Company suggested that the unit's mobility be increased and that it be made less of a depot outfit. He proposed that all its footbridges and assault boats be eliminated and that it be provided with its own transportation. Toward the end of 1940 OCE adopted these recommendations in part. The light ponton company was furnished its own trailers and some of its footbridges and assault boats were redistributed to corps engineers.[51]

During the fall 1940 research course at the Engineer School, the committees on river crossings recommended the assignment of bridge building to ponton units and corps engineers, the activities of divisional engineers to be limited to the assault wave. Specially trained corps engineer units would take over for erection of light ponton bridges. Heavy ponton bridges would be built by heavy ponton battalions, with the aid of personnel from general units.[52] Early in 1941, when friction developed between the commanders of a combat regiment and a light ponton company at Fort Benning, the issue was raised more specifically. Kingman and Godfrey backed the regimental commander's view that the light ponton company was primarily a transportation and care-taking unit. In January 1941 the mission of the heavy ponton battalion had been modified to permit it to construct heavy bridges "under certain circumstances," but this declaration of policy did not settle the issue. It was to arise again during maneuvers in 1941 and after Pearl Harbor.[53]

The engineer armored battalion, with its bridge company, represented an exception to the general doctrine and was subject to criticism even among armored engineers themselves. In March 1941 the research committee dealing with the mission and training of this unit noted that the bridge company did not have sufficient equipment for a major operation, that it deprived the battalion of working personnel for other missions, that it added to the battalion's road space, and that there was considerable terrain where it would not be needed. The committee urged the elimination of the bridge company and its replacement by a lettered company.[54] These recommendations came in the midst of development of the steel treadway bridge, and, as Clarke later recalled, the bridge company "was built around equipment that was not in existence, but equipment we hoped ultimately to get. The purpose of it was to establish a bridge organization that would guide our thinking and development." [55] When the commandant of the Engineer School endorsed the proposal for eliminating the bridge company, the Armored Force argued for its retention, at least for the time being. The

[51] (1) EFM, Vol. I, 1932, pp. 227–29. (2) Ltr, CO 70th Engr Co to CofEngrs, 27 May 40, sub: The Ponton Co. 320.2, Pt. 24. (3) Rpt, Capt Carl W. Meyer, The Use, Orgn, and Equip of the Ponton Co, Incl with Ltr, OCE to Comdt Engr Sch, 8 Aug 40, sub: Rpt on Light Ponton Co. 320.2, Pt. 24. (4) Ltr, ACofEngrs to TAG, 4 Dec 40, sub: Change in T/BA 5, 1 Nov 40. 400.34, Pt. 36. (5) Ltr, ACofEngrs to TAG, 16 Dec 40, sub: Light Ponton Co Equipage. AG 400.43 (11–11–36) (1) Sec 1–111.

[52] (1) Rpt, River Crossing Technique. (2) Rpt, River Crossings, Bridge Tactics. Both in First Research Course, Vol. I.

[53] (1) T/O 5–47, 1 Nov 40. (2) Corresp between Lt Col W. F. Heavey, CO 20th Engrs, Kingman, and Godfrey, Jan–Apr 41. 417, Pt. 9.

[54] (1) Ltr, Stanley, CO 16th Armd Engr Bn, to Godfrey, 1 Sep 40. R&D Div Mech Equip Br, Pile Drivers No. 1. (2) Info Bull 71, 2 Jan 41, sub: Mission, Duties, and Tng of Div Engr Units. (3) Rpt, Mission and Tng of Engr Bn (Armd). Second Research Course, Vol. II.

[55] Ltr, Clarke to C of EHD, 24 May 51.

need for additional troops in the engineer armored battalion could not be gainsaid, but this deficiency, the Armored Force emphasized, should not be confused with the need for bridging in close support of armor—a fact which foreign armies had recognized. Until a heavy ponton company and a fully motorized company having 500 feet of portable bridge became available for normal attachment to each armored division, the engineer armored battalion was not ready for a change. Nor did change come until well after Pearl Harbor.[56]

Passage of Artificial Obstacles

With bridging and with construction machinery the Corps of Engineers prepared to overcome the enemy's exploitation of natural obstacles. Encouraged by the feats of German engineers in the passage of mine fields and in the reduction of deliberate fortifications, the Corps gave thought to the execution of these duties, but before Pearl Harbor the amount of theorizing exceeded the amount of down-to-earth testing of doctrine and equipment. The first attempt to compare the effectiveness of various artificial obstacles was made at the request of the Engineer Board in 1937 and 1938 by a number of engineer troop units. Their study included land mines, antitank ditches, wooden piling, wire rolls, and road craters. All of these, it was concluded, would provide adequate barriers to tanks and trucks if properly and strategically placed.[57]

The second evaluation of the effectiveness of obstacles resulted from the research course at the Engineer School. The committee on obstacles stated baldly that "antitank mines alone are likely to constitute an effective obstacle" and that "other obstacles serve merely to augment the mine or replace it if normal supply fails." The superiority of the land mine over all other obstacles was not only evident in its crippling effect upon vehicles, but in the ease with which it could be transported, put in place, and concealed. The heavy steel and concrete obstacles which had been employed as part of the fortified lines of the continental countries required extensive fabrication and thousands of man-hours in placement. Such deliberate fortifications might be installed at Panama or Hawaii but had no place in a mobile situation. Craters and ditches, abatis, log obstacles, and wire rolls, the committee concluded, were suitable for installation in the field and were more or less effective, particularly if used in conjunction with mines.[58]

The technical aspects of land mines were matters in which responsibilities were divided between the Ordnance Department and the Corps of Engineers. Ordnance had the duty of developing the mines themselves while the Engineers were to develop means of detecting them. Both services were involved in the techniques and equipment for clearing them out of the way. In April 1940 the Engineer Board had been directed to investigate means for the detection, destruction, and removal of antitank mines, but

[56] (1) 2d Ind, CG Armd Force to TAG, 10 Oct 40, on Ltr, ACofEngrs to TAG, 23 Sep 40, sub: Asgmt of 87th Engr Bn, Heavy Ponton. 320.2, 87th Engrs. (2) Ltr, Comdt Engr Sch to CofEngrs, 1 Apr 41, sub: Rpt on Mission and Tng of Engr Bn (Armd). 352.11, Engr Sch, Pt. 10. (3) 1st Ind, 20 May 41, on Memo, C of O&T Sec for C of Armd Force, 8 Apr 41, sub: Rpt of Research Comm on Mission and Tng of Engr Bn (Armd). 352.11, Engr Sch, Pt. 11.

[57] (1) Engr Bd Rpt 517, 4 Dec 37, sub: Mines and Obstacles for Use Against Mechanized (or Motorized) Units. (2) Info Bull 27, 20 Jul 39, sub: Mines and Obstacles for Use Against Mechanized or Motorized Units.

[58] Rpt, Comm on Obstacles, 28 Nov 40. First Research Course, Vol. I.

during the following months the pressure of other work pushed the project into the background. Concerted efforts to develop a detector finally got under way in earnest in the fall of 1940.

The fact that all mines known to exist in 1940 were encased in metal simplified greatly the development of a mechanism which would signal the presence of a mine. In fact, there were on the market a number of "detectors" which had been used for such diverse purposes as the discovery of metal objects in the mattresses of convicts and the location of mineral deposits. Moreover, the British, French, and German Armies were equipped with mine detectors with which the Engineers were more or less familiar. But while commercial detectors were useful as a starting point, none could be adopted for military purposes without modification, and the Engineers' attitude toward the adoption of a detector in use by a foreign army was the cautious one of testing with the desire to improve upon it.

On 3 September 1940 the Engineers asked the National Defense Research Committee (NDRC) for assistance in the development of a metallic mine detector. The device, wrote Godfrey, must be capable of detecting a steel plate ⅛ of an inch thick, 10 inches square, buried 18 inches below the surface of the ground. The indicator must be simple so that personnel with little or no scientific training could read it. It should be rugged as well as light. Referral of this investigation to the NDRC did not result in cessation of the Engineer Board's activity. On the contrary, as personnel became available shortly thereafter, the board was able to devote more time and effort to the subject than before. For the better part of 1941 the NDRC and the Engineer Board sponsored parallel investigations.

After canvassing the market, Capt. George A. Rote, who was in charge of the investigation at the board, purchased seven of the most promising commercial detectors. Six of this group operated on a radio-frequency principle. The seventh, a device which Hedden Metal Locators, Inc., of Miami, Florida, demonstrated in February 1941, appealed particularly to Rote because it operated on audio-frequency. It was relatively light and possessed about the degree of sensitivity required. By the summer of 1941 Rote had settled upon the Hedden instrument as the starting point for further development.

Meanwhile the NDRC had contracted with the Hazeltine Service Corporation, a radio research establishment located at Little Neck, New York. Hazeltine produced a detector which was delivered to Fort Belvoir on 1 August. When lined up with the Hedden detector which the board had modified, the Hazeltine model had the disadvantage of being heavier and bulkier. The board's investigators indicated their preference for the Hedden-type detector, but realized that the Hedden company lacked facilities for quickly carrying out the many refinements required for quantity production. Hazeltine, on the other hand, was eminently equipped to take on this job, and did so following a conference at Fort Belvoir early in August.

The operator of SCR–625 (as the Hedden–Engineer Board–Hazeltine mine detector came to be called after the nomenclature of the Signal Corps which procured it) carried in his hand an exploring rod six feet long at the lower end of which was a pie-shaped search coil containing both transmitting and receiving elements. Batteries and an amplifier were carried in a haversack strapped to the operator's side.



SCR-625 MINE DETECTOR *in use in North Africa, April 1943.*

A resonator was attached to his shoulder. The presence of metal in the vicinity of the search coil produced a signal which was amplified into a warning sound in the resonator. SCR-625 would detect a metallic mine buried 6 to 12 inches. Its penetration was thus less than the 18-inch depth Godfrey had specified, but in practice few mines were buried deeper than a foot. By February 1942 the Engineers were in a position to standardize this set.[59]

The development of the portable mine detector was the outstanding Engineer contribution to the passage of artificial obstacles made during the defense period. Other studies by the Engineer Board and the Engineer School, notably the testing of various means of breaching shellproof and splinterproof weapons emplacements, resulted in some additional knowledge of demolitions techniques, but the inauguration of a comprehensive program for determining the most efficient means of reducing obstacles did not occur until 1942.[60]

Equipment for Aviation Engineers

By December 1941 the Engineers had accomplished the fundamental changes dic-

[59] (1) Engr Bd Rpt 678, 12 Mar 42, sub: Mine Detector Developed by Engr Bd. (2) Engr Bd Hist Study, Metallic Mine Detectors. (3) Engr Bd Monthly Rpts, Apr–Sep 40. (4) Ltr, C of O&T Sec to Chm NDRC, 3 Sep 40, sub: Design of Device for Detection of Buried Antitank Mines. 470.8, Pt. 2. (5) Ltr, Hazeltine Service Corp. to Dr. George R. Harrison, 4 Oct 41. ERDL file, GN 316.

[60] (1) Capt. William Whipple, Jr., "Assault of a Fortified Position," *The Military Engineer*, XXXIII (March–April, 1941), 85–94. (2) See below, Ch. XX.

tated by the new-found mobility of ground force units. They had, moreover, made a similar adjustment to the most mobile component of the new Army—the Air Corps. When, in the fall of 1939, the General Staff approached the Engineers about their service with the Air Corps, Kingman had noted that special equipment, as well as special troops, would be required for the construction of airfields. Seven months later, when the 21st Engineer Aviation Regiment became the first engineer unit attached to the Air Corps, its troops were assigned only the basic construction machinery issued to the general service regiment. Although Davison, commanding the 21st just before his assignment as Air Engineer, had given some thought to the special requirements of this new unit, it fell to Chorpening as chief of OCE's Development Branch, to make an immediate selection for procurement. He invited a construction contractor friend of West Point days home for the weekend. Together, they drew up a list of construction machinery which Kingman approved late in July.[61]

In making his selections Chorpening assumed that aviation regiments would build advance airdromes twenty to seventy miles behind the front and that such troops would remain in one place for a relatively long period of time. Because aviation engineers would not have to keep up with advance columns and because they had to be prepared to deal with all sorts of climatic and soil conditions, Chorpening assigned to them a great variety of the heavier, more efficient types of machinery. For grading and transporting fill, aviation units were equipped with four sizes of tractors; disk and tractor plows; rubber-tired, sheepsfoot, and tandem rollers; large carrying scrapers and shovels with draglines; and road graders and leaning wheel graders. Although aware that paving operations would be time-consuming, Chorpening thought that aviation engineers should be equipped to build bituminous or concrete runways if the ground encountered did not offer sufficient bearing capacity. For such work aviation engineers were to get concrete and road material mixers and asphalt and emulsion distributors. In all, aviation engineers were to receive twenty-six pieces of "special" machinery and were to come closer to carrying a "construction plant" than any other engineer unit. Although agreeing wholeheartedly with Chorpening's selection of tractors, scrapers, and other grading machinery, Davison, Smyser, and other officers with the Air Corps were becoming convinced that hard-surfaced runways were a luxury that aviation engineers could not afford. They consequently questioned the need for paving machinery.[62] The planes in existence at the time the Engineers were told to prepare for their mission with the Air Corps were so light that sod fields would suffice for advance bases. Runways for bombers based in rear areas could be built like standard highways. These plans for simple construction were almost obsolete as soon as made, for the Air Corps was even then designing heavier planes which called for runways of greater bearing capacity. Constructing runways at the front and more

[61] (1) 1st Ind, 16 Oct 39, on Ltr, AGO to CofEngrs, 21 Sep 39, sub: T/Os. 320.2, Pt. 22. (2) Stuart C. Godfrey, "Engineers With the Army Air Forces," *The Military Engineer,* XXXIII (November, 1941), 488. (3) Interv, Chorpening, 10 Jul 50. (4) Memo, C of Sup Sec for Kingman, 26 Jul 40, sub: Activities for Period 20–26 Jul 40. EHD files (5) Ltr, Smyser to C of EHD, 5 Jun 52.

[62] (1) Info Bull 53, 1 Aug 40, sub: Constr of Mil Airports. (2) Carroll T. Newton, "Construction of Military Airports," *Civil Engineering,* XI (April, 1941), 208, 211. (3) T/BA, 1 Nov 40. (4) Ltr, Smyser to C of EHD, 5 Jun 52.



AVIATION ENGINEER EQUIPMENT. *Road scrapers towed by tractors are grading for a landing field, 1st Army maneuvers, North Carolina, October 1941.*

elaborate ones farther back, as the planes being contemplated in 1939 dictated, would take a long time—long enough to interfere seriously with the striking power of the air arm.[63]

No wonder then that the Air Corps expressed immediate interest in news that the British and French were laying down portable steel mats as a substitute for hard-surfaced runways. In December 1939, the Air Corps asked the Engineers to develop a similar landing mat. Since practically nothing was known about the subject, the two services agreed that the Engineers would attempt to get more information from abroad, would canvass the American market for likely materials, and, after conducting field tests with loaded trucks, choose the most promising types for service tests with planes. To carry out this program, the Air Corps set aside $30,000 of fiscal year 1940 funds—$5,000 for preliminary and $25,000 for service tests. The goal was a suitable mat by 1 July 1940.[64]

The Chief of Engineers assigned the supervision of this investigation to the Construction Section, OCE, whose chief was Lt. Col. George Mayo. Responsibility for testing was placed upon Maj. William N. Thomas, Jr., at that time the only Engineer officer with GHQ Air Force, who thus

[63] (1) Memo, CofAC for Col Lindbergh and Col Spaatz, 25 Jul 39. AAF 611 "A" to Jul 40—Roads. (2) Memo, Plans Div Office CofAC for Maj Gen Henry H. Arnold, 12 Aug 39. Same file. (3) 1st Ind, 16 Oct 39, on Ltr, AGO to CofEngrs, 21 Sep 39, sub: T/BAs. 320.2, Pt. 22.

[64] The following discussion of the development of landing mats is based upon: (1) Corresp in 686, Pt. 1; 686.61, Pts. 1 and 2; 686, SP 318, Pt. 1; and 400.112, Landing Mats, Bulky; (2) Engr Bd Rpts 605, 15 Oct 40, sub: Tests of Emergency Landing Mats for Airfields, and 638, 15 Oct 41, sub: Emergency Landing Mats for Airfields; and (3) Ltr, Col George Mayo to C of EHD, 15 Jun 52.

assumed personally the role ordinarily played by the Engineer Board. Mayo and Thomas did not wait for reports from abroad but immediately sought suggestions from Clarence E. Meissner, the Washington representative of the United States Steel Corporation. On 18 December 1939, they met with Meissner, his colleague, Charles W. Meyers, of the American Steel and Wire Company, and two representatives from the Office of the Chief of the Air Corps. Meyers exhibited samples of a rectangular wire mesh which he believed would prove superior to the chevron grid in use abroad. In February 1940, the Engineers ordered enough rectangular grid for field tests, which were held in late March.

Far from providing the firm base necessary, the rectangular grid showed serious weaknesses: connectors broke, anchors failed, furrows and depressions appeared. Although Thomas recommended that efforts be made to correct these deficiencies, he also began to look about for something else. On 4 April 1940 he and several representatives of the steel industry met in Mayo's office. Pointing out that the rolling mills were piled up with orders while the strip mills were not busy, Gerald G. Greulich of Carnegie-Illinois Steel Corporation suggested thin steel plates as an alternative to grid and volunteered to design a "plank" type mat and connectors.

Greulich's design had progressed to the ordering stage by the first of May, when Maj. Gen. Henry H. Arnold, Chief of the Air Corps, began to express impatience. "The requirements," he stated, "may be divided into two separate categories: First, pursuit and observation, i. e., light weight types. Second, bombardment, i. e., heavy load types." It seemed possible to him that "if no delays are incurred and if this project is pushed that some concrete decision can be arrived at by the first of the Fiscal Year 1941." [65]

In replying Mayo outlined general plans but avoided specific commitments. As to requirements, the investigation had already led to the conclusion that they were divided into "two categories" so that "study will go forward under these headings." He could also report that "within the past week steps have been taken which will insure that all speed consistent with the production of a satisfactory solution will be made." Specifically, these steps were the assignment of the project to the Engineer Board which would hereafter work in close alliance with the 21st Engineer Aviation Regiment and its commanding officer, Davison, both on the development of the mats themselves and on techniques for their camouflage. As to a product by the first of July, Mayo made no promises. Indeed so far was he from expecting the deadline to be met that he sought the Air Corps' permission to divert $25,000 of the $30,000 allotted to the development of landing mats to the purchase of construction machinery for the 21st Engineers. If this plan were approved, he proposed to set aside an equivalent amount from Engineer funds to take care of the tests of landing mats which would take place during the coming months.[66]

Arnold's answer to the request for transfer of funds was emphatic. "The most recent information from operations now in progress abroad," he wrote, "indicates that permanent runways are out of the question in modern warfare," causing "the development

[65] The memo, while not signed by Arnold, was written at his request. Memo, ACofAC for Mayo, 1 May 40, sub: Tests of Port Steel Landing Mats. 686, Pt. 1.

[66] 1st Ind, 13 May 40, on memo cited n. 65.

of landing and take-off mats to assume the highest possible priority." Several landing mats were needed immediately in Puerto Rico. "It is strongly recommended," he concluded with some sarcasm, "that the policy be followed of supplying something usable and suitable at once, rather than reaching ultimate perfection at a later and undetermined date." [67]

Kingman was quick to assure Arnold the Engineers were making progress. Stronger connecting links were being procured for the rectangular grid; interlocking steel plates had been ordered; mats similar to those used in Europe were being investigated. But, he emphasized, "The Chief of Engineers is anxious to avoid a commitment to a portable landing mat without reasonably conclusive tests." [68]

On 4 June Arnold was on the telephone demanding a report from Schley. Despite strong doubts that anything "usable and suitable" would result, the Engineers felt compelled to produce something. After a conference with Kingman on 14 June, Mayo directed the board to submit a report by 1 July. Kingman would have none of Mayo's arguments that the chevron grid mat would prove worthless for any but the lightest aircraft. With full knowledge that neither this type nor the steel plank mat had been given field tests, Kingman ordered Mayo to buy enough of both for service testing. Although by mid-June this display of activity led an Air Corps officer to assure Arnold that "there will be no further delay in carrying forth this project to a rapid conclusion," the situation hardly warranted the hope that the 1 July deadline would be met.[69]

The deadline was met, however—at least to the satisfaction of the Air Corps. On 28 June, when the steel plank mat was submitted to tests under truck loads, Maj. Charles Y. Banfill, the Air Corps' representative at the Engineer Board, concluded that something "usable and suitable" had been found. "The tests, by no means exhaustive," he wrote the board, "indicated to me that the planking, laid on properly prepared surface would prove a suitable support for landing and takeoff of any airplane now in service." He urged that the Air Corps be advised to go ahead and buy whatever quantity it needed while the board proceeded with tests of the steel planking and with their investigation of other promising materials.[70]

With but one reservation, the Engineers were happy to endorse this statement. On 1 July, Adcock, the Executive Officer, OCE, reported to Arnold:

> I feel that the tests [of the plank mat] . . . offer reasonable basis for the conclusion that a usable and suitable type of landing mat has been found. . . . Although actual landing by airplanes on this mat has not yet been tested, the opinion was unanimous among the Air Corps officers . . . that this mat was suitable for such landing. . . . Of course our tests on this type, as well as other types, will continue in order that the most suitable type under all-round consideration can be determined. . . . It is suggested that no bulk purchase of any type of mat be made until the results of runway tests are known.[71]

The whole episode took on a slightly whimsical tone when Schley and Kingman appeared in Arnold's office with a sample

[67] Ltr, CofAC to CofEngrs, 17 May 40, sub: Port Landing Mats. 400.112, Landing Mats, Bulky.

[68] 1st Ind, 23 May 40, on ltr cited n. 67.

[69] Memo, Col William Ord Ryan, AC, for CofAC, 17 Jun 40. 686, Pt. 1.

[70] Memo, Banfill for President Engr Bd, 29 Jun 40, sub: Emergency Landing Mats for Airfields. 686, Pt. 1.

[71] Ltr, ExO OCE to CofAC, 1 Jul 40, sub: Progress Rpt on Emergency Landing Mats for Airfields. 686, Pt. 1.

of plank mat. Junior officers were charmed to see the generals on the floor, like small boys with an erector set, fitting the pieces together.[72]

By mid-August sufficient amounts of plank and chevron mat were on hand for a "touch-down" test, with planes landing and taking off immediately. Except for some cutting and burning of tires, no damage was caused to planes or mat. In the course of further field tests, however, deficiencies showed up in both types of mat. The chevron proved difficult to fasten together and was dropped from consideration. The plank mat proved slippery in wet weather. To overcome this defect Greulich suggested roughening it by means of raised buttons.

By September 1940 the board had added to its list of possibilities. Preliminary tests of grids constructed from expanded metal, deck grating, and bars and rods convinced Besson, who was in charge of this investigation as well as bridging, that all possessed in common with the plank mat the essential characteristics for a runway suitable for the operation of both light and heavy planes. Contrary to Mayo's assurances to Arnold, the board had wrapped up in one package the requirements for a light and heavy type of mat by aiming to find one design that would serve all purposes. With four promising designs on hand the board was anxious to receive from the Air Corps a more definite statement as to just what was needed both at the front and in the rear. The plank, expanded metal, deck grating, and bar and rod mats, Besson reported on 15 October 1940, were all strong enough and smooth enough, could be laid down in about one day, could be produced in quantity, and could be repaired in sections. They varied in ease of camouflage, cost, production time, cargo space occupied, weight, ease of repair, durability, and degree of skidproofing. The board announced itself ready to procure one or more of these types in quantities for service test as soon as the Air Corps indicated the relative importance of these variable factors and the differences in the tactical use of landing mats for light and heavy planes.

At this point the Engineers ran into difficulties in communication. Baker explained the maze thus to Besson:

> Major Wilson this morning asked the Office of the Chief of Air Corps for decisions on some of these important factors. He was informed that those decisions would have to be made by the GHQ Air Force if they were to be made by anyone in the Air Corps.
>
> So—the question came up as to how the Chief of Engineers should or could direct the commander of the GHQ Air Force to give this information.
>
> Col. Read, A. C. then suggested the following procedure:
>
> The Engineer Board, having authority to deal directly with the 21st Engrs, can take the matter up with Col. Johns—he in turn can request decisions from the GHQ Air Force Engineer, Col. Davison, who can then secure the desired information from the Staff and CO of the GHQ Air Force. Then (I suppose) it can come back down to Col. Johns, from him to us, thence to the OCE, and finally from there will go the dope to the Chief of the Air Corps—what he will do I don't know.[73]

Through Lt. Col. Dwight S. Johns, commanding the 21st, the Engineers got an unofficial answer. On 25 October Mayo and Besson sat down with Davison, Smyser, Thomas, and Banfill to go over Besson's questions. When they had finished, Arnold's urgent project had shrunk considerably in importance. It was the opinion of the advisers that landing mats would be used to a

[72] Interv, Adcock, 27 Dec 51.

[73] Memo, ExO Engr Bd for Besson, 20 Sep [40], sub: Tel Conv with Maj Wilson Today. ERDL file, SP 318.

very limited extent, and then only for pursuit planes and light bombers. A tendency to wear out tires or to corrode was not considered particularly damning. What was essential for the few mats required was a reasonably skidproof surface which would lend itself to camouflage. Since no representatives of the Chief of the Air Corps had been present at the meeting, Kingman forwarded the conclusions to Arnold on 12 November with copies of Besson's report. No comment—at least until 15 April 1941.

Meanwhile the Engineers were forced to make a choice for the mat needed in Puerto Rico. They selected the deck grid manufactured by the Irving Subway Company. It had an advantage over the steel plank in that it was easier to camouflage. It was more rugged than the expanded metal mat which had now been discarded because of the failure of its connectors. It had undergone more thorough tests than the bar and rod type. During the spring of 1941 the Irving grid was laid down in Puerto Rico. All kinds of planes landed on it in all kinds of weather, and pilots considered it completely satisfactory. Grass growing through its openings so completely obscured it that white markers had to be placed on its edges.

Yet the Engineer Board hesitated to recommend standardization. The plank mat possessed more bearing capacity, took up less cargo space, could be produced in greater quantity, and was cheaper. It "would probably have been adopted as standard long before," asserted Besson, "if the Air Corps . . . had not stated that camouflage was of prime importance." Now Greulich, the designer of the plank mat, proposed piercing the sections in order to make the mat more susceptible to camouflage and more skidproof. The bar and rod mat, far from being ruled out, seemed to the Engineer Board to offer the advantages of a grid—that is, ease of camouflage and a nonskid surface, while being cheaper and capable of being produced in greater quantity than the Irving mat. But while the Engineer Board recommended more work toward the improvement of these three mats, it clearly felt its main job was behind it by the spring of 1941.[74]

It was then that the Air Corps announced the board's work was only half done. Commenting at last on Besson's report of October 1940, the Chief of Staff, GHQ Air Force, announced that "the results obtained to date by the Engineer Board . . . indicate satisfactory progress in the development of a metal runway for heavy aircraft, but little progress upon the true emergency landing mat for light planes." The board had assumed—wrongly, he believed—that one mat could serve both purposes. The "emergency" mat for use in forward areas should weigh less than 3½ pounds per square foot. (None of the materials so far tested by the board was this light.) A runway 100 by 3,000 feet should be laid down in twenty-four hours. Ease of camouflage was essential. It did not need to be rigid, but it should not be excessively slippery. The "semi-permanent mat" from which heavy bombers would operate had to possess greater rigidity, could weigh as much as 5 pounds per square foot, might take 72 hours to lay down. Whatever the shock this news engendered at Belvoir, it was detailed enough and definite enough to provide a real guide for future work. From this time

[74] Incl, 22 Mar 41, with Ltr, Engr Bd to Fortifications Sec, 25 Mar 41, sub: Second Interim Rpt. 686.61, Pt. 1.

on investigations were pursued along the two separate lines indicated.[75]

In midsummer, after the board had tested two light, woven wire mats with indefinite results, the Air Corps called attention to a light British mat, known after its manufacturer as Sommerfeld track. It weighed only one pound per square foot. Americans in England had seen planes land on it successfully even in wet weather. On 22 July 1941, representatives of Air Corps, Engineer Board, and Fortifications (Construction) Section, OCE, agreed that priority would be given to developing a mat weighing less than two pounds and that Sommerfeld track would be among the types tested.

The board found the Sommerfeld mat suitable enough to recommend for service testing in October 1941, but nevertheless expressed reservations about it because of the difficulty of handling the heavy rolls in which it was delivered. The Reliance Steel Products Company produced a lighter rod and bar mat, which, after preliminary tests, the board also considered suitable. Yet two months after Pearl Harbor, development of the light mat was still in the preliminary stage, no designs having as yet been service tested.

In the meantime, a heavy runway constructed of pierced plank had been tested at the Carolina maneuvers in the fall of 1941. The weather was dry, the soil sandy. Under these conditions, it proved entirely satisfactory. Plank mat was also being utilized at several of the Atlantic bases, but the Engineer Board remained uneasy. Calling for more service tests in November 1941, Baker warned that "sooner or later one of these mats will be put down in a place where it is unsuitable." Although the Air Corps agreed that further tests would be desirable, none was arranged immediately.[76]

In the midst of the efforts to develop an acceptable landing mat, the Corps of Engineers, in November 1940, received by transfer from The Quartermaster General the job of constructing airfields for the Air Corps in the United States. These fields were to be permanent pavements of either bituminous or concrete materials. The Engineering Section, OCE, which had to recommend methods of construction, soon discovered that little was known about the design of such pavements. There began almost immediately a race to provide suitable bearing capacity for the increasing wheel loads of the new planes, but although some knowledge was gained during the year preceding Pearl Harbor, a suitable design was not arrived at. Exactly what type of field was best for the aviation regiments and the general service regiments to build for the Air Forces in a theater of operations was still an open question when war came. At that time, the 21st Engineers were testing runways constructed of soil-cement, soil-asphalt, and soil-treated Vinsol resin and comparing them with landing mats.[77]

If Pearl Harbor found the Corps of Engineers uncertain about many innovations, it also found the Corps possessed of the basic engineering tools of mobile warfare. The bulldozer had replaced the pick and shovel as the symbol of the engineer soldier. Behind the bulldozer stood the full

[75] 1st Ind, 15 Apr 41, on Ltr, TAG to GHQ Air Force, 25 Feb 41, sub: Landing Mats for Aircraft. 686, SP 318, Pt. 1.

[76] Ltr, ExO Engr Bd to Fortifications Sec, 10 Nov 41, sub: Additional Sv Tests of Emergency Landing Mat. 686, SP 318, Pt. 1.

[77] (1) Fine and Remington, The Corps of Engineers: Construction in the United States. (2) Stuart C. Godfrey, "Engineers With the Army Air Forces," *The Military Engineer*, XXXIII (November, 1941), 490.



MAJ. GEN. HENRY H. ARNOLD, *Chief of the Army Air Forces, inspecting a runway constructed of pierced steel plank, November 1941.*

power of construction machinery to move mountains and cut through jungle. In the steel treadway the Armored Force had a bridge which could be rapidly built to carry weights undreamed of in the mid-thirties. With the development of landing mats aviation engineers were furnished with a similar means of adjusting to the heavy loads of the newer bombers.

The effort to revolutionize equipment had had its share of opposition both within and without the Corps, but nothing even approaching a counterrevolution was ever imagined. The differences between various groups arose mainly because of the presence of strong personalities. The force with which they presented their arguments, whether radical or conservative, worked in the long run toward achieving a balance between the new and the tried.

CHAPTER III

Effects of Aerial Photography on Mapping and Camouflage

To exploit fully the advantages of speed and mobility made possible by the motor vehicle, the tank, and the airplane, the new Army had to have maps charting areas deep within enemy territory. The Corps of Engineers, guided by the plans and policies of G–2 of the War Department General Staff, worked out the technical details and troop organization to meet demands for large quantities and different types of military maps. Essential to the accomplishment of this task were the motor vehicle and the airplane, but most of all the airplane and its potential product, aerial photography.

Topographic maps, which present both horizontal and vertical positions of terrain, are needed for most military operations. For making plans involving a large combat area, command and staff headquarters require general maps of a scale smaller than 1:1,000,000 and strategic maps of somewhat larger scale that show the relief, the major systems of communication, bodies of water, and centers of population. Air force navigators use charts of similar scale for long-distance flights. The stabilized trench warfare of World War I accustomed American artillery units to the highly accurate large scale—1:20,000—battle map for firing on unobservable targets, and the Field Artillery clung to this map despite the distinctively mobile characteristics of the new Army. Even in a war of movement, the Field Artillery insisted, it must have such large-scale battle maps in order to reduce enemy strongholds and thus open the path for the advance of infantry and armor. Between the extremes of the strategic map and the precise battle map are tactical maps of scale 1:100,000 and larger which are of primary interest to field commanders for selecting routes, controlling troop movements, and locating the enemy. Exact representation of transportation systems down to the measurement of roads is shown on the tactical map. If tactical and battle maps are not available, troops can secure terrain information from the more quickly prepared map substitutes. The photomap, for example, is an aerial photograph to which are usually added grid lines, contours, and place names, as well as indications of scale and direction. Although more difficult to interpret, map substitutes yield much more information than the hasty field sketches relied upon before advent of the airplane.

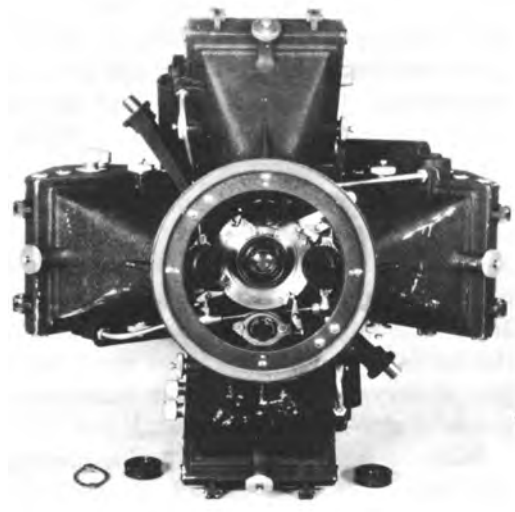
Mapping Techniques

Before development of the airplane and aerial photography, maps were prepared from data gathered by survey parties. Even with highly refined instruments for measuring distances and angles, such field surveys

are time-consuming and costly. In rough terrain, forests, and swamps this work is especially difficult; in enemy territory it is virtually impossible because field parties have to occupy the ground they survey.

Freedom from dependence upon ground surveys was forecast during World War I, when Maj. James W. Bagley, a former civilian employee of the U.S. Geological Survey and a pioneer in American photomapping, brought his recently invented trilens camera to France. Bagley's camera took one vertical and two oblique photographs and in that way produced a much larger picture than the single lens camera previously used. Study of these photographs enabled topographic engineers to overprint the sites of enemy trenches and gun emplacements on existing base maps. These experiments had more bearing on later developments than on the immediate mapping effort because there seemed little chance of improving the existing coverage of the Western Front with photomapping equipment and techniques then available. But the Chief Engineer, AEF, recognized the potential value of aerial mapping and collected much material for the guidance of future research.

Soon after the Armistice, Bagley was placed in charge of a small Engineer detachment at Wright (then McCook) Field to work with the Air Service in applying aerial photography to military mapping. Although the Wright Field detachment seldom exceeded two officers, six enlisted men, and a few civilians, it gradually provided a nucleus of expert photogrammetrists. In the course of his experiments, Bagley developed a five-lens camera, the T–3A, which became the standard mapping camera of the thirties. The aerial photographs taken by this camera, or any other for that matter, convey only a relative idea of relief and of distances.



FIVE-LENS CAMERA, T–3A

With preliminary knowledge of distances between several points on the photograph, topographers could compute the remaining measurements so as to prepare a two-dimensional or planimetric map, but field surveys were still necessary to determine every elevation or contour line that would show up on a three-dimensional topographic map. To eliminate the production bottleneck entailed by survey operations, map makers required instruments for determining elevations directly from the photograph.[1]

In 1936 1st Lt. Benjamin B. Talley of the Engineer detachment at Wright designed a simple stereoscopic plotting instrument for this purpose. By viewing overlapping aerial photographs through a stereoscope, topographers could obtain an impression of the

[1] (1) Engr Bd Hist Study, Photomapping, pp. 1–9, 23–25, 28. (2) *Historical Report of the Chief Engineer, Including All Operations of the Engineer Department: American Expeditionary Forces, 1917–1919*, pp. 95–97.

Unless otherwise noted this section and the section following are based upon correspondence in ERDL file, MP 205.

terrain in relief from which they could sketch the lay of the land. Talley combined the stereoscope with measuring and drawing attachments. With this device and the aid of special mathematical tables, a topographer could determine vertical distances fairly accurately. The new instrument, the stereocomparagraph, was small and portable and could be carried into the field to make maps good enough for reconnaissance. It was not sufficiently refined for preparing the battle maps desired by the Field Artillery, however, unless a large number of points of elevation were known.[2]

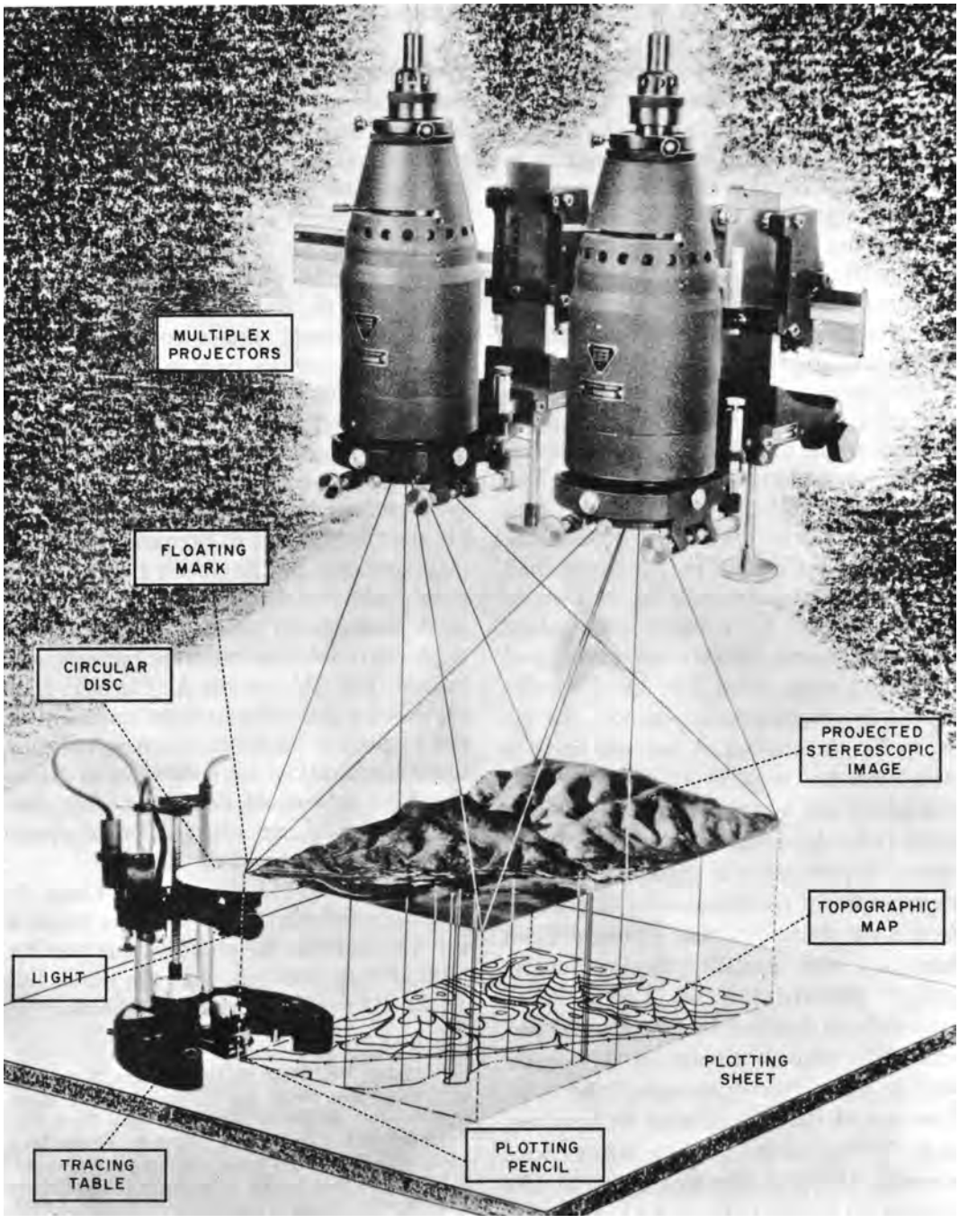
More refined stereoscopic instruments had been developed abroad. By 1936 the Engineer detachment had studied a number of these instruments and had narrowed its choice to the aerocartograph and the multiplex aeroprojector, both of which were made in Germany by Zeiss. The aerocartograph was slightly more accurate, but it was also more expensive, more difficult to operate, and almost impossible to move about. The detachment chose the multiplex set, but even this weighed about 1,800 pounds and required shelter for operation. The multiplex set consisted of a number of delicate instruments for measuring the spatial projection of images of the landscape. During 1936 and 1937 the Field Artillery tested topographic maps which the Engineer detachment prepared with the multiplex set. Although these maps depicted areas extending from 12 to 20 miles into unsurveyed territory, they were almost as accurate as the Field Artillery desired. To eliminate reliance on foreign sources, the Engineer Board persuaded the Bausch and Lomb Optical Company, an American manufacturer of microscopes, lenses, and scientific instruments, to add the multiplex to its list of products. Working closely with the Engineer detachment, Bausch and Lomb improved the design, lenses, and lighting of the German model so as to produce sharper images of the landscape. By February 1939 the first American multiplex had appeared. Multiplex sets were subsequently assigned to two of the three engineer mapping units, the army topographic battalion and the base topographic battalion.[3]

Production of the battle map was the army topographic battalion's main task. Tactical maps would be compiled as time allowed because at the outset of any conflict in a theater where map coverage was scanty, it would be impossible for topographic units to prepare both. Reproduction of existing maps was a major task for all topographic echelons. The army battalion could reproduce large quantities of maps in dimensions up to 22x28 inches, but in case it could not meet demands within its area, it could call upon the base battalion for assistance. Further potential sources of map supply were the Engineer Reproduction Plant at Washington, which was staffed by civilians under military administration and which had fairly elaborate lithographic equipment, and a number of federal agencies, such as the U.S. Geological Survey, which compiled original maps for various purposes, using modern photogrammetric

[2] (1) CE Sup Catalog, Pt. II, 1942. (2) TM 5–240, Aerial Photography, 10 May 44.

[3] (1) Ann Rpts Engr Bd, 1935–39. (2) Special Rpt I–205, Engr Det, 26 Feb 37, sub: Preparation of Fire Control Data Sheets, Ft. Bragg, N. C., 1936. Topo Br Engr Intel Div file, 061.1A. (3) TM 5–244, Multiplex Mapping Equip, Jun 1943. (4) Engr Bd Rpt 599, 11 Dec 40, sub: Interim Rpt for the Period 1 Jul 35–1 Dec 40. (5) Capt. B. B. Talley, "The Mass Production of Maps," *The Military Engineer*, XXXI (May–June 1939), 194. (6) Engr Bd Hist Study, Photomapping, pp. 5–6.

The engineer base topographic battalion was at this time and until late 1943 the engineer topographic battalion, GHQ.



MULTIPLEX SET

techniques. Lower echelons in the army would ordinarily be served by the corps topographic company, which had been formed when the shift from the square to the triangular division eliminated mapping from that organization. Like its predecessor, the mapping section of the engineer combat regiment, but on a much broader scale, the corps company had the job of reproducing existing maps and of preparing photomaps and other types of map substitutes.[4]

Substitution of photomapping for time-consuming ground surveys offered great advantages to all topographic units, but this change-over had its disadvantages also. The new mapping techniques placed the Corps of Engineers in a position of dependence upon the Air Corps. The Air Corps had photographic requirements of its own in preparing charts for strategic and tactical planning, for long distance navigation, and for plotting target areas. The Air Corps also had to fly reconnaissance missions for the Army. To the conflict of interests likely to arise from this multiplicity of tasks, there was added the fact that mapping photography called for a higher degree of skill and more complex aircraft than did charting photography or reconnaissance. "I doubt if there is any flying . . . that is more difficult than . . . high altitude mapping photography," declared Captain Talley. "It is more difficult than bombing because 95 percent of the time on a bombing mission the pilot is flying 'across country,' the other 5 percent of the time he must fly very precisely." [5] For mapping, these figures were reversed. Mapping required flights at altitudes of 20,000 feet. The Air Corps had to crowd in as many flights as possible whenever weather permitted. Unless the pilot flew in parallel straight lines close enough for the photographic strips to overlap, there were either too many or too few prints. An excessive number of prints slowed down compilation, but too few left gaps in the map and necessitated reflight. The pilot had to maintain a uniform altitude and avoid tip and tilt of the plane to keep the photography in proper perspective.

The relative crudeness in aircraft design and navigational equipment made these operations strenuous even in peacetime. At high altitudes photographic crews sometimes fainted from lack of oxygen or suffered frostbite from cold. It was therefore tempting to gloss over this work, losing sight of specifications, and consequently multiplying the complexities of preparing the final map. In 1937 the Engineers began to express doubt that the Air Corps could do the work satisfactorily unless aircraft assigned to photographic missions were radically improved. The Chief of the Air Corps in turn expressed a desire for an exact statement of the Engineers' photographic requirements. Once specifications were set down in detail, the Air Corps could determine what personnel, planes, cameras, and other equipment had to be provided.[6]

From Wright Field, Capt. Louis J. Rumaggi suggested that in many respects the specifications for photographic and for high altitude bombers were the same. But 1st Lt. Richard R. Arnold who headed the

[4] (1) Ltr, ExO Engr Bd to CofEngrs, 27 Jun 39, sub: Orgn and Equip for Corps Engr Map Unit, with 1st Ind, 19 Jul 39. 320.2, SP 286, Pt. 1. (2) Engr Bd Rpt 583, 27 Sep 39, sub: Corps Map Unit. (3) FM 5–5, Troops and Opns, 31 Jan 41.

[5] Memo, Talley for 1st Lt Richard R. Arnold, 11 Dec 39, sub: Cameras and Photo Airplanes. ERDL file, MP 205.

[6] (1) AAF FM 1–35, Aerial Photography, 3 Dec 42. (2) Engr Bd Rpt 531, 10 Feb 38, sub: Rpt on Aerial Photos for Preparing Maps. (3) Engr Bd Hist Study, Photomapping, p. 92.

mapping section at the Engineer Board questioned the feasibility of obtaining suitable wartime photographic coverage with bombers. Not only were bombers unwieldy and exposed to enemy attack, but they would certainly be confined to their primary task. "In time of war, bombers will be required for Air Corps bombing missions and will not be available for photography when they are needed. The largest number of photographic mapping missions will probably be required immediately following the outbreak of hostilities. It is during this time also that there will be the greatest number of bombing missions to destroy enemy factories and depots. Mapping missions will undoubtedly suffer." [7] In the report which he prepared for the Engineer Board in response to the inquiry from the Chief of the Air Corps, Arnold set forth the following characteristics as essential for planes assigned to mapping photography:

a. A minimum service ceiling of 30,000 feet or more
b. A size suitable and economical for its mission
c. A maximum of visibility
d. Six hours endurance
e. A cruising speed of 200 m. p. h.
f. A gyro-pilot and provision for heating and supercharging the cabin
g. Mounting for two T–3A [five-lens] cameras in tandem.[8]

Arnold took this opportunity to emphasize the advisability of close co-operation between the Corps of Engineers and the Air Corps, urging the Air Corps to activate a photographic mapping squadron to work with the base engineer topographic battalion and to appoint a liaison officer to the Engineer Board. The officer, Maj. Charles Y. Banfill, arrived soon after Arnold's report was forwarded to the Air Corps in March 1938. The following September, Kingman reopened the subject of the special plane and the Air Corps indicated that lack of funds was preventing its development. In January 1939 this obstacle was seemingly removed when the Air Corps received authority to include in its budget a sum for this purpose. These signs of activity on the part of the Air Corps were encouraging to the Engineers.[9]

The Air Force-Engineer Team

The Field Artillery, having followed Air Corps-Engineer experiments with a special interest because its requirements for accuracy in maps exceeded those of the other arms, concluded that the application of aerial photography to mapping was sound. It was clear, the Chief of the Field Artillery informed the Chief of Engineers in November 1937, that the basic problems had been solved. Certain "refinements"—improvements in quality and quantity—still had to be achieved, but these were of less immediate concern to him than the clarification of responsibilities between the Corps of Engineers and the Air Corps. Although the Engineers were inclined to think that their relationship to the Air Corps was sufficiently clear and that co-operative efforts with that arm were producing good results, Kingman,

[7] Engr Bd Rpt cited n. 6 (2).
[8] *Ibid.*
[9] (1) *Ibid.* (2) Engr Bd Hist Study, Photomapping, pp. 92, 94. (3) Ltr, ACofEngrs (Kingman) to CofAC, 14 Sep 38, sub: Aerial Photos for Preparation of Mil Maps, with 1st Ind, 7 Oct 38, 3d Ind, CofAC to CofEngrs, 6 Dec 38, and 5th Ind, TAG to CofAC and CofEngrs, 5 Jan 39. G–2 file, 183–Z–382. (4) Incl, n.d., with Memo, ACofS G–3 for G–2 *et al.*, 26 Apr 40, sub: 1st Photo Squad. AG file, 320.2 (3–25–40).

at the Field Artillery's insistence, forwarded copies of the file to G–2 in March 1938.[10]

The correspondence came to Lt. Col. Orlando Ward, himself an artillery officer, for handling. On 6 July, after getting the comment of various interested parties, Ward laid his conclusions before the Chief of Staff. He called attention to the inadequacy of existing coverage of the United States and to the noteworthy progress in the field of photomapping, and then advanced a new and radical principle. In the event of war, he declared, "the Army should be prepared to map as it moves." Following a military mapping service test to be held in the summer of 1939, Army regulations and field manuals would be revised along these lines, giving aerial photography the prominence it had earned and defining the respective duties of Air Corps and Engineers in peace and war.[11]

The camera used in this test was the five-lens model T–3A which had been developed by Bagley at Wright Field. When two T–3A's were placed side by side they produced a composite photograph that covered an area of about 400 square miles. With this camera, the Air Corps' 91st Observation Squadron photographed an area of 5,800 square miles in southern California between 10 March and 15 May 1939. This preliminary operation lasted over two months because the weather was often unfavorable. In the scheme of production, the 29th Engineer Topographic Battalion (Army) first prepared planimetric sheets which were issued as provisional maps. Then multiplex operators determined elevations and filled in contours by stereocomparagraph. For an extension of 42 miles beyond surveyed territory, the average errors amounted to 34 feet in elevation and 81 yards in horizontal position. Although these maps were less accurate than those prepared on previous tests, they covered much greater distances. Furthermore, once photography was in hand, the rate of production was high. Starting on the fifteenth day after delivery of photographs, the battalion prepared 100 square miles of contour maps a day.[12]

On the whole the results of the military mapping test were deemed favorable. Basing his conclusion on reports from lower echelons, Maj. Gen. Albert J. Bowley, a former artillery officer commanding the Ninth Corps Area, commented that the mapping at this test was acceptable both as to speed and quality and recommended adoption of the methods and equipment used by the 29th Engineers. In this connection, Maj. Russel McK. Herrington of the 29th Engineers stated that the method of map compilation from multi-lens photography was faster than any other so far discovered, and Col. W. Goff Caples, Engineer, Ninth Corps Area, remarked that "accuracy, while desirable always, is entirely secondary to speed in the choice of equipment and methods for making the Battle Map." [13]

While equally enthusiastic about the possibilities of photomapping, a number of individuals saw room for improvement, particularly in equipment. From the west coast, Air Corps and Engineer officers telegraphed

[10] Ltr, C of Fld Arty to CofEngrs, 24 Nov 37, sub: Mil Mapping, with 1st Ind, 31 Jan 38, 2d Ind, CofAC to CofEngrs, 10 Mar 38, and 3d Ind, ACof Engrs (Kingman) to TAG, 16 Mar 38. G–2 file, 229–1.

[11] Memo, ACofS G–2 (initialed OW) for CofS, 6 Jul 38, sub: Mil Mapping. G–2 file, 061.01.

[12] Engr Bd Rpt 589, 17 Jan 40, sub: Rpt on Mil Map Sv Test, 1939.

[13] Rpt, Engr Ninth Corps Area to CG Ninth Corps Area, 30 Sep 39, sub: Mil Map Sv Test, 10 Apr to 30 Jun 39. ERDL file, MP 205.

to the War Department the urgent necessity for better aircraft. Kingman, commenting on this demand, expressed understanding of the many problems facing the Air Corps and a willingness to accept the Air Corps' assurance that the simple, inexpensive plane currently furnished, the Beechcraft F–2, was merely a step in the right direction, not the last word in design. Kingman nevertheless took the opportunity to list once more the special features that an airplane destined for photographic work should have. In further comment to G–2 the Engineers stressed the inherent differences between mapping photography and that which the Air Corps was required to make for intelligence purposes. In order to obtain pictures of extensive areas rapidly and at a scale consistent with accurate delineation of terrain, mapping photography had to be accomplished at high altitudes with cameras of wide coverage. Intelligence photographs, by contrast, had to be obtained at relatively low altitudes in order to acquire detailed information about the enemy's position and installations. Such photographs could be secured by semiskilled personnel operating from simple observation planes. Mapping photography demanded not only special planes but also special air force units to perform this work to the exclusion of all other duties.[14]

Despite the generally favorable reaction of the Field Artillery, Capt. Frederick J. Dau, in command of the Engineer detachment, expressed doubt that the multi-lens photography employed in the test permitted compilation of sufficiently accurate maps. The T–3A camera had originally been designed for making planimetric maps, and, owing to the presence of obliques which surrounded the small center photographs, was not altogether adaptable to multiplex work. Oblique multiplex projectors produced errors of ten times the amount specified for projectors used in connection with vertical photography. Not only was much of the composite unfit for multiplex mapping, but the loss of detail away from the center also reduced its value as a photomap. Dau recommended replacing the T–3A camera with a new single-lens wide-angle camera which the Air Corps and the Corps of Engineers were jointly developing. Like many other valuable mapping instruments, the camera with wide-angle lens had been introduced in Germany by the Zeiss firm. In 1936, upon the recommendation of a German scientist employed by the Engineer detachment, the Air Corps had purchased a Zeiss wide-angle camera. Two years later the Air Corps began to procure wide-angle lenses from Bausch and Lomb and awarded a contract for the camera bodies to the Fairchild Aviation Corporation. This camera, known as the T–5, was designed to register tilt variations, altitude, and other data on the film to facilitate compilation of the map. The Engineer detachment concurrently adapted the multiplex for use with wide-angle photography. Bausch and Lomb again co-operated in this effort, and in December 1938 the Corps of Engineers ordered fifteen experimental wide-angle projectors from the firm.[15]

[14] (1) Telg, Lt Col Charles B. Oldfield to TAG, 10 Jun 39, with 2d Ind, CofAC to CofEngrs, 22 Jun 39, and 3d Ind, ACofEngrs to TAG, 6 Jul 39. Topo Br file, SP 205, 207, 209. (2) Memo, Col James M. Churchill, Actg ACofS G–2, for CofS, 5 Apr 40, sub: Conversion of Three Attack Bombers to Photo Airplanes. G–2 file, 183–Z–382.

[15] (1) 1st Ind, 8 Sep 39, on Ltr, C of Dev Br to CO Engr Det, 1 Sep 39, sub: Aerial Photo Map Equip. 061.1A, SP 205, Pt. 2. (2) Ann Rpt OCE, 1936. (3) Ltr, ExO Engr Bd to CofEngrs, 19 Mar 42, sub: T–5 Cameras. 061.1, SP 205 E, Pt. 1. (4) Engr Bd Rpt 668, 10 Apr 42, sub: Wide Angle Map Equip.

The T–5 camera took standard 9½-inch film which could be printed more rapidly than the several 6-inch films that made up the multi-lens composite. Its photograph covered an area more than twice as large as the vertical part of the composite and thus eliminated the excessively complicated rectifications that accompanied use of oblique photographs. A wide-angle photograph could serve directly as a map substitute. All this would save time for engineer topographers and increase accuracy. The T–5 camera also seemed preferable to the Air Corps because it was lighter and more compact than the T–3A and would thus be easier to install in an airplane. But the T–5, if employed singly to take vertical pictures as the Corps of Engineers desired, would make the Air Corps' task more difficult. With the T–3A camera mounted in tandem, flyers could space their courses about eight miles apart. With the T–5 camera they had to make twice as many runs. Furthermore, as Major Herrington pointed out, the T–3A had a great advantage over the wide-angle equipment, namely, it was already in production, whereas development of the T–5 had progressed only to an imperfect pilot model. When advantages were weighed against disadvantages, however, the T–5 camera seemed vastly superior. In March 1940, at a conference called by the Corps of Engineers, representatives of the General Staff, Air Corps, and Field Artillery agreed to retain the older type of mapping equipment only as a stopgap until the wide-angle camera and plotting accessories became generally available.[16]

By this time revision of the Army regulation and field manual was well on its way toward completion. Ward, now secretary of the General Staff, continued to display keen interest in the project, although its details had been turned over to Capt. Howard V. Canan, an Engineer officer who had taken Ward's place in G–2. Before Canan were the glowing reports of the military mapping test. Unchallenged was Ward's "map as you move" dictum. Unquestioned was the view that battle maps were the most universally desirable means of presenting terrain information. Unmentioned was the interference to be expected from hostile aircraft. All that was lacking, it seemed, were special photographic planes manned by expert crews. To Canan's dismay, G–3, which was at this time headed by an Air Corps officer, soon made clear its intention of permitting this lack indefinitely, if not permanently.

To attain speed in the production of aircraft, G–3 insisted, the number of types of planes must be held to a minimum. Mapping photography was a natural adjunct of Army reconnaissance, G–3 maintained. Reconnaissance crews, taking intelligence photographs at low altitudes in normal weather, would be on hand for mapping photography on the few days when clouds were not present at high altitudes. Photographic missions were no more difficult than bombing missions. Reconnaissance units could be taught to produce the high quality of photography desired.[17]

[16] (1) Incl, Dau for C of Photo Lab AC Mat Div, 17 Oct 40, with Monthly Rpt Engr Det. ERDL file, 319.1. (2) Ltr, Herrington to Capt F. Z. Pirkey, C of Dev Br, 25 Aug 39. 061.1A, SP 205, Pt. 2. (3) Proceedings and Transactions Mil Map Conf, 4–7 Mar 40. ERDL file, Tech Intel Br. (4) Summary Mil Map Conf, 4–7 Mar 40. 061, Pt. 1.

[17] (1) Memo, Churchill, Actg ACofS G–2 (initialed HVC), for CofS, 5 Apr 40, sub: Conversion of Three Attack Bombers to Photo Airplanes, with Incls. G–2 file, 183–Z–382. (2) Memo, Brig Gen Frank M. Andrews, ACofS G–3, for ACofS G–2, 21 May 40, sub: Conversion of Three Attack Bombers to Photo Airplanes. Same file. (3) Ltr, Canan to C of EHD, 7 Dec 55.

Canan revised his drafts only slightly to conform to G–3's wishes. The need for the manual and for consolidating gains thus far obtained dictated an early publication even though it was far from perfect. If experience demonstrated, as Canan believed it would, that the Army's requirements could not be filled as easily as G–3 supposed, the subject of special equipment and crews could then be reopened. As finally published in May 1940 the Army regulation and the field manual on maps and mapping continued the "map as you move" doctrine pending more extensive tests. The Air Corps and the Corps of Engineers were the Army's "mapping team," the Air Corps to furnish, through reconnaissance units, specially trained personnel operating from planes of the light bombardment type. Systematic collection, collation, and compilation of maps and basic map data were to start at or before the outbreak of hostilities, making possible immediate quantity production of small-scale strategic maps. Field commanders could expect only crude maps and map substitutes at first, but within ten days to two weeks they should receive accurate battle maps of areas of concentrated fighting. Full coverage of the front by battle maps would eventually be attained if the tactical situation stabilized.[18]

As set up in 1940 the Engineers' corps topographic company was equipped to move with the army. For this unit the Engineer Board had developed a mobile mapping plant installed in a 2-ton trailer drawn by a small truck. Since the unit's main job was the reproduction of maps, its main piece of equipment was a power-driven multilith press with a 17x19-inch printing area that could turn out several thousand maps an hour. For making copies of sketches, tracings, and drawings, there was a 9x13-inch hand-operated multilith, a 14x18-inch fluid duplicator, and a 24x30-inch black and white reproduction set. A modest photographic outfit could produce 7x9-inch photomaps from aerial negatives. A separate truck carried an electric generator to run the offset press and additional lithographic, drafting, and surveying equipment.[19]

Theoretically, the army topographic battalion, whose principal job was to compile battle maps, would also move with the army in the field. As set up in early 1940 this was almost physically impossible because the multiplex and most of the unit's other equipment had to be operated in permanent structures. To pack, crate, and transport its bulky, delicate impedimenta required months of preparation. In June 1940 OCE directed the Engineer Board to plan a mobile map reproduction train for the battalion, authorizing $125,000 for constructing the pilot model. During the summer the board and OCE bought operating equipment and ordered eight 12-ton trailers to arrange a completely mobile printing shop with air conditioning, heating, and plumbing. These trailers contained three 22x29-inch offset presses, a 24x30-inch copy camera, and other printing and photographic facilities, including a darkroom, arc lamps, sinks, shelves, racks, and tables. In addition there were eleven cargo trucks for carrying electric generators, water purification units,

[18] (1) Memo, ACofS G–2 for CofS, 6 Jul 38, sub: Mil Mapping. G–2 file, 229–1. (2) AR 300–15, 7 May 40; cf. AR 100–15, 2 Jul 27. (3) FM 30–20, Mil Intel, Mil Maps, 1940. (4) Ltr, Canan to C of EHD, 7 Apr 56.

[19] (1) Engr Bd Rpt 583, 27 Sep 39, sub: Corps Map Unit. (2) 1st Lt. R. R. Arnold, "Map Reproduction Equipment for Combat Engineers," *The Military Engineer*, XXX (March–April, 1938), 97–100. (3) Engr Bd Rpt 510, 6 Oct 37, sub: Map Reproduction Equip Status Rpt.

maintenance equipment, and other supplies. A far more ambitious undertaking than the corps mobile reproduction plant, the first mobile reproduction train was not completely assembled until 1941, by which time the functions hitherto assigned the unit were being called into question. Both the corps' plant and the battalion's train were to undergo many changes after being put to the test in training and maneuvers.[20]

At Kingman's suggestion, Arnold investigated the Air Corps' portable copying camera in December 1939 but found it unsatisfactory. A month later Arnold discovered a suitable commercial model which could be used to make photographs up to 24x24 inches. In order to utilize this camera in the field, the board first installed it in a special darkroom trailer. With the new equipment the corps company could make map substitutes itself without having to send aerial negatives and lithographic plates back to a permanent installation for processing. The Engineer Board also eliminated the 9x13-inch offset press and the 14x18-inch fluid duplicator from the corps' plant because they were too small for overprinting standard map sheets. After the manufacturer of the fluid duplicator expressed unwillingness to experiment with a larger model, the board in June 1940 procured a commercial gelatin roll duplicator which could overprint the 22x29-inch battle map. Although normally this machine operated satisfactorily, Arnold felt some misgivings about it because the prints tended to fade and in hot weather the roll gummed up. But with both the black and white set and the gelatin roll duplicator, the company's mobile plant was able to handle any duplicating work for the corps. Needed was an improvement in equipment for the production of photomaps.[21]

Because contact prints were clearer and showed more detail than lithographic copies of aerial photographs, the Engineer Board sponsored the development of a mobile contact printer that would operate at greater speed than commercial models, but the designer failed to achieve the desired combination of efficiency and lightness. The disappointment felt when the automatic contact printer turned out to be unsuitable was mitigated by the fact that the Engineer Reproduction Plant was making great improvements in the quality of lithographic reproduction. Experts at the plant could preserve much detail by means of the halftone process which involved the use of fine glass screens. The main objection to adopting these screens for field units was their cost, scarcity, and fragility. The national output was about one screen every three weeks. After enlisting the co-operation of the Eastman Kodak Company, the plant succeeded

[20] (1) Memo, ACofEngrs for ACofS G–3, Jan 40, sub: Participation of 30th Engrs in the Intensive Tng Maneuvers. 354.2, Pt. 6. (2) Summary Mil Map Conf, 4–7 Mar 40. 061, Pt. 1. (3) Ltr, ExO OCE to President Engr Bd, 5 Jun 40, sub: SP 319, Mobile Map Reproduction Train, Topo Bn, with 2d Ind, Sup Sec to Engr Bd, 3 Jul 40. Rqmts Br file, Engr Bd Misc Corresp. (4) Ann Rpt Engr Bd, 1941.

[21] (1) Ltr, C of Dev Br to Arnold, 29 Nov 39, sub: Copying Camera, Air Corps. 061.1A, SP 205, Pt. 3. (2) 2d Ind, ExO OCE for C of Sup Sec, 1 Dec 39. ERDL file, 413.52, MP 210 A. (3) Ltr, Arnold to Rutherford Machine Co., 12 Jan 40. ERDL file, 413.52. (4) 1st Ind, CO 30th Engrs to CofEngrs, 18 Oct 40, on Ltr, C of Sup Sec to CO 30th Engr Bn, 19 Sep 40, sub: Copying Camera. 320.2, SP 210 A, Pt. 1. (5) Ltr, C of Sup Sec to CofEngrs, 16 Sep 40, sub: Rpt on Second Army Maneuvers. 354.2, Pt. 7A. (6) Ltr, ExO Engr Bd to CofEngrs, 29 Jun 40, sub: Gelatin Roll Duplicators. 320.2, SP 286, Pt. 1. (7) Ltr, ExO Engr Bd to CofEngrs, 11 Oct 40, sub: Duplicator Equip. 413.52, SP 210, Pt. 1. (8) Memo, Asst ExO Engr Bd for C of Dev Br, 4 Dec 40. Same file. (9) Engr Bd Rpt 510, 6 Oct 37, sub: Map Reproduction Equip.

in making acetate film contact screens at low cost and in ever-increasing quantities.[22]

But even with this new process topographic companies could not produce acceptable photomaps. To exploit halftone lithography they needed presses of greater precision than the relatively simple multilith which had been the only commercial model light enough to install in the corps' mobile trailer. In the summer of 1941 the Harris-Seybold-Potter Company adapted a 17x22-inch press especially for this purpose, and in the fall delivered a revised model for printing a 20x22-inch sheet. With aluminum instead of iron castings, the Harris press weighed only 2,268 pounds—just half as much as commercial presses designed for work of comparable quality. Army and base topographic battalions, of course, also benefited from the improvements in lithographic techniques.[23]

Divergent Opinions on the Team and Modification of Doctrine

In improving topographic equipment the Engineers were trying to meet the challenge of "map as you move" and to assume a position of responsibility as a member of the mapping team. But the fact remained that the Engineers' task was easier than that of the Air Corps. Presses were simpler to redesign and to produce than were planes. During the months when the United States moved ever closer toward global conflict, there arose a gnawing doubt whether the Air Corps could carry out its part of the job or whether the Engineers could produce maps fast enough to keep up with the modern army.

At first the pressure remained upon the Air Corps to equip and organize itself in conformity with stated doctrine. By midsummer 1940 the Engineers were hopeful that the case for separate mapping photography units would be won, this time on the Air Corps' own initiative. On 2 July, the Air Corps convened a board of officers under the chairmanship of Major Banfill, its liaison at the Engineer Board, to develop a comprehensive program for aerial photography to meet the need for Air Corps charts as well as Army maps. After hearing witnesses from Infantry, Armor, Field Artillery, and Cavalry, from G–2, from OCE, and from the Air Corps, Banfill's board reported in favor of special organizations. Photographic squadrons should be the sole units charged with mapping photography and they should obtain this photography to the exclusion of all other types. Using four areas in the Western Hemisphere which had been indicated by the General Staff as possible theaters of operations, the Air Corps board recommended the organization of five photographic squadrons, three to be activated at once. On 18 September 1940, the Chief of the Air Corps approved these recommendations "in principle," and directed his staff to lay plans for putting them into effect.[24]

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[22] (1) ERDL file, MP 304. (2) Telg, Arnold to Levy Camera Co., 17 Feb 40. ERDL file, MP 210 A. (3) Telg, Levy Camera Co. to Engr Bd, 19 Feb 40. Same file.

[23] (1) Memo, C of Intel Sec for Kingman, 1 Jul 41, sub: Equip for Engr Cos (Topo) (Corps). Topo Br. Engr Intel Div file, SP 210. (2) 2d Ind. ExO OCE to TAG, 18 Aug 41, on Ltr, ExO Office of C of Fld Arty to TAG, 6 Aug 41, sub: Reproduction and Distr of Air Photos. 061.02, Pt. 3. (3) Ltr, Arnold to Capt W. K. Wilson, Jr., C&GS Sch, 1 Jul 41. ERDL file, MP 304.

[24] (1) Proceedings of Bd of Offs Convened at Washington, D. C., 2 Jul 40, for Purpose of Studying and Making Recommendations re Photo Problems. 320.2, Air Corps, Pt. 2. (2) 4th Ind, Office of CofAC to TAG, 30 Sep 40, on Ltr, ACofEngrs (Kingman) to TAG, 24 Jun 40, sub: Air Corps Units for Map Photo. Same file.

But winter came and went without action, and G–2, prodded by the Engineers, showed signs of impatience. Concern centered primarily around the lack of suitable aircraft and trained photographers, but there were other matters that needed settling. The Engineers were beginning to shy away from the doctrine that the Army must map as it moved, at least if this were interpreted as starting from scratch and supplying large-scale maps or even photomaps. An army topographic battalion could supply battle maps covering approximately 100 square miles per day or a total of 2,500 square miles about three weeks after receipt of photography. Was this rate of production consistent with the increased mobility of the new Army? The Germans had their maps ready before launching the blitzkrieg. Had it not been so prepared, the German *Sixth Army* would have required an average of 750 miles of new mapping daily during the period from May 10 to May 26. Did the American Army really need a map on so large a scale as 1:20,000 at the high degree of accuracy specified? Because of the short time the photomap had been in existence it could not yet be fully accepted as a substitute for the battle map, but the speed with which it could be produced (after the delivery of photographs) argued strongly for assigning its preparation to army topographic battalions and base plants as well as to corps topographic companies. It might be desirable to relax the standards of accuracy specified for photomaps, relegate the preparation of the battle map to the base battalion and base plants, and remove the bulky multiplex equipment from the army topographic battalion, thus increasing the mobility of the latter organization and freeing it to concentrate upon photomap work. Would it not be desirable also to lower the standards of training now established for the army topographic battalion? It seemed unnecessary to place so much stress upon refinements and appearance.[25]

Banfill, in G–2 at this time, prepared a study which the Engineers' questions had touched off, and he discountenanced any relaxation of standards. The mobility of the new Army, ran his major premise, had not only multiplied the area of map coverage but had placed a greater premium on accuracy. Because it preserved so much detail, the scale 1:20,000 was most "generally satisfactory." In order to serve all military purposes, Field Artillery standards would be adhered to. While conceding the impossibility of attaining such accuracy in concert with the Army's movement, Banfill stressed the necessity for compiling large-scale maps or photomaps of critical areas. Neither the Air Corps nor the Corps of Engineers was prepared to handle this job, Banfill asserted, concluding gloomily that "the wartime Engineer-Air Corps mapping team contemplated by existing regulations is substantially nonexistent." [26]

At the end of May 1941, the Air Corps and the Corps of Engineers were directed to get together to devise a system of teamwork within the rules of the game as laid down by G–2. The rules were strict, stricter indeed than those established by Army regulation and field manual. Special Air Corps units must cover the entire theater of operations by aerial photography before the entry of ground troops. Plans would center on production and distribution of maps and photomaps at scale 1:20,000. Every topo-

[25] Memo, Actg CofEngrs (Kingman) for ACofS G–2, 11 Mar 41, sub: Mil Mapping Orgn and Procedure. G–2 file, 061.01.

[26] Memo, Actg ACofS for G–2 CofS, 18 Apr 41, sub: Maps and Terrain Intel in TofOpns. G–2 file, 061.01.

graphic unit capable of preparing battle maps would be kept on this type of work and efforts would be made to increase the output. The Corps of Engineers must furnish enough topographic troops to guarantee continuous production of photomaps at a rate of 10,000 square miles a day.[27]

Two weeks before issuing these instructions the War Department announced the imminent activation of the Air Corps' 1st Photographic Group, describing it as "a unit of special purpose aviation, trained and equipped for combat aerial photographic operations." Although less skillful work was not necessarily excluded from its duties, the 1st Photographic Group was designed primarily for mapping photography and for such other aerial photography as was beyond the capability of observation and reconnaissance squadrons.[28] Just how much of the unit's work power was to be at the disposal of the Engineers and how much retained by the Air Corps for its own badly needed charting photography was as yet undetermined. In commenting on the War Department's mapping directive the Air Corps noted that "part of this Group will be equipped and trained as the Air Corps member of the Engineer-Air Corps Mapping Team." [29]

In further comment on the directive, the Air Corps joined the Engineers in questioning the sanctity that had been bestowed upon the scale 1:20,000. Also known to G–2 was the British opinion, based upon action in France and North Africa, that a scale 1:100,000 was about right in a mobile situation. Against these doubts stood the custom of World War I and the apparent blessing of G–3 and the War Plans Division, although just what WPD's concurrence meant in this instance is a matter for conjecture. Less than three months after Brig. Gen. Harry J. Malony approved the directive as chief of WPD's Plans Group, thereby giving his approval to the widest possible distribution of large-scale maps and map substitutes, he joined the ranks of the skeptical as Deputy Chief, Army General Headquarters. Maps of scale 1:20,000 were not to be preferred for all troops in all situations, Malony asserted from GHQ. They were "highly desirable" for infantry and artillery on the defensive but not for a rapidly moving force.[30]

Agreeing that battle maps were of limited use in mobile warfare, Engineer and Air Forces representatives questioned yet other policies that they were supposed to use as a basis for teamwork. If the General Staff had areas other than the United States or its possessions in mind, it had better discard the idea that an entire theater of operations could be photographed before the entry of ground troops. Foreign countries, even friendly ones, seldom permitted such activities in peacetime. Once war broke out, the weather and the enemy could be counted upon to prevent any such systematic photography. To supply photomaps at the rate of 10,000 square miles per day, as the General Staff envisaged, was out of the question. The entire plan to compile, reproduce, and distribute maps and map substitutes on such a large scale was completely uncalled-for anyway. Coverage must be confined to areas of critical tactical importance. A less ambitious program was suggested. During peacetime, the War Depart-

[27] Ltr, TAG to CofEngrs and CofAC, 29 May 41, sub: Maps and Terrain Intel in TofOpns. 061 (S).

[28] Ltr, TAG to CofAC, 15 May 41, sub: Constitution of the 1st Photo Group, Air Corps. 320.2, Air Corps, Pt. 2.

[29] Memo, ACofAC for Secy WDGS, 16 May 41, sub: Gen Staff Memo, Maps and Terrain Intel in TofOpns. G–2 file, 061.01.

[30] (1) *Ibid.* (2) G–2 file, 061.01.

ment should concentrate upon obtaining photography for the preparation of aeronautical charts and maps needed for defense of the Western Hemisphere. To this end all the mapping facilities of the federal government, both civil and military, should be placed under the control of a director of surveys. In wartime and for peacetime training the preparation of all battle maps would be relegated to base topographic battalions, photography to be supplied by special photographic squadrons. Army topographic battalions and corps companies would concentrate upon map revision and the preparation of photomaps and provisional maps, photography to be furnished by observation and reconnaissance aviation. The proposed reply to the General Staff gave unmistakable evidence of major concessions to the Air Forces' point of view. The phrase "map as you move" might never have existed. Reconnaissance and observation aviation was deemed acceptable for furnishing photography to field mapping units.[31]

The joint recommendations, ready in draft in late September 1941, were still in the office of the chief of the AAF awaiting final approval when the attack on Pearl Harbor occurred. Lt. Col. Herbert B. Loper, chief of OCE's Intelligence Branch, attributed this inaction to the fact that Air Forces officers who participated in the study "carry no weight." [32] The AAF was to oppose steadfastly the establishment of any additional authority such as the proposed director of surveys.[33]

The October–November 1941 maneuvers tended to bear out the general tenor of the conclusions arrived at by Air Forces and Engineer representatives in September and to reveal as well a good deal about the common attitude toward maps. Following the decision to relegate precise mapping to base topographic battalions, the Engineers organized a light topographic battalion of about 400 men for assignment to the field army organization. In line with its simplified duties in preparing photomaps and tactical maps and revising existing maps, the new unit carried the portable stereocomparagraph instead of the bulky, delicate multiplex. During the summer the 30th Engineers, the Engineer Reproduction Plant, and civilian lithographic firms prepared the initial supply of maps for the maneuvers. Major Rumaggi, commanding the light topographic battalion, discovered during the first month of operations that distributing millions of maps in the field was an overwhelming job. Because the battalion had to stock tons of maps, it needed a permanent structure from which to make the distribution. For close co-ordination with Air Forces photographic units, the best location was near an airfield. Under these circumstances, the battalion could not economically accompany every minor movement of army headquarters. The excessive length of the reproduction trailers made them difficult to drive and to conceal from enemy observation. The Engineer Board therefore decided to substitute van-type trucks that were easier to handle and to conceal. In November, after lending thirty trucks to other outfits, the battalion settled down at Fort Bragg and compiled and reproduced large quantities of new photomaps which covered about one fourth of the

[31] (1) Memo, CofEngrs for CofS, 23 Sep 41, sub: Maps and Terrain Intel in TofOpns. 061 (S). (2) Ltr, TAG to CofEngrs and CofAC, 19 Jun 41, sub: Obsvn Avn. AG file, 320.2 (4–8–41).

[32] Memo, C of Intel Br OCE for Reybold, 15 Dec 41, sub: Joint Engr-AF Tech Comm. 061, Pt. 2.

[33] See below, pp. 451, 453–54.

maneuver area. When other duties diverted from 10 to 25 percent of its personnel from technical work, Rumaggi advocated an increase in the strength of the unit. The T/O which became effective the following April raised the army topographic battalion to 508 enlisted men.[34]

Loper meanwhile analyzed maneuver experiences. The reproduction done by topographic units had been of unusually high quality, but the units had been denied opportunities to perform photogrammetric work for lack of aerial photography. Loper concluded that aviation squadrons organically assigned to army and army corps were inadequately trained and equipped to furnish this photography even if they were unopposed by enemy forces. Because troops had received immense quantities of maps at the start, they made few additional demands during the course of the exercises. The Engineer Reproduction Plant, base battalions, and commercial lithographic firms supplied the Third Army alone with over 600 different map sheets, comprising about 600 tons of maps. The next month they furnished 30 maps to each officer in the combined maneuvers of the Second and Third Armies, and in October had about 200 sheets ready for the First Army. These base plants had thus assured an ample supply of maps, but this very production deprived tactical mapping units of the chance to test their ability to turn out maps under combat conditions.

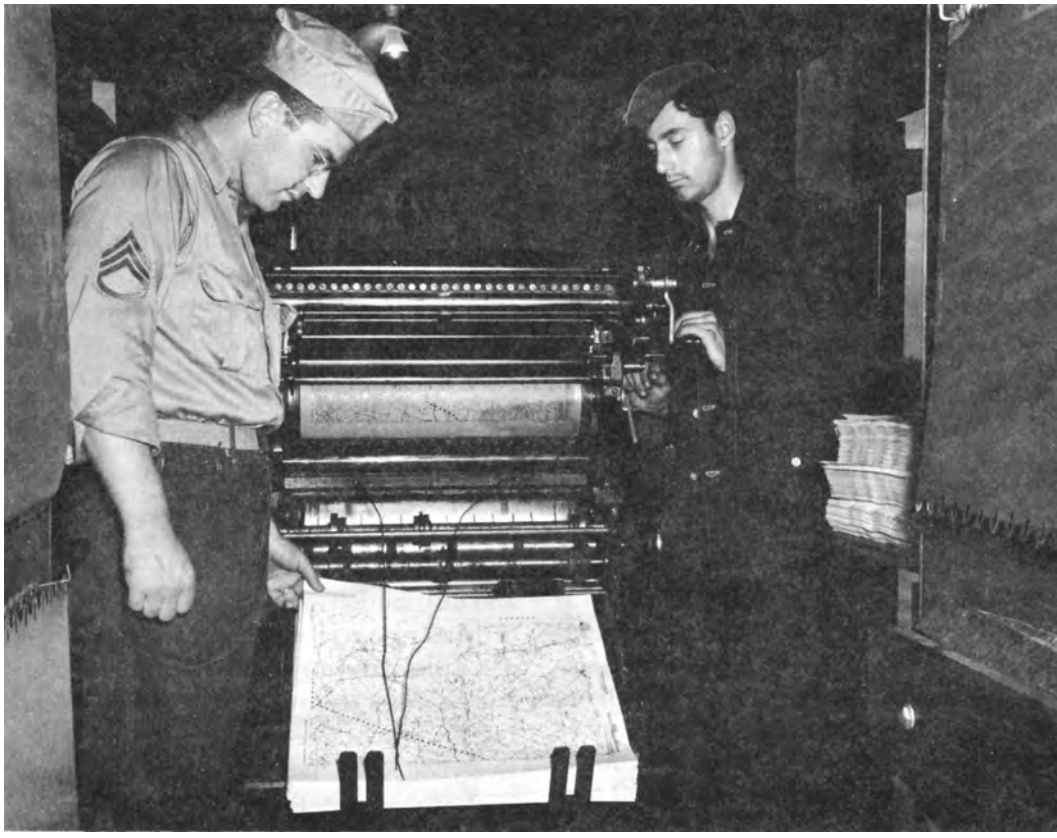
The maneuvers also disclosed that troops gave insufficient attention to their maps. One exception was the IX Corps, which according to its Engineer, avoided a great deal of road work by studying the maps carefully. But in general other troops depended too much on filling station road maps, which contributed little to their training and which sometimes led to disturbing consequences. Even with maps that contained clearly marked road and bridge information, artillery units in the 1941 Carolina maneuvers overloaded and damaged bridges by crossing first and inspecting later. Through failure to record data showing the location of important command posts, traffic stations gave little help in tracing troops in their vicinity. One observer spent hours seeking the whereabouts of First Army headquarters until he was informed by an ice-cream vendor that it was in Troy, South Carolina. Military police in that town could not give specific directions to this post, but a girl in their booth told the observer how to get there.

Loper maintained that unit engineers and staff officers needed training in map supply and distribution, and decried their tendency to demand special maps to suit personal idiosyncrasies. During the Carolina maneuvers, one observer reported: "Maps were plentiful. In fact, there were too many kinds. Everybody one talked to had a different kind of map." [35] This profusion of custom-made maps not only slowed down production but also caused confusion among their users. In Loper's opinion, "standard sheet sizes, geographical arrangement, scales and content are essential to efficient map preparation, supply, and use. Types of maps must be limited to those actually essential and the preparation of special maps to meet the in-

[34] (1) 1st Ind, 3 Sep 41, on Memo, ExO OCE for CofS GHQ, 21 Aug 41, sub: Prov Topo Bn for First Army Maneuvers. 320.2, Engrs Corps of, Pt. 14. (2) T/O 5–55, Engr Topo Bn (Army), 1 Apr 42.

Unless otherwise noted, the remainder of this section is based upon correspondence in (1) 354.2, Pts. 7A, 9, 10, and 11, and (2) 061, Pt. 2.

[35] Memo, Maj Theodore T. Molnar for CofEngrs, 8 Dec 41, sub: Rpt of North and South Carolina Maneuvers. 354.2, Pt. 11.



PRINTING MAPS IN THE FIELD, CAROLINA MANEUVERS, 1941. *Trailer equipped to make plates and print maps has a separate small trailer furnishing electricity for the printing machine.*

dividual desires of certain unit commanders must be discouraged." [36]

At the same time Loper recognized the futility of issuing maps which would not be used. The rapid pace of the maneuvers bore out GHQ's contention that there would be little demand for large-scale maps in mobile warfare. Artillerymen welcomed detailed photomaps for locating enemy targets, but other troops remained apathetic to them, pronouncing them "too bulky, too heavy, too stiff." [37] Some units did not even open the cartons to examine them. Loper believed that photomaps should be issued automatically to the artillery only; to others on request. To cut down their weight and bulk by 40 to 50 percent, he favored reducing their scale to 1:25,000 or less. As for tactical maps, most troops preferred scales of 1:125,000 and 1:250,000. Loper favored the former because it was sufficiently large

[36] Memo, C of Intel Br for CofEngrs, 9 Dec 41, sub: Map Sup for 1941 Special Fld Exercises. 061, Pt. 2.

[37] Ltr, Capt Paul W. Thompson to Kingman, 7 Oct 41, sub: Army Maneuvers in Louisiana, 15–30 Sep 41. 354.2, Pt. 10.

to cover an area of about 750 square miles on a single sheet. Loper also concluded that the only practical approach to preparing maps of potential enemy areas consisted in exploiting to the utmost maps already in existence, depending upon aerial photography for revision and for filling gaps in coverage. Loper's conclusions struck a hopeful note in a situation that had been rendered frustrating by the AAF's inability to supply planes and personnel for the extensive precise mapping photography that the General Staff had insisted was necessary. The sights had been lowered not simply by limitations imposed by the AAF but also as a result of observing the behavior of American troops in what was a reasonably close approximation of battle conditions.

Camouflage for Open Warfare

Aerial photography opened up vast areas denied to the ground surveyor but magnified the difficulty of keeping military operations secret. It was still imperative for soldiers to employ natural and artificial cover. It was vastly more important to conceal large concentrations of units and the presence of installations such as airfields through elaborate camouflage in order to convey false information to aerial observers.[38]

The AEF had met the need for camouflage in World War I by employing special engineer units which supplied camouflage materials and circulated among the field armies as technical advisers. The field forces they served were responsible for camouflaging their own positions. These special troops were disbanded at the end of the war. Emphasis reverted from protective concealment to parade-ground appearance. Camouflage methods remained geared to earlier conditions of battle, ill-suited to mobile tactics, and lagging behind advances in observation techniques. Regarding camouflage as something for the experts to worry about if war broke out, the other arms seldom asked the Corps of Engineers for advice on this subject during peacetime. Part of the reason for this failure to consult the Engineers may have been the fact that the Corps had no clear-cut responsibility for camouflage. The Army regulation which spelled out the Engineers' duties made no mention of the subject. Yet since no other agency had been charged with the functions carried out by engineer troops during World War I, the Corps naturally continued its interest, assuming that its general responsibilities for supplying materials for the organization of defense systems included camouflage.[39]

For a good many years the only person who consistently devoted time and study to camouflage was Lt. Col. Homer Saint-Gaudens of the Carnegie Institute, an Engineer Reserve officer who had been in charge of camouflage for the Second Army in World War I. Relating camouflage to the other problems which troops encounter in the field, Saint-Gaudens helped keep this subject alive by contributing to training manuals, teaching at the Engineer School, and observing developments in foreign armies. Following his recommendation, the Engineer Board in 1937 set up a camouflage section which Arnold directed in addition to his mapping duties. By 1941 the study

[38] Except as otherwise noted, the discussion of camouflage is based upon: (1) OCE files, 467, SP 272, Pts. 1 and 2, and 467, SP 314, Pt. 1; and (2) ERDL files, CM 272 A, CM 272 B, CM 329, and CM 330.

[39] (1) *Historical Report of the Chief Engineer . . . AEF, 1917–1919,* pp. 68–78. (2) Rpt, Comm on Camouflage, Engr Sch, 30 Nov 40, sub: Special Course in Technique of Assault Opns. 352.11, Engr Sch, 670, Bulky. (3) AR 100–5, 6 Dec 21.

and testing of materials and techniques became so intensive that this section required ten full-time officers and a complement of architects, designers, chemists, modelmakers, and other craftsmen.[40]

In the interim the G–2 had been shocked at the prevailing ignorance of camouflage techniques that became evident at the spring 1940 maneuvers. "There is a tendency to associate spit-and-polish and Duco finished equipment with morale," he advised the Chief of Staff in June 1940. "This idea is believed to be false and detrimental to training. It is also positively dangerous, having as it does a tendency to defeat any serious effort at concealment." [41] The need for education and for modernization of camouflage methods to meet the challenge of infra-red and color photography caused the General Staff to clarify and publicize the Engineers' responsibilities in this area. On 29 June 1940 the War Department announced its intention to include assignment of responsibility for the development of techniques, materials, and methods of training in camouflage in the next revision of the appropriate Army regulation. There followed a letter to the chiefs of the arms and services and to corps area commanders calling their attention to the deficiencies noted at the maneuvers and designating the Corps of Engineers as the service to which they should look for guidance in raising the level of performance.[42]

With the assistance of the photographic section from Bolling Field and a small detachment from the Engineer School, the Engineer Board had reported in October 1939 on general requirements for wartime camouflage. Following the system used in World War I, base battalions would fabricate materials in overseas theaters. Engineer battalions assigned to field armies would send out teams to instruct the troops and inspect their work. The board also recommended flat-tops for concealing gun emplacements from aerial observation. A flat-top consisted of a cover of fishnet or wire mesh, garnished with foliage or strips of burlap, stretched over a framework of posts and baling wire. Seen from the air, a properly garnished flat-top would blend with the color, texture, and shadows of surrounding terrain. For camouflaging vehicles, the board found the best solution was to drive them under cover. In areas where cover was not available, the board suggested dispersing the vehicles and spreading garnished nets over them. Even if not completely hidden, trucks, tanks, or other vehicles could be sufficiently obscured to deprive the enemy of clues to their purpose.[43]

Anticipating wartime shortages of materials required for camouflage, the board in 1939 tested the concealment properties of cotton and pulp-paper fabrics used commercially for vegetable sacking. This type of material proved too transparent and practically impossible to garnish. But the board was able to substitute osnaburg—a cotton cloth somewhat coarser than unbleached muslin—for burlap which was

[40] (1) Ltr, ExO Engr Bd to CofEngrs, 4 Sep 37, sub: Camouflage Practice in Foreign Armies. 467, SP 204, Pt. 1. (2) "Engineer Board Notes: Research in Camouflage and Concealment Facilities," *The Military Engineer,* XXXIII (March–April, 1941), 121. (3) Ann Rpt OCE, 1941.

[41] Memo, Actg ACofS G–2 for CofS, 7 Jun 40, sub: Protective Coloration and Camouflage. G–2 file, 300.3 (AR 100–5) 2–10–41 (6–7–40).

[42] (1) WD Cir 72, 29 Jun 40, sub: Protective Coloration and Camouflage. (2) Ltr, TAG for COs of Arms and Svs *et al.,* 12 Jul 40, same sub. AG file, 321.7 (11–28–33), Case 1.

[43] (1) Ann Rpt Engr Bd, 1939. (2) Engr Bd Rpt 585, 18 Oct 39, sub: Gen Review of Camouflage Procedure and Mats. (3) Engr Bd Rpt 562, 1 Feb 39, sub: Camouflage Equip for Vehicles.



FLAT-TOP CONCEALING 3-INCH ANTIAIRCRAFT GUN EMPLACEMENT, *3d Army maneuver area, Louisiana, August 1941.*

made from imported jute. Like burlap, osnaburg was also suitable for baling, sandbags, and target cloth. Working in co-operation with the Department of Agriculture, the board developed special impregnants for preventing deterioration and damage to this material by fire, mildew, and rot.[44]

From 1939 on, the board tested the effects of paints and colors on visibility. Study of terrain throughout the country indicated a need to stock only seven to nine colors. Of these, olive drab promised the widest application under most circumstances. In 1941 the Army applied the information by adopting this color for numerous articles of wood, metal, and cloth. But even with colors that blended with the surroundings, the standard paint had a conspicuous gloss. It was combustible and required turpentine or linseed oil for thinning. After testing a number of commercial products, the board recommended a lusterless casein paint which could be thinned with 50 percent water. It was inexpensive, had good concealment qualities, and reduced fire hazard, but it took several days to become resistant to rain, and when stored outside, froze in winter and turned sour in summer. Since most casein was imported, the board encouraged private industry and the Federation of Paint, Varnish, and Lacquer Production Clubs to seek a substitute. The resulting product was an inexpensive resin-bound cold-water paint which dried rapidly and stored readily.[45]

[44] Rpt cited n. 43 (2).

[45] (1) Engr Bd Rpt 585, 18 Oct 39. (2) Ltr, Arnold to ExO Engr Bd, 8 Aug 40, sub: Rpt of Visit to Armd Center, 5–6 Aug 40. ERDL file, SP 272.

Advances in observation techniques meanwhile created a formidable new weapon against camouflage—infra-red photography. Improvements in film now permitted taking infra-red photographs from fast-flying aircraft. With infra-red filters and film, artificial pigments photograph much darker than the green of natural vegetation even though they look the same to the eye. The problem, then, was to get camouflage materials that both visually and photographically matched the colors of nature. The board experimented with cut foliage, which made ideal garnishing except that it withered and required frequent renewal. With help from the Department of Agriculture, some headway was made in preserving cut plants; however, the foliage did not endure outdoors. The board was more successful with infra-red paint. Having no commercial demand, this product did not exist before 1941 and had to be specially developed. The board again profited from research carried out by its own new laboratory and by the paint industry. By the fall of 1941 it was possible to prepare casein and resin-bound paints in standard colors which could not be detected by infra-red photography.

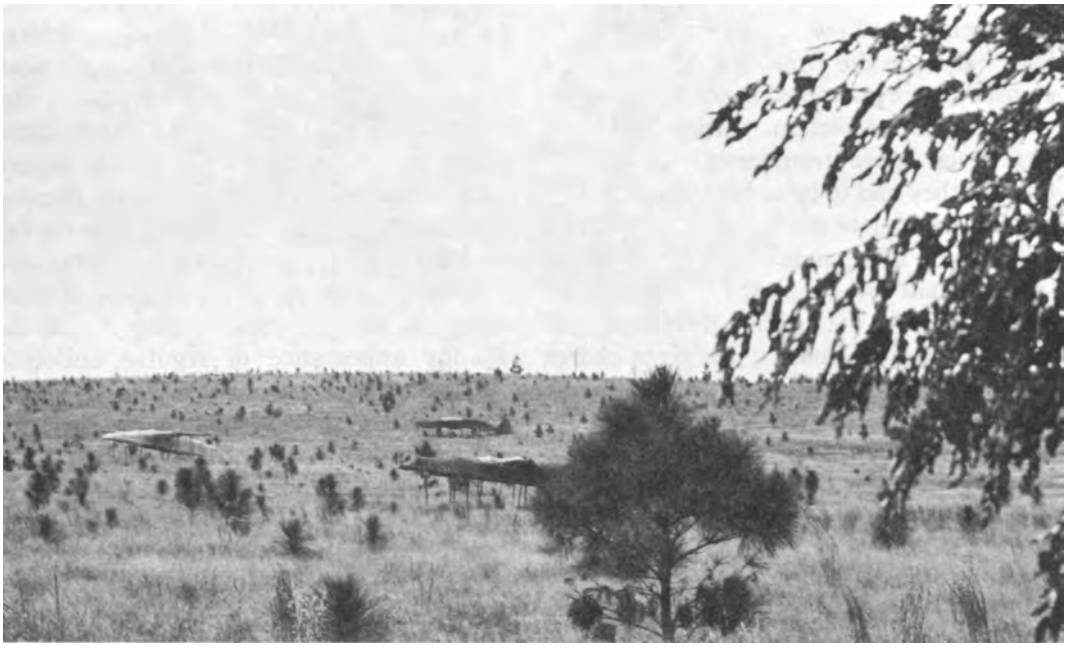
While working on these general problems, the Corps of Engineers also developed special camouflage equipment for other arms. In 1939 Arnold reported on experiments with two-dimensional decoys made from strips of painted cloth which from high altitude resembled silhouettes of aircraft on the ground. By distracting attention from real planes, they would lure the enemy into wasting his efforts and expose him to antiaircraft fire. To simulate shadows, panels of black cloth were placed along the lighter silhouettes. These decoys were partially effective against visual observation at 2,000 feet, but to deceive the aerial camera and to avoid the necessity of moving the shadow panels to correspond with the position of the sun, Arnold suggested elevating the silhouettes onto frames.[46]

More intensive research on decoys for the AAF as well as other arms came later. So long as troops lacked guns, tanks, and planes for training, it seemed frivolous to talk about using decoys in battle. Thus in August 1941, Maj. Lyle E. Seeman, chief of the camouflage section at the Engineer Board, explained to a display manufacturer: "The subject of elaborate dummies as you outline, would be secondary to placing the real thing in the hands of a man to defend himself. If and when a good bluff will . . . be required, and whether that will fall into our responsibility in camouflage work, is a matter of conjecture." [47]

Decoys were only incidental to the protection of actual military objects. Concealment of aircraft on the ground depended largely on how effectively the airdromes themselves were concealed. Aviation engineers were trained to pay particular attention to camouflage and dispersion, to disturb the existing terrain as little as possible, to blend the runways with the rest of the landscape, to build repair shops that resembled farm buildings, and to erect flattops and camouflaged sandbag barricades at the edge of the field where dispersed aircraft could be parked. If time permitted,

[46] Engr Bd Rpt 574, 16 Jun 39, sub: Silhouettes for Aircraft.

[47] Ltr, Seeman to Jenter Exhibits and Display Co., 11 Aug 41. ERDL file, CM 329.



DUMMY PLANES IN POSITION, *1st Army maneuver area, October 1941.*

they would even lay out decoy airdromes to divert the enemy from the real installation.[48]

Field artillery batteries needed camouflage that could be quickly applied whenever they moved. But flat-tops originally designed for stabilized conditions took a long time to set up. Garnishing the nets themselves was such a slow operation that troops often disregarded concealment altogether or flung bare netting over their parked vehicles and emplacements. Although the board had originally felt it preferable for troops to paint and garnish their own nets to match the local terrain, Saint-Gaudens repeatedly advised simplification of work in the field. It would be overly optimistic to expect troops to bother with elaborate concealment measures in combat; they had not done so in World War I and they would not now, he maintained. The board therefore arranged to furnish precut colored strips of osnaburg as well as nets which were already garnished in three standard blends of colors for different terrains and seasons.[49]

Even with pregarnished nets, it took hours to dismantle and set up flat-tops for artillery

[48] (1) Ltr, Lt Col E. P. Sorensen, Actg Dir AC Bd, to CofAC, 9 Oct 39, sub: Air Corps Bd Study 42, Shadow Shading of Airplanes, in Air Corps Bd Study 42, 21 Jul 41, 467, SP 314. (2) Col. Stuart C. Godfrey, "Engineers with the Army Air Forces," *The Military Engineer,* XXXIII (November, 1941), 487–91. (3) Maj. R. E. Smyser, Jr., "Airdromes for War," *The Military Engineer,* XXXIII (December, 1941), 556.

[49] (1) Info Bull 15, 14 Nov 38, sub: Camouflage. (2) Lt. Col. Homer Saint-Gaudens, "Discussion," after Capt. P. Rodyenko, "An All-purpose Camouflage Net," *The Military Engineer,* XXXIII (March–April, 1941), 152. (3) Memo, Saint-Gaudens for Files, 7 Feb 41, sub: Investigation of Engr Camouflage Through the Mil Attaché at the British Embassy and the British Mil Mission . . . 6 Feb 41. ERDL file, CM 314. (4) Memo, Seeman for Saint-Gaudens, 11 Oct 41, sub: Proc of Camouflage Mats. 467, SP 62, Pt. 1. (5) Engr Bd Rpt 656, 15 Jan 42, sub: Camouflage Mats and Equip.

emplacements. Low trajectory firing left blast marks on the ground, requiring either painstaking precautions or changes in position to avoid detection. Antiaircraft guns were even more troublesome to conceal because they had to be mounted in the open to secure complete traverse and elevation.[50]

Realizing that modern warfare required faster means of concealment, the board started to revise the artillery frame in January 1941. Saint-Gaudens, just given charge of camouflage at OCE, submitted details about a prefabricated frame for a 30x30-foot net that the British were using. He had seen a crew erect it in eight minutes, and when ready to fire, clear the net from the gun by releasing a switch. After experimenting with various flat-top structures, the board adapted the British model for the 3-inch gun. In place of bulky wooden posts which the old type of flat-top required, the new set used iron pipes which fitted into sockets welded on the outriggers of the gun and which were further secured by guy wires fastened to stakes. Because the British net was too small to conceal both gun and crew, the board added two nets measuring 14x29-feet each. A crew could now camouflage a gun in fifteen to twenty minutes, clear away the net in ten seconds, and reuse the same frame about a hundred times. The principle of knocked-down prefabricated sets was further applied during the war to the concealment of other artillery pieces and even to small aircraft.[51]

For several years the Engineer Board, upon requests by the infantry, had also investigated the use of small nets for concealing individual soldiers on duty as scouts and snipers. Such nets were helpful so long as soldiers remained motionless but hindered combat activity by catching onto weapons and equipment. Arnold believed it simpler to break the form of the helmet with foliage and to darken the face and hands with dirt.[52] Meanwhile reports from abroad described special camouflage suits and helmet covers. In 1940 the board began to experiment with mottled garments which blended with foliage, fields, and grass, and in the fall of 1941 sent samples to the Infantry and Armored Force. At first, adoption of these suits was resisted because they lacked the snappy appearance of regular uniforms. Although the commander of the Hawaiian Department believed that such garments would benefit forces on the beaches or in tropical vegetation, the Chief of Infantry doubted that any "self-respecting Army would wear suits like that." [53] On First Army maneuvers that fall, some lookouts hid their suits rather than bear the taunts of fellow soldiers, but other forward observers that wore them evaded discovery from tanks that passed within a few yards. In December 1941 the Infantry and Armored Force Boards, while recommending changes in tailoring, reported favorably on the idea of camouflage clothing. Special suits of this type were issued during the war, and some troops painted their fatigues in mottled patterns.[54]

However ingenious these measures were, their value in the last analysis depended upon the using arms. Interest flagged when

[50] Info Bull 15, 14 Nov 38, sub: Camouflage.

[51] (1) Info Bull 42, 11 Mar 40, sub: Camouflage. (2) Engr Bd Rpt 675, 16 Mar 42, sub: Camouflage Net Set for Light and Medium Fld Arty Batteries.

[52] Engr Bd Rpt 572, 29 May 39, sub: Camouflage Nets of Individuals.

[53] Memo, Maj R. P. Breckenridge, Engr Bd, for File, 12 Nov 41, sub: Memo of Conf OQMG, 11–7–41. ERDL file, CM 330.

[54] (1) Armd Force Bd Rpt P–185, 11 Dec 41, sub: Camouflage of Individuals. 467, SP 330, Pt. 1. (2) Inf Bd Rpt 1280, 3 Dec 41, sub: Individual Camouflage Suits. Same file.



SOLDIERS CAMOUFLAGED WITH INDIVIDUAL NETS

it was found that camouflage involved work and foresight. Even when natural cover and artificial materials were available, troops on maneuvers generally failed to use them. They left their nets in cartons, or set them up incorrectly; they concealed against lateral, but not overhead, observation; they double-parked long lines of vehicles bumper-to-bumper; and they failed to observe blackout regulations. No doubt the exaggerated rapidity of operations as well as the virtual absence of aircraft tended to minimize the incentive to camouflage on these exercises. In addition, observance of camouflage in training seemed superfluous to troops who could not sense any immediate and visible danger. What they neglected to practice they expected to apply in battle. The Engineers knew this type of thinking would result in initial casualties, but so long as camouflage discipline was a command decision, there was little they could do beyond extending the scope of instruction in this subject to the other arms.[55]

[55] (1) Memo, ExO OCE for Kingman, 8 May 40, sub: Rpt on the IV Corps Maneuvers at Ft. Benning. 354.2, Pt. 7A. (2) Ltr, Kingman to TAG, 12 Jun 40, sub: Rpt of Obsvrs on Spring Maneuvers. Same file. (3) Rpt, Comm on Camouflage, Engr Sch, 30 Nov 40, sub: Special Course in Technique of Assault Opns. 352.11, Engr Sch, 670, Bulky. (4) Memo, Gorlinski, AC of O&T Br, for Fowler, 4 Dec 41, sub: First Army Maneuvers, 22–28 Nov 41. 354.2, Pt. 10. (5) Ltr, Kingman to TAG, 28 Oct 41, sub: Activation of Additional Camouflage Bns. 320.2, Engrs Corps of, Pt. 14.

CHAPTER IV

A Start in the Procurement of Equipment

In the hands of trained troops, power machinery, new types of emergency bridges, mine detectors, landing mats, and intricate devices for the compilation and reproduction of maps would become instruments for attaining the speed and efficiency required of engineer units in the new Army. Some of the most ingenious of these items were still in the development stage in 1940 when the United States began to build up its military strength. Assistant Secretary of War Robert P. Patterson, whose main function was to oversee the purchase of supplies for the Army, realized the potential of the equipment under development but insisted that suitable substitutes be bought immediately. The search for improvements must continue but not at the sacrifice of an accelerated procurement program, Patterson instructed Schley in August.[1] Except for a few items, such as trucks, the Engineers had authority to buy all the equipment for engineer troops doing engineer work. Camouflage materials and searchlights were the only significant purchases made for other arms and services. For the accomplishment of its major tasks the Corps was ready in 1940 to order construction machinery and other equipment already selected as soon as money was forthcoming.

Peacetime Plans

For almost twenty years, during the interim between the two wars, the Corps of Engineers had planned for wartime procurement of equipment under the general rules laid down by the Office of the Assistant Secretary of War (OASW). The aim of such planning was the orderly placement of contracts during any future military expansion so as to avoid the competition for facilities and labor that had characterized military buying in World War I. Given the number of troops specified by the General Staff for a wartime Army, the services could presumably calculate the quantities of equipment needed. Industrial capacity could then be investigated and specific plants lined up. On the basis of recommendations received, OASW was to allocate plants or portions of plants to the various services.[2]

The services did not make elaborate plans for each item to be procured. Many articles that would be bought in wartime were commercial products and could be obtained without difficulty. For these items OASW required only that lists of prospective suppliers be maintained. For special military items and for commercial products which for one reason or another might prove scarce in wartime OASW encouraged the preparation of drawings and specifications, descrip-

[1] Memo, ASW for CofEngrs, 26 Aug 40, sub: Freezing of Designs. 400.112 (C).

[2] R. Elberton Smith, The Army and Economic Mobilization, a volume in preparation for the series, UNITED STATES ARMY IN WORLD WAR II, Draft Ch. VII, pp. 6–7.

tions of the manufacturing process, schedules of production, and estimates of the requisite machine tools and manpower.[3]

The Corps of Engineers was not in a position to derive much benefit from the procurement planning program because accurate requirements were impossible to predict. It was simple enough to figure out how many bulldozers would have to be produced for direct issue to troop units, but it was quite another matter to estimate how many bulldozers, road graders, tons of cement, square feet of landing mat, or other such supplies, would be needed for special wartime construction projects. Estimates for a war in the Pacific would differ vastly from those for a war on the continent of Europe. Since the planners could not know where the war would be fought they had to make assumptions. The Operations and Training Section compiled lists of equipment and materials that would be needed in a given type of activity in a given climate and terrain. The Supply Section had little faith in such compilations and frankly admitted in 1939 that plans for operational supplies were incomplete. Since ultimate expenditures for such supplies accounted for approximately 60 percent of the dollar value of the Engineer procurement program, plans which did not state these requirements accurately were necessarily deficient in forecasting the amount of industrial capacity needed.[4]

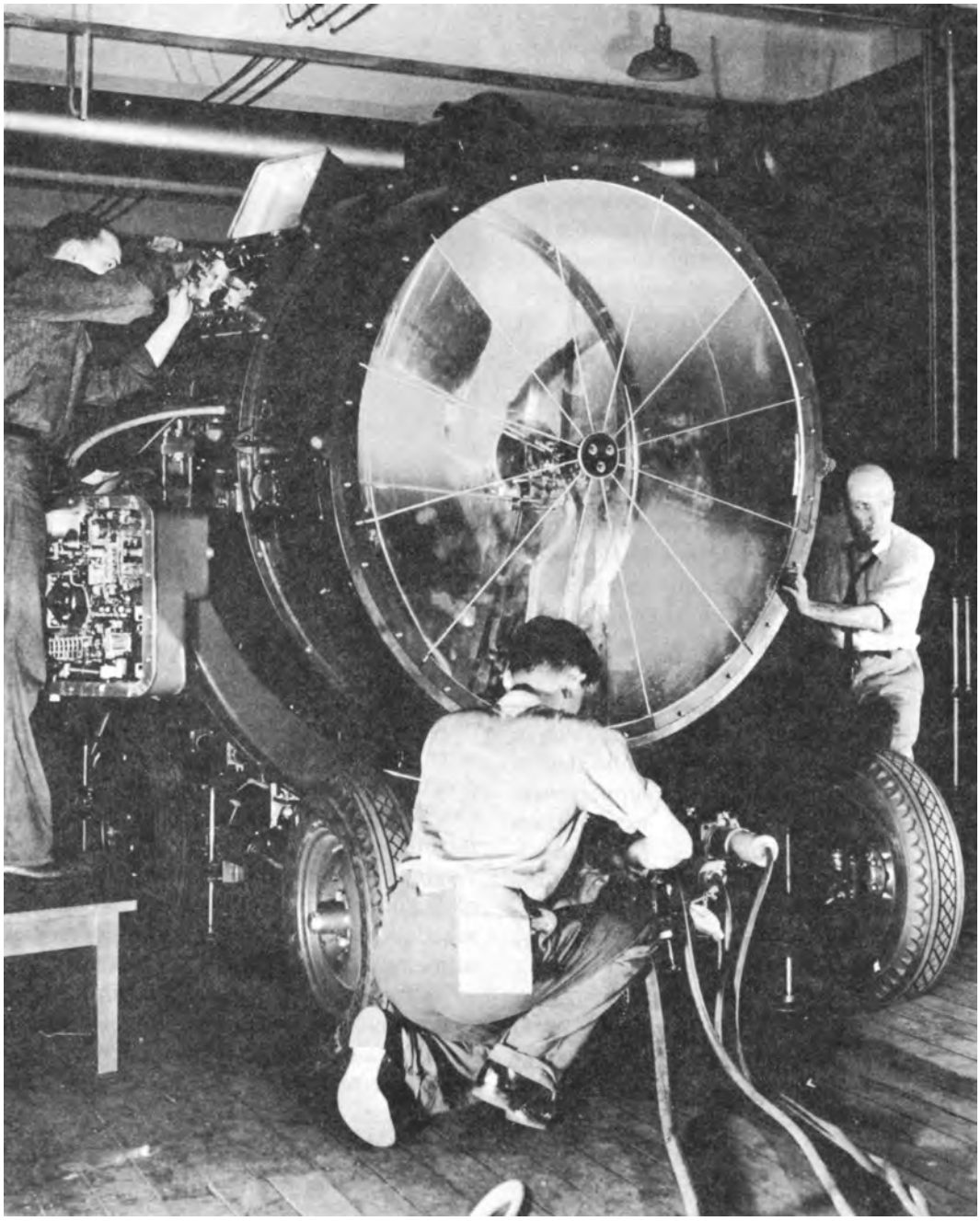
The Engineers did not fit well into the planning program for another reason. Most of the items they were preparing to buy, including the whole array of construction machinery, were either standard or slightly modified commercial articles. OASW was naturally for the most part preoccupied with planning for the production of weapons and other matériel not manufactured in peacetime, an attitude clearly expressed shortly after war broke out in Europe. Anxious that procurement planning be accelerated, OASW considered limiting the allocation of facilities to special military equipment. The Engineers were quick to protest. Allocation of facilities and preparation of production schedules for construction machinery and numerous other standard commercial articles should be continued, the Supply Section maintained, since wartime requirements were certain to tax productive capacity, and since no reserve stocks had been authorized.



ASSISTANT SECRETARY OF WAR ROBERT P. PATTERSON. *(Photograph taken 1944.)*

[3] (1) OASW Plan Br Cir 2, 10 Jun 38, sub: Proc Plans. 400.12, Pt. 89. (2) Ltr, Dir Plan Br OASW to CofEngrs, 23 Sep 38, sub: Progress in Proc Plan. Same file.

[4] (1) Lectures on Proc Plan, Lecture 2, 18–23 Mar 29. EHD files. (2) Engr Mob Plan Based on WD Mob Plan (1933 Rev), 15 Jun 34. EHD files. (3) Memo, C of Sup Sec for O&T Sec, 24 Jun 39. O&T Sec file, 370.94 Mob Sup Folio 6.



60-INCH SEARCHLIGHT UNIT *being tested by engineers in the General Electric plant, Schenectady, N. Y.*

The Supply Section was also acutely conscious that many of the plants on which the Corps was dependent could be readily converted to the manufacture of munitions. If OASW were to stop allocating such plants, other services might successfully crowd the Engineers out. OASW did not press the matter.[5]

Ironically, the Supply Section was most successful in planning production for searchlights which were for the use of another service and which the development of radar made practically obsolete by 1943. The fear lest there be insufficient searchlights was understandable enough in the late thirties when to all but a handful of farsighted individuals the defense of the United States extended no farther than its borders. The Engineers could get money for searchlights when little could be had for anything else. With this one item, plans could be acted upon. The 60-inch searchlight unit consisted of a reflector with mirror, control station, power plant, and control and power cables. Sources of production were extremely limited. In the thirties the Sperry Gyroscope Company was the only plant tooled up for production of the light; the only producer of the parabolic metal mirror was Bart Laboratories of Belleville, New Jersey, a small plant owned and operated by the inventor of the process by which metal mirrors were made. In addition, the Engineer Board maintained a small experimental mirror laboratory at Fort Belvoir. In 1938 the Engineers received the first of three allotments of money to increase productive capacity for mirrors and lights. Under a program authorized by Congress to provide industry with some experience in the manufacture of special military items the Engineers granted an educational order to the General Electric Company which induced that plant to tool up for the manufacture of lights. Expansion of the Bart Laboratories, conversion of the Engineer Board's laboratory to manufacturing, and finally, as demands for searchlights mounted in 1940, construction of a new mirror plant at Mariemont, Ohio, followed in quick succession.[6]

In June 1940 Kingman announced that procurement plans were complete for all but a fraction of those items which might present production problems.[7] This meant at least that various facilities had been earmarked for wartime production. If the Engineers entertained any fears that these facilities would prove insufficient they did not say so. Indeed, lacking a firm base from which to estimate quantities of operational supplies, the Engineers could not produce any facts to bolster such a claim. Unfortunately, these uncertainties about requirements persisted throughout the period before Pearl Harbor. Of equally serious consequence was the fact that during this time the Engineers were afforded practically no opportunity to order the operational supplies that were to account for so much the greater part of their wartime purchases.

[5] (1) Ltr, Dir Plan Br OASW to CofEngrs, 2 Nov 39, sub: Alloc of Industrial Capacity. 400.12, Pt. 95. (2) Ltr, C of Sup Sec to ASW, 14 Nov 39, same sub. Same file.

[6] (1) Memo, Control Office OCE for Col John W. N. Schulz, OASW, 8 Jul 39, sub: Educational Order—60-inch AA Searchlight. AG 381/147 Educational Orders. (2) Ltr, C of Sup Sec to ASW, 5 Jul 38, sub: Program Under Educational Order Legislation. 400.12, Pt. 89. (3) Elaine A. Nelson, The Construction of the War Department Searchlight Mirror Plants (typescript, March 1944). EHD files. (4) Engr Bd Hist Study, Metal Searchlight Mirrors.

[7] Ann Rpt OCE, 1940.

Two Million Extra

The Corps of Engineers was constrained to limit its purchases as a result of War Department policy. Uncertain itself as to if, or when, or where the United States might be committed to fight, the War Department concentrated upon readying an emergency defense force and providing industrial capacity for the production of weapons and ammunition. Accordingly the procurement program developed by the Engineers was limited to providing troop units with organizational equipment. Such a program was desperately needed. The bulk of ponton bridging on hand was obsolete. Troop units authorized construction machinery trained with hand tools.[8]

The Engineers received their first substantial allotment of money to buy modern equipment for troop units in February 1940, following the President's declaration of a limited national emergency and his authorization to increase the size of the Regular Army from 210,000 to 227,000 men. The Engineers' share of the February appropriation was $2,000,000, a small sum, not quite sufficient to equip completely all units in the Regular Army much less the National Guard. Small as it was the February appropriation signaled a fundamental change that was immediately recognized. The Supply Section shared in the general enthusiasm and understood the eagerness of unit commanders to receive new equipment, but cautioned restraint. The first of a series of bulletins designed "to furnish . . . an insight into the inner workings of the Supply Section" and to "prevent dire accusations from the field of unwarranted delay and gross inefficiency," pointed out that "we are not at war, and the supply of troop organizations still must follow our normal peacetime procedure. . . . Many bright ideas of speeding up purchases have been proposed, but remember the laws must be observed." [9]

The most fundamental of the laws which had to be observed was that requiring competition for government orders. Competition was assured by a system of bidding whereby a government agency advertised its intention to buy a given product and invited business firms to submit proposals as to quality, time of delivery, and price. The lowest bidder usually got the order, although the government could pass over a firm whose product did not meet specifications or who clearly would not be capable of delivering. This system of buying had many advantages in a normal peacetime market. Since all prospective sellers had an opportunity to bid, charges of favoritism were obviated. Since contracts were awarded to the lowest responsible bidder, the government presumably paid a price that was both economical and fair. But the system was not expected to work during an emergency. First, it was incompatible with the planned-for allocation of facilities. Second, it was too time-consuming. In case of a major rearmament the government would negotiate its contracts, as was the universal practice in private industry.

The time consumed by competitive bidding was of immediate concern to the Supply Section. Ten to thirty days were allowed for the submission of bids. Evaluation of bids and necessary paperwork followed. Anxious to get equipment into the hands of

[8] Unless otherwise noted this section is based upon: (1) Smith, *op. cit.*, Ch. IV, pp. 4–9; (2) Ann Rpt OCE, 1940; (3) Sup Notes 1, 15 Feb 40, and 2, 26 Mar 40, in Rqmts Br file, Engr Sup Notes 1940–41.

[9] Sup Notes 1, cited n. 8 (3).

the troops as soon as possible, the Supply Section tried to speed up this process somewhat. The Procurement Branch sent out invitations to bid as soon as money had been appropriated, not waiting as was customary for the actual receipt of funds.

By 1 March 1940 contracts valued at about a million dollars had been let for air compressors, power shovels, road graders, concrete mixers, bulldozers, assault boats, bridges, water purification units, and map reproduction trains. The Supply Section was most anxious to obtain all this equipment in time for the maneuvers scheduled for May but doubted this could be done. Bridges, boats, and water purification units—special military items—took a year or more to produce in quantity.[10] "It takes months to buy even a standard type of gasoline shovel," Godfrey lamented.[11] Six months from ordering to delivery was about average for the amount and types of construction machinery the Engineers had placed under contract.

Engineer troops took little new equipment to the spring maneuvers. Their equipment, the Chief of Staff recalled, was "tragically short even for the few Engineer units in the Regular Army." [12] Summing up the situation at the end of June 1940 Kingman noted that funds allotted had enabled the Engineers to order equipment for the triangular divisions, IV Corps, and GHQ troops which represented most but not all elements in the 227,000-man Army. As Assistant Secretary of War Patterson presented the facts, in short, the twenty-four engineer units in the Regular Army in June 1940 were lacking some critical items and the National Guard's nineteen engineer units had scarcely anything at all.[13] Up to this point, both lack of money and lack of time had contributed to shortages. After the German advance through the Low Countries, it was time more often than money that threatened to run out.

Rearming in Earnest

When the Chief of Staff appeared before the House Appropriations Committee early in 1940 to defend the Army budget for the next fiscal year, the American people had recovered from the shock of the German attack on Poland. There had been little military action after the completion of the Polish campaign. This fact, generously reinforced with wishful thinking, had led to the popular concept of the phony war. Under these circumstances, many congressmen were unsympathetic toward the Army's request for $853,000,000. The military, far less sanguine about the world situation, regarded the Army budget as the barest minimum of safety, but felt compelled to say nothing that could be construed as warmongering. On 9 April 1940, six weeks after General Marshall's testimony on the appropriation bill, the Germans moved into Norway. On 10 May came the full-scale blitzkrieg in the west. Suddenly the budget that had seemed so large appeared modest indeed.[14]

The War Department had a plan—the Protective Mobilization Plan—that provided for the orderly expansion of the Army in case of a national emergency. The first increment was to bring the active Army to

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[10] Memo, C of Sup Sec for G–4, 13 Apr 40, sub: Proc of Engr Equip. Rqmts Br file, Gen Staff, G–4.

[11] H, *Military Establishment Appropriation Bill for 1941, Hearings,* p. 656.

[12] Special Senate Committee Investigating the National Defense Program, 77th Cong, 1st Sess, *Investigation of the National Defense Program, Hearings* on S. Res 71, Pt. 1, p. 162.

[13] *Ibid.,* Pt. 6, p. 1538.

[14] Watson, *Chief of Staff,* pp. 164–65.

750,000 men. The $853,000,000 budget which the Chief of Staff defended in February 1940 included money to stockpile critical items (defined as items not readily available from commercial sources) for the Initial Protective Force and to procure both critical and essential items available on relatively short notice for the currently authorized 227,000-man Regular Army and 235,000-man National Guard. On 19 April, ten days after the Germans attacked Norway, the Supply Division (G–4) of the War Department General Staff asked the services to prepare estimates to cover those critical items omitted from the budget which were needed by active units of the Army. This was the first of a number of estimates called for during the spring and summer of 1940 as the battle of France was being lost. By the end of June, Congress had appropriated nearly $3,000,000,000 to the Army, the goal now being to provide critical and essential items for a force of 610,000 and critical items for 1,200,000 men. The Munitions Program of 30 June raised the sights still higher. Under this program the Army proposed to provide a force of 1,200,000 with critical and essential items by 31 September 1941, to provide critical items for 500,000 more men by the following December, and to create productive capacity for the eventual arming of 4,000,000. In the fall, Congress appropriated additional money, bringing the total funds available to the Army to $7,000,000,000. The Corps of Engineers' share of this amount was $70,000,000.[15]

Justifications for this sum had been prepared by the Requirements, Storage and Issue Branch, Supply Section, in great haste. The request for estimates made on 19 April had to be answered the following day. But the small staff of the Requirements Branch had had no difficulty in arriving at the answers to such requests. Computing requirements for organizational equipment, and this was all the Engineers were asked to do, was a matter of simple arithmetic. Quantities of items required for the initial equipment of troops were found by multiplying T/BA allowances for each type of troop unit by the number of units authorized. To this figure the Requirements Branch added a percentage to allow for replacement. From the resulting total it deducted quantities known to be on hand or previously financed and prepared a statement of requirements as called for.[16]

Since War Department policy prohibited the stockpiling of commercial products the Munitions Program did not include allowances for the purchase of any operational Class IV supplies for the Corps of Engineers. Although deploring this rule the Engineers did not apply immediately for its relaxation. They did call attention to deficiencies that were demonstrable under specific defense plans. In the spring of 1940 defense plans provided for the deployment of task forces to defend strategic points in the Western

[15] (1) *Ibid.*, pp. 30, 128, 171, 178–80. (2) H, *Military Establishment Appropriation Bill, 1941, Hearings,* p. 2. (3) Memo, WD Budget Off for CofEngrs, 19 Apr 40, sub: Supplemental Estimate for Critical Items. 111 (1941) (S). (4) Memo, C of Sup Sec for ACofS G–4, 28 May 40. Fiscal Liaison Sec file, Regular Estimate 1942. (5) Memo, ACofS G–4 for Cs of Sup Arms and Svs, 26 Jun 40, sub: Army Rqmts for a Force of 4,000,000 Men. Rqmts Br file, Gen Staff G–4. (6) S, *First Supplemental National Defense Appropriation Bill for 1941, Hearings,* 76th Cong, 3d Sess, pp. 1–3. (7) Incl with Memo, C of Fiscal Br for Dir Purch and Contracts OUSW, 17 Dec 41. 400.13, Pt. 3.

[16] (1) Army Industrial College Short Course 3, Current Proc in Corps of Engrs, given by Brig Gen John J. Kingman, Sep 41. (Hereafter cited as AIC Short Course 3.) Intnl Div file, 400.113. (2) Memo, Maint Sec for C of Rqmts and Resources Sec, 30 Oct 42, sub: Maint Factors. 400.4, Pt. 1. (3) Ann Rpt OCE, 1941.

Hemisphere.[17] After a study of the requirements for an expeditionary force which if necessary was to be sent to Brazil, Kingman commented:

> A review . . . indicates that the magnitude of the engineer tasks involved needs to be appreciated and further emphasized. The theater of operations involved is one of very meager routes of communication and facilities for engineer operations.
>
> . . . . . .
>
> The equipment needed for this force will involve much more than organizational equipment. Special attention will have to be paid to road building equipment, heavier than normally issued to troops, and including such plant as portable rock crushers. . . . A considerable number of water purification units should be included. Portable sawmills will be needed to utilize local timber resources.
>
> The tonnage of Class 4 operational supplies will be large. Such supplies as barbed wire, sandbags, cement, prepared timbers, structural steel, railroad rails, . . . and many other supplies, must be taken in large quantities.[18]

When the General Staff revised its plans for defense in the light of the German victories, Kingman made a specific request. RAINBOW 4, as the new plan was called, contemplated the occupation of certain foreign possessions in the Western Hemisphere and provided for the defense of Hawaii and Alaska. Under the schedule of movements, troops would be deployed in three contingents, the first force to move on ten days' notice, the second in thirty days, and the remainder in forty. The Engineers estimated they would need about $15,000,000 to ready themselves for the operations included in RAINBOW 4: $1,808,000 worth of equipment of the same type but in greater amounts than that automatically furnished troop units; $1,560,000 worth of special equipment such as heavy construction machinery and rock crushers; and $11,718,000 worth of construction materials. Only a small part of these supplies was on ha. ' included in the current procurement program. Kingman notified G–4 in September 1940 that it would take at least 60 days to obtain the total quantities specified. G–4, persuaded by this justification, suggested that the request for funds be included in the next appropriation bill.

Early in December a representative of the War Plans Division, General Staff, persuaded the Engineers to withdraw the request for most of the funds. RAINBOW 4 had been changed to allow thirty days before movement of the first contingent. Strictly speaking, most supplies included in the $15,000,000 estimate might be gathered together within thirty days. But Lt. Col. John M. Silkman, the chief of the Supply Section, warned that "new equipment may not be available and . . . used equipment might have to be commandeered or even confiscated depending upon the urgency of the situation under which the RAINBOW Plan became operative. The potentiality of such action as a source of confusion and delay in activities of first importance . . . should not be overlooked nor underestimated." The funds were not restored.[19]

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[17] On the various plans and measures for protection of the Western Hemisphere, see: Stetson Conn and Byron Fairchild, The Framework of Hemisphere Defense, a volume in preparation for the series, UNITED STATES ARMY IN WORLD WAR II.

The following discussion of the Engineers' part in these defense plans is based upon: (1) Conn and Fairchild, *op. cit.*, Ch. I, pp. 10–12, and Ch. II, pp. 10–11; and (2) Corresp in P&T Div file, 381, RAINBOW, Folio 1, and G–4 file 31604–3 (S).

[18] Memo, ACofEngrs for ACofS WPD, 4 Mar 40, sub: Rqmts for Task Force 1, JBWP–R–1. P&T Div file, 381, RAINBOW, Folio 1.

[19] Memo, C of Sup Sec for Lt Col R. W. Crawford, 3 Dec 40, sub: Special Equip for RAINBOW Plan. P&T Div file, 381, RAINBOW, Folio 1.

On occasion the Engineers called attention to the great discrepancy between what was being bought under the Munitions Program and what would be required in wartime. The emergency had not developed according to the book with an M Day touching off a prearranged series of steps. Instead, as Kingman pointed out, "plans and requirements for supply, at least for the Engineers, have been made piecemeal with constantly changing objectives and authorizations dependent on expected appropriations." [20] The result was a relatively small procurement program which the Engineers believed could be executed without difficulty.

The launching of the Munitions Program resulted in a number of changes in the laws and policies which regulated government buying. The expansion of productive facilities was assured by a relaxation of the tax laws to allow amortization of expenditures for plant construction, and by government financing in the form of loans or outright ownership. Competitive bidding was no longer required. Advance payments on contracts could be made. In an attempt to insure the production of first things first the Army and Navy Munitions Board (ANMB) established a system of priority ratings for military orders. In general, speed of delivery consistent with an acceptable product replaced cost as the factor to be given primary consideration.[21]

A score of suggestions were added to these formal arrangements for expediting the Munitions Program. OASW directed that the time allowed for submission and evaluation of competitive bids be cut. In order to spread the work to as many suppliers as possible, restrictive specifications were to be avoided, awards split, the use of subcontractors encouraged, and inspections speeded up. The Advisory Commission to the Council of National Defense (NDAC), the civilian group charged with supervision of the over-all productive effort, gave further guidance to the program. The NDAC reminded the services of their responsibility for protecting the rights of consumers and of labor, cautioned against overconcentration of orders, and recommended that the financial condition of prospective suppliers be carefully investigated.[22]

That many of these rules and regulations were not particularly applicable to the Engineer procurement program points up once again its relatively small size as well as the commercial nature of the products being bought. While the Ordnance Department was sponsoring the construction of a multimillion dollar munitions industry, the only government-owned plant sponsored by the Corps of Engineers was the $450,000 searchlight mirror facility at Mariemont, Ohio. But some few contractors had to expand their facilities in order to fill Engineer orders and in these cases the Corps certified that they were eligible for relief under the tax amortization law. The Engineers were well acquainted with their prospective suppliers. They did not have to worry, as did those services whose volume of buying would tax productive capacity, about the fast talking gentlemen with offices in their hats who turned up in Washington offering to produce almost anything.[23]

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[20] AIC Short Course 3.

[21] For a discussion of the priorities system, see below, p. 99.

[22] (1) Ltr, ASW to CofEngrs *et al.*, 12 Jun 40, sub: 1941 Proc Program. Legal Div file, Directives, 1940–41. (2) HR Doc 950, 76th Cong, 3d Sess, National Defense Contracts.

[23] For a detailed discussion of the construction of facilities for the Ordnance Department, see Fine and Remington, The Corps of Engineers: Construction in the United States.

With these facts in mind the Engineers decided to keep procurement centralized in the Procurement Branch of the Supply Section, OCE, although mobilization plans called for other administrative arrangements. In its civil works divisions and its district offices the Corps of Engineers possessed an extensive field organization which it believed would prove of great assistance in case the procurement load became unmanageable from Washington. In wartime the civil works program would shrink and personnel of the districts, experienced in the handling of government business, would become available to the procurement organization. In peacetime the Engineers maintained a procurement planning district in six of their district offices. Each manned by one officer and a clerk, the procurement planning districts had done much of the preparatory work in connection with the allocation of facilities. Mobilization plans stipulated the decentralization of purchasing to these six districts whose staffs would be expanded with personnel transferred from civil works and which would be supervised by Reserve officers especially trained for such duties. Even though procurement remained centralized in Washington the civil works districts and the procurement planning districts participated in the current program to some extent. The procurement planning districts sought out additional facilities and the civil works districts performed inspections required before acceptance of a product. In OCE the Procurement Branch handled the bulk of the workload.[24]

The Procurement Branch believed that most of the contracts to be let under the Munitions Program of 30 June 1940 could be advertised, but proposed to negotiate whenever possible and whenever to the government's advantage.[25] The decision to continue the use of competitive bidding wherever feasible was in perfect accord with the policies announced by OASW, which notified the services on 2 July that "the authority to purchase without advertising will be resorted to only in cases where that method of procurement is essential to expedite the accomplishment of the defense program." When negotiation was resorted to, it should be preceded by solicitation of informal bids. Negotiated contracts amounting to $500,000 or more had to be submitted to the Assistant Secretary of War for approval; the supply services were to set up appropriate safeguards for controlling the award of contracts of lesser amounts.[26] In order to speed up the placement of orders within the competitive bidding system the Procurement Branch reduced the time allowed between advertising and awards to a maximum of ten days.[27]

On 8 July, with $25,000,000 available from the regular appropriation, the Supply Section announced its intention to let contracts worth $17,002,266 within the next thirty days. All but one, an order for metallic parts for ponton bridges, would be advertised. By early September the Engineers

[24] AIC Short Course 3.

[25] Memo, ACofEngrs for ASW, 24 Jul 40, sub: Proc Plan for Munitions Program of 30 Jun 40. 470, Pt. 1.

[26] Memo, Dir Current Proc OASW for CofEngrs *et al.*, 2 Jul 40, sub: Proc Without Advertising. 160, Pt. 1.

[27] Unless otherwise noted, the remainder of this section is based upon (1) Smith, *op. cit.*, Ch. VII, pp. 7–8; (2) AGO file, Wkly Rpts to USW and Wkly Status Rpts; (3) Corresp in 160, Pt. 1; 400.12, Pts. 99–102, 107; 400.12 (S), Pt. 1; 400.13, Pt. 3; 400.333, Pt. 1; 400.333, China, Pt. 1; 3820, National Defense, Pt. 2; and Denman Personal Files, Misc, and Procedure.

had obligated almost all of their $25,000,000, and another appropriation, for $42,000,000, was approved. Again the Procurement Branch moved quickly, obligating more than $19,500,000 by the middle of the month.

Of the approximately $44,000,000 obligated, more than $16,000,000 went into orders for searchlights in contracts negotiated with the two available suppliers, Sperry Gyroscope and General Electric. One other contract in the group let at this time, with the W. & L. E. Gurley Company for transits, was negotiated. A little over $2,000,000 in contracts for ponton bridge parts and road graders was advertised. Excluding contracts amounting to less than $100,000, the Engineers had obligated by the end of January 1941 over $23,500,000 through advertisement and over $30,500,000 through negotiation. Searchlights absorbed over 50 percent of the total spent under each type of contract. Of the major items contracted for during this period six were bought exclusively through competitive bidding, eleven by direct negotiation, and seven in part after bidding and in part through negotiation. In accordance with the instructions of the Assistant Secretary of War the Procurement Branch tried to retain as much competition as possible. Thus before the negotiation of a contract the branch sought informal bids from companies who could be expected to respond to advertisement.[28]

Even when contracts were advertised it was possible through a skillful wording of specifications to restrict the bids received to those manufacturers whose products were preferred, and the Supply Section did this on occasion. Carryall scrapers are a case in point. The Development Branch wrote specifications for scrapers so that only two manufacturers—R. G. LeTourneau, Inc., and La Plant-Choate Company—could meet them. When the Bucyrus-Erie Company, a newcomer to the scraper market, protested, the chief of the Development Branch noted the poor quality of some scrapers offered in the commercial market. Relaxation of the specifications in order to allow Bucyrus-Erie to bid would force the Procurement Branch into the undesirable position of accepting bids from a good many other, less competent, manufacturers.[29]

Writing restrictive specifications was a deviation from an announced policy to spread the work. "The majority of the items on the munitions program . . . could be supplied expeditiously by one or two manufacturers," Kingman informed the Assistant Secretary of War. "However, it is planned to distribute the load to 2 or 3 of the more prominent manufacturers, who are allocated to the Corps of Engineers and who have sufficient capacity to meet the war time requirements." [30] During the period July 1940 through February 1941, major contracts were placed with thirty suppliers out of a list of forty-eight potential ones. Of the forty-two separate companies represented in the list of potential suppliers, thirty were awarded contracts:[31]

[28] AIC Short Course 3.

[29] (1) John Perry Miller, *Pricing of Military Procurements* (New Haven: Yale University Press, 1949), pp. 30–32. (2) Memo, C of Dev Br for CofEngrs, 13 Oct 41. 413.8, Pt. 10.

[30] Memo, ACofEngrs for ASW, 24 Jul 40, sub: Proc Plan for Munitions Program of 30 Jun 40. 470, Pt. 1.

[31] (1) Memo, C of Proc Br for Intel Sec, 18 Jan 41. Denman Personal File, Misc. (2) Memo, Sup Sec for Finance Div, 4 Mar 41, sub: Memo for USW . . . Re Investigation of Army and Navy Proc Opns, with Incls. 3820, National Defense, Pt. 2.

Item	Number of Potential Suppliers	Number of Suppliers Awarded Contracts Over $100,000
Total	48	30
Earth auger	2	1
Air compressor	6	2
Road grader	3	2
Gasoline hammer	1	1
Power shovel	7	3
Trailer	6	6
Water purification unit	3	1
Magnifying lens prism stereoscope	1	1
Magnifying mirror stereoscope	1	1
Assault boat	4	1
Steel highway bridge	3	1
Ponton bridge		
Metal parts	3	3
Wooden parts	3	3
Footbridge	3	2
Searchlight	2	2

A number of the companies to whom the Procurement Branch took its business had been allocated to the Corps of Engineers under the procurement plans developed by OASW. A number had not. The system of allocations so painstakingly worked out during the thirties was quietly laid to rest during the creeping mobilization that preceded Pearl Harbor. As monies were received, all the services, the Engineers included, gradually acquired an interest in a facility through the placement of orders. Where one service could not utilize all the productive capacity available, another service was welcome. Yet there was a marked tendency to gravitate toward allocated facilities whose product and management were known. Patterson credited the procurement planning sponsored by him and his predecessors for much of the promptness with which the services let supply contracts. Procurement planning, together with the experience accumulated in the supervision of civil works and of development projects, goes far to explain not only the promptness with which the Engineers placed appropriated monies under contract but also the confidence they displayed in the abilities of their suppliers to produce on schedule.[32]

Contractors normally filled orders on the basis of first come, first served. Under the priority system established by the Army and Navy Munitions Board on 12 August 1940, contractors were to fill orders in any given month on the basis of preference ratings. Preference or priority ranged from A–1 to A–10 with an AA reserved for emergency use. The A–1 rating was to be applied to critical and essential items needed to complete the equipment of all active units of the Regular Army and National Guard; A–2 to critical and essential items to equip the 1,200,000-man protective mobilization force and maintain it for one year; A–5 to critical items and A–6 to essential items to equip 800,000 men and maintain them for four months. Under this setup most engineer articles were rated A–1 or A–2. At the end of October the Procurement Branch reported that no difficulties had been encountered in connection with priorities.

Indeed the Engineers had few difficulties of any sort. With the receipt of additional funds for searchlights for seacoast defenses and for the Navy, the Procurement Branch had a program of close to $76,500,000 and had put about 70 percent of it under contract by the end of December 1940.[33] The

[32] S, *Investigation of the National Defense Program, Hearings,* 77th Cong, 1st Sess, Pt. 1, p. 30.

[33] (1) Ltr, CofEngrs to ASW, 2 Jan 41, sub: Wkly Rpt. EHD files. (2) Engineer Service Army sums allotted to projects other than No. 3 ($4,035,176) as shown in Incl, Engr Sv Army Appropriations, with Memo, C of Fiscal Br for Dir Purchases and Contracts OUSW, 17 Dec 41 (400.13, Pt. 3), have been subtracted from $80,526,294 as shown in the letter cited above.

most critical items were on order and deliveries had equaled or exceeded scheduled production in nearly all cases. (*Table 1*) Three items—gasoline shovels, earth augers, and searchlights—were behind schedule. A strike had interfered with the production of shovels. Technical engineering problems had for a time dogged the production of searchlights. The essential fact was that troops in training had experienced no shortages of equipment. Troops were 98 percent equipped, General Schley estimated in January 1941.

Although the Engineer procurement program continued to be small, during the calendar year 1941 it became more complicated. After the passage of the Lend-Lease Act in March 1941 the Engineers began to purchase supplies for Great Britain and China. In January the first of several task forces moved out to one of the Atlantic bases that had been acquired from Great Britain. As the year wore on and more task forces occupied the defense perimeter the demand for power machinery and construction materials began to put a strain upon engineer supply. In January 1941 the War Department decided to ask immediately for funds to cover that part of the Munitions Program heretofore included in the budget for fiscal year 1942. The Engineers received $18,674,000 from the appropriation act passed in April. That same month the Engineers received their first allocation in the amount of $9,707,000 from lend-lease funds. By the end of the summer, appropriations for troop equipment had added $73,000,000 and lend-lease allotments $13,000,000 to Engineer funds.[34]

The Engineers saw nothing in this situation that called for the decentralization of procurement activities. So far the Supply Section in Washington had been more than equal to the job. It should prove capable of being so in the foreseeable future. Naturally some minor administrative changes had to be made. In April the Requirements Branch established a small organization to take care of the special problem of lend-lease. But while the Washington office handled the bulk of the work, the Procurement Branch called increasingly on the civil works districts to investigate delays in production, to look into questions about priorities, in short, to expedite.[35]

The Procurement Branch planned to award contracts under the April 1941 appropriation in much the same way it had handled previous programs, by a combination of advertising and negotiation. But when the month of June arrived with a substantial amount of money still to be obligated, advertising was temporarily abandoned. For the first time the Procurement Branch resorted to the use of letter contracts, which were informal instruments authorizing the contractor to go ahead, with the guarantee of his expenses for a certain amount of preliminary work. Letter contracts did not replace formal contracts but served as another short cut pending the execution of a formal contract which, even if negotiated, consumed valuable time. By such expedients the Procurement Branch succeeded in obligating practically all of the funds allocated to purchases for the Ameri-

[34] (1) Conn and Fairchild, *op. cit.*, Ch. III, p. 34. (2) Memo, WD Budget Off for CofEngrs, 24 Jan 41, sub: Supplemental Estimate FY 1941. Rqmts Br file, Budget Off.

[35] Memo, C of Sup Sec for Cs of Brs Sup Sec, 29 Apr 41, sub: Procedure for Purch Under Defense Aid Supplemental Appropriation Act, 1941. Intnl Div file, 400.12–400.13.

TABLE 1—STATUS OF MAJOR ITEMS OF ENGINEER PROCUREMENT PROGRAM: 31 DECEMBER 1940

Item	To Be Procured Fiscal Year 1941	Under Contract	Cumulative Deliveries as of 31 December 1940	
			Scheduled	Actual
Construction Machinery				
Angledozer [a]	547	547	289	289
Auger, earth	68	68	60	48
Compressor, air	890	890	296	312
Grader, road	93	93	75	79
Hammer, paving breaker	1,063	1,063	143	143
Mixer, concrete	78	78	78	78
Shovel, gasoline, ⅜-cubic yard	83	94	54	38
Special equipment, engineer aviation battalion	7	0	0	0
Welding and cutting set	131	131	131	131
Boats				
Assault	3,446	3,446	2,446	2,456
Bridges				
Fixed steel, box girder, H–10	86	86	21	28
Fixed steel, box girder, H–20	10	10	0	0
Footbridge	111	111	43	43
Ponton, 10-ton	81	81	40	48
Ponton, 25-ton	47	47	1	1
Mapping Equipment				
Compass, lensatic	113,194	50,000	0	0
Reproduction equipment				
Corps Area Headquarters	4	[b]	[b]	[b]
Mobile reproduction train	1	1	0	0
Motorized	32	32	[b]	[b]
Stereoscopes				
Lens-prism	142	142	1	1
Magnifying mirror	2,450	2,450	0	0
Utilities				
Water purification units				
900 gallon	217	217	140	155
5,000 gallon	34	34	4	8
Electric lighting equipment, 5 KVA	15	15	15	15
Searchlights				
60-inch	1,870	1,870	35	0

[a] Procured for the Engineers by the Ordnance Department at this time.
[b] Data not available.

Source: Sched of Prod Rates on Critical Items and Status of Engr Equip Required To Meet Time Objective, submitted with Ltr, Sup Sec OCE to Prod Br OUSW, 31 Jan 41, sub: Sched of Prod Rates. . . . Special Collection Subsec of Hist Div WD Special Staff file, OUSW Plan Br 381, Time Objectives.

can Army before the close of the fiscal year.[36]

The branch failed, however, to make much headway with the program for the British. The Engineers could transfer a few items from depot stock. Beyond this they had put under contract by midsummer only $2,500,000 of the $9,000,000 worth of construction machinery, bridges, boats, and other equipment requisitioned by the United Kingdom. By the end of the fiscal year 1941 the Engineers had $23,000,000 in lend-lease funds, $13,000,000 of which was for construction materials and rolling stock for the Burma-Yunnan Railway. Between July and December 1941 they received an additional $56,000,000, most of which was for railroad building materials and rolling stock for lines in the Middle East. By December the Procurement Branch had obligated $53,000,000, or 67 percent of the total.[37]

The Beginning of Production Problems

As early as January 1941 the Engineers had expressed some uncertainty about the future rate of production. Kingman had called attention to "an apparent slowing trend" in the receipt of certain raw materials which the Supply Section feared might cause a reduction in the rates of delivery of end products. These materials could be readily identified by a look at the Army and Navy Munitions Board's priority list, he wrote the Under Secretary of War, "but among other things, a shortage may be expected of steel and steel alloy products, aluminum sheets, certain qualities of plywood, and expanded rubber." [38] The Army and Navy Munitions Board had by this time overhauled the priorities system, which had become overcrowded in the A–1 category. Accordingly, a hierarchy ranging from A–1–a to A–1–j was created. Under the new ratings engineer items that formerly enjoyed an A–1 priority with planes and tanks dropped to A–1–i or A–1–j. Yet the Engineers could hardly protest; all the Army services were in the same position. The Air Corps and the Navy absorbed top priorities.

What bothered the Engineers and indeed all the Army services more than the lowering of ratings was the fact that the rating system did not cover a sufficient number of items and raw materials. The civilian agencies in charge of production—first the NDAC and after January 1941 the Office of Production Management (OPM)—were anxious to preserve the normal flow of production to civilians. They sought to achieve this result by keeping raw materials and components which went into civilian products free of the priorities system. Accordingly, the ANMB limited the extension of ratings to those items or materials appearing on the Critical Items List which were in general "noncommercial in character or type, made in accordance with particular military or naval specifications." Commercial steel and lumber were offered

[36] (1) Interv, R. L. Pilcher, 26 Oct 50. (2) Ltr, M. S. Denman to C of EHD, 18 Jan 51. (3) Memo, PC–L–031 (White House), OUSW Actg Dir Purchases and Contracts for CofAC *et al.*, 31 May 41, sub: Obligation of Current Funds, with Incl, Form of Ltr Contract. Legal Div file, Memos, OASW and OUSW, 1940–42.

[37] Memo, C of Sup Sec for Defense Aid Dir, 2 Dec 41, sub: Lease-Lend Rpt. Intnl Div file, 400.333, Latin America.

On lend-lease before Pearl Harbor, see Richard M. Leighton and Robert W. Coakley, *Global Logistics and Strategy: 1940–1943*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1956), pp. 44–45, 76–116.

[38] Memo, Actg CofEngrs for USW, 10 Jan 41, sub: Proc Act for the Corps of Engrs Under the Various 1941 Appropriations. 400.12, Pt. 102.

as examples of materials to which preference ratings could not be extended.[39] This order created situations such as the one described by the Buffalo District Engineer:

> Efforts made to accomplish the contracts of the Rogers Brothers Corporation . . . and the Hanson Clutch and Machinery Company . . ., both manufacturing platform type trailers, have previously required that this office extend preference ratings to subcontractors. Preference ratings have been given to items which are normally considered commercial items, such as structural steel, tires, brakes, etc. . . . Steel mills have insisted that preference ratings be extended to the purchase orders from these companies in order that the mills themselves may be authorized to give precedence to the contracts.

The new system failed to make sense to the Buffalo representative who pointed out that there was "comparatively little commercial demand for specialized articles, and because of this lack of demand, obtaining delivery of special items is seldom difficult, whereas industry as a whole demands commercial items (structural steel, rubber, etc.), and because of the great demand, precedence for materials used for defense contracts is necessary. This indicates that strict interpretation of the new priority rulings nullifies, to a large extent, the underlying 'raison d'etre' of the priority system." [40] The Supply Section registered its alarm over the new policy to the ANMB in February and again in April, and asked that the restriction be lifted.[41] The Army was wholeheartedly in favor of lifting the restriction. All the services had experienced similar difficulties and entered similar protests. Gradually the OPM retreated. As of 1 May the services could extend ratings to nearly all the standard nonferrous metals and to iron and steel. By the fall of 1941 OPM had agreed to allow extensions to all materials that were physically incorporated in the product. By this time, the priorities system itself had undergone yet another overhauling which lifted all military orders into the A–1–a to A–1–j categories and placed limitations on the amounts to be produced in each category.[42] Although the new rating structure was a step forward it did not get at the root of the problem, which was a rapidly developing shortage of raw materials. The Under Secretary of War had to call upon OPM to intervene in order to obtain steel for searchlight trailers. The priority rating on optical glass had to be raised in order to obtain delivery of stereoscopes. Substitutes for aluminum had to be made whenever possible.[43] "Until such time as by joint command decision the War and Navy Departments establish a military priority for ponton bridges on the same level of importance as that which has been established for aircraft," the ANMB Priorities Committee informed the Supply Section, "it is believed realistic to face the fact that in all probability aluminum will no longer be available for the production of ponton bridges." [44] The Engineer Board duly wrote

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[39] (1) Smith, *op. cit.*, Ch. VIII, pp. 36–37. (2) C/L (Finance 1), 4 Jan 41.

[40] Ltr, Buffalo Dist Engr to CofEngrs, 13 Jan 41, sub: Priorities Instructions. 3820, National Defense, Pt. 1.

[41] (1) Ltr, C of Sup Sec to USW, 28 Feb 41, sub: Rev of Priority Critical Item List. 400.12, Pt. 103. (2) Ltr, C of Sup Sec to ANMB Priorities Comm, 12 Apr 41, sub: Changes in Priorities Critical List. Denman Personal File, Misc.

[42] Smith, *op. cit.*, Ch. VIII, pp. 37–39, 51–71.

[43] (1) Memo, Gen Rutherford for USW, 27 Jun 41, sub: Trailers. USW file, Misc and Subject Steel Through Dec. (2) Ltr, Dir Prod Br OUSW to CofEngrs, 24 May 41, sub: Optical Glass for Stereoscopes. 400.12, Pt. 105. (3) Memo, Plan Br OUSW for CofEngrs *et al.*, 7 Jul 41. Legal Div file, Directives Tanney, 1940–41.

[44] 1st Ind, ANMB Priorities Comm to Control Off OCE, 2 Aug 41 (basic missing). 417, Pt. 10.

specifications for steel pontons despite their excessive weight, and despite the fact that many signs pointed toward a steel shortage.[45]

In August 1941 the Engineers reported a slight slippage in total deliveries:

> Of the 54 items in the expenditure program deliveries were scheduled on only 21 items and were received on 18. At the beginning of the month 10 items were behind schedule and 6 were ahead, while at the close of the month 12 were behind and only 3 ahead. . . .
>
> The materiel provided by the Fifth Supplemental Appropriation Act was scheduled to come into production in a large number of cases in July but in some instances no deliveries were received. With these new contracts the Engineers are beginning to run into priority trouble in that the suppliers are unable to get the raw material and parts required because of the higher priority of other services and suppliers. This is a situation which did not prevail a number of months ago when earlier contracts were filled without difficulty.

Yet the Engineers preferred to look for the silver lining. The program was "well along." Troop units had nearly all of their authorized equipment on hand. Statistics therefore might be deceptive because "from a military viewpoint the picture is very bright in that the initial requirements have been obtained." [46] The argument was true as far as it went. The goals of the Munitions Program were being met. But the over-all picture was not bright because the Munitions Program had made practically no provision for emergency stocks. The $1,716,400 left the Corps from its $15,000,000 estimate for RAINBOW 4 had been obligated, largely upon the advice of the War Plans Division of the General Staff, for portable buildings, water purification units, portable evaporators, and machine gun emplacements. The slim margin on which the Engineers were operating became apparent as soon as emergency needs cropped up. In May 1941 Brigadier J. F. M. Whiteley came to the United States with an urgent plea for supplies for the beleaguered British in the Middle East. When the General Staff assigned top priority to filling requirements on the "Whiteley List" the Supply Section discovered that deliveries to the British would cause some delay in equipping United States troops.[47]

Other emergencies likewise called for emergency measures as Engineer troops left for Alaska, Newfoundland, and Iceland. Bulldozers and dump trucks had to be transferred from the 18th Engineer Regiment stationed at Vancouver Barracks, Washington, to the 32d Engineer Company stationed at Fort Richardson, Alaska. On 29 August, the Operations and Training Section requisitioned five bulldozers and three carryall scrapers for delivery at the New York Port of Embarkation in twelve days. Stevedoring equipment, structural timber and connections, rope tackle, power distribution equipment, a water supply system, and miscellaneous construction materials were requisitioned on 29 June to be available for shipment between 29 July and 14 September. Money was no problem, since the Engineers received special funds for this purpose. Approximately $3,000,000 was transferred from the Construction Section to the Supply Section between 25 June and 10 September 1941 for the Iceland task force alone. But the confusion that Silkman had predicted if the Engineers were not allowed an emergency stockpile was fast becoming part of the daily routine. In order to get supplies

[45] Engr Bd Hist Study, Medium Floating Bridging, 14 Jan 46, pp. 49–50.

[46] Stat Br OUSW, Wkly Stat Rpt 6, Sec. 3, 9 Aug 41. QM–Engr–Med Wkly Stat Rpt 6.

[47] (1) Leighton and Coakley, *op. cit.*, pp. 91–92. (2) Memo, C of Sup Sec for C of Defense Aid Sec, 1 Jul 41, sub: Proc of Items on Whitely List. Intnl Div file, 400.333.

out on schedule the Supply Section was sending equipment direct from factory to port. When sailing schedules changed, equipment piled up at the dock. When factories could not make deliveries in time the Supply Section drew upon small stocks stored for training purposes. This practice so depleted depot stocks that by late August 1941 the War Department directed field army commanders to cut down on training requisitions. Largely because of the higher priorities accorded to the defense build-up in these areas close to the United States, to equipping troop units, and to lend-lease, OCE could not begin to consider urgent requests from the Philippines until the fall of 1941. Support from the States failing, the Engineers in the islands exploited local resources to the utmost in a feverish attempt to provide airfields and other facilities for their defense. What was gathered together proved far from sufficient for that formidable task. And when the actual defense of the Philippines began, Engineer supplies, like those of the rest of the Army, were pitifully meager.[48]

On 17 June Schley entered a new plea to purchase a small stockpile of special equipment—"a minimum," in his words, "which should be procured and stored at once near a port of embarkation." This time G–4 approved the request. In the supplemental appropriation bill passed in August the Engineers received a minimum, $2,800,000, for this purpose.[49] Meanwhile Kingman lodged an additional plea with the General Staff:

> Our ports of embarkation are set up with a view to securing a continuous flow, and are unable to provide storage for any considerable time pending overseas shipment. Since factories cannot deliver supplies on prearranged schedules, storage difficulties will arise if purchases are made for delivery direct from factories to ports. Moreover, delivery of many kinds of Engineer supplies cannot be secured on short notice. It is, therefore, necessary that a reasonable quantity of Engineer supplies be purchased well in advance for delivery at interior Engineer depots and then shipped direct in proper quantity and kind to ports of embarkation as required.

Specifically he requested a directive to cover engineer operations in the field for task forces and emergency projects.[50]

Agreeing that a stockpile containing "a reasonable quantity" of supplies was "desirable," G–4 directed the preparation of an estimate based on two infantry divisions, one operating under arctic and the other under tropical weather conditions, and one corps operating under either tropical or temperate weather conditions. On this basis Kingman requested an immediate allotment of $5,250,000. Funds were not available, the General Staff replied on 10 October. Engineer needs must be met through the next supplemental appropriation bill where provision had been made (on 27 September) for the inclusion of funds to purchase balanced stocks of construction materials and equipment that would be needed in Ice-

[48] (1) Ltr, Engr Fourth Army to CofEngrs, 14 Jul 41, sub: Constr Equip for Alaska, with Incls. 400.31, 32d Engrs. (2) Memo, AC of O&T Sec for Actg C of Sup Sec, 30 Aug 41, sub: Purch of Tractors and Carryalls. 451.3, Pt. 6. (3) Memo, C of Fortifications Sec for C of Sup Sec, 29 Jun 41, sub: Purch of Constr Mat for TofOpns. 381, INDIGO (S). (4) Ltr, Actg CofEngrs to Stat Br OUSW, 10 Sep 41, sub: Wkly Rpt. EHD files. (5) Corresp in 400.31, Pt. 4. (6) Dod, Engineers in the War Against Japan, Ch. II.

[49] (1) Ltr, CofEngrs to TAG, 17 Jun 41, sub: Engr Equip and Supplemental Request To Meet Demands of War Plans. P&T Div file, 381, RAINBOW, Folio 1. (2) Memo, Actg ACofS G–4 for CofS, 20 Jun 41, sub: Engr Equip and Supplemental Request To Meet Demands of War Plans. G–4 file 31604–3 (S). (3) S, *First Supplemental National Defense Appropriation Bill for 1942, Hearings,* 77th Cong, 1st Sess, p. 112.

[50] Memo, ACofEngrs for CofS, 26 Jul 41, sub: Directive for Engr Rqmts. 400.31, Pt. 4.

TABLE 2—STATUS OF MAJOR ITEMS OF ENGINEER PROCUREMENT PROGRAM: 20 DECEMBER 1941

Item	Current Program		Cumulative Deliveries as of 20 December 1941	
	Appropriated Fiscal Years 1941 & 1942	Under Contract	Scheduled	Actual
Construction Machinery				
Angledozer	547	547	547	547
Auger, earth	100	100	68	68
Compressor, air	890	890	890	890
Grader, road	119	119	119	119
Hammer, paving breaker	1,079	1,079	1,079	1,079
Mixer, concrete	117	117	117	117
Saw, timber	1,715	0	0	0
Shovel, gasoline, ¾-cubic yard	5	5	3	3
Shovel, gasoline, ½-cubic yard	191	191	81	81
Shovel, gasoline, ⅜-cubic yard	99	83	83	83
Special equipment, engineer aviation battalion	31	31	17	17
Trailer, for medium tractor	1,265	609	609	609
Welding and cutting set	182	182	182	182
Boats				
Assault	3,446	3,446	3,446	3,446
Power, with trailer	62	62	2	2
Bridges				
Fixed steel, box girder, H–10	165	129	97	91
Fixed steel, box girder, H–20	62	62	10	10
Crane, truck mounted	100	77	62	51
Footbridge	174	174	164	127
Ponton, 10-ton	91	81	81	81
Ponton, 25-ton	95	76	62	48
Trestle, steel	8	8	8	8
Mapping Equipment				
Camera, copying	24	24	16	15
Reproduction equipment				
Corps Area Headquarters	4	4	4	4
Lithographic, platoon	3	2	2	2
Mobile reproduction train	2	2	1	1
Motorized	40	34	32	32
Stereocomparagraph	188	187	57	57
Stereoscopes				
Lens, prism	142	142	142	142
Magnifying mirror	3,975	3,679	2,243	1,431
Theodolite	287	22	22	22

TABLE 2—STATUS OF MAJOR ITEMS OF ENGINEER PROCUREMENT PROGRAM: 20 DECEMBER 1941—Continued

Item	Current Program		Cumulative Deliveries as of 20 December 1941	
	Appropriated Fiscal Years 1941 & 1942	Under Contract	Scheduled	Actual
Utilities				
Water purification units				
900 gallon	580	572	520	496
5,000 gallon	103	59	34	34
Electric lighting equipment				
5 KVA	352	352	183	166
3 KVA	1,025	1,025	621	571
Searchlights				
60-inch	3,907	2,261	1,788	1,583
24-inch	126	126	22	0
18-inch	160	160	160	160
Tilting trailer for	8,698	4,000	3,485	1,840

Source: OUSW Stat Br, Wkly Stat Rpt 25, Sec. 3, CE, 20 Dec 41. QM–Eng–Med Wkly Stat Rpt 25 (C).

land, Alaska, Newfoundland, Greenland, and the Philippines, and for the 1st Division Task Force in the event of its involvement in combat. The Engineers put in for approximately $15,000,000 in the estimates for the third supplemental bill, but the attack on Pearl Harbor occurred before its passage. The Engineers were caught without a single crawler tractor or square foot of landing mat in reserve.[51]

Yet the Engineers had more than met the War Department's objective, stated in October, of initial equipment for 1,418,000 men by the end of December. With $49,000,000 still unobligated, the Procurement Branch had let contracts for practically all engineer items, both essential and critical, for a force of 1,725,000 and by the end of November had received deliveries of 87 percent of this equipment.[52]

The status of forty-three key items was similarly encouraging. (*Table 2*) No contract had yet been let for timber saws or for 18x18-inch duplicating equipment. On the other hand, contracts for steel trestle bridges, ½-yard gasoline shovels, and special aviation equipment would eventually provide

[51] (1) Memo, Actg ACofS G–4 for CofS, 5 Aug 41, sub: Directive for Engr Rqmts. AG 400.312 (11) 7–26–41 (1) Directive for Engr Rqmts. (2) Ltr, TAG to CofEngrs, 9 Aug 41, same sub. 400.31, Pt. 4. (3) Ltr, ACofEngrs to ACofS G–4, 7 Oct 41, sub: Rqmts for Engr Opns in the Fld. Rqmts Br file, Gen Staff G–4, with 1st Ind, 10 Oct 41 (400.31, Pt. 5). (4) Ltr, TAG to CofEngrs, 6 Oct 41, sub: Funds for Projects Which Indicate Early Involvement in Combat, with Incl. O&T Sec file, 381, Gen Folio 6 (S). (5) H, *Third Supplemental National Defense Appropriation Bill for 1942, Hearings,* 77th Cong, 1st Sess, Pt. 2, p. 137. (6) Logistics in World War II, Final Rpt of ASF, 1947.

[52] (1) Ltr, CofEngrs to Stat Br OUSW, 3 Dec 41, sub: Wkly Rpt. EHD files. (2) Stat Br OUSW, Wkly Stat Rpt 24, Sec 3. QM–Engr–Med Wkly Stat Rpts. (3) Ltr, Dir Prod Br OUSW to CofEngrs, 7 Oct 41, sub: Time Objectives. WD Records Br Special Collection Subsec of Hist Div WD Special Staff File, OUSW Plan Br 381, Time Objectives.

for a 3,200,000-man Army. Deliveries of twenty-nine articles were either completed or on schedule. Twelve were behind: portable water purification units, both 3 and 5 KVA electric lighting equipment, magnifying mirror stereoscopes, motorized copying cameras, H–10 portable steel bridges, 25-ton ponton bridges, footbridges, truck mounted cranes, 60-inch searchlights, 24-inch beach defense searchlights, and tilting trailers. All activated antiaircraft regiments, however, had their allowances of 60-inch searchlights and new deliveries were for replacements and warehouse stocks. Production of searchlight trailers, delayed for months, was at last catching up—for the last week of November, for example, 700 were delivered against a monthly schedule of 580.[53] The new Chief of Engineers, Maj. Gen. Eugene Reybold, summed up the procurement situation with satisfaction. "All existing troop units have been furnished practically all items of Engineer organizational equipment. In addition, small amounts for maintenance incident to training are stocked in depots." [54]

[53] WD G–4, Expenditure Program Pertaining to First Supplemental National Defense Appropriation for FY 1942, 25 Aug 41.

[54] Ltr, CofEngrs to ACofS G–4, 24 Dec 41, sub: Proc Program. Mil Sup and Proc Fiscal Liaison Office file, Supplemental Estimate D, FY 1942, Equip I.

CHAPTER V

Converting to a Citizen Corps

Of all the elements that make up an army the most essential and yet the most variable is the human one. At the outbreak of war in Europe the United States Army was composed of a small core of professional soldiers in the Regular Army and a group of semiprofessionals in the National Guard and Officers Reserve Corps. With these forces, augmented by voluntary enlistments, the War Department planned to have a million men ready to fight within six months after the beginning of an emergency. In case of a full-scale mobilization the War Department contemplated the creation of a citizen army of four million men. In the two years following the invasion of Poland, the Army more than reached its initial objective of one million men. At the same time it changed from a professional to a citizen army. The transition was not a simple one. Since most recruits had had no previous military experience they had to be trained from scratch in the art of warfare. Yet in view of the increasing dependence of branches like the Engineers on mechanical equipment, those citizen soldiers with industrial skills could be considered partially trained. The creation of an effective fighting force depended in large part on the proper utilization of such men and their integration with the professionals and semiprofessionals to form efficient operating units.

The Nucleus

On 30 June 1939 there were 786 Engineer officers and 5,790 Engineer enlisted men in the Regular Army. Most of the officers were assigned to OCE, civil works districts, Reserve Officers Training Corps (ROTC) units, or sundry tasks in the War Department. Little more than a fourth of them were on duty with troops in the field. Although the primary source of their commissions was the United States Military Academy, many had obtained Regular Army commissions by appointment from civil life or after service as reservists.[1]

The Engineers considered all new officers, whatever their background, only partly trained. The basic education of an Engineer officer became complete only after two years with troops, a year of graduate work at a civilian engineering school, nine months at the Engineer School, and two years on rivers and harbors duty.[2] Circumstances did not always permit this program to be followed in prescribed sequence, but OCE frowned

[1] (1) Ann Rpt OCE, 1939. (2) Memo, ACofEngrs of ACofS G–1, 12 May 39. 310.3, Engrs Corps of, Pt. 15. (3) Rpt, Distr of Commissioned Pers—RA Active List, 30 Jun 39. Same file.

[2] (1) Info Bull 6, 16 Mar 38, sub: New Appointments in CE. (2) Memo, CofEngrs for ACofS G–3, 5 Apr 39, sub: Additional Offs for ROTC Duty. 210.64, Pt. 1. (3) Memo, ACofEngrs for C of Pers Sec, 25 Jan 40, sub: Six Year Tng Program for Offs. 210.4, Pt. 1.



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upon deviations from it, as the following reaction toward Rhodes scholarships shows:

> It has been the observation of this office and of the faculty of the Engineer School that although the three year course at Oxford University undoubtedly has a cultural value it nevertheless delays by that amount the essential training of an officer. It has been noted that the Rhodes scholars usually stand near the bottom of their class in the Engineer School and that their Oxford training appears in large measure to have neutralized the splendid training previously received at West Point.[3]

The Engineers were concerned first and last with the technical competence of their officers.

The 5,790 enlisted men in the Corps in June 1939 were volunteers, many of whom, especially among the noncommissioned officers in the top grades, had been in the Army for many years. Except for some three hundred on duty at the Engineer School or scattered among corps area and department headquarters they were members of troop units. During the thirties most of the enlisted men were jacks-of-all-trades admirably equipped for the varied duties performed by the divisional units which made up the bulk of the engineer component of the Army. By 1939 the background of a good many recruits had changed. They were younger, had more formal education, but, as a result of the unemployment of the thirties, had acquired fewer skills.[4]

[3] Liaison Ind, Kingman to TAG, 11 Oct 38, on Liaison Memo from AGO, 7 Oct 38. EHD files.

[4] O&T Office Study 160. EHD files.

The engineer Regular Army units had a dual function—operations and training. All of them devoted much time to road building, construction of simple structures, or landscape gardening. Some helped instruct Reserves at summer camps or tested new techniques and equipment. Others had more specific tasks at overseas bases or Army schools. Such work hindered systematic training. Even though troop units were small and few in number (there were only twelve of them in 1939) shortages of equipment, particularly modern equipment, forced officers to improvise and to simulate some aspects of training. As a consequence, field exercises were distorted and unrealistic.[5]

The Army tried to compensate for this imperfect unit training by emphasizing the schooling of individuals. Engineer units conducted courses to qualify men as construction foremen, demolitions experts, electricians, and carpenters. Officers broadened their knowledge at general service schools, the Command and General Staff School, and the Army Industrial College, but for special training the Army relied mainly upon special service schools within each branch. The backbone of the training program at the Engineer School was a nine-month course for Regular Army officers. Instruction covered organization of the Army and of the Corps of Engineers, military history, mobilization problems, training management, principles of command and logistics, equitation, tactics of the Engineers and of associated arms, mapping, fortifications, and construction. All officers were expected to take this course. Three technical courses in the most complicated duties of engineer soldiers were offered to key enlisted men selected for attendance: electricity, motors, and water purification; surveying, drafting, and aerial photographic mapping; and map reproduction and photography. The Engineer School had a capacity for about forty officers and about fifty-five enlisted students. Administration, instruction, and caretaking were carried on by about eighteen officers and a group of 215 enlisted men who formed the school detachment. Because of their low grades and ratings, enlisted instructors sought and received offers of better positions with other organizations. The resulting turnover in personnel, coupled with inadequate facilities, hampered the school's program. Although individuals who attended went away better equipped to perform their military duties, the school could not entirely make up for the shortcomings that existed in the field.[6]

With such typical deficiencies in training, manpower, and equipment, the Army of the thirties did not present a very formidable fighting force. After war broke out in Europe the War Department, in an effort to improve the state of preparedness, began a limited reorganization and expansion. For the Engineers an immediate effect was the demand for more officers with troops, a need that was met by transferring a number of officers from civil works districts and by compressing the course at the Engineer School into one semester. Regulars who

[5] (1) Ann Rpt OCE, 1939. (2) Info Bull 9, 25 Jul 38, sub: Unit Tng. (3) Tng Memo 52, Hq 5th Engrs, 26 Oct 38, sub: Tng Program, 1 Nov 38–31 Oct 39. 353, Pt. 14.

[6] (1) Bull cited n. 5 (2). (2) 2d Ind, Comdt Engr Sch to CofEngrs, 27 Jun 38, Incl, with 1st Ind, Comdt Engr Sch to CofEngrs, 8 Nov 38, on Ltr, ExO Mil Div to Comdt Engr Sch, 5 Nov 38, sub: RA Offs 1939–40 Course at Engr Sch. 210.3, Engr Sch, Pt. 3. (3) 1st Ind, Hq Engr Sch to CofEngrs, 8 Jul 39, on Ltr, AC of O&T Sec to Comdt Engr Sch, 6 Jul 39, sub: Capacity of Enl Spec Sch. 352.4, Engr Sch. (4) Personal Ltr, Capt C. T. Hunt, CO Engr Sch Det, to Kingman, 3 Jan 40. Loose Corresp, 1940. (5) Ltr, Hunt to CO Ft. Belvoir, 25 Jan 40, sub: Increased Grades and Ratings for Engr Sch Det. Same file.

would normally have been tied up at the school were assigned to troop units and their places filled by National Guard and Reserve officers who needed a brush-up course prior to field duty. But it was within troop units themselves rather than at the school that the major adjustments to the expansion were made.[7]

Old units provided new units with cadres. Thus the 1st Engineer Regiment sent experienced men to the 1st Engineer Battalion, the 27th Engineer Battalion, the 70th Light Ponton Company, and the Headquarters Company, 18th Engineer Regiment. Even the 4th Engineers which consisted of but a single company gave up twenty-four men. Such transfers insured the mingling of seasoned troops with recruits and distributed the training load.[8]

In 1935 OCE had prepared a 16-week mobilization training program (MTP) for emergencies and during the summer of 1939 had made a hurried revision to delete training in animal transportation, to change text references, and to increase the time allotted to defense against tanks and other vehicles. Although the MTP of 1939 was devised for the combat regiment, other types of units were expected to use it as a guide. More than half of the program's 640 hours was to be devoted to training in military engineering, about one sixth to drills, marches, and other basic and disciplinary subjects, and the remainder to marksmanship and tactical exercises such as scouting and patrolling.[9]

Few units had time to follow this schedule. As station areas were enlarged, engineer troops became involved in surveying sites, laying out tent camps, pulling up stumps, installing utilities, and building roads. At Fort Benning, the 21st General Service Regiment spent its 1939 Christmas holidays erecting a tent camp for armored units. At Camp Jackson, the 6th Engineers built and repaired combat ranges and took over construction of a hospital, about twenty mess halls, and other buildings. Good practice in construction, certainly, but hardly varied enough to create a balanced engineer soldier. Equipment, like personnel, had to be shared. The 21st Engineers had little but hand tools when it started building the camp for armored units. Most of the equipment of the 4th Engineers was five years old and needed replacing. Often troops had to borrow power machinery from the Quartermaster or the WPA. Nearly all units complained of an acute shortage of vehicles. If not in short supply, vehicles were usually run-down.[10]

The meagerness of equipment and lack of opportunity for realistic training that plagued the Regular Army existed in an exaggerated degree in National Guard units, the first line of reserve strength. In June 1939 there were 487 officers, 17 warrant officers, and 5,380 enlisted men in the engineer component of the National Guard; a year later, 569 officers, 18 warrant officers, and 10,191 enlisted men. National Guard units were controlled and administered largely by the states. Practices were therefore not uniform, even though units had to

[7] Ltr, AG 352 (11-3-38) M-C to CofEngrs, 9 Nov 39, sub: Modification of Sch Courses. 352.11, Pt. 4.

[8] O&T Office Study 160. EHD files.

[9] (1) 1st Ind, ExO Mil Div to Engr Fourth Corps Area, 1 Feb 39, on Ltr, Actg Engr Fourth Corps Area to CofEngrs, 23 Jan 39, sub: Tng Sched for Engr Units for Use Upon Mob. AG file, Engrs, 370.93, Mob Engr Ser Nos. 50-Folio 3. (2) AG Ltr 381 (9-12-39) P (C) to CofEngrs, 18 Sep 39, sub: Unit Tng Programs for Mob, with 1st Ind, C of O&T Sec to TAG, 12 Oct 39. Same file. (3) O&T Office Study 162. EHD files.

[10] O&T Office Studies 160 and 162. EHD files.

meet standards established by the War Department and had Regular Army instructors.[11] Because of the little time available—a few hours weekly and a two-week summer camp—such units received but a smattering of training. The Engineer School did offer two courses each year for National Guard personnel. One was a three-month course for Guard and Reserve officers that covered approximately the same subjects as the nine-month course for Regular Army officers. The other, for noncommissioned officers, ranged over the whole of their duties in a combat regiment. But the school's limited facilities permitted few to attend.[12]

The occupational backgrounds of Engineers in the National Guard could not make up for lack of modern equipment and haphazard training. "A regiment is fortunate if half its officers are engineers either by education or practice," Schley pointed out regretfully in September 1939. "Few noncommissioned officers are foremen, and most of the men do not work with their hands in their vocations." [13] Observers at the August 1940 maneuvers remarked on the Guard's lack of initiative and the failure of its officers to make significant contributions to organizational theory or tactics. Galloway of O&T rated National Guard engineer units from poor to good in comparison with the excellent he accorded Regular engineer units.[14] Yet for all its deficiencies, the National Guard was an organized force that had had some training. It provided a ready-made framework into which the first group of selectees could be absorbed, and the War Department urged that it be called up as a necessary prelude to the draft. The furor following the fall of France was to lead at the end of August 1940 to Congressional authorization for such action and the National Guard was thereafter gradually absorbed into the main body of the Army.

While the National Guard was the first line of reserve, another civilian component, the Officers' Reserve Corps, was considered the major base for a large-scale expansion. In the prewar years there were few enlisted men in the Reserves. Mobilization plans were based on a nucleus of officers around which new units could be organized and trained. Appointments in the Engineer Officers' Reserve Corps were open to men between the ages of twenty and thirty who had an engineering degree, who had practical experience in military drill, and who qualified in military subjects through examination or by taking extension courses. On 30 June 1939 there were over 8,000 men in the Engineer Officers' Reserve Corps, but not all were eligible for active duty either because of failure to maintain an interest in Reserve affairs or because of age. Only about 200 were directly under the control of the Chief of Engineers, the rest being assigned to corps area commands. Nevertheless, OCE was expected to maintain an interest in their status and for all practical purposes determine the standards for granting commissions and promotions. There were 29 ROTC units in 1939, one third of which had been established since 1935. The Engineers received

[11] Ann Rpts OCE, 1939, 1940.

[12] Programs of Instruction NG and Res Offs Course 1940 and NG NCOs and Sgt Instructors Course 1939, Incl with Ltr, Comdt Engr Sch to TAG, 17 Jun 40, sub: Rpt of Opns of Engr Sch 1939–40. EHD files.

[13] Info Bull 31, 26 Sep 39, sub: Extracts From Comments on First Army Maneuvers.

[14] (1) Personal Ltr, Col G. Van B. Wilkes, Engr Second Army, to Godfrey, 3 Sep 40. 354.2, Pt. 7A. (2) Rpt, Lt Col J. H. Carruth, Engr Sch, to Comdt Engr Sch, 20 Sep 40, sub: First Army Maneuvers, Aug 40. 354.2, 315A, Bulky. (3) Ltr, Galloway to CofEngrs, 12 Sep 40, sub: Rpt on Third Army Maneuvers, Aug 40. 354.2, Pt. 7A.

600 officers from this source in 1939. By 1941 the number had jumped to 800.[15]

Although applicants for the last two years of ROTC training were supposedly selected on the basis of scholastic standing and military aptitude, absolute control of ROTC membership was more wishful than real. Since civil engineering provided the best preparation for construction work, men who had majored in this subject were preferred, but the number of civil engineering students had so sharply declined during the thirties that the Engineers were forced to accept more graduates from other branches of engineering than they wished. Only 16.4 percent of the officers commissioned from ROTC engineer units in 1939 were civil engineers. The largest number, 25.5 percent, were mechanical engineers.[16]

Once commissioned, ROTC graduates continued military training under Corps Area Engineers aided by officers in the civil works districts who had Reserve instruction as a secondary duty. From time to time the General Staff criticized the Engineer system, comparing it unfavorably with that of other branches in which officers were assigned exclusively to Reserve instruction. The Engineers defended the arrangement on the grounds that it enabled them to use their small number of Regular Army officers to better advantage and argued that it was practical in view of the day-to-day contact maintained by civil works officers with civilian engineers who were also Reserve officers. Schley's awareness of the criticisms of this system probably led him to make Reserve instruction a particular concern. Theoretically, he could act only in an advisory capacity, but his direct authority over Division and District Engineers enabled him to push the matter.

The primary purpose of Reserve training was to ready each officer for a mobilization assignment. He was also expected to perform occasional duties in peacetime and to qualify for the next higher grade. Extension courses prepared by the Engineer School and periodic meetings made up his course of study. Upon completing a designated block of such training a Reserve officer was eligible for active duty at a military camp where he worked on tactical and administrative problems. While these requirements were not excessive, certain obstacles stood in the way of carrying out the program effectively. Its success depended on maintaining the reservist's interest. Most officers were assigned positions in specific units, but in rural regions it was difficult to assemble them for instruction. The bulk of training literature was aimed at general units. General training, O&T argued, would not only suffice for all special units except for topographic, camouflage, and railway, but would also make officers in such organizations available as fillers and loss replacements for the "more important" combat and general units.

In 1939 and 1940 the Engineers began to explore new ways to promote interest in the Reserves and to improve the quality of instruction. Pleas for more training literature, particularly literature for special units, were met by a concerted effort on the part of the Engineer School to bring Reserve instruction abreast of the latest advances in tactics and technique. OCE announced itself ready to supply additional Regular officers to summer camps. District and Corps Area Engineers who were closest to the situation offered many suggestions which

[15] (1) Ann Rpts OCE, 1935, 1939, 1941. (2) Info Bull 22, 11 Feb 39, sub: Engr Res Tng. (3) AR 140–5, 17 Jun 41.

[16] Memo, C of O&T Sec for CofEngrs, 7 Apr 41, sub: Brs of Engineering Represented in ROTC Grads. 353, ROTC, Pt. 16.

OCE summarized and published. Interest could be stimulated by social activities and by joint meetings with the Society of American Military Engineers. Experience with standard equipment might be obtained through association with National Guard units.

Meanwhile events forced further changes. As the Army expanded, and as personnel in civil works districts began to be absorbed in the supervision of airfield construction, District Engineers had less and less time to devote to the Reserve. In December 1940, OCE recommended that Reserve officers take over this job entirely. By then increasing numbers of Reserves were being called up for extended active duty.[17]

The "Terrific" Expansion

Furnishing cadres for new units during the first nine months of the European war had entailed more or less serious dislocations, but the adjustments of that period were insignificant compared to those required when the Army began to expand in earnest. As of 30 June 1940 only forty-four Engineer Reserve officers had been called to extended active duty. There had been a twenty-four-man increase in Regular Army officers and the number of enlisted men had risen from 5,790 in June 1939 to 9,973 in June 1940. But this was a mere trickle of new men. Within the next year the flow turned into a raging torrent.[18]

In August 1940 Kingman called attention to the "serious deficiency" in engineer troops. Particularly lacking were general service regiments, topographic companies, depot companies, shop companies, and dump truck companies. He urged that more of these units be activated if there were a further build-up of the Army and proposed a contingent of 91,000 Engineers, or 7 percent of a 1,300,000-man Army. By October the War Department had authorized 75,000 Engineers, exclusive of aviation units. In view of the 1,400,000-man Army then projected, engineer troops would comprise but 5.45 percent, which Kingman contended was insufficient. His argument for more engineer units in the Army, like his arguments in justification for more engineers within these units, was based on the lessons of the war in Europe. Despite Kingman's realization that the authorized expansion to 75,000 men might overtax existing units since the Engineers were already absorbing men twice as fast as the Army as a whole, he urged the activation of more topographic and camouflage units and called for more Engineers for the Air Corps and for armored divisions. The General Staff's War Plans Division conceded that the existing proportion of combat engineer troops in the Army might be too small, but wished to abide by existing plans pending the completion of an overall study or until the Army took in more men. Recognizing that augmentations in engineer troops would have to occur at the expense of other arms and services, G–3 took a similar position. An exception was to be made only in the case of engineer aviation units.[19]

Even though Kingman did not obtain all the troops he wanted, the Chief of Staff announced in April 1941 that the Engineers had undergone "one of the most terrific

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[17] (1) Info Bull 22, 11 Feb 39, sub: Engr Res Tng. (2) Info Bull 44, 10 Apr 40, sub: Res Tng. (3) Corresp in 353, Organized Res, Pts. 10–12; 326.02, Pt. 3; and 210.3, Organized Res, Pt. 1.

[18] Ann Rpts OCE, 1940, 1941.

[19] (1) 320.2, Pt. 25. (2) 320.2, Engrs Corps of, Pt. 12.

expansions" in the Army.[20] As of June 1939 the Corps of Engineers comprised 3.3 percent of the Army; a year later, 4 percent. In June 1941 the percentage rose to 5.1 and by 31 December 1941 had reached 5.5. By September 1941 the Engineers had added 98 units to the 12 they had had in June 1939. In actual numbers the bulk of the growth occurred in the fiscal year 1941 when enlisted strength, fed by the draft, climbed from 9,973 to 69,079. The Army as a whole increased five and a half times in that period; the Engineers, almost sevenfold.[21]

Shortly after passage of the Selective Service Act in September 1940, O&T notified engineer units that about one third of their men would have to be used as cadres for new units and for the engineer replacement training centers that were to go into operation the following spring. As administrators and instructors of recruits, enlisted cadremen had to be noncommissioned officer material. In order to assure some stability to a unit it was also desirable that they be three-year men rather than draftees, who were then being called up for only one year. Not all units could be evenly pruned. Those designated for task forces at overseas bases had to be kept in a reasonable state of readiness. The percentage of three-year men within each unit varied therefore with the nature of the unit's mission and the complexity of specialist training. One commanding officer who was fairly hard hit for cadremen estimated that two out of every three in his organization would be recruits.[22]

The ability of the cadremen to turn the incoming tide of citizens into soldiers depended in large degree on the qualifications of the recruits themselves. Conscious of the need to put civilian skills and knowledge to good use the War Department inaugurated a new classification and assignment system in the fall of 1940. One of its two essentials was the Army General Classification Test (AGCT) which, like other standard tests, reflected the individual's social, economic, and educational background as well as his innate ability. According to their scores on this test individuals were placed in one of five classes, the highest being designated Class I. The other means of classification was an analysis of occupational skills. The occupational classification system listed 272 civilian jobs which were directly useful to the Army. To each of these a specification serial number (SSN) was assigned. At the same time the Army listed military jobs taken from T/O's and gave each of these an SSN. Thus the numbers from 001 to 272 represented both civilian and military jobs. A civilian carpenter and a military carpenter had the same SSN. Since the Engineers had understood that some such arrangement would be devised they had made no provision for training enlisted specialists except at the Engineer School and at a few selected trade schools.

Under the classification and assignment system the Engineers enjoyed certain theoretical advantages, for of all the branches of the Army they required the greatest variety of occupational specialists. Although the main demand was for carpenters, construction foremen, truck drivers, toolroom keepers, riggers, mechanics, and demolitions

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[20] Testimony of General George C. Marshall, 28 Apr 41. H Comm On Appropriations, *Military Establishment Appropriation Bill, 1942, Hearings,* 77th Cong, 1st Sess, p. 32.

[21] (1) Watson, *Chief of Staff,* p. 16. (2) Ann Rpts OCE, 1939–41. (3) Greenfield, Palmer, and Wiley, *Organization of Ground Combat Troops,* p. 203.

[22] (1) Memo, O&T Sec for Brig Gen Clarence L. Sturdevant, 19 Feb 41, sub: Distr of Engr Specs From ERTC and Three-Year Enl Pers. 327.3, Pt. 1. (2) Corresp in 320.2, Pts. 25, 27, 28.

men, the Engineers needed 91 different kinds of specialists at a rate of 727 per thousand. The Infantry required only 40 different specialists at 239 per thousand, the Air Corps 71 specialists at 777 per thousand, and the Signal Corps 66 specialists at 892 per thousand. Percentagewise also the Engineers stood well up on the list. Sixty percent of Engineer troops would be specialists, as compared with 78 percent of the Air Corps; 74 percent Finance Department; 69 percent Signal Corps; 63 percent Quartermaster Corps; 51 percent Ordnance Department; 48 percent Field Artillery; 47 percent Medical Department; 38 percent Coast Artillery; 28 percent Cavalry; 21 percent Chemical Warfare Service; and 21 percent Infantry.[23]

The fact that the theoretical correlation between civilian and military jobs was not always achieved worked considerable hardship on the Corps of Engineers. The system assumed proper classification, but at first the Army had few qualified classifiers. After being classified, recruits could be kept at reception centers only a short time because room had to be made for newcomers. From the reception center a recruit was assigned on a quota basis and frequently there was no quota for a specialist of a particular type at a particular time. Rarely could the reception center hold such an individual until the branch that needed him requisitioned him.[24]

Recalling that the Corps of Engineers had been forced to stand by during World War I while other branches received many men with engineering experience, Schley counseled early and constant vigilance to secure qualified selectees.[25] After analyzing the process of reception and classification, Maj. William W. Bessell, the chief of the Personnel Section, concluded:

> The allotment of quotas of each classification of specialists . . . will be based on "occupational frequency" or averages computed for a division or other Army unit. In other words, rather than determine the *exact* needs of a unit in particular Specialists, a "type" number is used, much as shoe and clothing tariff sizes are used in computing depot needs.
>
> In the last analysis . . . despite such efforts at standardization, the old and familiar "personal equation" will dominate the method and results of the classification, and the best way to insure getting good men for the Engineers is to contact the individuals doing the classification.[26]

Not a few commanding officers complained that the first recruits were a disappointment. One regiment, the 43d Engineers, which had secured its men by the personal approach, illustrated the wisdom of Bessell's method, although it was manifestly impossible on a larger scale. The corps area commander had allowed officers from the regiment to handpick selectees at the reception center. Most of them had "construction experience or if basic privates, are husky country boys," exulted the commanding officer. As the Army's classifiers acquired experience other unit commanders who had

[23] (1) MR 1–8, 18 Sep 40. (2) Testimony, Lt Col Harry L. Twaddle, 1940. H Comm on Military Affairs, *Selective Service Compulsory Military Training and Service, Hearings,* 76th Cong, 3d Sess, pp. 93–94.

The ratio of specialists was, of course, subject to change. In January 1943 the Transportation Corps required 788 specialists per thousand; the Corps of Engineers, 725; Ordnance Department, 641; Signal Corps, 579; Quartermaster Corps, 466. Palmer, Wiley, and Keast, *Procurement and Training of Ground Combat Troops,* p. 8.

[24] Roy K. Davenport and Felix Kampschroer, eds., Personnel Utilization: Classification and Assignment of Military Personnel in the Army of the U.S. During World War II, September, 1947 (Rev). MS, OCMH.

[25] Memo, Schley for Kingman, 23 Sep 40. 327.3, Pt. 1.

[26] Draft of Memo, C of Pers Sec (no addressee), 28 Sep 40, sub: Class of Selectees. 327.3, Pt. 1.

not resorted to personal interviews expressed similar satisfaction with the quality of personnel received.[27]

Lacking the educational and vocational opportunities of whites, the Negro was wanting in the training and experience which the Army used as a basis of classification. Although Negro strength in the Army was to be maintained at the same ratio that existed in the civilian population—around 10 percent—the War Department proscribed any mingling of white and Negro soldiers. The result was a concentration of poorly qualified personnel in Negro units and a concentration of Negroes in certain branches.[28] The War Department notified the Engineers that "the number of colored personnel which must be accepted . . . together with the undesirability of activating large numbers of colored combat units requires that service units must, in general, absorb more than their normal percentage. . . ." [29] Under the announced policy more than one fourth of engineer enlisted men would be Negroes. Most of them were destined for separate battalions which were large pools of unskilled labor, and had in fact during World War I been called labor battalions. Other Negroes were to be organized into dump truck companies, light ponton companies, and general service regiments. Segregation into units such as these prevented the most effective use of skilled Negroes.[30]

The 105 Negro enlisted men in the Corps in June 1940 were assigned to the Engineer School detachment at Fort Belvoir where they performed menial tasks. Only twenty of them had grades above private first class. Since it was impossible to supply cadres from this group, the first Negro engineer tactical unit in World War II had to draw its cadre from the infantry and cavalry. This unit, the 41st General Service Regiment, was organized on 15 August 1940 under the command of Lt. Col. John E. Wood, who had great enthusiasm and confidence in his men and their ability. "We have made it clear that we are soldiers—for either construction or combat; that we are not to be confused with labor troops . . . ," he wrote in September 1940, adding proudly, "We can handle any expansion the War Department prescribes for us." [31] Notwithstanding Wood's optimism the 41st Engineers was hardly a broad enough base on which to begin an expansion. In February 1941 the Engineers faced a job of activating four separate battalions and providing cadres for twenty-three companies at

[27] (1) Ltr, CO 29th Engr Bn to CG Fourth Army, 13 Dec 40, sub: Analysis of Qualifications, Selective Service Men. 327.3, Pt. 1. (2) Personal Ltr, Lt Col William F. Heavey, CO 20th Engr Regt, to Kingman, 15 Mar 41. 417, Pt. 10. (3) Personal Ltr, Kingman to Heavey, 21 Mar 41. 417, Pt. 10. (4) Personal Ltr, Lt Col Mason Young, CO 43d Engr Regt, to Godfrey, 24 Mar 41. 320.2, 43d Engrs. (5) Ltr, CO 62d Engr Co (Topo) to CofEngrs, 26 Aug 41, sub: Comments on Orgn and Tng of Topo Co (Corps). 320.2, 62d Engrs. (6) Ltr, CO 67th Engr Co (Topo) to CofEngrs, 27 Sep 41, sub: Rpt on Orgn, 67th Engr Co (Topo). 320.2, 67th Engrs.

[28] The subject of Negro troops in World War II is covered fully in Ulysses G. Lee, Employment of Negro Troops, a volume in preparation for the series, UNITED STATES ARMY IN WORLD WAR II. Except when otherwise noted the following discussion is based upon Lee, Chapters II, V, and VI and upon correspondence in 322.999, Pt. 1; 680, RTC, Pt. 1; 320.2, Pts. 25–26; 320.2, 41st Engrs; and 320.2, Engrs Corps of, Pts. 12, 14.

[29] 1st Ind, AG 680.1 (10–30–41) MC–C to CofEngrs, 21 Nov 41, on Ltr, CofEngrs to TAG, 30 Oct 41, sub: ERTCs for Augmentation of Army. 680.1, RTC, Pt. 1.

[30] Incl 1, RTCs, with AG Ltr 680.1 (10–15–40) M–C–M to Cs of Arms and Svs *et al.*, 25 Oct 40, sub: RTCs. 327.3, Pt. 1.

[31] Personal Ltr, Wood to Kingman, 27 Sep 40. 320.2, 41st Engrs.

replacement training centers. Four more separate battalions, a general service regiment, two light ponton companies, and two dump truck companies were to be activated in June. Cadre requirements for February alone were estimated at 700 Negro enlisted men. Yet in November 1940 there were only 695 enlisted men in the 41st Engineers and Kingman judged 195 of them unfit for any grade above private. Kingman first requested Negro cadres from other arms and services but they had their own requirements to meet. Wood then proposed to improve the ability of the 41st Engineers to furnish cadres by expanding the unit to war strength, by staggering the activation of new units, and by using the 41st as a partial replacement depot to train Negro recruits for other branches. The War Department approved all these proposals within the next few months.[32]

These measures did not resolve the situation. One of the commanding officers of a new separate battalion noted in March 1941 that many of his enlisted cadremen could scarcely add or spell. The following August Kingman remarked on the relatively few Negroes who were qualified to become noncommissioned officers of the first two grades and directed O&T to arrange more schooling for Negroes. Meanwhile more white Reserve officers had to be assigned to Negro units.

About the same time the Engineers began to discuss the possibility of securing a reduction in the number of Negroes allotted them. According to the War Department's plans for fiscal year 1942, the Engineers would have received 15 percent of the Negro strength in the Army. OCE agreed with the War Department that combat units should be white and felt further that except for dump truck and ponton companies the technical nature of the duties of special units precluded the acceptance of Negroes. The fact that the AAF was willing to permit 28.1 percent of its aviation engineers to be Negro relieved the situation somewhat. Still the Engineers figured that 70 percent of the troops organized for major construction would be Negro, and they felt this ratio was too high. Construction work with power machinery required skills which comparatively few Negroes had and which few could readily acquire, the argument ran. The proper percentage of Negro construction troops was concluded to be 40 percent.

Early in October Col. Raymond F. Fowler, chief of O&T, pointed out that to achieve this percentage, either several corps combat regiments would have to be organized as Negro units or the number of Negroes coming to the Engineers must be reduced. At the end of that month Reybold, the new Chief of Engineers, asked the War Department to cut the number of Negro troops being assigned.[33] The War Department rejected both suggestions, reiterating that large numbers of Negro combat units would be undesirable, and adding that experience had shown that "certain engineer units, notably separate battalions and dump

[32] (1) Ltr, AC of Engrs to TAG, 31 Oct 40, sub: Tng of Colored Cadres (320.2, Pt. 26), states that twenty-six RTC companies were to be activated. Only twenty-three were finally activated. (2) Info Bull 84, 10 Apr 41, sub: Orgn of Engr Units.

[33] (1) Memo, Capt William W. Brotherton, AC of O&T Sec, for Fowler, 31 Jul 41, sub: Negro Units in Augmented PMP. AG file, Engrs, 370.9, Mob Ser. Nos. 435–63. (2) Memo, C of O&T Sec for Kingman, 4 Oct 41, sub: Engr Units for Force of 3,200,000. 320.2, Engrs Corps of, Pt. 14. (3) Ltr, CofEngrs to TAG, 30 Oct 41, sub: ERTCs for Augmentation of Army. 680.1, RTC, Pt. 1. Specifically, Reybold asked that plans for expanding capacity for Negro troops at ERTC's be reduced.

truck companies function reasonably well with colored personnel." [34]

The initial expansion of the Army during fiscal year 1940 had imposed little strain on the supply of Regular Engineer officers. By transferring 40 from the civil works program, by reducing by almost 100 the attendance at special and general service schools, and by withdrawing 27 from ROTC units, OCE had succeeded by 1 September 1940 in assigning 378 officers to engineer troops as compared with 198 a year before. The Engineer Reserve, too, had seemed ample. When in December 1939 the War Department limited new appointments in the Officers' Reserve Corps to ROTC graduates, OCE accepted the action with equanimity. The constant additions coming to the Engineers through the ROTC made the supply of reservists sufficient, noted Major Claterbos of O&T, and the suspension of other appointments was sound—at least until it was possible to weed out those who were over-age or physically unfit. Calling up reservists seemed primarily a matter of setting up a system of priorities in assigning them. Under the system established in September 1940, priority was to be given first to existing units, then to overhead and service requirements, and finally to new units. Preferably a Reserve officer would take a refresher course at the Engineer School but if this were not possible he would report direct to his unit.[35]

The expansion which resulted from the draft changed this happy situation, both as to Reserve and Regular Army officers. The shortage of Regular Army officers became apparent at once. As a matter of fact, only 435 of 767 needed for projected troop units and replacement training centers were available. A committee appointed to devise means of surmounting this crisis made several concrete suggestions. Immediate quotas could be filled by reassigning 188 officers from existing troop units and by transferring 51 more from civil works to troop duty. Cutting allotments to troop units would enable the Corps to spread its small supply of Regulars. The number of Regular Army officers was accordingly reduced from 18 to 10 per aviation regiment, from 14 to 6 per general service or combat regiment, and from 6 to 4 per combat battalion. Whereas 170 had been previously slated for replacement training centers, only 24 were allotted to each of the two centers in October. To provide for the future the committee suggested that more retired officers be recalled to active duty and that some of the Engineer instructors at West Point be released. The proposal to tap the supply of retired officers was adopted and many of them were recalled. The other proposal, to reduce the number of Engineer instructors at the Military Academy, while not immediately acceded to, fired the opening gun in a struggle to abate the assignment of Engineer officers to nonengineer duties, a struggle that was waged over Reserve as well as Regular Army officers. Prominent, if not at the core of the arguments that were advanced during the push and pull that ensued, was the desire of the Corps of Engineers to as-

[34] 1st Ind, AG 680.1 (10–30–41) MC–C to CofEngrs, 21 Nov 41, on Ltr, CofEngrs to TAG, 30 Oct 41, sub: ERTCs for Augmentation of Army. 680.1, RTC (C), Pt. 1.

[35] (1) Ltr, Actg CofEngrs to ACofS G–1, 10 Mar 41, sub: Effect of the Expansion Program on Distr of RA Offs, CE. 320.2, Engrs Corps of, Pt. 12. (2) Ann Rpts OCE, 1939, 1940. (3) AG Ltr 210.1 ORC (11–14–39) R–A to Corps Area Comdrs *et al.*, 8 Dec 39, sub: Suspension of Appointments in ORC. 326.3, Pt. 27. (4) Personal Ltr, Claterbos to Maj D. G. White, U. S. Engr Office Boston, 26 Sep 40. 326.3, Pt. 29. (5) Memo, C of Pers Sec for O&T, 23 Sep 40, sub: Policy on Calling Res Offs to Active Duty. 326.02, Pt. 4.

sume control of the military construction program.[36]

The Quartermaster General was supervising the building of camps, airfields, munitions plants, and other military installations that had become necessary with the expansion of the Army. From the start, the Quartermaster Corps had been forced to dip into the Engineers' pool of Reserve officers in order to manage this program, eventually to reach eleven billion dollars. As of October 1940, 198 of the 249 Engineer Reserve officers assigned to other branches were with the Quartermaster Corps. Early in December the QMC began to bite into the Engineers' Regulars. At this time, Lt. Col. Brehon B. Somervell was called in to direct military construction, and he brought with him six other outstanding Engineer officers.[37] The Engineers wanted these officers back and sought to prevent the loss of additional officers to General Staff and other duties outside the Corps. At the same time they aspired to take charge of the military construction program, asserting that their field organization for the now diminishing civil works was ideal for the purpose. As Schley strove to explain it, "the Corps of Engineers can readily take on additional work but can not spare additional officers for assignment or detail to other agencies." [38]

In November 1940 the Engineers had obtained a slice of the military construction program when airfield construction was transferred to their jurisdiction. Shortly afterward they were given equal priority with the Quartermaster Corps in calling up Reserve officers for this work. In January 1941 they gained a few more officers when the General Staff agreed to a smaller number at the Military Academy.[39]

Until the spring of 1941 the Engineers were more concerned about the distribution of Regular Army officers than about that of Reserve officers. In March 1941 Kingman notified the General Staff of the shortages caused by unexpected demands for armored and aviation engineers. Engineer Regulars available for troop units constituted about 18.3 percent of the number authorized whereas Regulars constituted 21.5 percent of the officers in the Army as a whole. He recommended that his Corps be given sixty graduates of the 1941 class at West Point, that no additional officers be assigned to branch immaterial duties, that the number of instructors at West Point be cut again, that assignments to public works not essential to national defense cease. Finally and most important, he wanted all the officers loaned to the Quartermaster Corps, with the single exception of Somervell, returned to the Engineers by June. The Adjutant General allotted 64 of 764 new appointments to the Engineers and agreed to do his best to prevent the assign-

[36] (1) Memo, C of Pers Sec for Kingman, 13 Sep 40, sub: Rpt of Activities Pers Sec for Wk Ending 13 Sep 40. 025, Pt. 1. (2) Memo, C of Pers Sec for Kingman, 16 Sep 40, sub: Reorgn Incident to Expansion Program. 320.2, Pt. 25. (3) Rpt Special Bd OCE to CofEngrs, 17 Oct 40, sub: Proposed Distr of Commissioned Pers Expansion Program, 1941. 210.3, Engrs Corps of. (4) Testimony, CofS, 28 Apr 41, H Comm on Appropriations, *Military Establishment Appropriation Bill, 1942, Hearings,* p. 32. (5) Memo, C of Pers Sec for Kingman, 31 Jan 41, sub: Rpt of Activities Pers Sec for Wk Ending 31 Jan 41. 025, Pt. 1.

[37] Memo, C of Pers Sec for Kingman, 10 Oct 40, sub: Res Offs Detailed to Brs for Extended Active Duty. 326.02, Pt. 4.

[38] Memo, Kingman for Schley, 27 Jan 41, sub: Det of Experienced Engr Offs From Work of CE. 210.3, Engrs Corps of, Pt. 15.

[39] (1) Memo, C of Pers Sec for Kingman, 28 Feb 41, sub: Rpt of Activities Pers Sec for Wk Ending 28 Feb 41. 025.1, Pt. 1. (2) Ltr, TAG to Cs of Arms and Svs, 26 Dec 40, sub: Extended Active Duty, Constr Program. 326.02, Pt. 4.

ment of additional officers to branch immaterial duties or nondefense tasks. Engineer officers supervising the construction program would not be returned to the Corps but would remain with The Quartermaster General.[40]

The reservoir of Reserve officers, which had seemed so ample, meanwhile developed unanticipated leaks. In October 1940 the War Department allowed key employees in defense industries to be deferred, and the following January the Navy was permitted to siphon off engineers from ROTC units. In spite of these losses and of continuing levies by the Quartermaster Corps the Engineers remained sanguine about their Reserve until April 1941. At this time Bessell of the Personnel Section pronounced the supply of second lieutenants sufficient to fill vacancies in all units through the 30th of June provided only that unexpected deferments, expansion of the military construction program, or a step-up in mobilization did not occur. The supply of officers in grades above second lieutenant was already deficient.[41]

Throughout the rest of the year the Engineers protested the depletion of their Reserve. In some corps areas Engineer officers had been ordered to duty with troop units of other arms and services; in others, non-Engineer officers had been ordered to duty with the Engineers. Contrary to assurances that adequate numbers were available for assignment to the Engineer School, corps areas had not met quotas. The Quartermaster General continued to press for and receive more officers.[42] Between July 1940 and August 1941 the Engineer Reserve had been reduced by 1,659 officers through transfers and deferments. Schley estimated that 6,736 officers would be required for 1942 and that only 6,187 were available—an over-all shortage of 549 that was most pressing in the upper grades. "I have expressed concern on several previous occasions about the continued diversion of officers . . . ," he reminded the Chief of Staff in August. "I feel that a once adequate Reserve, built up by peace time planning, is now depleted to the point where further diversion must be suspended or standards must be lowered to permit appointments from civil sources." [43] Although a somewhat different analysis showed a surplus of 338 officers, Kingman pointed out that continued transfers would whittle this away and recommended that no more be made.[44]

For the most part the War Department avowed itself helpless to correct this situation and argued that officer candidate school graduates, ROTC graduates, and ineligible reservists on inactive status should, in the future, provide the needed officers. In the summer of 1941 the War Department did

[40] (1) Ltr, Actg CofEngrs to ACofS G–1, 10 Mar 41, sub: Effect of the Expansion Program on Distr of RA Offs, CE. 320.2, Engrs Corps of, Pt. 12. (2) AG Ltr 320.2 (3–10–41) C–A to CofEngrs, 22 Apr 41, sub: Distr of RA Offs, CE. 210.3, Engrs Corps of, Pt. 16.

[41] (1) Incl, 7 Oct 40, with Ltr, ExO Plan Br OASW to Cs of Sup Arms and Svs, 23 Nov 40, sub: Clas of Res Offs as Key Employees in Industry. 210.01, Res Offs, Pt. 1. (2) AG Ltr 045.71 (1–6–41) M–C to CGs All Corps Areas *et al.*, 21 Jan 41, sub: Navy Proc of Engr Grads, Incl ROTC. 353, ROTC, Pt. 16. (3) Personal Ltr, Godfrey to Dr. J. E. Burchard, MIT, 1 Feb 41. 326.3, Pt. 29. (4) Memo, C of Pers Sec for TAG, 15 Apr 41, sub: Appointment in CE Res, with 1st Ind, AG 210.1 ORC (4–15–41) R–A to CofEngrs. 326.3, Pt. 29.

[42] Ltr, ACofEngrs to TAG, 28 May 41, sub Availability of Engr Res Offs. 210.3, Engrs Corps Pt. 17.

[43] Memo, CofEngrs for CofS, 13 Aug 41, sub: Suspension of Transfer and Detail of CE Res Offs to Other Brs. 326.3, Pt. 31.

[44] Ltr, ACofEngrs to TAG, 13 Oct 41, sub: Shortage of Engr Res Offs. 320.2, Engrs Corps of, Pt. 14.

promise to require corps area commanders to seek approval before assigning Reserve officers to branches in which they had not been commissioned, and, on 4 September 1941, suspended all transfers or details of Engineer Reserve officers above first lieutenant to other branches except the AAF.[45]

In December 1941 the Engineers finally got all the officers—Regular and Reserve—who had been assigned to The Quartermaster General, and with them the entire military construction program. But the increase in manpower was matched by the expanded mission. The shortage remained unalleviated.

As the shortage of officers became more acute, the effective use of skills became more important. At the outbreak of war in Europe the classification system for officers was confined to rating them according to military and physical efficiency. There was no consistency. Regular Army officers were given annual efficiency reports and periodic physicals. The only records of National Guard officers which were subject to War Department review were the medical reports of those belonging to the National Guard of the United States. Ratings of Reserve officers were made on the basis of sporadic reports filed in the offices exercising jurisdiction over them. Classification by occupational qualifications was haphazard. Although OCE retained under its jurisdiction those Reserve officers having special qualifications, and although these qualifications were recorded when the officers received commissions, the records were not kept up to date. In June 1940 The Adjutant General directed each Reserve officer to fill out a questionnaire about his experience so that the branch in which he was enrolled could check this against his mobilization assignment. In November, the War Department went a step further when an attempt was made to classify all officers as command, staff, or specialist, but it was not until after the declaration of war that a comprehensive system went into effect.[46]

Meanwhile, the Engineers were becoming conscious of the need to depend on more than the law of averages in assigning officers. Godfrey noted in February 1941 that general service regiments should contain five or six highway engineers. About the same time Schley, intent upon increasing the number of civil engineers in ROTC units, suggested closing out all enrollments to other than this group. Godfrey demurred. ROTC enrollments of all types of engineering students should show a sharp rise as a result of the quickening interest in military preparedness. Rather than shut the door as Schley advocated, he proposed a priority system that would place civil engineers in a preferred position, followed by mining, mechanical, electrical, and other categories of the engineering profession. In further defense of his method, Godfrey pointed out that dependence upon power machinery made large numbers of mechanical engineers acceptable. In addition to the establishment of priorities, he sought permission to obtain civil engineers by transfer from

[45] (1) Personal Ltr, Bessell to Maj Paschal N. Strong, 7 Jul 41. 326.3, Pt. 30. (2) Ltr, ACofEngrs to TAG, 13 Oct 41, sub: Shortage of Engr Res Offs, with 1st Ind, 28 Oct 41. 320.2, Engrs Corps of, Pt. 14.

[46] (1) MR 1–3, 30 Oct 39. (2) Ltr, C of Pers Sec to TAG, 5 Jan 39, sub: Clas of Res Offs. 370.01, Pt. 1. (3) Memo, CofEngrs for Lower Miss. Valley Div Engr, 12 Dec 39, sub: Estab of Offs' Qualifications File. 201.6, Pt. 1. (4) AG Ltr 381 (9–18–39) P (A) to CofEngrs, 27 Sep 39, sub: Rev of Mil Qualifications List for Offs. 326.3, Pt. 27. (5) Davenport and Kampschroer, Personnel Utilization, pp. 87–89, 183–85.

nonengineer ROTC units.[47] In July 1941 both of Godfrey's schemes were approved. On 15 September 1941, when war was almost upon the country, the War Department gave its blessing to commissioning as Engineers 5 percent of the total number of ROTC graduates from other branches. Similar concessions were made to the Quartermaster Corps at the same time, while the Signal Corps and the Air Forces were each allowed to commission 10 percent from other branches.[48] In a further effort to classify officers, the Personnel Section had established a machine records unit. By the end of July, 95 percent of the qualification questionnaires sent to Engineer Regular Army, National Guard, and Reserve officers had been received and 80 percent of these had been classified. Henceforth OCE was prepared to furnish lists of Reserve officers with 285 different engineering qualifications to Corps of Engineers agencies.[49]

Training the First Civilians

The great expansion in personnel, especially of citizen soldiers, challenged the Engineers' training facilities almost at once. Before recruits could be instructed and led, teachers and leaders had to be developed. Regular officers and enlisted men were prepared to command and teach, but there were not enough of them. In order to qualify more individuals for this job, the Engineer School in July 1940 abandoned the nine-month course for Regular Army officers entirely and cut the length of the enlisted men's courses. For the next year and a half Reserve and National Guard officers, who were only partly prepared, and officer candidates, who were wholly unprepared to instruct others, would make up the bulk of the school's student body. Reserve and National Guard officers attended from four to five weeks and officer candidates for twelve.

In an effort to supply occupational specialists in greater numbers and more quickly, the school divided the long multipurpose courses for enlisted men into shorter courses of one subject each. Thus surveying and drafting became two courses as did water purification and mechanical equipment. Instead of spending four to eight months at the school, enlisted men graduated after three months. The graduate of 1941 mastered only one subject, but within his limited sphere he could perform just as well as the graduate of 1939. In order to train men faster, the Engineers had begun what is known in industry as job breakdown or what might be called the specialization of specialists. Officer training was not so narrow. The aim in the case of OCS candidates was to impart a little knowledge about a great number of things. National Guard and Reserve officers were at the school to brush up on the latest tactics and equipment.

By shortening the course of study and by

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[47] (1) Memo, Schley for Kingman, 28 Feb 41. 353, ROTC, Pt. 16. (2) Memo, C of O&T Sec for CofEngrs, 7 Apr 41, sub: Brs of Engineering Represented in ROTC Grads. Same file. (3) Memo, C of Pers Sec for Kingman, 9 May 41, sub: Rpt of Activities Pers Sec for Wk Ending 9 May 41. 025.1, Pt. 3. (4) Memo, C of O&T Sec for CofEngrs, 4 Feb 41, sub: Off Pers for Gen Sv Regts. 320.2, 41st Engrs.

[48] (1) Memo, C of O&T Sec for Kingman, 9 Jul 41. 353, ROTC, Pt. 16. (2) Memo, ACofEngrs for TAG, 18 Jul 41, sub: Commissioning of ROTC Grads in CE Res. 326.3, Pt. 30. (3) Memo, C of O&T Sec for Senior Engr Instructors ROTC Units, 22 Jul 41. 326.3, Pt. 30. (4) Ltr, AG 210.1 ORC (7–18–41) RB–A to COs *et al.*, 15 Sep 41, sub: Instrs Governing Commissioning of ROTC Grads in Arms and Svs Other Than Those in Which Trained. P&T Div file, ROTC–Policies–Grads.

[49] (1) Memo, J. Y. Lineweaver, Pers Sec, for Cs of Secs OCE, 29 Jul 41. 210.01. (2) Ann Rpt OCE, 1941.

enlarging facilities and faculty, the school was able to multiply its output from 87 officers and 66 enlisted men in the fiscal year 1940 to 1,528 officers and 260 enlisted men in 1941. Many officer graduates were destined to become instructors at the two engineer replacement training centers which opened in the spring of 1941 to give basic military and engineer technical training to citizen soldiers. But before Pearl Harbor most of the incoming tide of civilians flooded directly into engineer units, which had to turn them first into soldiers and then into engineers who could contribute to the functioning of the unit as a whole.[50]

Confusion inevitably attended the beginnings of such a vast program. When the 19th Engineer Combat Regiment was activated in June 1940 personnel arrived in exactly reverse order from that prescribed—first, the recruits, then the enlisted cadre, and finally the officers. Shortages of equipment were evident in the newly organized 12th Engineer Combat Battalion which had as its first month's objective a complete uniform for every man. The experience of the 4th Engineers in expanding from a company to a battalion was typical. Within a few months the unit had to train recruits, supply cadres to other units, and send a group on maneuvers, as well as to furnish men for demonstrations.[51]

General Headquarters had been activated in July 1940 to co-ordinate and supervise the training of Army field forces, and shortly thereafter tactical units were grouped into four armies. Although engineer units came under the control of separate army commanders, the training plan for all was essentially the same. They were expected to follow the Engineer MTP 5–1 which became available in September 1940. General engineer units were to receive thirteen weeks' training. At the end of the two-week basic period, troops were supposed to be able to wear and care for their equipment, to fire their rifles, and to march. From the third to the tenth week training of individuals continued with emphasis on technical subjects. In the remaining three weeks individuals were expected to learn how to function in a team. Special units were not to receive so much preliminary instruction. Two weeks of basic military training and two weeks of practice in operating together were expected to suffice because such units were to be made up of technically qualified individuals.[52]

After thirteen weeks of training under the MTP, general engineer units were expected to go on to combined training with other arms and services. Just as individuals had been welded into an engineer unit, so various units—infantry, artillery, engineers, and other combat or supporting elements—would be integrated into divisions, corps, and armies. This phase of training included participation in maneuvers, and was supposed to last seven to eight months. The Army thus allowed about a year to train the raw recruit—too short a time, in the judgment of the Engineer School, to permit all units to become efficient.[53]

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[50] Corresp in 352.11, Engr Sch, Pts. 9, 11; 325.11, Pts. 4, 9, 10; 210.3, Engr Sch, Pt. 4; 221, Pt. 8; and EHD file, Loose Corresp, 1940, 1941.

[51] (1) Memo, Lt Col Frank L. Blue, Jr., CE, to Herbert H. Rosenthal, 19 Jun 50. EHD files. (2) Personal Ltr, Galloway to Maj Robert E. York, CO 71st Engr Co, 2 Aug 40. 320.2, Pt. 25. (3) "Engineer Troop Activities," *The Military Engineer,* XXXIII (March–April, 1941), 158. (4) Personal Ltr, Maj Frank O. Bowman, CO 4th Engr Bn, to Godfrey, 26 Jul 40. 320.2, 87th Engrs.

[52] MTP 5–1, 5 Sep 40.

[53] (1) Incl, 25 Sep 40, with Ltr, Comdt Engr Sch to CofEngrs, 25 Sep 40, sub: Mission and Tng of Engrs. 353, Pt. 15. (2) Ltr, CofS GHQ to All Army Comdrs, 4 Jan 41, sub: Combined Tng. Same file.

The committees which studied the training of divisional engineer units in the research course agreed that it would take at least two years to create an efficient division. This much time could not be had but time could be made by eliminating or minimizing "numerous ceremonies, good will tours, white washed tent pegs, fatigue and police [duty]." One committee suggested that "post service commands should be instituted utilizing civilian employees, labor units organized from those less physically fit or relief labor. A recruit cannot be instilled with pride in being a soldier by sorting garbage on the post dump or driving the 'honey' wagon." [54] The committees returned time and again to the importance of resisting the inclination of post commanders to use engineers as labor troops and warned that "the post commander may be pleased at our efficiency in building barracks or greenhouses but inefficiency in building a ponton bridge and delaying a division or corps in maneuvers for six or eight hours is unexplainable and not soon forgotten." [55]

Corps combat regiments, general service regiments, separate battalions, and aviation battalions could profit considerably more than combat and armored battalions from assignment to construction work around an Army post. But such work should be comparable in kind, and preferably in extent, to that which the units might perform in a theater of operations. In November 1940 the assistant chief of O&T expressed fears that the approximately twenty-five corps and army units scheduled for activation by the following summer would lack such opportunities and consequently "much of their work will be of the 'dog-robbing' nature for the post commander and other units." [56]

Under pressure of expansion the Army was forced to alter some of its best-laid plans. For many individuals and for many units training did not proceed according to schedule. (*Table 3*) The 12th Engineer Combat Battalion, activated on 1 July 1940, struggled against shortages of equipment, inadequate facilities, turnover of personnel, and red tape—"every week there is a new form or an amendment to an old one, and it takes the best officers just to keep the papers straight." The unit succeeded in finishing about eleven weeks of a thirteen-week program in six and a half months. The 15th cleared stumps, graded banks, dumped sand for two swimming holes, and participated in post exercises and reviews, yet managed to spend about 60 percent of its time on the standard program. The 17th Engineer Armored Battalion reported similar diversions, having supervised and furnished tools and equipment for "various construction jobs . . . from building grease racks and canvas-top theaters to the construction of moving-target, moving-vehicle, and 1,000-inch pistol ranges." [57]

Some combat regiments, general service regiments, and separate battalions did engage in profitable construction work. The commanding officer of the 41st General Service Regiment treated the construction of a post road as a tactical assignment and

[54] Info Bull 71, 2 Jan 41, sub: Mission, Duties, and Tng of Div Engr Units, p. 11.

[55] (1) *Ibid.*, App. III, p. 3. (2) See also, Rpt, Mission and Tng of Engr Bn (Armed). Second Research Course, Vol. II.

[56] Memo, AC of O&T Sec for Godfrey, 7 Nov 40, sub: Tng of Engr Units in Other Than Combat Duties. 353, Pt. 15.

[57] (1) Info Bull 77, 28 Feb 41, sub: Activation of Engr Trp Units in 1940. (2) Memo, O&T Sec for CofEngrs, 31 Mar 41, sub: Inspec of Engr Units, Fts. Bragg, Jackson, and Benning, 23–29 Mar 41. 333.1, Pt. 2.

TABLE 3—DISTRIBUTION OF TRAINING TIME FOR ENGINEER COMBAT BATTALION OF INFANTRY DIVISION AND ENGINEER ARMORED BATTALION OF ARMORED DIVISION

Subject	Combat Battalion MTP-September 1940		Combat Battalion MTP-December 1941		Armored Battalion MTP-December 1941	
	Hours	Percent	Hours	Percent	Hours	Percent
Total	572	100.0	572	100.0	528	100.0
Basic	95	16.6	95	16.6	109	20.6
Technical, combat	82	14.3	82	14.3	74	14.0
Technical, engineer	303	53.0	300	52.5	134	25.4
Field fortifications and camouflage	40	7.0	40	7.0	0	0.0
Use and supply of tools, equipment, and materials	13	2.3	13	2.3	16	3.0
Bridges	80	14.0	77	13.5	56	10.6
Obstacles	50	8.7	50	8.7	20	3.8
Demolitions and mining	40	7.0	40	7.0	16	3.0
Roads, construction and maintenance	24	4.2	24	4.2	12	2.3
General construction	16	2.8	16	2.8	0	0.0
Engineer reconnaissance	20	3.5	20	3.5	6	1.2
Night operations, technical	8	1.4	8	1.4	0	0.0
Battalion field technical training	12	2.1	12	2.1	0	0.0
Map reading	0	0.0	0	0.0	8	1.5
Tactical	72	12.6	75	13.1	115	21.8
Open time	20	3.5	20	3.5	48	9.1
Specialist training, operation of vehicles	0	0.0	0	0.0	48	9.1

Source: MTP 5-1, 5 Sep 40, 19 Dec 41.

worked his men in two shifts to meet a self-imposed ten-day completion date. The 97th Separate Battalion, like the 41st a Negro unit, was not so fortunate. Progress would have been greater, reported its commanding officer, if there had not been an excessive amount of guard duty.[58]

Aviation battalions tried to take advantage of every opportunity to construct runways, taxi strips, ground facilities, and protective and defensive structures. The 803d saw many opportunities for improving the facilities at Westover Field, Massachusetts, and asked for money to buy construction materials. The 809th, activated on 1 June 1941 with a nucleus of seasoned troops from the 3d Engineer Combat Regiment, conducted specialist training for three weeks before setting sail for the Philippines. After arriving there the unit, with the help of some 800 civilians, began to construct a large airfield. Training as such, defined by the commanding officer as combat exercises in ground defense and protection of installations, was temporarily discontinued.[59]

[58] (1) Memo cited n. 57 (2). (2) Ltr, CO 97th Engr Bn (Sep) to CofEngrs, 9 Sep 41, sub: Rpts on New Orgn. 320.2, 97th Engrs.

[59] (1) Tng Directive 41–42, Hq 803d Engr Bn Avn (Sep), 30 Jul 41. 320.2, Pt. 30. (2) Ltr, CO 803d Engr Bn Avn (Sep) to CofEngrs, 26 Aug 41, sub: Rpt on New Orgn. Same file. (3) Ltr, CO 809th Engr Co Avn (Sep) to CofEngrs, 10 Sep 41, sub: Rpt on New Orgn. 320.2, 809th Engrs.

Ponton units, which were the most numerous of the special units activated during 1941, reported a considerable range of experience. The 73d Light Ponton Company and the 90th Heavy Ponton Battalion, both stationed at Fort Lewis, Washington, pronounced the bridging sites there excellent, and both units were able to begin formal training within a month of activation. In contrast, the 85th Heavy Ponton Battalion found the river near Camp Robinson, Arkansas, too wide for practicing ponton bridge construction. Activated on 4 June 1941, this unit went into the August maneuvers ill-prepared.[60] The 89th Heavy Ponton Battalion, stationed at Fort Leonard Wood, Missouri, spent the greater part of its first two months "on preparation of barracks and other buildings for the proper housing of the battalion; the policing, grading and draining of the battalion area, including the construction of essential foot paths and service roads; the drawing of equipment and supplies, particularly the unloading of the ponton equipage and its transportation . . .; the initial servicing of motor transportation and ponton trailers . . .; and the organization of the men . . . ." Organized training was confined to "disciplinary drill and guard, the schooling of certain necessary specialists, and the handling of the equipage." [61]

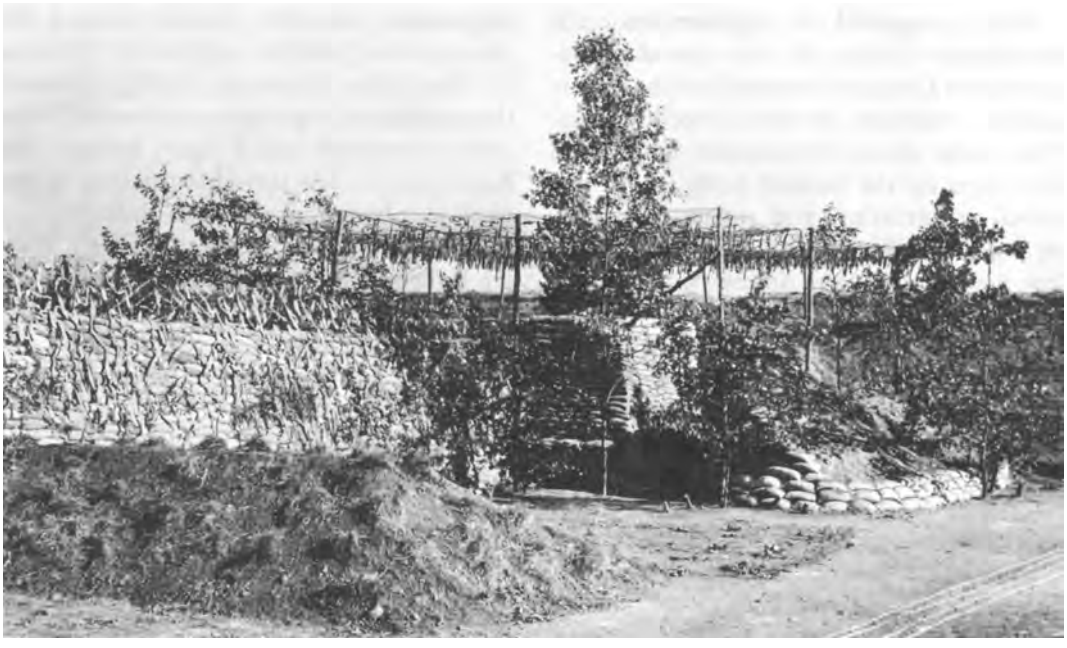
Much time and energy which engineer units might have expended on a systematic training program had been used, as had been feared, for unrelated duties. But maneuvers offered some hope of recapturing lost opportunities. Since the overriding consideration was the creation of armies capable of taking the field at any moment, not much was cut from this phase of training. Maneuvers were an extension and also a test of previous training. They were the peacetime Army's nearest approach to war. During maneuvers separate units and corps and field armies were expected to be fused into teams for offensive and defensive action.

The most extensive maneuvers in the Army's history began with a series of corps exercises in June 1941. The VII Corps of the Second Army operated in Tennessee, the V and VIII Corps of the Third Army in Texas and Louisiana, and the IX Corps of the Fourth Army in California. Maneuvers on a greater scale for the three armies followed in Arkansas, Louisiana, and Washington. The climax came in Louisiana in September when the Third Army was pitted against the Second Army in a simulated battle in which from 350,000 to 400,000 men participated. The exercises then drew to a close with the First Army operating in the Carolinas during October and November.

The maneuver area in Louisiana, dominated by three large rivers, offered a great many opportunities for the Engineers to test their capabilities. The rice country east of the Calcasieu River was low and swampy, cut through with canals and bayous. The Calcasieu River valley, like that of the Sabine, was wooded but swampy. By contrast the valley of the Red River was well drained and covered with scrubby pine so that foot

[60] (1) Ltr, CO 73d Engr Co to CofEngrs, 13 Sep 41, sub: Rpt on New Orgn. 320.2, 73d Engrs. (2) Ltr, CO 90th Engr Bn to CofEngrs, 3 Oct 41, sub: Rpts on New Orgn. 320.2, 90th Engrs. (3) Ltr, CO 85th Engr Bn (Heavy Ponton), 11 Sep 41, sub: Rpt on New Orgn. 320.2, 85th Engrs.

[61] Ltr, CO 89th Engr Bn to CofEngrs, 10 Sep 41, sub: Rpt on New Orgn. 320.2, 89th Engrs.



CAMOUFLAGED REVETMENTS *for protecting aircraft from enemy air attack constructed by 21st Engineer Aviation Regiment during the Carolina maneuvers, November 1941.*

soldiers could move cross-country.[62] The road system was excellent.

Engineers began to arrive in Louisiana about two weeks before the main forces in order to provide shelters and other facilities. Among the first units to get there was the 21st Engineer Aviation Regiment. The 21st turned the rutted, flooded airport at Lake Charles into a usable field, extended the runways at Monroe to provide a safer margin for landings and take-offs, and took advantage of the nearby woods to provide a camouflaged dispersal area at Natchitoches. So realistically did the 21st Engineers create false hedgelines over the Natchitoches field that a pilot almost landed outside the strip. All runways were paved. Landing mats did not come into the hands of aviation engineers until the November maneuvers in North Carolina.[63] The Commanding General, Air Force Combat Command, could scarcely contain his enthusiasm. "These exercises certainly *justified the requirements for Aviation Engineers* and the need for many additional ones becomes more and more apparent," he wrote.[64] Neither the Second nor Third Army had a full complement of engineers—a fact that accounted in part for repeated statements that engineer troops were overworked in what *Time* magazine summed up as "a battle of engineers." [65]

[62] Col. DeWitt C. Jones, "Engineer Activities With the Third Army," *The Military Engineer,* XXXIII (December, 1941), 549.

Unless otherwise noted, the following discussion of fall 1941 maneuvers is based upon correspondence in 354.2, Pts. 9 and 10, and 354.2, Bulky.

[63] Dwight F. Johns, "Maneuver Notes of Aviation Engineers," *The Military Engineer,* XXXIII (November, 1941), 495–97.

[64] Personal Ltr, Lt Gen Delos C. Emmons to Reybold, 30 Sep 41. 354.2, Pt. 9.

[65] *Time,* Oct 6, 1941, XXXVIII, 42.

What catapulted the engineers into such prominence during the two five-day maneuvers in Louisiana was the fact that many tactical situations involved river crossings. There was extensive simulated destruction of bridges by the Second Army and much actual construction and repair of bridges by the Third. Since the weather held good, few road repairs were necessary. An anticipated shortage of water did not develop. Neither land mines nor other obstacles were used to any extent although they might have been effectively employed in a campaign where so much depended on tanks. In the end Lt. Gen. Lesley J. McNair named the maneuver "the Battle of Bridges." [66]

The Engineers were quick to take up McNair's phrase, but not so eager to publicize the rest of his analysis. They did admit that engineers in both armies displayed tactical and technical weaknesses. The advancing Third Army did not have to make any assault crossings. Even with this advantage, Third Army engineers broke no records in bridge building. It took eight combat companies and one heavy ponton battalion 25 hours to complete one 872-foot 25-ton ponton bridge and its approaches and 48 hours to finish another only slightly longer. One battalion and two combat companies spent almost 15 hours constructing a reinforced 10-ton bridge 487 feet long. In all three of these Red River crossings, it was construction of the approaches that took such an inordinate amount of time. Perhaps reconnaissance was at fault; there was a general admission that reconnaissance was weak. At any rate the heavy ponton battalion which provided a 500-foot 25-ton ponton bridge for the Second Armored Division across the Sabine River made much better time—7 hours—but here the approaches were already constructed. Thompson warned, therefore, against blaming the delays on design of the bridges. Col. William F. Tompkins, Engineer, GHQ, believed that engineers in greater numbers and with more experience could have bridged the Red River in less time, particularly if the work had been carried out in shifts.[67]

Both General McNair and Lt. Gen. Walter Krueger, the Third Army commander, drew a more pessimistic lesson from the maneuvers. Krueger doubted that the engineer effort could have been bettered.[68] McNair agreed:

> If there is any one lesson which stands out above all others, it is the decisive influence of destroyed bridges. In spite of outstandingly intense and effective efforts by the engineers, it was demonstrated that destruction is vastly easier than repair. The best course seems clearly to lie in prevention of destruction, rather than repair after destruction. We have swift transportation and great fire power. The seizure of routes logically should be the first step of a force which contemplates a swift advance. . . . The enemy cannot destroy all routes completely in any reasonable time.[69]

Thompson had a ready answer. "In real war, a delay of a day or so in front of an obstacle which will surely be overcome is seldom a matter of great importance," he concluded, "whereas, in a maneuver problem lasting altogether only four or five days, such delay is highly important, and attracts great attention." German experience backed

[66] (1) Jones, "Engineer Activities with the Third Army," *loc. cit.*, 551. (2) Incl, with Ltr, Capt Clayton E. Mullins, Asst ExO Engr Bd, to Sturdevant, 9 Oct 41, sub: Critique Conclusions, Louisiana Maneuvers. 354.2, Bulky.

[67] Lt. Col. Mason J. Young, "Crossings of the Red River," *The Military Engineer,* XXXIV (January, 1942), 30–34.

[68] Ltr, Mullins to Sturdevant, 9 Oct 41, sub: Critique Conclusions, Louisiana Maneuvers. 354.2, Pt. 9.

[69] Incl with ltr cited n. 68.

up his contention, he claimed. None of the German victories had been won because of "split-second bridging of rivers." [70]

Maneuvers were the high point in training before Pearl Harbor. Danger of a letdown faced the Army after they were over. Without extraordinary efforts by commanding officers unit training would seem dull to troops who had gone through maneuvers, but the importance of making such an effort could not be exaggerated. Only by strenuous application to the correction of weaknesses which had shown up in maneuvers could an efficient fighting force be created. The Engineer of the Second Army put it this way:

> Engineer troops have reached a commensurate degree of efficiency for the length of time the majority of them have been in training. On this standard their work was exceptionally well done. As to the more severe standard of being fit to fight, there are many and serious shortcomings. Practically all of the technical shortcomings are known to all officers. Their remedy, more detailed training, is also known.[71]

He joined other Engineer observers in advocating more drill in basic Engineer subjects, more attention to reconnaissance and evaluation of information, and more training in ponton operations and in the tactical use of demolitions.

A common explanation of ranking officers for military deficiencies in maneuvers was want of leadership. Three other factors must be added: insufficient time to prepare, inadequacy of facilities, and shortages of equipment. All these elements contributed to the results or lack of results. In view of the problems which arose it is difficult to conceive what the story would have been had the Corps of Engineers been forced to mobilize under the much faster-paced plans of the thirties. As it was, the Engineers experienced their full share of the errors and confusion that pervaded the military history of this period. Yet the years 1939 through 1941 saw tremendous progress. These years were marked by great advances in organization and doctrine, by the development of new equipment, and by the creation of a citizen Corps which, although not quite ready to fight, was able to fight if it had to.

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[70] Memo, Thompson for Kingman, 7 Oct 41, sub: Army Maneuvers in Louisiana, 15–20 Sep 41. 354.2, Pt. 10.

[71] Rpt, Engr 2d Army to CofEngrs, 29 Nov 41, sub: Engr Activity in 2d Army Maneuvers During Aug and Sep 41 in Arkansas and Louisiana. 354.2, Bulky.

CHAPTER VI

Reorganization and Growth in 1942

After the Japanese attack in December 1941, the Corps of Engineers was under extraordinary pressure to organize, equip, and train its citizen soldiers. Moreover, this was but part of the task faced after Pearl Harbor. On 16 December 1941, the Corps of Engineers took over from the Quartermaster Corps supervision of the eleven billion dollar military construction program. The transfer of this program presented another challenge just when engineer troop units began to multiply at a rate that made the "terrific" expansion of the previous months seem insignificant.[1]

The Wartime Task and Administrative Changes

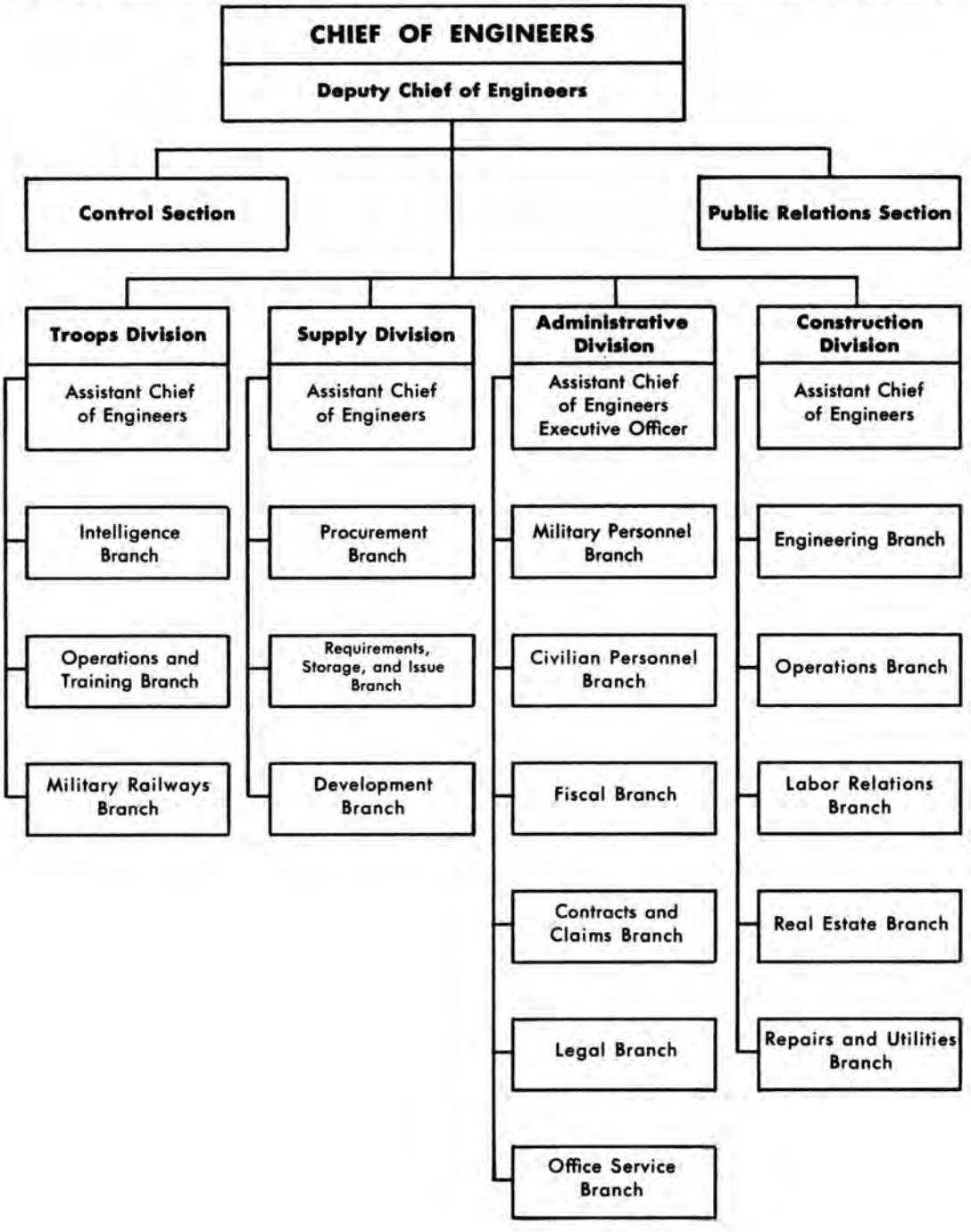
The transfer of military construction precipitated a reorganization in the Office of the Chief of Engineers which provided not only for the supervision of construction itself but also for more effective direction of the procurement of troop supplies. The appointment of Brig. Gen. Clarence L. Sturdevant as Assistant Chief of Engineers in charge of training in 1940 had brought the number of assistant chiefs to three. Under this arrangement General Kingman had supervised all other matters having to do with troops, including supply, and General Robins, all construction activities. The reorganization of December 1941 increased the number of assistant chiefs and changed their duties. (*Chart 2*) Brig. Gen. David McCoach, Jr., became Assistant Chief of Engineers in charge of the Administrative Division, in which were located the Civilian Personnel, Fiscal, Contracts and Claims, Legal, and Office Service Branches as well as the Military Personnel Branch formerly located in the Troops Division. Robins continued as Assistant Chief of Engineers in charge of the Construction Division, with the added duties accruing from the transfer. Sturdevant, as Assistant Chief in charge of the Troops Division, succeeded to Kingman's responsibilities for the Intelligence Branch and the Operations and Training Branch and through these branches for the Engineer Reproduction Plant, the Engineer School, and the replacement training centers at Fort Belvoir and Fort Leonard Wood. Unlike his predecessor, General Sturdevant had no control over military supply.[2] In the fall of 1941 Somervell had urged the appointment of an Assistant Chief of Engineers for Supply "so that he will have the opportunity through present procurement activities to become familiar with and be ready for the expanded supply activities which will come with a shooting war." [3] Although the Sup-

[1] For details about the transfer of military construction see Fine and Remington, The Corps of Engineers: Construction in the United States.

[2] (1) Orgn Charts OCE, 1940–42. EHD files. (2) OCE GO 8, 10 Nov 41.

[3] Draft of Memo, Somervell for CofEngrs, 8 Sep 41, sub: Consolidation—Constr Div OQMG With Corps of Engrs. Madigan files, Consolidation Bill—Collateral Data.

CHART 2—ORGANIZATION OF THE OFFICE OF THE CHIEF OF ENGINEERS: DECEMBER 1941





MAJ. GEN. EUGENE REYBOLD,
Chief of Engineers from October 1941 until October 1945.

ply Division was to purchase materials for military construction as well as equipment for troops, purchases for troops accounted for much the greater volume of its work. Brig. Gen. Raymond F. Fowler moved into the position of Assistant Chief of Engineers for Supply after having served for a brief period as chief of O&T.[4]

The Chief of Engineers in December 1941 was Maj. Gen. Eugene Reybold. He had been District Engineer at Memphis during the great floods of 1937 and his organization of the defenses of that area had won nationwide attention. In August 1940 he came to Washington as G–4 of the General Staff. A little more than a year later, upon Schley's retirement, he was appointed Chief of Engineers.

The administrative arrangements which OCE adopted in December 1941 were designed to insure a balance between troop and construction activities. The construction program reached its peak in July 1942 when the value of work placed amounted to $720,000,000, and although it continued to be large throughout that year, it had receded by the fall to the point where some personnel could be spared for duties connected with the procurement of troop equipment. Thereafter, the Engineers found it possible to focus more and more upon troop activities.

Over the same twelve-month period the number of engineer troops in the Army more than trebled from 93,109 to 333,209. In December 1941 the Engineers composed 5.5 percent of the Army; a year later they composed 6.2 percent. Of the technical services only the Medical Department with a strength of 469,981 was larger than the Corps of Engineers at the end of 1942. The Quartermaster Corps, with a strength of 327,794, was next in size. While the $650,623,000 worth of procurement deliveries to the Engineers during 1942 was trifling compared to the $6,815,541,000 of deliveries to the Ordnance Department and the $4,322,954,000 to the Quartermaster Corps, it was well above amounts delivered to the five other services. The striking fact about the job the Engineers had to accomplish was its many-sidedness. The five and a half billion dollars' worth of construction completed by the Engineers in 1942 was exceeded only by the Ordnance Department's total procurement program. The Medical Department had more troops than the Corps of Engineers but procured less than a fourth as much equipment, while the Ordnance Department with its huge procurement program had roughly 100,000 fewer troops. Even if the construction pro-

[4] Orgn Charts OCE, 1942. EHD files.

gram were left out of the picture, only the task of the Quartermaster Corps with its large procurement program and its substantial number of troops paralleled that of the Engineers.

Except for minor changes in the lower echelons, the administrative relationships established in OCE in December 1941 remained in effect for the next two years. Not so the relationships of the Corps of Engineers to higher echelons in the War Department. The reorganization of the Army which took place on 9 March 1942 brought about a drastic change in the chain of command through which the Chief of Engineers formerly had direct access to the General Staff and to the Under Secretary of War. Only in civil works matters did the position of the Chief of Engineers remain the same, and civil works were not, during wartime, important.

A reorganization of the Army was overdue. General Headquarters, which had been set up on the basis of World War I experience to assume control of combat operations overseas, lacked the power to cope with the very different situation which developed in 1940–41. Army aviation, half inside, half outside the control of GHQ, demanded complete independence to prepare for a unique mission. The supply system was particularly cumbersome. Requirements were established by the chiefs of arms and services under the supervision of G–4 of the General Staff, procured under the supervision of the Office of the Under Secretary of War, and distributed under the supervision of G–4. In an emergency, operations invariably take precedence over planning. In the absence of an agency to direct and co-ordinate the supply functions of the various arms and services, G–4 became to a large extent an operating staff. The same thing happened to G–1, G–2, and G–3. Some means of relieving the General Staff of operations duties and restoring its original function as a planning group seemed imperative.[5]

The means finally used to create a more efficient organization divided the Army into three commands: Army Ground Forces, Army Air Forces, and the Services of Supply. The Corps of Engineers emerged from the shuffle a supply service instead of an arm, under the Commanding General, Services of Supply. To be sure, the Corps of Engineers, unlike the arms that were absorbed by Army Ground Forces, retained its Chief and its traditional administrative organization, a fact that compensated somewhat for the feeling of lowered prestige which accompanied this designation as a supply service. If the supply function had ever been regarded with respect in the Army, it had lost all claim to it during the twenty-year financial famine following World War I. To most officers the word "supply" evoked a vision of banishment to a depot to count pants and beans. It was only the very farsighted who could grasp the role that logistics was to play in World War II. Lt. Gen. Brehon B. Somervell, the commanding general of the newly created Services of Supply (SOS), himself an Engineer officer, was one of them. In his recognition of the importance of the logistical task ahead, he perhaps overlooked the fact that some of the members of his own Corps had not caught up with him.

[5] (1) Greenfield, Palmer, and Wiley, *Organization of Ground Combat Troops,* pp. 128–55, 203. (2) Millett, *Organization and Role of ASF,* Chs. I, II. (3) Henry L. Stimson and McGeorge Bundy, *On Active Service in Peace and War* (New York: Harper & Brothers, 1948), pp. 449–50. (4) Control Div ASF, Statistical Review, World War II: A Summary of ASF Activities [1945]. (Hereafter cited as ASF Stat Review.) EHD files.

After the creation of the Services of Supply, the Corps of Engineers no longer had direct contact with the General Staff or with the Under Secretary of War. All business with these offices had to go through the Commanding General, SOS. The changed relationship with the Under Secretary lost its sting in the course of the reorganization itself, since most of the functions of his office passed to Headquarters, SOS. Severing direct connections with the General Staff was another matter. Up to this time the Engineers had been able to trade upon their congenial relations with the General Staff in such matters as opposing cuts in Engineer strength in the infantry division. Just how far SOS would curtail this freedom was debatable in March 1942, but nothing was clearer than the fact that Somervell's organization had the power to do so.

General Reybold, the new Chief of Engineers, had seen while he was G–4 the inherent defects of the old organization. Besides, good soldiers take orders. His attitude was expressed in June 1942 in an exchange with Congressman Snyder of the House Committee on Appropriations:

> Mr. Snyder: I believe your branch, under the recent reorganization falls under the "Services of Supply?"
>
> General Reybold: Yes, sir.
>
> Mr. Snyder: How do you find the new setup? So far as your branch is concerned, would you say that it is running smoothly and that you have found it to be an improvement over the former organization?
>
> General Reybold: Yes, sir.[6]

Refinement of Prewar Troop Organizations

The tactical organization of the Army before Pearl Harbor was geared to the pattern of the European war. The Army was unprepared for the logistical and strategic demands of the global conflict that developed after the Japanese attack and only gradually realized what these demands would be. After the 1941 maneuvers the War Department had called for a reconsideration of unit organization, but, though they came in 1942, the modifications that were made as a result of this directive reflected earlier trends.[7]

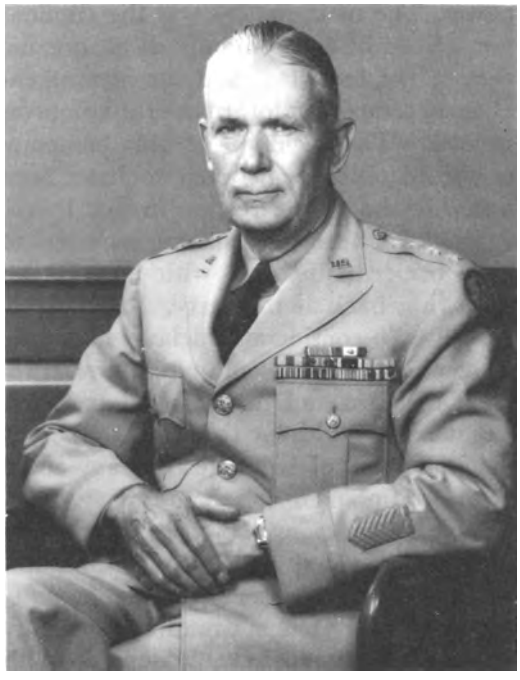
OCE's first concern, as it had been since 1937, was the adequacy of the combat battalion of the infantry division.The effort to make the engineers an integral part of the infantry–artillery combat team had succeeded almost too well. It became routine to assign one or two platoons of an engineer company to each of the division's three combat teams. Observers came away from the 1941 maneuvers convinced of the need for a corrective, noting that the few troops at the disposal of the division engineer left him inadequately prepared to carry out the general tasks that were certain to be demanded. The detachment of platoons from companies complicated messing and the distribution of equipment. Among the observers were Col. Joseph C. Mehaffey, who had been division engineer of the 1st Infantry Division, and Col. Raymond F. Fowler, then chief of O&T. Although both officers thought the engineer battalion too small, they saw little hope of enlarging it at that time. They proposed instead to redistribute its strength into four smaller companies of two platoons each instead of three companies of three platoons, the fourth

[6] H Comm on Appropriations, *Hearings on the Military Establishment Appropriations Bill, 1943,* 15 Jun 42, p. 212.

[7] Unless otherwise noted, the following discussion of combat and armored battalions is based upon correspondence in 320.2, Pt. 30; 320.2, Engrs Corps of, Pts. 14, 15; and 320.3.

company always to be at the call of the division engineer. The Engineer School showed little enthusiasm for this idea and in fact hung back when it came to endorsing the release of so many engineer troops from control of the division engineer. The school clung to traditional Engineer doctrine which held that combat engineers should usually be employed under unified control. Only when troops were on the march during an advance, a pursuit, or a withdrawal did the school favor attachment of engineers to a combat team. On the attack or on the defense they were to be employed under centralized control. The school opposed a reorganization within the existing strength of the combat battalion. A two-platoon company was less efficient than the existing three-platoon company because of the disproportionate overhead. The combat battalion did need four companies, but with three platoons each. Moreover, each platoon should be increased by eight to man newly assigned antitank weapons and machine guns, and there should be a slight addition to battalion headquarters personnel.

Early in January 1942, Sturdevant forwarded the school's recommendations to G–3, who rejected the 350-man increase but did allow 9 more officers and 102 more enlisted men. The battalion remained a three-company, three-platoon unit. The lettered companies received enough men for the new weapons and radios plus a few extra basics. The headquarters company gained motorboat operators, truck drivers, radio operators, basics, and a variety of specialists. The engineer combat battalion with its 745 men now composed 4.8 percent of the infantry division, a gain of .7 percent. G–3's generosity in this instance was typical. It reflected the trend toward



GENERAL BREHON B. SOMERVELL, *the commanding general of the Services of Supply. (Photograph taken 1945.)*

larger units which was one of three important characteristics of the 1942 reorganization. The trend was even more apparent in the treatment accorded the engineer battalion of the armored division.[8]

The commander of the engineer armored battalion, like the commander of the combat battalion, felt that he had too few men at his disposal. In September 1941 Oliver, the Armored Force Engineer, outlined the changes armored engineers considered necessary to increase their work

[8] (1) Schley, Maneuvers at Alexandria, La., May 40, Comments on Opns, Incl with Ltr, Actg CofEngrs to TAG, 12 Jun 40, sub: Rpt of Obsvs on Spring Maneuvers. 354.2. (2) EFM 5–6, 23 Apr 43, pp. 229–42. (3) T/Os 5–16, 5–17, 1 Apr 42.

power. The most radical was the elimination of the bridge company as an organic part of the battalion, and the attachment of such companies to armored divisions as needed. "The inclusion of this company in the battalion is believed to have been a step in the right direction in that it recognized the need for armored engineers to have bridge equipment with them at all times, not back at the rear . . . available on call with considerable delay," he wrote. In combat, bridges would often have to remain in place and the armored battalion might be left without this vital support if the equipment of only one company could be drawn upon. During the training period, one bridge company should be attached to each armored division. Overseas the number of bridge companies attached should depend upon the tactical situation. Flexibility was the characteristic most desired. With the elimination of the bridge company as an assigned unit, Oliver argued, the engineer armored battalion could absorb another lettered company, and all four companies be composed of three rather than two platoons. The battalion commander would then have sufficient men to perform unforeseen tasks. The argument had more pertinence for armored than for infantry engineers. The armored division was expected to spread out over a larger area. Because of this dispersion engineers would have to be attached to combat teams or commands and could not be readily assembled as a unit.[9] Recognition of this fact enabled armored engineers to gain readier acceptance for their recommendations than did the proponents of more engineers in the infantry division. When the new T/O for the armored battalion was approved in March 1942 the number of lettered companies was raised to four, platoons per company to three, and antitank weapons were provided. The bridge company was retained as an assigned unit until enough of these units had been organized to make attachment practicable. Under this temporary arrangement, the battalion had a strength of 1,174 officers and men or about 8 percent of the division.[10]

The second major characteristic of the reorganization of 1942—the first being the trend toward larger units—was simplification of the organization of general units.[11] At the close of First Army maneuvers in 1941 Adcock had commented:

> I think the time has come to reconsider the necessity for so many types of general engineer units. The combat battalion, armored battalion, and squadron meet a specific need in their particular divisions. There appears to be no sound reason for the remaining three general engineer units (combat regiment, general service regiment, and separate battalion) to continue under separate tables of organization with different types of equipment. They should be *just* Engineer regiments.[12]

Although this was Kingman's view also, the goal was easier to agree upon than to attain. Fowler argued that placing all engineer troops in the same type of regiment would be difficult because of the disparity in numbers of specialists available for white and Negro units. Agreeing to the principle of simplification but advocating a different approach, the Engineer School suggested

[9] Col. Lunsford E. Oliver, "Engineers With the Armored Force," *The Military Engineer,* XXXIII (September, 1941), 397–401.

[10] T/O 5–215, 1 Mar 42.

[11] The main body of correspondence on this simplification is in: (1) 320.2, Pts. 30, 31; 320.2, Engrs Corps of, Pt. 15; (2) AGF 321, Engrs Binder 2, Case 268, and Binder 1, Case 54 (S).

[12] Ltr, Adcock to CofEngrs, 25 Nov 41, sub: First Army vs. IV Army Corps Maneuvers (1st Phase). 354.2, Pt. 11.

that all combat and most general engineer units be organized with type squads, platoons, and companies, and that the two combat regiments per type corps be replaced by four combat battalions. Corps combat battalions would be similar to divisional combat battalions. With such units, employment would be more flexible and control no more difficult.[13] Once again Fowler objected. What advantage lay in type squads and platoons if equipment was to vary? "We should not overlook the fact," he cautioned, "that an Engineer squadron, an armored battalion, a corps regiment, and a general service regiment have very different primary functions. There are far better reasons for having a single type truck in the Army." [14] Should combat regiments be broken down to form battalions the corps engineer would have to deal with four commanders instead of two and suitable commands for Engineer colonels would vanish. Since there would also be an increase in strength, the General Staff was not likely to approve the change anyway.

Sturdevant took still another tack. The constant threat from armor and planes had made an extended protection of flanks and rear necessary so that engineers in the field army were required in greater depth than previously. General service regiments and combat regiments were very nearly alike and had been used interchangeably in maneuvers but general service regiments had been handicapped by their smaller number of vehicles. The combat regiment should replace the general service regiment in the field army; the general service regiment should be held in GHQ reserve for assignment to the communications zone. In March 1942 Sturdevant's plan was disapproved, partly because it would have involved the activation of more combat regiments. By this time the War Department had become more economical of motor vehicles than of manpower and was furthermore reluctant to take a step which so changed the concept of the engineer task in the field army—the use of combat troops for general construction. Under the new T/O which went into effect in the spring of 1942 the general service regiment gained only a few men. The combat regiment gained almost 150, most of its new-found strength resulting from the reorganization of its six companies in the same fashion as those in the combat battalion. At the same time some of the combat regiment's construction machinery was eliminated.[15]

The attempt to cut down the types of engineer units continued. In January 1942, Sturdevant suggested the conversion of separate battalions into general service regiments. The need for so large a concentration of common laborers in a separate battalion had disappeared. The plan for all separate battalions to be Negro was a discrimination the War Department wished to avoid. Separate battalions were cumbersome and ineffective; conversion would boost efficiency and morale. While laborers could not be converted into skilled workmen overnight merely by changing their name, they could be developed gradually within the regimental setup. Although Sturdevant did not wish to press the point until the question of substituting combat for general service regiments in the type army had been settled, by May he was ready to carry the fight to AGF.

[13] Rpt on Reorgn of T/O for Engr Bn Triangular Div, Incl with 1st Ind, Comdt Engr Sch to CofEngrs, 9 Dec 41, on Ltr, C of O&T Br to Comdt Engr Sch, 28 Nov 41. 320.3.

[14] Comments on School's Rpt, 10 Dec 41, by C of O&T Br. 320.2, Pt. 30.

[15] (1) T/Os 5-21, 5-171, 1 Nov 40. (2) T/Os 5-21, 5-171, 1 Apr 42.

On receiving Sturdevant's recommendation, the AGF Operations Division accused the Engineers of devious plotting to motorize the engineer separate battalion and increase its technician and NCO grades. The Requirements Division joined in opposing the plan. The Training Division, on the other hand, could discern "no ulterior motive seeking to motorize the Separate Battalion by indirection," and supported the Engineers.[16] G–4 of AGF was inclined to side with the Training Division but feared the additional equipment could not be supplied, much less shipped. G–4 remained convinced that common laborers equipped with picks and shovels would be in demand overseas. G–4's views prevailed, but the Engineers did not give up. In July 1942 they seized the opportunity to cite a cable from MacArthur's headquarters which stated that the separate battalion had too few officers and not enough machinery to be of much use. Everyone, including the General Staff, now concurred, but actual conversion would have to be delayed until additional officers became available some time after the first of the year.[17]

Aviation engineers had bridled somewhat under Kingman's insistence that the company in the engineer aviation regiment and in the engineer aviation battalion be organized in the same way as the combat company. At the beginning of 1942 the Engineer Section of the Air Force Combat Command prepared new T/O's which broke away from this concept, allowing higher grades as well as sufficient personnel for working in shifts. The new tables, furthermore, approved in April, also eliminated the separate engineer aviation company as too small for wartime service. Henceforth there was to be no distinction between the separate engineer aviation battalion and the battalion in the regiment; there was to be but one engineer aviation battalion patterned on the prewar separate engineer aviation battalion. To permit two- and three-shift operation of construction machinery substantial increases in the personnel of battalion headquarters were allowed. Lettered companies remained about the same size as the pre-Pearl Harbor combat companies, but they had more and heavier power equipment and were specifically designed for the primary mission of aviation engineers—constructing airfields. The basic engineer aviation unit was to be this battalion of 27 officers and 761 men.[18]

The third major characteristic of the 1942 reorganization was the perfection of the organization of special units. Aside from ponton and topographic units, special units had been slighted until relatively late in the defense period, when they were organized experimentally and whenever possible subjected to tests in maneuvers. This experience, together with new developments in equipment, enabled the Engineers to make firm recommendations.

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[16] M/S, Tng Div AGF to Rqmts and Opns Divs AGF, 11 May 42, sub: Elimination of Engr Sep Bns. AGF 321, Engrs Binder 2, Case 268.

[17] (1) 1st Ind, Hq AGF to CofEngrs, 23 May 42, on Memo, ACofEngrs for CG AGF, 2 May 42, sub: Elimination of Engr Sep Bns. 320.2, Engrs Corps of (S). (2) Memo, Hq AGF for ACofS G–3 WDGS, 19 Aug 42, same sub. Mob Br P&T Div file, Sep Bns–Reorgn (S). (3) Memo, ACofS G–3 WDGS for CGs AGF and SOS, 31 Aug 42, same sub. Same file.

[18] (1) Personal Ltr, Col Rudolph E. Smyser to EHD, 5 Jun 52. (2) Ltr, Smyser to Maj Gen A. C. Smith, 24 Dec 53. EHD files. (3) Ltr, CofS Hq AFCC to Chief of AAF, 2 Mar 42, sub: Rev T/Os for Avn Engr Units. AG 320.3 (10–3–41) (2), Sec. 5, Bulky. (4) Brig. Gen. Stuart C. Godfrey, "Engineers With the Army Air Forces," *Aviation Engineer Notes*, No. 11 (January, 1943), 34, USAF HD, 144.31A, Jan 43. (5) T/Os 5–415, 5–416, 1 Apr 42.

Heavy ponton battalions and light ponton companies had been among the first special units to be formed, but by the end of 1941 improvements in equipment as well as changes in responsibilities made revisions in organization desirable. Comparison of the poor performance of general engineer troops with the excellent showing made by ponton troops at the 1941 maneuvers clinched the running argument as to which type of unit should have the primary responsibility for building ponton bridges. In December, the Engineer School recommended that ponton units build as well as transport and maintain the bridges. The proposal soon became official doctrine. General engineer troops were to assist the ponton units as necessary.

The only change sought in the organization of the heavy ponton battalion was the inclusion of a light equipment platoon in battalion headquarters for the new ferrying equipment. The Engineers considered a greater increase in men and equipment essential for the light ponton company because the adoption of heavier tanks necessitated more 10-ton bridging material for the same length span. The Engineer School suggested the formation of a light ponton battalion similar to the heavy ponton battalion, with a headquarters company, including a light equipment platoon, and two bridge companies. Each bridge company was to carry two units of 10-ton equipage, as compared to the three units carried by the previous company. The battalion would therefore have only one more unit (250 feet) of bridging than the old company. The school figured that four units would enable a division to make a deliberate crossing over a river three or four hundred feet wide, with a partial reserve of material whether or not the bridge was reinforced.

The slight change in the heavy ponton battalion met little opposition. The new T/O approved in April contained a 46-man increase, bringing the unit's total strength to 16 officers, 3 warrant officers, and 501 enlisted men. The shift from a light ponton company to a light ponton battalion was not granted, partly because of the added personnel required for a battalion headquarters. Moreover, the Engineer argument that fewer men with better equipment were able to do more work was so convincing that each company was given half the amount of new ferrying equipment that otherwise would have been supplied battalion headquarters, one unit of 10-ton bridging was withdrawn, and the company was reduced by two men. The April T/O for the light ponton company provided for 6 officers and 213 men.[19]

The Engineers had been able to defer activation of a water supply battalion until August 1941 because divisional and other general engineer units had their own water supply equipment. Portable water purification equipment had been developed by the Engineer Board in co-operation with industry to enable facilities to keep pace with troop movements. The water supply battalion was meant to supplement such facilities. It was provided with a much heavier mobile purification plant and with tank trucks for transporting water. A T/O for the battalion had been formulated in November 1940, well before the first unit was activated.

[19] (1) Rpt on Reorgn of T/Os for Gen and Special Engr Units, 11 Dec 41, Incl with 1st Ind, Comdt Engr Sch to CofEngrs, 12 Dec 41, on Memo, C of O&T Br for Comdt Engr Sch, 4 Dec 41, sub: Rev of T/Os. 320.2, Pt. 30. (2) Corresp in 320.2, Engrs Corps of, Pt. 15. (3) T/Os 5-87, 1 Aug 42; 5-275, 1 Apr 42. (4) See above, pp. 51-52.

In April 1942 a well-drilling section was added to battalion headquarters and a redistribution of personnel in the three lettered companies resulted in a 73-man increase.[20]

One new special unit was added to engineer troops at this time. In June 1941 the Chief of Engineers had included a forestry company among the units to be investigated by the Engineer Board and the board in turn employed E. E. Esgate, a forestry engineer, to study the matter. Esgate urged quick action. With extensive construction in a theater of operations a foregone conclusion, the demand for lumber would become insatiable, he believed. In the United States the logging and milling industry had introduced much laborsaving machinery. Men who knew the business were therefore relatively few and most of them were too old to serve in the Army. But OCE was not sufficiently impressed with the urgency of the need. It was not until June 1942 that two companies of 5 officers and 166 men each, divided into a headquarters platoon, a logging platoon, and a manufacturing platoon equipped with a portable sawmill were activated.[21]

None of the three major characteristics in the 1942 reorganization indicated a sharp break from pre-Pearl Harbor concepts of military organization. The tendency to increase the size of units had become apparent as soon as the Army began to receive more men. The goal of simplicity in organization had also been enunciated before Pearl Harbor and the perfection of the organization of special units was an objective which the Engineers had had in mind for a long time. The 1942 reorganization marked the culmination of prewar thought and was a final adjustment to a nebulous war.

The Influence of Logistics on Engineer Growth

The emphasis on combat troops that characterized prewar thought was apparent in the troop basis of January 1942, which lumped combat and service units together. Of the 3,600,000 men expected to be under arms by the end of the year, 384,000 were slated for GHQ reserve; 998,000 for the AAF and its services; 1,300,000 for divisions, corps, and field armies; and 232,000 for overseas garrisons and bases. Some 600,000 were to compose overhead, replacements in training, and harbor defense units. The Engineers were expected to organize 128 new ground units. Forty-seven were either divisional units or combat regiments, 12 were ponton units, and 30 were general service regiments or separate battalions which could be used either in the communications or the combat zone. There was no hint here of the great role service units were to play in the prosecution of a global war. Special engineer units were supposed to round out the organization of field armies. No clear-cut distinction had been made between units needed to support combat operations and those required for more extensive logistical support in the rear. Maintenance, depot, and dump

[20] (1) Thompson, *What You Should Know About the Army Engineers*, pp. 158–65. (2) T/O 5–65, 1 Nov 40. (3) T/O 5–65, 1 Apr 42.

For additional information on engineer water supply activities both in the United States and in the theaters of operations, see William J. Diamond, "Water is Life," *The Military Engineer*, XXXIX (March–June, August, October, 1947).

[21] (1) Corresp in 400.34, SP 335, Pt. 1. (2) Memo, AC of O&T Br for Opns Div SOS, 4 Apr 42, sub: T/Os—Engr Railway Shop Bn (Diesel). 320.2, Pt. 32. (3) DF, ACofS G–3 to TAG, 18 Apr. 42, sub: Engr T/Os. AG 320.3 (10–13–41) (2) Sec. 5, Bulky. (4) Hist of 800th Engr Forestry Co in United States and Africa, 13 Jun 42–13 Dec 43. AG ENCO 80–0.3 (13364).



ENGINEERS CONSTRUCTING THE PIONEER ROAD *through virgin forests, Alcan Highway, British Columbia, May 1942.*

truck companies, general service regiments, and separate battalions all had this dual function. Sturdevant's early efforts to rectify the situation by eliminating general service regiments from the army echelon had failed.[22]

Strategy soon altered this distribution. Except in the Philippines the first phase of the United States involvement in the war did not lead to a large-scale clash of ground troops with the enemy. This phase of the war was a defensive one in which the United States sought to preserve its lines of communication with its Allies and bases overseas. While the Navy protected these lines by sea the Army tried to improve communications by land and to establish military bases. The initial effort was thus logistical and spurred the growth of service units. The Engineers had to answer an early and persistent call for construction troops to circle the world with airfields, to build strategic roads in Canada and Alaska, China and Burma, and to provide shelter for troops and supplies everywhere.

It soon became clear that there were not enough engineers. In February 1942 the War Department decided to transfer the building of bases in Iran and Egypt from civilian contractors to engineer troops. Because general service regiments had neither the equipment nor the skills to take up

[22] (1) Memo, ACofS G–3 (G–3/6457–433) for CofEngrs, 15 Jan 42, sub: Mob and Tng Plan, Jan 42. 370.93, Mob Tng Ser. Nos. 50 to Folio 3. (2) For discussion of depot and maintenance units, see below, pp. 227–29.

where the contractors had left off, OCE designed a special service regiment about the same size as a general service regiment but containing more skilled workers who could operate the machinery used by the contractors. A total of nine special and general service regiments were added to the troop basis for this mission. About the same time the Engineers began to organize three more general service regiments to construct bases for the build-up in Britain. By April the plan to militarize construction in the Middle East was all but canceled. The shortage of shipping which was to become a dominating influence on the strategy of the war had for the first time intruded upon the operations of the Corps of Engineers. Instead of some 16,000 engineer troops embarking for Egypt and Iran, as first planned, only 1,100 were to go.[23]

While few of these regiments were used as intended, it was fortunate they had been organized. In April the War Department became more deeply involved in planning for the build-up of American forces in Britain and demands for engineer troops immediately rose by nearly 24,000 men, most of whom were destined for service units. On top of this came an addition of 30 aviation battalions to the troop basis—more than doubling earlier estimates of requirements.[24] The troop basis of July 1942 reflected the trend toward service units—a trend which was to continue throughout the war. (*Table 4*)

Substantial as was the increase in engineer service units in the troop basis of July 1942 it was still too small. A month after its publication Reybold was pleading for the transfer of six general service regiments from AGF to SOS control. All but one of the regiments originally destined for the Middle East had moved out on other missions. Civilian laborers for construction jobs already under way in the Caribbean, Greenland, and Alaska were becoming harder and harder to hire. Troops would no doubt have to finish these projects as well as man scores of others from start to finish.

TABLE 4—ENGINEER UNITS IN TROOP BASIS: JANUARY 1942 AND JULY 1942

Unit	January 1942	July 1942	Change
Aviation regiment	(a)	3	------
Combat regiment	18	32	+14
General service regiment	22	49	+27
Special service regiment	0	3	+3
Armored battalion	10	14	+4
Aviation battalion	(a)	54	------
Camouflage battalion	3	6	+3
Combat battalion	55	57	+2
Heavy ponton battalion	10	10	0
Motorized battalion	4	2	−2
Separate battalion	24	9	−15
Topographic battalion (GHQ)	2	2	0
Topographic battalion (Army)	4	6	+2
Water supply battalion	4	6	+2
Engineer squadron	2	2	0
Depot company	7	20	+13
Dump truck company	10	21	+11
Light ponton company	16	22	+6
Maintenance company	10	15	+5
Topographic company (Corps)	11	15	+4
Heavy equipment company	1	2	+1
Heavy shop company	1	6	+5

[a] No engineer aviation units included in Troop Basis of January 1942.

Source: (1) Trp Unit Basis for Mob and Tng, Jan 42. AGF 3674–58, Mob and Tng Plan, 1942 (C). (2) Incl, Trp Basis for Mob and Tng, 1942, with Ltr, AG 320.2 (7–3–42) MS–C–M, 18 Jul 42. 370.93 (C).

[23] (1) Corresp in 322, Engrs Corps of, Activation of Constr Units, Folder 1 (S). (2) Memo, C of O&T Br for CGs Engr Units for Militarization of Overseas Constr, 19 Mar 42. 322, Engrs Corps of, Activation of Constr Units, Folder 2 (S).

[24] (1) Memo, Deputy Dir Opns SOS for ACofS G–3, 23 May 42, sub: Rqmts of Sv Units Which Should Be Activated by 31 Dec 42. EHD files. (2) Ltr, C of Sup Div to CG SOS, 27 Apr 42, sub: Proc Program. 400.12, Pt. 1 (C).

AGF balked at the transfer. Units the size of a battalion or regiment should be trained with other soldiers for better teamwork in battle. AGF's demurrer had scarcely been received when Reybold boosted his request to twelve regiments. He got what he had asked for originally. At the end of October the General Staff transferred six regiments from AGF.[25]

Even as the Engineers were striving to satisfy the demand for standard service units, new and specialized functions were thrust into the foreground. Invading armies, seeking footholds on the continent of Europe and on the islands leading to the Japanese homeland, faced manifold amphibious landings to gain beachheads. A major landing, involving great numbers of troops and a sustained offensive inland, would require the full facilities of large seaports. Petroleum products in unheard-of amounts would be consumed. So new, so specialized were the units organized by the Engineers for amphibious operations, for the distribution of petroleum products, and for the rehabilitation of ports, that their stories will be told separately in Chapters XVI, XVIII, and XVII.[26]

The transition from a peace to a war footing had been completed by the end of 1942, but the adaptation of engineer units to the demands of global warfare remained to be made. In the first months after Pearl Harbor the mobilization of men and equipment took top priority. There had been little opportunity to reconsider the organizational and doctrinal pattern elaborated in peacetime. The first enemy blows had to be met within the existing military framework. The reorganization of 1942 was not designed to alter that basic pattern, but rather to round it out. Yet even before the reorganization had been completed, the Engineers began to feel the impact of strategic and logistic requirements. The demand for logistical units was to continue to grow in volume.

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[25] (1) Ltr, CofEngrs to CG SOS, 13 Aug 42, sub: Activation of Additional Gen Sv Regts. 320.2, ASFTC Camp Claiborne. (2) Min, Staff Conf SOS, 23 Sep 42, sub: Résumé of Matters Presented at Staff Conf, 22 Sep 42. 337, Staff Confs. (3) Corresp in AG 320.2 (8–13–42) (C).

[26] The specially equipped engineer airborne aviation battalion was also authorized in 1942. See below, p. 315.

The T/O for another engineer unit, the engineer airborne battalion of the airborne division, was issued in September 1942, following the War Department's decision to activate two airborne divisions. The T/O for the engineer airborne battalion called for 23 officers and 401 enlisted men organized into a headquarters company, a parachute company, and two glider companies. Five such units were eventually activated. (1) Greenfield, Palmer, and Wiley, *op. cit.*, pp. 93–98, 340–41. (2) T/O 5–255, 5 Sep 42.

CHAPTER VII

Accelerated Training

The demand for the organization of specialized units was but the last hurdle in an unprecedented race to fill the already swollen Engineer troop basis. Pearl Harbor signaled a period of urgency in which to get as many men as possible organized into units and readied for commitment overseas. At first getting the requisite number of men presented no obstacle. The supply of manpower seemed inexhaustible. The most formidable block to Engineer preparations in 1942 was the shortage of officers and the training of the 241,733 enlisted men called into the Engineer service.

The Shortage of Officers

Months before the Engineers glimpsed the full measure of their commitments, they expressed concern about the dearth of experienced leaders. The detail of one officer to the General Staff in January caused Sturdevant to object that "we need everybody we now have for troops." He conceded that the Officer Candidate School would produce "some 4,000 green officers" in the next twelve months, but he warned, "if we are to build efficient organizations we certainly need some leavening experience to guide them." [1] There was reason for his concern. The Engineers faced a cut in their allotment from West Point. They had received fifty of the Academy's 1941 graduates. In June 1942 they would receive only thirty-nine and six of these would go directly to the control of the Air Forces or Armored Force. By March most of the Reserves would have been called into active service. The new crop of ROTC graduates would add a few hundred. Culling the lists of former Reserves and transferring some from non-Engineer to Engineer service might yield a few hundred more. But for the most part the Corps had to look to other sources than those that had supplied the officers for units activated during 1940 and 1941.

On 3 January 1942 Bessell, the chief of the Military Personnel Branch, described the sources to be tapped. Approximately 1,000 Reserve officers would be called to active duty within the next few months, placed in a pool, and given refresher training. The output of the Officer Candidate School had been expanded from 230 to 1,000 per quarter. Finally, authority would be sought to commission 500 officers from civil life, not for duty with troop units but for assignment to desk jobs with the military construction program so that a corresponding number of troop-age officers then employed on that program could be assigned to engineer units.[2]

[1] Memo, ACofEngrs (Sturdevant) for CofEngrs, 31 Dec 41. 320.2, Engrs Corps of, Pt. 14.

[2] (1) Personal Ltr, Lt Col William N. Leaf, Senior Instructor Engr Tactics USMA to C of Mil Pers Br, 19 May 42. 210.3, Engrs Corps of, Pt. 21. (2) 2d Ind, O&T Br to TAG, 21 Jan 42, on Ltr, TAG to OCE, 26 Nov 41, sub: Tng Res Offs at Sv Schs. 353, Orgn Res, Pt. 14. (3) Rpt of Activities of Mil Pers Br Wk Ending 17 Mar 42. 020, Engrs Corps of, Jan–Mar 42. (4) Memo, C of Mil Pers Br for C of Adm Div, 3 Jan 42. 320.2, Engrs Corps of, Pt. 15.

Prominent among the arguments advanced in support of the consolidation of the military construction program under the Corps of Engineers had been that it would save administrative overhead. The existing field organization of the Engineer Department, overwhelmingly staffed by civilians, could handle the job. Officers had already been released from the Engineer Department and could continue to be released and replaced by commissioning these civilians. Having confidence in this logic the Military Personnel Branch believed that the Engineer Department could disgorge even more officers than would have to be replaced by appointments from civil life. The expectation in January 1942 was that something in excess of 500 officers would become available for assignment to troop duty via the military construction program.

In accordance with this understanding the Military Personnel Branch sent an advance warning to Division and District Engineers. For months the branch had been coding applications for commissions. The districts would soon receive a list of names of individuals considered suitable to replace troop-age officers. The districts should meanwhile submit the names of those to be replaced. The response to this communication was far from gratifying. After declaring flatly that no surplus of officers existed, the Engineer of the Lower Mississippi Valley Division named nine officers of troop age, all of whom he considered key men who should not be removed unless there was no alternative. A review of the replies from the field showed that most of the names submitted for release were those of Quartermaster officers, who, even had they been suitable for assignment to engineer troop units, could not be considered eligible because they were slated to be returned to their own corps. Bessell, hastening to disclaim any intended interference with the progress of the construction program, promised to restrict transfers to those officers declared surplus by District and Division Engineers.[3]

About this time the Construction Division, worried about the fact that its program was behind schedule, lined up squarely behind those who claimed there was no surplus. Robins, its chief, had become convinced that there were too few officers on military construction projects, and on 24 March 1942 directed Division and District Engineers to take on more. Fully aware, however, that few Regulars would be assigned to construction duties in the future and that pressure to release Reserves of troop age would continue, he urged the field to prepare to staff itself with officers commissioned from civil life. Hard on top of this communication Division Engineers received a telegram from the Military Personnel Branch, asking for immediate submission of the names of company grade officers who could be released without violating Robins' directive. The officers were needed for the construction units then being activated for work in the Middle East and did not have to be of troop age. Only after the Military Personnel Branch phoned to read off the names of the first group of officers to be reassigned did the Construction Division learn about the existence of the telegram. The howl of pain that went up swelled into a roar of indignation when the Construction

[3] (1) C/L 1090, 19 Jan 42, with longhand note, sub: Reasgmt and Repl of Trp Age Offs Now on Constr Duty. 210.3, Engrs Corps of, Pt. 18. (2) Ltr, Miss. River Commission and Lower Miss. Valley Div Engr to CofEngrs, 6 Feb 42, same sub. 210.3, Engrs Corps of, Pt. 19. (3) Ltr, C of Mil Pers Br to Great Lakes Div Engr, 19 Feb 42, same sub. Same file.

Division found that twenty Engineer officers had been removed without its knowledge. The disgruntled deputy chief of the Construction Division, on seeing another list of officers slated to go, commented that, although the release of a few of them might actually be an advantage, on the whole the action would disrupt the construction program. A meeting with Reybold was scheduled forthwith.[4]

The resulting clarification of policy put a considerable brake upon the activities of the Military Personnel Branch. Immediate objectives were set forth as follows:

a. The expeditious and efficient prosecution of the war construction program.
b. To maintain the proper number of officers required for the prosecution of the war construction program.
c. To make maximum use of over troop-age officers and of officers appointed from civil life for special service who have had no military training.
d. To release troop-age officers qualified for duty with troops to the maximum extent consistent with *a* and *b* above.

That much being a victory for the Construction Division, the field was again urged to bring in replacements as understudies to troop-age officers and was put on notice that no officers of troop age would be assigned to construction duties except in "very unusual cases." [5] The Construction Division was resigned to this policy as applied to the future, but continued to resist the reassignment of its experienced officers. "I'd like to remind you," the South Atlantic Division Engineer told the chief of the Construction Division's Operations Branch in mid-April, "that they've just taken five regulars from me and are only giving me one in return." The chief of the Operations Branch doubted that anything could be done about it. Although he was inclined "to turn down all these requests for pulling people away," he was "under constant pressure" to release Regular troop-age officers other than District Engineers and their top assistants.[6] Still the Construction Division did succeed in holding up a good many transfers. Only fifty out of ninety officers listed by the field as subject to reassignment in late April were approved for release.[7]

Meanwhile, after the publication of the January 1942 Troop Basis, the Engineers arrived at a better estimate of officer requirements. With 131 new units scheduled for activation, more than 8,000 officers would be needed with troops alone by the end of the year. As of March 1942 there were 823 Regulars, 5,453 Reserves, 504 National Guardsmen, and 106 officers commissioned from civil life—a total of 6,886 distributed as follows: overhead, 831; construction duty, 2,070; service commands, 389; and troops, 3,596. With a large military construction program scheduled through 1942, the Engineers would have to add about 4,500 officers to serve with troops. The bulk of them would be graduates of the Officer Candidate School (OCS).[8]

When the Army offered enlisted men the opportunity to become candidates for commissions in July 1941, the main value of the

[4] (1) C/L 1423, 24 Mar 42, sub: Off Pers on Constr Projects. (2) Personal Ltr, ACofEngrs (Robins) to Col John S. Bragdon, South Atlantic Div Engr, 24 Mar 42. 210.1, Engrs Corps of, Pt. 7. (3) Memoranda in 210.3, Engrs Corps of, Pt. 12.

[5] C/L 1479, 13 Apr 42, sub: Mil Pers Policies: Asgmt of Constr and Utilities Offs.

[6] Tel Conv, Bragdon, South Atlantic Div Engr, and Col Strong, C of Opns Br Constr Div, 17 Apr 42. Groves files, Airfields.

[7] Rpt of Activities of Mil Pers Br for Wk Ending 24 Apr 42. 020, Engrs Office C of, Apr–Jun 42.

[8] (1) Ltr, CofEngrs to TAG, 12 Feb 42, sub: Allot of Grads USMA, Class of 1942. 210.3, Engrs Corps of, Pt. 19. (2) Ann Rpt OCE, 1942.

innovation was believed to lie in the boost it would give morale and the opportunity it would afford to put the talents of outstanding selectees to better use. Only secondarily was the program intended to provide a cushion in case of further expansion of the Army. Although officer candidates were supposed to represent the cream of the citizen soldiers, the more important of the standards which the Army established as a guide to selecting them were so indefinite that much was left to personal judgment. The most important qualification of all—potential leadership—was completely undefined. The candidate's ability to learn was deemed sufficient if he had achieved a score of at least 110 (Classes I and II) on the Army General Classification Test. The Army did not exclude anyone solely because of lack of formal education. It was enough if the candidate possessed "such education or civil or military experience as will reasonably insure . . . satisfactory completion of the course" although for certain services, the Corps of Engineers among them, more weight was to be given to the individual's technical preparation.[9]

The graduate of OCS was not expected to know much. At the end of the twelve-week course he was supposed to have acquired sufficient knowledge to perform "reasonably" well the duties of a junior officer in a unit undergoing training. He would come to the unit as an apprentice with enough general information to enable him to profit from the practical experience he would get thereafter. Perhaps he would take advanced courses later, but this was not the concern of the OCS.[10] The course of study offered at the Engineer OCS at Fort Belvoir was designed to teach the candidate how to lead enlisted men in the performance of engineer duties. Success in attaining even this objective, as experience invariably demonstrated, depended as much upon the caliber of candidates received at the school as upon the course of study and quality of instruction. Twelve weeks was too short a time to turn an engineer soldier into an Engineer officer—even a green Engineer officer—unless the individual had much to offer at the outset. The first class of Engineer officer candidates—the only class to graduate before Pearl Harbor—enrolled at the Engineer OCS on 7 July 1941. Sixty-seven of the ninety-seven students graduated. The second group, which entered the last week of October, contained 218 candidates, 167 of whom were successful. This second was the last class chosen for reasons of morale. The next group of candidates, which entered in January, was more than a third again as large as the second, and, had its quota been filled, would have been more than twice as large. The fourth class was indeed twice as large. It entered two weeks after the third so that a production of 4,000 officers could be achieved in 1942. On 16 January G–3 directed the Engineers to fix the capacity of their OCS at 3,680. By the end of May additions to the troop basis had created a demand for 1,200 more officers. Plans were immediately laid to expand the school's capacity to reach 5,160 by 30 September.

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[9] (1) Robert R. Palmer, Bell I. Wiley, and William R. Keast, *The Procurement and Training of Ground Combat Troops,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1948), pp. 327–28. (2) Watson, *Chief of Staff,* p. 271. (3) WD Cir 126, 28 Apr 42.

The following discussion of the Engineer Officer Candidate School, unless otherwise indicated, is based upon Outten J. Clinard and George H. McCune, A Survey of the Source Materials for a History of the Engineer Officer Candidate Course, an unpublished study with supporting documents, in EHD files.

[10] Palmer, Wiley, and Keast, *op. cit.,* pp. 331, 361.

In establishing criteria for the selection of candidates the War Department deemed it "desirable" that Engineer candidates have "an engineering degree or equivalent knowledge or special mechanical or engineering training." [11] In the atmosphere of scarcity which prevailed during 1942, quantity became the overriding factor. Quality, while not forgotten, was a luxury the Army could not afford. The sacrifice of quality to quantity showed itself both in the selection of candidates and in the lowering of standards for graduation. Accustomed to high professional competence and qualities of leadership in their officers, the Engineers refused to accept the inevitable without a struggle. But it was lack of intellectual attainments, rather than leadership, that the Engineers deplored most often. The conviction seemed to be that ability to lead would follow in the wake of knowledge. To the extent that confidence grows with knowledge this was sound reasoning. It was also true that many of the tasks performed by the Engineers did not call for the same degree of courage as those demanded in the combat arms but did call for special knowledge.

Complaints about the poor educational background of Engineer candidates began in March 1942 when the commanding general of the Engineer Replacement Training Center (ERTC) at Fort Belvoir despaired of filling his quota. Of 3,050 men then at the ERTC, he could produce only 52 with a year or more of study in engineering, geology, architecture, or science, and only 11 having college degrees with majors in any of these subjects. Some of these men would choose to attend the OCS of other branches; some would not have the necessary aptitude for leadership. After getting a similar report from the other ERTC at Fort Leonard Wood, Missouri, Sturdevant asked The Adjutant General to correct this situation. Sturdevant was at a loss to understand why the Engineers were not receiving more college graduates since he understood that almost 4 percent of all inductees had bachelor's degrees. He agreed that lack of formal education should not be established as an absolute barrier to officer candidacy but hastened to point out that "in a technical arm or service the officer personnel must include a large percentage of technically trained individuals." He asked that the Engineers be accorded a greater share of men with degrees in engineering or allied subjects and a larger share of those who, while not college graduates, had had some college courses in engineering.[12]

By the end of the month OCE had heard the same story from the OCS commandant. "The Engineer Officer Candidate School is not receiving the calibre of men who should be available," wrote Brig. Gen. Roscoe C. Crawford. Only about 6 percent of the candidates were college graduates in engineering and this was the group most likely to succeed. Over 90 percent with engineering degrees had been graduated from OCS as against 82 percent with degrees in other subjects and 77 percent who had some college courses in engineering. Although Crawford naturally urged that the number of engineers be increased, he was willing to settle for what he could get. "The only definitely unfavorable group is that which did not graduate from high school," he wrote on 31 March 1942. "It is believed that every effort should be made to send to

[11] WD Cir 126, 28 Apr 42.

[12] 1st Ind, ACofEngrs (Sturdevant) to TAG, 14 Mar 42, on Ltr, CG ERTC to CofEngrs, 2 Mar 42, sub: Shortage of Trainees with College Engineering Education. 353, ERTC Ft. Belvoir, Pt. 1.

the Engineer Officer Candidate School not only the largest possible number of engineering college graduates, but also interested applicants otherwise suitable who have at least one year of college, not necessarily in engineering. High school graduates without college training will also be acceptable if they are suitably qualified by outstanding leadership and engineering experience." [13]

Concerned about quantity, the War Department was inclined to think the standards for selection as established by the Engineers, the Ordnance Department, and the Signal Corps were set too high. These services must abandon peacetime notions, the War Department wrote on 6 April 1942:

> While in peace, the bulk of the officers of a technical branch may be engaged in planning, research, design and construction duties demanding a higher degree of training along those lines; in war the bulk of the officers of those branches is employed with field force units of the branch in support of the combat arms. While this higher training is a definite asset it is not an essential requirement of a platoon or company commander of a technical unit supporting the combat arms. The required basic knowledge of planning and construction by these commanders is taught at the officer candidate schools.[14]

In view of the growing number of large-scale construction projects being handled by engineer troops overseas, this statement had but limited application to the Corps of Engineers. The selection of officers with civilian education or experience was essential. The high rate of failures in the Engineer OCS further reflected this viewpoint, that only qualified men could fill such positions. G–1, still concerned over quantity, expressed displeasure at the fact that about one fourth of the Engineer candidates had failed to graduate. Sturdevant reluctantly adopted the position of his superiors. The War Department's "concept of officer qualifications . . . must be accepted as correct," he wrote to Crawford on 20 April. "Much as high professional qualifications are to be desired, an unpredictable expansion of the Army can only result in a lowering of standards which must be accepted as a necessary sacrifice." OCS had to assume the responsibility for instructing the candidates received. "A high rate of attrition may be as much of an indictment of the methods of instruction as of the quality of the candidates," he concluded.[15]

Crawford did not agree that quantity was that important, but he nevertheless expressed concern about the number of failures. He saw four ways in which to reduce them. Standards for graduation could be lowered even though he believed they were already at the danger point. "To make further concessions is not a matter of making a necessary sacrifice," as Sturdevant had phrased it, "it is more a question of accepting a disaster. . . . We are making no compromise on the quality of our guns, tanks, planes, etc. Why compromise on the most vital thing to the whole effort—leadership?" He agreed with Sturdevant that another way to reduce the number of failures was to improve the quality of instruction. The OCS had too few instructors and the ones they had were not good enough. Repeated attempts to get officers from the field had been largely unsuccessful. The faculty had of necessity been built up from gradu-

[13] Ltr, Comdt Engr Sch to CofEngrs, 31 Mar 42, sub: Standards of Engr Off Candidates. Clinard and McCune, *op. cit.*, App.

[14] Ltr, AG 352 (4–5–42) MT–A–M to All Comdrs, 6 Apr 42, sub: Off Candidates, Tech Brs. Clinard and McCune, *op. cit.*, App.

[15] Ltr, ACofEngrs (Sturdevant) to Comdt Engr Sch, 20 Apr 42, sub: OCS Standards of Performance. Clinard and McCune, *op. cit.*, App.



BRIG. GEN. ROSCOE C. CRAWFORD, *Commandant of the Engineer School, June 1940 until November 1943.*

ates of officer refresher courses and from the OCS itself. "Until properly qualified instructors in sufficient numbers are made available . . ., we should accept as a necessary sacrifice," using Sturdevant's phrase again, "a smaller number of graduates." Along with getting more and better instructors Crawford favored continuing the struggle for better candidates. Meanwhile the OCS had introduced a fourth way to salvage more candidates by giving those who seemed able but slow (about 10 percent of each class) more time to adjust. After five weeks at the school these men were placed in a special unit for two weeks after which time they were either returned to the course or discharged.[16]

Sturdevant had meanwhile visited the ERTC at Fort Leonard Wood and informed its commander, Brig. Gen. Ulysses S. Grant, III, that he must fill his quota. Up to that time the center had refused to appoint candidates with less than two years of college or engineering experience. Grant lowered these standards reluctantly, warning that the selection of men with only a high school education and no experience in engineering would only add to the number of failures at the school.

By summer the War Department had modified its position somewhat. In June and July it recognized the existing shortage of Engineer candidates and directed other arms and services to cull their ranks for highly qualified men, particularly graduate engineers, and any others with engineering training or experience. But in mid-September, with Engineer OCS quotas still unfilled, the War Department became alarmed at the fact that some boards had excluded men simply because they lacked the technical and educational background indicated in the directives of the previous summer. The War Department pointed out that while such highly qualified candidates were desirable, the quotas should be filled out with men of intelligence and native ability, the real essentials for success at OCS.

If ability to learn as measured by AGCT scores had been the only criterion for a successful officer the Engineers would have had no cause to complain. Of 21,958 candidates enrolled between 21 March 1942 and 1 April 1944 all had received high marks and a good many of them exceptionally high marks on the Army General Classification Test. Eleven percent tested 140 or over; 22.6 percent scored between 130 and 139; 34.9 percent between 120 and 129; and 27.4 percent between 110 and 119.

[16] 1st Ind on ltr cited n. 15. Clinard and MacCune, *op. cit.*, App.

While ability to learn was a great asset in developing leadership, it provided no absolute insurance. For the Engineers it was particularly difficult to fill quotas with potential leaders because the Engineers were assigned so few enlisted men in Classes I and II from which all officer candidates had to be selected. During the period March–August 1942 only 23.4 percent of the men assigned to the Corps of Engineers were in Class I and II—the lowest percentage of all the arms and services. Although the Engineers fared better during the year 1943 when this percentage rose to 29.1, they remained in an unfavorable position as compared to most other branches. Under such circumstances replacement training centers and unit commanders found themselves hard put to give much weight to potential leadership or to formal education; the most they could do was to find men who met the specified standards of intelligence.

One reason why the Engineers did not succeed in getting more men in the higher classes was the persistence of the idea that the Corps could function perfectly well with large masses of common laborers. Although the Engineers took every opportunity to point out the fallacy of this idea, it would not down. The other reason for their failure to gain access to the most suitable sources was the preferential treatment accorded the AAF in the assignment of personnel. Under a policy established in February 1942, 75 percent of all white enlisted men destined for the AAF were to have scored at least 100 on the AGCT. The objections of AGF and SOS received some consideration in the fall of 1942 when the percentage was lowered to 55, but the fact remained that the top cream had been skimmed before AGF or SOS were allowed into the market.[17]

The educational background of Engineer candidates was therefore limited. During the period 21 March 1942 to 1 April 1944 candidates with undergraduate degrees in engineering numbered only 1,750 or 8 percent of the 21,958 enrolled. The number of college graduates holding degrees in subjects other than engineering was but 3,698, or 16.8 percent. A much larger number—8,568 or 39 percent—had some college education. Most of the remainder—over 25 percent of the total enrollment—were high school graduates only. During the early period of peak demand for officers the percentage of candidates with college degrees must have been even lower than 8 percent because after January 1943 ROTC graduates began to enter OCS and by 1944 comprised a large percentage of the student body. Since the OCS failed to receive the number of highly qualified men desired, the administration strove all the harder to improve the quality of instruction in order to produce satisfactory officers.

As Crawford had pointed out in March 1942, the school had tried unsuccessfully to secure officers with field experience to act as instructors. In the spring and summer of 1942 the school had to turn to its own graduates to fill the growing vacancies on the faculty. By August 1942, 35 percent of the instructors had less than three months' commissioned service. That month the situation was bettered by the introduction of a rotation system. Under this setup a number of officers having at least a year's experience with troops were to be assigned to the school faculty each month, their places to be taken by inexperienced second lieutenants who had been acting as instructors. Following assignment to the faculty the experienced officers would enter newly activated units.

[17] Palmer, Wiley, and Keast, *op. cit.*, pp. 17, 18, 21, 23–26.

"The many advantages of such a rotation policy can be easily seen," the Engineers advised the Director of Military Personnel, SOS. "The Engineer School gains instructors with experience in the field, newly activated units obtain a source of experienced personnel, troop units receive qualified loss replacements junior in rank to those officers on duty with the unit." [18]

The rotation system was one of two means adopted by the school in an effort to raise the standard of instruction. The other, introduced about the same time, was a course in instructional methods. Like other courses in methods of teaching, this one stressed effectiveness of presentation, and through classroom observation and conference gave personal guidance to the teacher. The inauguration of the instructional methods course and the receipt of more teachers who were experienced with troops combined to improve the quality of instruction during 1943, but by this time the desperate need for officers had passed and the school's capacity had been lowered.

During the first two years of its existence the course of study given at the Engineer OCS varied little. Even lengthening the course to seventeen weeks in July 1943 brought only slight changes in subject matter. In the space of twelve weeks the candidates took about forty subjects varying in length of instruction from one to fifty hours. About one third of the school hours were allotted to pioneer and Engineer subjects, the remainder to subjects common to all arms and services. Although a good many subjects were introduced by lectures, conferences, and demonstrations, and some of the shorter courses were entirely confined to this method, the school gave as much instruction as possible by means of practical work. Thirty-one of the thirty-seven hours allotted to the study of floating bridging were set aside for exercises, including a night crossing in assault boats. Such exercises satisfied several purposes. They revealed a candidate's knowledge of the subject and his ability to put his knowledge into practice. They afforded an opportunity for developing initiative, judgment, and the ability to organize a job and give orders, as well as a means of observing whether or not the candidate was developing such skills satisfactorily.[19] In order to be commissioned the Engineer candidate had to attain an average of at least 70 in both academic subjects and leadership qualities. In arriving at this average, school administrators assigned some subjects such as bridging and operation of construction machinery and some qualities of leadership more weight than others.

Almost 12,000 candidates were supposed to be sent to the Engineer OCS to fill classes slated to graduate during 1942. Of the 10,999 that actually entered, 8,925 graduated. In terms of quantity the Engineers were over the hump by the end of that year. The class which graduated on 21 July 1943 was the last large one, the quota having been slashed drastically from 700 to 160 the preceding May. During the nineteen-month period between January 1942 and July 1943 the OCS produced 16,742 successful candidates out of a total enrollment of 21,569. Despite the turn-back system to afford slow learners an opportunity to catch up, the school rejected over 22 percent of those who entered.

While the demand for officers was at its height, however, the percentage of those

[18] Ltr, AC of Mil Pers Br to Dir of Mil Pers SOS, 27 Jun 42, sub: Instructors for Engr Sch. 210.3, Engr Sch, Pt. 4.

[19] Lesson Asgmts for OCS, 20 Apr 42; 2 Nov 42; 1 Apr 43; 1 Jul 43. EHD files.

failing to graduate was consistently less. The class which finished on 30 May 1942 graduated 86.4 percent of its candidates, practically by order,[20] and throughout the rest of that year no class failed to graduate less than 80 percent of those who entered. Beginning in January 1943 the percentage of failures began to climb again. The class which finished on 28 April had a mortality rate of over 30 percent—about the same as that of the school's first class when morale had been the keynote of the officer candidate program. The average thereafter was closer to one third than to one quarter.

In each class there were some individuals who dropped out because of physical disability or other reasons. In fact in a good many classes those relieved for such causes outnumbered those who failed because of deficiencies either in leadership or in course work. During the period of peak capacity at OCS physical disability and similar causes accounted for 6.3 percent of the failures. The greatest number—7.5 percent—was judged lacking in ability to lead. Failures because of academic deficiencies accounted for 3.3 percent while 4.3 percent fell down on both leadership and grasp of subject matter.

It may appear inconsistent that after objecting so strenuously to the receipt of candidates who had not been to college, the OCS failed so many candidates on leadership rather than on academic grounds. Several factors must be considered before coming to this conclusion. The primary mission of OCS being to develop leaders, more was expected of candidates on this score. Academic subjects were extremely simple. Much of the candidate's grasp of the subjects taught was measured by written tests, where a good memory went a long way toward the achievement of a passing grade. A candidate might easily reel off bridge capacities, but he might find it more difficult to take his place in the group erecting the bridge, and he might find his knowledge too slight indeed to enable him to take command of the group with the assurance demanded of a leader.

The Engineers' insistence on the importance of previous education proved justified. As class after class entered and graduated it was demonstrated over and over again that candidates with degrees in engineering had the best chance to succeed and college graduates with majors in other subjects the next best. Of students enrolled between March 1942 and June 1944, 81.3 percent of those with engineering degrees and 80 percent of those with college degrees in other subjects graduated, as compared with 73.4 percent of those who had gone no farther than high school and 61.8 percent who lacked a high school diploma.

The Engineers realized from the beginning that even though officer candidates might possess a solid technical background, their very youth would preclude much working experience. The supply of Reserves which contained older men with several years background in construction had dried up early in 1942. The sudden demand in the spring of that year for officers to man the units being activated for construction duties in the Middle East led the Corps of Engineers for the first time to commission civilians for assignment to troop units. The specialized nature of the duties which general and special service regiments were supposed to perform in the Middle East demanded much in the way of construction experience, little in the way of military knowledge. As the demand for construction

[20] Memo, Gen Crawford for Authors, 23 Dec 53.

units mounted, the Corps of Engineers found civilian sources increasingly inviting.[21]

In January 1942 the Military Personnel Branch had about 9,000 applications from civilians desiring commissions in the Corps of Engineers. After a preliminary selection of applicants on the basis of information coded on machine records cards, applicants were to be interviewed. The Military Personnel Branch expected Division and District Engineers to do most of this interviewing. In order to be commissioned direct from civil life, a man had to be over thirty, have had some previous military training, and must not be under orders for induction. But military and age requirements might be waived if it could be proved that the individual's specialty rendered him extraordinarily well qualified for a particular assignment. The War Department allotted a quota of civilian commissions to each branch.[22]

On 12 April 1942 the War Department approved the commissioning of 568 officers for assignment to the units slated for the Middle East. The following month the Engineers received authority to commission 350 more civilians for service with forestry companies, aviation battalions, and utilities detachments. The first week in June they were authorized another 1,000 for the recently activated Engineer Amphibian Command. In July, Fowler, alarmed at reports of new units filled up with OCS graduates who knew little or nothing about the operation and maintenance of construction machinery, suggested that additional civilian sources be tapped. Shortly afterward Godfrey registered similar misgivings about the officers coming into aviation battalions and also asked for civilians. In line with Fowler's suggestion, on 19 August the Military Personnel Branch put in a requisition for 450 civilians having five or more years' experience as highway contractors. Godfrey's plea was acted upon the following week in a request for 300 civilians with experience in supervising earth-moving operations on airport or highway construction.[23]

During the first half of 1942 the Engineers selected civilians for commissions in accordance with the system suggested by Bessell in which most interviewing and, in some cases, locating suitable individuals was accomplished by District and Division offices. The Engineers were pleased with the results. Almost 3,500 officers (most of them for the military construction program in the United States) had been obtained. On 6 July 1942 the War Department set up a central Officer Procurement Service and curtailed some of these activities. Henceforth the Engineers were to draw up specifications for the type of individuals wanted and to cite the specifications desired upon submitting requisitions. They were to stop trying to find potential officers, although if they happened to know of a particular individual who could fill a particular bill they could so advise the Officer Procurement Service.

The Engineers did not fare very well under the new arrangement and said so. On 10

[21] Unless otherwise cited, this section on civilian commissioning is based upon correspondence in 210.1, Engrs Corps of, Pts. 5 and 7.

[22] (1) Memo, C of Mil Pers Br for McCoach, 5 Jan 42, sub: Appointments of Offs From Civil Life and From Among Former Offs. 210.1, Engrs Corps of, Pt. 4. (2) Ltr, AG 210.1 (1-21-42) RB-A to Cs of Arms and Svs *et al.*, 26 Jan 42, sub: Appointments of Offs From Civil Life in AUS. P&T Div file, ROTC—Policies—Grads, Offs.

[23] (1) Draft Memo, C of Sup Div, 8 Jul 42. 337, Pt. 1. (2) Ltr, Engr AAF to CofEngrs, 12 Aug 42, sub: Commissioning Offs From Civil Life for Duty With Avn Engr Units. 210.1, Engrs Corps of, Pt. 6. (3) Ltr, AC of Mil Pers Br to TAG, 19 Aug 42, sub: Commissions in AUS. Same file.

October 1942, six weeks after requisitions for 750 construction men had been sent in, the Military Personnel Branch claimed that the Officer Procurement Service had produced only ten acceptable applicants. Calling attention to this, the Engineers urged a return to the old system. Actually, steps leading to a compromise had already been taken. On 9 October the Officer Procurement Service agreed to allow the Engineer field offices to locate construction men once again. By 27 October the Officer Procurement Service had turned up 58 men; the Engineers had found 230 apparently good prospects.[24]

Through the good offices of Brig. Gen. Joseph N. Dalton, Assistant Chief of Staff for Personnel, SOS, the Military Personnel Branch and the Officer Procurement Service succeeded in establishing more harmonious working relationships. The Officer Procurement Service demonstrated that the Engineers were at least partly to blame. During the period 20 August to 31 October, the Officer Procurement Service asserted, it had submitted over a thousand applications to the Engineers, and it charged that 745 of them were still pending in the Military Personnel Branch. The Officer Procurement Service asked the Engineers to furnish more details about desired qualifications. By November Bessell was convinced that the joint effort would work. But there was many a slip between a good prospect and a commissioned officer. As of 22 December 1942 only 132 men had been commissioned and only 37 more applications were pending. The Engineers then concluded that limitations of age and vulnerability to the draft were responsible for this situation and requested a relaxation of these restrictions.

This request came in the midst of the War Department's announced determination to cut down drastically on the number of commissions from civil life. From the over-all point of view the shortage of officers had been overcome. The production of Officer Candidate Schools would more than satisfy requirements for 1943. The War Department wished to afford officers and enlisted men already in the Army an opportunity to move into positions commensurate with the experience they had acquired. If civilians continued to be commissioned in large numbers such opportunities would be curtailed. Commissions from civilian life should be restricted, therefore, to highly skilled individuals who could not be produced through the officer candidate program. The Corps of Engineers expressed alarm at the possibility of being cut off from civilian sources. With the lowering of the draft age to 18 the prospect of receiving skilled individuals at OCS became dimmer than ever. Only through civilian sources could they find the 3,000 experts required in 1943. The General Staff recognized, at least in part, the validity of the Engineer case. Highway, airport, and building construction contractors, experts in petroleum distribution, and electrical engineers were included in the short list of specialists who could be commissioned from civilian life. But the General Staff refused to allow the Engineers anything approaching the 3,000 men they wished. All of ASF (exclusive of the Surgeon General's Office, the Corps of Chaplains, and the Provost Marshal General's Office) was given an over-all procurement objective of only 3,250 for the year 1943.

The Engineers continued to insist that OCS graduates could not fill all the vacancies. In March 1943 they asked permission

[24] Rpt of Activities of Mil Pers Br for Period Ending 30 Oct 42. 020, Engrs Office C of, Oct–Dec 42.

to commission 3,500 civilians during the next nine months and suggested that the capacity of OCS be reduced by that amount. On 13 October, the War Department cut off appointments from civil life altogether. During the eighteen months that this source was open the Corps of Engineers commissioned 5,616 civilians for service with troop units.[25]

The variety of sources which the Corps of Engineers drew upon to provide leaders for troop units radically altered the character of its officer personnel. Almost overnight this group changed from a homogeneous to a heterogeneous one, from a group of men with similar backgrounds to one with all manner and degree of professional and military training and experience. To strive for homogeneity was as unnecessary as it would have been impossible, for as the War Department had pointed out in connection with the officer candidate program, the needs of the small peacetime Corps were quite different from those of the wartime Corps. The duties of an officer in the peacetime Corps were apt to be comprehensive; he was in much the same position as the only boss of a small firm. The wartime Corps was a huge factory where workers and bosses alike could specialize. Even so, the Corps of Engineers, like any other organization, had to provide the newcomer with a certain amount of special background before he could assume his duties, however limited. The OCS was one means of accomplishing this objective; another was provided by the Engineer School in a program of instruction for officers that was adjusted to the diverse backgrounds of those who attended.

The shift from a peacetime to a wartime curriculum at the Engineer School had begun in the summer of 1940 with the institution of a four-week (later five-week) refresher course to bring Reserve officers abreast of the latest military doctrine. In October, after the passage of the Selective Service Act and the calling up of the National Guard, the school replaced the refresher course with a five-week instructor course. Graduates of the instructor course, mostly National Guard officers, were being groomed to instruct the cadres for the projected ERTC's. Three instructor courses with a total capacity of 550 officers were planned. Afterward there was supposed to be a reversion to refresher courses, but in February 1941 the Engineers decided to continue instructor courses through the summer. Instead of being assigned to teach at the replacement training centers many graduates of the first instructor courses had been sent to troop units because of delays in the opening of the ERTC at Fort Leonard Wood.[26]

Only two more refresher courses were given after Pearl Harbor—one for Reserves and the other in the summer of 1942 for ROTC graduates. Thereafter ROTC graduates attended OCS, and in fact made up the bulk of that student body during 1944 and 1945. Like the ROTC graduates, newly commissioned officers from West Point came to Fort Belvoir prior to assignment. Here, in six weeks, the school touched the high spots of the nine-month course they would have

[25] (1) Rpt of Activities of Mil Pers Br for Period Ending 15 Mar 43. 020, Engrs Office C of, Jan–Mar 43. (2) Ltr, CofS ASF to Cs of Tech Svs *et al.*, 18 Oct 43, sub: Cancellation of Proc Objectives. 210.1, Pt. 1. (3) Alphabetical Roster of Offs Commissioned From Civil Life, 9 Nov 43. Plan Br Mil Pers Div OCE.

[26] (1) 352.11, Pt. 9. (2) 352.11, Pt. 10. (3) P/I Instructor Course, Incl with Ltr, Comdt Engr Sch to TAG, 24 Jul 41, sub: Rpt of Opns of Engr Sch, 1940–41. EHD files.

normally had in peacetime, emphasizing the theory and practice of military engineering and the instructional methods used in the Army.[27]

The output of the refresher courses and of the Military Academy graduate course was small as compared with two other general courses—the divisional training course and the field officers' course—which were offered for the first time during 1942. The divisional training course was established in January for battalion staff officers and company commanders slated for assignment to newly activated divisions. The idea was to weld these officers into a team by giving them practical instruction in planning and supervising unit training and in administration. Between January 1942 and June of the following year, 371 officers completed this four-week course. The field officers' course had its origins in O&T's concern over the relatively poor showing made by Reserve and National Guard officers at the 1941 maneuvers. In February 1942 the Engineer School enrolled 43 of this group in an advanced course for three months. When the time came for a second class there were no students. Field officers could not be spared for such a long time. Still the need existed. "No instruction is given at the School other than in the Divisional Training Course to fit officers . . . for duty as battalion staff officers," Crawford pointed out in June. "There is also a distinct gap between the basic instruction in the Corps of Engineers and the instruction for division staff officers as carried out by the Command and General Staff School . . . ." He proposed a two-month field officers' course, soon to become the most heavily attended general course given. The first class opened on 7 September 1942. A total of 2,487 officers had graduated by the time the fifty-fifth class finished on 20 October 1945.[28]

By the summer of 1943 all but the field officers' course and the Military Academy graduate course had been dropped from the school's general training program. The four-week divisional training course, given until 1 May 1943, was broadened to admit officers of nondivisional units. Renamed the cadre officers' course, it offered the key officers of the cadre an opportunity to work together before activation of a unit. Beginning in August 1943 the course was divided into two sections corresponding to the principal categories of officers attending—a combat section and a section for general service regiments and other units. When, in the spring of 1943, the Engineer Unit Training Center at Camp Claiborne, Louisiana, was directed to transfer the military training being conducted for officers appointed from civil life to Fort Belvoir, the Engineer School established a basic officers' course from which 817 were graduated within the next two years. Later in 1943, when the Engineers received by transfer about 1,600 OCS graduates of other arms and services, the school instituted an Engineer training course which gave these men the equivalent of the engineering subjects that were offered at the OCS. During

[27] (1) WD Special Staff Hist Div, Schooling of Commissioned Officers, Corps of Engineers, 1 Jul 39–30 Jun 44. (Hereafter cited as Schooling, Commissioned Officers.) (2) Clinard and McCune, *op. cit.*, p. 14. (3) Memo 12, Engr Sch for All Concerned, 19 Feb 43, sub: Résumé of Courses. 210.63, Engr Sch.

[28] (1) Quote is from Ltr, Comdt Engr Sch to CofEngrs, 17 Jun 42, sub: Field Offs Course. 352.11, Engr Sch, Pt. 13. (2) Interoffice Memo, O&T Br for Mil Pers Br, 6 Jan 42, sub: Detail of Offs to Advanced Course. 352.11, Engr Sch, Pt. 12. (3) Schooling, Commissioned Officers.

1944 the Engineer School taught a more advanced course to some 1,400 AGF officers who had had troop experience and civilian training in engineering.[29]

The third and most important means of developing efficient leaders for engineer troops was the school of experience with troop units. On first being assigned to a unit, most OCS graduates displayed lack of confidence and initiative and a reluctance to accept responsibility, but after two or three months' service, most of the men began to act like officers. Comments from overseas on the performances of junior officers varied. Some European commanders expressed complete satisfaction with OCS graduates; others believed that faulty methods of selecting candidates resulted in officers commanding men who were their superiors in education and background. All theaters complained about the lack of technical competence among junior officers. From Europe came reports that they possessed scanty knowledge about the operation and maintenance of construction machinery and that few were prepared to handle jobs in depots or perform other supply functions. From the Southwest Pacific, where construction operations overshadowed all other engineer tasks and where machinery was often operated twenty hours a day, came the most severe criticisms. Commanders in this theater expected Engineer officers to know construction machinery and how to organize and supervise a construction job. All echelons of command agreed that the combat training given at OCS was out of all proportion to what was needed in the Pacific. The OCS began to respond to such complaints in the spring of 1944. By fall of that year, hours allotted to the operation and maintenance of engineer equipment had been increased from twelve to eighteen, engineer reconnaissance from ten to sixteen. Eight hours had been added to the study of military geography and ten hours to the study of land mines. Henceforth more weight was given to academic deficiencies than to failure to meet standards of leadership. This shift came too late, however, to have any appreciable effect upon the mass of officer candidates who had been rushed through training in the desperate attempt to provide leaders for the units being activated in 1942.[30]

Engineer Replacement Training

Until the spring of 1941 newly inducted men went directly to units for a full year of service. During the rest of 1941, however, recruits reported to replacement training centers established under the direction of the various arms and services. At these centers, individual instruction in simple military procedures could be standardized. The men would then be ready for group training immediately upon reaching their units. Relieved of the task of basic training, units

[29] (1) 352.11, Engr Sch, Pt. 13. (2) Memo, O&T Br for Comdt Engr Sch, 1 Apr 43, sub: Rev of Courses at Engr Sch. 352.11, Engr Sch, Pt. 16. (3) Memo, O&T Br for CG ASF, 31 Aug 43, sub: Cadre Offs Course. Same file. (4) Memo, Asst ExO Tng Div ASF for CofEngrs *et al.*, 12 May 43, sub: Schs for Offs at Unit Tng Centers. EHD file, Special Tng EUTC, Heavy Shop, 1943–44. (5) Memo, Mil Pers Div ASF for CofEngrs, 6 Aug 43, sub: Diversion to CE of Offs of Other Brs. P&T Div file, Engr Tng Course—P/I Gen. (6) Memo, ACofEngrs (Sturdevant) for ACofEngrs (McCoach), 16 Aug 43, same sub. Same file. (7) Ltr, C of WPD to Comdt Engr Sch, 30 Dec 43, sub: Program of Instruction, Engr Tng Course. 352.11, Engr Sch, Pt. 17.

[30] Robert B. Killingsworth, School Training, pp. 43–45. MS in EHD files.

were expected to attain a higher level of preparation in much less time.[31]

Under this system all engineer troops went to ERTC's under the direction of the Corps of Engineers for twelve weeks of intensive basic military and engineer training. Some specialist instruction was supposed to be given during the twelve-week program, but the Engineers soon abandoned this effort and concentrated upon teaching the recruit the basic duties of an engineer soldier. The emphasis in this stage of mobilization was upon the production of fillers for newly activated units and in the latter part of 1941 the product was sufficient—some 5,000 men each month.

This orderly arrangement did not last. Activations of engineer units in 1942 became so numerous that the ERTC's could no longer meet demands. No expansion of facilities was allowed. Therefore, only units slated for early movement overseas could draw upon the centers for fillers. Most of the remaining product replaced cadres withdrawn to form new units. The urgent requirement for service units in 1942, coupled with the fact that such units had a high percentage of technicians, led the War Department to channel the great bulk of branch-trained fillers into SOS organizations. With the supply still insufficient, 28 training battalions at AGF centers converted to branch immaterial and funneled some 80,000 men into service units, including engineer, between July and October. So few ERTC fillers were available for the engineer units serving with the AAF that in November 1942 the AAF withdrew from this system entirely, setting up its own facilities for training engineer recruits. Despite all these provisions, a great part of the engineer unit fillers in 1942 came to be once more selectees straight from reception centers, without any intermediate training at replacement centers.[32]

It was not surprising that one of the ERTC's was located at Fort Belvoir, traditionally an Engineer center, in spite of limited room for expansion in the adjacent well-populated farming area. Fort Belvoir encompassed a 10-square-mile area 20 miles south of Washington, D. C., on the Potomac River, a short distance below Mount Vernon, in the gently rolling tidewater district of Virginia. Just to the north of Fort Belvoir, across U.S. Highway No. 1, lay a run-down farm, much of it covered with a young growth of pine and scrub oak. This became the site of the first ERTC, opened in March 1941, a typical wartime cantonment with neat rows of two-story frame barracks liberally punctuated with chapel spires.[33]

The second ERTC, opened in May 1941, was at Fort Leonard Wood in south-central Missouri. In sharp contrast to the soft outlines of the cultivated Virginia countryside,

[31] Unless otherwise noted, this section on replacement training is based upon: (1) 353, RTCs, Pt. 1; (2) 353, ERTC Belvoir, Pt. 1; (3) 353, ASFTC Wood; (4) 353, Tng, Ft. Lewis; (5) Wood, 353.01, Tng Scheds; (6) 333.1, ASFTC Wood; (7) Belvoir, 333.1, Investigations and Inspecs, 1941–42; (8) 353.15, ERTC Belvoir; (9) 353.15, ASFTC Wood; (10) Wood, *Ft. Wood News* Clippings; (11) Pamphlet, prepared by Adj ERTC Belvoir, 18 Aug 42, sub: The ERTC, Ft. Belvoir, Va. Belvoir, 680.1 RCs, 1940–42; (12) Training of Replacements, Fillers, and Cadres, Corps of Engineers, 6 Mar 41–30 Jun 44 (based upon reports submitted by the ERTC's, and hereafter cited as Tng of Repls). MS, OCMH.

[32] (1) Palmer, Wiley, and Keast, *op. cit.*, pp. 170–79. (2) Info Bull 81, 12 Mar 41. (3) For discussion of aviation engineers, see below, Chapter XIV.

[33] (1) Info Bull 81, 12 Mar 41. (2) OCE, Real Estate Progress Rpt, 30 Apr 42. (3) OCE Quarterly Inventory: Owned, Sponsored and Leased Facilities, 30 Jun 44, p. 93. (4) Rough Draft, Hist of Engr Tng Center. Post Hq, Belvoir.

this site lay within the Mark Twain National Forest, in the rocky northern foothills of the Ozarks. The military reservation extended over 113 square miles of rugged cavernous limestone and sandstone hills, heavily covered with pine and hardwood forests and interlaced with numerous clear spring-fed streams. The cantonment area was built on a level ridge just to the west of the broad twisting loops of the Big Piney River, a stream about forty feet wide, well suited for ponton bridge training. Like the Belvoir ERTC, this center enjoyed a moderate climate. Although the summers were hot, the mountains and forests deflected the worst of the Great Plains weather, and although snow fell during the winter it lasted but a short time. In spite of their rough beauty and mild climate, these foothills had attracted few permanent settlers. There were no towns of any size within thirty miles. The closest railroad line was nearly twenty miles away. Cities such as St. Louis, Springfield, and Jefferson City were all about a hundred miles from the center.[34]

It was apparent at once that the replacement training centers could not supply the number of men required by the Army in the early months of 1942. Within a week after the Japanese attack, G–3 held a conference to discuss how to spread this training so as to reach more men. The War Department recognized the desirability of having all its ground force fillers supplied to units through replacement training centers rather than directly from reception centers, but realized that replacement centers could not be expanded at a rate commensurate with the growth of the Army. But the need for men, whether completely trained or not, was immediate and urgent. In order to increase the output, the Chief of Staff favored reducing the time spent at replacement centers from twelve to eight weeks. G–3 believed twelve weeks necessary for adequate instruction. Nevertheless, the representatives at this meeting were instructed to prepare for the reduction.[35]

In cutting replacement training to eight weeks on 19 December 1941, the War Department directed that as few subjects as possible be eliminated. Less time to individual subjects was the preferred method of effecting the reduction. Emphasis was to be placed upon basic individual military training common to all arms. Subjects involving team training could be dropped if absolutely necessary. The Operations and Training Branch, OCE, was fortunate in having just completed a revision of its twelve-week program which differed considerably from the existing published program of 1940 and represented a more realistic scheduling of subjects and hours based upon several months' experience at Belvoir and Wood. This new program was the basis for the eight-week revision.[36] (*Table 5*)

[34] (1) Inventory cited n. 33 (3), p. 107. (2) Fred W. Herman, "Fort Leonard Wood, Missouri," *The Military Engineer*, XXXIII (March–April, 1941), 108–10. (3) Brief Summary of Events Leading up to the Acquisition and Use of Fort Leonard Wood, Mo. Groves files, Misc Papers. (4) Memo, V. W. Whitfield, Dir Div of Opns, for Col B. M. Casteel, Administrator, 8 Jul 40, sub: Inspec of Proposed Mil Reservation, Missouri National Guard. QM 601.1, Seventh Corps Area—Seventh Corps Area Tng Center.

[35] (1) Ltr, TAG to CGs Corps Areas *et al.*, 4 Oct 41, sub: RTC Capacity. Wood, 324.71, Selectees (AG). (2) Ltr, TAG to CGs All Armies and Corps Areas *et al.*, 2 Sep 41, sub: Additional RTC Capacity. 680.1, RTC, Pt. 1.

[36] Ltr, S–3 ERTC Wood to OCE, 18 Dec 41. 352.11, ASFTC Wood, Pt. 1.

No subjects were dropped. Most of the reduction was accomplished by cutting off the last four weeks of training. The resulting program produced a basic infantry soldier and secondarily an engineer since the greatest reduction was in technical subjects that had been stressed toward the end of the training period. Presumably, Engineer subjects were the ones which could best be postponed for unit training. The product of the ERTC would be physically hardened and know the fundamentals of soldiering but would be barely introduced to the essentials of military engineering.

After a few confusing days at a reception center, the prospective engineer soldier was rushed to the replacement center. There he was given inoculations and a GI haircut, issued a gas mask, rifle, bayonet, and an assortment of clothes, assigned to strange barracks, and informed that he was quarantined for two weeks. During those two weeks of semiconfinement he drilled and marched, pitched tents, watched training films, saluted, and finally did not much care whether he was quarantined or not. Then he graduated to the obstacle course for advanced training in agility and endurance. This device for physical conditioning originated at Belvoir in 1941 and was copied immediately thereafter by other Army training centers. It was constructed on the most difficult terrain available and was usually an irregular horseshoe about 500 yards long and wide enough to accommodate several men at once. Barriers placed at intervals along this course required the men to climb cargo nets, jump hurdles, crawl through pipes, hop along a pattern of auto tires, and swing across a ditch of muddy water. The course could be made progressively harder, depending upon the speed at which it was run, the type of uniform worn, and the amount of equipment carried.[37]

During the first four weeks of drilling and physical conditioning the trainee spent many hours learning to fire the rifle, a recognition by the Engineers that the "one thing that is more important to the soldier than anything else is to be able to shoot straight and fast." [38] Ammunition during the spring of 1942 had to be carefully conserved. Only after much practice in "dry runs" and many hours of coaching in the correct positions was the trainee finally permitted to fire the rifle on the range. The hours devoted to marksmanship amounted to more than one week out of the eight, or 15 percent of the scheduled hours of training.[39]

The trainees were assigned to training groups which were organized along regimental lines, with battalions, companies, and platoons. The groups conducted all basic military and tactical work. The ERTC staffs gave little actual instruction, acting instead as co-ordinating agencies in the use of training sites and materials. Individuals from these staffs circulated through the training areas to advise company officers and to fill in as needed in incidental instruction. They acted as full instructors only in certain of the Engineer subjects such as road building, which required the operation of power machinery.

In addition to the regular training of the normal selectees, the centers after July 1941 developed alternate programs for men with mental, emotional, physical, or educational

[37] (1) "Military Obstacle Course," *The Military Engineer,* XXXIII (July–August, 1941), 274–75; "Super Obstacle Course Unveiled at Fort Belvoir," *loc. cit.* (November, 1941), 504. (2) *Duck Board,* 13 February 1942 (publication of ERTC Belvoir). EHD files.

[38] *Duck Board,* 13 February 1942.

[39] (1) Ltr, S–3 ERTC Wood to OCE, 18 Dec 41. 352.11, ASFTC Wood, Pt. 1. (2) See Table 5.

TABLE 5—ENGINEER REPLACEMENT TRAINING CENTER PROGRAMED HOURS: 1940–41

Subject	12 Weeks 5 Sep 1940 Published	12 Weeks August 1941 Wood Actual	12 Weeks June 1941 Belvoir Actual	12 Weeks 20 Dec 1941 Revision	8 Weeks 19 Dec 1941 Published
Total	528	528.50	564	528	352
Basic, total	93	127.50	150	109	92
Battalion commander's address	0	.50	1	0	0
Articles of War and Army Regulations	2	2.50	2	5	4
Military courtesy	1	1.75	2		
Guard duty	2	3.75	5	3	3
Sex hygiene	2	3.75	2	6	6
Hygiene and sanitation	2		2		
First aid	3	3.75	6		
Defense against chemical attack	5	5.75	6	3	3
Care and maintenance of equipment	2	5.75	4	8	4
Display of equipment and tent drill	3	5.75	8		
Marches and camps	12	23.75	24	12	12
Close order drill	18	26.25	35	22	20
Extended order drill	5	9.50	8	10	8
Physical training	12	9.00	15	24	16
Field days	0	3.75	6	0	0
Inspections	24	22.00	24	16	16
Technical total	343	318.00	326	328	188
Combat					
Marksmanship, rifle	40	51.25	54	52	48
Bayonet	6	5.75	6	8	8
Grenade, hand	2	2.00	2	2	2
Musketry	3	11.75	8	12	12
Antiaircraft firing	6	8.00	6	8	8
Operation and use of .30-cal. machine gun	0	8.50	8	8	8
Engineer					
Field fortifications and camouflage	8	22.50	20	20	12
Use and supply of tools, equipment, and materials	12	11.25	10	12	4
Bridges	68	60.00	72	64	28
Obstacles	50	41.25	34	40	12
Demolitions and mining	44	30.00	32	32	12
Roads, construction and maintenance	52	15.00	24	20	8
General construction	24	15.00	12	16	8
Engineer reconnaissance	20	14.00	22	8	6
Night operations, technical	8	8.50	0	8	4
Rigging	0	13.25	16	18	8

TABLE 5—ENGINEER REPLACEMENT TRAINING CENTER PROGRAMED HOURS: 1940-41—Continued

Subject	12 Weeks 5 Sep 1940 Published	12 Weeks August 1941 Wood Actual	12 Weeks June 1941 Belvoir Actual	12 Weeks 20 Dec 1941 Revision	8 Weeks 19 Dec 1941 Published
Tactical, total	44	38.00	40	43	4
Scouting and patrolling	8	7.50	(a)	8	8
Tactics of infantry squad	8	26.25	(a)	24	20
Tactics of infantry platoon	10				
Tactics of infantry company	10				
Night operations, tactical	8	4.25	(a)	8	8
Defense against air and mechanized attack	0	.00	(a)	3	4
Open time	48	45.00	48	48	32

[a] No breakdown of hours for each subject available.

Source: (1) MTP 5–1, 5 Sep 40. (2) MTP 5–2, 20 Dec 41. (3) Memo, AC of O&T Br for G–3, 19 Dec 41, sub: Curtailment of Tng in RTCs, with Incl, Sec. II, Program I, MTP 5–2. 353, RTCs, Pt. 1. (4) Ltr, ERTC Wood to CofEngrs, 19 Aug 41, sub: Tng Program for Second Increment of Trainees. 353, ASFTC Ft. Leonard Wood, Mo., 31 Jan 45, Bulky. (5) Ltr, ExO ERTC Belvoir to CofEngrs, 4 Jun 41, sub: Rev of Mob Tng Program, with 2d Ind, CG ERTC Belvoir to TAG, 4 Jun 41, with Incl, Tng Memo 64. 370.93, Mob Tng.

handicaps.[40] In August, Belvoir converted three white platoons from one battalion and one Negro platoon from another into a special training company. By January 1942 this responsibility had been spread to the three groups, one platoon in each group being filled with handicapped trainees. Although the Wood ERTC did not organize a formal unit for this training until October 1941, by August 1942 it had established special classes for several hundred illiterates, 11.7 percent of the Negro complement and 1.7 percent of the white, to enable them to read signs and directions, write letters, and do basic arithmetic. In October, one white company and two platoons from one Negro company were designated to form this unit. At both centers the men who were eventually assigned to these units began training under the regular program. After two weeks under observation they were referred to a reclassification board for reassignment. At Belvoir these men usually had five weeks of special work while those at Wood had as much as eight weeks. At either center they could return to the normal program at any time upon the recommendation of the instructors. The desired level of attainment was the equivalent of the first two weeks of normal training and a fourth grade education.[41] The special training units salvaged

[40] (1) Mob Regulations 1–7, 1 Oct 40. (2) Ltr, TAG to CofEngrs, 28 Jul 41, sub: Special Tng Units. 320.2, Pt. 29.

[41] (1) 1st Ind, 23 Sep 41, on Ltr, Asst Adj Third Corps Area to CG ERTC Belvoir, 18 Sep 41, sub: Special Tng Units. Belvoir, 320.2, Orgn of the Army, Gen 1940–42, Sec. I. (2) 2d Wrapper Ind, ExO ERTC Belvoir to CofEngrs, 24 Jan 42, on Ltr, AGO to CofEngrs, 15 Jan 42, sub: Special Tng Units. 353, Pt. 17. (3) Ltr, Adj ERTC Wood to CofEngrs, 14 Oct 41, sub: Additional RTC Capacity. 320.2, RTCs, Pt. 1. (4) Ltr, CG ERTC Wood to CG Seventh Corps Area, 15 Sep 41, sub: Special Tng Unit. 320.2, Pt. 30. (5) Memo, ExO ERTC Wood for File, 20 Sep 41, sub: OCS and Special Tng Co, Bakers and Cooks Sch. Wood, 353, Tng, Misc. (6) Ltr, CG ERTC Wood to OCE, 27 Jan 42, sub: Special Tng Units. 353, Pt. 17.

many men but placed a double strain upon the facilities of the centers. The normal trainee capacity had to be reduced for these battalion-size units, over 600 men at Belvoir and between 500 and 600 at Wood. Many of the men remained for the combined length of both the special and regular programs, 13 weeks at Belvoir and 16 weeks at Wood.

By March 1942 this group constituted the greater part of several categories of men who were housed and trained for varying lengths of time by direction of the War Department. Their presence created cramped living conditions for everyone, including those undergoing the normal program. In addition, each center held over and gave special preparation to a group that varied from 100 to 200 men in an attempt to pool those best qualified to fill future OCS quotas. Moreover, one whole company setup of four barracks and a mess hall had to be maintained at each center for cadre retained for the activation of new units. Smaller groups of enlisted holdovers included cadre for RTC expansion and losses, and personnel for task force units.[42]

The eight-week course, in effect from December 1941 to March 1942, caused faster depreciation of sites, aids, and facilities. At Wood, the already overworked staff could not keep the facilities repaired fast enough and instruction at individual training sites was intermittently curtailed. Requisitions for new units "ruthlessly depleted" the training staff. But most serious of all, despite the shortened schedule and despite the larger capacities made possible through using tents and crowding the barracks, the great number of holdovers prevented any real increase in the total output of regular trainees. A comparison of the last three months of 1941 under the twelve-week program and the three months of 1942 under the reduced schedule shows an initial jump in output in the first few weeks under the new schedule but the numbers trained averaged about the same, 17,295 and 17,598, respectively, for the two three-month periods.[43]

Although the eight-week program was unsatisfactory, it was also temporary. On 28 February 1942 the General Staff directed a gradual reversion to the twelve-week cycle beginning 15 March. Reversion to the twelve-week cycle automatically restored the time needed for training in such basic Engineer subjects as demolitions, bridging, road construction, and obstacles. (*Table 6, Columns 1 and 2*) This type of training was desperately needed, for the assumption that the creation of the engineer soldier could be safely left to his unit had soon proved false. With the rapid movement of troops overseas in the spring of 1942 it became clear that in many cases the training received by these fillers in replacement centers was all they would get before reaching a theater. Moreover, the product of the centers would in the future

[42] (1) Ltr, AGO to CofEngrs, 31 Mar 42, sub: Additional Constr at RTCs, with Incl, 24 Mar 42, and 1st Ind, OCE to C of Rqmts Div SOS, 27 Apr 42, and 2d Wrapper Ind, Hq ERTC Belvoir to CofEngrs, 10 Apr 42. 600.1, RTCs, Pt. 1. (2) Ltr, ExO ERTC Belvoir to CofEngrs, 12 Jan 42, sub: Increased Tng Capacity Using Tent Camp. Belvoir, 680.1, RCs, 1940–42. (3) 1st Ind, 20 Jan 42, on Memo, AC of O&T Br for CG ERTC Belvoir, 16 Jan 42, sub: Expansion of ERTC, Ft. Belvoir. 320.2, ERTC Belvoir, Pt. 1. (4) 1st Ind, 22 Jan 42, on Ltr, ACofEngrs to TAG, 8 Jan 42, sub: Increase in ERTC, Ft. Belvoir. Same file. (5) Rad, OCE to CG ERTC Wood, 19 Jan 42. 320.2, ASFTC Wood. (6) Ltr, Adj ERTC Wood to CofEngrs, 12 Feb 42, sub: Increase of Cadre. Same file.

[43] Ltr, CG ERTC Wood to CofEngrs, 20 Jan 42, sub: Shortages and Allots of Enl Pers. 220.3, ERTC Wood.







OBSTACLE COURSE, FT. BELVOIR, 1941

TABLE 6—ENGINEER REPLACEMENT TRAINING CENTER PROGRAMED HOURS: 1942–43

Subject	12 Weeks 11 May 1942 Wood Actual	12 Weeks 11 May 1942 Belvoir Actual	12 Weeks 7 Sep 1942 Wood Actual	12 Weeks 4 May 1943 Published	17 Weeks 1 August 1943 Published
Total	576.00	564.00	576.00	576.00	816.00
Orientation	1.50	1.00	0.00	0.00	17.00
Articles of war and Army regulations	1.75	2.00	3.00	3.00	5.00
Military courtesy	1.75	4.00	3.00	5.00	5.00
Guard duty	3.50	5.00	10.00	12.00	12.00
Hygiene and sanitation	3.50	3.00	3.00	3.00	8.00
First aid	3.50	6.00	8.00	8.00	8.00
Care and maintenance of equipment	5.25	4.00	5.00	5.00	8.00
Display of equipment and tent drill	5.25	4.00			
Safeguarding military information	0.00	0.00	1.00	1.00	3.00
Defense vs. chemical attack	5.25	6.00	5.00	5.00	8.00
Marches and camps	26.50	20.00	23.00	24.00	28.00
Close order drill	40.25	36.00	26.00	30.00	26.00
Extended order drill	10.00	6.00	4.00	4.00	6.00
Physical training	21.00	15.00	22.00	17.00	20.00
Field days	3.50	6.00	0.00	0.00	0.00
Inspections and ceremonies	28.00	20.00	24.00	24.00	32.00
Rifle marksmanship	58.50	54.00	[a] 58.00	[a] 65.00	[a] 76.00
Machine guns	12.00	8.00	12.00	15.00	18.00
Bayonet	7.50	6.00	8.00	6.00	8.00
Grenades	1.75	2.00	4.00	3.00	6.00
Musketry	20.00	12.00	20.00	12.00	12.00
Antiaircraft firing	8.00	6.00	9.00	9.00	9.00
Scouting and patrolling	7.00				
Combat principles, including defense vs. air and mechanized attack	32.50	44.00	33.00	28.00	38.00
Night operations, tactical	4.50		4.00	(b)	(c)
Engineer reconnaissance	8.75	16.00	11.00	23.00	19.00
Tools and equipment	14.00	18.00	12.00	11.00	16.00
Rigging	14.00	16.00	17.00	17.00	17.00
Fixed bridges	28.00	32.00	32.00	32.00	48.00
Night operations, bridges	4.50		4.00	(b)	(c)
Floating bridges	36.00	40.00	36.00	40.00	54.00
Roads	21.00	20.00	16.00	15.00	24.00
Night operations, roads	4.50		4.00	(b)	(c)
General construction	14.00	12.00	16.00	15.00	13.00
Field fortifications and camouflage	21.00	20.00	20.00	16.00	16.00
Obstacles	28.00	32.00	24.00	29.00	20.00
Demolitions	28.00	32.00	29.00	28.00	24.00
Training tests	0.00	0.00	22.00	16.00	17.00
Reserved for battalion commander	42.00	48.00	48.00	51.00	82.00
Carbine and .45-cal. submachine gun	0.00	0.00	0.00	4.00	0.00
.37 mm. gun	0.00	8.00	0.00	0.00	0.00
Village fighting	0.00	0.00	0.00	0.00	4.00
Map reading	0.00	0.00	0.00	0.00	12.00
Tactical and engineer field operations	0.00	0.00	0.00	0.00	39.00

TABLE 6—ENGINEER REPLACEMENT TRAINING CENTER PROGRAMED HOURS: 1942–43—Con.

Subject	12 Weeks 11 May 1942 Wood Actual	12 Weeks 11 May 1942 Belvoir Actual	12 Weeks 7 Sep 1942 Wood Actual	12 Weeks 4 May 1943 Published	17 Weeks 1 August 1943 Published
Booby traps and antipersonnel mines	0.00	0.00	0.00	0.00	8.00
Laying and passage of mine fields	0.00	0.00	0.00	0.00	32.00
Familiarization firing, individual weapons	0.00	0.00	0.00	0.00	8.00
Hand to hand combat	0.00	0.00	0.00	0.00	8.00
Infiltration course	0.00	0.00	0.00	0.00	2.00

[a] Includes antiaircraft firing.

[b] Five night operations of four hours or more each scheduled outside of the listed hours of the program.

[c] Fifty-six hours of night operations outside of regular listed hours.

Source: (1) Office Memo, Plans and Tng Off ERTC Wood for CG ERTC Wood, 11 May 42, sub: Comparison of Ft. Belvoir ERTC Tng Program with Ft. Leonard Wood ERTC Tng Program. Wood, 353, Tng, Misc. (2) 1st Ind, 7 Sep 42, with Incl, Twelve Wks Tng Program, on Ltr, C of O&T Br to CG ERTC Wood, 29 Aug 42, sub: Tng Program. Wood, 353.01, Tng Scheds. (3) MTP 5–2, 4 May 43. (4) MTP 5–6, 1 Aug 43.

have to qualify as battle loss replacements in existing units.[44]

The institution of the twelve-week program, which made possible an increase in both basic and technical training, coincided with the formation of SOS. The Training Division, SOS, henceforth acted as a central co-ordinating agency, establishing policies, standardizing programs, and determining course content and length. Through numerous reports and frequent inspections SOS maintained close supervision over all aspects of training. The constant objective was uniformity, the production of men at a predictable level of proficiency. But although the policies set forth by SOS influenced technical training at Engineer centers, SOS was most successful in standardizing the basic military training common to all the services under its control.[45]

From May until August 1942, SOS influenced this training through changes in subject matter or by shifting stress from one aspect of a subject to another. It directed emphasis upon the use of cover and concealment by the individual rather than by units. It restricted instruction in identification of aircraft and combat vehicles to those of the United States. The assumption in both cases was that this limited training would simplify subsequent unit instruction, which would amplify this basic information according to the needs of the theater in which the unit would operate.[46] Closer control of this part of replacement training came in August when SOS issued a basic military program to be used by all SOS centers during the first four weeks. Out of the total of 192 hours available in the four weeks, 163 were prescribed by SOS, the remaining number being left open for either additional hours in these subjects or for the presentation of introductory Engineer material. Around

[44] Memo, AC of O&T Br, 24 Jan 42, sub: Program of Tng at ERTCs. 320.2, ERTCs, Pt. 1.

[45] Speech, Dir Tng SOS at Conf of Comdrs of SvCs [31 Jul 42], sub: Tng Responsibilities in SOS. 337, Pt. 1.

[46] (1) Memo, Dir Tng SOS for CofEngrs *et al.*, 31 Jul 42, Use of Time Designated To Train Individuals in Airplane Recognition and Concealment and Concealment Discipline. 353, Pt. 18. (2) Memo, CG ERTC Wood for Adj ERTC Wood, 6 Mar 43, sub: Tng Notes, with Incl, Conf Notes on RTCs and Basic Mil Tng, prepared by Dir Tng SOS on conf held 8–10 Feb 43. Wood, 353, Tng.



SOLDIERS FIRING THE SPRINGFIELD M1903 *at the Engineer Replacement Center, Ft. Leonard Wood, Mo., April 1942.*

this hard core of prescribed hours the Engineers rescheduled the five weeks of basic training that preceded the seven weeks of tactical and technical work. By September the two centers had worked out their individual versions. Little additional instruction beyond that specified by SOS could be given during this first four weeks because a few hours had to be reserved each week as open time to compensate for interruptions. During the fifth week, instruction shifted completely to Engineer subjects.[47]

Rifle firing remained by far the most important subject in the basic military program, and SOS constantly urged the improvement of instruction in this field. As early as July 1942 the Director of Training, SOS, had expressed dissatisfaction with the standards for record firing and had set up a single standard for all centers. Every trainee was to fire for record before leaving the ERTC or, if he did not, the failure to do so was to be minutely explained. Of those firing, 80 percent were to qualify. A monthly report had to be submitted as a check upon performance. The training program prescribed in August went further in designating the type of ranges to be used and specified that rifle firing for record should be completed within the first four weeks. The Wood center had only one very small 300-yard firing point, and Belvoir only one suitable range of 88 targets. Instruction was further hampered by the relatively low

[47] (1) Ltr, Brig Gen C. R. Huebner, Dir Tng SOS, to All Concerned, 28 Aug 42, sub: Basic Tng Program. Hq EAC, 353, Tng. (2) Hq SOS, Basic Tng Program for All RTCs and Sv Units of Sup and Adm Svs SOS, Aug 42. Ft. Lewis, 353, Tng, 6 Sep 42 —.

priority given to the training centers for ordnance equipment. The Garand M1 rifle did not reach the two centers until December 1942. Meanwhile the older Springfield could not be obtained in sufficient quantities for each trainee to have his own weapon. No carbines were available at either center until August 1942, when the Engineers finally resorted to a special issue of four to each center for demonstration purposes. In the face of such weapon shortages and the lack of suitable ranges, the ERTC's obtained permission in September 1942 to spread rifle instruction throughout the five weeks of basic training instead of confining it to the first four weeks.[48]

The centers had extreme difficulty meeting the 80 percent standard. Neither approached the mark for months, as shown by the following table on record firing at ERTC's from July through December 1942.[49]

Month	Belvoir		Wood	
	White	Negro	White	Negro
July	64	39	(a)	(a)
August	75	25	(a)	(a)
September	66	60	58	17
October	78	37	(a)	(a)
November	79	(a)	57	(a)
December	81	78	73	15

[a] Record not available.

December was the only month in 1942 in which Negro troops at Belvoir reached an adequate score. Investigation proved the firing score to be the result of false marking and scoring of targets, and the whole firing procedure had to be reorganized. The scores thereafter dropped to the previous levels. As a result of reprimands for poor marksmanship, Wood revised its rifle training in December, giving special attention to Negro troops and to slow learners. A team of forty-eight white expert coaches devoted all its time to the Negro battalions, starting early in January 1943.[50]

In teaching marksmanship, military courtesy, drill, and other aspects of basic military training the ERTC's aimed at sending out a product interchangeable with that of other SOS centers, but the ultimate goal of Belvoir and Wood was to produce a technically trained engineer soldier. Seven weeks out of the twelve were devoted to technical training in combination with tactical instruction. The trainee learned the essentials of engineer reconnaissance—to note such important things as possible bridge sites, the width and flow of streams, the condition and contour of terrain for road building, and strategic locations for tank obstacles and mine fields. He learned to co-ordinate his efforts with groups of increasing size in tactical exercises, first squads, then platoons, and finally companies. Weapons instruction also shifted to group activity. Rifle instruction continued with emphasis upon the techniques of con-

[48] (1) Memo, AC of O&T Br, 4 Sep 42, Inspec of Tng, 1–3 Sep 42. 353, ASFTC Claiborne, Pt. 1. (2) Memo, Supervisor Weapons Tng ERTC Wood for Plans and Tng Off ERTC Wood, 14 Apr 42. Wood, 333.1, Inspec. (3) Ltr, ExO ERTC Belvoir to CofEngrs, 8 Sep 42, sub: Authority To Fire Qualification Course "C," Rifle Model 1903, with 1st Ind, CG Ft. Belvoir to CofEngrs, 11 Sep 42. Belvoir, 353.15, Marksmanship, 1942. (4) Memo, Grant for Wolfe, 16 May 42, sub: Subjects To Be Taken Up in OCE, with Notes on Gen Grant's Memo for Col Wolfe. 322, ASFTC Wood. (5) Ltr, ExO Belvoir to CofEngrs, 10 Aug 42, sub: Carbine, .30-Cal. M1. 475, ASFTC Belvoir. (6) Ltr, AC of O&T Br to CG SOS, 22 Aug 42, same sub. Same file. (7) Ltr, C of O&T Br to Dir Tng SOS, 10 Sep 42, sub: Rifle Marksmanship, ERTCs, with 1st Ind, 15 Sep 42. Wood, 353.15, Marksmanship.

[49] (1) 353.15, ERTC Belvoir. (2) 353.15, ASFTC Wood. (3) Wood, 353.15, Marksmanship.

[50] Memo, Dir Tng SOS for CofEngrs, 16 Jan 43, sub: Small Arms Record Firing, with 2d Wrapper Ind, CG ERTC Wood to CofEngrs, 23 Jan 43. 353.15, Ft. Wood.

centrating the fire power of small units. With the return to the twelve-week program, 20 percent of the trainees were supposed to learn to fire the .50-caliber machine gun and the 37-mm. antitank gun, but so few of these weapons could be obtained that for all practical purposes the .30-caliber machine gun remained the principal crew-served weapon. In technical Engineer subjects the trainee learned to work with other men in building floating and fixed bridges and various types of roads and obstacles.[51]

Finding training films inadequate for familiarization in technical Engineer subjects, the centers prepared elaborate sets of more tangible training aids. Sand tables duplicating in miniature the territory through which the men would move simplified tactical problems involving engineer operations. Short sections of temporary and permanent surfacing gave the trainee a general picture of road building for a variety of weather and terrain. Scale models of fixed and floating bridges, with structural parts painted in bright colors for positive identification, were an important part of the first lessons in this subject and saved hours in construction time at the bridge sites. In demolitions, classroom instruction included the use of models of common highway and railroad bridges to demonstrate strategic points to place explosives for maximum destruction. At the training site, large signs and billboards repeated the best methods of demolishing railroad tracks, concrete beams, and steel truss bridges. Classes in general construction used a series of models of temporary wooden buildings in successive stages of construction to show building procedures. At the building sites large display boards held short identified sections of the most common sizes of lumber, types of joints, and the nails, hinges, and other hardware which went into such construction. Numerous "knot boards" demonstrating types of knots, splices, and lashings were distributed to the barracks to keep the men conscious of the fundamentals of rigging during off-hours. OCE encouraged an interchange of ideas between the two centers and authorized visits by members of the two ERTC training staffs to witness new methods and aids in operation.[52]

Although training aids served to shorten the introductory phase of each subject, practical working exercises were the essence of engineer training. The men learned by doing. At Belvoir, six companies could train at the same time in the floating bridge area, a dredged channel 2,000 feet long and from 130 to 250 feet wide. The fixed bridge area across Accotink Creek provided space for 4 steel bridges, 16 wooden trestle bridges, and 48 footbridges simultaneously. In a typical week of training in the late summer of 1942, the trainees built some 180 bridges in these areas. A program on the same scale was carried out at the Wood center. But in spite of the excellent bridging facilities at both ERTC's, the men had no training during 1942 in the erection of the Bailey bridge. American units in England received some training on the Bailey in late 1942, but it was not until February 1943, when the Corps of Engineers finally adopted the Bailey, that any of these bridges were designated for training in the United States.

[51] (1) Ltr, Adj Wood to CofEngrs, 22 Aug 42, sub: Tng Equip. 472, ASFTC Wood. (2) Ltr, Adj ERTC Wood to CofEngrs, 24 Jul 43, sub: Request for Guns, Machine, .50-Cal., with 2d Ind, AC of Equip Br Trps Div to CG ASF, 6 Aug 43. 472.5, ASFTC Wood.

[52] (1) FM 21–7, List of Tng Films, Film Strips, and Film Bulls, 1 Jan 43. (2) Rpt, Tng of Repls, Fillers, and Cadres, CE, Ft. Belvoir, 6 Mar 41–30 Jun 44, pp. 11, 12. Engr Sch Library.

By the end of March, only 4 had been issued for troop use and in the next month only 24. Few men beginning training at the time these bridges were released could have appeared in combat zones before the latter part of 1943.[53]

Since it was not assumed that the engineer soldier could perform any task until he had done it, each man learned to make up both electric and nonelectric priming charges during demolitions training, and fired high explosives to break reinforced concrete pillars and steel beams. Bangalore torpedoes (metal pipes packed with a high explosive) were used to breach actual roadblocks and antitank obstacles as well as to make a path through simulated mine fields. The trainee not only learned the proportions of various explosives necessary for most engineering purposes but gained confidence in his ability to use them effectively.[54]

The centers divided the twenty hours of instruction in road building into four parts. In the first four-hour period the men assembled at the road building site with shovels, picks, saws, crowbars, axes, mauls, sledges, and machetes. Supervisors from the staff brought bulldozers and road graders, rakes, tampers, wheelbarrows, cement, sand, gravel, and landing mat. Following demonstrations with the earth-moving machinery, there was a short lecture on the major characteristics of good road building. The men then broke up into small working parties. Some spread gravel, others dug ditches, while still others laid concrete culvert pipes. Then they all moved to the adjacent landing field site where they received instruction in clearing, grubbing, and draining a field, and laid a small section of mat. At still another site they built wooden forms, mixed and poured concrete, and set it to cure with wet burlap. In the second period, again four hours, they learned expedient road building under swamp conditions, building short sections of corduroy, plank, plank-tread, log mat, wire mesh, and landing mat roads. The third period of eight hours was for road repair and maintenance, limited to emergency repairs including drainage, placing of culverts, removal of obstacles, and the detouring of traffic. The last four-hour period was a night operation in which each platoon had a definite task. It might be given a stretch of swamp road to build, or a road or trail to repair involving filling or bridging a crater. Each project was tested by having a truck drive over the completed work.[55]

In examinations as well as in instruction, emphasis was upon demonstration. Both centers agreed that the major part of the testing should require active proof of acquired skills rather than mere answers to questions. The ERTC's did diverge widely in their views upon the frequency of these tests and their content, however. The Wood center developed a system of frequent testing of small amounts of subject matter at a time while Belvoir held constant reviews toward a final examination. Each system had its advantages. There was little basis for comparison of the product of the two centers as long as the methods of determining proficiency varied so widely. The

[53] (1) Engr Bd Rpt 729, 5 Dec 42, Panel Bridge (Bailey Type), H–10 and H–20 Bridge. (2) 1st Ind, 4 Feb 43, on Memo, ACofS Materiel ASF for CofEngrs, 16 Jan 43, sub: Co-ordination of Vehicles Design With Capacities of Mil Bridges. 1st Ind in 417, Pt. 13; basic in 451, Pt. 1. (3) ASF Monthly Progress Rpt, Sec. 2–A, Distribution, 30 Apr 43 (C).

[54] 1st Ind, 9 Dec 42, on Ltr, C of O&T Br to CO ERTC Wood, 5 Dec 42, sub: Tng Tests. Wood, 353, Tng, Gen.

[55] Lesson Outlines, ERTC Ft. Belvoir, Nov 42, pp. 479–96. EHD files.

Wood center, in the latter part of July 1943, made the two systems uniform by adding a final examination patterned directly after that in use at Belvoir.[56]

During 1942 the ERTC's produced 79,571 engineer soldiers, 70 percent of whom entered directly into SOS units. Although by March the training program had been lengthened from eight to twelve weeks, the period from January to the autumn of 1942 was marked by great haste in training and by temporary measures designed to produce quantities of men to fill new units. There was little specialized training. The centers concentrated on teaching these men basic military skills and giving them a fundamental grasp of engineer tasks and techniques so that they might with additional unit training fill any engineer position. Similar emergency measures dominated the officer training program. Reluctantly, the Engineers had to presume that experience in the field would accomplish what the training program could not. Throughout 1942 the military construction program demanded the services of many of the Corps' most experienced officers and a large portion of its Reserve. It was not, however, the transfer of the construction program to the Corps which created this situation. The first inroads upon Engineer Regulars and Reserves had been made while the program was under the control of The Quartermaster General. The intraservice struggle over troop-age officers in the spring of 1942 was but a continuation of an interbranch feud. Certainly troop activities suffered no more from officer shortages after the transfer than they had previously. Amid the rush to supply officers and men to the new units the Engineers continued to devote a large measure of attention to perfecting unit organization, first applying the lessons learned during the defense period and then beginning an adjustment to the growing demand for service troops which was to prove one of the most characteristic aspects of global warfare.

[56] (1) Ltr, Tng Div ERTC Wood to Tng Div ERTC Belvoir, 19 Jul 43. Belvoir, 353, Tng, 1943. (2) Ltr, Tng Div ERTC Belvoir to Tng Div ERTC Wood, 24 Jul 43. Same file.

CHAPTER VIII

Mounting Pressure for Supplies

The fact that the emergency training program fed more than 240,000 Engineer officers and enlisted men into the Army in 1942 was cause enough for a substantial increase in requirements for engineer supplies. But requirements for organizational equipment, large as they were, accounted for but part of the soaring demand for engineer matériel in the months following the declaration of war. The urgent need for construction of overseas bases which had occasioned the rapid growth of engineer units themselves called forth an equally urgent requirement for machinery and materials over and above the organizational allowance to troops. Ultimately these Class IV supplies accounted for well over half the value of the Engineer procurement program.

Requisitions for Class IV supplies poured in during 1942 from Iceland, from the British Isles, from Alaska, from Australia, and from other far-flung areas where engineer troops had been sent to build—areas varying in climate, terrain, and degree of civilization. During the defense period the purchase of engineer equipment had been tied to the units then scheduled to be activated, to the task forces then deployed, and to the needs of Great Britain and other allies. What had been ordered had been issued as fast as produced. Pearl Harbor found the Corps with nothing in the way of a stockpile. For many months needs would be met from current production. Despite these meager resources it was reasonable to expect the Corps to continue to share with those nations that were engaging the enemy in a desperate holding action. So great was the demand for engineer matériel created by the growth of engineer units, by construction projects the world over, and by international aid that expenditures in 1942, although more than three times as large as those made during 1941, did not satisfy requirements.

The immense responsibilities which devolved upon OCE's military supply organization after Pearl Harbor amply justified the administrative change that on 1 December 1941 had raised the supply function to a co-ordinate level with operations and training. The Supply Division expanded rapidly from a staff of 210 in the summer of 1941 to 1,000 in the fall of 1942. This expansion was all the more notable since depot activities were increasing and field offices were absorbing more responsibilities for procurement.

It was fortunate that the Supply Division retained through the critical year 1942 many officers and civilians who had grown up with the organization—Colonel Chorpening as executive officer of the division, assisted by Charles G. Perkins; Col. Miles M. Dawson as chief of the Requirements, Storage and Issue Branch, assisted by Arthur E. Krum; Col. John S. Seybold as chief of the Procurement Branch, with Morris S. Denman as chief of the Purchasing Section; Lt. Col. Theodore T. Molnar as chief of the

International Section; and Lt. Col. C. Rodney Smith as chief of the Maintenance Section. Their experience served them in good stead in guiding a program that was not only larger but infinitely more complex than the one carried on before Pearl Harbor.[1]

On a War Footing

At the time of the Pearl Harbor attack the Corps of Engineers had before Congress a request for $15,000,000 for construction materials and equipment for task forces totaling 130,000 men. After war broke out this sum was hastily multiplied by eight to provide for a force of 1,000,000. In justification of the $120,000,000 requested, the Supply Division submitted a thirty-page list of items, largely of the type required for defensive action in the Pacific—sandbags, barbed wire, piling, and some construction machinery. On 24 December 1941, a week after this $120,000,000 had been appropriated, G–4 directed the Engineers to compile estimates for the next appropriation bill. This time the Engineers put in for $522,288,929, a sum they estimated would provide initial issue and three months replacement of Class IV supplies for camouflage, demolitions, field fortifications, bridging, water supply, and airfield, railroad, and port and dock construction for a force of 1,000,000 men—10 percent for a frigid and 90 percent for a temperate climate. By the end of the fiscal year Congress had appropriated more than $1,353,000,000 for procurement and replacement of engineer matériel. Early in July when the appropriation for fiscal year 1943 was approved, the Engineers received over $582,000,000. Supplemental appropriations passed in the six months following Pearl Harbor added $847,000,000 to the Engineer procurement fund for international aid purposes, mostly for Great Britain.[2]

Immediately after the Japanese attack the Office of the Under Secretary of War had spelled out various ways to speed up procurement of supplies. Production must be put on a 24-hour a day, 7-day week basis. Supply services were authorized to negotiate supplemental agreements to reimburse contractors for extra costs due to overtime and shift work, to obligate funds by letters of intent, to use letter purchase orders in place of letter contracts in the absence of detailed specifications, and to make advance payments on both letter contracts and letter purchase orders. Contracting officers were permitted to issue mandatory orders if manufacturers did not proceed promptly with production. The authority of chiefs of services to approve contracts jumped from $500,000 to $5,000,000. Early in March advertising for bids was prohibited. Henceforth all contracts were to be negotiated, although informal bids could be taken if there were sufficient time. Through the Renegotiation Act of April 1942 the services were freed of the obligation to fix a final price at the time the contract was signed. Bills would be settled later when more was known about

[1] (1) Orgn Charts, 1 Dec 41, 2 May 42. EHD files. (2) Rqmts Br Diary, 26 May 42.

[2] (1) Fiscal Liaison Office files, 2d Supplementary Estimate FY 1942, Supplementary Estimate "D" FY 1942, and Supplementary Estimate "E" FY 1942. (2) Ltr, ExO Sup Div to ANMB, 17 Dec 41, sub: Asgmt of Priority Ratings. 400.1301. (3) Memo, AC O&T for C of Sup Div, 17 Dec 41, sub: Rev of Engr Rqmts List. 400.34. (4) Memo, C of Sup Div for C of Legislative and Plan Br WDGS, 5 Feb 42, sub: Other Rqmts as Listed in Supplementary Estimate "D" FY 1942. Rqmts Br file, Gen Staff G–4. (5) Incl, Justification of Rev Estimate FY 1943, with Memo, AC Rqmts Br for C of Sup Div, 10 July 42, sub: Changes in Consolidated Rev Estimate FY 1943. Intnl Div file, 111 (1942).

over-all costs and profits. Finally, the Under Secretary's Office urged that the administration of the procurement program—the award of contracts and their follow-through—should be decentralized to the field to the maximum extent consistent with efficiency and the safeguarding of the public interest.[3]

During the defense period the Corps of Engineers had centered procurement in Washington. To be sure the civil works districts had inspected the products of manufacturers and the procurement districts had investigated potential suppliers, assisted with inspection, and on occasion engaged in that mysterious activity known as expediting. But all contracts had been let by the Procurement Branch in OCE. Anticipating a larger volume of purchasing in 1942 and faced with a shortage of applicants for jobs in Washington, the Supply Section had in September 1941 readied the procurement districts for activation in accordance with mobilization plans.[4]

As conceived in the plans drawn up in the twenties and thirties the six procurement districts—New York, Philadelphia, Pittsburgh, Mobile, Chicago, and San Francisco—were to be entirely separate from the civil works districts of the Engineer Department. The realities of 1942 did not jibe with these plans. Upon activation of the procurement districts in November 1941, only one Reserve officer with purchasing experience sufficient to take charge of a procurement district could be found. Plans were promptly modified and District Engineers assumed direction of procurement districts. This linking of military procurement to the Engineer Department came at the same time that the civil works districts were absorbing the vast responsibilities connected with the supervision of the military construction program. Thus several weeks elapsed before the procurement districts could award any contracts at all. After the field had surmounted the initial administrative adjustments, the Procurement Branch began to forward to the procurement districts requisitions to purchase the thousands of low-priced, common garden variety of supplies for which the Engineers had procurement responsibility and for which there were a multitude of suppliers all over the country. The Procurement Branch continued to handle the big contracts for the more costly and special types of equipment and materials for which suppliers were few and demand was heavy. Under this division of work the procurement districts were soon awarding many more contracts than OCE, but OCE still obligated approximately 90 percent of the funds.

In the summer of 1942 SOS began to press all the services for a maximum decentralization of procurement activities. Congressional representatives and businessmen, particularly small businessmen, viewed decentralization as a way to achieve a greater distribution of orders. Washington was already overcrowded and far from the sources of production. To decentralize seemed efficient and economical. In resisting this pressure the Engineers could argue that so far as small business was concerned the procurement districts were already handling the contracts that would normally

[3] (1) Smith, The Army and Economic Mobilization, Ch. VII, pp. 57–77, 94, 104–07; Ch. XII, pp. 6–10. (2) Memo, USW for Cs of Sup Arms and Svs, 8 Dec 41. USW file, 004.401, Production. (3) Memo, USW for CofEngrs *et al.*, 17 Dec 41, sub: Decentralization of Proc. 400.12, Pt. 109.

[4] Except as otherwise noted, the following discussion of administration is based upon: (1) Rpt, Mgt Br, Orgn for Engr Proc, 7 Oct 47, EHD files; (2) Wkly Rpts Sup Div; and (3) ExO Proc Div file, Misc Corresp.

flow to such concerns. Through the inspectors and expediters in the civil works districts the Corps was kept close to its sources of production. The Supply Division could also point to a number of reasons why it seemed desirable at least to postpone turning over any more work to the field. For many items, specifications were incomplete. In numbers of cases the time limit for purchases was extremely short. With the field offices still deeply involved in the military construction program, supervision of personnel in the procurement districts would probably be inadequate. Of greatest concern to the Supply Division, however, was the possibility that the transfer of all procurement action to the field would result in loss of control over the major items. The procurement districts were organized on a *territorial* basis. Purchase of searchlights, tractors, landing mat, and similar supplies should be made without regard to territorial divisions, on a *centralized* or *commodity* basis.

By the fall of 1942, some of these arguments were no longer valid. Of prime importance was the fact that the military construction program was on the wane, making available to the military procurement program numbers of persons experienced in the ways of conducting government business. In the face of continued pressure from SOS the Supply Division gradually transferred more and more responsibility to the field. By the end of September the system had been stabilized. Under the new setup commodity purchasing of certain key items was assured. The Chicago procurement district, located in the heart of the construction machinery industry, contracted for all tractors and cranes; New York, for searchlights; Philadelphia, for sandbags and camouflage nets; Pittsburgh, for barrage balloons. For the vast number of supplies not purchased on a commodity basis the Procurement Branch forwarded requisitions to procurement districts on the basis of known available facilities, the needs of small business and of distressed areas, and consideration as to the final destination of the product. On all items the Procurement Branch retained control over scheduling, priorities, and other matters which an economy of scarcity imposed. The procurement districts, whether purchasing on a commodity or on a decentralized basis, negotiated all contracts and followed them through to completion, calling on inspectors and expediters in other civil works districts and on materials and production experts in the Supply Division, OCE, for assistance as necessary.[5]

In letting and supervising contracts the Procurement Branch and the procurement districts availed themselves of most of the devices for accelerating the work that had been recommended by higher authority, but with a wary eye on the possibility of Congressional investigations, they exercised caution. Thus they discouraged the use of letters of intent, but did at times resort to them. They did not have to carry through on any compulsory orders but did threaten to employ them in order to get contractors to accept terms considered reasonable. Al-

[5] (1) Prod Liaison Subsec, Proc Opns, CE, 1943. EHD files. (2) Memo, CofEngrs for Dir Purch Div SOS, 29 Jan 43, sub: Special Proc of Trp Sup by CE, with Incl 2, n.d. 400.12 (C), Pt. 1. (3) Erna Risch, *The Quartermaster Corps: Organization, Supply, and Services, Volume I,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1953), pp. 251–52. (4) Memo, C of Alloc and Contract Br Proc Sv for C of Co-ordinating Sec, 2 Jul 43, sub: Ann Rpt ASF, 1943. Basic Materials for Ann Rpt 1943 in EHD files. (5) Min, Staff Conf SOS, 16 Sep 42. 337, Staff Confs ASF (S).

though formal advertising was out, they encouraged the taking of bids. But in other cases where costs could not be ascertained, they used short term experimental contracts subject to price revision instead of insisting on detailed estimates. The districts placed contracts at the best price obtainable, and then, if satisfied that the price was too high, referred the contract to OCE for redetermination. By the end of March 1942 the authority of the chiefs of the Procurement Branch and of the procurement districts to approve contracts had been increased from $2,000,000 to $3,000,000. The chief of the Supply Division could approve those above that amount up to the $5,000,000 limit reserved for approval by higher echelons.[6]

Valuable as were these measures for speeding up the contracting process and insuring round-the-clock production, they fell far short of solving the basic problems of industrial mobilization for war. To a much greater extent than during the defense period the nation's economy had to be regulated; its facilities, its materials, its products, controlled and allocated. On 16 January 1942, the President created a new agency, the War Production Board (WPB), to handle this gigantic task, abolishing the Office of Production Management which had guided the partial mobilization of the previous year. The primary task which faced the WPB was the balancing of the nation's wartime requirements with the nation's resources. The WPB needed to know in as specific terms as possible and as far ahead as possible what all the claimants on the nation's production—civilian and military—required. The SOS attempted to provide such information for the Army in the Army Supply Program (ASP).

The major component of the ASP was a translation of the troop basis into the quantities of items required and the dates when given quantities had to be available. The quantities set down were the sum of (1) initial allowances, (2) allowances for the replacement of equipment worn-out, destroyed, or lost, and (3) allowances for supplies in transit or in storage. To the totals thus arrived at were added requirements for international aid, for task forces, and for special operations insofar as these were known. The resulting compilation was subsequently checked with the production experts to determine need in terms of raw materials, facilities, and labor. Adjustments to insure "a practical, over-all program" followed. As published quarterly the ASP stated total required production for major items in terms of time objectives, giving procurement goals by calendar years and on-hand figures of the amounts in depots and assigned to troops as of the beginning of the year. The ASP had many uses. It served as the basis for allocations of materials and for the assignment of priorities. It was a primary source for the preparation of budget estimates. It was a measure of progress, revealing slippages in the procurement program, and thus served as a starting point for action to correct such slippages.

The ASP's accuracy and consequently its value as an instrument in planning depended on the reliability and coverage of the sources used in its compilation. During 1942 many of the sources were unreliable,

[6] (1) Memo, Contracts and Claims Br Adm Div for Legal Br Purch Div ASF, 28 May 43, sub: Proposed Rev of WD Proc Regulation 3. 300.8, Proc Regulations. (2) Memo, Contracts and Claims Br Adm Div for Legal Br Purch Div ASF, 15 Jul 43, sub: Proposed Regulations in re Compulsory Orders. Same file. (3) C/L 1559, 4 May 42, sub: Negotiation of Contracts and Purch. (4) Memo, ACofEngrs for Dir Purch Div SOS, 27 Nov 42, sub: Memo on Statement of Purch Policy. ExO Proc Div file, ASF.

incomplete, and above all, subject to frequent change. The troop basis fluctuated violently. T/BA's, replacement factors, and distribution factors came in for considerable revision. Requirements for task forces and for special operations overseas, a category of supply in which the Corps of Engineers carried exceptionally heavy responsibilities, proved almost totally unpredictable. The bulk of these special requirements never appeared in the ASP at all. They were met during 1942, as they had been previously, on an emergency basis.[7]

This was particularly true during the early months of the year. The Supply Division made up approximately two thirds of an urgent requisition from Hawaii out of secondhand, obsolete machinery. The remainder was bought with funds appropriated for the engineer theater of operations stockpile. The engineer stockpile did not represent any reserve of equipment and materials. Stockpile was a figure of speech, a bookkeeping term, used to cover all Class IV supplies.[8]

Pooling Production

Whether purchased as Class IV or as Class II supplies, or to meet the needs of allies, construction machinery was the most important category of engineer requirements. (*Chart 3*) In 1942 tractors and other construction machinery composed almost 40 percent of the $651,000,000 worth of Engineer deliveries. The industry which manufactured these machines included about 200 firms. There were four manufacturers of the type of tractor used for construction work: Allis-Chalmers Manufacturing Company, Caterpillar Tractor Company, Cleveland Tractor Company, and International Harvester Company. In 1939 these four firms had produced approximately 20,000 tractors, but many of these were low-powered machines for which military demand was small. The crane and shovel industry had produced an average of 3,000 units annually in peacetime. During 1942 Engineer procurement alone was to amount to approximately the $250,000,000 annual business the construction machinery industry had averaged just prior to the war. The Corps of Engineers was naturally at pains to emphasize its interest in and claim upon the products of this industry.[9] Late in January, at a conference with Lt. Gen. William S. Knudsen, Director of Production in the Office of the Under Secretary of War, Reybold expressed his fear "that they may convert some of those large machinery plants." This exchange then ensued between Knudsen and Fowler, Assistant Chief of Engineers for Supply.

Knudsen: "If you had to choose between tanks and shovels, I'm afraid shovels are going to get hurt."

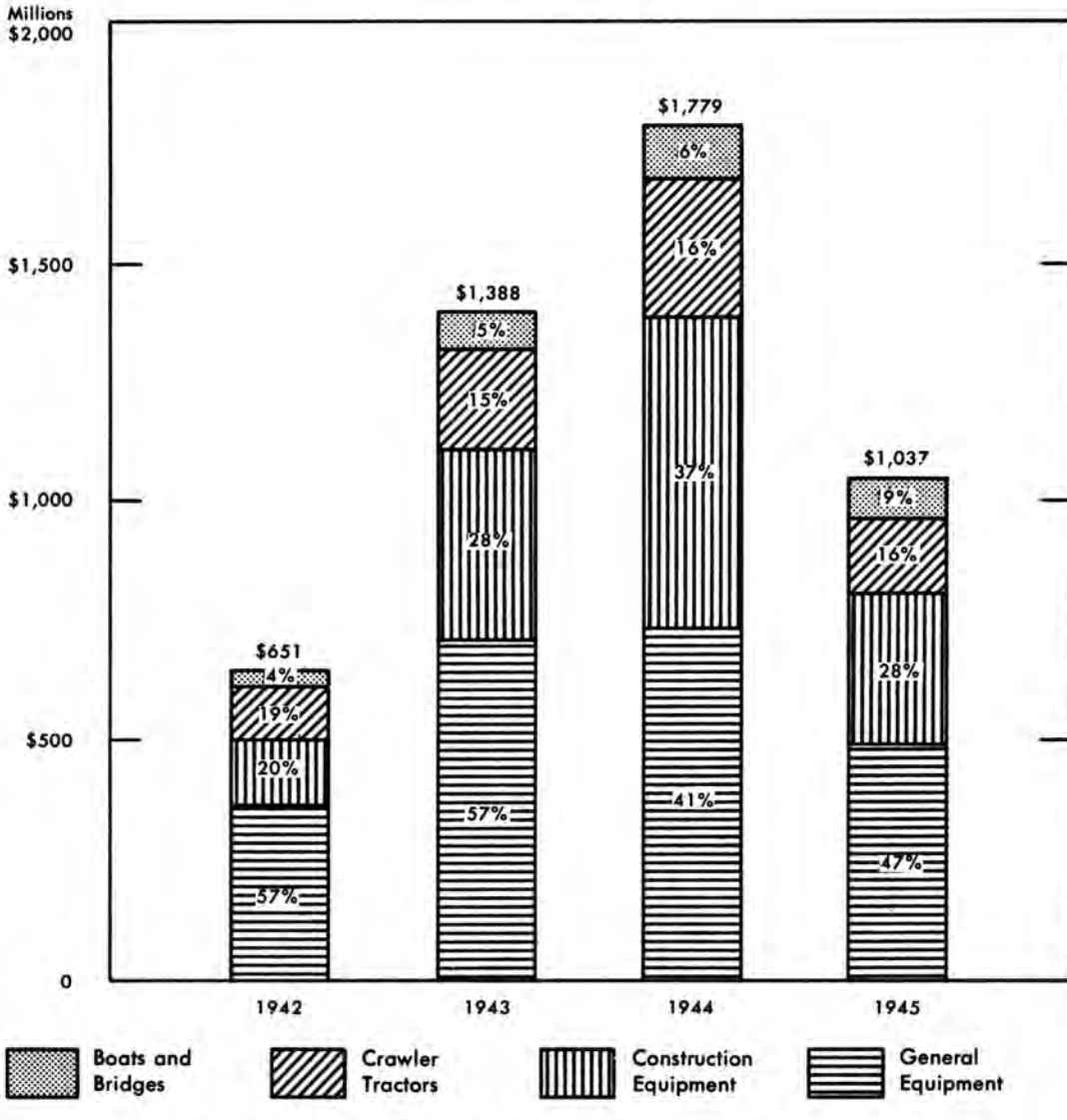
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[7] (1) Leighton and Coakley, *Global Logistics,* pp. 296–97. (2) Adm Memo 38, Hq SOS, 16 Sep 42. (3) Maj Harry F. Kirkpatrick, Dev of Sup Plan for Engr Class IV Sup (typescript), 20 Dec 45. EHD files.

[8] (1) Ltr, C of Rqmts Br to CG Hawaiian Dept, 26 Feb 42, sub: Recapture of Equip, with Incl. 400.31, Hawaiian Dept, Pt. 1. (2) Memo, C of Sup Div for ACofS G–4, 9 Mar 42, sub: Equip for Hawaiian Dept. Same file. (3) Memo, C of Rqmts Br for All Concerned, 24 Feb 42, sub: Methods of Operating TofOpns Stockpile. EHD files.

[9] (1) Richard H. Crawford and Lindsley F. Cook, "Procurement," a chapter in Statistics, a volume in preparation for the series, UNITED STATES ARMY IN WORLD WAR II, p. 16. (2) Sixteenth Census of the United States: 1940, Manufacturers, 1939, Vol. II, Pt. 2 (Washington, 1942), 423. (3) "American Tractors," *Automotive Industries,* LXXXIV, (March 1, 1941), 236–37. (4) History of the Construction Machinery Division of the War Production Board and Predecessor Agencies, 1941–1945 (typescript) (hereafter cited as Hist of Constr Mach Div WPB). EHD files.

CHART 3—VALUE OF ENGINEER SUPPLIES PROCURED BY MAJOR CLASSES OF EQUIPMENT: 1942–45



Source: Crawford and Cook, *op. cit.* pp. 15–16.

Fowler: "Your planes can't fly without airfields and you have to have the heavy machinery to make airfields."

Knudsen: "The best thing you can do is find a flat spot and use a scraper."

Fowler: "You can't make those things by hand labor. You've got to have . . . mechanical equipment."

Knudsen: "Well, take the next [item]." [10]

The Engineers did lose some facilities to tank and to other munitions production during the early months of 1942. During this same period, however, the intrinsic relationship between construction machinery and the world-wide logistical effort was clearly demonstrated, and, although it was not until December that the WPB declared tractors a military item, the Engineers, with the help of WPB's Construction Machinery Division, succeeded in preventing further diversion of facilities.

Equally important were the actions taken by WPB to channel production to the military. In the first of a series of "limitation orders" issued on 19 February, the WPB prohibited the sale or delivery of new tracklaying tractors to purchasers lacking a preference rating higher than A–2. On 2 May, WPB issued a similar prohibition to control the distribution of cranes and shovels. This assistance, plus the introduction of multiple shifts, extensive subcontracting, and complete use of plant that had remained partially idle in peacetime, resulted in a substantial increase in the quantities of construction machinery available to the Corps. Nevertheless, demand soared completely out of reach of manufacturing capabilities. Time was to prove that the construction machinery industry required more plant. During 1942 the supply of raw materials, particularly steel, was the determining factor in the production, not only of construction machinery, but of nearly all other types of equipment procured by the Engineers, as indeed it was the determining factor in the nation's over-all productive effort.[11]

Since this fact was becoming more evident each day, the Supply Division entertained little hope of success in getting more steel and saw little point in advocating an expansion of facilities. The division endeavored instead to extend its control over the distribution of construction machinery. As the situation stood at the beginning of 1942 there were a number of legitimate claimants for the products of the construction machinery industry. Farmers had to have tractors. Other segments of the civilian economy needed shovels and road graders, if only for purposes of repair. OCE's Construction Division had to see that its contractors had the machinery required to finish Army camps and munitions plants speedily. The Navy, the Marine Corps, and the Ordnance Department were all in the market. Foreign countries, Great Britain in particular, had also requested large quantities of construction machinery. It was by way of international aid, in fact, that the Corps of Engineers acquired the desired measure of control over the distribution of construction machinery and other scarce items of engineer equipment.

According to the agreement announced by Roosevelt and Churchill in January 1942, the military resources of both the United States and Britain were to be placed in a "common pool, about which the fullest information will be interchanged." [12]

[10] Memo for File, 24 Jan 42, sub: Notes Taken at Knudsen's Conf, 24 Jan 42. 400.12 (S), Pt. 1.

[11] (1) Hist of Constr Mach Div WPB. (2) Rqmts Br Diary, 8 May 42.

[12] Quoted in Leighton and Coakley, *op. cit.*, p. 252. The following discussion of methods of administering international aid is based upon Chapter X of this book.

The common pool implied that supplies would be distributed on the basis of greatest need. The British were prone to define this in terms of troop deployment in active theaters; the Americans, to insist that they must assure equipment to their own rapidly expanding Army and build up a reserve for the future deployment of that Army. Even with the best of good will (and this was abundant on both sides), it was easier to arrange for interchange of information than to decide upon what facts were pertinent to present or upon how to apply the facts once presented. The War Department developed elaborate procedures for exchanging information and for arriving at decisions for distribution of matériel in the common pool. (*Chart 4*)

As applied to the Corps of Engineers, the foreign country submitted its requirements to Major Molnar's International Section about two months before a revision of the ASP. After the interested offices in the Supply Division had studied these requirements in relation to the total procurement program, availability of materials, and so forth, the International Section recommended for or against approval. Dawson as chief of the Requirements Branch and Fowler as chief of the Supply Division either affirmed or vetoed this recommendation, which was then forwarded to the Engineer Subcommittee of the International Supply Committee. The International Supply Committee was composed of representatives of SOS, the General Staff, and the country to be supplied. The Engineer Subcommittee of the International Supply Committee was composed of representatives of the Supply Division and of the country to be supplied. Whether approved or disapproved by the Engineer Subcommittee, requirements went to the International Supply Committee for further action. Upon approval by the International Supply Committee, they were forwarded to the Requirements Division, SOS, which included them in the ASP, if approved. If that office disapproved, the British could appeal to the Munitions Assignments Board (MAB), the joint U.S.-U.K. body established by the Combined (U.S.-U.K.) Chiefs of Staff to preside over the assignment of all military items.[13]

The requirements submitted by foreign countries fell into two broad categories of items: common and noncommon. Noncommon items were those not needed by the U. S. Army. Once these items were authorized for procurement, the requisitioning country stood an excellent chance of getting them. But since their procurement might interfere with the general productive effort, SOS was anxious to keep this type of international aid to a minimum. The temptation to seek large quantities of noncommon items was considerably weakened by the fact that priorities assigned them were generally low and by the fact that a majority of members of the International Supply Committee were in agreement with SOS policy. The trend toward procurement of common items was steadily upward. In 1943 common items accounted for approximately 20 percent of international aid expenditures made by the Corps of Engineers; in 1944, for 60 percent; in 1945, for 75 percent.[14]

Common items enjoyed a much more favorable delivery schedule than did noncommon items, but they were subject to

[13] Rpt, Col Beverly C. Snow, 21 Oct 42, sub: Study of Intnl Br Sup Div OCE (hereinafter cited as Snow Rpt). EHD files.

[14] (1) International Aid [c. 1 Oct 42]. Intnl Div file, 310.1. (2) Testimony, Reybold, H Subcomm on Appropriations, *Military Establishment Appropriation Bill, 1946, Hearings,* p. 616.



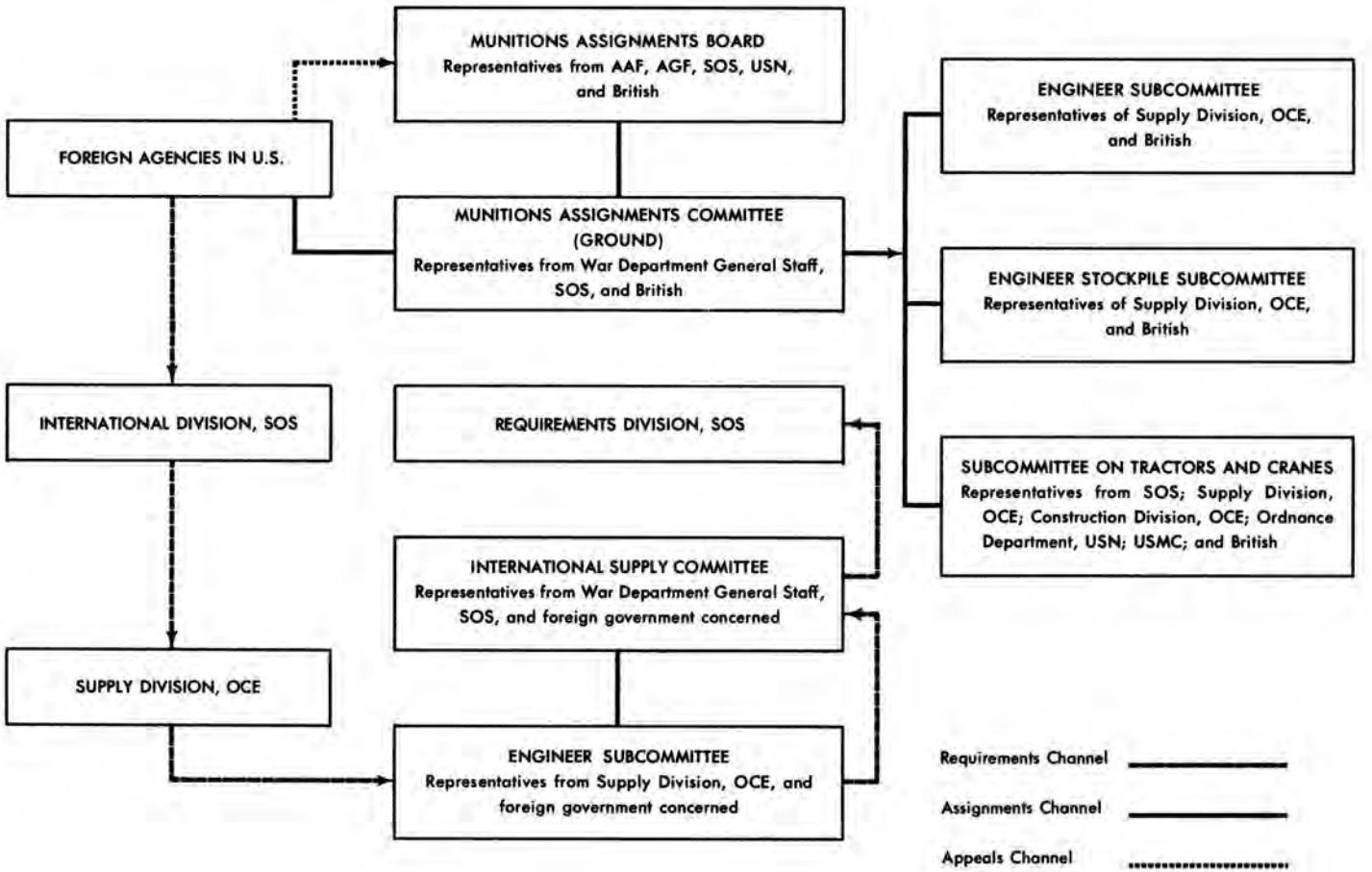
BRIG. GEN. RAYMOND F. FOWLER, *Assistant Chief of Engineers for Supply, January 1942 until June 1944.*

closer scrutiny on the part of the Army when it came to releasing them to international aid account. Their inclusion in the ASP at the behest of a foreign country did not guarantee their assignment to that country. The situation in regard to greatest need could change radically between the time the product was included in the ASP and the time of its delivery. The ultimate authority on assignment was the Combined Chiefs of Staff, but relatively few cases were appealed that high. Usually appeals stopped with a decision of the Munitions Assignments Board. MAB delegated its work to committees, the one applicable to the Corps of Engineers being the Munitions Assignments Committee (Ground). Like the International Supply Committee which passed on requirements, MAC(G), which passed on assignments, came to be dominated by SOS. SOS had greater representation than any other group. More important, it was SOS which did the staff work, SOS which indicated the point where international aid encroached upon the needs of the American Army. Yet the over-all guiding principle upon which decisions were made remained military strategy. For this reason the member from the Operations Division, General Staff, was always listened to respectfully. As to the British member, in view of the appeal procedures open to him and the political pressures he could exert at yet higher levels, the American side of the table would scarcely have had the temerity to attempt to push him around. The Engineer Subcommittee of MAC(G), formed of representatives of the Supply Division and of the British Army Staff, took its cue from the sponsoring authority. It was in the Engineer Subcommittee that the lengthy exchange of information took place and it was here that most decisions on assignment were reached. Molnar recalled that many decisions had to be reached on the basis of scanty information. No doubt the foreign representatives experienced not a few difficulties in extracting thoroughgoing justifications from their home governments. The Supply Division itself was to experience similar difficulties in securing information from theater commanders in the later years of the war.[15]

In the early months of 1942, however, the Engineer Subcommittee was passing upon a very small portion of the total of engineering supplies being procured for the British. Most of the British international aid funds for this type of equipment—$100,000,000 of the $102,000,000 then available—were in the hands of the Treasury

[15] (1) Snow Rpt. (2) Ltr, Molnar to C of Engr Hist Div, 26 Mar 55. (3) See below, pp. 500–502.

CHART 4—ORGANIZATION AND PROCEDURES FOR HANDLING INTERNATIONAL AID



Department in line with that agency's responsibility for procuring civilian goods for international aid. Priorities for this "nonmilitary" equipment were generally low. In March 1942, with 2,300 tractors requisitioned, some of them as far back as August 1941, the British had been given to understand they could expect no deliveries until the following December. The British were reasonably assured of faring better if the Corps of Engineers took over procurement from the Treasury Department. The Corps viewed this transfer of procurement responsibility not only as an opportunity to help the British, with whose position it was sympathetic, but also as a means of gaining a larger voice in the production and distribution of construction machinery. In May 1942, final arrangements for this transfer were made.[16]

Meanwhile the Supply Division, voicing alarm over the great discrepancy between tractor production and the known requirements of the several claimants, called upon SOS to arrange either for allocation of tractors or for sufficiently high priorities to satisfy emergency requirements. Brig. Gen. Lucius D. Clay, SOS Deputy Chief of Staff for Requirements and Resources, acted immediately. By the end of April, Clay had got WPB to agree to assign 85 percent of tractor production to the armed forces and the armed forces to agree to centralize procurement of tractors of the prime mover type in the Ordnance Department and those of the construction type in the Corps of Engineers. John H. Hassinger, commissioned a major in the Corps of Engineers, transferred from the Construction Machinery Division, WPB, to take charge of this program. Methods of allocation followed the general pattern established for the administration of international aid. MAB, subject to the Combined Chiefs of Staff, had ultimate authority which was delegated to MAC(G). Hassinger became chairman of an advisory committee composed of representatives of the claimant agencies, including the British Army Staff, and SOS. This committee became the Subcommittee on Tractors for MAC(G) and as such usually had the final word on their assignment.[17]

The next agreement involving procurement and assignment to which the Engineers became a party embraced the whole category of construction machinery and more, and resulted in a unique arrangement in the administration of international aid. Within the Corps of Engineers the conviction that Americans had first call upon American production was as strong as in SOS headquarters and was to grow stronger as production failed to measure up to early expectations. In the first months of 1942, however, the Engineers showed considerable concern over the fact that deliveries to the British were lagging far behind stated needs. Early in June 1942 Fowler asked Clay whether he would approve the establishment of an Engineer-British strategic

[16] (1) 1st Ind, 26 Feb 42, on Ltr, British Army Staff to DCofS, 14 Feb 42. 400.333, England, Pt. 2. (2) Memo, C Engr British Army Staff for Comdr British Army Staff, 5 Mar 42. Intnl Div file, 451.3, Alloc. (3) Memo, C of Sup Div for DA Dir SOS, 26 Feb 42, sub: Proc of Tractors on DA. 400.333, Pt. 2. (4) Memo, Dawson for File, 6 May 42. Intnl Div file, 040, Treasury Dept.

[17] (1) Ltr, Sup Div for CG SOS, 30 Mar 42, sub: Rev of Priorities on Tractors. 400.1301, Pt. 5. (2) Memo, Maj W. W. Goodman for Secy MAC(G), 10 Apr 42, sub: Tracklaying Tractor, Long Range Alloc for Approval (Not Asgmt). Constr Mach Br file, Procedure for Alloc Tractors. (3) Hist of Constr Mach Div WPB. (4) Memo, Chm Tractor Subcomm for Members, 22 Jul 42, sub: Tractor Subcomm Mtg. Proc Div file, WD Conf Group for Tractors and Cranes. (5) Intnl Div ASF, Lend-Lease as of 30 Sep 45, Vol. I, pp. 261–62. (Hereinafter cited as Intnl Div ASF, Lend-Lease.)

reserve. The idea had been germinating for some time. In January Brigadier W. E. R. Blood and Colonel Chorpening had agreed upon the desirability of maximum standardization of British and American supplies.[18] In February, Reybold had urged upon the Deputy Chief of Staff a number of steps to increase the quantities of matériel being transferred to the British—specifically that the British Isles be counted a theater of operations and equipment earmarked for use there be upgraded accordingly, that equipment for British units already organized or soon to be activated be afforded the same priority as similar equipment for American units, and that "a reasonable stock pile, the size of which is to be determined by agreement between Brigadier Blood and my office, be considered an urgent necessity for the conduct of the war . . . ." [19] The Deputy Chief of Staff preferred that higher priorities be sought on a case by case basis.[20]

But the idea of the stockpile would not down. The Engineers had long sought a reserve. They wanted to stop having to fall back upon secondhand machinery to fill emergency requisitions. They wanted to be able to avoid situations such as had occurred late in March when a large and urgent requirement for construction machinery in Australia and New Zealand had forced them to figure out what could be spared from troop stocks and what they could gather together by transfer from the military construction program. They reasoned that more headway could be made if American and British needs were lumped together.[21]

Both General Clay and Col. Simon N. Frank, the chief of the Requirements and Resources Division, SOS, threw quick support behind the project. The maximum number of items should be included, Clay directed, and he promised them highest priority. Brigadier Blood, for the British, was equally enthusiastic. He believed that 90 percent of engineer items required by the United Kingdom could be designated common. On 13 July the International Supply



MAJ. GEN. LUCIUS D. CLAY, *SOS Deputy Chief of Staff for Requirements and Resources. (Photograph taken 1943.)*

[18] (1) Memo, C of Sup Div for ANMB, 28 Mar 42, sub: Priorities on British DA, 5th Supplemental, 1942. Intnl Div file, 400.1301, Pt. 5. (2) Ltr, Sup Div to CG SOS, 30 Mar 42, sub: Rev of Priorities on Tractors. Same file. (3) Intnl Sec Diary, 10 Jun 42. (4) Memo, C of DA Sec for File, 29 Jan 42. Intnl Div file, 451.3.

[19] 1st Ind, 26 Feb 42, on Ltr, British Army Staff to DCofS, 14 Feb 42. 400.333, England, Pt. 2.

[20] 2d Ind, 2 Mar 42, on ltr cited n. 19.

[21] (1) Ltr, C of DA Sec to WPD WDGS, 27 Mar 42, sub: Constr Engr Equip for Australia and New Zealand, with Ind, n.d. Intnl Div file, 400.333, Australia. (2) Memo, C of DA Sec for Major Malloch, 1 Apr 42, sub: Tractors and Constr Equip for Australia and New Zealand. Same file. (3) Ltr, Brig Gen Miles M. Dawson to Actg C of EHD, 31 Mar 55.

Committee reviewed a long list of 300 common items as agreed upon by representatives of Blood's office and the Supply Division, OCE. For each item listed there were shown American and British requirements, minimum and maximum amounts to be stocked, and estimates of production by quarters through the year 1943. The International Supply Committee accorded immediate approval for procurement of the quantities set forth in the list.[22]

The harmony that had prevailed during negotiations about the common stockpile was soon marred by a few sour notes. The Engineers had understood they would control assignments. The British protested. This particular quarrel and other matters of disagreement came up before MAC(G) on 3 September. In an atmosphere described as tense, the British proposed that production anticipated in the following month be considered in making assignments. Clay supported the Engineers' objection. Apparently the British wanted a stockpile and not a stockpile, the general observed sarcastically. He would move that the stockpile revert to the Engineers and that the British bid for items in the usual way. After the British withdrew their original motion, Clay supported them completely in their insistence that the Engineers be required to submit bids to the engineer stockpile subcommittee which was being organized under MAC(G) and in case of failure to reach unanimous agreement to appeal the case to the higher body. The Corps of Engineers continued to protest this ruling which would have established the strange procedure of a component of the American Army justifying claims on the products of American industry. On 16 October, MAC(G) reversed itself. Henceforth only the British would be required to bid. If the stockpile subcommittee unanimously agreed to approve the requisition and the items requested were physically on hand, assignment would be automatic. Otherwise, the British could take the usual course of appeal to MAC(G). The engineer stockpile subcommittee thus had a freer hand in the distribution of supplies than did the Engineer Subcommittee or the Subcommittee on Tractors, for although in practice the unanimous recommendations of the latter two subcommittees were usually followed by MAC(G), MAC(G) did review these recommendations and could reverse them.[23]

Through the transfer of a large slice of procurement responsibility from the Treasury Department, centralization of the procurement of tractors, and creation of the common stockpile, the Corps of Engineers made noteworthy progress toward administrative control of the items most vital to the performance of engineer troops. This control was to mitigate somewhat the effect of delays in the production of engineer equipment.

The Crisis in Production

Production had been greatly accelerated in the six months after Pearl Harbor and was expected to rise at a still more rapid rate during the second half of 1942. Yet the prevailing mood was one of scarcity, and with good reason. In the summer of 1942 the

[22] (1) Intnl Sec Diary, 10 and 11 Jun 42. (2) Rqmts Br Diary, 23 Jun 42. (3) Min, Engr Intnl Sup Subcomm, 6 Jul 42. Intnl Div file, 334, Min of Engr Intnl Sup Subcomm. (4) 2d Ind, 16 Jul 42, on Memo, Comdr British Army Staff for ExO MAB, 10 Jul 42, sub: Engr and Trans Stores. Intnl Div file, 334, Intnl Sup Subcomm.

[23] (1) Memo, C of Intnl Sec for C of Rqmts Br, 4 Sep 42, sub: MAC Mtg, 3 Sep 42. Intnl Div file, 334, MAC. (2) Intnl Div ASF, Lend-Lease, pp. 487–88.

steel shortage hit the nation with full force. True relief from the shortage awaited the opening of new steel plants. Meanwhile the war agencies could but intensify the remedies applied previously. Efforts could be made to reduce demand, particularly civilian demand, and attempts could be made to substitute more plentiful materials for steel. After these avenues, which were not extensive, had been explored to their limits the supply had to be divided on the basis of the relative importance assigned the various military programs.

The development of an equitable and workable system of dividing up the supply of raw materials was the most challenging problem which faced the WPB during 1942. Dependence upon priorities to accomplish a rational distribution, although almost completely discredited, persisted in the absence of anything better. Various allocations systems, administered according to the historians of the WPB largely by inspiration, were scarcely superior. In June the ANMB superimposed on the A–1 series a hierarchy of priority ratings—AA–1 to AA–4 with an AAA reserved for emergencies. Although this directive marked an improvement over those issued previously because it took quantities into account, production of the quantities contained therein would have consumed practically all of the supply of critical raw materials. Indirect military and essential civilian needs—domestic and Allied—were left to go begging until the WPB succeeded in slipping in an AA–2X band in August.

The unanimous disapproval with which the WPB staff greeted the new priorities directive doubtless spurred that agency to adopt a master system, the Production Requirements Plan (PRP), for the allocation of materials. Under PRP, manufacturers applied to WPB for blanket priorities for materials needed for the next three months and WPB tried to allocate only the amount that would be available within that period. In point of fact the WPB had to base its allocations upon the very priorities it had called into question and at a time when manufacturers were scrambling to get orders rerated under the new directive. Hastily introduced and not universally popular within the WPB itself, PRP suffered from an unusually large number of administrative and mechanical difficulties which generated much criticism. As it operated in the third quarter of 1942 the system was vulnerable on another and more basic score: it did not accomplish its main objective of bringing about a balance between the supply of raw materials and scheduled production.[24]

In line with a formula established by the ANMB for assigning the new priority ratings, 50 percent of engineer Class II equipment slated for production in 1942 automatically received the top AA–1 rating; the remaining 50 percent, AA–2. No such formula was applied to Class IV and international aid. Ratings for such supplies were thereupon established by the ANMB on the basis of justifications made by the services through SOS. In a submission to Clay on 8 July, Fowler recommended an AA–1 priority for: (1) airfield construction machinery; (2) pipelines, bridging, and other landing equipment for the preinvasion build-up in the British Isles; (3) 100 percent of the maximum stockpile, includ-

[24] (1) Civilian Production Administration, Bureau of Demobilization, *Industrial Mobilization for War: History of the War Production Board and Predecessor Agencies, 1940–1945*, Vol. I, *Program and Administration* (Washington, 1947), pp. 295–300, 453–74. (2) Smith, *op. cit.*, Ch. VIII, pp. 45–48, 104–117.

ing replenishment; and (4) all nonorganizational equipment specifically requisitioned for combat operations. Other operational and miscellaneous supplies for the American Army should have an AA–2; all noncommon international aid supplies an AA–4 rating. A week later Clay notified Fowler of the lower ratings SOS was prepared to fight for. An AA–1 would be sought for (1) all matériel for the build-up in Britain, to include airfield construction machinery and landing equipment, (2) about 25 percent of the stockpile, and (3) equipment specifically requisitioned; an AA–2 for (1) equipment for overseas bases "certified as essential to operations" for airfield construction, for another 25 percent of the stockpile, and for filling requisitions, and (2) for miscellaneous supplies for the American Army; an AA–3 for the remaining 50 percent of the stockpile; and an AA–4 for the remainder of the international aid program. Although less than requested, these ratings placed the Engineer procurement program in a relatively favorable position. The trouble was that it took some time to get the new ratings approved and in the hands of the manufacturers and that allocations under PRP were not bound completely to them.[25]

On 10 June Hassinger learned that practically no steel had been allocated to construction machinery manufacturers for the third quarter of the year. He and Chorpening conferred immediately with Clay, with members of the Executive Committee, ANMB, and with representatives of the Construction Machinery Branch, WPB. All seemed sympathetic and anxious to help. Tractors stood to fare reasonably well because they were already allocated. It looked as if shovels and cranes would soon be allocated also. Three days after this meeting Hassinger learned from ANMB that if action were not taken at once all the tractor factories would be excluded from the July steel rollings. Efforts to get desired quantities of steel to the construction machinery manufacturers met with but partial success. The Caterpillar Tractor Company, for example, put in for 72,422 tons and received but 47,653.[26]

"The problem of production is becoming more and more serious," declared Hassinger on 23 June. "The War Production Board is having increasing difficulty in getting critical material for all types of construction machinery. Our losses in production in the 2nd quarter will be a great deal more than anyone anticipated. Unfortunately, these losses appear to be in the . . . large tractors . . . we need the most." Although exact figures would not be available until late in July, Hassinger was certain that "Caterpillar with their D–8 will be down . . . more than 36 percent . . . from the estimated production. . . . In this same class, the Allis-Chalmers with their H–D 14 will be down . . . more than 50 percent, and the Cleveland Tractor Company with their Model FD tractor will show a loss of nearly 60 percent."[27] An analysis made late in June re-

[25] (1) Smith, *op. cit.*, Ch. VIII, p. 45. (2) Memo, C of Sup Div for Clay, 8 Jul 42, sub: Priorities for Sec. III, ASP, with 1st Ind, 17 Jul 42. AG 400 (4–17–42), Sec. 1. (3) Memo, C of Intnl Sec for Opns Sec Rqmts Br, 14 Aug 42, sub: Priority Ratings for Stockpile Items. 400.1301, Pt. 1.

[26] (1) Rqmts Br Equip Control Sec Alloc Subsec Diary (hereafter referred to as Hassinger Diary), 10 and 15 Jun 42. (2) MPR, Sec. 6, Nov 42. For a bibliography of MPR's see Adm Sv Div, DRB AGO, Descriptive List of Monthly Progress Reports of Headquarters Army Service Forces, September 1942–May 1946 (Inventory No. 200.02, Pt. 1, Washington, April 1950.)

[27] Hassinger Diary, 23 Jun 42. Unless otherwise noted, the remainder of this section is based upon entries in this diary.

vealed that the number of large tractors available would be about 87 short of troop requirements. The following month a sudden demand for over 200 heavy tractors for units to be activated under the new troop basis sent Hassinger flying to WPB to plead that some be released from the 15 percent reserved for civilian use. He came away with 115 tractors, but most of them were low-powered machines.

At the end of July, with the new AA ratings being flourished about by some producers, tractor manufacturers were trying to get steel on an A–1–a priority. They couldn't. Fowler notified WPB that there had been "continual shutdowns of assembly lines due to the lack of critical materials." [28] WPB's Construction Machinery Division robbed Peter to pay Paul. It transferred steel from the manufacture of relatively less essential types of construction machinery to that of tractors and shovels.

In August another shortage, that of diesel engines, which was itself partly due to lack of steel, began to interfere with the production of construction machinery. Following a directive from the President to push the production of landing craft, the ANMB had granted the Navy an AA–1 priority for General Motors diesel engines that superseded all other AA–1 ratings. It looked as if Allis-Chalmers would have to close three of its lines, and in fact by 20 August one line had been closed. The ANMB advised a deal with the Navy and if that failed an appeal to the General Staff. The Navy agreed to release some engines, but only if they went into Navy tractors. By the end of the month the question had gone to the General Staff. Within ten days representatives of the Navy, SOS, Ordnance, and Engineers had met and reached an agreement. Under its terms the Navy diverted some engines from landing craft, Ordnance some from tanks, and SOS some slated for export under lend-lease. The Engineers got all the tractor engines requested.

With chronic shortages on the one hand, urgings to expedite production on the other, and a mass of paper flowing in all directions and piled up in the middle, manufacturers themselves were hard put to maintain a patient attitude. It took more than four pages of single-spaced type for an official of the Caterpillar Tractor Company to detail his woes to the Production Division, SOS. He was amazed to hear talk of expanding the tractor industry at the very time his company was assembling tractors at about 50 percent of capacity. Some departments at Caterpillar, those that had sufficient materials, were operating at capacity. The result was an unbalanced inventory. "Our track-type tractor shipments are currently under the pace as of a year ago, while we have a thirteen million dollar larger inventory. I realize," he reported from Peoria, "that thirteen million dollars sounds like two bits in Washington, but to us it is still a whale of a lot of money, and it is a lot of iron." Improvement in the flow of paper would help a lot, he claimed. Almost up to the minute he started to write the letter Caterpillar was holding 398 tractors for lack of bills of lading, releases, and shipping instructions. Now the situation had been improved. "It was discovered that a civilian representative of the Corps of Engineers stationed here in our office was sitting comfortably on 68 Bills of Lading. He has also disgorged 30 more, but I am not quite sure whether it is he or Chicago who is responsible for the delay of these 30. It

[28] Ltr, C of Sup Div to C of Tractor Sec Constr Mach Br WPB, 24 Jul 42, sub: Priority Rating for the Tracklaying Tractor Industry. 451.3, Pt. 8.

has been said that we have not asked for these Bills of Lading—that is not true because we have asked for them repeatedly. And just exactly why we should have to ask for them in the first place is a bit beyond my comprehension." Having got a lot off his chest, the Caterpillar official added a conciliatory postscript: "After returning home I was more severely critical of ourselves than I was of Governmental Agencies while in Washington. Our skirts are none too clean either. We are going to do better." [29]

It was Hassinger's hope that Caterpillar would do better. The Engineers had a great deal at stake for they had settled upon the Caterpillar tractor for their own troops to the exclusion of other makes. Specifically Hassinger complained that the factory had supplied faulty information as to the number of tractors produced, that its requests for aid in getting critical materials were inaccurate, and that the factory had too few expediters. During the fall of 1942 the Production Division, SOS, and the Supply Division, OCE, worked closely with the officials of the Caterpillar Company in an effort to iron out their production difficulties. These co-operative efforts got results. By early October, Hassinger reported with satisfaction that Caterpillar had increased its expediters from a handful of persons to seventy "and are only beginning to find out that they can help themselves on many of the problems that they thought were without solution." He considered the situation well under control and predicted an immediate improvement in operations.[30]

There were at least two more bright spots in the picture in the fall of 1942. One was that during the weeks ending the 5th and 12th of September the tractor factories had for the first time since the beginning of allocation actually shipped more tractors than were scheduled. The other was the decision to centralize the procurement of construction-type cranes and shovels in the Corps of Engineers.[31] These encouraging signs could not hide the fact that Engineer procurement was behind schedule at the end of the third quarter of 1942. Production of landing mats, bridges, boats, searchlights, and precision instruments, as well as construction machinery, was less than scheduled.

[29] Ltr, Chm of Exec Comm Caterpillar Tractor Co. to C of Prod Div SOS, 29 Jun 42. 095, Caterpillar Tractor Co.

[30] Hassinger Diary, 6 Oct 42.

[31] SOS Cir 63, 18 Sep 42, sub: Pier and Warehouse Mat Handling Equip.

CHAPTER IX

The Cutback in Production Goals

The unfavorable balance between deliveries and stated requirements which characterized the Engineer procurement program in the fall of 1942 was far from unique. The crisis in production was general, making imperative a re-examination of overall objectives.

Attempts To Reduce the Army Supply Program

For a number of months SOS had been trying and had by the end of the summer of 1942 at least partially succeeded in cutting down on quantities of Class II equipment.[1] In insisting that requirements be revised downward SOS was carrying out a policy first announced by the War Department in the fall of 1941 and reiterated in December of that year. T/BA's would be studied carefully "with a view to eliminating therefrom all items which are not absolutely essential for combat"—in particular allowances of motor vehicles and other bulky equipment which consumed large amounts of cargo space.[2] Again in June 1942 the Chief of Staff instructed his Operations Division to review T/BA's. The Requirements Division, SOS, had meanwhile attacked the problem and could report "substantial reductions," among them a cut in engineer requirements for searchlights, ponton boats, and 6-ton pneumatic floats. Clay assured Somervell that the Requirements Division, SOS, would continue to press the services for further reductions and he expected forthcoming cuts to offset to a large extent the impending increase in the troop basis. This generalization did not hold true for the Engineers, although quantities of construction machinery on the T/BA were reduced. As the Supply Division stated repeatedly, engineer requirements were geared to the character of military operations rather than to the number of men in the Army. The effect of reductions in organizational equipment was therefore to shift requirements from Class II to Class IV rather than to eliminate them.[3]

At the same time that the Requirements Division, SOS, was calling for reductions in the T/BA, it carried on a campaign for a re-examination of replacement and distribution factors. The application of percentages to amounts of initial issue in order to insure replacement of equipment upon its wearing out, destruction, or loss and to provide a sufficiency in the supply pipeline to insure a constant flow accounted for a large proportion of total requirements. In

[1] Leighton and Coakley, *Global Logistics,* pp. 302–03.

[2] Ltr, TAG to CofEngrs *et al.,* 31 Dec 41, sub: Reduction of Equip Included in T/BA 1 Oct 41. 400.34, Pt. 39A.

[3] (1) Memo, Somervell for Clay, 14 Jun 42. AG 400 (4–17–42), Sec. 1. (2) Memo, Clay for Somervell, 17 Jun 42, sub: Reduction in Rqmts and Prod Programs, with Incl, Tab B. Same file. (3) T/BA 5, 1 Jun 42, 1 Dec 42. (4) Ltr, Dawson to Actg C of EHD, 31 Mar 55.

1942, 55 percent of the ASP was in replacement and distribution. Naturally the Requirements Division, SOS, regarded this area as a fertile one for further cuts. The Supply Division, OCE, had its own reasons for failing to exhibit a corresponding enthusiasm.[4]

When in April 1942 SOS made its first inquiry about replacement and distribution factors, Fowler readily owned that replacement factors had not been revised since 1938 and strongly implied that they need not be in the foreseeable future. The current factors were 1 percent for all nonexpendable items in the zone of interior and 10 percent in theaters of operations. The Engineers had no experience on which to base a revision, Fowler argued. SOS should banish the fear that overprocurement might result from the application of unrealistic factors. Admitted, the Supply Division employed them in computing requirements. Admitted, the Supply Division purchased quantities to cover the replacement factor on initial issues. But replacement factors did not enter into buying thereafter. Subsequent purchases were "guided by actual needs to preserve stock levels, and not by the application of factors," Fowler explained. He declared further that replacement factors had little effect on issues to theaters of operations, their use being limited to establishing an initial reserve. Issues to maintain this reserve were based upon "the military situation." [5]

Although Fowler did not mention the fact at this time, the Engineers were relying heavily upon replacement factors to insure the shipment of sufficient quantities of engineer matériel. Because of the shortage of shipping space, very little Class IV equipment was being loaded. Top priority was going to the shipment of Class II supplies for units embarking for overseas. The extra allowances which accompanied units as a result of the application of replacement factors partially compensated for badly needed Class IV equipment which could not be shipped. Once this equipment was delivered, theater engineers could and did put it to work without regard to its original status as a reserve. As Chorpening later expressed it, the Engineers felt that the replacement factor was "fundamentally *'a means to an end'* and should not be considered otherwise." [6]

As for distribution factors, the Engineers had made no separate computation and saw no need for any. "Because Engineer supply functions are now in operation," Fowler argued, "because increases in issue will not produce proportionate increases in necessary echelons of stock, and because the uncertain precision of maintenance [replacement] factors for engineer equipment does not justify the refinement of a relatively small distribution factor, distribution factors are not considered justified or workable." [7] The character of operations, not the number of men involved, determined the quantity of engineer supplies needed. Currently much engineer equipment was being shipped direct to the using organization or to a port.

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[4] Rqmts Div ASF, Manual, Jul 43, sub: Determination and Use of Maint Factors and Distr. EHD files. The term "maintenance factor" was used at this time to describe what was subsequently termed "replacement factor." The latter usage has been employed throughout the text in order to avoid confusion.

[5] Memo, C of Rqmts Div SOS for CofEngrs, 6 Apr 42, sub: Rev of Maint and Distr Factors, with 1st Ind, 4 May 42. 400, Pt. 2.

[6] Ltr, ExO Sup Div to Dir Rqmts Div ASF, 4 May 43, sub: Maint Factors for Constr Equip. 400.4.

[7] 1st Ind, 4 May 42, Fowler for C of Rqmts Div SOS, on Memo, C of Rqmts Div SOS for CofEngrs, 6 Apr 42, sub: Rev of Maint and Distr Factors. 400, Pt. 2.

For all these reasons the Supply Division felt it unnecessary to render more than *pro forma* compliance with the request of SOS for a revision of replacement and distribution factors. Setting aside the prescribed forms, the Supply Division drew up a substitute which took account only of replacement factors. Reductions from the standard 10 percent were made in a number of cases, chiefly on heavy expensive machinery intended for use in rear areas.[8]

The Requirements Division, SOS, insisted that the Supply Division could and must do better. The durability and length of service of engineer items were bound to vary considerably more than was indicated by the monotonous uniformity of the factors. Further refinement of replacement factors and assignment of a distribution factor to all items destined to be stocked was essential for the planning and computation of requirements. Having been led to water the Engineers merely pretended to drink.[9]

The Supply Division placed the unwanted job in charge of 1st Lt. Warren S. Davis, who had no experience or training to qualify him for it. The factors he worked up varied considerably from one category of equipment to another. Bridging was assigned a replacement factor of 2 percent for the zone of interior, 6 percent in theaters of operations. Construction machinery received 2 percent in the zone of interior and 8 percent overseas. A distribution factor of 20 percent was assigned for bridging, and 10 percent for construction machinery.[10]

Although SOS approved the new factors in mid-July, its Requirements Division served notice in September of its intention to force periodic adjustments. Davis, who represented the Supply Division at a meeting called to discuss the subject, became deeply disturbed as SOS unfolded its plans and he recalled the circumstances under which the engineer factors had been developed. His own ignorance of the subject uppermost in his mind, he was dazzled by the brilliance of the seventy-five-page report prepared for the Ordnance Department by a board of seven lieutenant colonels. Back at his desk, he strongly recommended that the Engineers change their attitude and appoint a full-time staff to work on the subject as Ordnance had done instead of engaging in "sporadic bursts of attention and energy when such is called for by higher authority." The Supply Division shelved the lieutenant's recommendations, determined to postpone as long as possible the day when the Engineers might be forced to relinquish what had become an important safety valve in overseas supply.[11]

Tightening Controls on International Aid

Another important consequence of the failure to meet production goals was a less liberal attitude in dispensing international aid. By September Somervell and Clay had established the firmer controls over international aid that both desired and they supported the International Division, SOS, in a drive for improvements in administration. Within the Corps of Engineers international aid had been administered from a section of the Requirements Branch under Colonel Molnar. In response to a directive from SOS on 23 September, the International Aid Section was named a branch of the Supply Division with the understanding that Mol-

[8] *Ibid.*, with Incl, 1 May 42. 400, Pt. 2.
[9] 2d Ind, 9 May 42, on memo cited n. 7.
[10] (1) Memo, AC of Rqmts Br for C of Opns Sec, 21 Sep 42, sub: Maint and Distr Factors. 400.4, Pt. 1. (2) Maint and Distr Factors Approved by SOS, 15 Sep 42. 400, Pt. 2.
[11] Memo cited n. 10 (1).

nar would continue to report to his old boss, Dawson, in the latter's position as assistant executive officer of the Supply Division. None of the other branch chiefs went through this channel.[12]

This unique administrative arrangement was part of Fowler's plan for subordinating international aid to the needs of the American Army, a plan he spelled out on 14 October in a confidential memorandum to Dawson, Molnar, and Col. Beverly C. Snow, an Engineer officer recently assigned to study the international aid setup. Fowler wrote:

> a. Recommendations to International Supply Committee regarding requests for procurement of supplies:
>
> (1) The item must be an Engineer item in our Service. (Pipe lines and canning plants excepted).
>
> (2) The item must be for the prosecution of military operations in a Theater as distinguished from farming, manufacturing and resource development.
>
> (3) The quantity recommended for approval must be justified by the size of the military force involved.
>
> (4) Procurement will not necessitate the dropping of essential items from the U. S. procurement program.
>
> b. Recommendations to Munitions Assignments Committee reference withdrawal from U. S. stocks.
>
> (1) Non Common Stock Pile Items.
>
> (a) If a troop item, it must be destined for use by troops.
>
> . . . . .
>
> (c) For any equipment, the amount recommended for withdrawal will not so deplete stock as to delay the equipping of U. S. troops or the filling of requisitions for active U. S. Theaters. Weight will be given to the relative activity in the proposed foreign theater and the U. S. theater to be deprived of equipment.
>
> (2) Common Stock Pile Items.
>
> (a) To a reasonable extent, the British have a "lien" on existing stocks, in that they were told that these stocks would be available to them in lieu of purchases that might have been made with Lend Lease funds but under a lower priority.
>
> (b) The proposed use must be in direct connection with military operations.
>
> (c) The quantities to be permitted to be withdrawn at any one time shall be in proper proportion to those used by our troops for similar operations, and shall not so deplete stocks as to delay the filling of requisitions, on hand and anticipated, for *active* U. S. Theaters. For the present all U. S. Theaters will be considered *active* except the Caribbean Theater.
>
> (d) In event the replacement of items withdrawn from U. S. stock for Lend Lease becomes difficult by reason of action of A. and N. B., allocations by W. P. B. or other causes, a less liberal policy than above described will be followed.[13]

This was a tough policy, and Fowler was called upon to defend it almost immediately. On 21 October Snow submitted a report of his observations. He had talked to many persons in SOS, in other services, and to Brigadier Blood. He had studied the organization charts and the flow of paper across the desks in the International Aid Branch. He was convinced that the Engineers were in effect slighting international aid. He believed they should create an International Division at staff level to handle broad policy matters and free the International Aid Branch from Dawson's control. Unless the Chief of Engineers took this step or some-

[12] (1) Leighton and Coakley, *op. cit.*, pp. 261–62. (2) OCE Memo 191, 23 Sep 42, sub: Estab of Intnl Br. (3) Snow Rpt. (4) Memo, Fowler for Col Tulley, 22 Oct 42, sub: Intnl Aid. 400.333, Pt. 1.

[13] Memo, Fowler for Snow, Dawson, and Molnar, 14 Oct 42. Intnl Div file, 400.312.

thing very like it, Snow warned, "it is probable that he will receive a directive from the Commanding General, Services of Supply . . . ." As if the threat of a directive from Somervell were not enough, Snow hinted darkly at troubles from another quarter. The British wanted more direct access to persons in OCE. They wanted a relaxation of specifications. They wanted less red tape in the Engineer Subcommittee. According to Snow, it was only the good offices of Brigadier Blood which had "persuaded a certain Minister to withhold representations on high levels concerning inability to obtain satisfactory action on Engineer items of International aid." Although Snow agreed that American troops should not do without, he felt that the British should be accorded "more consideration." Certainly they should be told why their requisitions could not be filled. Unless these steps were taken and Brigadier Blood's recommendations acceded to, he predicted "a serious rift" in what he termed "the present harmonious relations" between the Corps of Engineers and the Office of the Chief Engineer, British Army Staff.[14]

The Snow report itself came as close to producing a rift as any conditions described therein. Fowler was outraged:

> Great stress is placed on the statements of the Chief Engineer, British Army Staff, to the effect that the British are not getting the supplies they need because the Chief of the Supply Division places the needs of the American Army ahead of British needs. . . . The recommendations of the Supply Division before the Munitions Assignments Committee have consistently followed the policies of that committee and their policies are certainly the policies of the War Department. Unless these policies are changed, the Chief of Engineers is bound to look after the needs of the American Army first and it would be most unwise to have a "high level" coordinating officer make recommendations contrary to those of the Chief of the Supply Division.[15]

Fowler stated he knew of no instance when the British had not been told why their requisitions had been turned down. The British were perfectly free to contact officers in the Supply Division. He was aware that the Engineers had refused to approve the manufacture of nonstandard articles. He thought Brigadier Blood agreed that such production should be avoided in order to simplify the supply and maintenance of equipment. There had been disagreement over an Australian requisition for a million dollars worth of tractor spare parts. Blood had agreed with Molnar's view that the request was far in excess of actual need, that $300,000 worth of spare parts previously supplied was sufficient. "As a matter of fact, the British are getting a better deal than they could reasonably hope for under Lend Lease priorities through their interest in the 'Common Stock Pile,' " Fowler asserted. "However, if they continue to create trouble as indicated by the statements in this report, I am inclined to recommend the discontinuance of the 'Common Stock Pile' plan and to let the chips fall where they may, i. e., let the International Aid and the Munitions Assignments Committee decide each of their requests; we will merely state facts as to availability of stocks and materials." Fowler declared he would, however, issue orders to make the International Aid Branch independent in fact. Under the new setup Molnar would secure information about requirements from Dawson, about procurement from Seybold, and about specifications from Besson. He, Fowler, would pass upon all recommendations submitted by Molnar.

[14] Snow Rpt.

[15] Memo, Fowler for Tulley, 22 Oct 42, sub: Intnl Aid. 400.33, Pt. 1.

"I cannot agree," he concluded, "that the recommendations coming from the Chief's office should represent the opinion of an officer who is in no way responsible for the supply of our forces. I do not believe that the War Department would want such recommendations." [16]

Shortly thereafter the channels through which international aid was to be administered were clarified substantially along the lines Fowler had indicated. Although the declared intention was to set up the International Aid Branch as a co-ordinate branch of the Supply Division, Dawson, as chief of the Requirements Branch, was to recommend action on all requisitions from Allied nations, and the final decision in case he and the chief of the International Aid Branch disagreed was to be made by the chief of the Supply Division or his assistant executive, Dawson. The form had changed; the substance had not.[17]

Once Fowler announced these decisions, the British graciously accepted them. "With my full support," wrote Brigadier Blood on 18 November, "the operation of the Stockpile is now virtually in the hands of the Chief of Engineers; he makes the assignment. . . ." In reality the British had received more than they were able to ship. The purpose of Blood's letter of 18 November was to liberalize the policy whereby equipment not shipped within forty-five days could be reclaimed by the American Army.[18] All told, Great Britain received a total of $35,499,000 worth of engineer supplies in the calendar year 1942.[19]

Fourth Quarter Production and the Final Reckoning

With no relief from the tight materials situation in sight, the Engineers entered the fourth quarter of 1942 with a procurement program that was swollen by the sharp rise in their troop basis. In May the Engineer program had stood at $939,600,000. In November, at the very time the total ASP was drastically reduced to bring it into closer balance with production possibilities, the Engineer portion rose to $1,356,800,000.[20]

Over and above this were Class IV requisitions which were filled on an emergency basis and thus did not appear in the ASP. Efforts to arrive at a more refined estimate of Class IV requirements were doomed to fail in this early stage of the war. Strategic plans were rarely firmed up much in advance of operations. The decision to invade North Africa in November 1942 was not made until late July. Strategists were most reluctant to reveal tentative plans lest they find themselves bound by logistical arrangements that were difficult to alter. There was, moreover, no formal liaison between theater commanders and the supply services. Under such circumstances the Supply Division continued throughout 1942 to purchase much Class IV matériel upon short notice against requisitions forwarded by O&T. Unavoidable as it was, the practice of purchase by requisition constituted a

[16] *Ibid.*

[17] (1) OCE Memo 211, 28 Oct 42, sub: Intnl Aid. (2) Memo, C of Sup Div for ExO Sup Div *et al.*, 5 Nov 42, sub: Handling of Intnl Matters in Sup Div. Intnl Div file, 310.1, Intnl Div.

[18] Ltr, Blood to Clay, 18 Nov 42, sub: Engr Equip—Opn of 45-Day Rule. Intnl Div file, 400.29, Repossession.

[19] Theodore E. Whiting, Carrel I. Tod, and Anne P. Craft, "Lend-Lease," a chapter in Statistics, a volume in preparation for the series UNITED STATES ARMY IN WORLD WAR II, p. 19.

[20] (1) ASP, Sec. I, 6 Apr 42, with changes to 29 May 42, 12 Nov 42, Sec. III, 18 Sep 42. (2) Ltr, Sup Div to C of Prod Br Resources Div SOS, 8 Oct 42, sub: Priorities for Increased Rqmts Required by ASP. Rqmts Br file, 400.1301, Pt. 1.

serious block to the attempts of SOS and of WPB to achieve planned production, which was in turn an essential part of the effort to get on top of the raw materials shortage.[21]

The shortage of steel continued to dominate production during the fourth quarter of 1942. Through the Production Requirements Plan of allocation the WPB succeeded in bringing about a better balance between demand and supply. Since this balance was achieved for the most part by arbitrarily reducing demand, the principal merit of PRP lay in replacing the uncertainty as to whether or not materials would be supplied as needed with the certainty that they would not be. In August Hassinger learned of a proposed 20 percent cut in materials for the tractor industry. He began working for an amendment at once, but all efforts failed. Allocations for the fourth quarter were actually less than anticipated. Tractors suffered a cut of 30 percent; shovels, 25 percent; graders, 35 percent; engines for construction machinery, 10 percent.[22]

At the same time that the Supply Division protested these cuts to SOS, it advised the field procurement offices to make the best of them. The WPB had done a "good job," the Procurement Branch informed the six procurement districts in mid-October. Some curtailment of production would result and some confusion in scheduling would exist at first. It could be expected that "many companies will 'cry on your shoulder.'" The procurement districts should take pains to explain the necessity to balance demand and supply. They should be alert but not too hasty in filing applications for additional materials from the reserve "kitty" that WPB had established for proven emergencies.[23]

Although by December 1942 monthly deliveries of construction machinery were valued at more than $35,000,000 as compared with $8,580,000 the previous January and although the Corps of Engineers had received deliveries to an estimated value of $254,236,000 during the year, deliveries fell almost 25 percent short of requirements as stated in December 1942. (*Table 7*) Since the December figures were in part at least the result of stating requirements in terms of anticipated production, the actual shortages were doubtless larger than appear in Table 7. The following comparison of tractor requirements with deliveries shows a striking difference between what was stated as required, what was believed feasible to produce, and what was finally delivered:[24]

Item	*Total Needs Stated April 1942*	*Total Production Authorized April 1942*	*Requirements ASP December 1942*	*Deliveries 1942*
D–8	4, 368	2, 560	2, 328	1, 947
D–7	3, 409	2, 900	2, 623	2, 133
D–6	1, 533	1, 800	1, 427	1, 399
D–4	4, 613	5, 500	5, 353	4, 181

[21] (1) Leighton and Coakley, *op. cit.*, pp. 296–97. (2) Rqmts Br Diary, 30 Nov 42.

[22] (1) Smith, The Army and Economic Mobilization, Ch. VIII, p. 123. (2) Hassinger Diary, 11 Aug, 6 Oct 42. (3) Memo, C of Equip Control Sec for C of Proc Br, 22 Aug 42, sub: Ltr from W. Blackie, Caterpillar Tractor Co., Aug 19. Exec Office Proc Div file, Tractors, Constr Mach. (4) Ltr, ACofEngrs to CG SOS, 15 Dec 42, sub: Rpt on Deliveries in the Tractor Industry. Mgt Br Proc Div file, Steel.

[23] Ltr, AC of Proc Br to Proc Dists, 17 Oct 42, sub: PRP Activities. Mgt Br Proc Div file, Instructions to Dists, Procedural PRP.

[24] (1) Crawford and Cook, *op cit.*, p. 16. (2) Chart, Relation of Deliveries to Rqmts, 1942, in CE Conf No. 3, 21 Jan 43. EHD files. (3) Memo, Maj William W. Goodman, Intnl Div SOS, for Secy MAC(G), 10 Apr 42, sub: Tracklaying Tractor, Long Range Alloc for Approval. Constr Mach Br file, Second Quarter Alloc, 1942 (Svs Combined).

TABLE 7—CONSTRUCTION MACHINERY ANNUAL REQUIREMENTS AS OF DECEMBER 1942 AND ACTUAL DELIVERIES IN 1942

Item	Requirements as of December 1942	Deliveries During 1942	Over or Short December Requirements
Auger, earth, skid mounted, gasoline engine driven	78	46	−32
Compressors, air			
Trailer mounted, pneumatic tires, diesel engine driven, 315 cubic feet per minute	[a]	98	----------
Truck mounted, gasoline engine driven, 105 cubic feet per minute	1,013	775	−238
Crane, tractor operated, non-revolving, 20-ton, 20-foot boom	[a]	226	----------
Cranes and shovels, crawler mounted			
½-cubic yard, 5- to 6-ton, Class II	753	329	−424
¾-cubic yard, 7- to 10-ton, Class III	100	47	−53
1¾- to 2-cubic yard, 30- to 40-ton, Class V	[a]	31	----------
Cranes and shovels, rubber tired			
⅜-cubic yard, 4- to 8-ton, Class X	250	266	+16
Crushing and screening plant, 2-unit, gasoline engine driven, semitrailer mounted, 25 cubic yards per hour	40	47	+7
Distributor, bituminous material, trailer mounted, 1,250-gallon	[a]	220	----------
Ditching machine, ladder type, crawler mounted, gasoline engine driven, digging depth 8 feet, width 18 to 24 inches	200	168	−32
Graders, road			
Motorized, diesel engine driven, 12-foot moldboard	1,388	1,229	−159
Towed type, leaning wheel, hand controlled, 12-foot moldboard	150	179	+29
Hammer, gasoline, portable	825	555	−270
Mixers			
Concrete, gasoline engine driven, trailer mounted, 14-cubic foot	625	328	−297
Pugmill, with dryer and soil stabilization unit, semitrailer mounted	50	27	−23
Rollers, road			
Gasoline engine driven, 3-wheel, 10-ton	401	192	−209
Gasoline engine driven, tandem, 2-axle, 5- to 8-ton	300	470	+170
Towed type, sheepsfoot, 2-drum-in-line	215	341	+126
Rooter, road, cable operated, 3-tooth	305	405	+100
Saw, chain, gasoline engine driven, 36-inch blade	1,850	759	−1,091
Scrapers, road			
Towed type, cable operated, 8-cubic yard, Type III	[a]	793	----------
Towed type, cable operated, 12-cubic yard, Type IV	[a]	723	----------
Semitrailer, low bed, rear loading, with dolly, 20-ton	93	16	−77
Tractors, crawler type, diesel engine driven, complete with accessories			
91 to 140 drawbar horsepower, Class I	2,328	1,947	−381
61 to 90 drawbar horsepower, Class II	2,623	[b] 2,133	−490
46 to 60 drawbar horsepower, Class III	1,427	[b] 1,399	−28
36 to 45 drawbar horsepower, Class IV	5,353	4,181	−1,172
Trailer, full, low bed, 8-ton	1,600	2,211	+611
Welding and cutting set	1,158	1,191	+33

[a] Requirements not shown in available records.

[b] These figures differ from those in Crawford and Cook, *op. cit.*, which have been adjusted to include procurement by the Ordnance Department.

Source: (1) MPR, Sec. 1, Dec 42; 31 Jan 43; 28 Feb 43; 31 Aug 43. (2) Crawford and Cook, *op. cit.*, pp. 25–27.

At the end of the third quarter of 1942 the various claimants for tractors had been shipped the following percentages of their allocations:[25]

Recipient	*Percent*
Engineer Troops	69.8
Construction Division, OCE	94.5
Navy Bureau of Yards & Docks	80.7
Navy Ordnance	68.4
Navy Aeronautics (public works)	47.4
Navy Aeronautics (equipage)	60.2
Marine Corps	91.8
Ordnance Department	100.0
United Kingdom	65.5
Australia	38.0
New Zealand	85.5

Like construction machinery, landing mats consumed large quantities of steel.[26] Despite the urgency which had characterized their development, requirements for landing mats were at first not large. In its original Class IV stockpile list, O&T recommended purchase of only 6,000,000 square feet. Early in February 1942, the Engineers and Air Forces agreed on a minimum of 15,000,000 square feet. Thereafter demands increased rapidly. By midsummer the total required production of pierced plank mat was at 180,000,000 square feet—an amount that would consume from 70,000 to 100,000 tons of steel per month or about one third of the nation's sheet capacity. Even with the AA–1 ratings they had, the producers of landing mat could not buy up this amount of steel. On 19 August WPB's Iron and Steel Production Branch told the Engineers it had no idea how much steel would be released to these producers. What saved the situation was a cutback in November, mainly in Navy requirements, to 130,000,000 square feet. Deliveries for the year slightly exceeded this amount.[27]

In comparison with the amounts of construction machinery and landing mat the number of bridges and boats required by the Engineers was small. Important as the steel treadway bridge was to become in the European theater, only 36 were slated for delivery in 1942. Requirements for other bridges varied from 44 H–10's to 150 Bailey's. Yet among them the H–20 was the only one delivered in the quantity desired. Here again shortages of raw materials—aluminum, plywood, and rubber, as well as steel—were the main reason for slippages in the program. Production of boats and pneumatic floats was generally satisfactory, although deliveries of storm boats fell behind because of lack of engines. On the basis of dollar value, procurement of boats and bridges reached 90.3 percent of the amount programed for them, but only because some items were delivered ahead of schedule. (*Table 8*)

In their attempt to procure precision instruments the Engineers ran into shortages of aluminum and brass, and in pressing for increased allotments of these materials encountered a "have-to-be-shown" attitude on the part of WPB that all possible substitutions had been made. The Engineers insisted that the W. and L. E. Gurley Company, the only firm having facilities for mass

[25] Memo, Hassinger for Capt G. E. Mumma, Chicago Engr Proc Dist Office, 19 Oct 42, sub: Tracklaying Tractor Shipments and Rqmts. Proc Div file, WD Conf Group for Tractors and Cranes, 1942.

[26] Unless otherwise noted, the remainder of this section is based upon: (1) MPR, Sec. I, Dec 42; Sec. VI, Nov 42; (2) Corresp in Exec Office Proc Div file, ASP; Mgt Br Proc Div file, Dierdorf Read File; and (3) CE Conf No. 3, 21 Jan 43, in EHD files.

[27] (1) Memo, AC of O&T Br for C of Sup Div, 22 Dec 41, sub: Rev of Engr Rqmts List. 400.12, Pt. 109. (2) 1st Ind, 5 Feb 42, on Memo, C of Sup Div for AC of Air Staff A–4, 27 Jan 42, sub: Rqmts for Landing Mat. EHD files. (3) ASP, Sec. I, 12 Nov 42. (4) Tel Conv, Larry Miller, I&S Prod Br WPB, and Seybold, 19 Aug 42. Mgt Br Proc Div file, Landing Mat, Airplane 1 (C).

TABLE 8—MISCELLANEOUS EQUIPMENT ANNUAL REQUIREMENTS AS OF DECEMBER 1942 AND ACTUAL DELIVERIES IN 1942

Item	Requirements as of December 1942	Deliveries During 1942	Over or Short
Boats			
Assault, M–2, without paddles or canvas bag	11,919	14,680	+2,761
Reconnaissance, pneumatic, canvas, 2-man, without paddles	3,625	5,639	+2,014
Storm, plywood	1,490	1,131	−359
Utility, gasoline powered, 18-foot	324	449	+125
Motor, outboard, with chest and spares, 50 to 55 hp	1,490	18	−1,472
Bridges			
Fixed steel			
Panel, Bailey type, M–2	150	33	−117
Box girder, H–10	44	36	−8
Box girder, H–20	50	52	+2
Ponton, steel			
10-ton	[a] 00	50	+50
25-ton [b]	100	45	−55
Raft, infantry support	1,037	456	−581
Treadway, steel	36	26	−10
Mapping Equipment			
Compasses			
Lensatic, luminous dial, liquid filled, 5 degree, 20 mil graduations (thousands)	266	205	−61
Watch (thousands)	569	537	−32
Level, engineer, with tripod	629	937	+308
Reproduction equipment			
Topographic company, corps	21	15	−6
Topographic battalion	9	5	−4
Topographic company, Air Force Headquarters company	18	5	−13
Topographic company, aviation	0	0	------
Stereocomparagraph	114	130	+16
Stereoscope, magnifying mirror, with binoculars and case	3,009	3,480	+471
Transits, engineer			
Night illumination, 1-minute reading, with accessories and tripod, Type I	1,850	1,604	−246
Night illumination, 20-second reading, with accessories and tripod, Type II	1,628	840	−788
Searchlights			
60-inch	3,926	1,222	−2,704
24-inch	264	168	−96
Landing Mat			
Steel, pierced-plank type (thousand square feet)	130,000	141,000	11,000
Other types (thousand square feet)	130,000	14,680	11,680

[a] Dropped in November when the bridge, M–3, pneumatic, was adopted.

[b] Procured as complete bridge sets during 1942. Thereafter components were procured and then assembled. Tables 12 and 15 show data for components rather than complete bridges as above.

Source: (1) ASP, Sec. I, 12 Nov 42. (2) MPR, Sec. 1, 31 Dec 42, 31 Jan 43, 28 Feb 43. (3) Crawford and Cook, *op. cit.*, pp. 25–29.

production, had gone to the limit in devising plastic parts, a step which had resulted in saving almost two pounds of aluminum and over a pound of brass per instrument. They therefore joined with the company in welcoming an expert from WPB to help out. The expert departed "pleased" and promising he "would present the picture in a different and more favorable light to WPB." [28] By 9 November Gurley had been given an AAA priority on both aluminum and aluminum forgings, but it was too late to make up all of the lost production. By the end of the year a shortage of parts made of brass and bronze had also arisen at Gurley. A second manufacturer of precision instruments, the Eugene Dietzgen Company, began to accept Engineer orders in the last half of the year, but this firm had difficulty hiring skilled workers. The combined factors of materials and labor shortages caused production of one-minute transits to be 246 short of the required production of 1,850, while only 840 of the twenty-second transits were delivered against an ASP of 1,628. On the other hand, deliveries of levels came to 937 against requirements of 629.[29] (*See Table 8.*)

Although the development of radar was by 1944 to reduce the requirements for searchlights to zero, in 1942 the searchlight program had lost none of the urgency which had characterized it before Pearl Harbor. For 1942, required production of sixty-inch searchlights was 3,926, and anticipated needs for 1943 were still larger. To meet them the Engineers applied for permission to expand production facilities. In April, Under Secretary of War Patterson approved two loans from the Defense Plant Corporation—one for $242,420 for machine tools for two subcontractors of Sperry Gyroscope, the other for $2,031,136 to enable General Electric to convert two of its plants. As it turned out, having the money did not help much. Despite frequent appeals for a higher priority rating, General Electric was unable to buy enough machine tools to produce complete searchlight units at the new plants until 1943. Even had plant operations got under way sooner it is doubtful whether the 1942 program could have been met. An attempt to save aluminum and also to create a more mobile unit led to a new design which specified pressed steel. This redesign, the retooling which it caused, and troubles in procuring high quality bearings brought about delays that could scarcely have been overcome by operation of the new plants. The delivery of only 1,222 sixty-inch searchlights in 1942 was less than a third of the quantity requested.[30] (*See Table 8.*)

Construction machinery, bridges, precision instruments, and searchlights were the

[28] (1) Ltr, C of Proc Br to C of Conserv Br WPB, 3 Nov 42, sub: Expert Advice Concerning Elimination of Aluminum From Transits. 413.72, Pt. 1. (2) Memo, AC of Dev Br for Besson, 2 Dec 42, sub: Rpt on Conf at Troy, N. Y., with Representatives of WPB, Gurley Co., and Dev Br. Topo Br, Read File.

[29] (1) Memo, C of Purch Unit Proc Br for C of Proc Br, 12 Jun 42, sub: Purch of Transits. Denman Personal File. (2) Ltr, C of Sched Br Chicago Engr Proc Dist to C of Proc Br, 22 Dec 42, sub: Eugene Dietzgen Co. Exec Office Proc Div file, Prod.

[30] (1) Memo, C of Opns Br Proc Div for ACofEngrs for Mil Sup, 21 Jan 44, sub: Sixty-Inch Searchlights. Exec Office Proc Div file, Engr Equip Misc 3. (2) WD Staff Conf, 22 May 42, sub: Sup, Proc, and Constr Activities of CE. 337, Engrs Corps of (C). (3) Memo, CofEngrs for USW, 4 Apr 42, sub: Defense Plant Corporation Agreement of Lease with Sperry Gyroscope Co. Mgt Br Proc Div file, Sperry Gyroscope Co., Plant Expansion. (4) Ltr, Sperry Gyroscope Co. to C of Proc Sec, 19 Mar 42. Same file. (5) OUSW, Memo of Approval 296, 1 Apr 42. Exec Office Proc Div file, Gen Electric Co., Plant Expansion. (6) Ltr, Actg CofEngrs to CG SOS, 2 Dec 42, sub: Delays in Searchlight Prod. 470.3, Pt. 1.

programs that fell most seriously behind in 1942. Although shortage of loom capacity interfered with production of camouflage nets, the Engineers succeeded in meeting 81.5 percent of requirements for nets, and production of camouflage materials as a whole amounted to 95.1 percent of requirements. In the case of trailers, production almost caught up with requirements after a slow start.[31]

One of the most successful of the Engineer procurement programs in 1942 was that for barrage balloons, which was transferred from the AAF in March. Before 1942 nearly all barrage balloon equipment had come from Great Britain so that the AAF was only beginning procurement at the time of the transfer. The AAF for the most part had taken over British designs, and the Engineer Board continued this policy, modifying the designs to fit military characteristics desired by the Coast Artillery Corps. Thus the D–8 low altitude balloon was modeled after the British Mark VIII.[32]

When the Engineers took over procurement of barrage balloons, deliveries were behind. They continued so through July. Then in August barrage balloon deliveries soared to over $35,000,000, an amount so great that the entire dollar value of Engineer procurement was raised to a new high not again reached in 1942. The barrage balloon program in 1942 met 98.1 percent of its requirements. During this time the British continued to ship balloons to the United States as reverse lend-lease. The Engineers received 3,123 balloons from Britain while purchasing 3,900 from American manufacturers. In addition to the balloons, the British supplied 807 M–1 winches and 1,011 M–2 BB–Flying Cables, while the Engineers bought 1,885 winches and 3,480 cables. Of the major components of the barrage balloon set, only cables were significantly behind schedule at the end of the year, and enough of them had been delivered so that the Engineers did not believe an AAA rating necessary.[33]

During the year, purchases of engineer equipment had increased from approximately $25,000,000 in January to almost $91,000,000 in December, with the peak having been reached in August when large deliveries were made in preparation for the North African campaign and the upswing in the barrage balloon program occurred. The relation of deliveries to requirements for the major types of equipment was as follows: [34]

Type of Equipment	*Percent*
Total	84.4
Searchlights	48.7
Precision instruments	75.1
Construction equipment	76.6
Boats and bridges	90.3
Camouflage materials	95.1
Barrage balloons	98.1
Electric lighting equipment	98.1
Landing mats	109.2
Water supply equipment	118.2
Miscellaneous	207.3

The shortages were not just on paper. As of the end of December requisitions for twenty-two major items could not be filled. (*Table 9*) Shortages notwithstanding, the Corps of Engineers had procured a vast

[31] (1) MPR, Sec. 1–A, 31 Mar 43, 30 Apr 43. (2) ASP, Sec. I, 12 Nov 42. (3) WD Conf, 28 Sep 42, sub: Engrs Prod Program Conf. 337, Engrs Corps of (C). (4) Ltr, C of Sup Div to CG SOS, 1 Jul 42, sub: Investigation of Mgt—Fruehauf Trailer Co. 095—Fruehauf Trailer Co.

[32] Engr Bd Hist Study, Balloons, pp. 3–4.

[33] Memo, C of Sup Div for File, 19 Mar 42, sub: Notes on Conf Concerning Transfer of Barrage Balloon Sup to CE. 337, Pt. 1.

[34] Chart, Relation of Deliveries to Rqmts, 1942, in CE Conf 3. EHD files. The percentages here given were computed by using all items included in SOS Monthly Progress Reports and will not agree in all cases with categories of equipment in Tables 7 and 8, which are not so inclusive.

TABLE 9—UNFILLED REQUISITIONS AND THE AVAILABILITY OF DEPOT STOCKS: DECEMBER 1942

Item	Unfilled Requisitions	Available for Issue or in Transit	Shortages
Boats and Bridges			
Motor for boat, storm, plywood	128	0	128
Bridge, ponton, 25-ton	42	21	21
Raft, infantry support	261	10	251
Camouflage Materials			
Nets, garnished: [a]			
22x22 feet	41,984	16,823	25,161
30x30 feet	2,564	126	2,438
36x44 feet	20,646	460	20,186
45x45 feet	3,691	47	3,644
Construction Machinery			
Compressor, air, skid mounted, gasoline engine driven, 105 cubic feet per minute	100	53	47
Cranes and shovels, crawler mounted			
½-cubic yard, 5- to 6-ton, Class II	56	29	27
¾-cubic yard, 7- to 10-ton, Class III	9	2	7
Hammer, gasoline, portable	115	63	52
Roller, road, towed type, sheepsfoot, 2-drum-in-line	27	7	20
Construction Machinery—Continued			
Saw, chain, gasoline engine driven, 36-inch blade	1,411	95	1,316
Shops, motorized (9 types) [b]	386	69	317
Mapping Equipment			
Reproduction equipment			
Topographic company, corps	13	0	13
Topographic battalion	4	0	4
Topographic company, Air Force Headquarters company	13	0	13
Topographic company, aviation	2	0	2
Stereocomparagraph	16	0	16
Transit, night illumination, 20-second reading, Type II, with accessories and tripod	245	178	67
Searchlights			
60-inch	189	134	55
24-inch	168	0	168

[a] More than enough nets were in the process of being garnished to fill the requirements.

[b] Seventy shops were available without chassis.

Source: Table, Items on Which Stocks Available for Issue or in Transit to Storage Are Not Equal to Existing Unfilled Requisitions on Depots, 23 Dec 42. 400.12, Pt. 1 (S).

amount of matériel—$650,623,000 worth in fact—during 1942. Included in this total was over $61,560,000 in international aid.[35]

The Late Start in Maintenance of Equipment

As this large quantity of equipment flowed out to American troops and Allies, the means of keeping it in running order demanded increasing attention. Providing for efficient maintenance was not simply a matter of economy in the usual sense of monetary savings. As compared with steel and shipping and production facilities, money was extremely plentiful. To replace what should be repaired was intolerably wasteful of materials, transportation, and plant. Finally and most important, lack of proper maintenance might spell failure on the battlefield.

The person who had worked longest and hardest to develop plans for the maintenance of engineer equipment was Lt. Col. C. Rodney Smith, who on 1 March 1942 was transferred from the Engineer Board and placed in charge of a newly created Maintenance Section in the Requirements, Storage and Issue Branch, Supply Division. Although the recommendations made by Smith for the activation and training of a large number of maintenance troops in the summer of 1941 had been declared "grandiose" and had not been put into effect, the fact is that the research and experimentation Smith had directed while at the Engineer Board had answered many basic questions about this hitherto neglected segment of engineer supply. Smith arrived at OCE prepared to give general direction to a program he was largely responsible for formulating.[36]

This program had its base in the echelon system of maintenance established by the Army. First echelon maintenance was the responsibility of the operator of the equipment concerned. It consisted of running the machine properly, cleaning and oiling it regularly, making minor adjustments, and replacing parts that wear out rapidly such as tires, fan belts, and cutting edges. Such spares as well as common tools went with the machine. Second echelon maintenance was to be accomplished within the troop units by personnel specially trained for coping with minor breakdowns. All major engineer units were equipped with a full range of hand tools, commonly used wrenches and sockets, a 10-ton hydraulic press with accessory attachments, portable power drills, power grinder, and welding sets, and kept on hand a supply of frequently replaced parts and minor subassemblies such as carburetors, clutches, and brakes. The engineer maintenance company, previously called the mobile shop company, was responsible for third echelon maintenance in the field. Its T/O called for 6 officers and 175 enlisted men comprising a headquarters platoon, a contact platoon to make on-the-spot repairs, and two maintenance platoons which were to fix equipment requiring evacuation to the platoon or company bivouac. The maintenance companies were supplied with light mobile repair shops—most of which had been developed by the Engineer Board with the expert assistance of the Couse Laboratories, Incorporated, of Newark, New Jersey—as well as major unit assemblies and spare parts necessary for complete field overhaul. Fourth echelon maintenance, including general overhaul, recla-

[35] (1) Crawford and Cook, *op. cit.*, p. 15. (2) ASF Stat Review.

[36] (1) Ltr, Smith to Lt Col A. MacMillan, 17 Mar 42. 400.312, Pt. 6. (2) See above, pp. 35–36.

mation, salvage, rebuilding, and reconditioning, was the responsibility of the heavy shop company, a unit of 6 officers and 193 enlisted men organized into a headquarters platoon, a manufacturing platoon, and a repair platoon. The heavy shop company would perform most of its work at a fixed installation such as a field depot, but it had some mobile shop facilities also.[37]

The dovetailing of skills and supplies upon which this system of maintenance depended was extremely difficult to achieve. Operators trained under the shortened programs of 1942 caused more than the normal number of breakdowns and multiplied the need for repairs. Given time, this situation was bound to improve. The training of an operator did not stop with the completion of this specialist course. He went on to gain experience and skill. The threat to the efficiency of engineer maintenance was much greater from defects in the supply system than from shortcomings in training.

In order for the various maintenance echelons to keep engineer equipment running they had to have on hand a supply of spare parts sufficient in kind and in quantity. The key to assuring sufficiency in kind and to a large degree in quantity was to standardize on a single make and model of a given type of equipment. Failure to standardize meant that depots at home and overseas, maintenance companies, and heavy shop companies would be compelled to stock many more parts. Identification, segregation, and issue of all these spares would probably be complicated beyond the capabilities of the personnel distributing them. Achieving balanced stocks would be vastly more difficult. Suppose it happened that shovels of a particular make and model got unusually hard usage. A shop company might find itself stocked with plenty of spares for another make of shovel but not enough to go around for those in need of repair.

For the limited number of special military items they procured, the Engineers were in much the same position as the Ordnance Department in ordering a rifle. All rifles of a certain caliber were manufactured according to a standard specification. So were all treadway bridges. But most engineer equipment was "commercial" rather than "military." With few exceptions the Supply Division was inclined to buy various kinds of shovels and other types of construction machinery instead of standardizing upon one make and model. Three factors encouraged this practice. One of these factors — competitive bidding — although persistent, was the most readily modified. With advertising for bids out for the duration, it required but a firm stand from those in authority to impress upon procurement officials the necessity for ordering the exact make and model specified. Another of these factors—the freedom allowed commanders overseas to requisition whatever make or model they happened to prefer—was somewhat more difficult to control. Overseas commanders could scarcely be blamed for ordering blind. A new Class II Engineer Supply Catalog had been issued early in 1942, but for Class IV items not listed on the T/BA they had only Sears, Roebuck and Montgomery Ward catalogs and their own past experience to look to in making up a requisition for equipment. Moreover these requisitions were edited by the Operations

[37] (1) Ltr, C of Sup Div to COs Engr Orgns *et al.*, 23 May 42, sub: Engr Maint and Sup of Spare Parts. 400.4. (2) Engr Bd Hist Study, Engr Maint Equip. (3) TO&E 5–357, 1 Apr 42, 7 May 42. There were five maintenance echelons by the end of the war.

and Training Branch of the Troops Division which was inclined to supply the theater Engineer with exactly what he asked for on the time-honored theory that the man on the spot knows best and that failure to accomplish missions may heap recriminations upon those who had not acceded to his wishes. But by far the most compelling factor operating against the standardization of engineer equipment was the tremendous demand for construction machinery which dictated the utilization of all facilities. Perhaps it would have been possible to overcome the natural reluctance of competitors to share their drawings and manufacturing processes in order to produce a standard model. Such a step was far from practical in 1942. The WPB estimated it would take close to six months for tractor manufacturers to retool; meanwhile all production would have stopped.[38]

An alternative to standardization was a concentration of particular makes and models within using organizations. On 16 April 1942, six weeks after Smith's arrival in OCE, the Supply Division announced its intention to promote this type of standardization to the maximum:

> Except in extreme cases, only one make and model of any one type of power equipment should be procured in the future. . . . The practice of "splitting" orders for mechanical equipment among various firms should be stopped completely, except when the replacement parts for such equipment are interchangeable, or when vitally urgent delivery dates cannot otherwise be met to any reasonable degree. Manufacturers should be prevented from changing models, using different sub-assemblies, bearings, clutches, carburetors, etc., except under extreme conditions of necessity.[39]

As a first step in support of this policy the Requirements Branch would prepare a list of major items of equipment giving the quantity of each make and model on hand and on order. Representatives of the Procurement and Development Branches would go over this list and recommend a standard make and model for each item. The Procurement Branch would see that manufacturers "froze" their models. Procurement of other than standard equipment—"in cases where adherence . . . is impossible, or will not meet urgent delivery requirements"—would have to be approved by the executive officer of the Supply Division.[40]

Action within the Supply Division to put this directive in effect was slow. One month to the day after its issue the chief of the Purchasing Unit of the Procurement Branch wondered what progress was being made. "If this program is to be carried to the maximum degree of efficiency," he wrote, "it is believed that the list should be forthcoming as we are continuing to obtain requisitions for various types of equipment and there appears to be no definite progress as yet on standardization except for a few items." [41] Even on these few items confusion existed between the Requirements and Procurement Branches. There seemed so many more important things to do that summer—taking over the procurement of tractors, getting the common stockpile set up, adjusting

[38] (1) Maj Harry F. Kirkpatrick, Dev of Sup Plan for Engr Class IV Sup (typescript), 20 Dec 45. EHD files. (2) Memo, Secy MAC(G) for Chm MAC(G) [c. 8 Apr 42], sub: Tracklaying Tractors, Long Range Allocs for Approval (Not Asgmt). Intnl Div file, 451.3 Alloc. (3) Ltr, AC of Intel Br to TAG, 4 Feb 42, sub: Cablegram to C of SPOB, London. 400.34, Pt. 40.

[39] Memo, Actg C of Sup Div for Br Cs of Sup Div, 16 Apr 42, sub: Standardization of Engr Equip. Exec Office Proc Div file, Proc Dists.

[40] *Ibid.*

[41] Memo, C of Purch Unit Proc Br for AC of Proc Br, 16 May 42, sub: Standardization of Engr Equip. Denman File, Misc.

to a new system of raw materials allocation, struggling to equip newly activated units and task forces. Not until 3 August was Smith able to send "tentative preliminary" standardization data sheets to the Engineer Spare Parts Branch of the Columbus General Depot which had taken over the preparation of spare parts lists.[42]

Shortly after arriving in OCE Smith had called a meeting of Washington representatives of the principal manufacturers of engineer equipment, seeking their help in setting up a nucleus of experts for manning the Spare Parts Branch. He felt most fortunate in having persuaded Raymond L. Harrison of the Harrison Equipment Company of Albuquerque, New Mexico, to accept a commission and to become head of the branch. Harrison in turn persuaded literally hundreds of experienced persons to leave their businesses and come to Columbus. Smith had the utmost confidence in the abilities of Harrison and his group, and thus deplored the more the delays in standardization.[43]

It was 30 October before the publication of the list of standard makes and models contemplated in the 16 April directive. As finally issued, it sounded as if the Supply Division meant business. No deviation was to be made without the approval of its executive officer. Requests for such deviation were to be submitted only if there was no possibility of adjusting requirements to the manufacturer's ability to produce, the standard make and model could not be obtained in time to meet an urgent requirement, there was no possibility of increasing production, or if the standard item had given unsatisfactory service. On 21 November the Supply Division published a list of Standard Components of Standard Makes and Models. Manufacturers would be required to adhere to this list in the installation of magnetos, axles, clutches, brakes, and the like in the machines ordered for engineer use.[44]

Although much of the success of the drive for standardization depended upon the Operations and Training Branch of the Troops Division, which drew up requisitions for task forces and edited requisitions from overseas, this office was naturally not compelled to comply with orders issued by the chief of the Supply Division. On 7 November the Requirements Branch forwarded a copy of the 30 October directive to O&T with a request that future requisitions specify only standard makes and models. If any deviation were necessary the reasons should be stated. On 25 November, with requisitions for nonstandard items still being received, the executive officer of the Supply Division felt compelled to address a somewhat stronger plea for co-operation to the chief of O&T.[45]

Whether or not his arguments in favor of standardization would eventually prevail

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[42] (1) Memo, Actg C of Proc Br for C of Rqmts Br, 2 Jul 42, sub: Standardization of Equip, Requisition E–1587. Rqmts Br file, Standardization of Engr Equip. (2) Memo, C of Maint Sec for Equip Control Sec, 7 Jul 42, same sub. Same file. (3) Ltr, C of Maint Sec to Engr Sup Off Columbus Gen Depot, 3 Aug 42, sub: Standardization Data Sheets for Establishing Spare Parts Lists and Depot Stocks. 400.291, Columbus Gen Depot, Pt. 3.

[43] Interv, Brig Gen C. Rodney Smith, 6 May 55.

[44] (1) Ltr, C of Sup Div to All Brs Sup Div OCE *et al.*, 30 Oct 42, sub: Standardization of Engr Equip, with Incl. 475, Engr Equip, Pt. 1. (2) Ltr, C of Sup Div to All Brs Sup Div OCE *et al.*, 21 Nov 42, sub: Standardization of Engr Equip, with Incl. Sup Div file, 400.34, Standard Components.

[45] (1) Memo, C of Opns Sec Rqmts Br for O&T Br, 7 Nov 42, Sub: Standardization of Engr Equip. Rqmts Br file, Standardization of Engr Items. (2) Memo, Exec Office Sup Div for C of O&T Br, 25 Nov 42, same sub. Same file.

they could certainly not affect the situation immediately. Six months of continuing to buy a variety of makes and models had intervened since the policy of standardization was first announced. And six months of buying in the quantities being purchased in 1942 resulted in the entrance of extremely large amounts of equipment into the Engineer supply system.

As if the continued purchase of different makes and models of new equipment were not sufficient harassment to Smith and his assistants, there was added the even more serious worry caused by the possibility that much secondhand machinery would have to be issued to troops. In April 1942 the Supply Division received $25,000,000 earmarked for the purchase of secondhand machines from sources such as state and municipal highway departments, for example. After the military construction program reached its peak in July, the Supply Division began to be urged to take over machinery no longer needed in building camps, airfields, and munitions plants. Clay wanted to tap this source for the common stockpile. That this machinery was already owned by the government was the least of the several attractive aspects of the scheme. Its main appeal lay in the fact that the machines were readily available, or about to be made available, at the very time when production was far short of requirements. Its disadvantages were readily apparent to those concerned about keeping the equipment in operation.[46]

In opposing the introduction of secondhand machinery into the military supply system, the Supply Division could argue from experience. Of the $25,000,000 available, only about $2,000,000 had been spent. A halt had been called after what had been bought was found unsuitable. From Australia where secondhand machines had been sent in the urgent days following the fall of the Philippines came reports of dissatisfaction. Eight tractors received there had proved to be in such poor condition that they should have had a complete overhaul, but the supply of spare parts was too low to permit this. Consequently they were patched up and made to run, although not efficiently. According to an inspection report, the theater had come to prefer delay to the shipment of used machines.[47]

Yet SOS and WPB could not be convinced. The Construction Division, OCE, had about $95,000,000 worth of machinery less than eighteen months old and was predicting early in September that by November it could begin to turn over large quantities to the Supply Division. By late September the WPB was referring to $20,000,000 worth of machinery which the Construction Division was about to declare surplus. Hassinger, fearful of the consequences of such an understanding, expressed his skepticism as to the amount that might be made available in view of new construction projects just assigned, but he came away from a conference at WPB discouraged and deploring the absence of understanding there about the necessity for standardization of troop equipment. By mid-October, Hassinger felt his apprehension justified on all counts. On the 30th of September he learned that new tractors that had been supposed to come to troops as a result of the tapering off of the military construction program were to be al-

[46] (1) 1st Ind, 15 Sep 42, on Memo, ACofS for Materiel SOS for CofEngrs, 11 Aug 42, sub: Survey of Heavy Constr Equip. 413.8, Pt. 13. (2) Memo, C of Intnl Sec for C of Rqmts Br, 4 Sep 42, sub: MAC Meeting, 3 Sep 42. Intnl Div file, 334, Munitions Asgmt Comm.

[47] (1) Ind cited n. 46(1). (2) Memo, C of Sup Div for ACofS for Materiel SOS, 21 Oct 42, sub: Reduction in Prod of Tractors, with Incl. 451.3.

located to the Construction Division after all. When the WPB cut the raw materials allocation so drastically for the fourth quarter, he attributed this action to the notion prevailing in WPB that the Supply Division would have received and would be able to use large quantities of secondhand machinery. On 21 October, Fowler entered a strong protest with Clay against the cut and against the idea of sending used equipment overseas. The cut was not restored. The Supply Division was resigned by this time to issuing some of the surplus machinery for troop training in the United States and by the end of November was discussing a program for reconditioning it with representatives of the Construction Division. There is scarcely room for doubt that shipments of secondhand machinery overseas remained the exception rather than the rule during the year 1942 not because the logic of maintenance staffs had prevailed but because the Construction Division was not in a position to declare much of it surplus. It was fortunate that the Corps was afforded this period of grace. Varied as were the machines issued, they were for the most part at least new. By the time the Construction Division was in a position to release substantial numbers of machines, supplies had become more plentiful.[48]

In as much as standardization was basic to an efficient maintenance system the Corps of Engineers could not hope to approach perfection. But lack of standardization was not the sole cause of weakness in the maintenance program. While the Supply Division had been conscious all along of the need to furnish enough parts for all echelons of maintenance, it was not until late in July that a comprehensive system was arrived at. Under the terms of the July directive, manufacturers of engineer equipment were to state the make and model of the machine they were supplying and the make and model of all its components, assemblies, and accessories, and to furnish catalogs of spare parts. The information furnished by the manufacturer was to be used by the Spare Parts Branch of the Columbus General Depot to draw up lists of spare parts for standard items of equipment and by the Maintenance Section, OCE, to prepare similar lists for nonstandard equipment. All specifications would henceforth include first echelon sets of spare parts which would be delivered by the manufacturer along with the machine. In addition, each contract would carry an order for an eighteen months' supply of parts for second, third, and fourth echelon maintenance. Delivery of second, third, and fourth echelon spares need not coincide with delivery of each machine but was to be scheduled in balanced lots. Thus 20 percent of all spare parts should parallel the delivery of 20 percent of the equipment; another 20 percent of spares should be ready by the time 40 percent of the machines had been delivered. Spare parts would carry the same priority as the main order.[49]

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[48] (1) Hassinger Diary, 9 Sep, 29 Sep, 30 Sep 42. (2) Memo, C of Sup Div for ACofS for Materiel SOS, 21 Oct 42, sub: Reduction in Prod of Tractors. 451.3. (3) Opns Sec Rqmts Br Diary, 21 Nov 42.

[49] (1) Memo, C of Sup Div for All Br Cs Sup Div, 25 Jul 42, sub: Standard Procedure for Requisitioning Spare Parts With New Equip. Exec Off Proc Div file, Proc Dists. (2) Ltr, C of Maint Sec to Engr Sup Off Columbus Gen Depot, 22 Jul 42, sub: Priorities for Proc of Spare Parts. 400.1301, Pt. 6.

The eighteen months' supply was subsequently reduced to twelve and the delivery schedules were also modified somewhat. See (1) Ltr, C of Sup Div to Br Cs Sup Div *et al.*, 23 Oct 42, sub: Standardization Procedure for Requisitioning Spare Parts With New Equip. Exec Office Proc Div file, Proc Dists; and (2) Same to Same, 8 Dec 42, sub: Rev Standardization Procedure for Requisitioning and Purch Spare Parts With New Equip. 460, Pt. 1.

To include an order for spare parts in the original contract the procurement organization had to receive the appropriate list of spare parts promptly either from Columbus or from the Maintenance Section, OCE. The implication in the July directive was that Columbus could make lists for standard equipment available immediately. The Maintenance Section was allowed fifteen days to prepare lists for nonstandard equipment. Late in October the Spare Parts Branch at Columbus took over the preparation of lists for both standard and nonstandard equipment and was given ten days after receipt of a requisition in which to draw them up.[50] Neither the Maintenance Section nor the Columbus Spare Parts Branch kept abreast of this work. In September the chief of the Purchase Section, Procurement Branch, claimed his office had "*never* received a requisition in which the list of depot spare parts was available at the time the requisition was submitted." In December he noted that lists of spare parts for standard equipment were not yet available.[51] Smith could see for himself that the Columbus Spare Parts Branch was all too often taking much longer than ten days to forward spare parts lists to the procurement districts. Failure to follow through on the policy of standardization, insufficient data from manufacturers, noncompliance with routine procedures, inexperienced personnel, and not enough personnel were, he felt, the main reasons for delays. "By no means should any one agency be blamed, especially not the Columbus Spare Parts Branch, which has performed a miracle of accomplishment. At the same time, the most vigorous ACTION must be taken to get this huge job straightened out and on a clear track AT ONCE," he concluded in December 1942.[52]

Lag though the program did, the quantity of spare parts placed on the order books was tremendous. It was so large in fact that manufacturers could not believe it represented a real need. The Maintenance Section could understand their skepticism. Under normal peacetime conditions of operation and ready access to dealers' stocks, the Maintenance Section figured a construction machine costing $2,500 would require approximately $750 worth of spare parts for eighteen months' maintenance. Under wartime conditions, with no dealers' stocks to fall back upon, $2,000 worth of parts were required.[53]

Requirement	*Value*
Total	$2,000
Actual use of parts	750
Overseas depot stock	250
Impounded in transit	375
Estimated shipping losses	250
Domestic depot stock	375

Incredulity was not confined to the manufacturers. Hassinger himself was amazed to learn from the Maintenance Section in September that $12,000,000 worth of spare parts was required from the Caterpillar Tractor Company for engineer troop use. "This figure could not be produced in a reasonable time," he recorded in his diary, "even if we stopped producing tractors . . ." [54]

[50] Ltr, C of Sup Div to Br Cs Sup Div *et al.*, 23 Oct 42, sub: Standardization Procedure for Requisitioning Spare Parts With New Equip. Exec Office Proc Div file, Proc Dists.

[51] (1) Memo, Denman for Actg C of Proc Br, 3 Sep 42, sub: Comments on Procedure for Requisitioning Spare Parts With New Equip. Denman file, Proc of Spare Parts. (2) Memo, Denman for Seybold, 15 Dec 42, same sub. Same file.

[52] Maint Sec Diary, 24 Dec 42.

[53] Notes, Bunting, Maint Sec for Record, [c. Oct 42]. Constr Mach Br Proc Div file, Spare Parts Subcomm.

[54] Hassinger Diary, 15 Sep 42.

Such large orders for spare parts were bound to compete with new equipment for production facilities. The conflict was noted shortly after the middle of August. On the 17th of that month Smith received instructions from Fowler to begin shipments of spare parts at once for the build-up in Britain. Smith explained that Columbus was assembling stocks for this purpose but that he had instructed the depot to fill the back orders for other theaters also. If he struck this balance, shipments to England could not begin for several weeks. Fowler insisted that some parts be shipped immediately and that no shipment be delayed pending the assembly of fully balanced stocks. Columbus had already been directed to reduce procurement of spare parts from an eighteen months' to a twelve months' stock level. The executive officer of the Engineer Section at Columbus advised Smith to get an AAA priority or curtail the production of new machines if he wished to catch up on the backlog.

Fowler was not prepared to go this far. Efforts would be made to obtain more materials for spare parts, for lack of materials was recognized as the real bottleneck.[55] Whenever Columbus found deliveries of spare parts blocked by orders for new equipment, the case was to be referred to OCE "where the relative needs for spare parts and new equipment can be compared and a decision made as to whether equipment deliveries will be deferred, or whether we must go without spare parts." [56] On 29 August the Procurement Branch notified inspecting officers of the production preference to be accorded where orders for spare parts themselves were in competition. Delivery of spare parts called for on the original order for new machines would take precedence over all but those "comparatively small orders for spare parts" to be made by Columbus for shipment directly overseas.[57] On 29 October priorities for the production of spare parts were spelled out in more detail:

> a. Spare parts orders placed by any procurement office for consignment direct to Ports of Embarkation.
>
> b. Spare parts orders placed by any procurement office for consignment direct to troops or other military projects (such as Alaska) but not via Ports of Embarkation.
>
> c. Spare parts furnished integrally with new machines as "first echelon" or "field" sets. This priority applies *only* to the first echelon and field sets of spare parts actually accompanying new machines. Depot stocks being procured concurrently with new machines will be given the lower priority shown in subparagraph *e* below.
>
> d. Spare parts orders placed by the Engineer Supply Officer, Columbus Quartermaster Depot . . . for delivery to Columbus.
>
> e. Spare parts orders for Columbus Depot stocks procured concurrently with new machines on purchase orders placed by any procurement office.[58]

Stocks of spare parts for second, third, and fourth echelon maintenance from which Columbus was supposed to supply engineer organizations all over the world got the lowest priority.

Meanwhile the trail of woes attendant upon a multiplicity of makes and models and the failure to issue spare parts along with equipment had become apparent in

[55] (1) Maint Sec Diary, 17 Aug, 24 Aug, 25 Aug 42, 12 Nov 42. (2) Ltr, C of Maint Sec to Engr Sup Off Columbus Gen Depot, 14 Aug 42, sub: Spare Parts Orders. 400.291, Pt 8.

[56] Ltr cited n. 55(2).

[57] Ltr, AC of Proc Br to Inspec Offs, 29 Aug 42, sub: Spare Parts Orders, CE Equip. 475, Engr Equip, Pt. 1.

[58] Ltr, C of Sup Div to Engr Proc Dists *et al.*, 29 Oct 42, sub: Relative Priorities for Expediting Delivery of Spare Parts Orders. 475, Engr Equip, Pt. 1.

the European Theater of Operations (ETO). When Smith visited the ETO in September, there were practically no spare parts left. The only parts received until shortly before his arrival had been small stores brought along with organizational equipment. Now the first shipments which should have gone out months before had begun to appear. Smith planned to build up stocks of spare parts as fast as possible to provide for approximately a year's maintenance and to keep them at that level by constant replenishment. In the beginning this would be most difficult to accomplish, Smith warned:

> Because of the lack of standardization in existing Engineer equipment, efficient spare parts supply from the U. S. to the theater, and from the theater depot to troop organizations, can be maintained only if an up-to-date record is kept of the make, model and serial numbers of all Engineer machines in the theater and transferred from this theater to other theaters. As equipment is sent from this theater to other theaters, and as new equipment is received in the theater, these records must be brought up to date promptly. Otherwise it will be impossible to maintain proper depot stocks of spare parts, prepare replenishment requisitions, or adjust maximum stock level requirements for respective machines.[59]

Gradually, if the new policy of standardization were adhered to, nonstandard equipment should be squeezed out of the supply system. Very limited amounts of spare parts were to be stocked for nonstandard items. Standard equipment would be assured of spare parts from balanced depot stocks in the United States and overseas.[60]

Suddenly there appeared to be too many "ifs" and "buts," too many plans, too few results, to suit higher authority. On 2 November, Fowler called Smith to his office and told him that Somervell was displeased. Spare parts must be procured with all new machines and be shipped with the machines overseas. Accordingly Reybold had directed that "spare parts problems be solved forthwith." Smith could not promise to make good so soon. Strict adherence to standardization and to the procedures for procuring spare parts would, he assured Fowler, "pave the way toward satisfactory long-pull results." But he admitted that "the immediate situation was very unsatisfactory, in fact, critical," and predicted that in the best of circumstances it would remain so for at least two or three months.[61]

Smith's description and forecast can be applied to all phases of engineer supply at the end of 1942. Statements of requirements were far from accurate. Production continued to lag. Shipments were behind schedule. In the Southwest Pacific, engineer supplies had reached but 50 percent of the required level, even though here as in the British Isles substantial quantities of matériel had been furnished through reverse lend-lease. Engineer headquarters in the ETO had expected 75,000 cargo tons of matériel during the summer months alone. Only 75,400 tons were received during the entire year. Although in the last six months of 1942 shipments to this theater were much larger than previously, much of the equipment received was diverted to the campaign in North Africa. Heavy machinery needed for the large construction program under way in the United Kingdom was still in short supply in December. Class II equipment had not arrived in sufficient quantity

[59] Ltr, C of Maint Sec to Engr SOS ETO, 22 Sep 42, sub: Maint of Engr Equip in ETO. Intnl Div file, 400.314.

[60] (1) *Ibid.* (2) Memo, ExO Sup Div for C of O&T Br, 25 Nov 42, sub: Standardization of Engr Equip. Rqmts Br file, Standardization of Engr Items.

[61] Maint Sec Diary, 2 Nov 42.

to meet current demand much less maintain the sixty-day stock level authorized.[62]

The failure of supplies to reach the theaters in desired quantities was as much the result of the scarcity of cargo ships as of insufficient production. The shortage of shipping was at least in part traceable to the shortage of steel. It was a characteristic of 1942 that such limiting factors in production and distribution fed upon each other and swelled the total difficulty. Thus the shortage of steel and of industrial plants caused tractor manufacturers to steal from their spare parts bins in an attempt to increase production of complete machines.[63]

In view of the difficulties encountered, the 1942 record was impressive. Deliveries of goods reached unprecedented levels. Equally significant were the administrative arrangements, born of confusion and shortages, which would make for smoother operation in the future. Centralized procurement of tractors and shovels and cranes, the creation of the common stockpile—both innovations—were to bear the test of time. In the production of Engineer matériel as in the provision of Engineer officers and enlisted men, 1942 was the crucial year, the year of greatest challenge to the Corps in the United States.

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[62] (1) *Engineers of the Southwest Pacific,* Vol. VII, *Engineer Supply,* pp. 19–32, 41. (2) Information from historians preparing volumes on the Corps of Engineers in the War Against Japan, and in the War Against Germany.

[63] (1) Leighton and Coakley, *op. cit.,* p. 202 ff. (2) Opns Sec Rqmts Br Diary, 17 Dec 42.

CHAPTER X

Reorganization for Global War

The accelerated mobilization which followed the Japanese attack dominated military activities for many months. At the end of 1942 most of the Army was still in the United States and most of its weapons were still to be produced. By the summer of that year, however, the armed forces had begun to turn their eyes overseas. The landings in North Africa in November marked the end of a period of transition. The build-up continued, but it was ever more intimately related to specific military operations.

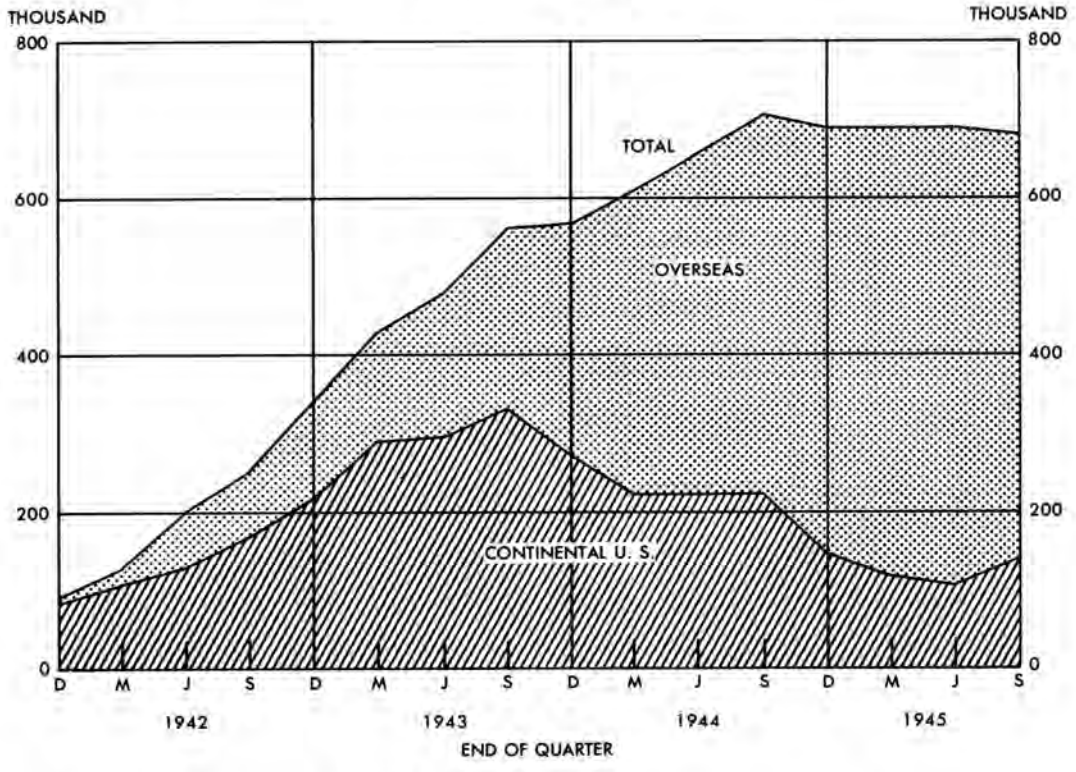
During the remaining years of the war, engineer troops increased not only numerically, as did most other services, but also in proportion to the Army as a whole. Only the Transportation Corps showed a similar trend, but the Transportation Corps was only about one third as large as the Corps of Engineers. In December 1943, with a strength of 561,066, the Engineers made up 7.5 percent of the Army. By May 1945, when the Army reached its peak, the Corps of Engineers with a strength of 688,182 constituted 8.3 percent of the Army. (*Chart 5*) Greater in numbers and proportionate strength than any other of the seven technical services the Engineers accounted for about 25 percent of the strength of this group. The Engineer procurement program reached its peak in December 1944 with the delivery in that month of over $190,000,000 worth of supplies. Dwarfed only by the programs of the Ordnance Department and the Quartermaster Corps, the value of Engineer procurement passed the billion mark in 1943 and the billion and three-quarters mark in 1944. While demands for the organization, training, and equipping of engineer troops continued unabated during the years of 1943 and 1944, the military construction program reached its peak in the summer of 1942. The value of construction work put in place in 1943 was $1,893,569,000 as against $5,565,975,000 in 1942. In 1944 the program shrank to less than half a billion.[1]

This decline in the military construction program left the Engineers relatively free to concentrate upon the task of preparing troops and supplies for action overseas. At the same time the acceleration of troop movements in the latter part of 1943 in anticipation of major offensives both in Europe and in the Pacific brought pressure upon OCE for greater flexibility and speed in training and equipping troops. On 1 December 1943, OCE was reorganized to conform with this shift in emphasis. (*Chart 6*) Its structure was to remain essentially unchanged until the war in Europe had been won.

At the top, the organization retained a

[1] (1) Greenfield, Palmer, and Wiley, *Organization of Ground Combat Troops*, p. 203. (2) Crawford and Cook, Statistics, p. 16. (3) Info from Office of the Comptroller of the Army.

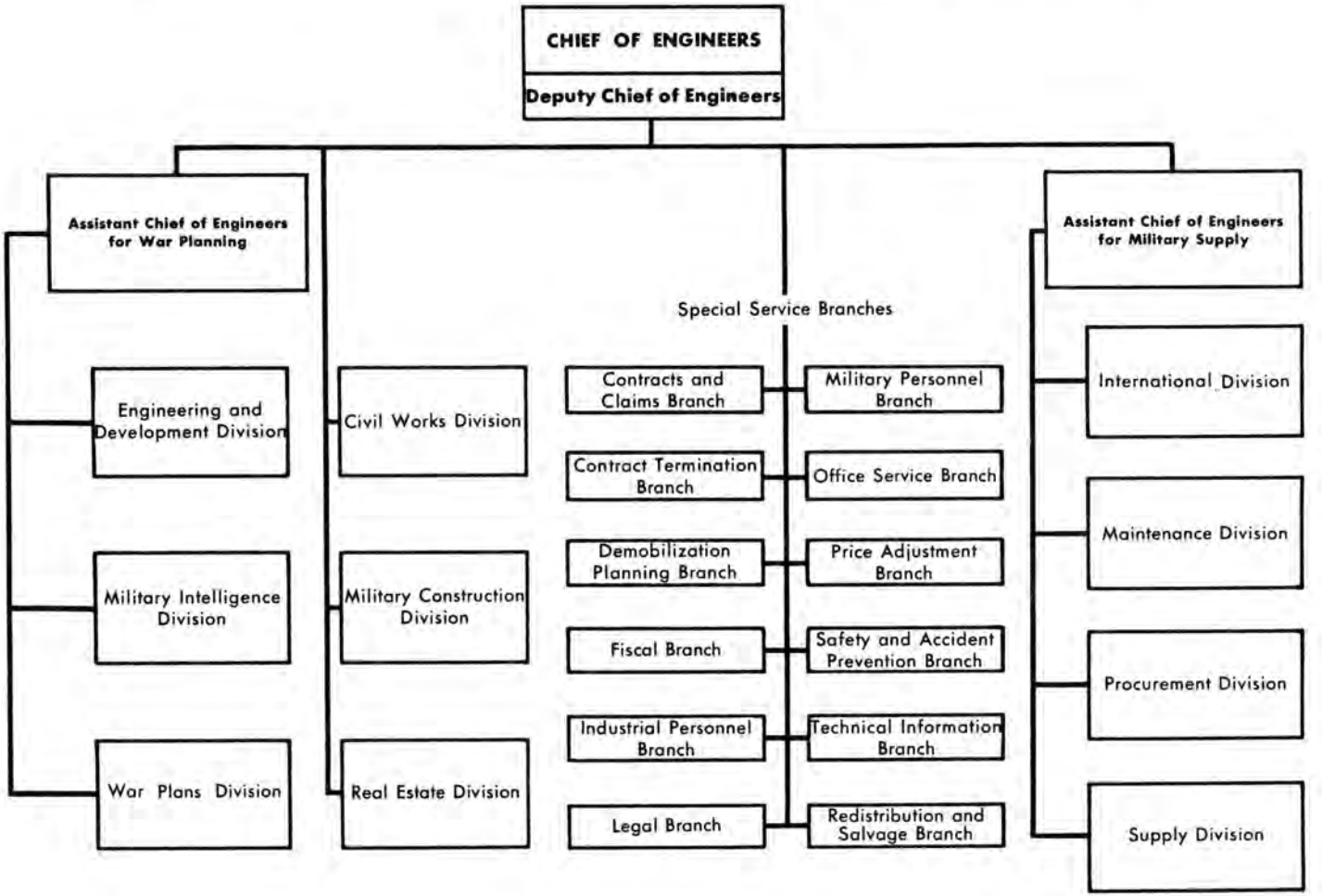
CHART 5—TOTAL NUMBER OF ENGINEER TROOPS, CONTINENTAL UNITED STATES AND OVERSEAS: 1942–45



Source: Statistical and Accounting Br, Adm Sv Div, TAGO.

Control Branch for administrative management which reported to the Executive Officer, OCE. The rest of the organization reported to a newly created Deputy Chief of Engineers in the person of General Robins who had been Assistant Chief of Engineers for Construction. The Offices of the Assistant Chiefs of Engineers for Construction and for Administration were abolished and all divisions and branches formerly under them were placed under Robins. Supervision of the remaining functions was divided between two assistant chiefs of Engineers. Fowler continued as Assistant Chief of Engineers for Supply, in charge of the Procurement, Supply, Maintenance, and International Divisions, until July 1944 when he was replaced by Brig. Gen. Rudolph C. Kuldell. Sturdevant's title changed from Assistant Chief of Engineers for Troops to Assistant Chief of Engineers for War Planning, symbolizing the shift of focus to the theaters of war. The War Plans (formerly Operations and Training Branch), Military Intelligence, and Engineering and Development Divisions were

CHART 6—ORGANIZATION OF THE OFFICE OF THE CHIEF OF ENGINEERS: DECEMBER 1943



grouped under the Assistant Chief of Engineers for War Planning. In May 1944, Brig. Gen. Ludson D. Worsham succeeded Sturdevant in this position.[2]

On 12 March 1943 the command under which the Corps of Engineers had been administratively placed, the Services of Supply, became the Army Service Forces (ASF). Somervell had become aware during the previous year that there was indeed something in a name. "Services of Supply" was not descriptive of many of the organizations contained therein, he wrote the Chief of Staff. It had, moreover, "an unhappy association with the last war." The title "Army Service Forces" would, he felt, "not only . . . be more descriptive of the work assigned to us, but . . . would remove the stigma which has had an actual retarding effect in attaining the high state of morale which we must have if we are to accomplish our job properly." [3] Under the ASF the supply services became technical services. Although this title was more palatable to the Corps of Engineers, the dropping of the word "supply" did not gainsay the fact that ASF saw its main job as the procurement and distribution of matériel. It was in this area that ASF could and did make its greatest contribution. With the wartime demand for goods placing an ever-increasing strain upon the nation's productive capacity, the ASF as a fighter for the Army's share and as an allocator of that share within the Army could not but demand the respect even of those who would have wished to curb its power.[4]

For the Engineers, however, procurement and distribution of supplies were subordinate to their primary logistical task, which was construction. The Corps felt little need for guidance from ASF in the organization and training of troops to perform construction duties which had been part and parcel of the Engineer mission for many years. Insofar as the Engineers felt that ASF was inclined to slight this function, or worse still, to move in upon it in ignorance, the Corps was restive. In the late summer and the fall of 1943, moreover, the Engineers, and indeed all of the technical services with the possible exception of the newcomer, the Transportation Corps, had cause for extreme resentment against ASF.

From the outset Somervell had looked upon the organizational structure of ASF with disapproval. By the summer of 1943, thinking the time ripe for a change, Somervell and his advisers in his Control Division began to express alarm at overlapping functions and the resulting waste of manpower which inevitably accompanied them. For example, the Corps of Engineers was only one of seven technical services having procurement offices in Washington and in the field. Supervising them was Headquarters, ASF, and ASF's field agencies, the service commands. This same type of overlapping was present to some degree in the performance of all the functions for which ASF was responsible. It could be eliminated, Somervell argued, by replacing the specialized, commodity type of organization represented

[2] (1) Ann Rpt OCE, 1944, 1945. (2) Orgn Chart, 1 Dec 43. (3) OCE Memo 395, 24 Nov 43. (4) OCE GO No. 23, 22 Nov 43. All in EHD files.

[3] Memo, Somervell for CofS, 9 Mar 43. AG 300.4, SOS (3–9–43).

[4] The following are essential for an appraisal of ASF: (1) Millett, *Organization and Role of ASF;* (2) Smith, The Army and Economic Mobilization; (3) *Industrial Mobilization for War,* Vol. I; (4) War Records Section, Bureau of the Budget, *The United States at War: Development and Administration of the War Program by the Federal Government* (Washington, n.d.); (5) Donald M. Nelson, *Arsenal of Democracy: The Story of American War Production* (New York: Harcourt, Brace and Company, 1946).



BRIG. GEN. CLARENCE L. STURDEVANT, *Assistant Chief of Engineers, Troop Division (War Planning), January 1942 until May 1944.*

by the technical services with a functional organization. In plain words the technical services were to be abolished.[5]

If the plan were carried out the Corps of Engineers would no longer be responsible for military construction; this job would be supervised by a director of utilities. Similarly, a director of personnel would take over the supervision of organization and training; a director of procurement, the purchase of engineer equipment; and a director of supply, its distribution. The Chief of Engineers was to be given, it was subsequently understood, a responsible position in the headquarters organization. The personnel of OCE and its field officers, insofar as they were needed, would be scattered throughout Headquarters, ASF, and its service commands. This goal was to be achieved in four steps beginning in October 1943 and ending in the spring of 1944.

Aware of the tremendous opposition that would develop if the ultimate aims of the reorganization were known to those who would be most affected, ASF planners confined their discussion of the plan to higher officials of the War Department. Marshall indicated his approval, but Secretary of War Stimson sought the views of Under Secretary of War Patterson, who displayed little liking for most of the changes. Unexpectedly, in late September 1943 the outlines of the proposal—somewhat embellished by avowed enemies of the New Deal—broke into the newspapers. In a story published on 25 September, it was stated that five ranking "conservative" officers, Reybold among them, were "slated to go." [6] In Somervell's absence, Maj. Gen. Wilhelm D. Styer, his chief of staff, worked hard to overcome the hostility that Stimson and Patterson now unmistakably showed. Stimson and Patterson pointed to the fact, which no one in ASF attempted to deny, that the present organization had proved workable. While acknowledging that the proposed organization might be more efficient in theory, they feared its practical result would be the creation of bad feeling and loss of morale.

Upon learning that Stimson wished to talk over with those concerned the consolidation of training which was included as part of the first step in the reorganization, Styer called Reybold in for a conference. The Chief of Engineers was opposed to the loss of training functions, Styer reported to

[5] The discussion of the proposed reorganization of ASF is based upon Millett, *op. cit.*, Ch. XXIV, and Stimson and Bundy, *On Active Service in Peace and War*, pp. 450–52.

[6] Millett, *op. cit.*, p. 409.

Somervell afterward, but was not expected to "indicate any strong opposition." [7]

The Engineers, meanwhile, had without fanfare made some organizational changes of their own as a reaction, it was later claimed, to the rumor that ASF intended to absorb the procurement organization. If the rivers and harbors divisions and districts were tied more closely to the procurement districts, it was suggested, ASF might be blocked. After all, the Commanding General, ASF, had nothing to say about civil works; for such matters the Chief of Engineers reported directly to the Secretary of War. On 1 September 1943 the Engineers brought all their civil works divisions and districts into their procurement organization. Whether this step, whatever its motivation, would have proved helpful in blocking the ASF reorganization was never put to the test. Secretary of War Stimson killed the scheme early in October.[8]

By 1944 passions had subsided. Perhaps indicative of the general feeling toward ASF at that time was Worsham's statement in May, shortly after he became Assistant Chief of Engineers for War Planning: "While in your own mind," he told his staff, "you may not approve of the organization of the Army, ASF does the best it can and they are the people with whom we have to work. Criticism gets back to them and consequently makes the situation even more difficult. The thing to do is to accept the facts and get the work accomplished even though there may be some obstacles that exist because of the magnitude of the organization of which we are a part." [9]

In the organization and training of troops it was not simply the magnitude of the ASF organization that created obstacles. It was more explicitly the fact that engineer troops, like those of the six other technical services, were entering Army Ground Forces and Army Air Forces as well as Army Service Forces. Questions as to which of the three commands would control various types of units arose frequently. On the face of it the assignment of responsibility might appear simple: combat units to AGF; service units to ASF and AAF. The trouble was that service units were destined to be employed both in the combat and in the communications zones and AGF operated on the maxim that troops should be trained and become accustomed to working with units with which they would be associated overseas.

The reorganization of March 1942 had little immediate effect upon the responsibilities of the Chief of Engineers for the formulation of doctrine and the organization and equipping of troops. Except in the case of aviation units the Chief of Engineers retained his primary position in these matters, albeit under the direction of ASF. As before, he was expected to co-ordinate plans and recommendations with other services in case of overlapping interests. The complication arose originally between AGF and ASF in the training of units. Organizations such as maintenance companies, depot companies, and general service regiments, which functioned both in direct support of ground combat troops and in the communications zone, were subjected to dual control. Some were assigned to AGF for training, others to ASF.

The situation was further confused when it came to the troop basis. On 28 August 1942, the War Department directed AGF

[7] *Ibid.*, quoted p. 412.

[8] OCE Mgt Br Rpt, 7 Oct 47, sub: Orgn for Engr Proc. EHD files. For further details on the changes in the Engineer procurement organization, see below, pp. 507–10, 521–22, 553–54.

[9] Wkly War Plan Conf, 22 May 44. War Plans Div file (S).

CONTROL OF ENGINEER UNITS, JANUARY 1943

Army Ground Forces	*Army Service Forces*
Special (amphibian) brigades [a]	General and special service regiments [b]
Combat regiments and battalions [b]	Separate battalions
Armored battalions [c]	Dump truck companies
Heavy ponton battalions	Forestry companies
Light ponton companies	Petroleum distribution companies [b]
Camouflage battalions and companies	Port construction and repair groups [b]
Topographic battalions (Army) and topographic companies	Topographic battalions (GHQ)
Water supply battalions	Equipment companies
Depot companies	Base shop battalions
Maintenance companies	Heavy shop companies

[a] ASF was responsible for training and controlled T/O's except for the period January–March 1943.
[b] Combat regiments, special service regiments, petroleum distribution companies, and port construction and repair groups are missing from the list of units contained in the 5 January 1943 document but are included here for the purpose of clarity.
[c] Also listed as AGF's responsibility were: motorized battalions, airborne battalions, and mountain battalions.

to determine the number and types of service units required for direct support of ground combat units. The determination of units needed for service of supply functions was left to ASF. During the fall of 1942 the possibility of doing away with dual control was discussed and a compromise reached. Responsibility for service units (except those peculiar to AAF) was divided between AGF and ASF on the basis of so-called primary interest. For the most part this meant that units needed for direct support of combat troops would be under AGF's control.[10]

The decision left some questions unanswered. Units of the technical services were not easily classified. In December 1942 the War Department laid down, for statistical purposes, broad definitions of combat and service troops. Engineer combat battalions, along with ponton and treadway bridge units, were classified as combat troops at that time. By the end of 1944, however, only divisional engineer units remained in the category of combat troops. Nondivisional combat battalions, ponton and treadway bridge units, amphibian brigades, engineer aviation regiments and battalions, and light equipment companies were designated combat support units. In 1944 the War Department also distinguished between two types of service units: combat service support units which would usually be employed in the combat zone, and service sup-

[10] (1) Memo, Maj W. W. Brotherton, O&T Br, to C of O&T Br, 14 Mar 42, sub: Conf with Gen Huebner, C of Tng Div SOS. 353, Pt. 18. (2) AG Ltr, 320.2 (3–13–42) to CGs AGF, AAF, and SOS, 31 Mar 42, sub: Policies Governing T/Os and T/BAs. EAC file, 320.2, Gen. (3) Memo, ACofS G–3 (WDGCT 353, 5–30–42) for CGs AGF, AAF, and SOS, 30 Mar 42, sub: Responsibility for Tng. 353, Pt. 18. (4) AG Ltr, 320.2 (8–27–42) MS–C–M to CGs AGF, AAF, and SOS, 28 Aug 42, sub: Trp Basis 1943. 320.2, Pt. 2 (S). (5) Leighton and Coakley, Global Logistics, MS, Ch. X, pp. 53–61. OCMH. (6) Greenfield, Palmer, and Wiley, *op. cit.*, p. 288. (7) Memo, ACofS G–3 (WDGCT 320.2, Gen, 11–17–42) for CG SOS, 5 Jan 43, sub: Sv Units. EAC file, 320.2, Gen. (8) Maj William Frierson, Activation Responsibilities (typescript). OCMH.

port units which would usually be employed in the communications zone.[11] It was substantially this 1944 line between the combat service support category and the service support category that the War Department tried to draw between AGF and ASF types of units in January 1943, when control of the organization as well as the training of engineer units was specifically divided as in table opposite.[12]

Changes in AGF Units

The redivision of responsibility for service units that occurred at the beginning of 1943 was a prelude to further reorganization of the Army's tactical units. The generosity in the allocation of manpower and equipment which characterized the 1942 T/O's lasted only a few months. The War Department soon discovered it did not have the inexhaustible supply of manpower and materials it had originally expected and was compelled to alter its strategy and redistribute its strength. Early in October the shortage of rubber and of cargo ships forced a review of all T/O's with the purpose of cutting the number of vehicles 20 percent and the number of men 15 percent.[13] At the end of that month the War Department warned that the great bottleneck in shipping "may dictate a considerable change in our strategic concept with a consequent change in the basic structure of our Army. Since . . . it appears that early employment of a mass Army, which must be transported by water, is not practicable, it follows that the trend must be toward light, easily transportable units." After the hope for a cross-Channel invasion during 1942 had faded, the War Department began to concentrate upon developing air power with the full knowledge that this step would "reduce the number of men available for the ground forces" as well as "complicate, if not curtail, the procurement of heavy equipment for other than the Air Forces." [14] In November the War Department cut from 140 to 100 the number of divisions that were to be ready by the end of 1943, and in February 1943 reduced the number still further to 90.

The 1943 reorganization of ground combat and service units was guided by all these considerations and by still others—not the least of which was the need to build a flexible Army that could fight a war under such diverse conditions as existed in Europe, the Mediterranean, the Southwest Pacific, and in India and other Far Eastern countries. Another factor of great consequence was the presence of Lt. Gen. Lesley J. McNair as commanding general of AGF. McNair upheld with great determination the principles for which he had fought during the reorganization of the thirties and specifically the belief that the most effective use of manpower lay in a concentration of maximum strength in fighting units, not service units. As a specialist on organization, McNair took a personal interest in almost every AGF unit which came up for review. This was not true of the other two commands. The AAF, which got preferential treatment in recruitment and matériel, did not face as much pressure to make economies in organization.

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[11] (1) Greenfield, Palmer, and Wiley, *op. cit.*, pp. 167–68. (2) WD Cir 356, 2 Sep 44. (3) WD Trp Basis, 1 Oct 44.

[12] Incl, with Memo, ACofS G–3 (WDGCT 320.2, Gen, 11–17–42) for CG SOS, 5 Jan 43, sub: Sv Units. EAC file, 320.2, Gen.

[13] Unless otherwise noted, this section is based upon Greenfield, Palmer, and Wiley, *op. cit.*, pp. 212–20, 271–76, 286–87, 298, 319–35, 352–57, 372–75, and corresp in 322, Pt. 1.

[14] Both passages quoted in Greenfield, Palmer, and Wiley, *op. cit.*, p. 289.

In ASF headquarters the organization of troops was of less interest than the execution of supply functions. Moreover AGF was better able to concentrate upon organization and training. AGF had no other tasks and a unity of approach was possible because the organization of AGF units could be tied to the functions and capabilities of the infantry division.

So far as AGF was concerned, the 1943 reorganization, like previous ones, began with the infantry division itself. The engineer combat battalion, sharing in the general cut, was pared from 745 to 647 officers and men—a reduction from 4.66 to 4.5 percent of the division's strength. Trucks, antitank weapons, infantry support rafts, and the motorized shop, all of which had been added in 1942, were now removed. For the duration of the war the strength and structure of the combat battalion remained much the same as fixed by the 1943 tables.[15]

When the armored division came under McNair's critical eye, it suffered a more drastic overhauling. The successful employment of antitank guns and mines against American armor in North Africa caused the Army to press for more infantry support in armored units. The 1943 T/O for the armored division cut tank personnel by 55 percent and increased infantry troops by about 20 percent. This step, taken in conjunction with the policy of economies in manpower, made radical cuts in other elements of the division inevitable. McNair personally insisted that the engineer battalion be cut more than 40 percent, to about the size of the combat battalion of the infantry division. It was inconsistent, he pointed out, to argue on the one hand that tracked vehicles could move easily cross-country and on the other to demand a large complement of engineers to repair roads. Armored engineers had never fallen back on road repair to defend their presence in the armored division. But the proponents of armor had indeed stressed the mobility of tanks to such an extent that they laid the Engineers open to McNair's thrust. The wishes of everyone were fulfilled when the treadway bridge company was made a nondivisional unit. Thus detached, treadway bridge companies served all elements of the Army, since overseas commanders employed the treadway almost to the exclusion of all other ponton bridges. Under the table approved in September 1943 the engineer armored battalion—once again consisting of three lettered companies—numbered 693 officers and men. This represented a cut from 8 to 6.3 percent of the division's strength.[16]

The number of divisional engineers had been reduced but their situation was far different from what it was in the thirties when McNair had wanted to limit them to a company. In July 1943 he wrote:

> There is no lack of appreciation of the number of engineering functions or of the considerable overall strength of engineers needed. However, a division of whatever type is supposedly a mobile unit and [the] nature and extent of engineer operations under such conditions necessarily must be

[15] (1) T/Os 5-15, 5-16, 5-17, 1 Mar 43. (2) M/S, CG AGF to Rqmts AGF, 7 Dec 42. This document and succeeding M/Ss in AGF file, 320.3, Engrs T/Os, Pt. 1, cover the reorganization of the combat battalion. (3) Memo, Hq AGF for ACofS G-3, 21 Feb 43, sub: T/O and T/E Engr Combat Bn Inf Div. AG file 320.3 (10-30-41), Sec. 5, Bulky.

[16] (1) M/S, Engr AGF to G-3 (Mob) AGF, 16 Apr 43, sub: Treadway Bridge Co. AGF file 320.3, Engrs T/Os, Pt. 1. (2) Memo, Hq AGF for CofS WDGS, 26 Feb 43, sub: T/O&E for Engr Treadway Bridge Co. AGF file 321, Engrs, Pt. 5. (3) Trp Basis, 1 Apr 45. (4) T/O&Es 5-216, 5-217, 15 Sep 43.

limited. If and when operations do not move so rapidly, it is readily possible to introduce engineers from the corps and army, reinforcing or relieving the division engineers of functions which are beyond their capabilities.[17]

During the thirties there had been some discussion of establishing pools of troop units which could be drawn upon to augment divisional forces as needed for specific operations. To achieve this end the Army had relied for planning purposes on the concept of type corps and type armies which served as a means of determining how many nondivisional units would usually be required to support a given number of divisions. Prescribed T/O's permitted the determination of troop requirements when the enemy and theater of operations were unknown. But even though used only for planning, type corps and type armies set up a rigid system comparable to that which would have existed had all equipment been assigned organically to units and none held in reserve for issue on demand. During the summer of 1942 McNair sought to eliminate this rigid system and to establish a more flexible means of providing the requisite supporting elements.

In his attempt to eliminate type corps and type armies, McNair had the Engineers' wholehearted support. In August 1942 the Corps presented a plan, concurred in by Col. John B. Hughes, the Ground Engineer, to remove all assigned engineer units from type armies and type corps. "The use of task forces of various strengths in all types of terrain demands a flexible organization that cannot be provided by the present Type Army Corps and Type Army," commented the executive officer of O&T. All engineer units in support of the division were to be placed in GHQ reserve. Combat regiments, to be made up of three battalions instead of two, were to be used for combat support. The separate battalion was to be eliminated and the general service regiment was to become solely a service unit, leaving one type of general unit, the combat regiment, in AGF, and one type, the general service regiment, in ASF. Finally the Engineers recommended the creation of a light equipment company to transport and operate the construction machinery that would be eliminated when combat regiments replaced general service regiments and separate battalions.[18]

To provide the desired pool of supporting elements once the type corps and type army were eliminated, AGF proposed the creation of a group headquarters organization to which a variety of units might be temporarily attached. Early in September 1942, Reybold agreed to go along with AGF's desire to organize corps and army combat engineers on the basis of groups rather than regiments provided there were sufficient group headquarters commanded by colonels so that from two to six combat battalions could be assigned to them.[19]

It was substantially on this basis that combat engineer troops in corps and armies were reorganized. On 19 January 1943 the War Department directed that the battalion-group system replace the regiment. As AGF conceived of the group about this time, it could be a combination of three combat battalions, an equipment company, and a maintenance company, or some combination of combat, ponton, and other units. The general service regiment and the separate

[17] Quoted in Greenfield, Palmer, and Wiley, *op. cit.*, p. 377.

[18] Memo, ExO O&T for ACofS for Opns SOS, 25 Aug 42, sub: Rev of Type Army Corps and Army Trps. 322, Gen (S).

[19] Rpt of Activities of Mil Pers Br for Wk Ending 11 Sep 42. 020, Engrs Office C of.

battalion were eliminated from the combat echelon. This meant that construction in the combat zone would be performed by combat battalions and that there would be a greater depth in combat engineers. When operations slowed down, heavier reinforcements could be brought forward.

With the over-all framework for handling corps and army troops established, AGF turned its attention to removing what it considered fat from the special engineer units under its control. First to go was the light equipment platoon from the heavy ponton battalion. The AGF Reduction Board commented: "The light equipment was included in the battalion probably because a certain amount of overhead already existed to care for it, but the net result was to increase the service personnel of the unit and to bog it down with considerable transportation used to carry equipment that could be kept in depots when not in use. The battalion should not be a roving depot, but a tactical unit able to construct a heavy bridge." [20] Under the T/O issued in July the strength of the heavy ponton battalion was reduced from 501 to 369 enlisted men. Despite the fact that another raft section was added to the light ponton company to compensate for rafts removed from the infantry division, the new T/O effected a 5.5 percent cut in personnel without essential change of function. During the rest of the war ponton units operated with comparatively little change in organization.[21]

In the water supply battalion AGF found still another unit to trim. McNair questioned especially the necessity for the special tank truck. "Why cannot the water be delivered in five-gallon cans, since it must be transferred to such cans sooner or later? . . . Why cannot this unit be made semimobile—that is the headquarters company be provided with a transportation section or platoon which would move the water supply companies as required? . . . If delivery were by trucks and cans, these same vehicles could be used to move the units when necessary." [22] His deputy chief of staff, Col. James G. Christiansen, labeling the battalion a "fancy" unit, recommended that it be changed to a company with facilities for water purification and storage only. Water would be delivered in cans by trucks provided by the army commander. Over the protests of Hughes and of OCE, Christiansen's recommendations were carried out in August 1943.[23]

The Engineers admitted there was no need for the water supply battalion in theaters amply supplied with water but insisted that in areas where water was scarce and in semipermanent camps a definite need for bulk transportation existed. As proof of their contention they cited the usefulness of the battalion in North Africa and Italy as attested to by high-ranking officers. But repeated efforts to restore transportation to the water supply company met with little encouragement until the 405th Water Supply Battalion, which had served in both of these theaters, submitted a report in the summer of 1944 that impressed McNair. Six months later the distribution platoon,

[20] (1) M/S, Reduction Bd AGF to CG AGF, 14 Jan 43, sub: T/Os 5–275, 5–276, 5–277, 5–87. AGF file 321, Engrs, Pt. 4.

[21] (1) T/O 5–275, 9 Jul 43. (2) Memo, Hq AGF for ACofS G–3, 15 Apr 43, sub: T/O and T/E 5–87, Engr Light Ponton Co. AGF file 321, Engrs, Pt. 4.

[22] M/S, CG AGF to Rqmts AGF, 29 Jan 43, sub: Engr T/Os. AGF file 320.3, Engrs T/Os, Pt. 1.

[23] (1) M/S, DCofS AGF to CG AGF, 20 Jan 43, sub: Engr T/Os. AGF file 320.3, Engrs T/Os, Pt. 1. (2) T/O 5–67, 4 Aug 43. (3) Wkly War Plan Conf, 26 Jun 44.

equipped with tank trucks, was restored, but the unit remained a company.[24]

Supply and Maintenance Units

The consequences of the division of engineer units between AGF and ASF are nowhere more strikingly illustrated than in the organization of supply and maintenance units. The park battalion, which had been provisionally organized in the prewar period to test the possibility of co-ordinating engineer supply and maintenance functions, never materialized. In its stead the Engineer Board had proposed an engineer maintenance and supply regiment, but Fowler had joined Sturdevant in disapproving such a large unit and had advocated instead a headquarters and service company to handle supply and administration for small units. Fowler's idea seems to have been the genesis of the engineer depot group headquarters and headquarters company, the T/O for which was formally submitted to ASF on 16 November 1942 and approved the following June for a complement of 11 officers and 62 enlisted men. The Engineers expected to use this unit near a port of embarkation or at a fixed base. As with the park battalion, they contemplated attaching depot, shop, equipment, and various other units to the new organization.[25]

The study of the maintenance and supply regiment led in still another direction. In the 1941 maneuvers it became evident that the Engineers would require a separate organization to take care of spare parts. The Engineer Board stressed this fact in its report on the maintenance and supply regiment, and during the summer of 1942 OCE had taken up the proposition. Under Smith's direction a depot company was experimentally organized into a parts supply company at the Columbus depot. On the basis of this experience the Engineers in November 1942 perfected a T/O for a parts supply company of 7 officers and 191 enlisted men which would function as part of a depot group. This ASF unit was designed to handle a stock of 100,000 to 300,000 spare parts in first, second, third, and fourth echelon maintenance sets on all of which accurate records would have to be kept.[26]

When the T/O of the parts supply company was referred to AGF for comment, Hughes expressed the view that "the parts supply company is an essential part of equipment maintenance. . . . Unlike many new tables, this has been built up by trial, and is believed to be about right for the purpose intended. There might be four or five such organizations in the world." [27] The official AGF view was entirely different.

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[24] (1) Conf cited n. 23 (3). (2) Memo, Equip Br for C of O&T Br, 19 Sep 43, sub: Water Sup Bn. Mob Br file, Water Sup Bn. (3) Cable, Gen Devers to WD, 18 Feb 44. Same file. (4) T/O 5–67, 3 Jan 45.

[25] (1) Ann Rpt Engr Bd, 1942. (2) Engr Bd Rpt 677, 25 Jun 42, sub: Orgn of Engr Maint and Sup Regt. (3) Informal Ind, ACofEngrs for CofEngrs, 3 Aug 42, on Ltr, ExO Engr Bd to CofEngrs, 26 Jun 42, sub: Rpt on Proposed Engr Maint and Sup Regt. 400.34, SP 335, Pt. 1. (4) Memo, C of Sup Div for C of Trps Div, 8 Aug 42. 320.2, Engr Park Bn. (5) Ltr, C of O&T Br to Plans Div SOS, 16 Nov 42, sub: T/O and T/E for Hq and Hq Co Engr Depot Group and Engr Parts Sup Co. Mob Br file, Engr Depot Group, Orgn of. (6) T/O 5–592, 30 Jun 43. (7) Change 1, 31 Mar 44 to FM 5–5, 11 Oct 43, pp. 26–29. (8) Ltr, C of O&T Br to CG USAF ETO, 8 Apr 43, sub: Engr Depot Group. 320.2 (C).

[26] (1) Ltr, CO 463d Engr Co (Depot) to Smith, 22 Oct 42, sub: T/O and T/BA for Spare Parts Sup Co. 320.2, Engrs Corps of, Pt. 16. (2) Ltr, C of O&T Br to Plans Div SOS, 16 Nov 42, sub: T/O and T/E for Hq and Hq Co Engr Depot Group and Engr Parts Sup Co. Mob Br file, Engr Depot Group, Orgn of.

[27] M/S, AGF Engr to Rqmts AGF, 5 Dec 42, sub: T/O 5—Engr Parts Sup Co. AGF file 320.3, Engrs T/Os, Pt. 1. Unless otherwise noted the remainder of this section is based upon correspondence in this file.

Christiansen, though an Engineer himself, indulged in an acid comment which revealed the limitations of the single-minded AGF approach of concentrating upon combat units.

> In our present stage in which we are cutting down organizations, no reason is seen for approving such a unit. We would do this if we commented on the set-up without indicating that we can see no reason for the proposal.
>
> This is just another case of adding overhead to the SOS, however, it is probably none of our business to tell them that; that being a WD function. Therefore rather than comment on the small points of the proposed organization, it is believed better to file the paper.[28]

In time, AGF would recognize the need for men specially trained to handle spare parts. Meanwhile, in April 1943, the War Department approved a company of 6 officers and 176 enlisted men organized into warehouse, procurement, and headquarters platoons.[29]

Differences of opinion between Hughes and his colleagues in AGF headquarters also arose when it came to the organization of maintenance units under the control of AGF itself. In May 1943, after consulting the Engineer Board and the Maintenance Section, OCE, Hughes submitted a new T/O for the maintenance company which added personnel to distribute spare parts and trucks so that nearly all repairs could be made at the job site. Although the number of enlisted men was raised from 175 to 194, Hughes believed that an over-all saving of 15 percent could be made by having two instead of three maintenance companies for every nine divisions. McNair grumbled that he did "wish that the Corps of Engineers would have a conscience in the matter of vehicles," but he went along with the T/O "largely because I know too little about the matter." [30] McNair had been led to abandon his opposition to increases in supply units by the illusory prospect, as it turned out, of having fewer total engineer maintenance troops. At this point major opposition to the T/O developed from G–4 of AGF who objected to a supposed duplication of facilities by ordnance maintenance companies, to the concept of sending platoons off on independent operations, and to the fabrication of parts on the site of the construction job. Suggesting that the G–4 concentrate on other matters "rather than hammer at this poor little company," Hughes jumped to its defense:

> Last January, at his [G–4's] insistence, the general purpose shop truck was removed from the engineer battalion. In other words, the organic means of fabricating local materials for construction was taken away from the combat elements on the theory that it would be more efficiently massed in the maintenance organizations. Now it is insisted that the use of maintenance equipment to augment construction . . . is not permissible, as maintenance will suffer thereby. . . .
>
> There is a steadfast refusal to understand jobsite maintenance and the necessity to disperse engineers to work. . . . Combat troops employed massed and with rapid movement cover wide terrain through which we must keep communications open clear back into the army area, regardless of the space covered or the damage done. . . . All construction experience has indicated that the only economical way to repair heavy plant is to bring the shop and spare parts to the plant. . . . The only real existing difficulty with the company in the field is that it lacks the means of handling spare parts, . . . which the new table provides for. Our maintenance in the field is

[28] M/S, DCofS AGF to Rqmts AGF 18 Dec 42, sub: T/O 5—Engr Parts Sup Co. AGF file 320.3, Engrs T/Os, Pt. 1.

[29] T/O 5–247, 23 Apr 43.

[30] (1) M/S, CG AGF to Reduction Bd, 14 Jun 43, sub: T/O Engr Maint Co. AGF file 320.3, Engrs T/Os, Pt. 1. (2) M/S, CG AGF to Rqmts AGF, 5 Jul 43, same sub. Same file.

suffering badly from this deficiency and the blocking we receive from G–4, AGF in organizing both the Equipment and Maintenance Companies is having a detrimental and serious effect on engineer field operations.[31]

Hughes was right; the Engineers were sorely deficient in maintenance troops. In September, despite continued objections from its G–4, AGF began to process the T/O. In December 1943 it was approved.[32]

An interesting feature of the War Department's attempt to divide primary responsibility for service units between AGF and ASF was the complexity it added to the Army's structure. In place of one equipment company and one depot company the Army ended up with two of each. Hughes persuaded McNair that a new unit was necessary to supply divisional combat battalions with extra construction machinery. In January 1943 AGF began working on a T/O for the unit and six months later received authority to organize a light equipment company. For ASF the Engineers developed the base equipment company to supply operators for heavier and more specialized machinery withdrawn from depots. In the spring of 1943, shortly after AGF became responsible for depot companies, OCE submitted a T/O for a base depot company. As first set up the company could not be readily broken down into smaller units needed for assignment to the many depots in Britain, but in May 1944 changes were made which corrected this defect. In October 1943, meanwhile, the old depot company had been expanded to include a parts supply platoon. Thus after several unhappy months of trying to handle spare parts with men who had no knowledge of the work, AGF had tempered its former hostile attitude toward a special unit, although it still denied the need for an organization as large as a company.[33]

Changes in ASF Units

Perhaps the most significant difference between the AGF and ASF approach to the organization of troops was that there was no central core or body of doctrine to which ASF units could be tied. AGF had a theory of tactics based on the structure of the division, corps, and army. ASF units had a host of miscellaneous and sometimes unrelated jobs to perform. The main one for the Engineers was construction, but growing out of this general mission was a variety of other tasks which required specialized personnel and equipment in specialized organizations such as the petroleum distribution company, the port construction and repair group, forestry companies, base equipment companies, base depot companies, and heavy shop companies.

The many-sidedness of the ASF engineers' job can best be seen in the development of T/O 5–500. Before Pearl Harbor, maintenance of searchlights was the only engineer task which called for a small independent unit. Shortly after the outbreak of war a demand developed for sundry others. Requests for utilities personnel came in from the Caribbean, Iceland, and the Middle East where the Engineers were expected to take over the operation of utilities plants from civilians and from Quartermaster units. The first contingents were organized according

[31] M/S, AGF Engr to Rqmts AGF, 17 Aug 43, sub: T/E 5–157, Engr Maint Co. AGF file 320.3, Engrs T/Os, Pt. 1.

[32] T/O&E 5–157, 18 Dec 43. See below, pp. 570–71.

[33] (1) Ltr, Hughes to C of Mil Hist, 14 Jan 54. (2) T/O 5–367, 22 Jul 43. (3) T/O 5–377, 8 Aug 43. (4) Change 1, 31 Mar 44, to FM 5–5, 11 Oct 43, pp. 7–8, 19–23. (5) T/O 5–267, 20 Apr 43. (6) Personal Ltr, Col Howard V. Canan, Office of C Engr SOS ETO, to Gorlinski, 29 Jun 43. O&T Br file, Personal Ltrs to Gorlinski. (7) T/O 5–267, 30 May 44. (8) T/O 5–47, 29 Oct 43.

to the demands for each particular job, but in April 1943 the War Department published a T/O for utilities detachments for establishments varying in size from 1,000 to 4,000 men. Meanwhile, in June 1942 the Engineers were asked to form gas generating units to operate and maintain plants producing, oxygen, acetylene, and nitrogen. A month later OPD authorized the Engineers to activate fire fighting detachments. When the water supply battalion was converted to a company, its well drilling section was left to ASF.[34]

With this increasing diversity in tasks requiring small teams or detachments the War Department decided late in the spring of 1943 to organize "flexible 'cell type' T/O's . . . within which teams or units of skilled specialists can be provided—in varying strengths—to satisfy special requirements." [35] Col. Herbert B. Loper, wartime chief of OCE's Intelligence Branch, was eager to see the innovation applied to topographic units. "We have concluded here," he wrote the Chief Engineer of the Southwest Pacific Area in July 1943, "that the . . . battalions seldom meet actual theater requirements. Accordingly, we have devised a number of typical reinforcements on the cellular basis, and have submitted Tables for W.D. approval. Further, we have submitted our recommendation to the effect that the major part of the topo troop augmentation to correspond with the new troop basis shall be made up of these independent reinforcing units, rather than of complete battalions." [36]

T/O 5–500, published in July 1943, carried columns labeled platoon headquarters, battalion headquarters, mess team, supply team, map depot detachment, utilities detachment, fire fighting section, well drilling section, mobile searchlight maintenance section, dump truck section, and others. In a few cases there were several different teams of the same type. If a theater had requirements which standard engineer organizations could not fill because they were either too large or too small or because they lacked the specialists and equipment, the theater commander could use these cellular units to form platoons, companies, or battalions, using whatever combinations he deemed necessary either to supplement a standard organization or to form a service unit for a base installation. The cellular idea caught on quickly. The 26 July 1944 revision of T/O 5–500 was divided into eight categories—administrative, supply, water supply and transportation, maintenance and special equipment, utilities, fire fighting, topographic, and marine. The published document was seventy-eight pages long and—most remarkable of all—contained an index.[37]

Akin to the cellular idea was the group concept which AGF had applied to the en-

[34] (1) Memo, C of O&T Br for Opn Div SOS, 24 Apr 42, sub: Searchlight Maint Dets. 320.2, Engrs Corps of, Pt. 15. (2) Memo, O&T Br for Constr Div, 14 Apr 42, sub: Utilities and Maint Dets, Island Bases. Same file. (3) T/O 5–283, 23 Apr 43. (4) 1st Ind, ExO Opns Div SOS to CofEngrs, 27 Jun 42, on Ltr, Dev Br to CG SOS, 17 Jun 42, sub: Opn of Gas Generating Equip. Mech Equip Br file, Gases. (5) Ltr, AC of O&T Br to CG SOS, 8 Aug 42, sub: Activation of Engr Fire Fighting Dets. 320.2, Engrs Corps of (S). (6) Memo for Record, with Memo, Hq AGF for CG ASF, 7 Aug 43, sub: Separate Well Drilling Cos. AGF file 320.3, Engr T/Os, Pt. 1.

[35] Memo for Record, on D/F, Exec G–1 WDGS to G–4 WDGS, 8 Jul 43, sub: T/O for Engr Constr Regts. ASF Mob Div file, T/O&E 5, Engr Constr Group (S).

[36] (1) Personal Ltr, C of Intel Br to Brig Gen Hugh J. Casey, Hq SWPA, 4 Jul 43. 061.01 (C). (2) See below, pp. 454–55.

[37] (1) T/O 5–500, 31 Jul 43. (2) Change 1, 31 Mar 44, to FM 5–5, 11 Oct 43, p. 37. (3) T/O&E 5–500, 26 Jul 44.

gineers in the combat zone. The War Department tried to apply this principle to ASF engineers as well. As outlined above, the Engineers had themselves proposed a depot group headquarters to which various companies might be attached, but most of the demand for group organization came from higher echelons and was resisted by the Engineers. The War Department insisted on its use in the case of port reconstruction and repair.[38]

Still more irritating to the Engineers was the attempt to organize general construction units on a group basis. It will be recalled that the War Department had agreed to begin conversion of separate battalions to general service regiments in January 1943 and that the general service regiment became solely an Army Service Forces unit.[39] Shortly thereafter, on the 12th of that month, the War Department directed ASF to review all T/O's with the group concept in mind and suggested that general service regiments might be reorganized as battalions. A week later the War Department directed ASF not to convert separate battalions to general service regiments but to consider retaining them as labor units or organizing them as general service battalions. Sturdevant objected to the retention of labor units in the face of demands from the theaters for highly skilled troops equipped with construction machinery and argued that the Quartermaster Corps and the Transportation Corps were the proper sources of laborers at depots and ports. He further questioned whether the substitution of the group organization for the general service regiment would save manpower or be as efficient as was claimed. ASF supported the Engineers in opposition to labor units but directed more study of the battalion-group organization.[40]

In March OCE submitted T/O's for both a battalion-group setup and a general service regiment with 145 fewer men. Over Sturdevant's continuing objections ASF decided that the service group would supersede the general service regiment. On 1 May Sturdevant asked for a reconsideration and launched an all-out assault on the battalion-group idea. Let ASF cite an example to prove the battalion-group adopted by AGF was superior to the regimental organization, he challenged. Granted it might be suitable for the control of small units such as equipment, maintenance, and depot companies, where was the desired saving in overhead? He pointed out that the group commander seemed to duplicate the functions of the corps commander who had to rely on the group for all his information. ASF was fooling itself: "The gain in flexibility resulting from the formation of Corps Combat Battalions is believed more theoretical than real since, if additional battalions are to be attached to divisions, they could be detached from a regiment as well as a Group." If attachment was normal then the divisional engineer element was too small. "On the whole the present Ground Force organization is considered cumbersome, wasteful and probably unworkable. It is anticipated that it will not be retained by Theaters involved in combat," Sturdevant went on. Grouping might conceivably work in the combat zone where there would be little

[38] For a discussion of the port construction and repair group, see below, Ch. XVII.

[39] See above, p. 140.

[40] Unless otherwise noted the remainder of this section is based upon correspondence in (1) 322, Engrs Corps of (S); (2) Mob Br file, Engr Gen Sv Regts (S); (3) Mob Br file, T/O&E, Engr Constr Group (S); (4) Mob Br file, Engr Constr Bn (C); and (5) ASF Mob Div file, T/O&E 5, Engr Constr Group (S).

construction anyway. But the group-battalion system had no place in the communications zone where large-scale construction projects were the rule and changes in location infrequent.[41]

A few days after receiving Sturdevant's communication ASF changed its mind. After all, a reduction of 145 men in the general service regiment would satisfy the demand for economy even better than the group-battalion. AGF did not give in so easily. Although conceding that the regimental organization was generally acceptable for operations in the communications zone, AGF pointed out that some of these units might have to move into the combat zone. It would be better therefore to have the regiments broken up into independent battalions, paralleling the organization of the engineer combat battalions with which they would work. Both types of units would operate best under a flexible grouping. The large number of engineer units required by the modern army might lead to the organization of brigades to command engineer groups, AGF held, but it would be ridiculous to provide a brigade setup for two or three regiments. AGF's arguments failed to convince the General Staff. The general service regiment was retained.

To complicate the situation, early in 1943 the Engineers became alarmed over the Navy's aggressive policy of recruiting skilled men for numerous construction battalions, commonly known as Seabees. The Corps of Engineers was sufficiently practical to realize that the best way to prevent the Navy from encroaching upon engineer construction functions was to be prepared to do as much work as possible. Early in 1943 Reybold asked that a total of thirty additional construction units be activated that year and that he be authorized to recruit experienced construction men to fill them. ASF refused to authorize additional units at that time but in March the Joint Army and Navy Personnel Board permitted the Engineers to begin recruiting 9,000 construction workers a month. The Navy was allowed a similar quota.[42]

Still, the Engineers found themselves at a disadvantage because the Seabee units contained higher grades and ratings than those in Army engineer units. In an effort to establish themselves on an equal plane with the Navy the Engineers sought permission to organize a construction regiment containing higher ratings. This unit would replace the special service regiment and the white general service regiment. The Negro general service regiment was to be retained for reinforcing construction regiments on heavy routine jobs such as roads or airfields. The construction regiment was to be used on more complicated jobs.

With this seemingly mild proposal, the Engineers had in fact stirred up a hornet's nest. The Operations Division, General Staff, questioned the need for such a unit, much less the need for one with such attractive ratings. The general service regiments were doing a good job overseas. Under the new joint procedure for procurement of personnel the Army was receiving from four to five thousand skilled workers a month and the Engineers should have no trouble getting their share. Noting that nearly all engineer units contained some skilled construction

[41] Memo, ACofEngrs for CG ASF, 1 May 43, sub: T/Os for Engr Gen Sv Units. Mob Br file, Engr Gen Sv Regts (S).

[42] (1) Memo, OCE (unsigned) for CofEngrs, 15 Jan 43, sub: Navy Constr Bns. Mob Br file, Constr Regts (S). (2) Ltr, ACofEngrs (McCoach) to Div Engr Great Lakes Div, 15 Mar 43, sub: Voluntary Induction of Enl Specs. 341, Engrs Corps of, Pt. 1.

men, OPD balked at singling out one unit for higher ratings. The initial reaction to such a step would be a lowering of morale followed, in all probability, by efforts to transfer to the unit with higher ratings. The ultimate result would be an upward revision of all ratings.[43]

At the beginning of July representatives of OPD, G–1, G–3, and G–4 decided to defer approval of the construction regiment pending consideration of a flexible cell-type unit. G–3 passed this suggestion on to ASF in the form of a directive to include in T/O 5–500 "a section or sections of specialized construction personnel . . . capable of organization into small groupments or companies to work with General Service Regiments or other units which are primarily labor." [44]

The General Staff's solution found little favor with either ASF or the Corps of Engineers. Brig. Gen. Frank A. Heileman, Deputy Director of Operations, ASF, and formerly an Engineer officer, was convinced of the need for a unit composed of men experienced in construction. "It appears to me," he commented in July 1943, "that the plan of the Chief of Engineers to differentiate between a highly trained white regiment, whether it be called a special regiment or a construction regiment, and a lesser trained colored regiment which might be called a general service regiment, is a more efficient setup than the proposed cellular organization." Just because composite organizations had worked well for small units and installations was no reason to apply the principle universally.[45] OCE prepared a T/O for a construction specialist company in conformity with the desires of the General Staff, Reybold at the same time entering a vigorous dissent. The construction regiment desired by the Engineers, he wrote, was not a special purpose unit but a means of inducing better qualified personnel to enlist. The construction company slated for inclusion in T/O 5–500 added 205 officers and men to the basic strength of a regiment. There was no way to tell how many such companies would be needed. The patience of the Chief of Engineers was well-nigh exhausted:

> It is the view of this office that all regiments require the skills provided. A contrary view assumes that regiments not so reinforced are classified as "units which are primarily labor." . . . This misconception is apparently the basis of the current proposal and is not shared by . . . any . . . responsible commander engaged in active operations so far as known to this office. Although General Service Regiments have been used as stevedores and for similar labor jobs in emergency, they are not set up for such purposes. . . . Speed of construction requires the use of machinery almost to the exclusion of common labor equipped with hand tools. The demand from theaters is for more and heavier equipment and a larger proportion of skilled construction men for three shift operation by every regiment.

The Engineers held that men in a specialist company should be a permanent part of a construction unit in order to give the commander a better knowledge of their abilities, to insure teamwork, and to avoid the lowered morale that would result from discrepancies in ratings. The specialist company could not be a balanced organization since it was a special group.[46]

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[43] D/F, Trp Sec Logistics Group OPD WDGS to G–1, G–3, G–4, 30 Jun 43, sub: T/Os for Engr Constr Regt. ASF Mob Div file, T/O&E 5, Engr Constr Group (S).

[44] Memo, WDGCT 320.2 (20 Jul 43) ACofS G–3 for CG ASF, 20 Jul 43, sub: T/Os for Engr Constr Regt. ASF Mob Div file, T/O&E 5, Engr Constr Group (S).

[45] Memo, Heileman for Lutes, 23 Jul 43. ASF Mob Div file, T/O&E 5, Engr Constr Group (S).

[46] 1st Ind, CofEngrs to CG ASF, 14 Aug 43, on Memo, Dir of Opns ASF for CofEngrs, 28 Jul 43, sub: T/Os for Engr Constr Regts. ASF Mob Div file, T/O&E 5, Engr Constr Group (S).

Shortly after receipt of this communication, ASF decided to take matters into its own hands. Up to now, so it seemed to Maj. Maurice L. Hiller, head of the T/O Section of the Troop Units Branch, "the type, size, structural organization and need for highly specialized Engineer units has been 'buck passed' back and forth between the Chief of Engineers and the Secretary of War, with the Commanding General, Army Service Forces acting as intermediary." "The result," according to Hiller, "is that today we are saddled with an Engineer General Service Regiment that does not have sufficiently high grades to perform its functions; a table of organization for an Engineer Port Construction and Repair Group, and a proposed Engineer Construction Specialist Company . . . which we have been directed to prepare to replace the proposed Engineer Construction Regiment." These did not, to be sure, exhaust the list of construction units. Separate battalions under the control of ASF and engineer aviation battalions under the control of AAF brought the types of construction units to five. Hiller was convinced he had a solution—so convinced in fact that he, an Engineer officer, was "willing to stake both my professional and military reputation" on it, even though it ran counter to the opinion of the Chief of Engineers. Hiller proposed that the five construction units be replaced by an engineer construction group and a separate engineer construction battalion. The group would operate much like the offices of District Engineers in the United States. It would be made up of planners and supervisors, and, in case a definite need existed, of divers and ship salvage crews for port reconstruction. The construction battalion would be modeled on the Seabees.[47]

Perhaps the most ingenious aspect of Hiller's plan was to wrap up engineer aviation units in the same package with those construction troops that had given rise to the original discussion. That ASF should have control of construction units in the AAF had been maintained in ASF headquarters for some time. In the Southwest Pacific theater where construction projects threatened to outrun the total supply of engineer troops, it had been found necessary to pool all available manpower. In February 1943 MacArthur's headquarters denied the Fifth Air Force control of engineer aviation battalions. The theater SOS was made responsible for the disposition of all construction forces on projects in the communications zone. In combat areas, the task force commander had control until conditions became stabilized when control would pass to SOS. In the European Theater of Operations, the SOS had succeeded in the summer of 1942 in borrowing engineer aviation battalions for the construction of airfields in the United Kingdom. The agreement was that they be returned to AAF for a period of training prior to the invasion of the Continent and remain under AAF control thereafter. In North Africa, which was from the outset a "combat" theater, engineer aviation units remained under the control of AAF. Even here, however, the SOS displayed dissatisfaction with this arrangement. When General Styer visited the Mediterranean and European theaters in the summer of 1943 he looked into the matter and found the commanding generals of the SOS as well as the Chief Engineer, ETO, in agreement with him that general service regiments should replace aviation bat-

[47] Memo, Head T/O Sec Trp Units Br ASF for Col Dissinger, 18 Aug 43, sub: Engr Constr Units. ASF Mob Div file, T/O&E 5, Engr Constr Group (S).

talions. The ETO was also suffering from a shortage of construction workers. Only fifteen general service regiments—half the number asked for—were slated to arrive in the theater by the end of August 1943. In June the Chief Engineer, ETO, had asked for as many combat regiments and aviation battalions as he could get. Putting all construction troops into one organization would render the manpower more accessible.[48] "General Service Regiments can do everything that Aviation Engineers can do, and perhaps a great deal more," Styer wrote Somervell from abroad. "General Service Regiments can be attached to the Air Forces whenever necessary, but it is a mistake to make them part of the Air Forces." [49]

ASF's view that general service regiments under ASF control should replace aviation battalions was shared by OCE but encountered stiff opposition from the AAF which insisted that only Air Forces control would permit first priority to be given Air Forces tasks. But Hiller's plan in respect to aviation battalions appealed to ASF and this together with the rest of his proposal plus a recommendation to convert the base equipment company to a cellular type of unit went up to the General Staff in September.[50]

The road up through the channels for comment was easier than the road down. While everyone found some merit in the plan, everyone found some aspects of it extremely distasteful. Army Ground Forces applauded the basic idea of reorganizing construction units into a group-battalion system, but frowned upon the application of the cellular idea to construction units. The policy was to reduce the types of units; the cellular organization made for infinite variety. In any case, AGF thought it "desirable in considering subjects of this nature to have available the professional views of the responsible technical agency, in this case, the Chief of Engineers." [51] Army Air Forces echoed AGF views on cellular organization as well as on the failure to consult the Chief of Engineers, and called attention to the lack of supporting evidence from the theaters. Most of all, AAF was adamant about retaining engineer aviation units. Aviation engineers had been shaped for the particular needs of the Air Forces and the magnitude of airdrome construction justified the existence of special units under its control, the AAF maintained. This opposition from AAF and AGF led the General Staff to approve only the replacement of general service regiments, special service regiments, and separate battalions by

[48] (1) Office of the Chief Engineer, General Headquarters, Army Forces, Pacific, *Engineers of the Southwest Pacific 1941–1945, Vol. II, Organizations, Troops and Training* (Washington, 1953), pp. 95–96. (2) Administrative and Logistical History of the ETO, Pt. II, Organization and Command in the ETO, Vol. I, MS, Hist Div U.S. Forces ETO, March 1946, pp. 39–40, 126–27. OCMH. (3) 1st Lt. Lloyd F. Latendresse, CE, Comd Historian IX Engr Comd, *History of IX Engineer Command* (Wiesbaden, Germany, 1945), pp. 15–16. (4) Hq, AAF Engr Comd MTO (Prov), A History of Policies Affecting Aviation Engineers in the Mediterranean Campaigns (multilithed, 2d interim ed. [c. Jan 45]), pp. 2–3. Army Map Service files. (5) Memo, C Engr ETO for Col E. P. Lock, 26 Jun 43, sub: Availability of Engr Units for U. K. O&T Br file, Personal Ltrs to Gorlinski.

[49] Quoted in Memo, ACofS ASF for CofEngrs, 21 Jul 43. 322, Engrs Corps of (S).

[50] (1) Ltr, Godfrey to Styer, 19 Apr 43. MTO Comd—Engr 638.129, Jan–Jun 43, 900.3. (2) Memo, Air Engr for CG AAF, 13 Oct 43, sub: Control of Avn Engr Trps in TofOpns. AAF file, 321–C, Engr Corps (S). (3) Personal Ltr, Air Engr AAF to Godfrey, Air Engr Air Sv Comd Hq CBI, 7 Aug 44. AAF file, 321–F, Engr Corps (S).

[51] Memo, Hq AGF for CofS, 14 Oct 43, sub: T/Os for Engr Gen Sv Units (Engr Constr Activities). ASF Mob Div file, T/O&E 5, Engr Constr Group (S).

the construction group and battalion. The General Staff also agreed to place such teams as marine divers in composite units but did not rescind the port construction and repair group.

In line with ASF's suggestion to keep the Seabees in mind when drawing up a table for the construction battalion, the Engineers provided higher grades and ratings for foremen and equipment operators, increased the amount and size of power machinery, and added sufficient personnel to provide for two-shift operation. As finally approved, the table of organization called for 29 officers, 2 warrant officers, and 913 enlisted men.[52]

In January 1944 ASF prepared a memorandum which informed the theaters that the construction battalion was comparable to the engineer aviation battalion in earth-moving capacity and to the Seabees in equipment and grades for skilled personnel. General service regiments, separate battalions, and special service regiments were to be converted to construction battalions on a one-to-one ratio. In a most caustic letter, delivered in person to ASF headquarters, Robins, acting for Reybold, challenged what he termed "several incorrect or inconsistent statements" contained in the memorandum:

> "The battalion is comparable . . . to the Navy Sea Bee battalion in . . . grades for skilled personnel." The construction battalion cannot be considered comparable in that respect . . . . The directive to this office requiring preparation of tables contained the statement that it was desired that grades be comparable, but, in fact, the table submitted carried fewer high grades and final changes by War Department General Staff involved substantial cuts. The statement is in gross error.
>
> The proposal to substitute one construction battalion for one general service regiment is based on no known recommendation of this office. Informal recommendation was made for a conversion ratio of one group of three battalions to two regiments. This would practically absorb all personnel.
>
> The idea expressed . . . that excess personnel will be available as a result of this conversion shows complete ignorance of the conditions now existing in the theaters. Almost without exception engineer general service units . . . are using equipment from depot stocks (Class IV) in amounts at least comparable with that included in the new organization. These new tables, in effect, merely establish higher grades and ratings for men now doing the work under inadequate ratings, and authorize, in equipment tables, items now drawn from depot stocks on loan. The idea that the adoption of this unit will increase the capabilities of engineer personnel in active theaters is fallacious.
>
> . . . . . .
>
> Many General Service Regiments, reinforced with additional heavy equipment, have made notable construction records and are considered equivalent or superior to Navy Construction Battalions for Army work and superior to Aviation Battalions in production capacity. These regiments will not relish a formal statement by the War Department that they are to be reorganized to bring them up to the standard of their competitors. . . . The importance of unit esprit and morale should be recognized and fostered. The necessity for this invidious comparison is not apparent.
>
> General Service Regiments with authorized equipment only are definitely inferior to CB's in construction capacity and theater experience has shown that the prescribed equipment of General Service Regiments is inadequate for earth moving and some other jobs. This has been recognized by this office for two years but efforts to improve the situation have frequently met with War Department disapproval. In particular, this office some months ago proposed a Construction Regiment comparable in equipment to the recently approved

[52] (1) Memo, Dir Mob Div ASF for CofEngrs, 3 Nov 43, sub: T/O&Es for Engr Constr Units. O&T Br file, Personal Ltrs to Gorlinski. (2) T/O&E 5-75, 23 Dec 43.

Construction Group and much more nearly approaching the CB standard in grades and ratings. This proposal was quickly disapproved but is now approved, in general, under another name apparently on the basis that it would conserve personnel.

This matter emphasizes again that little attention is paid by higher echelons to the advice of the agency best prepared to advise on engineer matters: the Chief of Engineers. It is believed that utilization of such advice will contribute to the war effort.[53]

Backing up their arguments with facts and figures the Engineers pointed out that in the 913-man construction battalion only 232 men were grade four (sergeant) or better; in the Seabee battalion of 1,081 men, 741 were equal to grade four or better. Conversion on a one-to-one ratio, explained Sturdevant in a follow-up memorandum, would cut construction troops in theaters by one third when the percentage of engineers in the troop basis was already too small and had recently been further reduced by the inactivation of a number of aviation battalions. There was no necessity to require the formation of group headquarters and headquarters companies in the communications zone because in most cases adequate administrative staffs already existed in base, intermediate, and advance sections. Groups should be organized only upon request of the theater. The Engineers' protest achieved immediate and favorable results. ASF's controversial memorandum was withdrawn and conversion to new units arranged for on a man-to-man basis.

Meanwhile a new aspect of the problem had arisen. In June 1943 the Engineers had resisted a proposal to convert white general service regiments to Negro. Although the Army as a whole contained approximately 8.6 percent Negro troops the Engineers had 19.3 percent. In their effort to secure technical specialists by voluntary induction the Engineers had been unable to secure even 10 percent who were Negroes. As a result ASF had agreed to amend the troop basis to include an augmentation of six white general service regiments so that volunteer white specialists could be absorbed. The revised troop basis was to provide for a total of 87 regiments, 44 to be white and 43 to be Negro.

Following the decision to do away with the general service regiment, 32 construction battalions—6 white and 26 Negro—were projected in the 1944 troop basis. The Engineers in March declared themselves powerless to fill so many construction battalions with Negroes. They cited a number of arguments. Because the background of Negro soldiers currently being inducted was mainly agricultural they were not qualified to operate all the mechanical equipment. Negroes, it was stated, lacked the sense of responsibility necessary for the care of this equipment. The majority of Negro soldiers were in AGCT Classes IV and V. Great numbers were poorly qualified physically, and with their lack of interest and leadership were making "very undependable soldiers." Since they proved slow to absorb instruction, their training had to be lengthened from 17 to 27 weeks. The Engineers recommended the troop basis be changed to 20 white units and 12 Negro units. To avoid charges of discrimination, two of the twelve Negro units were to be construction battalions, the rest general service regiments.[54]

Having received ASF's assent to the broad outlines of this plan and having learned that the Central Pacific theater

[53] Memo, Actg CofEngrs for CG ASF, 20 Jan 44, sub: Memo W220–44. 320.3, Engr Constr Units.

[54] Ltr, DCofEngrs for CG ASF, 15 Mar 44, sub: Activation of Engr Constr Bns. Mob Br file, Engr Constr Bns (C).

wanted battalions, not regiments, OCE submitted tables for a three-battalion general service regiment consisting of 87 officers and 1,710 enlisted men and a general service battalion of 41 officers and 801 enlisted men. These units were especially designed for Negro personnel who fell into Classes IV and V on the AGCT tests, but the Engineers did not consider them labor units. They still had more construction machinery and higher grades and ratings than the old general service regiment.[55]

For all the extensive and prolonged discussion over the organization of ASF construction units, the desired simplification was not achieved. In addition to distinctions arising from the differentiation of Negro and white units, the freedom given to overseas commanders in forming and administering their commands helped to defeat the program of organizational experts in the United States. The ETO requested permission to retain the old organization of construction units and the War Department acquiesced. As of 30 June 1945 the following ASF construction units were active: [56]

Units	*Total*	*White*	*Negro*
Total	337	92	174
General service regiments	79	29	50
Special service regiments	5	5	0
Construction battalions	36	33	3
General service battalions	8	2	6
Separate battalions	3	0	3
Dump truck companies	135	23	112
Petroleum distribution companies	59	(a)	(a)
Port construction and repair groups	12	(a)	(a)

[a] Not available.

Distribution of Engineer Troops

The most notable feature of the reorganization of engineer troops that followed the outbreak of war was its concentration upon construction, supply, and maintenance units. In part this situation resulted from the prewar Army's preoccupation with the structure and tactics of its fighting elements. But the shift in emphasis resulted equally as much from the added importance of logistics in global warfare. The Army could not concentrate as many men in divisional units as it had originally intended.

It became necessary to expand the proportion of service troops because of the Army's motorization and mechanization, its reliance on air power, and its use of power machinery—all of which required extensive maintenance and supply operations. More important for the Corps of Engineers was the fact that the United States fought with greatly extended lines of communication at the ends of which facilities had to be built in order that men and matériel could be massed preparatory to battle. In June 1945 approximately 40 percent of the Engineer officers and enlisted men mobilized in troop units were serving with AGF, another 40 percent with ASF, and the remaining 20 percent with AAF. (*Table 10*)

The distinctions between AGF, ASF, and AAF engineers more or less broke down in the theaters. Whatever troops were available were used for the work to be done. It seemed to the Engineers, as it probably did to all arms and services, that they needed more men. In terms of function, front-line engineers had to clear and construct obstacles, lay mine fields, ferry troops in river crossings, build bridges and, as the necessity arose, act as infantry. Those in the rear were more concerned with building shelters, roads, ports, or airfields and with perform-

[55] Wkly War Plan Conf, 4 Sep 44.

[56] Info from Office of the Comptroller of the Army.

TABLE 10—NUMBER AND STRENGTH OF ENGINEER TABLE OF ORGANIZATION UNITS: 30 June 1945[a]

Type of Unit	Number	Strength
Total	2,126	596,567
Ground Force type—total	805	253,966
Divisional—Total	89	[b] 56,357
Infantry division combat battalions	66	[b] 42,042
Mountain division combat battalions	1	[b] 807
Cavalry division engineer squadrons	1	[b] 674
Armored division engineer battalions	16	[b] 10,784
Airborne division engineer battalions	5	[b] 2,050
Nondivisional	716	197,609
Combat battalions	204	127,270
Heavy ponton battalions	15	5,652
Combat companies (separate)	7	1,129
Depot companies	54	10,599
Light equipment companies	38	4,567
Light ponton companies	44	9,027
Maintenance companies	83	15,334
Treadway bridge companies	33	4,446
Other engineer ground force type	238	19,585
Service Force type total	1,060	236,400
Port construction and repair headquarters companies	12	3,026
Special brigades	3	17,927
General service regiments	79	94,429
Special service regiments	5	6,405
Construction battalions	36	29,539
General service battalions (separate)	8	5,283
Special shop battalions	4	3,435
Base depot companies	24	3,786
Base equipment companies	31	5,195
Dump truck companies	135	14,200
Forestry companies	23	2,505
Heavy shop companies	27	4,422
Parts supply companies	16	2,763
Petroleum distribution companies	59	12,323
Fire fighting platoons	92	2,547
Utility detachments	85	3,857
Other engineer service force type	421	24,758
Air Force type total	261	106,201
Engineer aviation regiments	11	4,568
Engineer aviation battalions	124	88,555
Engineer aviation camouflage, topographic and utilities battalions	6	2,444
Other engineer air force type	120	10,634

[a] Excludes engineers with all communications zone and zone of interior overhead, such as European theater headquarters, service command station complement, replacement training centers, and schools.

[b] Strength allowed by War Department actions as shown in 1 July 1945 War Department Troop Basis, published by Strength Accounting and Reporting Office, Office, Chief of Staff, U. S. Army.

Source: Statistics, Trp Units Sec, U. S. Army in World War II. MS in OCMH.

ing supply functions. The important fact here is that the engineers were needed both in forward and in rear areas. Wherever they found themselves, however, their most important job was the logistical task of construction—whether of roads or bridges under small arms fire or of hospitals and airfields under the threat of bombing. The great bulk of engineer troops was concentrated in a few large units which were capable of undertaking such construction projects. By June 1945, 89 divisional combat battalions, 204 nondivisional combat battalions, 124 aviation battalions, 79 general service regiments, and 36 construction battalions had been mobilized. Although the idea persisted in certain segments of the Army that the Engineers could absorb a

large number of unskilled labor troops, the Engineers had in fact become more and more dependent on skilled and semiskilled men. The Army would have needed many more such units had the engineers been merely labor troops. Under the conditions of modern war the Engineers relied increasingly on machine power and the trend was toward more and heavier machinery. The demands of global warfare made the Corps of Engineers in World War II a corps of specialists.

CHAPTER XI

The Engineer Soldier

The modifications and innovations introduced into the organization of engineer troop units in response to wartime strategy, to manpower and materials shortages, and to the idiosyncrasies of the three major commands had a parallel in the preparation of the engineer soldier for his job overseas. Before the North African landings, the training of the engineer soldier, like that of his officers, had been governed by the drive to fill new units. Both officers and trainees were expected to learn most of what they should know after assignment to a unit. Resumption of the twelve-week cycle at replacement training centers in the spring and summer of 1942 decreased the amount of training left to the unit. But even twelve weeks was scarcely long enough to turn out soldiers equipped with the skills prerequisite to team training unless large numbers of them coming to the Engineers had been skilled workers in civilian life.

The expectation that the draft would channel a superabundance of skilled men into the Army was one of the most serious miscalculations in the mobilization plans. If the United States had only been required to raise an Army there would indeed have been a superabundance of such men. If it had only been required to produce matériel for its own armed forces, there might have been enough men with such qualifications to go around. But even the most industrialized nation in the world found itself short of skills when, in addition to creating a huge fighting force, it continued to man the arsenal of democracy.

It was the technical services whose plans were most upset by the failure to arrive at a more accurate estimate of the numbers of skilled men who would be drafted. The Infantry required only 164 occupational specialists per 1,000 enlisted men. In contrast, the requirements of the seven technical services ranged from the 409 per thousand needed by the Chemical Warfare Service to 788 per thousand needed by the Transportation Corps. The Corps of Engineers, needing 725 occupational specialists per thousand, was second only to the Transportation Corps in the number of skilled and semiskilled men required.[1] At no time did the Engineers receive anything approaching the desired numbers. The corps of specialists had to be created. During the expansion before Pearl Harbor the enlisted men's courses at the Engineer School and the units themselves—the latter often with the help of trade schools near their posts—managed to produce enough bulldozer operators, carpenters, demolitions men, map makers, and other technicians. By the spring of 1942, however, the job had become too big for them to handle. From the fall of that year until the following summer the Engineer training program was dominated by the demand for specialists. By the summer of 1943

[1] Palmer, Wiley, and Keast, *Procurement and Training of Ground Combat Troops,* Table 1, 28 Jan 43, p. 8. See also above, pp. 116–17.

the crisis had passed, not only in regard to specialists but in regard to officers and nonspecialists as well. From then on the Engineers were relatively free to develop the type of training program they had long hoped for, a program designed to turn out engineer soldiers who could fight, who possessed a well-rounded technical knowledge, and who, if they were supposed to perform a skilled job, could in fact do just that.

Training the Corps of Specialists

Late in the spring of 1942 the Engineers, at the behest of SOS, made an analysis of training needs for the remainder of the year. Adding to the troop basis those units almost certain to be approved for activation but excluding amphibious units and utilities detachments, the Troops Division calculated that 146,144 engineer soldiers would require training during the last nine months of 1942, this load to be distributed as follows:[2]

Engineer replacement training centers	51,487
Replacement training centers of other services	39,052
Engineer School	9,562
Civilian trade schools	7,309
Schools of other services	1,505
Engineer units	37,229

The probable output of the ERTC's, after deductions for OCS and other special purposes, was 32,295 below what it should have been to insure this number. The Engineer School was under by about 3,000 and civilian trade schools then holding contracts with the Engineers by approximately 5,500. If training in signal communications was to be provided by the Signal Corps as the Engineers recommended, that service would have to enroll some 1,500 engineer soldiers. On 20 May 1942 Sturdevant asked SOS to authorize a third ERTC and make arrangements to increase the output of the courses for enlisted men at the Engineer School, trade schools, and the Signal Corps Service School.

Sturdevant's plan for training specialists deviated little from the practice of the past year and a half. Specialist training would have been centered where it had always been, at the Engineer School. Specifically, Sturdevant sought to increase the school's output of draftsmen, surveyors, and other topographic specialists from 814 to 2,170 over the nine-month period and increase construction machinery operators from 282 to 1,073. The number of construction machinery operators to be trained at the school would represent but a fourth of the total required. They would be assigned to units to teach the others. ERTC's would conduct no specialist training; it would be their job to select those qualified to attend the schools.[3]

SOS's Training Division modified Sturdevant's plan drastically. It saw no need to establish another replacement training center. AGF was expected to transfer a large number of trainees to the technical services during 1942. Convinced that the Engineers had underestimated the number of skilled workers they would receive from the draft, SOS cut their estimate of training requirements. On the other hand, Sturdevant's idea of drawing upon facilities of the Signal Corps Service School and for increasing the kinds and amounts of training being conducted by civilian trade schools was encouraged. Noting that a number of the specialists required by the Quartermaster Corps, the Signal Corps, and the Corps of Engineers were the same, SOS established

[2] Memo, ACofEngrs (Sturdevant) for Dir Tng SOS, 20 May 42, sub: Analysis of Engr Tng, with Incls 1–7. 353, Pt. 18.

[3] *Ibid.*

a co-operative system so that the three services pooled their resources. Each trained for all concerned the specialists in which that service had a primary interest. Under this arrangement the Quartermaster Corps would assume the training of ten types of specialists which the Engineers had been sending to civilian schools and the Signal Corps would produce the communications experts already listed by Sturdevant. SOS authorized the Engineers to contract with trade schools for the training of topographic instrument repairmen, powerhouse engineers, electricians, electric motor repairmen, and tractor mechanics.

At this point agreement upon the facilities for training engineer specialists ceased altogether. By the spring of 1942 the Engineer School had stretched its space to the utmost to take care of the growing roster of officer candidates. The War Department scrutinized all requests for new construction with an eye to cutting down on nonessentials. SOS accordingly ruled that the capacity of the enlisted men's courses at the school was not to be augmented by any significant amount. Instead, preparation should be made to take care of no more than 200 additional students in courses already being offered. Civilian schools should train draftsmen, surveyors, and geodetic computers. To meet the large and all-important requirement for construction machinery operators, SOS suggested that the Engineers look to the ERTC's.[4]

Although from the beginning some enlisted men had been sent to schools directly from the ERTC's and some few specialists had been trained at the ERTC's themselves, the main job of the Belvoir and Wood centers during the first year of their existence had been to feed basically trained engineer soldiers into units. Emergency arrangements for the production of specialists in the summer of 1942 did not subtract at all from this responsibility. The change appeared to be a simple one, involving only a shift in the immediate destination of the product. Instead of going directly to units, a good proportion of the men would henceforth be siphoned off to learn a trade at service or civilian schools or at the ERTC's themselves. But the lack of time complicated the program. No sooner had the ERTC's overcome an emergency demand for the basically trained soldier than they were faced with an emergency demand for specialists. They satisfied the new demand in the same way they had the earlier one, by cutting out some training.

The new program was introduced just at the time the ERTC's were changing back from the eight-week to the twelve-week basic training cycle. The longer cycle produced a more satisfactory filler but reduced the number of men available for specialist schooling. The Belvoir center in early July 1942 worked out a compromise plan to produce both qualified fillers and quantities of men suitable for more individual instruction. Under this plan, which went into operation at both Belvoir and Wood in August, there were two types of battalions, one for general replacements on a twelve-week schedule and one which trained potential specialists for only five weeks. The centers classified and separated the men upon arrival on the basis of their qualification cards. The men who appeared best qualified by intelligence and background went to the specialist candidate battalions for the shorter course which consisted of four weeks of basic military subjects and one week of technical Engineer subjects. At the end of the five weeks, special-

[4] Memo, Deputy Dir Tng SOS for CofEngrs, 13 Jun 42, sub: Engr Spec Tng. 353, Pt. 18.

ist candidates were then assigned to specialist schools, or if selected for OCS or rejected for specialist training were transferred to a regular battalion. The schedule for both types of battalions coincided through the first five weeks to facilitate such transfers. By converting two white battalions and one half of one Negro battalion to the five-week program each center could furnish 780 white and 430 Negro specialist candidates each month. This output would more than fill the quota of 6,181 students for service and civilian schools through December.

Under the pooling of school facilities established by SOS, about 3,000 of these men would attend Quartermaster Corps schools to learn welding, automotive repair, and other mechanical trades. Signal Corps schools would produce about 300 telephone linemen, radio operators, and repairmen. The 3,000 potential construction machinery operators, tractor mechanics, surveyors, draftsmen, aerial phototopographers, and electricians—specialists in whom the Engineers had a primary interest—were to be dispersed to the Engineer School, to civilian institutions, and to the ERTC's own specialist courses.[5]

On 4 August Col. Joseph S. Gorlinski, chief of O&T, set forth in some detail the arrangements for handling this dispersion. The Engineer School would drop all courses in drafting, surveying, and topographic computing. A college or trade school would take on this work. The Engineer School could then enroll more men in the map reproduction, aerial phototopography, and water purification courses, which would then take up over two thirds of its capacity of 452 enlisted students. The assignment of construction machinery operators to the ERTC's for training made room at the school for 120 more students. O&T decided to devote this capacity to a special twelve-week construction machinery course which would satisfy the engineer aviation battalions' need for versatile, highly skilled operators and maintenance men.[6]

By the end of September 1942 the Engineer School had made the basic readjustments to carry out the new plan. Early that month O&T signed a contract with the University of Kentucky to give courses of three months each in general and topographic drafting, surveying, and geodetic computing to white enlisted men, the first classes to enter on 21 September with others following at weekly intervals to fill the authorized capacity of 870 students. The following month the Engineers made similar arrangements to train Negro enlisted men at the Virginia State College for Negroes, classes to begin in mid-November. From their opening dates until September 1943 when the contracts were terminated, the University of Kentucky trained 2,985, and the Virginia State College for Negroes 440 topographic specialists. Meanwhile the Engineers hastened to enlist the aid of trade schools and factories. Between June and December 1942 they made arrangements with the Radio-Television Institute to train electricians, with the Evinrude Motor Company to give instruction in the operation

[5] (1) 1st Ind, CG ERTC Belvoir to CG Ft. Belvoir, 9 Jul 42, 2d Ind, CG Ft. Belvoir to CofEngrs, 10 Jul 42, 4th Ind, Dir Tng SOS to CofEngrs, 2 Aug 42, on Ltr, Actg C of O&T Br to CG ERTC Belvoir, 30 Jun 42, sub: Spec Rqmts. 353, ERTC Belvoir, Pt. 1. (2) Ltr, C of O&T Br to CG ERTC Wood, 29 Aug 42, sub: Tng Program, with 1st Ind, 7 Sep 42. Wood, 353.01, Tng Scheds. (3) Memo, AC of O&T Br to Gorlinski, 20 Jul 42, sub: Engr Spec Tng. 353, Pt. 18.

[6] The discussion of the enlisted men's courses at the Engineer School is based upon Clinard and McCune, Engineer Enlisted Specialists.



TRACTOR-OPERATED LETOURNEAU CRANE M20 *used by engineers to unload pierced steel plank at an airfield in North Africa, January 1943.*

and repair of outboard motors, with General Motors Corporation to train diesel mechanics, and with the manufacturers of gas and electric generators to teach the operation and maintenance of this equipment. The Engineers looked to the Caterpillar Tractor Company and to R. G. LeTourneau, their prime contractors for construction machinery, to supplement the elementary schooling given by the ERTC's. By using the facilities of these manufacturers the numbers of highly skilled operators and maintenance men required by SOS and AGF units could be supplied. Caterpillar and LeTourneau would do for these services what the Engineer School was doing for the Air Forces.

The new plan for the training of engineer specialists was barely under way before it had to be modified. The Army Air Forces expanded at a more rapid rate than had been estimated the previous summer and its training program had to be enlarged. Beginning in December 1942 aviation engineers would be trained in replacement centers operated by the Air Forces. Potential aviation engineer specialists would still be sent to the Engineers for schooling. Under the accelerated program the Engineers would have to furnish 700 specialists each

month to the AAF, of whom 264 would be construction machinery operators. Since the first reduction in the capacity of OCS had made room for more men at the Engineer School, O&T decided to concentrate specialist training for the AAF at the school. But training time had to be cut from twelve to four weeks. Instead of turning out a worker who was familiar with all the machinery used in the construction of airfields as had been contemplated under the twelve-week course for aviation engineers, the four-week course turned out a worker familiar with only one type. The graduate of the school's mechanical equipment course for aviation engineers was no more versatile than the graduate of the mechanical equipment courses given at ERTC's. Those highly skilled men needed by engineer aviation battalions were trained at Caterpillar and LeTourneau along with those destined for SOS and AGF engineer units. Room was also made at the Engineer School to admit AAF trainees in map reproduction, water purification, and camouflage. By December the school's capacity was almost double that of the previous September: [7]

Total	890
Phototopography	130
Map reproduction	160
Water purification	200
Camouflage	100
Mechanical equipment, aviation	300

To satisfy the demand for other specialists required by AAF, the University of Kentucky enrolled additional students in its surveying and topographic computing courses and contracts were executed with the Franklin Technical Institute of Boston and the Metropolitan Technical School of New York for the training of draftsmen and electricians, respectively.

The Engineers expected the quality of specialist candidates sent from ERTC's to be superior to those chosen by unit commanders, who were reluctant to separate many of their best men from their organizations. The qualifications for the different courses varied. Candidates for the phototopography courses were to be high school graduates, preferably with a knowledge of trigonometry and drafting; candidates for the aviation engineer equipment course were to be quick at arithmetic and the use of formulae, with aptitude for, or experience in, electrical and mechanical work. AGCT scores between 90 and 100 and in certain courses Mechanical Aptitude Test scores of not less than 100 were prerequisites. Lacking control over the qualifications of men sent to the Engineers from reception centers and under pressure to fill quotas, the ERTC's found themselves in an impossible position. From the Enlisted Specialists Branch at the University of Kentucky came complaints that half its students had less than the minimum amount of education required. The Army Air Forces confessed it could not fill quotas unless it lowered standards. SOS directed the Engineers to allow all but "obvious misfits" to complete the aviation engineer equipment course, although they need not be graduated. In March 1943 the qualifications for enrollment were revised downward to fit more nearly the qualifications of candidates being received. A high school diploma, the commandant of the Engineer School insisted, was more important to the topographical specialist than was his AGCT score which could be as low as 90 for some courses.

[7] Ltr, Comdt Engr Sch to O&T Br, 2 Nov 42, sub: Proposed Increases in Off Courses and Enl Spec Courses, Engr Sch, with 2d Ind, 16 Nov 42. 352.11, Engr Sch.

Candidates in the mechanical equipment course could score as low as 85 on the AGCT and 90 on the Mechanical Aptitude Test. They should have some knowledge of arithmetic. Previous experience with machinery was essential.

The entire output of the five-week battalions at the ERTC's was at first channeled into service and civilian schools. Men destined for specialist training at the ERTC's—would-be construction machinery operators, carpenters, demolitions men, truck drivers, buglers, messengers, clerks, typists, mess sergeants, cooks, and bakers—had to be drawn from the regular twelve-week battalions.[8] OCE furnished quotas for each of these ERTC courses according to current estimated needs. The ERTC's selected men to fill these quotas on the basis of civilian experience, interest, and capability. Some directly allied civilian occupations fitted reasonably well into the system, but for the most part the men had to be trained completely at the center. As a consequence, native ability and interest were the qualifications most often sought. Since the jobs to be learned were all simple, none requiring an AGCT score above Class III, sufficient numbers were in most cases available. The Wood center in November 1942 reported 10 percent more men suitable for this instruction by AGCT scores than it could use. Lack of interest accounted for much of the difficulty in obtaining cooks, in spite of the low requirements for this course. The danger involved in demolition work made this one of the hardest of the courses to fill at Belvoir, but the Wood center received enough men with mining experience to meet its quota. Quotas for construction machinery operators, the group of specialists most vital to the success of the engineer mission, were the hardest to fill. In the first place the quotas were much larger for this course than for any other. Perhaps more important, some familiarity with power machinery was almost mandatory for its successful completion. The high ratio of failures among this group of specialist candidates at Wood was attributed to the large number of trainees who saw such machines for the first time at the centers. Few men with civilian experience in construction work reached the replacement centers. They went instead directly from the reception centers to fill general service or special service regiments.[9]

Each center developed its own organization for specialist instruction. At Belvoir, one company from each of the seven regular battalions became a specialist company. After seven weeks of regular training, the selected men transferred to the specialist company for the remaining five weeks. In September the officer refresher, railway officer, pre-OCS, special development, and specialist programs at Wood were placed in a special training group under a single administrative head. The specialists remained in their original battalions for housing but for administrative and training purposes were considered a part of this group after the first seven weeks. There was a further centralization in December. After that time all ERTC-trained specialists transferred physically to one battalion once the seven

[8] Unless otherwise cited, the remainder of this section on specialist training is based upon: (1) 353, Engr Specs, Pt. 1; (2) 353, ASFTC Wood, 7-12-41–1-3-46; (3) Belvoir, 353, Tng, 1941–42; (4) Wood, 353.01, Tng Scheds.

[9] (1) Ltr, Asst Adj Belvoir to CofEngrs, 21 Dec 42, sub: Qualifications of Specs, with Incl 1, List of Spec Schs in Order of Difficulty of Mtg Rqmts With Well-Qualified Trainees. P&T Div file, Ft. Belvoir ASFTC. (2) Memo, Dir Pers Div ERTC Wood for Col Edward H. Coe, 29 Dec 42, with Incls. 320.2, ASFTC Wood.



CLASS IN AUTOMOTIVE MECHANICS *at the Enlisted Specialists School, Ft. Belvoir, Va.*

weeks of basic and general technical training were completed. The special training group as a separate administrative unit was discontinued in February 1943, but the specialist battalion setup lasted until the following October.[10]

Instruction in each specialty was a combination of theory and practice but with much the greater amount of time being spent in practical work. Demolitions men learned the skills necessary to crater roads, demolish highway bridges, destroy railroad rails, bridges, and rolling stock, and cripple water and power plants. Carpenters learned to build several types of structures using both wood and concrete. The centers managed to give the specialists practical experience and at the same time benefit their own plants. Carpenters added classroom buildings. Machine operators built roads, excavated swimming pools, and prepared terrain for firing ranges.[11]

The general step-up in the production of ERTC specialists after August 1942 entailed additional equipment. But the shortage of construction machinery which pre-

[10] (1) Ltr, CO ERTC Wood to CofEngrs, 10 Sep 42, sub: Orgn of Spec Tng Group. Wood, 353, Tng (Special Tng). (2) Tng of Repls, Annex II, and Exhibits 1 to 13, Chart 3, 6 Aug 43.

[11] (1) Specialist Lesson Outlines, ERTC, Ft. Belvoir, Va., Jan 43. (2) 2d Ind, ERTC Wood to CG Seventh SvC, 7 Dec 43, on Ltr, Col John T. Minton to CG Seventh SvC, 2 Dec 43, sub: Tng Inspec, ERTC, Ft. Leonard Wood, Mo. Wood, 333.1, Inspec Rpts by Visiting Offs. (3) *Belvoir Castle*, 18 Feb 44.

vailed during 1942 dictated that all available standard models be sent overseas. In order to have any at all, the centers had to be content with a variety of used nonstandard types, and even these were scarce for months after the courses began. The total additional equipment authorized for each ERTC, as the result of lists submitted in August, included 21 air compressors, 31 bulldozers, 2 ditching machines, 2 earth augers, 2 road rollers, 1 grader, 4 shovels, 3 cranes, 1 concrete mixer, and 20 bugles. By 5 October Wood had received 20 bugles. Small amounts of more useful equipment began to arrive, however, at the end of that month. Yet as late as February 1943 Belvoir still had less than its authorized amount of machinery. By this time, furthermore, there was an additional complication. A new ERTC was being built in Oregon with an opening date in May. Everything that could be obtained on the low training priority during the spring of that year was earmarked for the new center.[12]

Other portions of the specialist program faced similar difficulties. The courses in driver instruction were so restricted by a shortage of trucks and motorcycles through 1942 that the burden of this training was in effect returned to the units, with higher maintenance costs as a result.[13] Task force requirements, production levels, priorities, and other training needs went a long way to explain and excuse the presence of substandard equipment in 1942 and early 1943. But in the eyes of many this was false economy. "When we got the good equipment," wrote the commander of the 41st Division from New Guinea in the summer of 1943, "we were very apt to ruin it because our operators were not trained on it. They must be trained in the equipment they are to use in the field." [14] Many never were.

The specialist program precipitated reorganizations and brought on equipment crises, and was also the deciding factor in renewed demands from the centers for larger training and administrative staffs. The Wood center had increased its capacity from 8,800 to 9,760 trainees on 1 February 1942 by emergency crowding. Proportional cadre had not been granted because the measure was intended to last only until the new ERTC could be built. Belvoir shifted to the same basis on 27 September, absorbing the increase into the established training battalions. Mainly at the insistence of Belvoir, the officer complement for the centers had been revised upwards from 341 to 375 by June 1942, but the enlisted allowance remained at the previous December level of 1,640. In September 1942 both centers insisted upon a revision. The Wood center by that time realized that the plans for the new ERTC did not include any reduction in trainee capacity at the existing centers, that the temporary enlarged capacity was in effect permanent. The specialist program increased the pressure. By early October both

[12] (1) Ltr, AC of O&T Br to C of Sup Div, 1 Sep 42, sub: Equip for ERTCs. 475, ASFTC Belvoir. (2) Ltr, CO ERTC Wood to CofEngrs, 5 Oct 42, sub: Increase of T/BA, with 1st Ind, 17 Oct 42. 475, ASFTC Wood. (3) Ltr, ExO ERTC Belvoir to CofEngrs, 18 Feb 43, sub: Status of Equip, with 2d Ind, C of O&T Br to CG ERTC Belvoir, 1 Mar 43. 475, ASFTC Belvoir.

[13] Ltr, AC of O&T Br to C Allowance Br SOS, 12 Dec 42, sub: T/A 5–1: Prospective Change in Ord Motor Transport Equip, with 2d Ind, Dir Rqmts Div SOS to CofEngrs, 13 Jan 43. 400.43, Pt. 45.

[14] Trudeau file, General Ogden.



ENGINEER EQUIPMENT IN NEW GUINEA, *February 1943. Sheepsfoot roller (left) and road grader used by 43d Engineers to build an airstrip near Dobodura.*

centers had been granted an additional 75 enlisted men and in December SOS approved an allotment of 380 officers and 1,715 men.[15]

An added complication to the ERTC specialist program was the rigid specification by ASF of the content, length, and sequence of training in several of the courses. In the interest of standardization of courses for cooks, clerks, automotive mechanics, and motor vehicle operators which were given at all ASF replacement centers, the ASF Training Division in March 1943 issued individual eight-week schedules to be followed without modification. The full eight weeks for the ASF courses had to be given even if the centers had to use processing time or curtail basic training. No omissions or substitutions could be made in these ASF courses, contrary to the policy with regard to those prescribed by OCE, which

[15] (1) Ltr, Asst Corps Area IG to CG Third Corps Area, 13 Dec 41, sub: Ann Gen Inspec, Station Complement and ERTC, Ft. Belvoir. Belvoir, 333.1, Investigations and Inspecs, 1941–42. (2) Office Memo, AC of O&T Br for Col Garlington, 3 Mar 42, sub: T/Os ERTCs. 320.2, RTCs (C). (3) T/O 5–510, ERTC (Consolidated), 16 Jun 42. 320.2, RTCs, Pt. 1. (4) Ltr, C of O&T Br to CG SOS, 2 Sep 42, sub: Increase in Allot of Pers, ERTC, Ft. Leonard Wood. 320.22, ASFTC Wood. (5) Ltr, Actg C of O&T Br to CG SOS, 12 Sep 42, sub: Increase in Allot of Pers, ERTC, Ft. Belvoir. 320.2, ERTC Belvoir, Pt. 1. (6) Ltr, AGO to CG ERTC Belvoir, 5 Oct 42, sub: Allot of Grades and Authorized Strength. Same file. (7) Ltr, AGO to CG ERTC Wood, 17 Sep 42, sub: Allot of Grades and Authorized Strength. 320.22, ASFTC Wood. (8) 1st Ind, 16 Dec 42, on Ltr, Asst QMG to O&T Br, 14 Dec 42, sub: Rqmts for ERTCs. 320.2, ERTCs, Pt. 1. (9) Memo, AC of O&T Br for Tng Div SOS, 2 Jan 43, sub: Pers for New ERTC, Camp Abbot (Bend). 320.2, ERTC Abbot.

were left flexible enough to allow for local differences and training emergencies.[16]

In spite of shortages of instructors and equipment, the centers did turn out the required specialists, whether fully qualified for their positions or not. Between June 1942 and June 1943, the two centers produced 14,409 specialists from a total of 82,301 men received, or 17.5 percent of the whole. Of these 14,409 specialists, 10,486 were white, constituting 17.83 percent of the total white trainees. Of the 23,500 Negroes received, 3,923 or 16.69 percent became specialists. Many more Negroes were selected for training in the elementary courses given in the ERTC's than for the more advanced specialist training at service and trade schools. Of the 15,876 men selected to attend schools, 14,685 were white and only 1,191 were Negro.[17] By May 1943, the program of specialist training at the centers had settled sufficiently so that O&T could predict the combined annual output of Belvoir, Wood, and the new center at Camp Abbot, Oregon: [18]

Total	14,182
Heavy equipment operator	5,032
Chauffeur and driver	1,980
Carpenter	1,895
Cook	1,850
Demolition man	1,351
Clerk and typist	1,221
Mess sergeant	296
Half-track driver	278
Bugler and messenger	222
Sign painter	37
Mechanic, maintenance	20

While the ERTC specialist courses were gradually being straightened out, the other part of engineer specialist training which affected the centers, the production of men qualified for more advanced training in schools, ran into difficulties of its own. Because of insufficient co-ordination between the times the five-week specialist candidate battalions emptied and the opening dates of specialist courses at the schools, there was alternately a piling up of men for whom no school assignments existed and then openings in schools when there were no five-week battalions scheduled for completion. Though each center had only two and one-half battalions on this shorter program, the more rapid rate at which they completed training resulted in their turning out more than one third of all the trainees passing through the ERTC's. The already closely packed centers had no place to house such large numbers. Each battalion had to be cleared to make room for the next contingent which pressed close behind.

Since these men ranked second only to officer candidates in intelligence and aptitude, it was important that they be conserved and advantageously placed. The obvious answer was a pooling arrangement to store them for short intervals until they could enter the schools. During September 1942 the need for such a regulatory pool was particularly acute. OCE made arrangements with the Engineer Unit Training Center at Camp Claiborne, Louisiana, to take these surplus men into units there until

[16] (1) MTP 5–2, 4 May 43. (2) Ltr, Actg C of O&T Br to CG ERTC Belvoir, 18 Mar 43, sub: MTP 5–2. 353.01, ETC Belvoir, 18 Mar 43–20 Aug 46. (3) Ltr, Adj ERTC Wood to CofEngrs, 15 Dec 42, sub: Request for Approval of Spec Tng Program, with 1st Ind, 8 Jan 43. Wood, 352, Schs (Gen).

[17] (1) 2d Ind, ERTC Belvoir to CofEngrs, 17 Dec 42, on Ltr, O&T Br to CG ERTC Belvoir, 5 Dec 42, sub: Rpt on Trainees Received at ERTCs. 353, ERTC Belvoir. (2) Ltr, Asst Adj ERTC Belvoir to CofEngrs, 5 Jan 43, same sub. 353, ASFTC Belvoir, Pt. 2.

[18] Memo, AC of O&T Br for CG ASF, 21 May 43, sub: Rqmts for Sch Trained Specs, with Incl. P&T Div file, Engr Spec Tng.

they could be recalled to schools. If not recalled within designated times they were to be incorporated into units.[19] This plan might have worked had the total number of men produced by the five-week battalions coincided with the total capacities of the schools, but by October the centers were delivering more than the 700 to 800 which the schools could absorb each month. These excess men had to be assigned to units as general replacements after only five weeks of training, not only wasting their potential skills but handicapping them as well with inadequate tactical and technical instruction. By early November 1942 more than 40 percent of the specialist candidates were going to units, not schools.

Dissatisfied with this obvious misuse of manpower, SOS called for a decrease in the output from the five-week battalions or an increase in the capacities of the schools. The latter was not feasible. On the other hand, to equalize the capacities of the five-week battalions with those of the schools would waste considerable space at the centers. In mid-November, Belvoir evolved a system which was adopted immediately at Wood. The five-week battalions continued to produce as many men as before, but one company from each of these battalions shifted to ERTC specialist training after five weeks. This plan provided a better qualified group for the center specialist courses, which ran through the full twelve weeks, and made much better use of engineer manpower. Fewer men were then selected from the twelve-week battalions for the center specialist courses. The remaining three companies in the five-week battalions normally furnished enough men to fill school quotas. When they could not, fewer men were transferred to the ERTC specialist program which then selected more men from the regular battalions.

Replacement requirements were such in November 1942 that the 8,800-man annual loss in output under this plan was no serious matter. When requirements were reviewed once more in the spring of 1943, the maximum output of both general replacements and specialists which had been imposed by the 1942 troop basis no longer seemed necessary. Mobilization had stabilized. O&T thereupon recommended that the five-week battalions be discontinued altogether. The shift promised to be advantageous in a number of ways. All trainees, including specialists, would have twelve weeks of ERTC training before transfer, five weeks of basic training and seven weeks of tactical and technical work. All trainees at the end of that time would be qualified as general replacements if the quotas for school-trained specialists were further reduced. Since no transfer would be necessary from one battalion to another as the school quotas changed, the administrative load would be decreased. Specialists would enter the ERTC courses after the fifth week. ASF approved this plan at the end of March, with the stipulation that for those trainees taking the four ASF-standardized specialist courses the division of time must be four weeks and eight weeks, since for those courses eight weeks had been prescribed.[20] In formulating these plans, G–1 failed to

[19] (1) Ltr, AC of O&T Br to CG EUTC Claiborne, 22 Sep 42, sub: Engr Spec Tng. 220.3, ASFTC Claiborne. (2) 2d Ind, C of O&T Br to CG SOS, 12 Jan 43, on Ltr, CG ERTC Belvoir to CofEngrs, 22 Dec 42, sub: Proposed Table of Pers. 320.2, ASFTC Belvoir.

[20] Ltr, C of O&T Br to Dir Tng SOS, 2 Mar 43, sub: ERTC Program for 1943, with 1st Ind, 25 Mar 43, 2d Ind, 29 Mar 43, and 3d Ind, 30 Mar 43. 353.01, ERTC, Pt. 1.

anticipate the increase in replacement needs that accompanied the climax of the Allied campaign in North Africa in the spring of 1943. Once again the centers and schools had to concentrate on a maximum output. The lengthened program for school specialists had to be postponed for several months. Belvoir and Wood operated above capacity to furnish the men needed, since the new center in Oregon was not completed until May.[21]

Even so, from May to early July 1943 both Belvoir and Wood found it hard at times to meet the school quotas. It was not only a matter of numbers, but also the quality of men received and priorities given to other training. The plan worked out by Belvoir in November 1942 had provided for the use of all the men in the five-week battalions as specialists, trained either at the ERTC's or at outside schools. By this time, the ERTC courses had established a priority claim upon these men because construction machinery operators were more desperately needed than any other group. Quotas for school training had to be met from those remaining after the ERTC courses were filled. This situation was coupled with Army Specialized Training Program withdrawals and OCS selections, and aggravated by large numbers of men who, although assigned to the five-week battalions, were not qualified for schools because of low AGCT scores, poor attitude, age, or physical condition. Out of 2,027 men in the five-week battalions at Belvoir in mid-July, 1,241 were either not qualified or not available for specialist training at the center or at schools.[22]

The expanded specialist program, combined with numerous extra training responsibilities and the increased demands for men for other purposes, pushed the training of regular replacements into a relatively minor position despite the efforts of OCE and the centers themselves to co-ordinate and improve the quality of this instruction. By November 1942 Col. Frank S. Besson, Sr., the commanding officer of the Wood center, had come to the conclusion that the training of the nonspecialized replacement was completely disrupted. He recommended abolishing both the five- and twelve-week programs and suggested a substitute uniform period of only seven weeks for all. Seven weeks represented the extent of actual uninterrupted training at his center. About one third of the men were in the five-week battalions which did not pretend to give adequate basic instruction. In the twelve-week battalions, the transfer of OCS candidates, the attendance of ERTC specialists at schools, and frequent calls for shipments to units so depleted their ranks that in the last few weeks there were often not enough men left both for guard duty and for all of the scheduled training. Such depletions wasted space, facilities, and instructors' time. Since the length of stay of any given group of trainees could not be predicted, a balanced schedule could not be drawn up to fit the amount of time available. The trainee simply had the latter part of his training cut short. Not until August 1943 could the cen-

[21] (1) Ltr, Asst Ground Adj Hq AGF to CofEngrs, 8 May 43, sub: Increase in Capacity of Spec Schs for AGF Engr Units. 220.63, Special Sv Schs. (2) Memo. Actg C of O&T Br for CG ASF, 8 May 43, sub: Output of ERTCs. 320.22, ERTC, Pt. 1. (3) Memo, Lt Col J. D. Strong for Dir Mil Tng ASF, 21 Jun 43, sub: Inspec of ERTC, Ft. Leonard Wood. 333.1, ASFTC Wood.

[22] (1) Ltr, Asst Ground Adj Hq AGF to CofEngrs, 8 May 43, sub: Increase in Capacity of Spec Schs for AGF Engr Units. 220.63, Special Sv Schs. (2) Ltr, Asst Adj ERTC Belvoir to CofEngrs, 14 Jul 43, sub: Spec Schs, with 1st Ind, AC of O&T Br to CG ASF, 17 Jul 43. P&T Div file, Engr Spec Tng.

ters abolish the five-week battalions and give a longer uniform period of training to all replacements.

Reflections From Battle

While dissatisfaction on the home front played a part in bringing about changes in the training of the engineer soldier, the ultimate test was the battle.[23] Reports from North Africa were full of praise for the engineer soldier when he was called upon to perform such strictly engineering activities as road building and bridging. In their particular specialties the engineer replacements were on the whole well trained. As combat troops they were as unprepared for their role as the men from other services. The reports from the North African campaign criticized the unreal quality of training, the lack of hatred for the enemy, the sense of playing a game on a vast scale. As one private expressed his angry contempt for this attitude: "I know so well those men who were cut to ribbons at the KASSERINE PASS, and I know why they were thrown into confusion, panicked by attacks, and accepted their fate almost paralyzed. When they jumped into foxholes to let the tanks roll over them, and were bayoneted in these foxholes by the Infantry that came behind the tanks, they died with an astonished look on their faces, as if they wanted to ask: 'Could that be possible, would they really do that?' " [24]

Discipline in the early stages of the invasion was poor. Souvenir hunting led to casualties from booby traps. First aid instruction proved inadequate. The use of camouflage was apparently understood, but rarely employed. Foxholes were not dug deep enough to provide adequate protection. Units did not disperse widely enough from road convoys to avoid strafing from planes. Members of many weapons teams could fill only one position; one casualty could incapacitate an entire crew. Observers recommended training with live ammunition and real mines, more night work and extended field operations during bad weather under conditions of extreme fatigue, with subsistence for long periods on field rations. The use of engineers as infantry pointed up the need for tanks in tactical training, and for a broader program of instruction in machine gun fire in support of engineer combat missions. Engineer combat battalions had little straight engineering duty in North Africa, except mine laying and removal. A detailed knowledge of mines and mine detectors was imperative.[25]

The ERTC's had been contending for months against restrictions which prevented them from exposing trainees to anything ap-

[23] With the exception of those files noted separately, this section and the one immediately following are based upon: (1) 353, ERTCs, Pt. 1; (2) 353, ETC Belvoir, Pt. 2; (3) Belvoir, 353, Tng, 1943; (4) Wood, 353, Tng; (5) 353.01, ETC Belvoir, 1943–46; (6) 322, ASFTC Abbot; (7) 400.34, ERTC, Pt. 1; (8) Belvoir, 470, Ammunition, Armament, and Similar Stores, 1943.

[24] Pamphlet, Pvt Frank B. Sargeant, The Most Common Shortcomings in the Training of Battalion and Regimental S–2 Personnel, and Some Suggestions to Overcome These (Washington, 1943), p. 17. Ft. Lewis, 353, Illumination, Irregularities, and Dim-Out Inspecs (Separate File).

[25] (1) Ltr, C of O&T Br to CGs ERTCs, 24 Feb 43, sub: Notes on Recent Fighting in Tunisia. 353, ASFTC Belvoir, Pt. 2. (2) "Errors in Africa to Bring Changes in Training Here," *Fort Wood News* [late March or early April 1943]. Wood, *Fort Wood News* Clippings. (3) Ltr, Asst G–3 Engr Amph Comd to CG Engr Amph Comd, 14 Apr 43, sub: Obsvns on Tng of Trps in the Fld in Tunisia. EAC, 370.2, North Africa (S). (4) Ltr, OCofOrd to All Mil Estabs Ninth SvC, 12 Jul 43, sub: Unit and Individual Tng. Lewis, 353, Tng, 17 Jun 43–31 Oct 43. (5) Ltr, C Engr AFHQ to CofEngrs, 19 Jul 43, sub: U. S. Engrs in the Tunisian Campaign. Intel file, Engr Sch, Doc 1547, U. S. Engrs in the Tunisian Campaign (S).

proaching the feel of battle. Instead of live ammunition, the centers had to use firecrackers to simulate everything from small arms fire and supporting weapons to mine charges and booby traps. The trainees, hearing only the report of a cap when a "mine" exploded were not unduly impressed. Struck by this fact, the cadre at Belvoir had, as early as July 1942, asked for one antitank mine for every 150 men for demonstration purposes. Despite the fact that only cadres were to handle the live mines—and log mats would cover them—SOS ruled against their issue on the grounds that the demonstration was too dangerous.[26]

By spring 1943 the experience gained in Tunisia began to be reflected in the training of engineer replacements. In April ASF directed that every trainee must "so far as practicable . . . be subjected during training to every sight, sound, and sensation of battle." He must be prepared mentally to perform his duties "regardless of noise, confusion, and surprise." [27] Combat training, as interpreted by O&T, was to duplicate battle conditions just short of causing casualties. Allowances of explosives, detonating cord, firing devices, mine detectors, smoke and tear gas pots, gas alarms, and blank ammunition were revised upward. By the end of the summer Belvoir and Wood received sufficient quantities to conduct the required training.[28]

In infiltration courses the men crept over rough ground with full field equipment, subjected to the constant chatter of machine guns and the intermittent jarring of explosives. Tear gas, smoke, and still more explosives accompanied assault problems. Small villages were built in which to train the men in house-to-house fighting, routing snipers from roofs and attics and machine gunners from street barricades. Booby traps exploded when doors were opened or unattached articles touched, detonations simulating mortar and artillery fire shook the surrounding area. One of the trainees at Belvoir expressed the desired result when he exclaimed after a particularly rough day on these "diabolical" courses, "Nothing can scare us now, we hope!" [29] Such training did not always stop just short of casualties. Carelessness no longer produced a firecracker burn.

From battle zones came repeated demands for combat training with tanks. The centers were well aware of the value of tanks for combat training as well as for testing bridges and obstacles but the two or three allotted them through 1942 allowed too little instruction in antimechanized attack or combat principles. Accordingly, on 24 June 1943, OCE requested four light and four medium tanks for each center. This allowance enabled the centers to include tactical problems against and in support of actual tanks in combat training. The techniques of hasty defenses could be made more realistic, with the tanks rolling over the trainees as they crouched in foxholes.[30]

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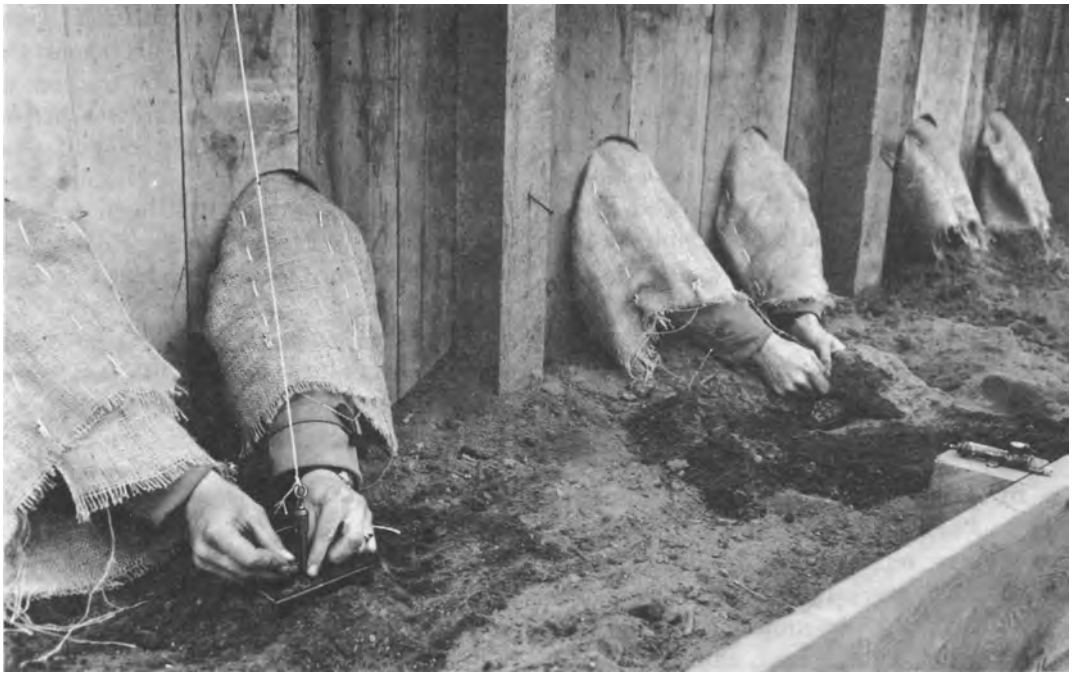
[26] Ltr, ExO ERTC Belvoir to CofEngrs, 27 Jul 42, sub: Antitank Mines, M–1, with 2d Ind, C of O&T Br to CG ERTC Belvoir, 3 Aug 42, with 3d Ind, CG ERTC Belvoir to CofEngrs, 7 Aug 42. 471, ASFTC Belvoir.

[27] AGO Memo S 350–26–43, 25 Apr 43, sub: Combat Tng, ASF.

[28] WD Cir 111, 29 Apr 43.

[29] *Belvoir Castle,* 11 Jan 43. For a fuller discussion of realism in training, see Palmer, Wiley, and Keast, *op. cit.,* pp. 387, 388.

[30] (1) Incl, Office Memo, Coe for Gorlinski, 11 Dec 42, sub: Supplement to Rpt on Tng Inspec of ERTC, Ft. Leonard Wood, to Office Memo, Gorlinski for Sturdevant, 12 Dec 42, sub: Inspec of ERTC, Ft. Leonard Wood. Wood, 333.1, Inspecs. (2) Ltr, CG Ft. Belvoir to CofEngrs, 14 Dec 42, sub: Request for Tanks. 470.8, ETC Belvoir. (3) Ltr, CO ERTC Wood to CofEngrs, 21 Dec 42, sub: Inspec of ERTC, Ft. Leonard Wood. 333.1, ASFTC Wood. (4) Interv, Col Paschal Strong, 28 Nov 52. (5) Info from Coe, 7 Jan 53.



DEACTIVATING ANTIPERSONNEL MINES AND BOOBY TRAPS, *by touch only, part of combat training for Engineers, Camp Abbot, Oreg.*

Physical hardening and marches were intensified. Additional obstacle courses were built and repeatedly run. At Belvoir, physical conditioning was combined with a practical application of rigging lessons in an additional knot obstacle course. Night operations were expanded to include five problems at Belvoir. The first one came in the second week and consisted of a cadre demonstration of night patrolling. In the fourth week, four platoons worked together on a night outpost problem. Four weeks later there was a night bridging operation, in total darkness, with maximum secrecy. A week later, the same type of operation followed in road building. In the last week or two of training there was a night reconnaissance trip which involved the use of a compass.[31]

New Proportions and Capacities

At the same time that the centers reoriented instruction along more practical lines in the spring of 1943 their prime function changed from furnishing fillers for new units to replacing actual battle losses in existing ones. This functional shift began to be apparent by early spring and was one of the factors in promoting realism in training. Another aspect of this change was the dif-

[31] (1) Memo, Lt Col C. D. Hill for Dir Tng SOS, 21 Oct 42, sub: Inspec of ERTC, Ft. Belvoir, Va. Belvoir, 333.1, Investigations and Inspecs, 1941–42. (2) Memo, C of RTC Br ASF for Dir Tng ASF, 8 Apr 43, sub: Inspec of ERTC, Ft. Belvoir, Va. 333.1, ERTC Belvoir. (3) Memo, Lt Col J. D. Strong for Dir Tng ASF, 21 Jun 43, sub: Inspec of ERTC, Ft. Leonard Wood, Mo. 333.1, ASFTC Wood.

ferent basis upon which the production of Negro and white trainees had to be calculated. Belvoir and Wood produced white and Negro engineers in a set proportion based upon the numbers needed for the new units, about three Negroes to every seven white trainees. The shift in emphasis to training replacements upset this balance. The demand for white replacements outran the numbers produced by this ratio, while the demand for Negro replacements was so small that too many Negro engineers resulted. By May 1943, this situation was chipping away at the efforts to improve training. White engineer replacements had to be supplied from the centers of other arms and services where they had received no engineer training. Surplus Negro engineers who had received this training were sent to other arms and services. OCE strongly recommended to ASF in May that the Negro and white capacities of the ERTC's be placed upon a basis directly proportional to Engineer loss requirements.[32]

To reduce the proportion of Negro trainees at each Engineer center while keeping the same total capacities would have resulted in housing both white and Negro trainees in sections of each center which had been set apart for Negroes only. In early August OCE recommended a solution which would keep the races separated, provide equal facilities, and at the same time reduce the Negro output to conform to loss requirements. All Negro training at Belvoir would be discontinued. The three Negro battalions at Wood could furnish all the Negro engineers required. The decision to give all Negro training at Wood instead of at Belvoir was based upon the fact that Negro housing at Wood was more widely separated from that of the white trainees. Recreational areas were comparable. No Negro trainees went to Belvoir after August 1943. As the Negro battalions there completed training under the twelve-week program over the course of the next few months, they were replaced by white battalions which began on a newly approved seventeen-week program.[33]

By July 1943 it seemed once more that Belvoir and Wood might be able to relax their efforts. Long-range estimates for the rest of 1943 and 1944 indicated that a lower output would be required since available manpower would be such that only replacements for existing units would be provided after August. The new ERTC at Camp Abbot, Oregon, had begun its first cycles and would relieve still more of the pressure from the other two centers.[34]

Camp Abbot was located in the sparsely populated central part of Oregon in a region given to Indian reservations, bird sanctuaries, and national parks. It lay on the extreme northwest edge of a huge, high, relatively level bowl filled with extinct volcanoes, warm springs, and crater lakes. The site followed the course of the Deschutes River at an elevation of 4,000 feet, just a few miles east of the high peaks of the Cas-

[32] (1) Memo, Asst CofEngrs for OSW, 30 Aug 43. 353, ASFTC Wood, 7-12-41–1-3-46. (2) Memo, Actg C of O&T Br for CG ASF, 8 May 43, sub: Output of ERTCs. 320.22, ERTC, Pt. 1.

[33] (1) Memo, C of O&T Br for CG ASF, 2 Aug 43, sub: Transition to 21-Wk Tng Cycle, ERTCs. 353.01, ERTC, Pt. 1. (2) Memo, McMath for Garlington, 2 Aug 43. Wood, 353.01, Scheds, Programs, and Directives. (3) Memo, C of O&T Br for CG ASF, 4 Aug 43, sub: Transition to 21-Wk Tng Cycle, ERTCs. 353.01, ERTC, Pt. 1.

[34] (1) Memo, G–3 for CGs ASF AGF, 7 Jul 43, sub: RTCs, with Incl, Readjusted Capacities of ASF RTCs—21-Wk Cycle. 320.2, RTCs (S). (2) Ltr, G–3 to CG ASF, 29 Jul 43, sub: Misasgmt of Specs. 220.63, Pt. 2. (3) Tng of Repls, Annex I. (4) Hq MDW, Notes on ASF Tng Conf, Camp Lee, Va., 20 Oct 43. EHD files.

cade mountains. It consisted of a natural open meadow of shallow volcanic soil, and a logged-over area of second-growth pine.[35]

This site had definite advantages. Its western location cut down the time needed by personnel from that section of the country for furloughs and other processing. The eastern slope of the Cascade Range was cool and dry, without the sweltering summer heat of Belvoir and Wood. The installation was entirely new. There was no military post or camp at the site and none other than the center was established thereafter. In the year of Camp Abbot's existence, from May 1943 to June 1944, it had no other function than to serve as an Engineer center, with the same administrative personnel for both center and post. Full advantage could be taken of the mistakes made at Belvoir and Wood in the location and distribution of buildings and training areas without any concession to the needs of other training groups or post complement.[36]

In spite of the obvious attractions and potential advantages of such a site, many of its drawbacks were apparent from the beginning. It was even more isolated than Wood. Although it was directly on the Oregon Trunk Line of the Great Northern Railroad, it was over 150 miles from any main east-west track and could not expect main line service. The few large cities of the state were over a hundred miles away, almost twice that distance around the mountains by rail. The nearest town, some eight miles away, had a population of only 10,000. Deschutes County, excluding its two small towns, had about two people for each square mile. Local sources for training supplies were practically nonexistent. Supplies and fuel had to be shipped in to the camp from a distance, at high cost, and subject to the uncertainties of winter mountain weather. The distance of this site from any established Engineer installation made a disproportionately large maintenance staff necessary. There were at first no adequate power lines east of the Cascade Range to serve the camp. The firing area was miles away from the main site, with connecting roads that had not been built for heavy military traffic. The lava rock which underlay the shallow soil of the camp made the laying of sewer and water pipes costly and slow. The dryness of the region made clouds of volcanic dust a constant irritant, summer and winter. Drivers of combat vehicles and operators of heavy equipment were forced to wear protective masks.[37]

Nevertheless, the advantages of the site outweighed its defects. Besson, transferred

[35] (1) Ltr, Portland Dist Engr to CofEngrs, 27 Nov 42, sub: Desig of ERTC at Bend, Deschutes County, Orc., as Camp Abbot. 600.05, Bend, Orc. (2) Memo, Somervell for G–4, 8 Jul 41, sub: Site for Antiaircraft Firing Center (18,000 Men), Bend, with Incl, Memo on Engineering Features of Bend–Fort Rock Valley Firing Center, Deschutes and Lake Counties, Orc., 7 Jul 41. QM 685, Camp Abbot (C–ED).

[36] (1) Ltr, Adj ERTC Wood to CofEngrs, 31 Dec 42, sub: Proposed Rev of Camp Abbot ERTC Layout. Wood, ERTC Bend, Corresp. (2) Memo, ASF Mil Tng Div for Dir Mil Tng ASF, 5 Oct 43, sub: Inspec of ERTC, Camp Abbot, Ore. 333.1, Inspecs, 1 Aug 43–20 Nov 43, CofS Job A 44–21. (3) Ltr, C of O&T Br to CSigO, 13 Feb 43, sub: Request for Recommended Issue of Photo Equip for ERTC, Camp Abbot, Ore. 413.53, ERTC Abbot.

[37] (1) Memo and Incl cited n. 35 (2). (2) Ltr, C of O&T Br to C of Sup Div, 16 Jan 43, sub: Authority to Purch for New ERTC, Camp Abbot, Orc., with Incl, Ltr, Adj ERTC Wood to CofEngrs, 22 Dec 42, sub: Authority to Purch Locally—Camp Abbot ERTC. 161.0, ASFTC Abbot. (3) 4th Ind, CO ERTC Abbot at Wood to CG SOS, 2 Mar 43, on Ltr, Besson to TAG, 10 Feb 43, sub: Suballot of Grades and Authorized Strength, Corps of Engrs, CASC, Ninth SvC. 320.22, ASFTC Abbot. (4) Memo, ExO Equip Br for CG ASF, 23 Jul 43, sub: Respirator for Camp Abbot, Orc. 426, ASFTC Abbot.

from Wood to be the first commanding officer of the new center, made a reconnaissance of the site late in February 1943. Apparently satisfied with the camp at that time, he became enthusiastic upon its completion in May. He believed it to be "the best camp in the entire country. The buildings are ideally situated and the facilities will bear small improvement . . . ." Camp Abbot was "without a doubt destined to be remarkable as a replacement training center." [38]

The combination of increased total capacity and lowered requirements allowed the Engineers to plan once more for a longer training period and to discontinue the troublesome five-week battalions, since specialist school quotas would be reduced as well. On 16 July, OCE directed the centers to give all trainees thirteen weeks of training whether they were destined for schools or for general replacement. This was in the nature of a temporary order, pending a decision by the War Department on an even longer cycle including seventeen weeks of actual training time. The latter program was instituted on 15 August, with a transition period lasting through December. Transfers to specialist schools could be made at any time between the sixth and the seventeenth weeks as needed. Engineers at home and overseas welcomed the seventeen-week schedule. The centers wanted a simpler or at least a uniform program and overseas commanders wanted a more thoroughly trained basic replacement.[39]

Col. Edward H. Coe, who had been head of the Training Section, OCE, reflected somewhat later that "training of specialists was over-emphasized to a fault in training both officers and men. . . . There is a real deficiency in our supply of specialists, but the crying need is and always has been for the versatile, balanced engineer soldier who can scramble over a bridge, tighten a bolt, set a jack, drive a truck, skin a cat, and shoot a rifle, all in one night shift." [40] Actually the crying need for the first eighteen months after Pearl Harbor had been for something which could not be secured—time. Under this handicap the training of the engineer soldier was pieced together to meet sudden, unexpected emergencies. It developed from an oversimplified program of basic military instruction to an overcomplicated one dominated by the production of specialists.

The Balanced Engineer Replacement

With supplies and time at last ample and with much experience to draw upon, the quality of ERTC training should have approached the ideal. It did improve, but not to the extent anticipated. After the fall of 1943 manpower shortages supplanted equipment shortages in imposing restrictions upon the training program. The lengthened time for training and a better balance of subject matter could not wholly compensate. From August 1943, when the seventeen-week program went into effect, to June 1944, when the replacement system absorbed both replacement and unit training, the three ERTC's produced replacements on a reduced scale, within rigid limits defined by the War Department and by ASF. Although these restrictions grew out of the

[38] Ltr, Besson to CofEngrs, 22 May 43. 322, ERTC Abbot.

[39] (1) Ltr, TAG to CofEngrs, 19 Jul 43, sub: ASF RTCs. 320.2, RTCs (S). (2) Msgform, OCE to ERTCs Belvoir, Wood, Abbot, 20 Aug 43. 353, ETC Belvoir, Pt. 2: 353, ASFTC Wood: 353, ERTC Abbot.

[40] Ltr, Coe (341st Engr Regt) to OCE, 27 Feb 45. 353, Engrs Corps of, Remarks on Tng at Engr Installations.

desire at all levels for the most efficient and economic use of the dwindling manpower, the incidental effect upon training standards proved most unfortunate.[41]

Emergency peak needs remained unpredictable. The time necessary to induct, train, and move a replacement overseas under a seventeen-week program in a nineteen-week cycle could not have been less than six months—too long to meet an unexpected crisis. In August 1943 ASF devised a plan which would create a reserve of trained men to meet such emergencies and at the same time stabilize administrative work loads and cadres. To each of the services ASF assigned total trainee capacities, breaking these down into monthly inputs. The capacities, including ERTC graduates held over awaiting assignment, could be exceeded only through the rest of 1943, during the gradual transition period between the twelve-week and the seventeen-week programs. The monthly inputs were effective at once and could not be changed. A steady output was mandatory by the end of the year, and desirable before that time.

The Engineers were assigned slightly over 27 percent of the ASF monthly inputs and trainee capacities. The suballotment from OCE reduced capacity at Belvoir from 9,760 to 8,120, Wood from 9,760 to 8,000 (6,000 white and 2,000 Negro), and Abbot from 6,272 to 5,880. The monthly input to Belvoir was set at 1,800, Wood at 1,660 (1,260 white and 400 Negro), and Abbot at 1,240.[42]

The centers were to lengthen or shorten the programs of the battalions already in training in order to provide as even a monthly output as possible during the transition period, the remaining months of 1943. But the centers found it impossible to level off the output and stay within the authorized capacities. There were too many uncontrolled sources feeding into them—overshipments from reception centers and rejects from OCS, ASTP, and trade schools. Graduates from the ERTC's were at times held for over two weeks before being transferred. Civilian and service school graduates awaiting shipment and physically unfit men awaiting further disposition swelled the totals. Neither capacities nor outputs could be controlled through 1943.

Although the lower input made the battalion setup awkward, it was not quite small enough to warrant a change to reception by companies. To handle the smaller increments, Abbot reorganized in early October 1943 from seven battalions to nine and reduced the number of companies in each battalion from four to three. The Wood center retained the same nine and a half battalions but split the training in four of them, starting part of the companies in these battalions behind the others as necessary. The multiple stages of training resulted in

[41] Unless otherwise noted, this section on the balanced engineer replacement is based upon: (1) 353, ASFTC Wood, 7-12-41–1-3-46 and 5-6-41–12-8-42; (2) 354.1, Engr RTC, Tng Div ASF; (3) Wood, 333.1, Inspec Rpts by Visiting Offs; (4) 333.1, Inspecs, 1 Aug 43–20 Nov 43, CofS Job A 44–21; (5) MTP 5–6, 1 Aug 43; (6) 333.1, Rpt of Maj Inspecs, ASFTC Belvoir, 1944; (7) Hq MDW, Notes on ASF Tng Conf, Camp Lee, Va., 20 Oct 43, EHD files; (8) 400.34, ERTC, Pt. 1, Corresp; (9) Wood, 333.1, Inspecs, Vol. 3; (10) Belvoir, 470, Ammunition, Armament, and Similar Stores, 1943; (11) Belvoir, 354, Camps and Maneuvers, A. P. Hill, 1943; (12) Study, Rotation of Pers, prepared by ExO Dir Mil Tng ASF for Fourth ASF Tng Conf, Ft. Monmouth, N. J., 15–17 Mar 44, P&T Office File, Tng Conf, 15–17 Mar 44, Rotation of Pers; (13) 353.15, ERTC Belvoir; (14) 353.15, ASFTC Wood; (15) 353.15, ASFTC Abbot.

[42] (1) Ltr, TAG to Cs of Svs, 28 Aug 43, sub: ASF RTCs. 353, ETC Belvoir, Pt. 2. (2) 1st Ind on above ltr, Asst CofEngrs to CGs ERTCs Belvoir, Wood, Abbot, 1 Sep 43. 353, ETC Belvoir, Pt. 2; 320.2, ASFTC Wood; 353, ERTC Abbot.

a much less economical use of cadre and facilities. By late October each of the ERTC specialist courses at Wood had six different stages of training going on at the same time. Belvoir also kept the existing battalion organization but tried not to split training. The Belvoir plan to receive trainees every other week did not coincide with the monthly input schedule. Four times out of a year a longer interval was necessary between trainee shipments. The authorized capacity also had to be exceeded frequently, and a very tight schedule had to be maintained.

Additional complications stemmed from the fact that while the regular trainee increments arrived on a monthly schedule the centers operated on a weekly basis. This lack of co-ordination between planning and training agencies was resolved in January 1944 by a new trainee input schedule based upon thirteen four-week periods each year instead of calendar months. The trainee allotments for each period were scaled downward accordingly. The Belvoir input for each period was set at 1,661, Wood at 1,532 (1,163 white and 369 Negro), and Abbot at 1,144.

This downward revision did not prevent the continued overproduction caused by the irregular number of men received by the centers as casuals. In addition, the centers were responsible after December 1943 for refresher or partial training of men returned from overseas, released from deactivated units, or declared surplus in station complements. The Belvoir center by the end of January 1944 estimated its excess for each four-week period at 200 men.[43]

With the invasion of Europe imminent, replacement estimates climbed sharply within a few weeks. On 6 March 1944 another revision raised the trainee inputs for each period and returned the maximum capacities to previous levels at Belvoir and Wood. Abbot remained about the same. The input for each four-week period at both Belvoir and Wood was set at 1,900 (1,300 white and 600 Negro at Wood), Abbot 1,100. The trainee capacity at Belvoir was raised to 9,750, that at Wood to 9,875, while that at Abbot was lowered to 5,775. Although the higher number of trainees at the centers should have simplified the organization once more, it placed an immediate increased load upon reduced cadres. The new figures were as inflexible as before. Apparently the desire for a uniform flow of trainees from induction to replacement outweighed the very real training difficulties which this system imposed.[44]

The program developed for the longer training period in August 1943 struck a balance between the production of specialists and versatile engineer soldiers. "The program provides a uniform amount of military, tactical and technical training during and in addition to the training of the soldier in his specialty," observed Gorlinski. "This training is considered the minimum amount necessary to make an engineer soldier as well as a specialist out of the trainee. It follows recommendations from all theaters of operations which emphasize that, while training

[43] (1) Ltr, ERTC Wood to CofEngrs, 1 Oct 43, sub: Maximum Authorized Trainee Capacity, with 2d Ind, AC O&T Br to CG ASF, 11 Oct 43. 320.2, ASFTC Wood. (2) 1st Ind, 5 Nov 43, on Memo, CG Ft. Belvoir for CG ERTC, 29 Oct 43. Belvoir, 337, Confs, 1943. (3) Ltr, CG ERTC Belvoir to CofEngrs, 15 Nov 43, sub: Request for Permission to Exceed Authorized Trainee Capacity. 353, ASFTC Belvoir, Pt. 2. (4) Ltr, TAG to CofEngrs, 4 Jan 44, sub: Intake of Pers at RTCs. 352.15, ERTC, Pt. 1. (5) ASF Cir 172, 31 Dec 43.

[44] (1) ASF Cir 66, 6 Mar 44. (2) Memo for Record, 15 Mar 44, sub: Reduction in Operating Pers at Ft. Belvoir, Va. P&T Div file, Engr Sch Orgn.



CLASS IN DRAFTING AT A CIVILIAN UNIVERSITY *under the program to train Engineer enlisted specialists, 1942.*

in a specialty is desirable it should not and cannot take the place of a thorough training in military, tactical and technical subjects." [45]

All battalions which filled after August 1943 began on the revised seventeen-week schedule. Basic military training increased from five to six weeks and basic technical training from seven to eight weeks. Specialists in training at the ERTC's received their instruction after the first six weeks of military training and during the eight weeks in which the rest of the trainees were learning basic engineer tasks. In the last three weeks of the seventeen, all of the trainees were given a period of team training under field conditions.[46]

Since by this time the critical shortage of technicians had been overcome, most of the candidates for specialist schools received the full seventeen weeks of training. The reduction in the demand for specialists coincided with a similar falling off in requirements for officers from OCS and a consequent opening up of additional facilities for enlisted men at Fort Belvoir. The immediate result was a sharp curtailment in the use of civilian schools and a rise in the number of courses and in the enrollment of enlisted specialist candidates at the Engineer School.

The first cut was in Army Air Forces specialists. Production for the AAF would continue at the rate of 700 per month

[45] Office Memo, Gorlinski for Sturdevant, 7 Aug 43, sub: Inspec of ERTC, Camp Abbot, Ore. 353, ERTC Abbot.

[46] (1) MPT 5–6, 1 Aug 43. (2) 4th Ind, Mil Tng Div ASF to TAG, 7 Sep 43, on Ltr, ERTC Belvoir to TAG, 24 Aug 43, sub: Interpretation of Basic Tng. 353, Pt. 23.

through June 1943, ASF's Training Division notified the Engineers, but beginning in July the number would be cut 50 percent. The Engineers hastened to terminate contracts with the two civilian schools which had been training electricians and draftsmen for AAF units, the University of Kentucky and the Virginia State College for Negroes. By the end of the year only four civilian institutions were still serving the Engineers.

Enlisted specialists such as draftsmen, surveyors, and aviation engineer equipment operators, formerly taught by civilian schools, shifted to the Engineer School, and between October 1943 and December 1944 the school graduated a total of 5,568 men. A substantial number of school-trained specialists were also produced at the Granite City Engineer Depot, which gave instruction in the maintenance of mechanical equipment, advanced machine shop practices, welding, and carburetion and ignition.[47]

The ERTC's were allowed considerable freedom to experiment with the allocation of time and the sequence of subjects to be given under the seventeen-week program. A certain amount of confusion resulted from the fact that they had as guides two MTP's, one published by ASF, the other by OCE. Although the OCE program was supposed to incorporate all of the ASF program the two varied, particularly in the spacing of the hours for subjects. The Wood center by January 1944 had settled for its own version of the OCE program. The OCE schedule had been carefully arranged to allow for a more logical sequence of instruction than that of ASF. In some instances ASF had prescribed more instruction than time permitted. Hours for physical conditioning were badly spaced in relation to some strenuous marches. Transition firing and technique of fire were so scheduled that the trainee would have to be taught combat range firing before having had adequate instruction in range estimation, target designation, landscape firing, or combat principles. Both in total hours and in the division of time the planning of OCE more nearly met engineer training requirements than did that of ASF.[48]

The allocation of hours to the various subjects for the regular engineer replacements as set forth in the MTP published by OCE reflected the change toward realism and the increased emphasis upon physical hardening. (*See Table 6.*) More time was allotted to Engineer subjects. New subjects which appeared for the first time in the published MTP included infiltration, village fighting, hand-to-hand combat, map reading, booby traps, and antipersonnel mines. Thirty-two hours were given to laying mines and gaining passage through mine fields. Night operations increased to a total of fifty-six hours, all of which were in addition to the scheduled forty-eight hours for each week. The hours for hygiene and sanitation were increased to include a more thorough explanation of malaria prevention since by this time many of the major campaigns of the war were being conducted in areas where the control of this disease was of prime importance. An orientation course intended to integrate the trainee more easily into the military system and to keep him in-

[47] Engr Enl Specs, pp. 15, 16, 48, 91.

[48] (1) 1st Ind, CG ERTC Wood to CG Seventh SvC, 7 Jan 44 (basic missing). Wood, 353, Tng Gen. (2) Ltr, ExO ERTC Belvoir to CG Ft. Belvoir, 25 Apr 44, sub: Tng—First Corrective Action Rpt. Post Hq, Belvoir, 333.1, Rpt of Maj Inspecs, ASFTC, 1944.

formed on current developments of the war added seventeen hours to the program.[49]

A part of the enthusiasm for the new program had been based upon the consideration that better basic engineer soldiers would emerge than those so hastily trained in the past. For one thing, the new soldiers should shoot better. There was indeed a steady improvement in marksmanship scores. Monthly qualification reports exceeded the ASF 80 percent mark at all three centers. Belvoir and Abbot, which trained only white troops from August 1943 to June 1944, rarely fell below a 98 or 99 percent rating. Wood trained both white and Negro troops and its average was a few points lower.

Although ammunition and weapons shortages were much less severe after the fall of 1943, there were some exceptions. In an effort to provide engineer units with a more effective defense against aerial attack practically all of these units were issued the .50-caliber machine gun in February 1943, but low training priorities and a meager ammunition allowance had precluded any effective center training in firing the weapon. Additional ranges, more .50-caliber guns, and an increased ammunition allowance improved this situation somewhat by the spring of 1944, although there remained a disproportionate amount of .30-caliber machine gun training.[50] Flame throwers, which were needed in both demolition specialist training and in the regular program for assault demolitions, continued to be scarce. The allowance of antitank rockets was never raised above one for every fifty men despite the insistence of OCE, after pressure from the centers, that each man should fire at least one rocket for minimum familiarization. As late as October 1943 there was still little prospect of obtaining sufficient captured enemy equipment. At that time ASF indicated that absolute essentials would be provided when possible on a priority basis by G–3. By March 1944 the enemy mines requisitioned by Wood still had not arrived.[51]

With the adoption of the longer program in August 1943, the centers eliminated the twelve-week and five-week battalions and simplified the handling of ERTC specialists. One company from each of the seventeen-week battalions became a specialist company. All of the companies had the same basic military training during the first six weeks. At the end of six weeks the specialist company in each battalion reported to the ERTC specialist courses for the next eight weeks while the rest of the battalion continued the regular program of basic technical work. At the end of the eight weeks of separate work the specialists and the regular trainees were brought back together for the last three weeks of field training.[52]

The cadre for the specialist company, about 5 officers and 22 enlisted men, remained with the company as assistant instructors during the eight weeks of specialist training. This cadre also conducted what little military and basic technical instruction was given to specialist candidates, 85 hours

[49] (1) MTP 5–6, 1 Aug 43. (2) Ltr, AC of Office of the Surgeon General to CG ASF, 13 Sep 43, sub: Malaria Control. 353, Engrs, Mil Tng Div ASF.

[50] Ltr, Adj ERTC Belvoir to CofEngrs, 9 Dec 43, sub: Change to T/A 5–1, with 2d Ind, Adj MDW to CG ASF, 21 Jan 44. 400.34, ERTC, Pt. 2.

[51] (1) Ltr, C of War Plans Div to CGs ERTCs Wood, Belvoir, Abbot, 19 Feb 44, sub: Assault Demolitions. 353, ERTC, Pt. 1. (2) Memo, AC of Equip Br for CG ASF, 1 Sep 43, sub: Captured Enemy Mat for Tng Purposes, with Incls, Lists for ERTCs. 386.3, ERTC.

[52] 2d Ind, CO ERTC Belvoir to CG Ft. Belvoir, 29 Mar 44, sub: Course of Instr for USMA Grads in 1944 Asgd to Corps of Engrs (basic, 3 Mar 44, missing). 352.11, Engr Sch, Pt. 17, Corresp.

for those platoons in the ASF courses and 120 hours for those in OCE courses. All were required to run the infiltration and village fighting courses and spend a few hours in map reading, mine laying, drills, physical conditioning, and guard duty.

Twenty-five percent of the replacements produced by the three centers between July 1943 and June 1944 qualified as basic specialists. Out of a total of 63,458 trainees who completed ERTC training, over 15,600 were specialists. The Negro battalions, concentrated at Wood, produced one less man each than the white battalions in almost all of the specialties. Accurate selection and assignment of men for specialist training had much to do with the high number of qualifications at the end of the courses. Less than 5 percent of the men sent to specialist companies at Belvoir proved to be misfits.

After fourteen weeks of instruction in basic and ERTC specialist subjects the trainees learned to operate in units and realized more fully how each would fit as a replacement into a working Engineer organization. But since for many the type of unit used for these exercises was not the type to which they would ultimately belong, this phase was an experience in teamwork rather than in realistic unit training. The trainees lived in the field during this time. Bivouac areas were dispersed and camouflaged, foxholes were dug and occupied during simulated attacks. Shelter halves were the sole protection against the weather. Field kitchens prepared the food. Mine laying, demolitions, bridge, road, and obstacle building were carried out on difficult terrain through rain, snow, and penetrating mountain fog.

Team training required much more space than that needed for the individual instruction given previously. Only the Fort Wood center had enough land close by. The area used at Abbot was quite far from the cantonment. Belvoir had no such area for miles around. A part of the A. P. Hill Military Reservation to the south of Belvoir was open to the Engineers, but since Quartermaster and Ordnance troops were already in training there the ERTC elected to use a part of the Shenandoah National Park in the vicinity of Luray, Virginia. The Big Meadows site, at an elevation of 3,500 feet, offered a rugged and varied training ground. Construction and repair of roads, trails, and bridges provided valuable experience and the permanent nature of the work gave the trainees a sense of accomplishment. But the use of the area was hedged about with restrictions. Care had to be taken to preserve the natural features of the park, and to avoid damaging individual objects of geological or historical value. Road and bridge construction had to be approved in advance by the park superintendent. Such work was exhausted within a few months and by September 1944, the Belvoir center was compelled to shift this training to the A. P. Hill Military Reservation after all.[58]

Although the three weeks of team training were authorized on 1 August 1943, several months elapsed before the centers began to produce replacements with such training. The selection of training sites and the procurement of special winter clothing and bedding and minimum unit equipment took time. Trucks, tractors, tents, tools, stoves, air compressors, machine guns, radio sets, mine detectors—practically all of the operational equipment for the field

[58] (1) *Belvoir Castle*, 22 Oct 43; 24 Mar 44. (2) Tng of Repls, Annex I. (3) Interv, Col Louis W. Prentiss, 20 Nov 52. (4) Interv, Col Paschal Strong, 28 Nov 52.

units—had to be added to the existing center allowances, which could not be stretched to cover this additional demand. Heavy mittens, wool mufflers, and sleeping bags had to be provided to temper somewhat the abrupt change from the previous fourteen weeks of training while housed in barracks. Wood and Belvoir did not give their first team training until early October and Abbot not until December.[54]

More time and equipment and the introduction of realistic field exercises produced a better qualified basic engineer soldier, but attempts to insure more effective utilization of available manpower gradually came to have a detrimental effect upon replacement training. In addition to the normal reductions in cadre which accompanied the decreased size of the centers during most of this period there were continuous cuts in the suballotments beyond that point. In October 1943 ASF determined that training installations were overstaffed if the officer complement was over 4 percent and the enlisted cadre over 18 percent of the trainee load. Although intended merely as a starting point from which to calculate training needs according to the amount of technical training given at the various centers, the suballotments to the Engineer centers from the service commands soon pointed to this yardstick as an absolute standard of efficiency. Less than a month after these percentages were set down both Wood and Belvoir warned that the quality of training had been impaired as a result of cadre shortages. For months thereafter the Wood ERTC tried without success to get permission from the Seventh Service Command to reorganize into fewer and larger companies in order to have enough cadres for each unit. By the middle of March 1944 Belvoir indicated that inferior training had resulted from the repeated cuts and that any further cadre decreases would entail reductions in training activities. In line with the general findings of the ASF staff that the smaller centers could be operated more economically than the larger ones, the Abbot center offered little objection to the reductions. A work load study completed by ASF in March 1944 placed the Engineer centers fairly high upon the efficiency list, the Wood center being the only one that was out of line to any extent. Of the sixteen ASF centers, Abbot, Belvoir, and Wood placed fifth, sixth, and eighth, respectively. Although the study indicated that the Wood ERTC was overstaffed, ASF recognized that a proportion of cadre above the yardstick was necessary since most of the instruction of substandard Engineer trainees was done there. The necessity for further reductions at all centers was emphasized.[55]

Such a work load study measured only the numerical proportion of cadre to trainees. It did not take into consideration the changing quality of the instructors at the centers. If an experienced and capable cadre could have been kept throughout this period, a smaller number of people might well have done a comparable job. It was during this same period of reductions, however, that other economy measures for the use of manpower began to drain from the ERTC's the very people who might have been able

[54] Ltr, ExO ERTC Belvoir to CG MDW, 24 Sep 43, sub: Special Equip for Trps During Unit Tng in Shenandoah National Park. Belvoir, 475, Equip of Trps, 1943.

[55] (1) Memo, CG Ft. Belvoir for CG ERTC Belvoir, 29 Oct 43, with 1st Ind, 5 Nov 43. Belvoir, 337, Confs, 1943. (2) Tel Conv, Dir Tng Div Seventh SvC to CG ERTC Wood, 5 Feb 44. Wood, 311.3, Summary of Tel Convs, 1944. (3) Work Load Studies, prepared by Office Dir Mil Tng ASF for Fourth ASF Tng Conf, Ft. Monmouth, 15–17 Mar 44. P&T Div file, Tng Conf, 15–17 Mar 44, Overhead—Work Load Studies.

to handle the increased work load. Late in 1943 the War Department became concerned over the number of men qualified for overseas duty who were serving in training positions in the United States. These men should be at the battle fronts. Accordingly on 8 December 1943, ASF directed that qualified officers and enlisted men who had served for eighteen months or longer in training assignments be released as soon as understudies could be prepared for their positions.

An even more stringent rotation policy for enlisted personnel was introduced on 24 January 1944 upon the orders of Lt. Gen. Joseph T. McNarney, Deputy Chief of Staff. Physically qualified men under thirty-five years of age who had been in the Army for a year without overseas duty had to be reassigned by 30 June 1944 to units slated for overseas movement. These enlisted trainers or other overhead personnel were to be replaced by men over thirty-five, the physically handicapped, those with less than twelve months service, returned veterans, and wherever feasible by Wacs and civilians.[56] Few positions at replacement centers could be filled by Wacs or civilians. The physical toughening which had been introduced into all phases of the training program required physically fit trainers and made the selection and use of physically handicapped and older men a difficult matter. Brig. Gen. Creswell Garlington, commander of the Wood center, warned that "the men (and officers for that matter) who participate personally with the trainees in the training program, must be men of great stamina and a high degree of physical fitness. If they are not, we will not be able to maintain the training standards set for us by the ASF itself." [57] Men with less than twelve months service were inadequate substitutes for men who had been in the Army for several years. The obvious answer was more veterans. One of the avowed aims of the rotation system was to channel a substantial number of men with combat experience into training positions. Unfortunately, combat experience alone had little to do with a man's ability to instruct others, and men of recognized teaching ability could not be requisitioned from overseas. Selections had to be made from those sent back through the normal operation of the rotation system, and many were not desirable cadre material. Shortly after the new policy went into effect Garlington observed that "the majority of replacements from overseas received to date have been either physically, mentally, or emotionally unfit to stand the rigors of the training program." [58] The Military Personnel Branch of OCE agreed that few officers returned through rotation were qualified for assignments in training staffs.[59] In the opinion of Col. Louis W. Prentiss, executive officer for the Military Training Division of ASF and formerly executive officer of the ERTC at Belvoir, the explanation for this was simple:

> The driblets which have been coming back up to now have not given any promise of being good trainer material for the reason that there has been a tendency upon the part of the theater commanders to send back many of the border-line cases, which they could get rid of through no other means. The reaction in the theaters to such tactics has been as might be expected; the men, learning that they could return to the United States only by doing an indifferent job, began to do an indifferent job, and the theater commander,

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[56] ASF Cirs 143, 8 Dec 43, and 26, 24 Jan 44.

[57] Ltr, CG ERTC Wood to CG Seventh SvC, 2 Feb 44. Wood, 312, Gen Garlington's Corresp file.

[58] *Ibid.*

[59] Rpts, Mil Pers Br, 15 Jan 44; 15 Feb 44. 020, Engrs Office C of, Pt. 14.

perforce, had to revise the standard for those eligible for rotation. Consequently we expect to see better material coming back in the future.[60]

The Engineers were not required to give up all their experienced instructors. On 25 February 1944 ASF exempted from immediate reassignment those instructors whose duties were of a highly technical nature and for whom there were no adequate replacements.[61] As a result, the quality of Engineer technical training showed less deterioration than did basic military training. By the spring of 1944 basic military training at both Belvoir and Wood was badly disorganized. Inspection teams reported inadequate supervision, lack of correlation of subject matter, wasted time, poorly handled equipment, and slavish dependence upon the letter of the lesson plans. The quality of basic military training at Belvoir had deteriorated below the standards of comparable training establishments and that at Wood was unsatisfactory. The quality of the cadre at Belvoir was so poor that the total number of training hours had to be cut back in order to give the cadre more time for preparation. The same reasoning which delegated nonstandard equipment to the centers during the period of matériel shortages operated during the period of personnel shortages to reduce the number of capable and experienced instructors. Personnel restrictions had brought about a curious paradox. The quality of basic instruction declined during a period in which all phases of training should have improved.

The training of engineer replacements under ideal conditions was first prevented by limitations of time, then by the allocation of used equipment to the centers, then by administrative restrictions and personnel shortages. That overseas theaters had first call upon the experienced and the skilled and upon the best in equipment there can be no doubt. But those who believed that training centers staffed with inexperienced instructors and nonstandard equipment could supply men who would run this equipment efficiently were fooling themselves. Standard arms and equipment might well have repaid several times over in increased operating efficiency, less deadlining of machinery, and decreased maintenance. An adequate and early rotation system could have maintained both combat proficiency and training efficiency. Planners showed scant realization of or regard for the degree of disruption which resulted from what were undoubtedly considered minor changes or restrictions. Lack of co-ordination among the agencies responsible for training created unnecessary confusion. Although training doctrine was developed by the Chief of Engineers, the conduct of training of all ASF replacement centers, including the ERTC's, became the responsibility of the service commands, and in the case of Belvoir, the Military District of Washington. Different interpretations by these three commands could disrupt the uniformity of training desired by all. But such conditions were only additional manifestations of the basic War Department attitude which mistakenly relegated replacement training to a relatively unimportant place as revealed by the low priorities and lack of a definite program to provide adequate instructors.

With the exception of basic training the over-all quality of engineer replacements showed steady improvement. Facilities were gradually expanded; equipment increased.

[60] Study, Rotation of Pers, prepared by ExO Dir Mil Tng ASF for Fourth ASF Tng Conf, Ft. Monmouth, 15–17 Mar 44. P&T Div file, Tng Conf, 15–17 Mar 44, Rotation of Pers.

[61] ASF Cir 58, 25 Feb 44.

Each center showed remarkable ingenuity in developing its own training aids and making the best use of materials at hand. The introduction of more realistic instruction provided the trainee with more useful information as well as a better physical and psychological preparation for his immediate future environment, improving his chances for survival and the performance of his mission. The production of specialists multiplied. Between May 1941 and June 1944 the ERTC's produced some 40,874 specialists out of a total of 216,662 men. The longer training time produced such a superior nonspecialist engineer replacement that he was given a special SSN designation so that he would not be confused with the basics from other branches, many of whom received only six weeks of training. From a preponderance of common military subjects, course content shifted until a balance was struck between instruction common to every enlisted man and the infusion of technical knowledge which was the distinguishing mark of the engineer soldier.[62]

[62] (1) Interoffice Memo, Asst Dir Pers Div ERTC Wood for Dir Pers Div ERTC Wood, 24 Feb 44. 353, ASFTCs. (2) Memo, ExO Mil Tng Div ASF for Cs of Svs, 15 Apr 44, sub: Rev Loss Repl Rqmts for Jul to Dec 44, with Incl, Repl Rqmts, Engrs. 320.2, File 2 (S).

CHAPTER XII

Centralized Unit Training for Army Service Forces

One of the first signs of the emerging importance of engineer service units after Pearl Harbor was the organization and training of over sixteen thousand men for construction in the Middle East and in the United Kingdom.[1] Only a fraction of this number went to the Middle East. Instead, most of these men were absorbed into the broadening stream of service unit activations which followed the publication of the troop basis of July 1942. From mid-1942 on, preparation of service units claimed a large part of the Engineers' training effort. Whereas AGF and AAF were responsible for engineer ground force units and engineer aviation units, the Corps of Engineers itself, under the general direction of ASF, assumed the primary job of developing engineer service units.

West Camp Claiborne: The Experimental Phase

The five special service regiments, seven general service regiments, and ten dump truck companies which the Engineers activated for special construction jobs in the spring of 1942 were to construct ports, roads, railroads, barracks, and shops—jobs which required a high proportion of foremen and skilled workers. Since these units were needed long before such a highly skilled group of men could be trained, the War Department allowed the Engineers to recruit men under forty-five who had civilian experience requisite for the positions. Under the assumption that these men would be technically qualified for their jobs, the units were to have only six weeks of basic military training before assignment overseas.[2]

In searching for a camp where training could begin immediately the Engineers found only one site large enough—West Camp Claiborne, Louisiana. It was a temporary field tent camp in rather poor condition which even after much improvement was never considered desirable for training engineer units. Large numbers of troops were already concentrated in several nearby camps, at Polk, Livingston, Beauregard, and the main camp at Claiborne, as well as at three airfields near Alexandria. Recreational facilities at the adjacent towns were overtaxed. Training areas were restricted, and firing ranges were insufficient. But since the Engineers did not intend to give these construction units any tactical or technical training and did not contemplate occupa-

[1] See above, pp. 143–44.

[2] Unless otherwise cited, this section on the Claiborne PEOC is based upon: (1) 322, Engrs Corps of, Activation of Constr Units, Folders 1 and 2 (S); (2) 353, ASFTC Claiborne, Pt. 1; (3) 322, ASFTC Claiborne; (4) 320.2, ASFTC Claiborne; (5) 333.1, ASFTC Claiborne; (6) 319.1, ASF Engr Units, Pt. 1.



BRIG. GEN. JOHN W. N. SCHULZ, *seated next to driver, and members of his staff, West Camp Claiborne, La., 1942.*

tion of the camp for more than four months, the site did not have to be ideal.

West Claiborne was located approximately sixteen miles southwest of Alexandria in the rolling cutover timber land of the Kisatchie National Forest. It lay about two and a half miles from the main camp and occupied very rough and broken ground on the south slope of a ridge cut by several drainage valleys. At the time the Engineers decided to move in, during March 1942, it presented a desolate picture of bare tent frames, a few small administrative and mess buildings with felt paper siding and no flooring, pit latrines, and an open drainage sewage system. Gravel roads connected the main parts of the camp but there were no sidewalks or duckboards. Tents and buildings had been laid out on a set plan without reference to local topography and part of the camp was subject to frequent flooding by surface water. The impervious red clay underlying the thin sandy topsoil served when wet to form a thick plastic mass in which vehicles mired to the axles whenever they left a prepared roadbed.[3]

Brig. Gen. John W. N. Schulz, who was to supervise the training of the units at Clai-

[3] (1) Completion Rpt 1942, West Camp Claiborne No. 4, 15 Jun 42, p. 1. (2) Ltr, Col W. N. Taylor to TIG, 12 Feb 42, sub: Special Investigation of Constr Activities of Temporary Tent Camp at Camp Claiborne, La. 652, Claiborne, Vol. 3. (3) Memo, Robins for Schulz, 4 Apr 42, sub: Additional Constr West Camp Claiborne, La. Same file.

borne, came from Under Secretary of War Patterson's office, where he had served as Director of Purchases and Contracts. In March 1942, Schulz made a preliminary survey of the Claiborne site during several days of constant rain. In a depressed mood he wrote the Chief of Engineers detailing the many deficiencies of the camp, concluding that "the use of west Camp Claiborne for the Organization Center is not desirable if it can be avoided . . . . [but] there appears to be no alternative . . . ." He predicted gloomily that "this will mean, almost certainly . . . that this camp, once used, will be continued in permanent, or at least frequent, intermittent use . . . ."[4] His prediction proved correct. Within a few months West Camp Claiborne developed into the first Engineer Unit Training Center. General Schulz remained in command until October 1943.[5]

To supervise the training of these units through mid-July, Schulz set up a Provisional Engineer Organization Center (PEOC) on 1 April. The Claiborne PEOC consisted of a small group of fourteen officers selected from the pool under the control of the Chief of Engineers and sixty-three enlisted men from the ERTC's at Belvoir and Wood. In the tactical units themselves commanders of all but two of the twelve regiments were Engineer officers with previous military experience in the Regular Army, National Guard, or Engineer Reserve. Each regiment had two former sergeants; one served as adjutant and the other as supply officer. The rest of the unit officers were commissioned from civilian life on the basis of their construction experience. Regimental commanders recruited many of them personally. District Engineers recommended some. OCE selected still others from applications on file. A trucking association furnished officers for a number of the dump truck companies. Cadres, chosen largely from men found surplus in grade upon the triangulation of square divisions, came from the Second and Third Armies. The poor quality of the cadres so obtained would indicate that the divisions disposed of many undesirables in this manner. Realizing that the draft would fail to produce the 10,000 specialists required for these units, the Engineers conducted an intensive campaign for voluntary enlistments between 10 April and 20 May. In an attempt to get the right proportion in each specialty, reception centers all over the country screened these fillers for assignment to Claiborne.[6]

Cadres and fillers were supposed to arrive at Claiborne in six increments, one week apart, the cadres one week ahead of their respective fillers. The normal weekly increment was to be two regiments and two dump truck companies. If no other units had been ordered in, the center would have built up to a peak load in the latter part of May and dwindled thereafter. Cadres for the first units arrived on schedule on 15 April, fillers a week later.

Training under a special six-week MTP, derived from the eight-week program then in effect at the ERTC's, began on 27 April. Since the men were supposed to be technically competent already, this MTP went

[4] Memo, Schulz for CofEngrs, 25 Mar 42, sub: Engr Orgn Center for Constr Regts and Dump Truck Cos. 322, Engrs Corps of (S).

[5] GO 32, Camp Claiborne, 20 Oct 43. EHD file, EUTC Orders, 1942–44.

[6] (1) GO 12, OCE, 1 Apr 42. (2) List of COs Constr Regts, 12 Mar 42. 322, Engrs Corps of (S). (3) Ltr, TAG to CGs, Second, Third Armies, SOS, and Fourth, Sixth, Seventh, and Eighth Corps Areas, 24 Mar 42, sub: Activation of Engr Units Required for Militarization of Overseas Projects. 210.3, Engrs Corps of, Pt. 21.

even further than the abbreviated ERTC program in eliminating Engineer subjects: [7]

	ERTC Eight Weeks	*PEOC Six Weeks*
Total	352	244
Basic	92	90
Technical		
Combat	86	80
Engineer	102	36
Tactical	40	14
Open time	32	24

With its emphasis entirely upon the production of an individually trained soldier, this program could scarcely be called unit training. It included no practical training in engineer tasks. There was no provision for building roads, bridges, or obstacles, no time allowed for demonstrations in rigging or general construction. There were no night operations, and there was but a minimum of tactical teamwork. The time given to basic military subjects was almost equal to that at the ERTC's.

Conditions at the PEOC made even this simplified program difficult to administer. The two officers and eight enlisted men in the Training Section proved insufficient for the guidance and control of 16,000 men. Capable unit officers and enlisted men had to be called upon frequently for staff duty. The details of actual training were to be handled by the unit officers, but except for the regimental commanders the unit officers had no more military experience than the troops. These new officers were not commissioned on schedule and after commissioning had several days of leave before reporting to the PEOC. According to the harassed executive officer they were "fooling around all over the country." [8] After arrival, they had to have two weeks of indoctrination before assignment to training duty. In the meantime, the bulk of the responsibility fell upon a group of forty officers loaned to the center from the ERTC's in the latter part of April. A few of these ERTC officers ran a school for the new unit officers. Others moved along from one regiment to another, staying only until the incoming unit officers qualified for duty. Another temporary source of experienced trainers was the group of officers that brought the cadres to the center, some of whom were held as long as four weeks before being returned to their home stations. The forty officers on temporary assignment began to receive orders to other stations by late May, just as the training load reached its height. After repeated appeals from Schulz for a more permanent staff, OCE on 1 July finally increased the allotment of officers to the PEOC headquarters from fourteen to forty.[9]

An equally serious obstacle in preparing these units for overseas service was the failure by the reception centers to provide fillers at the right times, in sufficient amounts, and with desired skills. Despite the special recruiting, too few men from the construction industry found the prospect of military service attractive. With the military construction program approaching its peak, jobs were plentiful and working on them was considered patriotic. Some corps areas fell short of their quotas by several hundred. At the end of May six of the units had been forced to postpone training a week or more be-

[7] (1) MTP—Engr Constr Regts and Dump Truck Cos [26 Mar 42]. 322, Engrs Corps of, Activation of Constr Units, Folder 1 (S). (2) See Table 5.

[8] Tel Conv, ExO PEOC to C of O&T Br, 20 Apr 42. 322, Engrs Corps of, Activation of Constr Units, Folder 1 (S).

[9] (1) Ltr, CG PEOC to CofEngrs, 2 Jun 42, sub: Offs for EOC, Camp Claiborne, La. 210.3, ASFTC Claiborne, Pt. 1. (2) Ltr, C of Mil Pers Br to CG PEOC, 1 Jul 42, sub: Allot of Offs, AUS. 320.21, ASFTC Claiborne.

cause of delays in receiving fillers. Dump truck companies had not filled at the same time as the regiments with which they were to operate. The first ten regiments and corresponding dump truck companies had received only 1,535 of the 5,750 specialists needed in some seventeen categories. The same units contained a surplus of 2,413 nonspecialists. Schulz, perturbed lest the units reflect no credit upon the center or the Engineers, wrote to Sturdevant in early May:

> I am deeply concerned about the matter since the regiments at Claiborne will be supplanting contractors' trained employees who have been carefully selected at premium pay and should be expected to have developed construction teams of considerable efficiency. The regiments, on the contrary, are untried aggregations of individuals selected more or less by chance and, at present, lacking many of the necessary skills. . . . At best the contrast between the contractor's performance and the regiment's may be expected to be unfavorable until they have developed some team play. . . . Any delays or falling off in production will subject the Corps and the regimental commanders to severe criticism.[10]

The specialist shortage reached 3,126 by mid-July. Withdrawal of OCS candidates and cadres for future units, sickness, and physical disqualifications further depleted the ranks. Such losses became critical when the first few units began to move out. Since they were required to leave at full strength, the center resorted to transferring men from later units to fill the earlier ones. By the end of July, when all twelve should have completed basic training, the enlisted complement of the last regiment numbered only 250 men. The entire unit had to be refilled and retrained.

Equipment and training areas were no more adequate than cadres and fillers. Equipment was supposed to arrive by 10 April and training areas were to be ready by the end of that month. However, publications such as field and training manuals, Army regulations, and War Department circulars could not be obtained in any quantity until July. Office supplies had to be borrowed for weeks. Shelter halves, packs, web equipment, and clothing were scarce for months. Despite the fact that the main emphasis was to be placed upon basic military training, no rifles appeared. In desperation, the center borrowed 1,600 Enfields from the main camp, but this number was insufficient for both general training and range work and the whole arrangement was unsatisfactory since the rifles were subject to recall at any time. The center at first used the crowded 100-target range at the main post during rigidly scheduled time allotments. The construction of 200 additional targets and the acquisition of 7,216 Springfields and Enfields in mid-July seemed a vast improvement to the officers at West Claiborne, but they continued to press for the authorized allotment of 11,459 M1's and carbines and for machine guns. The lack of suitable inclosed buildings for assembly and instruction further handicapped training. The only place to show training films during daylight hours was at the main camp theater, two and a half miles away.

Although it was soon apparent that most of the men classified as truck drivers needed specific instruction and experience in driving and maintaining military vehicles, the urgent administrative needs for the few vehicles on hand precluded their use for this purpose. When the first two regiments and dump truck companies began to fill in late April, the center had only two trucks for over 2,000 men—less than enough to haul

[10] Ltr, CG EOC Claiborne to ACofEngrs, 8 May 42. 322, Engrs Corps of, Activation of Constr Units, Folder 2. (S).

rations. Again the center resorted to borrowing, and finally a few trucks were issued to the units; yet there were still none for training drivers by mid-May when another crisis developed. Just as the PEOC approached its peak strength, the borrowed trucks had to be returned. There remained but twenty-five trucks for 16,000 men. A constant shuttle had to be maintained to get the incoming men and baggage from the troop trains. Perishable foodstuffs lay neglected. The hauling of rubbish and nonfood garbage was virtually abandoned. Sufficient trucks for pickup and delivery arrived in June, but none were forthcoming for driver instruction on the low priorities assigned. Schulz was convinced that unless driver training could be given the units would experience difficulty even in such a fundamental maneuver as moving vehicles from shipside. Two sets of heavy construction machinery—one for a general service and one for a special service regiment—arrived toward the end of April. The amount received sufficed to familiarize experienced construction men with the particular makes and models they would be using overseas and provided an opportunity to turn some of the men with no construction background into construction machinery operators.[11]

This attempt to add specialist training to an already crowded six-week program was indicative of the spirit of the PEOC. The small, overworked, but determined staff put in long hours of planning and supervision to overcome the worst effects of the primitive housing conditions, the poor quality of cadres, the military inexperience of the unit officers, the shortage of technically trained fillers, and insufficient weapons and equipment. Yet, had it not been for the high quality and responsible attitudes of the fillers, the obstacles might still have been overwhelming. Intelligent, mature, anxious to learn, willing to sacrifice much during the brief training period, these men maintained a healthy outlook and a high sense of mission.

The decision not to employ these units on construction in the Middle East and the United Kingdom as originally intended provided the necessary time for a more rounded program of training. Only the first few of the twenty-two units moved out with six weeks or less instruction. The majority remained for twelve weeks or more. In the absence of any definite information on when the remaining units would leave or where they would go, the PEOC staff determined upon a decentralized plan of concurrent basic military and unit training. Units prepared their own extended schedules based on the construction projects assigned to them and their own knowledge of their basic military deficiencies. Construction of a permanent nature provided valuable experience in organization and teamwork for any eventual employment.

Beginning early in June the regiments bivouacked in the field from one to three weeks on a variety of projects. Two regiments and four dump truck companies at a time worked on the Claiborne-Polk Military Railroad then being constructed between these two camps. One regiment alone laid 22 miles of ties and rails on this road, graded part of the hospital grounds and parade field, built 1.5 miles of road including two highway bridges, repaired an additional 7.1 miles of road, and built an office building complete with wash rooms and sep-

[11] (1) Memo, C of O&T Br for C of Proc and Distr SOS, 22 May 42, sub: Shortage of Motor Vehicles and Ord Matériel at EOC Camp Claiborne, La. 451.2, ASFTC Claiborne. (2) 1st Ind, 30 May 42, on Memo, ExO PEOC for CofEngrs, 20 May 42, sub: Equip for Units, EOC Camp Claiborne. 413.8, ASFTC Claiborne.



PONTON EQUIPAGE BEING UNLOADED *at water-filled gravel pit six miles from West Camp Claiborne, La., October 1942.*

tic system for the PEOC headquarters. On smaller tasks the regiments rotated battalions in the field while continuing supplementary basic military training for those at the camp. The additional time also allowed the units to bring the PEOC-trained construction machinery operators to a higher standard of performance through on-the-job training. Highly skilled operators from two regiments acted as instructors and supervisors of projects undertaken by less qualified regiments. The camp itself profited much from such projects. In addition to the rifle range, office building, and parade ground, the regiments constructed two obstacle courses and developed areas for training in field fortifications, antitank obstacles, camouflage, and demolitions in preparation for the more extensive engineer training to be given in the future. Dump truck companies lived in the field with the regiments to which they were attached and to the relief of Schulz received excellent driving experience and convoy practice hauling ties, rails, and ballast for railroad construction, materials for bridging, and dirt for roads and grading projects. Even though in the end the regiments and dump truck companies received much more practical training than had been planned, equipment shortages and topography imposed limitations. The two sets of construction machinery which had been adequate for familiarization were not sufficient for the unit train-

ing of so many regiments. No instruction in quarrying could be given in a country without rock nor could there be fixed or floating dock construction in the immediate area, which had no large bodies of water or streams of any size.[12]

West Camp Claiborne: The Permanent Center

Despite the unfavorable features of West Camp Claiborne, the Engineers became convinced that they had found the way to provide efficient unit training. A concentration of like units at one place made a small allowance of scarce equipment serve numerous units at the same time. Moreover, many of the ASF engineer units being activated in 1942 had officers drawn directly from comparable civilian positions but who had no knowledge of military procedures. A grouping of such units under the supervision of a few capable Engineer officers would provide uniform training with the least possible diversion of seasoned officers from troop duty.[13]

In June 1942, when the future of the center beyond 15 July was still in doubt, Schulz, despite his earlier misgivings, began to emphasize to OCE the importance of retaining the center for subsequent units. On 20 June O&T assured him that SOS was supporting the center against the opposition of AGF which also wanted the space. The final decision was in the hands of G–3 who seemed favorably inclined toward the Engineers. At any rate, OCE had authority to activate two more general service regiments at Claiborne under the same arrangements as before and it seemed likely that the center would not be closed on 15 July. Schulz, dissatisfied with this temporary reprieve, insisted that the provisional stage should not be prolonged indefinitely. By 29 June the final decision had been made. The Engineers were to retain West Camp Claiborne as a permanent Engineer Unit Training Center (EUTC), the pioneer unit training center in all the Army. Between July 1942 and the summer of 1943, when two new EUTC's at Camp Ellis, Illinois, and Camp Sutton, North Carolina, opened, all but a small fraction of ASF engineer units trained at Claiborne. As many as 31,000 men trained there at one time during the peak training period in the fall of 1943 and the average number in training each month during 1943 and 1944 was 23,000 and 16,500, respectively. In July 1942 the Engineers began to concentrate at Claiborne those units which required quantities of heavy equipment. The bulk of the many general service regiments and dump truck companies and all of the few special service regiments trained there. Heavy shop companies, base equipment companies, foundry

[12] (1) Ltr, Adj PEOC to CofEngrs, 19 Jul 42, sub: Status of Tng. 319.1, ASF Engr Units, Pt. 1. (2) Ltr, Adj PEOC to CofEngrs, 25 Jul 42, sub: Status of Tng. Same file.

[13] With exceptions hereafter noted, this section on the permanent center is based upon: (1) 353, ASFTC Claiborne, Pts. 1, 2; (2) 320.2, ASFTC Claiborne; (3) 320.21, ASFTC Claiborne; (4) 353, ASFTC Claiborne, Tng Offs for Units, Bulky; (5) 322, ASFTC Claiborne; (6) 330.13, Claiborne; (7) 413.44, ASFTC Claiborne; (8) 475, ASFTC Claiborne; (9) 353.15, ASFTC Claiborne; (10) 353, Engr Heavy Shop Units, Claiborne, Bulky; (11) 413.8, ASFTC Claiborne; (12) P&T Div file, Forestry Units; (13) Rpt, Col E. G. Paules, Engr Member WD Obsvr's Bd to CofEngrs, 16 Feb 44, sub: ETO Engr Obsvr's Rpt 2, 370.2, ETO (S); (14) Ltr, Adj EUTC to CofEngrs, 16 Dec 42, sub: Capacity of EUTC, with Incl ?, Units in Tng as of Midnight 15–16 Dec 42, 353, Claiborne (C); (15) Memo, Brotherton for Gorlinski, 12 May 43, sub: School Tng at the EUTC, Camp Claiborne, La., P&T Div file, Inspec—Claiborne; (16) Unit Training in the Corps of Engineers, 1 Jul 39–30 Jun 45, MS prepared by Mil Tng Div, OCE (hereafter cited as Unit Tng). EHD files.

detachments, petroleum distribution companies, and forestry companies, all of which needed permanent or semipermanent installations of heavy machinery, received instruction there from then on.

Once in command of a permanent unit training center, Schulz tackled the many complications accompanying its growth from a capacity of 16,000 to 25,000 men. He determined he would not run the EUTC on the shoestring basis of the PEOC. In June 1942 he prepared a T/O for 137 officers and 516 enlisted men, apologizing for the large size of the new organization only to the extent of hoping that it would not occasion too much shock and surprise in OCE. By mid-September his request had been approved and the officers allotted. The following month SOS approved a reduced enlisted allotment of 414 men.[14]

Meanwhile, Schulz worked out the procedures which he felt would best capitalize upon the advantages and opportunities inherent in a training center and at the same time sustain the continuity of leadership of the unit officers. The commanders were responsible for the conduct of training within their own units. At the outset, while awaiting fillers, unit officers were to prepare training schedules, subject to the approval of the EUTC Training Division, emphasizing weapons instruction and military discipline. Thereafter, the Training Division provided weekly schedules for each unit—schedules which showed an hourly breakdown of each day by subject, lesson number, and training area. Also provided were detailed lesson outlines for each subject, enough copies for each officer and NCO in each unit, including text references, lists of films, and a general plan of presentation. The EUTC staff manufactured training aids and distributed them as needed from a central warehouse. The center provided a supervisor at each of these sites to suggest the best use of these aids, to answer questions put by the unit officers, and to report to S–3 upon the quality of instruction.[15]

The number and the variety of units made it impossible for Schulz to maintain close personal contact with each unit. By October 1942 the center contained four regiments, eight separate battalions, and twenty-four companies or detachments, about 14,000 men in all, with prospects of six more regiments and three battalions to be activated soon. Since most of the unit officers had only a few weeks of military service and needed constant supervision, Schulz prepared in early October a decentralized organization which grouped the units into three training brigades of manageable size. OCE was reluctant to present this plan to SOS for approval, doubtless because it included a request for three brigadier generals.

Meanwhile, Schulz took matters into his own hands. He placed the diverse small units, equal in strength to two general service regiments, in a provisional battalion under the direction of an officer borrowed from one of the general service regiments. At the end of October he reorganized his entire command. On 1 November he announced to Sturdevant that he had taken advantage of the assignment of three Regular officers to the center to set up provisional training brigades and regiments. Around this windfall of three colonels the center was organized into two brigades. All of the regiments and most of the dump truck companies were placed in the first brigade.

[14] Ltr, Actg C of O&T Br to CG EOC, 17 Sep 42, sub: Table of Pers. P&T Div file, Orgn ASFTCs.
[15] Tng Memo 1, EUTC Claiborne, 22 Feb 43. EHD file, Tng Memos, Claiborne, 1943–44.

The second brigade was divided into two training regiments, one containing railway units, later transferred to the control of the Transportation Corps; the other a concentration of the smaller units in three battalions. In the first battalion were heavy shop companies; in the second, petroleum distribution companies and equipment companies; in the third, fire fighting detachments, utilities detachments, and depot companies. The executive officer of the center commanded the first brigade, and the three new officers the second brigade and the two training regiments.

A week later, Schulz explained his dilemma to his former boss, Under Secretary of War Patterson, who was in Louisiana inspecting several camps. A few days later Patterson, attending an SOS staff conference, expressed great satisfaction with the Claiborne EUTC. About the same time he wrote a note to Reybold commending the state of training at the center but strongly urging that the EUTC be reorganized into two training brigades. The Chief of Engineers replied that Schulz could set up whatever training groups he pleased, but an allocation of brigadier generals was out of the question.

Despite the fact that by November 1942 the center had an increased personnel allotment and a more efficient organization, neither development brought permanent relief. The new organization depended upon the three Regular Army officers assigned to units in training and therefore available for only thirteen weeks. At the end of this time Schulz repeated his request for three brigadier generals. In March 1943, the center finally gained a permanent allotment of three colonels and was reorganized into three brigades. By this time the railway units had been removed and more regiments added. The three brigades held, respectively, thirty-four small units, four Negro regiments, and eight white regiments.[16]

The 414 enlisted men authorized in October 1942, although an enormous increase over the 63 allotted to the PEOC, was still far short of the 516 requested. The center was expected to make the 414 suffice without impressing men from the units for staff duty. Troops in training were to train. But after a short period of attempting to operate within the 414 ceiling, Schulz concluded that he could not expect these men to continue indefinitely at such a pace. By 1 December he succeeded in getting approval for 239 additional men. Although this number was ample for a time, the continued expansion caused the center to resort to the same expedient as before. By May 1943 the Training Division alone was using 150 men from the units, spreading the loss of training by taking men for only a week at a time from any one unit.

In June 1943 an ASF directive on economies in manpower caught the center unprepared. ASF assumed that the major organizations under its control had reached their peak strength, that they were well established, and that personnel allotments were stabilized and adequate. Increases were to be discouraged. Decreases were expected everywhere. The directive restricted the use of pool officers for staff duty and prohibited altogether the use of enlisted men from troop units.[17] The EUTC was by this time drawing between 350 and 400 men from each source, in addition to the 145 officers and 653 enlisted men then authorized.

[16] (1) Ltr, CG EUTC to CofEngrs, 9 Oct 42, sub: Improved Tng Orgn, EUTC. 210.3, ASFTC Claiborne, Pt. 1. (2) Min. Staff Conf SOS, 11 Nov 42, sub: Résumé of Matters Presented at Staff Conf, 1000, 10 Nov 42. 337, Staff Confs ASF (S).

[17] ASF Cir 39, 11 Jun 43.

Fortunately, although the Eighth Service Command was required to reduce its total personnel, the EUTC in July received increases in quotas to 165 officers and 856 enlisted men, and for the first time some civilian employees.

The paucity of officers and enlisted men allotted to the EUTC during the period of greatest expansion from July 1942 to July 1943 was but one indication of the generally bare subsistence level which obtained. Not until February 1943 did the conversion of tents to hutments begin to catch up with the number of men in training. By that time there was space for 19,290 men in huts and 5,668 in tents, with eighteen men in each fifteen-man hut and six in each pyramidal tent. As at the ERTC's vehicle and equipment shortages plagued the EUTC during most of this time, restricting some important phases of training. Because of the manpower pinch, fillers were slow in arriving. Nevertheless, the job was accomplished. The leadership of Schulz, the ability of the center staff, and the willingness of all concerned to put in long hours of planning and working eased the growing pains. Most important, during this period the center began to give real unit training.

Until July 1942 the training had differed little from the abbreviated program of the ERTC's. The emphasis had been upon individual basic military training. The main difference was that at Claiborne the men were organized into tactical units under their own officers instead of into training battalions.

The change-over to genuine unit training came on 25 July 1942 when OCE replaced the special six-week program with the regular unit training program of thirteen weeks. This regular program published in December 1941, incorporated with little change a prewar program for combat engineer units. More than half the training period was allotted to technical Engineer subjects. Most of the subjects were spread throughout the whole thirteen weeks, with three major concentrations of subject matter. A unit started out with a basic period of two weeks. A company period of eight weeks and a battalion and regimental period of three weeks followed. All general construction, all technical night operations, most of the tactical night problems, and all battalion and regimental tactical and technical work in the field were concentrated in the last three weeks.[18]

In the thirteenth week of training each regiment had an opportunity to take part in a small-scale maneuver. The members of the unit were presumed by this time to be ready to assume the responsibilities of their positions and to demonstrate their ability to co-ordinate the many separate lessons learned in the past weeks. The center staff furnished observers who suggested changes in case of gross errors and provided an enemy force to simulate combat conditions.

In a typical unit problem a regiment defended a bivouac position. Each regiment marched with full field equipment to the designated area, constructed roadblocks, laid dummy mine fields, and built bridges essential to the assumed tactical situation. Surveyors and heavy equipment operators constructed road approaches with materials furnished by other teams working nearby gravel pits, and runners kept the regimental commander informed of all developments.

To test how well the unit could continue

[18] (1) MTP—Engr Constr Regts and Dump Truck Cos [26 Mar 42]. 322, Engrs Corps of, Activation of Constr Units, Folder 1 (S). (2) MTP 5-1, 19 Dec 41.

to work under the harassing conditions of warfare there were attacks upon the position with simulated artillery fire and tanks, and attempted infiltration by night raiders. At times the attacks elicited too realistic a response. During one such maneuver, an indignant staff officer with the enemy force reported that some of the defenders wielded unsheathed bayonets and that "live Molotov Cocktails were used against our tank, cutting one P&T officer about the hands and face and soaking three officers with gasoline as well as spraying the interior of the tank with gasoline and glass." [19] Observers not a part of the enemy force were sometimes captured and lost valuable time being processed as prisoners of war. Mistakes were inevitable, but this week in the field was an invaluable addition to the EUTC program. Officer control steadied. Men gained confidence in their unit. The EUTC could analyze individual and unit deficiencies and modify instruction accordingly.[20]

The center, in the latter part of August 1942, had just begun to work out its course outlines and lesson plans to implement the thirteen-week program when SOS dictated a compulsory minimum basic military program of four weeks. As a consequence, by early September the thirteen-week program was not yet in full operation. Lesson plans were under preparation, training areas for the new tactical and technical subjects were not yet developed on the scale needed, and training methods had not yet crystallized. West Camp Claiborne appeared somewhat disorganized and disheveled, but, to the credit of the center, morale was undamaged.[21]

Actually, very little training was going on in early September, a hiatus between the final departure of the early units and the organization and filling of the new ones. But by the end of 1942 six general service regiments and one special service regiment were in training under the new program. By April 1943 the number had increased to ten general service regiments and two special service regiments and by July to thirteen regiments.[22]

Officers for these regiments had to have knowledge of construction techniques if the units were to function satisfactorily, for little combined training was contemplated between completion of the formal period of unit training and assignment overseas. OCE specified that the ideal officer should be a man between 35 and 45, physically fit for troop duty, and currently working in the construction industry, preferably as field superintendent or foreman. The Engineers wanted men who had bossed construction gangs, not topside management or professional engineers or architects. Essential was the ability to handle labor and a reputation for getting the maximum out of machinery consistent with its continuous operation. Although the Engineers found sufficient numbers of superintendents and foremen they were unable, even with the help of District and Division offices, to persuade the most capable to volunteer for commissions as company grade officers. Many of the

[19] Ltr, 2d Lt W. C. White *et al.*, to Tactics Sec, 18 Jun 43, sub: Bivouac Problem of 393d Engr Special Sv Regt. EHD files.

[20] (1) *Ibid.* (2) Ltr, Tactics Sec EUTC to S–3 EUTC, 17 Jun 43, sub: Final Rpt on Tech-Tactical Problem Given 393d Engr Special Sv Regt. EHD files.

[21] (1) Ltr, Dir Tng SOS, 28 Aug 42, sub: Basic Tng Program. Hq EAC, 353 Tng. (2) Hq SOS, Basic Tng Program for All RTCs and Sv Units of the Sup and Adm Svs of the SOS, Aug 42. Lewis, 353, Tng.

[22] Prov Orgn of Units, EUTC West Camp Claiborne, 5 Jul 43. EHD file, Monthly Rpts, Claiborne, 1943–44.

men willing to leave construction jobs at this time were second-rate.[23]

The two-week Officer Training School (OTS) in basic military training which had been started in April 1942 for the newly commissioned officers of the original regiments continued, but on a four-week basis. Between July 1942 and January 1943, when this course was lengthened to six weeks, some 821 officers completed the course before being assigned to their units. From January to the closing date, 3 July 1943, an additional 485 officers graduated. Meanwhile, in selecting officer candidates for schooling at Belvoir the center discovered enlisted men in these regiments who were just as well qualified for direct commissions as the officers currently being received. Accordingly, each regiment sent its best qualified enlisted men to the OTS course where they could be observed further. Some could be commissioned directly, others went to OCS. In addition to more general subjects, the course included a few hours in technical subjects such as aerial photograph reading and motor maintenance. A new class started each week, organized as a platoon or a company according to the number of students. Each student officer rotated through all of the positions from private to company commander in tactical situations in order to grasp the duties of each man under his future command. After July 1943, in compliance with ASF policy, all of this training was concentrated at the Engineer School.[24]

A much larger task than preparing officers to assume command was that of insuring a sufficient number of enlisted men with appropriate skills to fill the noncommissioned foremen positions and to run the heavy construction and earth-moving machinery. Like potential officers, such men were few and far between until the decline of military construction in the United States in the spring and early summer of 1943. The general run of recruits did not include nearly enough men with the proper qualifications. By mid-September 1942, when the first of the new units began to fill, the need for specialists had become acute. Three regiments were short a total of 1,564 specialists in twenty-one different categories, the greatest lack being in construction foremen, electricians, quarrymen, riggers, demolitions men, bridge carpenters, jackhammer operators, and general mechanics, with lesser shortages of draftsmen, water supply engineers, and sheet metal workers. To relieve this particular situation, SOS arranged with the Recruiting Section, The Adjutant General's Office, for a special drive during October and November much like that for the original regiments. As before, specified quotas of the various specialists were required of the service commands. Contractors furnished names of employees who were about to be inducted or about to enlist and of former employees already in the Army. Division Engineers helped publicize the need. On 27 November the last of these three regiments, activated in August, filled to operating strength.[25]

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[23] (1) Ltr, C of Mil Pers Br to New England Div Engr, 6 Nov 42, sub: Assistance in Off Proc. 210.1, Engrs Corps of, Pt 7.

[24] (1) Notes re the Hist of the EOC, EUTC, and ASFTC, Camp Claiborne, La., 1 Apr 42 to —. EHD file, EUTC, Gen. (2) Memo, Asst ExO Tng Div ASF for Cs of Svs, 12 May 43, sub: Schs for Offs at UTCs. EHD file, Spec Tng, EUTC, Heavy Shop. 1943–44.

[25] (1) Telg, CG PEOC to CofEngrs, 11 Sep 42, with 1st Ind, AC of Mil Pers Br to Dir Mil Pers SOS, 18 Sep 42. 341.3, Engrs Corps of, Pt. 1. (2) Ltr, AC of Mil Pers Br to CG EUTC, 1 Oct 42, sub: Proc of Enl Specs for Direct Asgmt to Camp Claiborne, La. Same file. (3) Ltr, AC of Mil Pers Br to Great Lakes Div Engr, 27 Nov 42, sub: Proc of Specs. 220.3, Engrs Corps of, Pt. 3.

By November, when it had become clear that fillers for future regiments could not be expected to have the skills necessary for many of the positions, the center began to organize specialist courses to train a portion of these men while the rest engaged in the technical and tactical work that followed the basic military program. Since some qualified men continued to arrive, the center made no comprehensive plans for opening courses for all of the specialists in the tables of organization. Instead, the courses provided instruction for enough men to fill out the number of specialists found to be short for each unit. Classes therefore fluctuated in size unpredictably. Courses began and ended according to the need for a particular specialist. Some courses were offered only a few times to fill a temporary shortage. Others were repeated for months. The number of weeks for each class was kept to an absolute minimum, two weeks in some courses, because the trainee was meanwhile missing the corresponding number of weeks of the regular program. In order to get men who would be interested, the center sought volunteers to attend the courses. But other factors had to be considered. As the specialist training program progressed, the center recommended that unit officers select these men carefully after personal interviews and a scanning of records to discover any secondary civilian interests approximating the skills needed. An AGCT score of 90 or better was desirable.

Mainly because of the small number of administrative personnel, center control over these courses lacked uniformity until well into 1943. Officers from the Training Division, aided by a few enlisted men from the headquarters company, taught the first courses in addition to their regular duties. As the number of courses increased, the Training Division drew instructors from the officer pool and from units. The inevitable result was a constant turnover among instructors as pool officers were assigned to units, unit officers left with their organizations, and enlisted men were replaced by limited service personnel. The Training Division could do little more to insure competent instruction than to pick men who had some past qualifying experience. Some turned out to be good teachers, others did not. Competent or incompetent, the instructors themselves determined course content, wrote their own lesson outlines, produced their own training aids, and decided when tests should be given. The only check upon their performance was approval of plans and outlines and an occasional inspection. Since units had first priority on training facilities, it took close co-ordination to arrange for specialists to have access to them. In an effort to tighten up its control of the specialist courses the Training Division in February 1943 grouped all the courses under the supervision of one officer. Better co-ordination with the rest of the EUTC resulted. Not until May, after the center had acquired a larger administrative staff, could officers devote full time to specialist schooling.

By December 1942 the center had begun to produce draftsmen and surveyors from its own specialist courses. Expert surveyors could not be produced in a few weeks, but men with some mathematical background could be taught to use a transit, level, and planetable and qualify as instrument men, recorders, chainmen, and rodmen, for routine surveying. The course for draftsmen concentrated upon lettering, overlaying, topographical mapping, construction drawing, and the use of a slide rule. In January 1943, additional courses qualified operators

of power shovels, bulldozers, air compressors, road graders, earth augers, and rock crushers. Other courses trained motor mechanics, water supply specialists, machine gun crews, and camoufleurs.

By early 1943 the draft began to reach the eighteen-year old level and consequently produced fewer men with working experience. As the technical ability of fillers continued to drop, still other courses had to be added. Men selected as riggers learned the use of knots and lashings on tripods and gin poles, the advantages of simple block and tackle combinations, and the proper methods of cable splicing. Demolition specialists learned to prepare primers, firing caps, and explosive charges. Blacksmiths did repair work for the center after a short period of theoretical instruction in forging, shaping, and repair of tools. Mapping specialists worked out reconnaissance problems using a compass, collected field data such as bridge and road capacities and stream volumes, and transferred the information to maps, using the military grid system and the conventional signs, measurements, and contouring. The expansion of specialist courses was virtually completed by the end of June 1943. Within the next year over 15,000 specialists graduated.[26]

The growth of the center and the addition of specialist training occurred during a time of general equipment shortages. The two sets of regimental equipment which the center had in July 1942 would not suffice for the unit exercises prescribed under the new program and for the training of specialists. No great quantities of additional equipment were at first requested because the units were supposed to receive their organic equipment upon activation. But the fact that these units were not to be rushed overseas immediately gave them a low priority. Some of the equipment did not reach them until after they had left the EUTC. The center in October began to ask for a pool of organizational equipment equivalent to that for six regiments and individual equipment for 8,000 men, but construction machinery was not requested at this time since OCE insisted that these items would be supplied to the regiments upon activation. The continued growth of the EUTC, and the addition in late October of training for all engineer equipment companies soon created a shortage in construction machinery as well as in other organizational allowances. By the end of February 1943, adequate unit training in the regiments had become dependent again upon the receipt of organizational sets. During the next month, however, there began to be some relief as military construction projects in the United States began to taper off and District Engineers released quantities of used equipment. From this source the center built up by early summer a pool of 350 pieces of equipment, divided about equally between the units and the specialist courses.

A shortage of trucks resulted both from the rapid growth of the center and from the special issue method by which general purpose vehicles were furnished. On 25 November 1942, ASF authorized a pool to be used in turn by all units in training in order to obviate the necessity for issuing general purpose vehicles to each unit activated. If issues of additional vehicles had kept abreast of the growth of the center the system might have worked, but by May 1943 there had been no further issues. An effort by the EUTC to change the basis of issue to a table

[26] Tng Memo, Adj EUTC Camp Claiborne for All Unit Comdrs, 10 Jun 43, sub: Spec Tng of Enl Pers. EHD file, Tng Memos, Claiborne, 1943–44.

of allowances which would have included more trucks met with disapproval in March. Fortunately, while decision on the table of allowances was pending, some AGF regiments with full equipment were transferred from AGF to ASF control and to the center for training. The use of these vehicles for the whole EUTC brought about a short reprieve. When these units prepared to leave in May the shortage again became imminent. Additional vehicles were at last procured in the latter part of that month. Meanwhile, training exercises had been curtailed to conform to the amount of transportation available.

The center had so little ponton or other emergency bridging equipage that training had to be confined almost entirely to fixed trestle bridges. As late as April 1943 the center still had no Bailey bridges; practically none of the unit officers or men had even seen one. Additional training in bridging had to be given after these units arrived overseas.[27]

By spring 1943 the lessons learned from the campaign in North Africa had begun to shape the training of engineer troops. Although training service units, the EUTC as well as the ERTC's placed greater stress upon combat engineer missions. General service regiments might well be called upon for combat duty. Exercises were stepped up to harden the troops physically. Training became more realistic. In June 1943 the center built a small village of ten houses in order to place mine and booby trap instruction in a more natural setting, since in actual warfare "everything must be examined for traps—innocent looking flowers, cabinets, books, tables, drawers in dressers, windows, doors and even commodes." [28] But a special issue of 600 M1 practice mines had to suffice for exercises in mine field laying, and not until July 1943 did the center get a meager allowance of six standard mine detectors. Enemy mines and mine detectors could not be obtained at all. To demonstrate the power and tactical use of tanks the center borrowed from units at the main camp. When these units left Claiborne in late September 1942, instruction in antitank measures lost much of its realism. A request to OCE for five tanks and fourteen operators to replace this loss resulted in the approval on 9 December of two used tanks. The center had to furnish its own operators as best it could. Portable radios for co-ordination between umpires, inspectors, and units during tactical exercises were borrowed from AGF units at Claiborne until June 1943, when a special issue of ten radio sets was finally authorized.[29]

Toward the end of 1942 the center received 3,543 M1 rifles. Never sufficient to go around, the M1's had to be shifted about constantly. The shortage of rifles was common to the ERTC's but the ERTC's did not suffer under the additional handicap of lack of military experience among the officers.

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[27] (1) Ltr, O&T Br to CG EUTC, 11 Aug 43, sub: Rpt of Inspec Off, with 2d Ind, CG EUTC to CG Eighth SvC, 21 Aug 43. 333.1, ASFTC Claiborne. (2) Ltr, ExO EUTC to CofEngrs, 3 May 43, sub: Vehicle Rqmts, with 1st Ind, O&T Br to CG ASF, 13 May 43. 451, ASFTC Claiborne. (3) Ltr, ExO EUTC to CofEngrs, 27 Apr 43, sub: Request for Special Issue of Equip. 417, ASFTC Claiborne.

[28] Ltr, Obstacle Sec EUTC to American Legion, Alexandria, La., 25 Jun 43. EHD file, 353, Misc (Index) 1943, Claiborne.

[29] (1) Ltr, Adj EUTC to CofEngrs, 16 Apr 43, sub: Request for Credit of Ord Equip, with 1st Ind, 29 Apr 43. 476.1, ASFTC Claiborne. (2) Ltr, Adj EUTC to CofEngrs, 15 Jun 43, sub: Request for Tng Equip, with 1st Ind, 28 Jun 43. 413.6, ASFTC Claiborne. (3) Memo, ExO EUTC for CofEngrs, 16 Sep 42, sub: Light and Medium Tanks for Obstacle Tng, with 1st Ind, O&T Br to CG SOS, 25 Sep 42, with 2d Ind, SOS to CofOrd, 9 Dec 42. 470.8, ASFTC Claiborne.

Although SOS required 80 percent rifle qualifications, the EUTC in December qualified only 61 percent of its white trainees as compared with 81 percent at the ERTC at Belvoir and 73 percent at Wood. In an effort to raise the low scores at Claiborne, OCE in February 1943 arranged to send twenty-four officers with experience in basic military training at the ERTC's, two men a month from each center over a period of six months. At the same time, OCE secured ten infantry officers with special training in weapons for a temporary assignment of six months. Although instruction improved, the number of qualified men continued to be unsatisfactory. In April 1943 three general service regiments fell below the 50 percent mark mandatory for any unit before assignment overseas. By June the center estimated it would take 16,024 additional M1 rifles and 3,691 carbines to bring this instruction up to standard.[30]

While the EUTC increased in size it also began to train many different types of units besides the general service regiments, special service regiments, and dump truck companies originally planned. Among these were nine heavy shop companies scheduled for activation during 1942. These units were designed to overhaul and reclaim unserviceable engineer equipment at a fixed base, furnish parts, and perform less extensive on-the-spot repairs wherever breakdowns occurred. Such work required heavy-duty fixed equipment for welding and forging, power-driven tools for manufacturing machined parts, and electrical facilities for reconditioning motors and generators. Truck-mounted shops were included for emergency repairs in rear areas not served by maintenance companies. Because separate equipment for so many companies could not be obtained before October 1942, and the units were scheduled for early shipment overseas, the Engineers determined in late July to consolidate the training of all engineer heavy shop companies at Claiborne, and to set up one highly organized training installation to be used by all such units in rotation as they became active.

Several other factors besides economy of tools and machinery influenced the Engineers in the choice of Claiborne. Space was opening there as the original regiments and dump truck companies completed training and moved out. Several civilian vocational schools were nearby. One highly qualified, fully equipped, heavy shop company was already in training at the main camp in a prefabricated metal engineer shop company building. This unit could form a nucleus for the training of additional companies.

The reorganization of this heavy shop company into the Heavy Shop Training Section of the EUTC began in August 1942. Five officers from this company organized the section along company lines, with Capt. Eugene L. Davis, the commanding officer of the original company, at the head of the section. His permanent staff consisted of an officer for technical training, one for supply, one to supervise the manufacturing shop, and one to supervise the repair shop. Officers from units in training assisted in preparing lesson outlines and schedules, and in the supervision of work projects and tests. En-

[30] (1) Ltr, O&T Br to CG SOS, 12 Jan 43, sub: Issue of Bayonets to EUTC. 474.7, ASFTC Claiborne. (2) Memo, Asst ExO Tng Div SOS for CofEngrs, 30 Dec 42, sub: Antitank and Antiaircraft Tng of Sv Units. 400.34 (S). (3) Ltr, O&T Br to CG EUTC, 5 Feb 43. 210.3, ASFTC Claiborne, Pt. 1. (4) Ltr, Mil Pers Br to CG EUTC, 24 Feb 43, sub: Temporary Duty Asgmt of Inf Offs as Trainers With the SOS. 210.3, Engrs Corps of, Pt. 24. (5) Ltr, Adj EUTC to CofEngrs, 28 Jun 43, sub: Request for Small Arms. 474.1, ASFTC Claiborne.

listed men did the actual instruction. In the absence of official provision for such instructors, the center selected about forty qualified men from the first few units, retaining them by transfer from one unit to another as the companies left the center. This method of holding experienced instructors was maintained throughout 1943 to supplement the ten enlisted men finally authorized. Four civilian master mechanics joined the staff in October 1942. By February 1943 the number of these key civilian instructors reached twenty-one.[31]

In the first shop units most of the men required only familiarization with military procedures and equipment. Fillers for two of these units had been experienced maintenance men recruited from the Associated Equipment Distributors of Washington, D. C., and from the Caterpillar Tractor Co. Shop companies formed later had fewer skilled men. By February 1943, the Engineers were getting only one fourth as many specialists for these units as they had in the beginning, but continuous co-operation among manufacturers, the Engineer Field Maintenance Office, OCE, and TAG assured the direct assignment upon induction of sufficient skilled men to fill the more responsible positions.[32]

Upon the completion of basic training, the heavy shop units transferred to the Heavy Shop Training Section, which operated as a semi-independent organization with little EUTC control. After interviewing the men individually and determining which company position each could best fill, the section staff assigned them to small specialist sections. Men destined for manufacturing platoons went into machine shop, welding, blacksmith, or carpentry sections. Those for repair platoons began to repair electrical and nonelectrical instruments, small tools, radiators, or heavy equipment. All spent five hours in the classroom and forty hours in the shop each week.[33]

Although it had been recognized from the beginning that some men from these units would need specialized training to supplement civilian skills, it had also been assumed that most of this instruction could be given within the EUTC. This might have been the case had the fillers for the heavy shop companies arrived on schedule and with a better distribution of skills. But the companies activated in July, August, and September 1942 did not fill completely until mid-October and the units were supposed to move out at a rate of one each month after October. The quickest way to train the men without waiting for special equipment or for service school quotas was to send them directly to civilian schools and factories, despite the reluctance of OCE to circumvent War Department policy against duplication of facilities.

In anticipation of this need, Davis made a survey of the civilian schools and factories near Claiborne in July 1942. He decided at that time to use six steel and foundry companies at Kansas City, Missouri, for heavy machinery training and arranged for

[31] (1) Memo, Engr Fld Maint Off for C of O&T Br, 18 Feb 43, sub: Master Mechanics for Camp Claiborne Tng Shop. 231.2, Claiborne. (2) Ltr, C of O&T Br to CG EUTC, 25 Feb 43, sub: Master Mechanics for Camp Claiborne. Same file. (3) Ltr, AC of O&T Br to CG Eighth SvC, 5 Oct 43, sub: Transfer of Master Mechanic Advisers. 230.36, ASFTC Claiborne. (4) Ltr, Eighth SvC to CofEngrs, 11 Nov 43, sub: Transfer of Master Mechanic Advisers. Same file.

[32] Ltr, Engr Fld Maint Off to O&T Br, 18 Mar 43, sub: Asgmt of Inductees to Engr Orgns at EUTC, Camp Claiborne, La. 220.3, ASFTC Claiborne.

[33] (1) Ltr, Adj EOC to CofEngrs, 25 Jul 42, sub: Status of Tng. 319.1, ASF Engr Units, Pt. 1. (2) MTP 5–1, 19 Jun 43.

this instruction in October at no cost to the government. Two vocational schools one at Lake Charles, Louisiana, and one at Pascagoula, Mississippi, provided courses at a minimum cost. Some skills, welding for one, could be mastered in a week or two, but regardless of difficulty, all of these courses lasted for eight weeks in order that the time might coincide with the technical training period of the EUTC.

By the end of February 1943, when the emergency need for these specialists had passed, OCE directed that all heavy shop technicians be trained thereafter at the EUTC or at special service schools. The center managed to duplicate most of the training of the Kansas City factories by doubling the civilian instructors for the section. Ordnance automotive schools supplanted vocational schools in training welders, machinists, and mechanics.[34]

After eight weeks of technical training, thirteen weeks of unit training followed. The Heavy Shop Training Section found much to criticize in the allocation of hours and subjects. Too many hours were allotted to demolitions and defense against mechanized attack, too much time to motor and rail movement, too little to field operations. Most of the criticism stemmed from the fact that the heavy shop companies operated as fixed field installations. As finally worked out, the field training provision did not mean much more than a continuation of manufacturing and repair within the established shops.[35]

Opinions on such "unit" training varied. Gorlinski, chief of O&T, admitted in August 1943 that the heavy shop companies were being trained in a "thorough and efficient manner" but believed that unit training was being neglected "in that the companies never function completely as a unit." He pointed out that no one company did the entire job of overhauling any single tractor. One shift or company worked on the machine and then turned it over to the next shift.[36] One month later the Deputy Director of Military Training for ASF made a point of praising this system. "The training being given the heavy shop companies was excellent and can be considered as real 'unit training,' " he reported. "It was conducted in shops and with equipment similar to that they will be expected to use overseas. The shops were operated on three 8 hour shifts, each shift being in charge of a separate company. The training consisted of base shop repair of all types of engineer equipment, including a great deal of reclamation and manufacture of parts." [37]

During the period March 1942 to June 1944 the EUTC trained sixteen heavy shop companies and activated three more, approximately 3,135 men. Meanwhile, the services of the Heavy Shop Training Section had been broadened to train men from other types of units—in March 1943 maintenance companies, and in August a few specialists for base equipment and petroleum distribution companies.[38]

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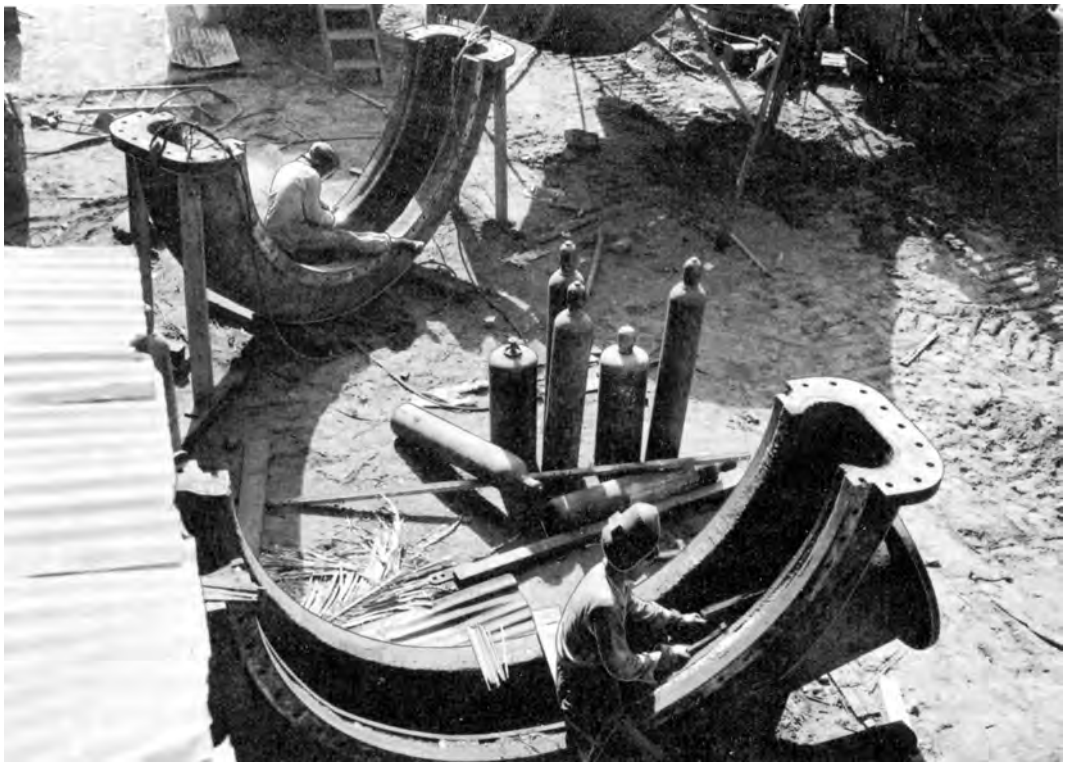
[34] 2d Ind, C of O&T Br to CG EUTC, 6 Nov 42, sub: Use of Civilian Manufacturing Plants for the Tng of Engr Heavy Shop Co Enl Pers (basic missing). 220.66, Pt. 4.

[35] (1) MPT 5–3, 15 Mar 43. (2) Memo, Brotherton for Gorlinski, 1 May 43, sub: Comments on MTP 5–1 and 5–3 by S–3 Sec EUTC. 353.01, Pt. 1. (3) Ltr, Actg ExO EUTC to CofEngrs, 10 May 43, sub: Proposed Plan of Instr During MTPs 5–1 and 5–3, with 1st Ind, 5 Jun 43. 353.01, ASFTC Claiborne.

[36] Ltr, C of O&T Br to CG EUTC, 11 Aug 43, sub: Rpt of Inspec Off. 333.1, ASFTC Claiborne.

[37] Memo, Deputy Dir Mil Tng ASF for Dir Mil Tng ASF, 8 Sep 43, sub: Inspec of Tng Estab at the UTC, Camp Claiborne, La. 353, ASFTC Claiborne, Hist of Mil Tng, Bulky.

[38] See Chapter XVIII for a full discussion of training petroleum distribution units.



WELDING DREDGE EQUIPMENT, *a repair job undertaken by an Engineer heavy shop company, Leyte, February 1945.*

The forestry company, another of the small special units which OCE began to assign to Claiborne, duplicated civilian lumber camps and sawmills. A headquarters platoon for administration, mess, and supply was also the planning section under the direction of the company commander whose position was that of a sawmill superintendent. A logging platoon headed by expert timber cruisers made stumpage estimates, felled timber, and hauled the logs to the mill. There the manufacturing platoon milled the logs into boards and beams for building and bridging, sorted and piled the lumber at a storage yard, and handled all shipments. The company had its own maintenance mechanics for the repair of vehicles, tools, and machinery and carried its own electrical plant.[39]

Although other national forest areas offered more mature timber, the Engineers wished to train these forestry companies at Claiborne because of the extensive basic military and tactical training facilities which had been developed there. In early December 1942 the Engineers found what they considered an adequate stand of timber within thirty miles of the camp, and the following month the Department of Agriculture agreed to release the area subject to

[39] FM 5-5, 11 Oct 43, Engr Troops, pp. 181–86.

certain restrictions providing for the care of young growth and the prevention of forest fires.

Training began in February 1943 with the transfer of the first of these companies from the A. P. Hill Military Reservation in Virginia. Another company joined the first in March and a third in April. In June, the first of the forestry battalions was activated with one headquarters company and three lettered forestry companies.

After five weeks of basic military training these companies began an eight-week program of tactical and technical work followed by thirteen weeks of unit work, with 198 hours of field operations. By the end of July two forestry companies were bivouacked in the forest area, operating mills and logging timber. The center encouraged these companies to produce the maximum amount of lumber for building and training materials and as a result curtailed more realistic exercises which should have included frequent dismantling and moving of the mills to new locations. Each of the two companies then in the field had moved only twice in thirteen weeks, an operation that took about two days from dismantling to resumption of operations. Each company hauled the lumber as it was sawed to the EUTC lumberyard instead of setting up a yard of its own to develop competent stackers, checkers, and stock clerks. Neither of the two companies had run the infiltration course or fired the familiarization course with its principal weapon, the carbine. Although fully armed, one of the companies was carrying wooden cutouts for both rifle and carbine on the excuse that the real weapons were difficult to take care of in the woods, got dirty, and were liable to be run over or otherwise damaged. Further lack of realism was apparent in the bunching together of the tents both for individual shelter and for mess and supply. All of them were placed so close to the mills that a bombing attack would have destroyed both the mills and most of the operators. Mill sites had been chosen for optimum working conditions with little regard for observation. Locations which would have given the troops some experience in operating under adverse conditions had been passed over on the grounds that they would cause difficulties in production.

If anything, these units were indeed too competent in the production of lumber. The timber in the training tract was almost exhausted by August 1943 when the companies of the forestry battalion were supposed to begin their eight weeks of technical instruction. In January 1944 the center had to seek a new tract. Through July of that year the forestry companies received basic military and tactical training at Claiborne and then moved to the Ninth Corps Area for technical and practical instruction in the mature timber stands of the Rogue River National Forest near Camp White, Oregon.[40]

From February 1943 to June 1944, fifteen forestry companies or about 2,250 men received complete or partial training in basic military and technical subjects at Claiborne. All of the units shipped overseas by December 1944. The last eight organized went to the European theater, joining the first such company, which had trained at

[40] (1) MTP 5–1, 19 Jun 43. (2) MTP 5–3, 15 Mar 43. (3) Memo, AC of O&T Br for C of O&T Br, 31 Jul 43, sub: Tech Tng Inspec of Dump Truck and Forestry Cos at the EUTC Camp Claiborne, La. 353, Engr Dump Truck Units. (4) 1st Ind, OCE to CG Eighth SvC, 20 Jan 44, on Ltr, 12 Jan 44, sub: Tng of Engr Forestry Cos. 353, Engr Forestry Units. (5) Ltr, C of WPD to CG Ninth SvC, 11 Jul 44, sub: Tech Tng of Engr Forestry Cos. 353, Engr Forestry Co (C).



OVERSEAS SAWMILL *operated by men of an Engineer forestry company, 1943.*

Ft. Lewis in 1942. Although these nine companies exceeded all expectations in lumber production, and were indeed competent enough to run two sawmills each, they were too few to keep up with the requirements of the European theater. As many as twenty forestry companies could have been employed. Consequently, general service regiments and combat battalions, as well as numbers of civilians and prisoners of war, had to be enlisted for this work. Although the Southwest Pacific Area would have welcomed more forestry companies, the lack of these units was not serious because the nature of the climate and terrain permitted many types of improvisations which required little or no processed lumber.[41]

By July 1943 the Claiborne EUTC had trained and sent out 47,488 men in 85 units, including 23 regiments. Most of these units were special types for which the Engineers secured officers and men with related civilian backgrounds, gave them only thirteen weeks of training, and sent them overseas without further joint training. The concentration at one place of units of this composition, needed within a very short time, was more effective than would have been the case had they been scattered among many posts and trained with less supervision. This

[41] Liaison Sec Intel Div, Office of C Engr ETO, Hist Rpt 4, Troops, p. 115. AG Special Collection Opn Rpts. (2) *Final Report of the Chief Engineer, European Theater of Operations, 1942–1945* (Paris: Hervé et Fils [1946]), prepared in Office of C Engr ETO, 1946, p. 400. (Hereafter cited as *Final Engr Rpt, ETO.*) (3) Information from historian preparing the volume, The Corps of Engineers: The War Against Japan.

advantage, together with the exceptionally energetic and determined staff, in the end outweighed the equipment shortages, lack of sufficient training personnel, uncomfortable and inconvenient living conditions, too few fillers with civilian skills, and, in many cases, inadequate numbers of fillers.[42]

One of the major criticisms of the center, perhaps valid, was that it lacked clear-cut lines of control. Schulz had taken exceptional advantage of the abilities of the men assigned to him and given varying degrees of independence to those at the head of the various schools and training sections. To ASF representatives, accustomed to looking at elaborate organization charts, the result was lack of uniformity. To the busy men at the center, the system seemed both logical and efficient.

[42] (1) EUTC West Camp Claiborne Highlights, 5 Jul 43. EHD file, Monthly Rpts, Claiborne, 1943–44. (2) Ltr, ExO Mil Tng Div ASF to CG Eighth SvC, 28 Oct 43, sub: Camouflage Tng, ASF Units. 353, Engr Mil Tng Div ASF.

CHAPTER XIII

A Lengthened Program and Additional Centers for Unit Training

In anticipation of increased needs for construction and repair, the Engineers prepared to activate 203 ASF engineer units in the third quarter of 1943—by far the greatest number of such activations for any three-month period during the war.[1] West Camp Claiborne was relieved of much of this load by the two new EUTC's at Camp Ellis, Illinois, and Camp Sutton, North Carolina, both of which operated just long enough to carry the excess. Although Claiborne received a greater influx of trainees through these numerous activations, the strain upon the center was not comparable to that of the previous year. The major adjustments for the operation of a large establishment had already been made. Shortages of equipment were no longer acute. The decline in military construction projects released at last the superior group of civilian specialists which the Engineers had been trying unsuccessfully to reach since the spring of 1942. Moreover, from the summer of 1943 until the change-over to an ASFTC in May 1944 Claiborne trained on successively longer programs. This move eliminated some of the urgency, and the need to crowd so much information within a very short space of time.

Planning at higher levels for a lengthened training program had begun as early as July 1942. In January 1943, SOS requested OCE to submit by the first of February a thirteen-week advanced unit training program for units that had completed the first thirteen weeks of training but did not have an immediate assignment overseas. The advanced program was to be flexible enough to fit whatever additional time each unit might have, up to thirteen weeks, and was to emphasize team training in tactical and logistical exercises. At least two weeks were to be spent away from camp in practical tasks under field conditions, with full organizational equipment. By June, OCE had also revised the regular thirteen-week program and the center then worked out new schedules covering the whole twenty-six-week period. The revised program for the first thirteen weeks, published on 19 June 1943, was much more elaborate than the preceding one. Although it included a specific program for each type of unit with varying subjects and hours for each, certain basic engineering subjects were included for many types of units, no matter how diverse their functions. While insisting on the need for specialized units, the Engineers remained firmly convinced that such units should be able to turn to and perform any general engineer task. Bridging exercises were prescribed for petroleum distribution companies, water supply battalions, and forestry companies, as well as for other units with a

[1] Unit Tng, Table I.

more direct need for such training. Some knowledge of demolitions, rigging, and the use of basic engineer tools and equipment was required of all units of whatever type.

The basic military training period, lengthened from four weeks to five, was dominated still by rifle marksmanship, 76 hours out of the 240. During the sixth through the thirteenth week, while specialists attended school at the center or at off-post installations, nonspecialists completed the revised regular program of tactical and technical work. Bridge building took up a large block of this time for general service regiments, but less than in the previous program. There was a sharp revision downward in the amount of time for obstacles, demolitions, field fortifications, and camouflage since part of this instruction was moved into the field period. Road building and general construction remained about the same. Tactical subjects were concentrated in the seventh through the tenth week. The emphasis in the last three weeks was on technical engineer work, on fixed and floating bridges, roads, and general construction, with a few hours in obstacle building and a march and bivouac exercise of eight hours.[2]

At the end of the first thirteen weeks all of the specialists rejoined their units for whatever additional training time might remain before leaving for a port of embarkation. During this period, up to thirteen weeks, each unit trained as a team, with emphasis upon defensive security against attacks, night work with motor convoys, practice in rail movements to familiarize troops with loading procedures, combat tactics in village fighting, shooting at moving targets, and infiltration techniques. During the eleventh and twelfth weeks, regiments engaged in a continuous day and night field operation with full equipment on a simulated tactical mission, including demolitions and construction. These two weeks of field training were mandatory for all units. Other portions of the program could be compressed or eliminated as necessary. The last week of the program consisted of training tests and inspections in preparation for overseas movement.[3]

Thirteen regiments, activated at Claiborne between May and September 1943, trained on the new longer program. The quality of fillers, which had become progressively poorer up to this point, took a turn for the better as construction firms all over the country began to complete their contracts with the government. Between July 1942 and February 1943 the number of civilian employees working for contractors on military construction projects dropped almost 50 percent. As construction jobs became increasingly scarce, a part of this labor force, which had until now resisted the blandishments of the Engineers, became much more susceptible. In February 1943 the Chief of Engineers proposed that at least half of the men for the thirteen regiments be procured from among these workers by a voluntary induction campaign similar to those that had been tried before. On 16 March The Adjutant General's Office authorized the recruiting. The Engineers estimated in April that 3,614 men

[2] (1) Ltr, Asst ExO Tng Div SOS to CofEngrs, 15 Jan 43, sub: Advanced Unit Tng Programs, with 1st Ind, 1 Feb 43. 353.01, Pt. 1. (2) Memo, Brotherton for Gorlinski, 1 May 43, sub: Comments on MTP 5–1 by S–3 Sec EUTC. Same file. (3) Ltr, Actg ExO EUTC to CofEngrs, 10 May 43, sub: Proposed Plan of Instr During MTPs 5–1 and 5–3, with 1st Ind, 5 Jun 43. 353.01, ASFTC Claiborne. (4) MTP 5–1, 19 Jun 43.

[3] MTP 5–3, 15 Mar 43.

would be needed each month to fill positions in the third, fourth, and fifth grades.[4]

The Corps recognized that this newly available group was made up for the most part of highly skilled and experienced men that contractors had retained as long as possible. To insure the fullest accuracy in assignment, the Engineers activated the 361st General Service Regiment at Claiborne in May 1943 and used it as a receiving pool for all voluntary inductees designated for ASF and AGF engineer units. In this way a temporary surplus of men in any one skill could be held for future units instead of being wasted in immediate assignments to positions for which the individuals had no particular aptitude. The EUTC staff interviewed the men upon arrival, classified them, and assigned them in appropriate grades in the 361st. Finding that the general service regiment had insufficient technician grades to hold all the skilled men desired, the Engineers soon turned the 361st into the more generously endowed special service regiment. While in the 361st, the men were given basic training, fillers for newly activated units being transferred in grade regardless of how much of this training they had completed. Fillers for units that had already begun training transferred only after completion of the prescribed five weeks.[5]

The vast improvement in the quality of enlisted men was not without an ironical twist. By early 1944 Col. Earl G. Paules, who had commanded the 361st the previous summer, observed overseas that many enlisted men in the new regiments had superior education and more construction experience than their officers, who were graduates of OCS or the Officers Training School at Claiborne. "About all that some of the OCS men appeared to have was a High School education. They lacked professional knowledge and aptitude. As regards OTS men, too many were 'second raters' in their profession and many of them lacked technical education. In comparison, many of the enlisted men—volunteers and some draftees—were Graduate Engineers." [6] Although these enlisted men were better qualified for commissions than the "second raters" who had volunteered or applied for commissions earlier, they entered the regiments at a time when OCS quotas were being drastically reduced and the Engineers were channeling the small number of commissioned civilians into petroleum distribution companies, port construction and repair groups, heavy shop companies, and forestry companies.

By the second week of August the 361st had received 6,570 white inductees and transferred 4,232 of them to units. Of the 4,232 transferred to units, the Claiborne regiments received 2,013, and the regiments at the EUTC at Camp Ellis 1,049. The rest were better qualified for other types of units and were assigned to petroleum distribution companies, heavy shop companies, equipment companies, and base depot companies at Claiborne, and to parts supply companies at both Claiborne and Ellis. All of the 120

[4] (1) Min, Staff Conf ASF, 28 Apr 43, sub: Résumé of Matters Presented at Staff Conf, 1000, 27 Apr 43. 337, Staff Confs ASF (S). (2) Ltr, CofEngrs to CG SOS, 6 Feb 43, sub: Engr Work Required Overseas. 322, Engrs Corps of (S). (3) Memo, CofEngrs for CG ASF, 14 Apr 43, sub: Voluntary Induction for Engrs. 341.3, Engrs Corps of, Pt. 1. (4) Stat Table, sub: Number of Civilians Employed on Constr Program . . . 1 Jul 40 Through 30 Sep 46. EHD files.

[5] (1) Memo cited n. 4 (3). (2) Ltr, CofEngrs to CG Eighth SvC, 29 May 43, sub: Asgmt of Engr Technicians to New Units of the ASF. 220.3, ASFTC Ellis. (3) Ltr, CG EUTC Claiborne to ACofEngrs, 7 Jul 43. 320.2, ASFTC Claiborne.

[6] Rpt, Col Paules, Engr Member WD Obsvrs Bd to CofEngrs, 16 Feb 44, sub: ETO Engr Obsvr's Rpt 2. 370.2, ETO (S).

Negro specialists were absorbed immediately into four Negro regiments at Claiborne.[7]

As the quality of fillers improved the number of specialist courses declined. Between August and October 1943, the center shut down its courses in drafting, mapping, surveying, supply, administration, camouflage, chemical warfare, and communications, and discontinued specialist instruction for riggers, electricians, carpenters, and truck drivers. Many of the courses were not resumed until the spring and summer of 1944 when the quality of fillers again deteriorated.

A further increase in training time occurred in the fall of 1943. At the request of the War Department, OCE extended the initial training program for ERTC's and EUTC's from thirteen to seventeen weeks. Added to the maximum of thirteen weeks in the advanced unit program, this made possible a maximum of thirty weeks of training in the EUTC's. The seventeen-week program, effective for units activated after 25 September 1943, was divided into a basic military period of six weeks, a technical and tactical period of eight weeks, and a field period of three weeks. The training at Claiborne approached a more reasonable pace from this time until the reorganization in May 1944 into an ASFTC.[8]

From the inception of centralized training for ASF engineer units in the PEOC in the spring of 1942 to the end of the EUTC period in May 1944, the Claiborne center trained and sent out approximately 88,000 men in over 200 units. Of the 39 regiments, 15 were Negro. Over 24,000 troops remained at the center in varying degrees of readiness in 81 units, making a total of some 112,000 men either partially or completely trained during this time.[9]

Camp Ellis: A Study in Personnel and Command

The training of all ASF engineer units activated during the latter part of 1943 would have been an impossible burden for the one EUTC at Camp Claiborne. The center system had proved so successful, however, that the Engineers opened two similar EUTC's, one at Camp Ellis, Illinois, and the other at Camp Sutton, North Carolina.[10]

Unlike Camp Claiborne and the other EUTC at Camp Sutton, Camp Ellis was sponsored by ASF for the joint training of several of the technical services. This move, primarily an economical arrangement to obviate the need for several small separate centers for individual services, was also indicative of a tendency at ASF headquarters to establish tighter control over the technical services, to make ASF more like AGF and AAF. When the joint training center was first proposed in August 1942, the Corps of Engineers welcomed the additional facilities at Camp Ellis.

At the end of March 1943, Brig. Gen. Walter L. Weible, Deputy Director of Training, ASF, called a conference in Chicago for all ASF officers selected for key positions at the new camp. Weible's remarks to the conference revealed ASF's

[7] Ltr, ExO EUTC Claiborne to CofEngrs, 10 Aug 43, sub: Wkly Rpt of Status of Voluntarily Inducted Constr Specs, 361st Engrs, EUTC Camp Claiborne, with Incl, Two Stat Summaries, Voluntary Inductees. 353, ASFTC Claiborne, Pt. 2.

[8] MTP 5-101, 25 Sep 43.

[9] (1) EUTC West Camp Claiborne, Highlights, 1 Feb 44, 1 Sep 44. EHD file, Monthly Rpts, Claiborne, 1943–44. (2) Rpt, C of Scheds Br EUTC to Dir Mil Tng EUTC, 1 May 44, sub: Apr Monthly Rpt Scheds Br. Same file.

[10] Unless otherwise indicated, this section on Camp Ellis is based upon: (1) 353, Ellis; (2) Ellis, 353, 1944, Book II–C, Tng; (3) 322, ASFUTC Ellis; (4) 323.3, ASFTC Ellis; (5) ASF, 354.1, 17 Apr 44; (6) ASF, 333.1, Ellis, 1 Jun 43–31 Oct 43.

anxiety that the experiment succeed. Camp Ellis presented an opportunity to demonstrate the value of a single type of center for all ASF training. At pains to weld the oft-times unruly technical services together, Weible warned against the dangers of branch rivalry:

> It is the first time that we have had a center of our own that we haven't had to beg, borrow or steal from somebody else. It is the first chance we have had to develop it along the lines it should follow. . . . This is probably the first time where we have placed Units representing so many different Services at the same post and under the same Unit Training Center Commander.
>
> There are going to be times when various people get hot under the collar and say that So and So isn't playing ball, and there is a chance for much, much friction if you want to develop it, but I think it will run if you can apply the idea that it has to—that we are all in the same war, and we have to cooperate to the advantage of all.[11]

In this objective ASF apparently succeeded. No serious branch rivalry developed to disrupt the training at Ellis.

The conference at Chicago also served to outline the proposed organization of the center and some of the details of operation. The center was to be flexible enough to allow several combinations of ASF units, according to the needs of the various branches at any one time. In the beginning Camp Ellis would be occupied by Quartermaster, Signal, Medical, and Engineer groups, any of which could be expanded, reduced, or eliminated entirely and others substituted. Administrative and training functions were, as far as possible, to be separated. The post complement, under the control of the Sixth Service Command, was to be the administrative body for the whole camp. An ASFUTC headquarters, made up of representatives of the services and responsible directly to ASF, was to supervise training. Individual service groups were to concentrate solely on the conduct of training. Although trainees were not to be considered in a common pool for the use of all branches, they could be transferred between units within any one service group in order to distribute experienced and capable men as evenly as possible and to make the units more uniform in quality.

The site selected for the camp was near Lewistown in the western part of central Illinois, a tract of about eighteen thousand acres along the Spoon River a few miles north of the confluence of that river with the Illinois.[12] Construction at Ellis began in the fall of 1942. During the following winter a railroad spur was brought in, roads and streets were cut through the cornfields, and building foundations were laid. Despite unforeseen hitches caused by construction during freezing weather, the center was formally organized on 15 March 1943 and the camp was sufficiently near completion by April to house the first cadres.

Meantime the Engineers had designated Col. Robert D. Ingalls to be the commanding officer for the Engineer group. Ingalls held an engineering degree from Cornell University. He had served overseas with an engineer regiment during World War I and had been on troop duty with engineer units almost continuously from that time till the outbreak of World War II. In 1941 he was executive officer of the 41st General Service Regiment. He subsequently commanded the 35th Engineer Combat Regiment, which he moved, complete with equipment and five months' supplies, from Fort St. John to

[11] Conf on Orgn of ASFUTC Camp Ellis, 30–31 Mar 43. 353, Ellis.

[12] WD Quarterly Inventory, Owned, Sponsored and Leased Facilities, 31 Mar 44, p. 84 (C).

Fort Nelson, British Columbia, in the winter of 1941–42, over 200 miles of narrow, twisting, wilderness trail. With this same regiment he built 250 miles of the Alcan Highway through the Canadian Rockies. His ability to lead the troops in achieving this feat, in spite of freezing weather and mountainous terrain, won him the Distinguished Service Medal and the supervision of the southern half of the highway. Ingalls had ample experience in training units at the regimental level. In February 1943 the Engineers sent him to West Camp Claiborne to study the larger job of integrating the instruction of many units. At the conference in March in Chicago he received a further clarification of his task of training a number of engineer units at a center which was not solely an Engineer installation.[13]

To fill the remaining positions in the Engineer group, the Engineers selected experienced instructors and clerks from the two ERTC's, the EUTC at Claiborne, and the Engineer Amphibian Command. On 28 April Colonel Ingalls, 26 officers, and 86 enlisted men arrived at Ellis. On 25 May two general service regiments, two dump truck companies, one parts supply company, and one base depot company were activated. The Engineer group, or EUTC, was organized on 1 June with a unit training capacity of 7,400 men. Space remained for four more regiments and several dump truck companies.[14]

The initiation of a standard program of training awaited the reception of fillers. It had been hoped that the voluntary induction of skilled construction workers would provide the major part of the men needed. These volunteers would be older than the average recruit but since they would be experienced in earth-moving and construction operations their organization and training would be greatly simplified. Unfortunately volunteers did not arrive in nearly the numbers required. By the first part of August the 361st Special Service Regiment at Claiborne had sent only 1,049 men to Camp Ellis. Other fillers in addition to these brought the units to only 36 percent of strength. The original units were less than half filled. Two more regiments and dump truck companies had been activated with even fewer men.

There was plenty of work to do pending the time when training could begin. In late April Ingalls had started the trainer overhead and cadres upon the development of training areas sufficient for the numbers of men scheduled to arrive. With the failure of the voluntary induction program to meet expectations, schedules were soon awry. Fearing that the great mass of fillers would descend upon the center all at once, overtaxing the normal facilities, Ingalls foresightedly put the half-filled units to work enlarging all training areas. Until the middle of August the regiments and dump truck companies built fixed and floating bridge sites along the Spoon River, constructed an additional rifle range, and enlarged obstacle, demolition, rigging, and field fortification areas. When the Engineers discovered that the Spoon River was so narrow and the current so slow that it would freeze over in

[13] (1) Rpt of Activities Mil Pers Br for Period Ending 15 Feb 43. 020, Engrs Office C of, Jan–Mar 43. (2) Ltr, C of Mil Pers Br to CG EUTC Claiborne, 17 Mar 43, sub: Off and Enl Cadre. 320.2, ASFUTC Ellis. (3) WD GO 23, 15 May 43.

[14] (1) 220.3, ASFTC Ellis. (2) Ltr, C of Mil Pers Br to CG EUTC Claiborne, 17 Mar 43, sub: Off and Enl Cadre. 320.2, ASFUTC Ellis. (3) Memo, C of O&T Br for CG ASF, 24 Apr 43, sub: Special Issue of Equip to Engr Sec, ASFUTC Camp Ellis, Ill. 475, ASFUTC Ellis. (4) Memo, Hq EAC for G–1, 21 Apr 43. Hq EAC—Class Sec, 312.1, Corresp (Misc).

winter, they moved the ponton equipment 140 miles north of Ellis to a hutment camp in Starved Rock Park on the Illinois.[15]

During this same interval, before the full training program could begin, the center worked out its procedures for instruction in rifle marksmanship. Ingalls gave marksmanship his personal attention, concentrating it into eight consecutive days to the exclusion of all other training. This procedure produced excellent results. In July, 99 percent of the 1,308 white trainees qualified, 18 percent as experts. Of the 391 Negroes, 93 percent qualified, with 4 percent expert. The average of all trainees qualifying during the following month was 97 percent and the number remained high. Qualifications among the first 6,000 men at the center approached 96 percent.

All Engineer training moved toward realism and physical hardening by the spring of 1943 in response to reports from overseas. The Ellis center opened just as this trend became more pronounced. Ingalls was convinced personally, as well, through his recent experience on the Alcan Highway, that the Engineer training at Ellis should be rugged in order to prepare both officers and men for the fatigue of sustained overseas operations. On 31 July 1943, before the majority of the fillers had arrived, he delineated his policy to the unit officers who would conduct the training:

> Time is short. Your unit will soon be in battle. Every hour is precious. Each one must be devoted to preparation. You cannot press too hard. Put the pressure on as hard as you may, yet you still will not approach the conditions of fatigue and hardship your units will soon face. An attitude of tolerance, pity or sympathy for your unit during the rigors of training will be reflected in poor preparation and consequent suffering or disaster when in an active theater. Every training task must be approached as though it were a battle mission. There must be no "breaks." No rest should be prescribed, except that due to physical exhaustion. There should be constant pressure through the chain of command to "get the job done." [16]

Shortly thereafter, just as had been expected, the center was swamped with the remaining fillers. Within three weeks, beginning on 17 August, almost 8,000 arrived. By 7 September space designed for 7,400 men held 10,500. Until the end of October, two regiments and four dump truck companies had to be housed in pyramidal and shelter tents without floors. Yet it was not the quantity but the quality of the fillers that caused the greatest concern to the center's staff. Most of these fillers were either men reclassified from a limited duty status, or eliminated as surplus overhead from service commands and other stations. Some obviously were undesirables. An OCE inspector in late August took a close look at four of the general service regiments and reported some startling cases of men wearing metal braces on their backs, injured right hands on right handed men, victims of infantile paralysis, deformed arms, legs, feet, and glass eyes.[17] A contingent of 461 men arriving at Ellis in late August represented the dregs of a group of undesirables who had been shunted from one station to another. In early August, Belvoir received these men from Fort Harrison. Out of the 862 men, Belvoir found 95 illiterates, 60 courts-martial cases, 87 limited service per-

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[15] Ltr, Ingalls to ACofEngrs, 15 Jan 44. 353 ASFTC Ellis.

[16] Incl 32, in Hist of Engr Group, Camp Ellis, Ill., 25 Jan 45. 353, Camp Ellis.

[17] Incl, Rpt of Inspec of 368th, 371st, 1301st, 1303d Gen Sv Regts, 29 Aug 43, by Capt Erhard E. Dittbrenner, to basic Memo, C of O&T Br for CG ASF, 2 Sep 43, sub: Tng Inspec of Units Committed for Overseas Movement. ASF, 333.3 Engr (S).

sonnel, 33 aliens, and 62 cases of time lost because of misconduct. Sixty-six percent of the total were in AGCT Classes IV and V. Belvoir retained 401 of these and shipped the remainder to Ellis.[18]

The efforts of the unit officers to conduct an orderly course of training were in the main abortive. Frequent disruptions occurred during the next few months as the men were screened to determine how many could be retained. Great numbers were discharged. Many of the men in the first three grades could not be used in these units and had to be reassigned. Transfers between units were continuous. In the month of October so many men were eliminated that one regiment could not begin training and three other regiments had to repeat their last four weeks. By the end of November the screening process in the seven regiments came to an end. Out of the 8,000 fillers, 3,940 were examined and reclassified. Of these examined, 1,917 were discharged, 1,310 were reassigned, and only 713 returned to duty. About 3,000 replacements had to be obtained.

Almost two thirds of these replacements were needed in specialist positions. The greatest deficiencies were in construction foremen, construction carpenters, bridge carpenters, electricians, utility repairmen, riggers, quarrymen, and blaster powder men—the very core of engineer skills. Realizing that the replacements would probably not furnish the skills needed, the center set up specialist schools. Sixteen different courses were offered. Since many of the OCS graduates knew little more about construction machinery than the men, the center attempted to provide this background through two specialist courses for officers in vehicle and heavy equipment maintenance.

According to the original plans the EUTC overhead was to conduct the training of specialists, but the great influx of trainees all at one time made it impossible for the small overhead to carry the load. Compared with the EUTC at Claiborne, which had one officer for every 27 men in training, Ellis had one officer for every 144 men. Enlisted overhead was comparable. In a period when the War Department was insisting on cuts in overhead, requests for additional men for group headquarters met with little success. The first solution for the conduct of specialist training under these restrictions was to leave specialist training to the units, each regiment running for all the rest those schools for which it had the best qualified instructors. When a unit moved out of the camp, whole schools had to be discontinued. In March 1944 the Ellis center, as Claiborne had earlier, tightened its control over this program. Although still under the necessity to draw upon unit personnel for instructors, the schools themselves were centralized under the group headquarters and given a continuity which they had not had before.

The fact that industrial specialists were older than the average recruit and that many of the men retained after screening of the group of limited service fillers barely met the physical requirements for engineer duty did not induce Ingalls to change the philosophy of training that he had formed during his years of Army service. In an effort to toughen his men and make the training more realistic, he allowed few breaks at any time during the day except for meals, devised twenty-four-hour bridge building exercises, and emphasized night problems and bivouacs. The MTP set aside five days

[18] Memo, Maj Gen Virgil L. Peterson for Deputy CofS, 23 Sep 43, sub: Overseas Readiness Status of the 355th Engr Gen Sv Regt. ASF, 333.3 IG, Engr.

for a marching exercise to cap the end of the period of technical training, four days for marching and the fifth day for rest. The distance and rate of march were left to the discretion of individual center commanders. At Ellis the units took a 125-mile road march in four days. The impact of this exercise varied directly with the weather. According to a battalion commander in the 1301st General Service Regiment, the "125 mile hike permanently injured some of our men that had a partial disability." [19] The regimental commander who took over the unit shortly after the march noted that the exercise "crippled a number of men and left scars on everybody." [20]

Typical of Ingalls' ideal—intensive training under realistic conditions—was the building of two landing mat airstrips 150 by 5,500 feet in late November and early December 1943. At one o'clock one afternoon five general service regiments and dump truck companies started on the first strip. One regiment loaded mat onto trucks continuously. The four others met in the center of the strip and began to lay the sections, each regiment working toward a corner of the field. Work continued all night. By five o'clock the next afternoon the last section was in place. Although he realized that the training manual was overly optimistic in prescribing this job as an eleven-hour operation for one regiment, Ingalls was understandably dissatisfied with the twenty-eight hours which the five regiments had taken. He determined to build the second strip in eight hours by using six regiments. Each of the 108 platoons had 320 sections of mat to place. Without previous warning, Ingalls gave the signal to begin work just as it started to get dark one cold December afternoon. An hour later it began to snow, a "heavy fall of big wet flakes" that continued all through the night. "Brooms and shovels were brought out to clean snow from the joints as the work progressed." [21] By six o'clock the next morning the first platoon had finished. The first regiment to finish had placed all its mat by early the next afternoon. Although the entire strip was not completed until five o'clock, the first plane could land by the middle of the afternoon. Ingalls again expressed disappointment. Even with an additional regiment, building time had been speeded up by only four hours. Conceding that the weather was partially to blame, Ingalls nevertheless believed that poor leadership at all levels and poor organization within the platoons were the major delaying factors. Accordingly he sponsored a series of competitions in mat laying among all of the platoons, each platoon laying 160 sections. By the middle of January 1944 when each regiment had eliminated all but one champion platoon he scheduled a final competition for the best platoon of the whole Engineer group. In this way Ingalls brought the best platoons to such a level of competence that they could lay 160 sections of mat in thirty minutes. He estimated that under ideal conditions six regiments could complete a landing strip in four hours. The competitions verified the fact that it took much more time to lay this mat than the training manual indicated. It would take one regiment as much as four or five days to haul and lay a strip of this size as opposed to the allotted eleven hours.[22]

Much good training resulted from the urgency which Ingalls injected into the pro-

[19] Ltr, Col Willard B. Wells, USAR, to C of EHD, 3 Feb 55.

[20] Incl to Ltr, Col Francis X. Purcell, Jr., to C of EHD, 31 Dec 54.

[21] Ltr, Ingalls to ACofEngrs, 15 Jan 44. 353, ASFTC Ellis.

[22] *Ibid.*

gram. The thoroughness with which he attended to details was undoubtedly beneficial. Rifle marksmanship qualifications remained high. The regiments knew how to lay landing mat before the competitions were over. The extensive bridge building exercises gave the units more than a familiarization in this fundamental engineer operation. Physical conditioning was continuous. For example, obstacle courses were so placed that troops moving from one training area to another ran these courses instead of simply marching from place to place.

The commanding officer of the 1301st General Service Regiment, which distinguished itself overseas as a combat unit, regarded Ingalls as "a devoted and brilliant engineer officer, an independent thinker, and a man of the finest quality." However, he had some reservations about training methods at Ellis:

> The best result of the type of training conducted was that no situation that the regiment met in combat seemed nearly as hard as what we went through in training. On the other hand, it was difficult under these conditions to develop the engineering techniques that a general service regiment or similar organization should have. Also, the severity of the training eliminated some men who were highly qualified technically but were not strong enough or young enough to stand up under such conditions.
>
> Most people with whom I discussed this training system were opposed to it, and . . . I was about the fifth commander of the 1301st during its nine months of training. I accepted Colonel Ingall's system and tried to get the most out of it, but I believe that the method was extreme, and I would prefer to train engineer troops under more favorable conditions and with more attention to the development of techniques as opposed to combat type training.[23]

A battalion officer in the same regiment recollected, "We all thought we would never 'make the POE' but someone . . . thought differently and how right he was. We had no sooner reached England when the men (and Officers) settled down, went to work and developed into the best General Service Regiment in the Third Army." [24] Varying shades of opinion came back to Ingalls from England as the units deployed overseas. Some of the unit officers observed that the training had served them well. One believed that "your training is exactly along the right lines; only if anything, it should be more so." Another wrote "We are learning a great deal and what I wanted to tell you more than anything else is that the training you gave me was the best thing that ever happened. . . . We needed everything you gave us and a little more. I actually wish that the training was stiffer." A third gave a rather weak endorsement, saying that "the way you are carrying on your training is O. K. for what we are doing here . . . ," and added rather ambiguously, "at present we are living in tents on a fine camp site, and finding our job here mighty easy compared to Ellis." [25]

While some of the engineers at Ellis considered the training ideal, others chafed under the realistic standards. Contributing to the unrest was the fact that the Engineer group could compare these standards quite easily with those set by the adjoining Quartermaster and Medical groups. Training methods and types of tasks varied greatly in the three groups; these variations could scarcely go unnoticed. Morale suffered further as a result of overcrowding in the Engineer group. Contrary to one of the primary

[23] Ltr, Purcell to C of EHD, 31 Dec 54.

[24] Ltr, Col Willard B. Wells to C of EHD, 3 Feb 55.

[25] Quoted in Incl 32, in Hist of Engr Group, Camp Ellis, Ill., 25 Jan 45. 353, Ellis.

aims of this ASF center, there was not enough flexibility in the space arrangements. In late August 1943, for example, when part of the engineers were forced to live in pup tents, there was vacant housing in the Medical group. Moreover, the majority of the August fillers were of a different sort from the relatively small group of volunteers that had arrived earlier. Discipline and morale were poor. Many of these fillers had been in the Army for months without completing basic training. Some came from other services and needed instruction in basic Engineer subjects. Such men resented further basic training. The interruptions to the program throughout the fall months of 1943, including the wholesale discharges and transfers and the shifting of personnel from one unit to another, did nothing to improve the situation.[26]

But the chief source of discontent was the constant pressure. Gripe letters reached Sixth Service Command headquarters, ASF headquarters, OCE, and at least one congressman. OCE received numerous informal requests for transfers. Although most of the inspectors found nothing fundamentally wrong with the Engineer training, some reported the physical requirements too severe and commented specifically on the 125-mile march. Accordingly, this march was abandoned in January 1944. Perhaps such reactions as that of the 1317th General Service Regiment which had made the march in severe winter weather, pointed out even more dramatically than the inspectors some of the disadvantages of the exercise. The AWOL rate in this regiment jumped from 52 at the end of November to 112 in mid-December and to 139 by the end of that month.[27]

No official action, other than the request to discontinue the 125-mile march, resulted from any complaints until the spring of 1944. Then a single letter triggered off a series of actions which culminated in the transfer of Ingalls. On 17 April a major serving with a construction battalion at Ellis wrote a short note to a contact in ASF headquarters. The note included a request that Somervell be given an inclosed letter detailing some of the things which he considered wrong about engineer training at Camp Ellis. The complaints ranged from "special hand salutes," use of swagger sticks by officers, and the necessity of "dodging 'gestapo' informers of the high command," to the "careful assignment of men to units by height rather than qualification" and the sodding of the lawns in the Engineer group. The lawn sodding came in for special comment. "A few days ago the entire Engineer Group of some 2000 men, 172 trucks and more than a dozen bulldozers were ordered to haul sod to pretty up the place. It was the third day of rain. Equipment and men worked in mud from 6 inches to 3 feet deep. Imagine the damage to equipment alone." [28]

Whether or not this letter ever came to

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[26] (1) Inspec, 1317th Gen Sv Regt (Negro), 1 Jan 44, by Lt Col Charles B. Schweizer, OCE. ASF, 333.3, Engrs 1–1–44. (2) Incl, Rpt of Inspec of 368th, 371st, 1301st, 1303d Gen Sv Regts, 29 Aug 43, by Dittbrenner, to Memo, C of O&T Br for CG ASF, 2 Sep 43, sub: Tng Inspec of Units Committed for Overseas Movement. ASF, 333.3, Engr (S). (3) Ltr, Dittbrenner to Sixth SvC, 29 Aug 43. Sixth SvC, 333.1–6, Gen.

[27] (1) Ltr (unsigned) to CG Sixth SvC, 14 Oct 43. Sixth SvC, 333.1–6, Gen. (2) Interv, Mary Pagan, Mil Pers Br OCE, 16 Aug 54. (3) Inspec, 1317th Gen Sv Regt (Negro), 1 Jan 44, by Schweizer. ASF, 333.3, Engrs 1–1–44.

Inspection reports of OCE, Sixth Service Command, and ASF have been scanned for this entire period. There was no special inspection made by The Inspector General's Department in the spring of 1944.

[28] Ltr, Maj C. P. Carson to Somervell, 17 Apr 44. ASF, 354.1, 17 Apr 44.

the attention of Somervell, it did circulate among various divisions in ASF headquarters. The person who first received the letter was of the opinion that, although it was addressed to Somervell, the proper place for it was in OCE. Within a few days, however, the letter reached the desk of Col. Arthur G. Trudeau, Deputy Director of Military Training, ASF. On 22 April 1944 Trudeau directed a memorandum to the Chief of Engineers and to the Commanding General, Sixth Service Command, inclosing a copy of the major's letter with the signature deleted. Trudeau noted that the military training of engineer troops at Ellis had been under similar criticism for almost a year. He requested both OCE and the Sixth Service Command to eliminate immediately any existing malpractices. Each was to submit a report recommending any desirable changes in trainer personnel or any further action which might be taken by ASF.

This memorandum came as a surprise to the staff at Camp Ellis. Ingalls' immediate superior in command of Camp Ellis, Col. John S. Sullivan, considered him an excellent trainer, if something of a martinet.[29] Sullivan's eventual reply to the Sixth Service Command was therefore almost solely a defense of Ingalls, in fact, a rephrasing of Ingalls' own memorandum to him on the subject on 26 April. Ingalls wrote proudly of the marksmanship record which the Engineer group had earned and emphasized that no other training subjects had suffered from this achievement. Many of the specific criticisms concerned matters which Ingalls had hoped would improve morale:

> As I remember, the anonymous writer mentioned swagger sticks, special salute, assignment of men to companies by height, sodding of areas alongside of barracks and officers assembly.
>
> I don't believe in officers carrying their hands in their pockets. I also believe in doing whatever may rightly be done to render a unit distinctive. I have encouraged officers to carry swagger sticks for these two reasons. No officer is forced to carry one, nor discriminated against if he chooses not to do so.
>
> The method of salute taught follows exactly the salute prescribed in training regulations and also as taught at West Point (so I have been told by those in attendance there).
>
> I have served in two regiments where men have been assigned to companies by height and have found it to be a morale factor of value to those units. It also has practical advantages. I have found no disadvantage. It is a simple way to solve a large percentage of initial classification procedure because of the operation of the law of averages.
>
> Most of the sodding accomplished here has been done after retreat. On one very rainy day recently when it was felt that most training would have been inefficient, all worked at sodding. There was a considerable element of training for all in that days work. Our area now is the best looking area in Camp Ellis. I'm sure our soldiers are proud of it.[30]

Other portions of the major's letter had contained adverse comments on the assignment of personnel to engineer units and upon the course of instruction at the Engineer School. From OCE Sturdevant confined his answer to these matters, assuming that the Sixth Service Command would counter the criticisms applying directly to Camp Ellis. That this reply was less than satisfactory was evident in the subsequent memorandum from Trudeau reminding the Chief of Engineers that OCE was responsible for the assignment of officers and for the character of training being given at Ellis. On 6 May 1944, Reybold answered in more detail. He touched upon the "large number of misfits and cast-offs" received as fillers

[29] Interv, Sullivan, 20 May 54.

[30] Memo, Ingalls for Sullivan, 26 Apr 44. Ellis, 353, 1944, Book II—C Tng.

at Ellis and the shortage of heavy construction equipment and trucks throughout 1943. The "unduly strenuous physical requirements" had come to his attention and were "no longer required." But the burden of his answer was the "inadequate allotment of officer and enlisted administrative and trainer personnel." As to the assignment of officers, Reybold explained that "a careful study is made of all those available before actual assignment is made to any unit or training center. Obviously, these studies and assignments are based upon available records. When an officer fails to meet his responsibilities, the Chief of Engineers, upon the request of the Service Command, promptly supplies his best available qualified officer to replace the unqualified officer. For the determination of an officer's actual ability, the Chief of Engineers depends upon the service commander and the camp commander . . . for units not under his control." [31]

Since the camp commander believed Ingalls was doing an exceptionally good job and the Sixth Service Command had rendered no adverse report, the transfer of Ingalls early in May 1944 undoubtedly followed a different procedure from that described. ASF was acutely conscious of public relations, was obviously concerned over the unofficial comments being received, and might conceivably be hypersensitive about the reputation of this ASF center. Pressure from ASF to remove a controversial figure might well have been the deciding factor. There was never any formal investigation of the EUTC.[32]

Col. Herman W. Schull, Jr., took command of the EUTC on 17 May 1944. With the decline of engineer unit activations, the center soon thereafter had served its main purpose. On 25 January 1945 the Engineer group was formally disbanded. In all it trained fifty units, including seven general service regiments, a total of about 13,000 men. The work of preparing these units for overseas assignments was largely completed during the year Ingalls was in command. He had organized the center with hand-picked men familiar with the intricacies of an Engineer training installation. With them, he had developed an excellent physical plant well planned for engineer use. He had infused the center with a sense of realism, had given the troops a foretaste of the discomforts and hardships to come. Despite the disruptions caused by the numerous unqualified fillers, the difficulties of supervising with too small a staff, and the dissatisfactions and dissensions that arose from his interpretation of the training mission, Ingalls prepared these troops to play creditable roles in active theaters.

The 1301st, 1303d, and 1306th Engineer General Service Regiments made the list of eleven such units which the Office of the Chief Engineer, ETO, recommended for Meritorious Service Unit Plaques on 20 November 1944. These three regiments sup-

[31] 1st Memo Ind, Sturdevant for CG ASF, 28 Apr 44; 2d Memo Ind, Trudeau for CofEngrs, 1 May 44; 3d Memo Ind, Reybold for CG ASF, 6 May 44; all on Memo, Trudeau for CofEngrs, CG Sixth SvC, Dir Mil Tng Div ASF, 22 Apr 44, sub: Engr Tng at Camp Ellis, Ill. 323.3, ASFTC Ellis.

[32] (1) Interv, Sullivan, 20 May 54. (2) Interv, Col J. P. Buehler, 20 May 54. (3) Interv, Col Edward A. Brown, Jr., 16 Aug 54. (4) Interv, Mary Pagan, Mil Pers Br OCE, 16 Aug 54. (5) Interv, Trudeau, 4 Mar 54.

Most of the people interviewed had but vague recollections of this whole affair. Trudeau and Brown (of Military Personnel, OCE) remembered nothing. The consensus was that ASF pressure most likely caused the transfer of Colonel Ingalls.

Drafts of this chapter were submitted to Ingalls for review, but in accordance with his request comments he made on them in letters to the Chief of Military History have not been used.

ported the drive of the Third Army through France in place of combat engineer organizations, which were not at that time available. Innumerable bridges had to be placed in the shortest possible time in the most forward positions. At Thionville, the 1306th threw a 200-foot double-triple Bailey across the Moselle under constant mortar and artillery fire. The 1301st maintained this high caliber of work later on the 70-ton Oppenheim bridge, built within fourteen days from materials obtained in the locality. This bridge, both in design and construction, was considered by the Chief Engineer, ETO, as the best of all the Rhine bridges built by field force units. A grateful XII Corps in the spring of 1945 reported magnificent support from the 1303d.[33]

Camp Sutton: A Study in Racial and National Tensions

The Engineers opened the third EUTC on 20 July 1943 at Camp Sutton, North Carolina.[34] The site covered over two thousand acres of steeply rolling, partially wooded land near the southern border of the state a few miles east of the town of Monroe. Two good highways bounded the tract on the north and south. A railroad and another highway paralleled each other through the center. Troop quarters, connected by dirt roads with the outlying tactical areas, adjoined the central east–west highway. A small creek which ran through the camp from north to south provided good sites for fixed bridge construction. The nearest river of suitable size for ponton bridge and stream crossing instruction was the Catawba, thirty-four miles southwest of Sutton in South Carolina. The firing range was eighteen miles southeast of the camp on 7,000 acres of leased land near Pageland, South Carolina.

Camp Sutton had many of the characteristics of the original setup at Claiborne. It was a tent camp built in 1941 for only three months' use. The Engineers expected to occupy Sutton for about a year, or just long enough to train the units sent there at the outset. Minimum improvements were to be made. By November 1943 the tents had been modified for winter use but were extremely dilapidated. The few theater-of-operations type of buildings were insufficient to house all post and EUTC headquarters personnel. Negro and white troops were housed separately on opposite sides of Richardson Creek.[35]

As set up in July 1943 the center had a capacity of 13,000 men, enough for five white and four Negro general service regiments, but almost immediately had to expand to accommodate 16,000 men and

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[33] (1) Ltr, C of Troops Div Office C Engr ETO to Engr Channel Base Sec ComZ *et al.*, 20 Nov 44. Hq OCE ETO, 200.6, Awards and Decorations, 1944. (2) After Action Rpt, Third Army, 1 Aug 44–9 May 45, Vol. II, Staff Sec Rpts, Engr Sec, pp. 2–18. (3) Hugh M. Cole, *The Lorraine Campaign*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1950), pp. 407–08. (4) Ltr, Purcell to C of EHD, 31 Dec 54. (5) *Final Engr Rpt, ETO*, pp. 303–04. (6) Rpt, Hq XII Corps to TAG, sub: Rpt of Combat Opns, 1–31 Mar 45. Opns Br AGO, Vol. IV, XII Corps A/A Rpt, Mar 45.

[34] Unless otherwise noted, this section is based on: (1) 353, Sutton (C); (2) 353, EUTC Sutton; (3) P&T Div file, EUTC Sutton; (4) 602, Sutton (C); (5) Rpt of Visit to Camp Sutton, N. C., C of Sv Force Br, Office ACofS G–3, 2 May 44. EHD files; (6) Lee, Employment of Negro Troops, Ch. IX, pp. 42–44; X, pp. 68–79; XIV, pp. 48, 76–80.

[35] (1) Ltr, TAG to CG Fourth SvC, 15 Jul 43, sub: Estab of EUTC Camp Sutton, N. C. 323.3, EUTC Sutton. (2) Ltr, CO EUTC Sutton to CG Fourth SvC, 15 Oct 43, sub: Constr at Camp Sutton, N. C., with 3d Ind, C of Mil Constr Br to CG ASF, 12 Nov 43, with 4th Ind, C of Constr Plan Br ASF to CofEngrs, 18 Nov 43. 600.1, Sutton (C).

other types of units. During the year and a half of its existence the Sutton EUTC trained forty-nine units, including base equipment companies, base depot companies, dump truck companies and utilities detachments, general service regiments, and construction battalions. Some 3,500 Italian collaborators, formerly prisoners of war, arrived to be organized and trained in April 1944. A German prisoner of war compound of several hundred men remained in the camp at all times. From this highly charged mixture was to come an explosion in late summer 1944.[36]

Just as for Camp Ellis, the Engineers drew upon existing training installations to staff Camp Sutton. The 50 officers and 94 enlisted men who made up the original training division at Sutton came from the two ERTC's at Fort Belvoir and Fort Leonard Wood, from the Engineer School, from OCE, and from the Manhattan District. All officers had from six months to two years experience as instructors. The officer allotment proved sufficient for the task but the number of enlisted men had to be more than doubled. By June 1944, 49 officers and warrant officers and 201 enlisted men were on the staff of the training division. Within the next six months limited service personnel, given an opportunity to serve as understudies before appointment to positions of responsibility, gradually replaced them. In December 1944, when the center closed, about 80 percent of the training division was subject to limited service only. As at the other EUTC's the training division co-ordinated the efforts of the individual units in the use of time and facilities and attempted to make the training more uniform.

All of the training at Sutton should have been of extremely high quality. The pattern for concentrated instruction had already been tested at Claiborne and at the ERTC's. The experienced supervisors had only to make a synthesis of the training procedures and practices that had worked well at the training installations from which they came. Since few of the units were pressed for time, MTP's could be followed almost to the letter. Faulty planning at higher levels canceled out these advantages to some extent. Too great a load was thrown upon the center within a short space of time. Six general service regiments arrived within the first thirty days, allowing little staggering of training and resulting in an inefficient use of equipment. Special equipment for units other than general service regiments did not arrive at all and could not be procured for several months. Equipment and materials for the specialist schools came in insufficient quantities. The simplest sort of training areas, such as drill fields, had not been prepared in advance. While the construction of such areas provided excellent exercises for heavy equipment specialists and the dump truck company during the first few months, general training would have been improved if the areas had been ready for use at the start.

By October 1943 facilities were much improved. At the end of the first three months twenty-six drill fields had been laid out, graded, and drained. Four fixed bridge sites lined the lower course of Richardson Creek, including one site for the H–10 and one for the Bailey bridge. Nine tactical areas were defined in the wooded northern portion of the camp for squad and platoon scouting and reconnaissance. A demolitions area occupied the isolated northern tip of the whole tract. Three regular obstacle courses and

[36] Ltr, ACofEngrs to CG ASF, 14 Sep 43, sub: EUTC, Camp Sutton, N. C. 322, EUTC Sutton.

one knot obstacle course provided physical conditioning and practical tests in rigging. By early 1944 the center was well supplied with classroom buildings, motor vehicles, and special equipment such as asphalt repair plants, woodworking machinery, blacksmith and welding sets, and well drilling gear.

The headquarters staff at Sutton gave ample evidence that it had learned much from past experience. Inspectors expressed satisfaction with detailed plans for executing and supervising the work. Specialist training was orderly and efficient and received repeated commendation. Instructors came from the Schools and Specialist Section of the Training Division or from the officers' pool. When the EUTC schools became crowded, individual units set up parallel courses using lesson plans furnished by the Schools and Specialist Section, but this expedient had to be resorted to only occasionally. The bulk of the nearly 7,000 specialists received instruction in schools run by the center.[37]

What made Sutton fail to live up to expectations was the personnel received and the uncertainties in unit organization. A preponderance of Negro troops who had had little opportunity to acquire fundamental skills presented an almost insuperable handicap. Few Negroes assigned to Sutton had ever driven a truck or worked with mechanic's tools before assignment to dump truck companies. General service regiments required men of a higher degree of education, aptitude, and experience for draftsmen, surveyors, structural designers, construction supervisors, and operators of complicated heavy machinery.

Following the War Department's decision that Negro and white units of the same type could not be trained at the same rate, OCE published an MTP in October 1943, ostensibly for substandard units but primarily to give the Negro engineer soldier a longer training period to compensate for his educational and vocational deficiencies. The basic military period for substandard units was extended from six to nine weeks. The new program emphasized discipline. No Negro officers were to give basic military instruction. Twice as much time as usual was allotted for military discipline, customs and courtesies, and guard duty. There was an enormous increase in marches and bivouacs, from twenty to seventy-six hours. Five weeks were added to the regular eight-week tactical and technical period, and field training lasted for four weeks instead of three. Review and makeup time was doubled for both general service regiments and dump truck companies. The repetition of subject matter during these frequent reviews helped to keep the material fresh in the minds of slow learners. The number of tests was also doubled to keep a closer check upon unit progress.[38]

The longer period of preparation reduced some of the pressure in qualifying Negro dump truck companies and general service regiments at Sutton. The center had sent out three white and three Negro regiments, or about 7,500 men, by March 1944. In the same month the Engineers began to convert some of the general service regiments to construction battalions, which had more and heavier equipment. One white regiment just completing its training did not reorganize as a construction battalion, but the remaining white regiments and the four

[37] 1st Ind, 8 Mar 44, on Ltr, Dir Mil Tng Div Fourth SvC to CG Camp Sutton, 4 Mar 44, sub: Tng of Well Drillers. 353, Engrs, Mil Tng Div ASF.

[38] (1) MTP 5–101, 25 Sep 43. (2) MTP 5–101–A, 30 Oct 43.



NEGRO TROOPS TRAINING AT CAMP SUTTON, *February 1943.*

Negro regiments made the change in early March.[39]

In addition to having more and heavier machines of the types issued to general service regiments, the construction battalions also had tractor operated cranes, concrete mixers, powered and towed road rollers, cable operated road rooters, towed road scrapers, trailer mounted lubricators, and a mobile power plant. OCE tried unsuccessfully to get enough additional machinery to the EUTC to make up four full sets of construction battalion equipment upon conversion of the units. Only one complete set of equipment had arrived at the EUTC by mid-April; the other three sets were scheduled for delivery some time within the next two months.[40]

It seemed to the staff at Sutton that an impossible goal had been set. OCE was in full agreement and had already protested the conversion of Negro units to construction battalions. Although with constant supervision many of the Negro men had become proficient in operating the organizational equipment of the general service regiment, the new machines to be issued to the construction battalion imposed a demand for a whole new group of operators, supervisors, and foremen. The same questions would have to be answered. How can one train a surveyor without a mathematical background to build on? How can one turn a dirt farmer into an experienced construction

[39] (1) Rpt, CO Camp Sutton, 10 Sep 43, sub: Consolidated Strength Rpt (Present and Absent) as of 2400, 8 Sep 43. 320.2, EUTC Sutton. (2) Analysis of the Present Status of the War Dept Troop Basis, 1 Jan 45. AGO Special Reference Collection. (3) Memo, C of Mob Br for ACofEngrs for War Planning, 31 Mar 44, sub: Engr Units at Camp Sutton, N. C. 320.2, Jan 42–Sep 44 (C). (4) See above, page 236, for a discussion of the organization of construction battalions.

[40] (1) T/O&E 5–27, 1 Apr 42. (2) T/O&E 5–75, 23 Dec 43.

foreman in so few weeks? The most promising of the enlisted men had already been sent to off-post schools and most had returned qualified only as rodmen and chainmen, machinists, and construction machinery operators. Few had been recommended for supervisory positions. The EUTC flatly announced it could not fill nine master sergeant and technical sergeant ratings. Maintenance inspectors, construction superintendents, machine shop foremen, stonemason foremen, plumber foremen, surveyors, construction supervisors, road construction designers, and battalion motor sergeants would have to be obtained elsewhere. OCE replied that none could be supplied and that for the most part they must be developed at the EUTC from the best men possible, since special service schools could train only four of the nine ratings. In early July one of the construction battalions, sent out on a construction operation near Lenoir, North Carolina, had to be removed from the job because of the poor quality of the work.

OCE finally succeeded in convincing the War Department of the soundness of its position. The new general service regiment, which was adopted as a compromise organization, eliminated many of the more complicated jobs. Three of the four Negro construction battalions, the only units of that type remaining at the center by that time, were thereupon reorganized for the second time, with the expectation that the simplification would enable the EUTC to get all five units into shape for movement overseas by September. In August, with the occurrence of racial disturbances, it was determined to move all of the Negro troops, including the dump truck companies, overseas at their current status of training as quickly as possible. The last of the Negro units left the center in October 1944.

Some of the tensions that built up at this center were typical of those at other training establishments with concentrations of segregated Negro troops. Disorders involving large numbers of Negro soldiers occurred frequently at many camps during the summer of 1943, and by January 1944 ASF had placed the prevention of racial disturbances at the top of its list of current problems. Post and unit officers were cautioned to stress a high degree of military discipline, improve recreational opportunities, allow the advancement of Negro officers according to their merit, better public relations, and above all keep alert for potential trouble and take preventive measures. A careful and secret mail censorship could be used to gather information. Sutton had the additional friction of Italian troops after the spring of 1944. Neither Negroes nor Italians were welcome in the small southern communities surrounding the camp. Through race and language barriers, both groups were isolated from their environment.

The 3,500 Italian troops that arrived at Sutton in April 1944 were at first slated for organization into dump truck companies, but almost immediately plans changed. They were to be formed into general service units instead. A month after their arrival they were still disorganized, the center having received neither a T/O&E for them nor any general directive to guide their training. This uncertainty and lack of direction damaged morale. The fact that they were foreigners and, until recently, active enemy soldiers limited off-post recreation. The center authorities believed that their "conduct has been reasonable under the circumstances" but "there are continued irritating

affairs between them and civilians. Their demands for privileges increase . . . ." Had it been possible to give them more active and constructive work away from the camp their attitudes might have improved, but civilian complaints brought about closer confinement. "Fourth Service Command refuses to allow them to go in the field for three weeks. A very good project had been worked up for them—cutting fire lanes on state land, well away from habitation. As it is now, they are doing WPA work around the post." [41] By early July, to the relief of the commanding officer, 25 percent of the Italians had been shifted to another station. By mid-July all had gone.

The Italians had been only one of the sources of irritation and tension that had disrupted the training at Sutton. The principal one was still the Negro units. The reorganizations, from general service regiments to construction battalions and then back again, caused frequent changes in officers and kept the units off-balance. The trend toward the use of more complicated machinery forced the inexperienced Negro soldier to the limit of his ability. The frustrations of trying to do a job with too little background caused the men to appear undependable when promoted to positions of responsibility. They resented their complete isolation from white troops as well as the fact that great care was taken to keep white officers superior to Negro officers in units of mixed command. Aggravating the situation was the unfortunate attitude of some of the center officials who suspected that much of the slowness to learn and the bad performance in the presence of inspecting officials was deliberate, a calculated effort to delay assignment overseas.

It could not be denied that learning was slow and a sullen attitude developed. The officers showed up just as badly as the men, although Negro officers had considerable control over the troops. By late April 1944, when some of the units had been in training for thirty-three weeks, posture was still bad, marching and manual of arms sloppy, military courtesy practically nonexistent. Instruction was being given in a desultory manner in the use of simple tools such as pick and shovel, crosscut saw, climbing irons, adze, square, and power drill. Naturally neither instructors nor trainees exhibited much interest. The progress made in the specialist schools offered the only bright spot in this dismal display. Perhaps because specialist candidates were a select group, perhaps because they wished to seize the opportunity to advance, these trainees presented quite a contrast to the mass of the men. They were attentive, interested, and applied themselves diligently and on the whole successfully. Nevertheless, the general training program was in a state of deterioration. A partial explanation lay in the fact that Brig. Gen. Lehman W. Miller, commanding at Sutton, was not a well man. Control of the center alternated between him and his executive officer, a capable man, but lacking in the tact and finesse necessary to deal with racial disturbances. A somewhat dismayed inspector from the General Staff reported in May 1944 that what the center needed above all was a firm hand.

Officers accustomed to a faster training tempo had responded to the understandable slow progress of Negro units with understandable discouragement. Added to the greater training burden was the constant psychological pressure engendered by the concentration of Negro troops. Some white

[41] Ltr, ExO Camp Sutton to OCE, 4 Jul 44. 353, Sutton (C).

officers resented assignment to Negro units, became mentally depressed by the association, and in some cases were emotionally unnerved by the experience. In June 1944 Gorlinski made a visit to the center and noted that morale was very low among those officers who had been at the camp for a long period. He consequently sent in five fresh officers who were placed in strategic positions with the idea that they would leaven the pessimistic attitudes.

The center had by this time acquired the firm hand that had been recommended in April. Col. Clinton W. Ball, assigned to Sutton as executive officer by early June, assumed command in July. His previous background included "actual experience with raw jungle natives in the mines and bush of the Transvaal, Rhodesia, and German East Africa, native soldiers, Jamaica negroes, colored American soldiers of long service, river workers on the Mississippi and Ohio Rivers, and cotton hands in Texas." Although he considered Negro troops capable of a "cunning dumbness," he believed that "for the large percentage of normal, sturdy, well-balanced American officers, their assignment to a colored unit becomes a detail like any other job." [42] His formula for raising the training standards at Sutton, as well as for improving morale, was hard work and rigid discipline. Shortly after becoming executive officer, he wrote Gorlinski:

> In connection with the uplift of morale, the following procedures have been taken. The basic trouble is that the white officers with colored units have held their heads and wondered why "they" should be picked on to command these outfits. This is a very normal reaction and takes about three days to recover. I have made it my business to get each regimental commander and staff and tell them that it has been done, can be done, and will be done, that if they do not start now to instill discipline, fundamentals of good soldiering and housekeeping into their men, they will find that they will smoke on the decks of transports, in the holds with inflammable freight, inviting submarine attention; they will light fires and flashlights in blackouts, be careless with firearms and explosives and endanger lives of their own officers and all other troops in their vicinity. I have been petitioned by three officers directly and a few more indirectly for transfer to white units and I am sure I know what I talk of. The whole trouble is in putting some starch into these young men who have been either undertrained or mother's darlings.[43]

The resulting campaign to put some starch into the young officers, who seemed to be suffering already from a form of claustrophobia, consisted of retaining 75 percent of all the officers on the post at all times and instituting a compulsory maintenance course for them to occupy their spare hours. They could attend to their social affairs later. Other morale measures may have had a more positive effect. As a result of a directive from ASF, a Negro captain was brought to headquarters as a part-time staff officer and trouble shooter. Mail was carefully censored. An intelligence officer gathered and sifted rumors and reports.

Despite the firm hand at Sutton the friction, resentment, and mutual suspicion at last reached a climax in the sultry days of late August 1944. Instances of insolence and insubordination to officers, M.P.'s, and civilian police became frequent. Civilians stoned busses filled with Negro soldiers, apparently without direct provocation. From several sources came definite information that the Negroes had devised a "planned, continued course of conduct against both the Post and

[42] Ltr, CO Camp Sutton to OCE, 10 July 44, with Incl, Info for Visiting Offs. 353, Sutton (C).

[43] Ltr, ExO Sutton to Gorlinski, 29 Jun 44. 353, Sutton (C).

the Town of Monroe." [44] On 29 August the Ordnance warehouse was robbed of twenty-eight pistols and a number of other weapons and instruments. Ball acted immediately. All post training ceased. He ordered the three regiments and one construction battalion off the post, miles apart, on bridge and road construction jobs and on extended marches. This left only 200 Negro soldiers on the post, the station complement, 450 German war prisoners, and a few others. After a careful search of quarters for hidden weapons, the units were brought back separately and given a thorough inspection.

The incident served to accelerate the plans to move these units overseas at their current status of training and to close down the camp completely. In spite of improvements Sutton was poorly suited for training and its facilities could not even be used for storage purposes. All of the units shipped out in mid-October and the camp closed at the end of the year. The Sutton EUTC trained about the same number of men as the Ellis center, some 13,000 in forty-nine units.

In June 1944, ASF combined replacement and unit training at the same installations, doing away with separate centers for the two types of work, redesignating them ASFTC's. The ERTC's at Belvoir, Wood, and Fort Lewis (successor to Abbot), and the EUTC at Claiborne made the change. Ellis and Sutton continued to train only units until their closing at the end of 1944.

Between April 1942 and June 1944 the Engineers concentrated most of the training of the many diverse types of service units at three locations, with a resulting economy of equipment and training overhead. Elaborate training aids for basic military training served all units alike. Carefully constructed sites for bridging, road construction, demolitions, obstacles, and for many other general engineering subjects, promoted efficient instruction with a minimum of duplication in facilities. Equipment peculiar to specific types of units such as the semipermanent shop installations at Claiborne could be used over and over to train successive units in the repair and maintenance of machinery. Three sets of center supervisors, after training a large number of units in succession, built up a body of experience which could be applied to recurring basic problems in the training of all similar units. Each EUTC, having authority to shift men around from one unit to another, could approximate an equal distribution of talents and abilities among the units under its supervision. Centralized production of lesson plans and schedules and minute supervision helped to provide further uniformity in the quality of the units. Capacities for training grew from a provisional setup for 16,000 construction troops to a maximum of over 57,000 in the peak month of September 1943. These three centers produced a total of about 138,000 Engineers during their existence as EUTC's. These were the men who kept the machinery of the engineers' war working night and day, provided lumber, built bridges, and laid thousands of miles of pipeline for the distribution of vital petroleum products. These were the men who repaired airdromes in Europe in a matter of hours, constructed landing strips from Pacific jungle in a matter of days, and hewed strategic roads through forests and mountains the world over.

[44] Ltr, CO Camp Sutton to Dir Mil Tng Fourth SvC, 29 Aug 44. 353, Sutton (C).

CHAPTER XIV

Engineer Aviation Units

In contrast to the early trend toward centralization in the training of ASF engineer units, the AAF did not provide Engineer Unit Training Centers until the spring of 1943. This variation in approach to a similar training task was indicative of different concepts within each command which had appreciable effects upon the training of engineer troops. Engineer aviation units occupied an ambiguous and somewhat unstable position between the Corps of Engineers with its long, proud, exclusive tradition and the Army Air Forces—new, aggressive, and equally proud.[1] Control of these units was never a clear-cut matter, either in their training or overseas. Some theater commanders, short of engineer troops, used aviation battalions for any priority construction job; others reserved them for Air Forces projects only. During the units' training in the United States, conflict arose chiefly from the attempt to apply Engineer concepts of training within the AAF framework. Although engineer aviation units made up a significant portion of the total number of engineer troops, the Corps of Engineers came to have little control. The units were a negligible fraction of the AAF, which gradually assumed almost complete charge. At no other one point did the divided loyalties collide with greater force than in the Office of the Air Engineer where Engineer officers served on the AAF staff. It was the Air Engineer who had to reconcile the two pressures with the least possible damage to the units involved.

New Activations During the Equipment Shortage

During 1941 twelve engineer aviation battalions had been activated, hurriedly organized at various scattered Air Forces bases, and rushed to Alaska, Hawaii, Puerto Rico, Panama, and the Philippines after about three months of training. Activations in 1942 increased rapidly.[2] In the first four months the Engineers formed seventeen battalions with white personnel and five with Negro troops. For a time the ERTC's furnished basically trained fillers, but by April this supply became thin. Transfers from other types of engineer units and from training centers of other branches helped somewhat until late spring, but engineer aviation battalions had to rely increasingly upon recruits from reception centers. The experience of the 833d Engineer Aviation

[1] Because most of the information in this chapter on the training of aviation engineers came from the AAF Central File, citations from that source have no depository indicated. (See Bibliographical Note.)

[2] In addition to those documents and files cited throughout the text, this section is based upon: (1) Engr Avn Units, CONUS and Overseas, as of 1 Mar 44. OCE 320.2, Engr Avn Units (C); (2) 321–A, Engr Corps (S); (3) OCE 475, Engr Avn Units; (4) R&D Div file, A/B Engr Equip GN 356; (5) ERDL GN 355, 1 Oct 42–31 Jan 43.

Battalion provides an insight into some difficulties encountered in the early summer months of 1942. Fillers were a mixture of ERTC personnel, basic infantrymen, and recruits, but the unit had so few officers that it was impossible to run separate programs for recruits and for those who had already had basic training. Therefore, the whole battalion began an eight-week program of basic training, engaging in no combat problems or engineering operations. In mid-July this unit, still some 250 men understrength, moved to a staging area. By the end of summer the supply of ERTC-trained initial fillers dried up completely. Only cadres, cadre replacements, and last-minute filler replacements could be obtained from the ERTC's.[3]

Just as the sources of basically trained engineer fillers diminished in the spring of 1942, the War Department acted upon the presumed urgent need for airborne engineer aviation troops. Brig. Gen. Stuart C. Godfrey, Air Engineer, took the initiative in delineating the support role of engineer units in an airborne infantry operation to capture and make use of airfields, many of which would probably be deep within enemy-held territory. The engineers in such an operation would go in in three waves, each with a progressively more complicated mission to perform. The first was to consist of airborne combat engineers, dropped by parachute, who would clear with hand tools a space just large enough to assure a landing spot for the gliders of the second wave. This second wave, the engineer airborne aviation battalion, was to follow immediately for more extensive but still limited repair with bantamweight machinery. Permanent reconstruction and enlargement of the airdrome would be undertaken later by engineer aviation battalions, moving overland, with standard construction machinery.

At a conference in Godfrey's office on 8 June 1942 planners agreed that the second mission represented the greatest innovation. At least one airborne engineer aviation battalion should be formed to test the new organization and special equipment. Maj. Ellsworth I. Davis of the Engineer Board was designated to develop the equipment for this battalion and Capt. Harry G. Woodbury of the 21st Engineer Aviation Regiment was given the full-time job of integrating doctrine, organization, and training.[4]

Within the next month Woodbury worked out the details which governed the training of the eighteen airborne aviation battalions activated during the course of the war. He recommended that the battalion be armed and trained in weapons sufficient only for its own defense. The unit should proceed unhampered to do the most rapid repair job possible in order to provide minimum field space for cargo planes, fighters, observation planes, and light bombers. Woodbury suggested that a provisional aviation training unit be furnished to supervise the basic and technical programs for these battalions. Each unit should then be transferred to some airborne command station for further development of techniques.[5]

The provisional training unit was not established at once. Instead, Woodbury was

[3] (1) Ltr, ACofEngrs to CG SOS, 6 Apr 42, sub: Trp Basis for Activation of Engr Units with AAF. OCE 320.2, Engrs Corps of, Pt. 15. (2) USAF HD, Engr–823 HI (S). (3) Ltr, Godfrey to Engrs First, Second, Third, and Fourth Air Forces, 3 Aug 42, sub: Tng of Avn Engr Trps. KCRC AF 353, Tng Book III. (4) USAF HD, Engr–833–HI.

[4] Min, Conf on A/B Avn Engrs, 8 Jun 42. OCE 320.2, A/B Engrs (C).

[5] Woodbury, Notes on Orgn, Opns, Equip, and Tng of A/B Avn Engrs, 9 Jul 42. OCE 320.2, A/B Engrs (C).

placed in charge of an experimental battalion, the 871st, activated at Westover Field, Massachusetts, on 1 September 1942. The organization of this unit began in late August with a cadre of 100 volunteers from other aviation units and was brought to full strength in the same manner by 20 September. The Engineer Board meantime chose certain types of lightweight construction machinery suitable for transport by air. The Air Transport Command furnished four C–47's in mid-September. Within the first month each crew flew 120 hours of training flights, and those engineers who could not adjust to airborne operations were eliminated.

The battalion's cargo planes were soon busy on another task. Even though the organization and equipment had been given no tests, two companies of this first battalion were slated for the North African invasion within six weeks of activation. Consequently, manufacturers were prodded to produce at least some of the bantam equipment that the board had tentatively selected. The four cargo planes then began a shuttle service to Midwest factories, picking up bulldozers, carry-all scrapers, graders, sheepsfoot rollers, air compressors, jeeps, asphalt repair plants, and electric lighting sets as they came off the assembly lines. By mid-October the two companies had been trained, equipped, and sent to a staging area.

Anticipating a great demand for such units, the War Department activated five additional airborne aviation battalions before the end of 1942. Two of these were organized at Westover Field in October and three at Camp Claiborne in November—the latter three moving to Westover Field by late February 1943 after a basic and technical period at Claiborne. These five units had a longer period of training than did the companies rushed off to North Africa, giving the Engineer Board more time to study and perfect the airborne construction machinery.[6]

Standard machinery for all engineer units was scarce. The conventional engineer aviation battalions felt the shortages most keenly because they carried a more complete construction plant than any other engineer unit. With such a short period in which to bring these units to proficiency, the logical solution seemed to be the one already in operation at the Claiborne EUTC. Sets of training equipment would be furnished to the seventeen bases then being used to train aviation engineers. Such sets would remain at these stations permanently and be used in turn by each unit assigned.

In requesting these seventeen sets in August, the Director of Base Services, AAF, explained that nonstandard equipment would be acceptable. But even this modest request was more than either the Engineers or Ordnance could fill. In November the Construction Division, OCE, released twenty used tractors to each of the three engineer aviation regiments. The machines were dilapidated but they were tractors. Some air compressors were also available, and it was almost certain that a few shovels and welding sets would be shipped before Christmas.[7] OCE at this time was not responsible for determining the types or amounts of engineer equipment carried by aviation units. At the direction of the War Department, AAF assumed this function

[6] Ltr, Adj EUTC Claiborne to CofEngrs, 1 Jan 43, sub: Capacity of EUTC, with Incl 2, Units in Tng as of Midnight 31 Dec 42–1 Jan 43. OCE 320.2, Camp Claiborne (C).

[7] AR 310–60, 12 Oct 42.



BANTAM TOWED SCRAPER *being loaded on a cargo plane for shipment to North Africa, January 1943.*

on 12 October 1942. Procurement of the equipment as determined by AAF was still a function of OCE, however.

Basic Military Training

Early in November 1942 the War Department also made the AAF responsible for the basic military training of all arms and services personnel with the AAF (ASWAAF).[8] From December 1942 to May 1943 all aviation engineer recruits went from reception centers to Jefferson Barracks, Missouri, for basic training under the supervision of the Army Air Forces Technical Training Command (AAFTTC). In effect, this system contemplated a return to the prewar period when fillers came from the ERTC's. With basic military training behind him, the engineer recruit would be ready, upon assignment to a unit, to refine his technical skills, begin tactical exercises, and practice airfield construction. But such was not to be the case. Basic training at Jefferson Barracks differed considerably from that at the ERTC's.[9]

[8] In addition to those documents cited separately, this section is based upon: (1) 353, Basic Tng Book I; (2) Wesley Frank Craven and James Lea Cate, eds., *Men and Planes,* Vol. VI, *The Army Air Forces in World War II* (Chicago: The University of Chicago Press, 1955), pp. 528–31.

[9] (1) Memo, Brig Gen Thomas J. Hanley, Jr., Deputy C of Air Staff for G–3, 13 Nov 42, sub: Tng of Colored Pers at Jefferson Barracks. 353–A, Negro Tng (S). (2) Ltr, AG Hq AAFTTC to CG AAF, 20 Nov 42, sub: Tng of Colored Trps. Same file.

At first there were encouraging signs. Just as the AAFTTC received the new responsibility for conducting the basic military training of ASWAAF troops, AAF directed the gradual extension of the basic military period from four to eight weeks for all recruits except those slated for technical schools. The latter would move out after four weeks of instruction. Also, some branch training would be allowed during the second month. On 8 December 1942, at a conference held at AAFTTC headquarters, the arms and services presented their proposals for branch training. Only Ordnance, Chemical Warfare, and the Engineers desired any special work. Chemical Warfare wanted 20 hours, Ordnance 37. The Engineers, always anxious to produce a basic soldier who would also be skilled in demolitions, rigging, and carpentry, and familiar with engineer tools and equipment, presented a program including 61 hours of branch training. Unfortunately, the conversion to an eight-week basic course took six months. On 1 May 1943 the eight-week schedule was finally effective, but by that time Godfrey was ready with suggestions which would curtail the AAFTTC control of engineer aviation basics to five weeks.

One particular source of dissatisfaction with AAFTTC control was the improper classification and assignment of men to the airborne battalions. The rigorous conditions under which airborne troops would operate made it imperative to select only young men who were physically and mentally tough, but of the 883 men assigned to Westover Field in December 1942, only 716 could be used in the first battalions. Some were subject to airsickness, others lacked stamina or did not show the required aggressive attitude. There were 102 men over the desired age limit who had to be kept.[10]

None of the engineer aviation units which received fillers late in 1942 and during the early months of 1943 could depend upon getting troops with the minimum four weeks of basic training. Even had these recruits actually remained at Jefferson Barracks for that length of time they would still have received only sixteen days—the first twelve days being devoted to classifying, testing, equipping, and immunizing. Men selected to attend SOS schools, roughly 40 percent, rarely stayed at the center for four weeks. Until mid-January 1943 the AAF basic training centers filled specialist school quotas regardless of whether or not the recruits had finished basic training. Some had as little as five days. Such men would pick up some basic instruction at SOS schools, but would still have to receive some elementary training within the units to which they were eventually assigned.[11]

On 8 February the AAF Director of Individual Training called a halt to this trend, demanding that the AAFTTC give four weeks to all, and eight weeks to those not going to schools. By the end of March AAF tightened its control still further by denying all special waivers to shorten the four-week program. Eight weeks was not yet mandatory, but each man transferred with less than eight weeks had to have the reason therefor stated in his record.

The early transfer of Engineer specialists to SOS schools and the brief period of training for the remaining fillers nullified the December agreements on branch training.

[10] Ltr, CO 925th Prov A/B Engr Avn Regt to CG AAF, 1 Jan 43, sub: Fitness of Pers for A/B Engr Avn Units, with 1st Ind, 10 Jan 43, with 2d Ind, Dir Pers AAF to CG AAFTTC, 26 Feb 43. 321–A, Engr Corps (S).

[11] 2d Ind, Hq First Air Force to CG AAF, 1 May 43, on Ltr, Hq First Air Force to CG AAF, 3 Apr 43, sub: Immediate Specialist Rqmts for 924th Engr Avn Regt. 321–A Engr Corps (S).

There simply was no second month. Nevertheless, Godfrey determined to strengthen this training wherever possible and to "stamp the recruit from the beginning as an engineer soldier." [12] To this end he managed to have scores of young Engineer officers assigned to training positions at the Jefferson Barracks center. By May 1943 he had secured 165 such instructors as well as one colonel who served as a staff assistant. But adequate facilities for branch training were never developed at Jefferson Barracks because of the continuous postponement of the eight-week program.

Centralization Begins

From January through May 1943 the AAF activated forty-six engineer aviation battalions—as opposed to thirty-nine during the whole of 1942—and organized seven airborne engineer aviation battalions.[13] The provision of cadres, officers, basic fillers, and specialists, as well as tools and equipment would have been complicated under ideal circumstances. The job of welding these separate parts into unified, smooth-functioning teams, capable of airfield construction and defense, would have taxed the ingenuity and resources of the most well-regulated centers. To have so many battalions scattered at widely separated air bases would have made co-ordination difficult and standardization practically impossible. Some technical supervision might come from the Air Engineer at AAF headquarters through the small Engineer staff of each of the four air forces, but essentially each unit would be on its own.[14]

By May 1943, however, a more centralized system had evolved from the training of engineer aviation regiments. Few engineer aviation units of this size had been activated since the Engineers, late in 1941, had determined that the battalion would be the more useful and manageable unit overseas. In August 1942 two regiments had been formed, one at Geiger Field, Washington, and one at Eglin Field, Florida. Subsequent activations at Richmond, Virginia, in October, and at Westover, Massachusetts, in November, brought the total number of regiments to four.[15]

It was apparent by the fall of 1942 that the grouping of even a few battalions at one installation offered some decided advantages over the training of isolated units. Equipment could be shared and personnel exchanged just as in the EUTC's. Training was faster. Gradually the regiments took on the function of unit training centers. By November 1942, battalions were being detached from these regiments and placed on overseas shipment schedules. The regiments then refilled. Early in 1943, with the beginning of the big expansion, it became a common practice to attach extra battalions to each regiment for training in addition to the three organic battalions.

There were several flaws in this arrangement, as the Engineer staff in the Second Air Force headquarters quickly pointed out in January 1943. Battalions which remained organic to a regiment did not develop ini-

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[12] *Aviation Engineer Notes*, No. 12 (February–March 1943). USAF HD, 144.31A, Feb–Mar 43.

[13] In addition to those documents cited separately, this section is based upon: (1) 321–A, Engrs Corps of (S); (2) 321, Engr Avn Bn, Bulky (S).

[14] (1) Engr Avn Units, CONUS and Overseas, as of 1 Mar 44. OCE 320.2, Engr Avn Units (C). (2) Ltr, Godfrey to Engrs First, Second, Third, and Fourth Air Forces, 3 Aug 42, sub: Tng of Avn Engr Trps. KCRC, AF 353, Tng Book III.

[15] (1) See above, p. 25. (2) Incl, Hq AAF, Avn Engr Priority List, to Ltr, Dir Base Svs to OCE, 23 Mar 43, sub: Avn Engr Priority List. OCE 322, Engr Avn Units.

tiative. Battalions which were only attached gained a more thorough knowledge of property procurement and accounting since they did their own supply requisitioning. Morale in the independent battalions seemed higher. The Second Air Force suggested that a more uniform and flexible system might be provided. Discarding the fiction of battalions being organic to regiments, groups of battalions might be trained on an equal footing at several Aviation Engineer Training Centers. In mid-February the AAF Proving Ground Command submitted a similar plan.

A long step in the development of such centers came in March with the activation of two regimental headquarters, one at March Field, California, and the other at MacDill Field, Florida, each with a strength of 19 officers and 257 enlisted men and with no organic battalions. Instead, the individual battalions already stationed at these two bases were assigned to the new regimental headquarters for administration and training. During the same month, the battalions of the regiments stationed at Geiger Field and at Eglin Field were redesignated as individual, numbered battalions. Training stations had been reduced to thirteen, five for the training regiments and eight others. In April, three more regimental headquarters were activated, one to replace the 924th Regiment at Richmond, and two at new locations, at Davis-Monthan Field, Arizona, and at Gowen Field, Idaho.[16]

Although the overhead was small at these regimental headquarters and only a few battalions could be attached to each, some centralization resulted nonetheless. Engineer aviation units occupied fewer bases during a period when activations rose at an unprecedented rate. Moreover, the staffs devoted their entire time to the supervision of training, providing more local and immediate direction than heretofore. Some standardization resulted from using fewer installations for training increasing numbers of troops. The number of stations OCE had to supply with training equipment in a period of shortages remained practically static.

Used Equipment Appears

In the spring of 1943 the used construction machinery so long promised by the Construction Division, OCE, finally appeared. In the belief that the release of great quantities of this equipment was imminent, Maj. William D. Eister, Godfrey's assistant for supply, presented to OCE on 2 March an analysis of engineer aviation battalion needs. He proposed that a complete set of standard construction equipment (set "A") for each battalion be shipped to a port of embarkation straight from the sources of supply when a unit moved overseas. During the training period each battalion would be issued a station set of used equipment (set "B"), containing a minimum amount of essential machinery. A third set (set "C") of special equipment, in the use of which little training beyond familiarization was contemplated, would be

[16] (1) Memo, Asst Air AG for TAG, 24 Feb 43, sub: Activation and Reasgmt of Certain Engr Units with the AAF. 322, Engr Misc (Bns, Cos, Plats, etc). (2) Ltr, TAG to CGs Second Air Force and AAF Proving Ground Comd, 1 Mar 43, sub: Redesig of Certain Engr Units with the AAF. OCE 322, Engr Avn Units. (3) Ltr, Air Engr Office to OCE, 2 Mar 43, sub: Tng Equip for Engr Avn Units. OCE 475, Engr Avn Units. (4) Memo, Asst Air AG for TAG, 20 Mar 43, sub: Constitution, Activation, and Reasgmt of Certain Engr Units with the AAF. 322, Engr Misc (Bns, Cos, Plats, etc).

supplied to each station at a ratio of about one set for every two or three battalions.[17]

By the end of March the Supply Division, OCE, had begun to act upon Eister's plan. It was sending sets "B" and "C" to the thirteen training bases, subtracting in each case the amounts of equipment currently held by the units. Nonstandard and used machinery made up the bulk of these sets. Complete sets of equipment, standard and new if possible, would accompany the units overseas within a few months. The units moving out would meanwhile have to appropriate parts of the training sets to make up for any deficiencies in the "A" sets at the ports. In this way, OCE made sure that the standard equipment which had been absorbed into the station sets would gradually be taken from those sets and given to units going overseas.[18]

A strong argument for the immediate removal of all standard equipment from training establishments came from Capt. Richard F. Grefe, Supply Division, in the latter part of May:

> In this particular case Geiger Field has been shipped their full allowance of construction equipment and in addition has some surplus over and above the Engineer equipment we had shipped to the organizations as part of their T/BA. The 851st now getting ready to depart were unable to take from Geiger Field a complete Aviation Battalion set of equipment as the story came back from Geiger Field that the equipment was "deadlined." Of 20 D–7 tractors, six (6) ½-yard shovels, 4 sets of Couse shops, etc., the 851st were unable to find 8 serviceable D–7 tractors, two (2) ½-yard shovels, one (1) set of Couse shops, etc. This equipment, some of it, had been at Geiger Field for only a short time. I immediately got in touch with Columbus through Major Bugbee and requested a complete check of the Geiger Field equipment by master mechanics from the Regional Field Maintenance Office. Three of them are now at Geiger Field and the report came through May 22, that the equipment listed above is not serviceable and was in need of 4th echelon repairs. All of the tractors have 600 hours operation or less on them.
>
> I mentioned this to Major Eister and he was in complete agreement that we should immediately take out of these posts, camps, and stations the surplus standard equipment and get it into our depots for repair and conditioning for overseas use before it is too late. Another two months of this equipment being abused will render it useless for overseas duty. . . . We are also taking action to notify the Commanding General, Army Air Forces of the apparent abuse and neglect our equipment is getting in the field but of course much of this might be charged to green personnel as an inexperienced operator can wreck a ½-yard shovel in five minutes.[19]

Maintenance was indeed high on equipment constantly used by green personnel, but substituting already worn nonstandard machinery only served to multiply this work load. The equipment was in such poor condition that the battalions could not keep it in repair. Requests that engineer maintenance companies be assigned to the training centers to keep this machinery running met with refusals. Neither AGF nor ASF had any units to spare.[20]

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[17] (1) Ltr, Asst Air Engr to OCE, 2 Mar 43, sub: Tng Equip for Engr Avn Units, with 3 Incls, Set "A," Set "B," Set "C." OCE 475, Engr Avn Units. (2) Memo, Engr Fld Maint Office for C of Engineering and Dev Br OCE, 19 Mar 43, sub: Asphalt and Soil Stabilization Equip. OCE 400.34, Engr Avn Units. (3) 1st Ind, 8 Apr 43, on Memo, O&T for CG AAF, 31 Mar 43, sub: Asphalt and Soil Stabilization Equip. Same file.

[18] (1) 1st Ind, 1 Apr 43, on Ltr, Asst Air Engr to OCE, 2 Mar 43, sub: Tng Equip for Engr Avn Units. OCE 475, Engr Avn Units. (2) Interoffice Memo, Capt Richard F. Grefe for Lt Col Charles H. Brittenham, Sup Div OCE, 24 May 43, sub: Transfer of Equip to the Depots. OCE 400.22, Pt. 1.

[19] Memo cited n. 18(2).

[20] Ltr, ExO Office of Air Engr to CofEngrs, 22 Jun 43, sub: Temporary Asgmt of Maint Cos, with 1st Ind, 26 Jun 43. OCE 322, 2d Engr Avn UTC.

Evaluation of Unit Training

The units which trained from the fall of 1942 to the spring of 1943 did not have the benefit, however dubious, of this surplus equipment.[21] Only the later ones had the full advantage of regimental headquarters supervision. Within the short time available, the battalions had to complete the basic military training that was supposed to be given by the AAFTTC. Engineering skills had to be developed at stations that were primarily AAF bases. Most serious, the battalions had too little time or opportunity to engage in large-scale field exercises to prove their ability at airdrome construction.

The battalions engaged instead in many small jobs primarily intended to improve the bases where they were stationed rather than in co-ordinated efforts designed to mold the units through successive stages into competent and confident construction organizations. Negro battalions were particularly restricted. The units assigned to Eglin Field, Florida, were first of all labor troops at the disposal of the AAF Proving Ground Command.[22] One of the better trained of the Negro battalions from Eglin Field, the 857th, activated in November 1942, was interrupted frequently to do small jobs for the post. The only field problem attempted was the completion of a partially finished heavy bar and rod runway. Other Negro units were not even this fortunate.[23] White battalions fared somewhat better. In the west, the Fourth Air Force assigned one battalion at a time to the Desert Training Center. Here constant maneuvers designed to test and perfect the co-ordination of ground and air forces provided a high level of experience for aviation units. These few fortunate battalions lived under field conditions and participated in changing airground operations which developed foresight and ingenuity. The 835th built four small landing strips suitable for light planes by clearing, grading, and compacting the desert soil with water. The climax to this training came with an order to construct an entire runway of light bar and rod landing mat. The unit prepared first a water-bound compacted base which took an enormous amount of water in a region where there was little water to be had. The battalion borrowed tank trucks from other units and rented commercial tankers. Other equipment was also scarce. Although the commanding officer felt that he was in the uncomfortable position of never quite being able to do a finished job, his unit profited from an experience denied to many of the other engineer aviation battalions.

One exceptionally good tactical exercise to which Godfrey gave wide publicity through his magazine, *Aviation Engineer Notes*, was that of the 850th stationed at Hammer Field, near Fresno, California. This exercise simulated support of a bomber group and attached fighter squadrons. Warning came on 24 February that on the following day Company A would move out to a nearby ranch and lay an emergency landing strip of pierced plank mat. Company B would follow to install ground defenses and support A as needed. Company

[21] In addition to those documents cited separately, this section is based upon the following files: (1) 353.6 DTC Tng, Desert, Bulky (C); (2) KCRC, AF 353, Tng Books I, II.

[22] (1) Ltr, CG AAFPGC to Godfrey, 13 Feb 43. 321, Engr Avn Bn, Bulky (S). (2) Memo, Asst Air AG for TAG, 19 Dec 42, sub: Disbanding of Certain Engr Avn Units. 321–A, Engr Corps (S).

[23] (1) USAF HD, Engr–857–HI. (2) Ltr, Godfrey to CG AAFPGC, 24 Feb 43. 321, Engr Avn Bn, Bulky (S). (3) USAF HD, Engr–849–HI (S). (4) USAF HD, Engr–855–HI. (5) USAF HD, Engr–1872–HI.

C would go to another site near the Fresno municipal airport, set up ground defenses, and repair landing strips. This was the plan presented to the entire battalion except that Company C had secret orders to attack Company A. At two o'clock the next morning the officers and observers assembled at battalion headquarters for final instructions. Within the hour the trucks began to roll—first Company C, then A, followed by B—under blackout conditions, assuming the presence of the enemy. At about five o'clock Company A had reached its destination, organized work details, sketched out the field, and had the mat-laying underway. However, the company either neglected to post security details or the sentries were not alert. Company C formed a skirmish line within twenty-five yards of the strip and made a successful attack that wiped out the working party and captured all equipment. Company B could not be called up quickly enough to be of any help. Company A resumed work on the landing mat. Immediately thereafter a cloud of tear gas drifted over the field. The gas alarm passed quickly from man to man. Company A donned gas masks and again went on with the work. Raids continued sporadically until dawn but none as successful as the first. At seven, three B–25's made low-level strafing attacks which required dispersal and return of fire. Two hours later an A–17 simulated a mustard spray attack at an elevation of only 150 feet. The spray was a nontoxic but foul-smelling mixture with a molasses base that left a brown stain on clothing and equipment to show the exact extent of contamination. The maneuver then ended with a critique for all officers.[24]

The imagination, planning, and co-ordination of this tactical exercise was unusual, not standard. Too few battalions had experiences comparable to those of either the 850th or the 835th. Criticisms from overseas began to point out training deficiencies. Apparently the lack of realistic construction projects had not been too serious a matter for the units activated in 1941. Composed in large part of engineers from other organizations, supplemented by ERTC-trained fillers, they performed remarkably well overseas. As the experience level of succeeding units dropped, as equipment became scarcer and as the units began to move out with little more than basic training, the reports changed. The commanding officer of the 821st, activated in March 1942, commented thankfully that his unit had been "extremely fortunate in coming to a static theater where we could continue our training while carrying on construction work." [25]

By March 1943, the Office of the Air Engineer became perturbed by the frequency of such comments and appealed to the Construction Division, OCE, for help in broadening the scope of training projects. Only a few District and Division Engineers had co-operated with the requests of unit commanders and allotted hardstandings and other small jobs to individual units. The disinterest was understandable since the AAF could not guarantee the length of time the troops would be available. The abrupt withdrawal of a unit for an overseas assignment left a project half-completed, disrupting planning. The fact that the battalions had only a fraction of their equip-

[24] "Training Problems in Field Operations under Tactical Conditions," *Aviation Engineer Notes,* No. 13 (July, 1943). USAF HD, 144.31A, Jul 43.

[25] Ltr, Godfrey to Engrs First, Second, Third, and Fourth Air Forces, COs of Engr Avn Units, *et al.,* 29 Apr 43, sub: Excerpts From Overseas Ltrs. EAC 370.2, Rpts on Trps Obsvns of Overseas Installations (C).

ment made the arrangement awkward. Most important was the general policy that War Department work be carried out by private industry employing civilian labor. Neither construction contractors nor labor unions could be expected to assent to loss of business and jobs on a large scale. The Construction Division, though completely sympathetic with this viewpoint, found a way to help the aviation battalions somewhat. All posts employed a crew of maintenance men who also did a certain amount of primary construction. On 20 March 1943 OCE sent a directive to Division Engineers encouraging the use of aviation engineers on projects carried out on a hired labor basis.

By spring 1943 definite steps had been taken to improve the training of AAF engineer troops. Basic training at Jefferson Barracks had been brought under the control of Engineer officers. Arrangements had been made for fuller sets of training equipment for the units. A more comprehensive plan had been instigated for the advanced unit phase of training for the engineer aviation battalions. Some centralization of control and standardization of output had resulted from the assignment of nonorganic battalions first to engineer aviation regiments and later to regimental headquarters.

Engineer Aviation Unit Training Centers

The grouping of battalions under regimental headquarters was a temporary device to handle the immediate training load during the first few months of 1943.[26] Long-range plans for the year envisioned a total increase of engineer aviation troops from about 70,000 to over 121,000, most of which would have to take place by September in order to have all the units ready for duty by the end of the year. The processing, organizing, and training of a monthly increment of about 6,700 white and 2,100 Negro troops clearly demanded more centralized control in each air force. By 19 March Godfrey had worked out an organization for the airborne Engineer Aviation Unit Training Center (EAUTC), based upon a study of the Claiborne center. The strength of this EAUTC was 38 officers, 2 warrant officers, and 291 enlisted men. For the engineer aviation battalions he provided on 26 March a slightly larger organization with a strength of 58 officers, 2 warrant officers, and 306 enlisted men.[27]

Activation of the four EAUTC's came in April and May 1943—the airborne EAUTC at Westover Field in the First Air Force on 1 April, and the other three a month later at Geiger Field in the Second Air Force, at MacDill Field in the Third Air Force, and at March Field in the Fourth Air Force. Some of the training regiments disbanded at this time, but five remained in existence to serve those battalions grouped at locations more distant from the centers. Each of the four EAUTC's had approximately 5,000 engineer trainees transferred to its jurisdiction immediately. Westover Field trained the airborne engineer aviation battalions—all white troops. The center at MacDill Field had only Negro units. The

[26] In addition to those files and documents cited separately, this section is based upon: (1) 321, A–D, Engr Corps (S); (2) 322, Engr Misc (Bns, Cos, Plats, etc); (3) 353, Basic Tng Book I; (4) KCRC, AF 353, Tng; (5) 353–K, Tng Misc (S); (6) USAF HD, Engr–2–HI, May 43, Constr Hist 2d EAUTC, App. III (C); (7) *Aviation Engineer Notes,* No. 13 (July, 1943), USAF HD, 144.31A, Jul 43; (8) USAF HD, 251–1, May 42–Feb 44, The Tng of A/B Engr Avn Bns Within I Trp Carrier Comd, prepared by Hq IX Trp Carrier Comd, Nov 45; (9) Craven and Cate, VI, *op cit.,* pp. 375, 531, 621–25, 629, 648, 658–66.

[27] Interv, Brig Gen Thomas A. Lane, 27 Apr 55.

Geiger and March Field centers trained both white and Negro engineers.[28]

The small overhead at these centers was feasible only because the air bases assumed most of the administrative and supply work load. Nearly all of the EAUTC personnel engaged actively in the conduct or supervision of unit training. Technical guidance came from the Air Engineer at AAF headquarters. Co-ordination with other organizations within any one air force was the function of the Engineer staff at each air force headquarters. The EAUTC's handled the over-all organization and assignment of personnel to the units and supervised all training. Schools conducted by the EAUTC staffs gave individual special training in those less complicated skills not provided for in ASF schools. With the exception of the airborne troops in the First Air Force, the centers worked out the details of advanced unit training for each organization, including construction projects. The airborne battalions remained at Westover Field for twelve weeks, then moved to a Troop Carrier Command base for six weeks of simulated combat operations in conjunction with Troop Carrier and Airborne Command units. Below the EAUTC level, the regiments provided master training schedules for the battalions and supervised the simpler construction projects in the early stages of training. Essentially, the main load of training remained with the battalion commander.

The centers began to operate under the assumption that the recruits would arrive from Jefferson Barracks with an average of four weeks of basic AAF training, and that undoubtedly many would have more. Beginning with the fifth week, branch training in engineer tools and equipment as well as specialist training would begin. Shortly, however, this convenient assumption came into question. On 1 May the AAF lengthened its basic training to eight weeks but the new program made no provision for branch training at all. To Godfrey this was but one more indication of a much larger issue shaping up between the air force and the arms and services.

During the spring and summer of 1943 Godfrey fought against a tendency in AAF to absorb ASWAAF personnel into the air force organization. The trend began in April with an economy move. The Assistant Chiefs of Air Staff for Personnel and for Training, without consulting the Assistant Chief for Materiel, Maintenance and Distribution (MM&D) or his branch chiefs for the various arms and services, devised a more economical system for distributing personnel. Ostensibly to reduce the costs of rail travel, the proposal included the elimination of the concentrations of ASWAAF personnel such as the Engineers at Jefferson Barracks. All recruits would go to whatever basic training centers were nearest to the reception centers.

Undoubtedly under pressure from Godfrey and other ASWAAF branch chiefs, MM&D took issue with this decision at once. On 26 April all of the interested offices in conference agreed upon a compromise. Recruits for any one branch were to be sent to no more than three basic training centers and were to be grouped within a single organization at each center. Some branch training might well be advisable during the second month. MM&D insisted that the AAFTTC use branch personnel as instructors, and suggested that the instructors from the existing ASWAAF centers be reassigned for this purpose. But Godfrey was

[28] Ltr, TAG to CG Second Air Force, 27 Apr 43, sub: Estab of 2d EAUTC. OCE 322, 2d EAUTC.

still dissatisfied. He knew he would have less control over these troops at three centers than at one. Moreover, at the end of the basic period engineer soldiers went first to replacement wings where AAF administrative staffs with little background to appreciate Engineer needs diverted these men from their original destinations. Junior staff officers apparently "looked upon ASWAAF personnel above Class 4 as legitimate picking for any Air Corps assignment." [29]

The best alternative would have been to send recruits directly from reception centers to the four EAUTC's, bypassing the AAFTTC and the replacement wings. Housing and training facilities were ample at the new centers. A large basic training program had to be maintained in any case to complete the training that was supposed to be given by the AAFTTC. In addition, voluntarily inducted specialists would require five weeks of basic instruction beginning in June. The Air Engineer was in a good position to demand some revision since General Arnold himself had recently become alarmed over the morale and training of ASWAAF troops. On 20 May Godfrey recommended that the three AAFTTC basic centers designated to train engineer troops give the first five weeks of training as outlined by OCE in the current MTP 5–1. Shortly thereafter MM&D notified the four air forces of this plan but cautioned that the EAUTC's should not depend on picking up with the sixth week of the MTP right away because the basic centers were not well enough equipped to give all of the training required in the first five weeks. By mid-June the whole agreement was reversed. All engineer recruits after 1 July were to go to Jefferson Barracks for eight weeks. Engineer subjects could not be introduced until the fifth week.[30]

The insistence by AAF that there should be no branch training during the first four weeks was indicative of a fundamental dissimilarity between the AAF concept of basic training and that held by the Engineers. Whereas the Engineers sought to integrate Engineer subjects as early as possible into basic training, the AAF wanted no specialized instruction in the entire basic period. Actually, until 12 July 1943 the AAF could not insist upon any further compliance with its principles because it had no standardized program worked out beyond the first four weeks. Although thirteen weeks of military service was the minimum necessary before any individual could be transferred overseas, the last nine weeks did not have to be under any definite schedule to meet AAF minimum requirements.

As long as the eight weeks of basic training had been split between two types of installations the Air Engineer had been willing to defer to the AAF standard during the first four weeks. But with the definite commitment of engineer aviation troops for the entire eight weeks to an installation under the AAF Training Command (AAFTC), successor to the AAF Technical Training Command, he reverted to the Engineer principle of early integration of Engineer subjects. Almost simultaneously with the 12 July AAF program, Godfrey submitted an eight-week Engineer program based upon

[29] Interdesk Memo, Col Lane for Brig Gen L. P. Whitten, 16 Aug 43, sub: Obstacles to Avn Engr Tng. 353–K, Tng, Misc (S).

[30] (1) Ltrs, C of Sup and Svs Div MM&D to CGs Four Air Forces, 27 May, 2 Jun, sub: Tng of Engr Avn Units. 353, Tng Standards, Book II. (2) Ltr, AC of Air Staff Tng to CG AAFTTC, 19 Jun 43, sub: Tng of Each Br of ASWAAF in One Basic Tng Center. Same file.

the recently revised MTP 5–1 of 19 June 1943. Receiving a flat refusal on 14 July from the Assistant Chief of Air Staff for Training, the Air Engineer on 22 July finally devised a new program relegating all Engineer subjects to the second month of training. By the end of July the Air Engineer had lost most of his battle with AAF Training. The AAFTC retained control for eight weeks. An integrated program was impossible. Only one important gain had been made. All of the engineer basics were going once more to Jefferson Barracks, with fewer opportunities for AAF staff officers to siphon off the most intelligent and capable recruits.

In late August the Office of the Air Engineer renewed the attack, implying broadly that the AAFTC staff was incapable of carrying out directives. Basic instruction at Jefferson Barracks was a waste of time. Direct shipment of recruits to the EAUTC's would save money. The office had ample corroboration from the EAUTC's. Nearly all of the men received at March Field had been in the Army four months and had barely completed five weeks of basic training between numerous and costly transfers.[31]

A representative from AAF headquarters at last made an inspection of Jefferson Barracks. His report at the end of August proved that the Air Engineer had not exaggerated. Engineer inductees did not keep their branch insignia nor were they segregated as prescribed into a single organization. Instead of eight weeks of training, they were given the first four weeks, then retained for fifty-six more days and shipped out, regardless of training deficiencies in the second four-week period. Quotas to schools still held precedence over accurate assignment. Trainees who were already qualified as specialists in needed categories and who should have been sent straight to the EAUTC's were sent instead to any technical school for which they happened to have entrance qualifications. Specific instructions required reclassification of eligible engineers to fill Air Corps Technical School quotas which could not be met otherwise. As a result of these findings, on 26 August AAF Training directed that the AAFTC issue a composite basic training directive canceling all previous instructions and clearing up all misunderstandings.

Meanwhile, the basics who came to the EAUTC's through the AAF Training Command during the spring and summer of 1943 were of unpredictable quality. So thorough was the skimming that the EAUTC's had difficulty making specialists of even the simplest sorts from the men who arrived. Paradoxically, beginning in May, more of the specialist categories had to be unit-trained from this group. The War Department in that month cut the ASWAAF monthly inflow into the AAF by about one half, reducing the number of men from Jefferson Barracks qualified to meet the ASF school quotas. This large difference could not be made up by taking men from the units and sending them to the ASF schools without interfering seriously with the progress of training. Therefore the units intensified their on-the-job training, particularly for the simpler jobs such as carpentry. The March Field EAUTC met the new requirements with a combination of center-and-unit-trained specialists. It set up on 14 June an Individual Training School in order to furnish each battalion with 40 percent of its specialists before the unit as a whole started a formal training program. Between activation and filling, the units had a three-month organization period. The 40 percent nucleus which trained during this three

[31] Memo for Record, Hq 4th EAUTC, 24 Aug 43, KCRC, AF 353, Tng Book III.

months then instructed others within battalion schools during the MTP training which followed.[32]

July brought still another crisis. The General Staff decreed that all specialist school training be cut to the minimum. The resultant reduction in ASF specialist school quotas caught the AAF unprepared. It had depended solely on these schools for all advanced specialist training of ASWAAF personnel. Maj. Gen. George E. Stratemeyer, Chief of the Air Staff, protested the cuts, since the AAF was not nearly ready to absorb this load. But G–3 remained skeptical of AAF needs and highly critical of its methods, maintaining that AAF had in the past abused its privilege and sent too many specialists to ASF schools. Poor methods of assignment had dissipated ASWAAF talents and wasted training. Fuller use should be made of unit instruction.

Although the EAUTC's could do nothing to change the quality of the basics received from Jefferson Barracks, they could expand unit instruction and alter to some extent the initial assignments by transferring men between units. The Second Air Force EAUTC at Geiger Field, Washington, encouraged companies within each battalion to trade about until they achieved a balance of those skills present. Specialists that could not be trained at the company level received instruction in battalion, regimental, or EAUTC schools. Although the power of the centers to transfer trainees from one unit to another resulted generally in a more efficient use of manpower, it also allowed units with priority status to draw upon other units within the same organization in order to fill to strength.

In addition to such sporadic raids, there was a continuous drain upon the units for overseas specialist replacements. Unlike the ASF, which had three Engineer Replacement Training Centers, the AAF, with a significant proportion of total engineer strength, had set up no adequate system for furnishing engineer replacements. As more engineer aviation units left the United States, demands grew. Requests were overwhelmingly for specialists. Taking skilled men from units in training not only interfered with instruction but supplied unsatisfactory replacements. The calls had become so heavy by July 1943 that Godfrey began to urge some arrangement similar to that used by ASF. He suggested the establishment of a pool at Jefferson Barracks, to be filled largely with specialists from schools, but also to contain some of the basics completing the eight weeks at that station. To keep them from going stale, a special three-month program would be supplied. At the end of that time, those who had not been assigned overseas would transfer to units in training. AAF took no immediate action. Throughout the summer the Air Engineer pressed for a decision as personnel, training, and program planning officials discussed housing and overhead arrangements. At the end of September AAF finally agreed to use graduates of the ASF schools and basics from Jefferson Barracks as individual replacements in the existing AAF overseas replacement training centers but refused to allow them to train as a group in a separate Engineer center.

Fortunately, from March to September the War Department allowed the Corps of Engineers to procure a large number of specialists by voluntary induction in com-

[32] (1) Memo, Office of Air Engr for Engrs of First, Second, Third, and Fourth Air Forces *et al.*, 24 May 43, sub: Tng. KCRC, AF 353, Tng Book II. (2) Tng Memo 8, Hq 4th EAUTC, 3 Jun 43, sub: Individual Tng Sch. 321, Bundle 3, First, Second, Third, and Fourth Air Forces, Bulky (S).

petition with the Navy Seabees. Volunteers for AAF went to the four EAUTC's for the first five weeks and then to units. The airborne battalions in the First Air Force profited most, primarily because of a faulty policy which dictated that these men be sent to the nearest center rather than distributed among the four EAUTC's according to need. All of the AAF white specialists from the industrialized eastern half of the United States went into the airborne EAUTC at Westover Field because that was the only EAUTC in that area which trained white troops.[33]

The ready-made specialists did not reach the EAUTC's in any numbers until June. The need was particularly acute for construction foremen, highway construction machine operators, carpenters, electricians, utility repairmen, tractor drivers, and demolitions experts. By mid-May the first few men arrived at the March Field EAUTC in the Fourth Air Force. The staff was jubilant. AGCT scores were high, average schooling was above high school level, and most of the men were under thirty. Near the end of the month Godfrey noted with pleasure and relief that the flow of volunteers had finally begun.[34]

Specialists and basics alike in all four air forces trained after 19 June 1943 on a new MTP published by OCE. The first five weeks, which Godfrey had tried unsuccessfully to introduce as the limit to training at Jefferson Barracks, comprised a standard basic military and engineering program common to all engineer units. The next eight weeks of tactical and technical training OCE tailored individually for each type of unit, with separate schedules for construction companies and headquarters and service companies. OCE co-ordinated closely with Godfrey in this revision in order to take advantage of his knowledge of overseas operations. Since he had technical supervision of the deployed engineer aviation units as well as those in the United States, Godfrey maintained a voluminous correspondence with many Engineer officers after they left the country. Largely upon Godfrey's recommendation OCE added a new subject—airdrome construction, repair, and maintenance—to the instruction of all construction companies, 87 hours for those of the airborne battalions and 95 for those of the engineer aviation battalions. All bridge and road building was dropped from airborne training. Each unit began training at some point in this program, depending upon the general level of training of the fillers assigned.[35]

Following this tactical and technical period each unit was supposed to enter upon an eleven-week unit training program. OCE could only suggest these programs, however, and had no authority to supervise their execution. The training broke down at several points, but one of the weakest spots proved to be the unit training of airborne engineers with the I Troop Carrier Command (TCC) during the last six weeks.

In other than the unit training of airborne troops, practicality and realism gradually replaced the simulation of the hurried days of 1942. Godfrey advocated this tougher program in line with the prevailing

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[33] (1) See above, page 232. (2) Ltr, Lane for C of Mil Pers Br OCE, 25 Feb 43. OCE 220.3, Engr Avn Units. (3) Memo, Asst Engr Hq First Air Force for CofS Hq First Air Force, 15 Jan 44, sub: Rpt of Inspec of 1st Airborne EAUTC. 321, Engr Avn Bn (S).

[34] Ltr, Hq 4th EAUTC to Air Engr, 19 May 43, sub: Volunteer Individuals for Avn Engrs, with Routing Slip, Godfrey to Sturdevant, 27 May 43. OCE 353, 4th EAUTC.

[35] (1) 1st Ind, 18 Apr 43, on Ltr, O&T to Air Engr, 29 Mar 43, sub: Proposed MTP 5–1. OCE 353.01, Pt. 1. (2) MTP 5–1, 19 Jun 43.

opinion in the War Department and also out of personal conviction. To help inspire the desired realism, he distributed through his *Aviation Engineer Notes* many accounts of combat situations which units in training should be prepared to meet. Outstanding training exercises were also given extensive coverage. Further impetus came from Brig. Gen. Donald A. Davison, then Chief Engineer of the Northwest African Air Forces, who visited many training installations in the early summer and gave a first-hand account of aviation engineers in action. Officers from these battalions, after July, went to the newly created Army Air Forces Tactical Center at Orlando, Florida, for a 180-hour course of academic and on-the-job instruction in organization and equipment and in the techniques of camouflage and construction for air force needs. This elaborate school, with twelve airdromes, an academic plant costing twelve million dollars, and a complete model air force, gave the aviation engineer officers an excellent picture of their role in the Air Forces organization.[36]

Perhaps none of the battalions met all of the requirements which the Air Engineer set up for them but much improvement did take place during the summer and fall of 1943. Early in the summer one battalion engaged in a spirited defense of McChord Field, Washington, against a simulated airborne attack. The area selected for the exercise was ideal for the landing and consolidation of paratroops, an undulating cleared space near the field but hidden from direct ground observation by a small woods. "Occasional clumps of trees and patches of scotch broom" furnished concealment. A railroad embankment provided an easily defended position. One company spread out over this area as though dropped from the air and the rest of the battalion rushed out to counterattack before the paratroops could re-form and organize. Firecrackers and dynamite charges added noise and confusion to the scene. Although confusion seemed to be the chief product on both sides, the battalion learned many lessons during the day on the necessity for more training in scouting, relaying information, and concealment. With practice and retraining, confusion was no longer the chief result. Somewhat later, when this same battalion engaged in a night maneuver—the defense of a power station against a partially mechanized ground attack—communications were much improved. Installations were so well hidden that the enemy tanks were of little use. Control was excellent down to the lowest echelons. Other battalions shared in the general betterment, several building entire airdromes, including all necessary housing and facilities. The tempo increased, with some units maintaining for several weeks a twenty-four hour cycle of three eight-hour shifts. One battalion at Bushnell, Florida, pushed through a high-speed airdrome job in thirty-five and a half hours, including the laying of mat on a runway 100 by 4,000 feet. Battalions from March Field continued unit training under arduous climatic conditions at the DTC, and units in the Second Air Force spent limited periods in combined training under combat conditions in the Northwest Maneuver Area.[37]

[36] *Aviation Engineer Notes,* No. 14 (August, 1943). USAF HD 144.31A, Aug 43.

[37] (1) USAF HD, Engr–1878–HI (S). (2) USAF HD, Engr–2–HI, Oct 43. (3) Ltr, CO 1104th Engr Combat Group to CO EAUTC Ft. Wright, Wash., 24 Nov 43, sub: Avn Engrs in Oregon Maneuvers. KCRC, AF 354.2, Maneuvers. (4) Final POM Inspec Rpt by POM Div AFTAI, Hq AAF, 17, 23–24 Nov 43. 321 1871–1880, Engr Avn Bn, Bulky (S). (5) Ltr, Lane to CO Fourth Air Support Comd, 24 Jul 43. KCRC, AF 353, Tng Book II. (6) Excerpts from Inspec Rpt 1874th Engr Avn Bn by Maj Frank L. Read, 10 Oct 43. 321 1871–1880, Engr Avn Bn, Bulky (S).

Through the summer months of 1943 the EAUTC's began to function. OCE provided more suitable training programs, unit projects became more practical, voluntary specialists joined the mass of unskilled trainees, and used equipment flooded in from all points. It was just at this juncture, when aviation engineer training had achieved some measure of direction and stability, that the nationwide crisis in manpower developed. In order to fill the large number of units scheduled for activation in 1943, the Air Engineer had estimated a monthly intake of 6,750 white and 2,125 Negro trainees would be necessary from February through the month of September. In May the War Department cut the monthly allocation of inductees for aviation engineers to 2,650 white and 871 Negro trainees, less than half the number needed. No additional source of personnel to meet the established troop basis was indicated.

Nevertheless, Godfrey continued to activate the units according to plan. By early June sixteen engineer aviation battalions that had been activated for three months or more were not yet at full strength. Only one battalion out of an additional twenty-two that had been activated within the previous three months had as much as 50 percent of its fillers. Since the average rate of commitment of these units was six each month, and since much of the training program could not begin until the units were filled, the backlog of trained units was soon exhausted. By July it was clear that no engineer aviation battalions would be available for shipment during the months of August, September, and October. The two western EAUTC's in the Second and Fourth Air Forces, perhaps smarting under the unfair allocation of voluntary specialists, were convinced that their "huge shortages" were somehow a result of the complicated AAF personnel distribution system. At a conference held at March Field on 22 August they agreed that "without personnel to train, it is impossible for either Training Center to furnish any trained battalions in the future except the few now completing their training period. Calls from theater commanders for trained engineer aviation battalions must necessarily go unfilled under these conditions, and it was the consensus of the conference that the result could only be for the ASF to substitute general service regiments for engineer aviation battalions to build and maintain airdromes in overseas theaters." [38] By the end of August no action had yet been taken to open a firm supply of men to the engineer aviation battalions. The only relief in sight was the possible use of personnel released from disbanded air base security battalions, scarcely the type of men desired.[39]

September brought the first rumblings of the Bradley Plan which threatened to terminate all unit training of aviation engineers.[40] The double build-up of the AAF in England, for the strategic bombing of Germany and for the projected invasion the following spring, required a tremendous amount of men, supplies, and equipment. Maj. Gen. Follett Bradley, air inspector of the AAF, went to England in May 1943 and

[38] Memo for Record, Hq 4th EAUTC, 24 Aug 43. KCRC, AF 353, Tng Book III.

[39] Ltr, Lane to Godfrey, 5 Aug 43. 312.1–B, Classes of Corresp (S).

[40] Unless otherwise indicated, the following discussion of the Bradley Plan is based upon: (1) Wesley Frank Craven and James Lea Cate, eds., *Europe: TORCH to POINTBLANK, August 1942 to December 1943*, Vol. II, *The Army Air Forces in World War II* (Chicago: The University of Chicago Press, 1949), pp. 631–40; (2) 334–A, Bradley Plan, Comm and Rpts (S); (3) 321, A–D, Engr Corps (S).

drew up a plan which called for some 500,000 men in support of both operations. AAF headquarters approved the plan in July and the War Department followed suit, with minor reservations, on 21 September. Shipping arrangements included the transportation of most of the service units to England by early 1944, with ground assault forces following. It was at this point in planning that the AAF neglect of service units, including aviation engineers, came to light. Overemphasis upon combat elements had left the AAF seriously short of trained service organizations.

The AAF geared its shipments of units to the Bradley Plan quota of 40,000 men a month beginning in July, pending the final approval of the War Department. Although shipments for the month of August approached the numbers required, the forecast of trained units that would be available during the next four months fell far short. As a result of a combined study of this development by the OPD and AAF headquarters, Brig. Gen. John E. Hull of OPD suggested to General Arnold on 1 September that in lieu of trained units it might be necessary to ship the number of men desired as casuals, in whatever state of training, to be organized and trained as units by the Eighth Air Force in England. Arnold flew to England soon thereafter to discuss the matter in the theater. The solution seemed satisfactory. Units in training would be inactivated if necessary in order to furnish the full quota of fillers.

Service units already committed were to be shipped to the United Kingdom, as originally scheduled, intact. Units being prepared for special purposes and those required for duty in the United States would be spared. But all others activated and not committed were to be disbanded. Men from the inactivated units would fill the committed units to full strength and any above that number would go overseas as casuals. Engineer aviation units were hard hit. A preliminary list of units that would have to be inactivated, drawn up in the Office of the Air Engineer on 11 September 1943, included 33 engineer aviation battalions, 9 airborne engineer aviation battalions, and all 5 of the engineer aviation regiments. Moreover, no engineer units were to be activated in England and these men would be diverted into other AAF units. This was particularly embarrassing in the case of the airborne units that had been filled with voluntary specialists who were not supposed to be assigned to a type of unit for which they did not volunteer.

Still convinced of the need for the airborne units, Godfrey fought against their inactivation. He recalled for General Arnold the part which these special units, using bantam equipment, had played in providing crucial airstrips in the deserts of North Africa and in the remote mountain valleys of New Guinea. However, by September, two out of the three battalions in the Pacific were working on general construction jobs which called for standard equipment. So great was the need for heavier equipment that these battalions had begun independent experiments in knocked-down standard machinery. Godfrey was only partially successful in maintaining his stand and in prolonging the active life of those units still in the United States. Seven were inactivated by the end of February 1944, leaving eleven in existence.[41]

[41] (1) USAF HD, 251–1, May 42–Feb 44, The Tng of A/B Engr Avn Bns Within I Troop Carrier Comd, prepared by Hq IX Trp Carrier Comd, Nov 45. (2) Engr Avn Units, CONUS and Overseas, as of 1 Mar 44. OCE 320.2, Engr Avn Units (C).

Although many of the engineer aviation battalions were far understrength in September, the few that were definitely committed were at or near full strength. Therefore, few men from the uncommitted units had to be transferred. A freeze order of 14 September, prohibiting transfers except to committed units, caught the uncommitted units in every stage of organization and training. Unit training was supposed to continue, nevertheless, regardless of the number of men present. Inactivations would occur as the units were depleted through furnishing quotas of men to the Bradley Plan shipments. Unit training under such conditions would be at best half-hearted and without direction, even in those units that had the majority of their fillers. The men would never go overseas as units. They would probably not become part of an Engineer organization when they got there. The battalions would be little more than filler pools from which monthly quotas would be taken until the supply became exhausted.

Transfers to committed units were to be completed by 10 October. Thereafter no transfers would be allowed for any purpose, even if the committed units developed vacancies after that date. Voluntary specialists could not be distributed from the various basic training battalions. Units to be inactivated could not be consolidated when they became reduced to the point where the overhead would be uneconomical. No trading could be done between battalions to keep such reduced strengths in balance. In order to prevent complete chaos, Godfrey on 4 October proposed that the freeze order be lifted, temporarily at least. If about half of the units slated for eventual disbandment could be inactivated immediately and the personnel concentrated into those remaining, some semblance of a training program could continue. Not until 30 October did AAF headquarters take any action to unfreeze the personnel in these units to make training more economical.[42]

During the month of October, meanwhile, Godfrey made "a determined effort to stave off this slaughter" of engineer aviation battalions.[43] The General Staff early in that month revised the 1943 Troop Basis downward to a more realistic figure in terms of the manpower available. The cut in engineer aviation battalions, from 114 to 73, necessitated the disbandment of 41 battalions by the end of December. In order to disband this number of units, 8 out of the 16 committed battalions would have to be sacrificed. In his struggle to keep active as many engineer aviation battalions as possible, Godfrey was on firmer ground than in his fight for the airborne units. Theater commanders found the engineer aviation battalions useful and continued to call for them. OPD by 22 October had tentatively asked for 21 battalions for the first quarter of 1944. Godfrey could therefore resist the inactivations on the basis of predicted and actual needs. AAF Training was persuaded. No battalions could be furnished during the first half of 1944 if 41 battalions were to be inactivated by the end of 1943. By March 1944, only 13 engineer aviation battalions had been inactivated, leaving 101 in existence.[44]

One thing was clear. The great engineer aviation expansion was at an end. The unit

[42] (1) Hist of 2d EAUTC, Oct 43. USAF HD, Engr-2-HI (C). (2) Memo, Asst Engr First Air Force for A-3 Hq First Air Force, 26 Oct 43, sub: Rpt of Inspec of 881st A/B Engr Avn Bn. 321 842-880, Engr Avn Bn, Bulky (S).

[43] Ltr, Maj J. S. Caples to Col Russel M. Herrington, 3 Nov 43. 321, Engr Avn Bn (S).

[44] Engr Avn Units, CONUS and Overseas, as of 1 Mar 44. OCE 320.2, Engr Avn Units (C).

training load of the centers would become steadily less. Despite the fact that AAF delegated all replacement training of engineer aviation recruits to the centers, beginning the first of November, and directed that specialist training for all of AAF in categories primarily engineer should be concentrated at the EAUTC's, there was still no need for four large centers.[45]

Godfrey was not to preside over the reorganization and retrenchment.[46] Early in December he went to the CBI theater as theater air engineer. Col. George Mayo became Air Engineer. Although another drive just at this time on the part of AAF to integrate ASWAAF troops into the AAF without branch insignia failed, AAF Training in December did assume the responsibility for training and committing engineer aviation troops. During the ensuing period of contraction the Air Engineer would hold a less important post than before.[47]

In the First Air Force, the reduction of airborne troops at Westover Field had been drastic. In addition, the training regiment at Richmond had been inactivated. Therefore, on 19 December the EAUTC moved its headquarters to Richmond and took over direct supervision of all of the First Air Force units remaining. This organization lasted only a few months. As the units then in training finished their prescribed programs and moved out, the center dwindled. On 10 April 1944 the few men remaining transferred to the Fourth Air Force and the First Air Force EAUTC was disbanded. Fortunately, the great number of surplus voluntary specialists in the First Air Force were not all sent as casuals to the Eighth Air Force. After the lifting of the freeze order at the end of October, and with the reprieve given to many engineer aviation battalions, these men could be transferred and used as planned.[48]

The MacDill Field, Florida, EAUTC in the Third Air Force continued to train Negro units at about the same rate since a policy established in late November prohibited sending Negro troops overseas as casuals to fulfill the requirements of the Bradley Plan. On 7 December 1943 AAF Training made this center responsible for training all Negro engineer aviation troops, both unit fillers and replacements. A projected consolidation of the two western centers into a single organization to train all white engineer aviation troops could then be undertaken.[49]

By April 1944 the reorganization had been accomplished. All white trainees were under the supervision of the Geiger center and all Negro troops were at MacDill Field.

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[45] *Aviation Engineer Notes*, No. 17 (November, 1943). USAF HD 144.31A, Nov 43.

[46] In addition to the citations which appear with the text, the following section is based upon: (1) 321, Engr Avn Bn (S); (2) KCRC, AF 353, Tng; (3) 321-G, Engr Corps (S); (4) 321, First, Second, Third, and Fourth Air Force, Bulky; (5) 321 316–463, AAF Base Units, Bulky (S); (6) 321 802–807, Engr Avn Bns, Bulky (S).

[47] (1) *The Military Engineer*, XXXVII (September, 1945), 14. (2) Ltr, Godfrey to Engr Offs With the AAF, 4 Dec 43, sub: Integration of Arms and Svs, with Incl, Ltr, Arnold to All Pers of AAF, 6 Nov 43. KCRC, AF 321, Arms of Svs and Depots. (3) Ltr, Mayo to Col F. F. Frech, AF Engr SHAEF, 25 Apr 44. 321-E, Engr Corps (S).

[48] (1) 3d Ind, Hq 1st A/B EAUTC to CG First Air Force, 14 Feb 44, on Ltr, AAF Tng to CG First Air Force, 24 Jan 44, sub: Overseas Readiness Status of 1897th Engr Avn Bn. 321 1892–1907, Engr Avn Bn, Bulky (S). (2) Ltr, Mayo to Godfrey, 12 Feb 44. 353-K, Tng, Misc (S). (3) USAF HD, Engr-1-HI.

[49] (1) Memo for Record, Maj Francis M. Libershal, 18 Nov 43. 321 1882–1891, Engr Avn Bn, Bulky (S). (2) Hist Rpt, Third Engr Avn UTC, MacDill Fld, 18 Mar 43 to 1 May 44, Sec. 3, The Spec Tng of Engr Avn Bns, p. 80. USAF HD, 229.50-1, Vol. 1.

A further integration into the AAF organization occurred on 1 April and 1 May when these two centers lost their EAUTC designation and became the 463d and the 316th Army Air Forces Base Units (AAFBU), respectively. Both centers, for the rest of 1944, expended increasing efforts in training individuals in basic and specialist subjects to meet demands for replacements. Requisitions for units remained small and few were organized. At the year's end, 113 engineer aviation battalions were in existence.[50]

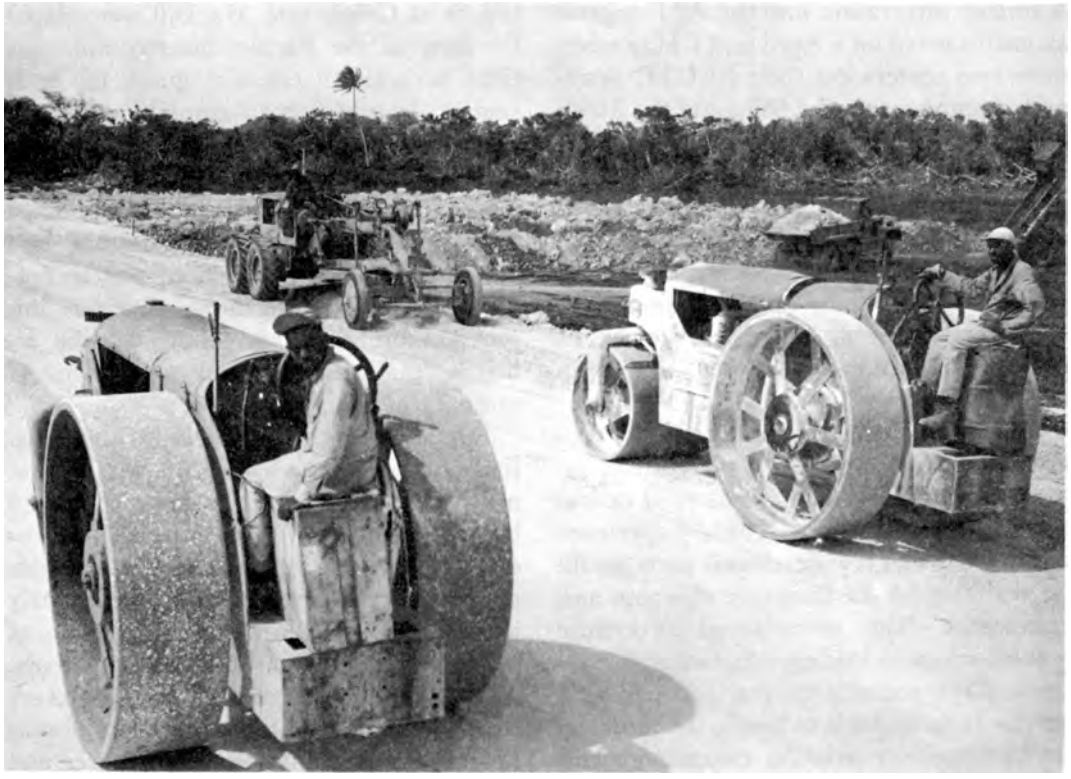
One new element in the training program resulted from the general shift of interest toward the Pacific theaters of operations in the summer of 1944. Experience had proved that few developed ports would be available for the discharge of troops and equipment. The more usual procedure would include unloading cargo ships directly upon Navy pontoon barges, and a shuttle service from shipside to beach. To familiarize the engineer aviation troops with this amphibious operation, the Fourth Air Force in July 1944 arranged to send small increments of men to a two-week course given by the Navy at Port Hueneme, California. During the first week the troops watched training films showing the assembly and launching of various types of barges and rafts, and floating drydocks and wharves, and then they actually assembled and launched the same types of craft. During the second week they learned to load, operate, beach, and unload the barges. The training was essentially that given the Seabees.

Further emphasis upon theater specialization began in December 1944 after the Chief Engineer, SWPA, outlined the subjects in which engineer units destined for his theater should be proficient. Since all of the battalions at Geiger and MacDill were slated for duty in the Pacific, his recommendations became an essential guide for both centers. In addition to amphibious operations, including the passage of beach obstacles, this list of subjects included air transport of equipment and supplies, drainage of wet areas, jungle reconnaissance and mapping, lumber production, waterproofing, construction with native materials, improvised bridging, and above all the efficient maintenance and operation of mechanical equipment.[51]

Demands from the Pacific for these last few units became so insistent, however, that much of the specialized training could not be perfected. On 20 December 1944, General Arnold directed that two of the battalions in training be sent out immediately in order to speed up the construction of strategic B–29 bases in the Central Pacific. A few days later, Arnold insisted that every effort be made to move the remaining battalions into the Southwest Pacific Area and the Pacific Ocean Areas. There followed a hasty training period reminiscent of the early days of 1942. Fillers from many types of Air Forces units, with no basic engineering training, and often with grades much higher than could be absorbed in the units, flooded into Geiger and MacDill. Readiness dates changed from week to week, always

[50] (1) Interdesk Memo, Maj R. W. Rogers to Col Elvin R. Heiberg, 14 Oct 44, sub: Rpt on Visit to the 463d AAFBU, Geiger Fld, Wash. KCRC, AF 333, Inspec and Investigation by IG and Other Offs, and Rpt (Cont), Book II. (2) Analysis of the Present Status of the War Dept Trp Basis, 1 Jan 45. AGO Special Reference Collection. (3) Ltr, TAG to CG Third Air Force, 1 May 44, sub: Discontinuance of the 3d EAUTC. 322, Engr Misc, Book II.

[51] (1) Ltr, AAF Tng to CO 463d AAFBU, 1 Dec 44, sub: Theater Spec Tng. 353–AD, Tng Misc (S). (2) Ltr, AAF Tng to CO 316th AAFBU, 13 Dec 44, sub: Theater Spec Tng. Same file.



ENGINEER TROOPS PREPARING BASE COURSE OF AIRSTRIP *on an island in the Marianas Group.*

shorter. Suggestions for redeploying battalions from the European and Mediterranean theaters in order to relieve the pressure met with no success. They too needed construction units to strengthen and lengthen existing paving to accommodate the new B–29. Consequently, many of the units, urgently needed, had several months deleted from their training time. Six Negro battalions activated in January 1945 had a June readiness date to meet. In January and February AAF was granted permission to send eleven battalions overseas without any unit training as long as individuals met the POM requirements. Between January and June 1945, twenty-one battalions were rushed to the Pacific to accelerate airdrome construction in the war against Japan.[52]

[52] (1) Rpt, Hq 1903d Engr Avn Bn to CG Fourth Air Force, 9 Dec 44, sub: Tng Status Rpt. 321, Engr Avn Bn, 1903d Engr Avn Bn (S). (2) Ltr, TAG to CG Third Air Force, 10 Jan 45, sub: Constitution and Activation of Certain Engr Units. OCE 322, Engr Avn Units. (3) Ltr, TAG to CG Fourth Air Force, 19 Jan 45, sub: Engr Avn Units. 321, Engr Avn Bn, 935th Engr Avn Regt (S). (4) Ltr, TAG to CG Third Air Force, 20 Jan 45, sub: Colored Engr Avn Units. 321, Engr Avn Bn, 1909th Engr Avn Bn (S). (5) R&R Hq AAF, Comment 1, OC&R to Tng, 28 Feb 45, sub: Engr Avn Units for Movement to POA. 321, Engr Avn Bn, 1915th Engr Avn Bn (S). (6) Station Lists, 463, AAFBU. KCRC, AF 320.2, Strength.

CHAPTER XV

Engineer Ground Forces Units

Engineer units which trained under the Army Ground Forces (AGF) were either organic to divisions or were nondivisional units which could be attached to armies or corps in variable numbers. The number of divisional units to be trained was the same as the number of divisions, since each division, of whatever type, had one organic engineer battalion or squadron. Although the number of divisions in the troop basis was subject to revision and underwent several changes, the most unpredictable element was nondivisional support. As strategy changed, as operations progressed, as emphasis shifted from one theater of operations to another, the need for these units also changed. Some campaigns required large numbers of nondivisional combat battalions, treadway bridge companies, heavy ponton battalions, and light ponton companies. For others, topographic battalions, topographic companies, and water supply companies were crucial. Light equipment companies, maintenance companies, and depot companies fluctuated in importance from time to time.[1]

McNair, Commanding General, AGF, a man of positive ideas and unflinching determination, made a definite personal impress upon the entire AGF organization and upon the training of all AGF troops of whatever variety. Just as he kept himself physically aloof from his own staff, emerging from his office once each year on Christmas Eve for a general tour of the headquarters, so also did he separate his staff from the rest of the War Department. Refusing space in the Pentagon, he preferred to keep his organization across the river at the Army War College.[2]

Colonel Hughes, Ground Engineer, occupied the same relative position at McNair's headquarters that Godfrey held in AAF, with some important differences. Although Godfrey found himself torn between two powerful forces, his office carried enough authority to bring measurable weight to bear upon problems concerning engineer aviation troops. Hughes was, by contrast, completely integrated into the established and conservative Ground Forces headquarters, which was an outgrowth of GHQ. A separate Engineer Section did not evolve until 12 July 1942, after several months of operation as a construction liai-

[1] Many of the Army Ground Forces headquarters files have been inadvertently destroyed. Much reliance has therefore been placed upon: (1) AGF Study 14, Problems of Nondivisional Training in the Army Ground Forces; (2) Palmer, Wiley and Keast, *Procurement and Training of Ground Combat Troops,* "The Provision of Enlisted Replacements," "The Building and Training of Infantry Divisions," and "The Training of Nondivisional Units"; (3) Greenfield, Palmer, and Wiley, *Organization of Ground Combat Troops,* "Reorganization of Ground Troops for Combat." However, since AGF headquarters files still make up the bulk of those used in the preparation of this chapter, citations from that source have no depository indicated.

[2] A Short History of the Army Ground Forces, Ch. II, pp. 51–56. AGF Study, Jul 44.



LT. GEN. LESLEY J. McNAIR, *Commanding General of AGF, with one of the general officers at the Third Army maneuver area, Louisiana, 1943.*

son office between AGF and the Corps of Engineers. The elevation to special staff status occasioned no abrupt change. A part of the meager staff of six officers retained the liaison function for months thereafter. Much of the responsibility for training engineer troops in the AGF remained perforce with the AGF G–3, who sought concurrence from the Engineer Section on matters which involved Engineer doctrine, training, and equipment. The section was too small to prepare training literature, and inadequate in numbers to supervise the numerous engineer units. Hughes found that he could not, as Godfrey did, distribute information on the latest developments in Engineer doctrine from his office or disseminate news of technical developments. AGF also forbade any regular conferences between the section and OCE. McNair ran his own show, taking occasional advice from his engineer consultants.[3]

To achieve his mission as he interpreted it, McNair modeled the AGF training establishment as closely as possible upon the structure of an active combat theater. His headquarters remained lean. A martial spirit in keeping with a theater command pervaded the old Army War College grounds. Contrary to the ASF practice of concentrating a number of units of like character at UTC's under the guidance of a few experienced men and with a common pool of training equipment, AGF units trained together from activation to sailing date under what McNair termed the normal association of troops. This normal association approximated the organization which would obtain in combat—training being conducted within tactical units. Emphasis centered upon the preparation of divisions, and upon teamwork at corps and army levels.[4]

Divisional engineer combat battalions profited from this emphasis even though they shared some of the hardships common to all AGF units. As units organic to divisions they had one invaluable asset. They trained on the longer schedule allowed for the preparation of divisions. Equipment shortages spread over a year or more were not as serious as similar shortages during a six-month period. Practice in road and bridge building, mine laying and clearing, and obstacle construction and demolition continued over a longer span of time. Unit

[3] Col. Hans W. Holmer, History of the Engineer Section, Hq AGF (four-page pamphlet, n. d.). Personal Papers of Col LeRoy G. Gilbert. (2) Ltr, Hughes to C of EHD, 28 Sep 55, with Incl. (3) Interv, Gilbert, 14 Sep 55.

[4] (1) A Short History of the Army Ground Forces, Ch. II, pp. 37–38, 44, 52, 53. AGF Study, Jul 44. (2) AGF Study 11, Training in the Ground Army, 1942–45, p. 9.

training of specialists could be prolonged. Supervision by division officers was direct and continuous.

AGF indeed trained divisions with great success, but at the expense of nondivisional units. McNair was under the impression that these comparatively small units would not need to be organized early, would present few difficulties, and could be trained quickly. Therefore, he worried little in early 1942 about having a balanced force of these "spare parts" on hand. Even those activated received little technical training as units, in spite of the fact that many of them carried complex equipment requiring a number of specialists. Inimical to their proper employment during the unit training phase was McNair's insistence upon combat instruction and his fear that the Army would become overspecialized and encumbered with machinery.[5] His advice to specialists was, "Do not allow yourself to become a technician only. Become first and last a fighting man." A fundamental tenet, held doggedly, was that despite "the technical and complicated equipment manned by a modern army . . . the fact remains that the most compelling need in this, as in past wars, is the front-line fighter and his leader. . . . Victories are won in the forward areas—by men with brains and fighting hearts, not by machines." The "final victory against a determined enemy is by close combat." [6]

AGF might have compensated in part for the heavy emphasis upon combat training in nondivisional units by careful activation plans, attention to equipment needs, and responsible supervision. Not until June 1943 did AGF provide an orderly mobilization procedure which paralleled that for divisions. Instead, cadres and officers from diverse sources, without any special preparation separately or as a group, arrived upon the scene simultaneously with fillers and equipment to form a unit. Thereafter, they were too often on their own. The staff at AGF headquarters, which McNair kept purposely small, could do little else than coordinate and supervise the activities of larger units. Nondivisional units developed according to their individual abilities. Officers from divisions and separate corps to whom they looked for guidance were too busily occupied with training their own units to take on anything extra—in fact they made matters more difficult by competing for post facilities and supplies. Their reputations rested squarely upon the preparation of organic units, not at all upon how the "spare parts" made out.[7]

Even without these complications the formation of new engineer units seemed formidable in 1942. During the first few weeks of the year, before any definite invasion plans had matured, the mobilization of new units had begun to strain the ability of older units to furnish trained cadres. The twelve-month period just preceding the April agreements with Great Britain had seen the number of engineer divisional battalions and squadrons in preparation within the United States grow from 15 to 35. Engineer combat regiments increased from 4 to 10, nondivisional battalions and companies from 20 to 59.[8] Still, the situation early in

[5] Memo, McNair for G–3 WDGS, 3 Aug 42, sub: Pers and Tng Status of Units of the AGF. 320.2, Binder 6 (S).

[6] All quoted in A Short History of the Army Ground Forces, Ch. II, pp. 31–33. AGF Study, Jul 44.

[7] Memo, McNair for G–3 WDGS, 9 Sep 42, sub: Pers and Tng Status of Units of the AGF. 320.2, Binder 6 (S).

[8] (1) OCE Info Bul 84, 10 Apr 41, sub: Orgn of Engr Units. (2) Directory of Army of the United States as of 1 April 1942 (Continental Limits of the United States).

1942 was not yet desperate. The question was how well trained the cadres were and how inconvenient it was for the older units to furnish so many. Half-joking, the commanding officer of a divisional engineer combat battalion wrote to Bessell, of the Military Personnel Branch, on 24 January 1942:

> I don't know why I ever write to you to ask for changes in your personnel orders—we never get them anyway! Apparently, every list I send you gives you new ideas. The only use I have seen made of our lists is to let you know which men we consider particularly valuable so you can pick them.

More seriously, the same officer pointed out that taking excessive numbers of men from his unit as cadres had led to confusion as to the primary goal of training:

> If we are to furnish well-trained officers for higher positions than they now occupy, and well-trained cadre, we should concentrate on the training of these men in the positions they are to fill. If we are to shoot for combat efficiency as rapidly as possible, we should put each man in the place he is to fill and make him thoroughly efficient in that particular position. I have discussed this with the Division and they are not completely clear on the situation either. Their policy, however, is that a primary mission is training for combat efficiency with the replacement demands being met as well as we may when such demands are made.[9]

Bessell replied that "since this is but one of 2,000 letters from troop unit commanders who complain of my stealing officers from them, I am beginning to take it like a hard-shelled turtle." But he was worried about the basic conflict in training goals and agreed that some decision would have to be made. He predicted that "as in all such things, the decision will be a compromise which, of course, will work to the detriment of the older units." [10]

This was just the beginning. The agreement in April to launch a cross-Channel invasion of Europe by the fall of 1942 or the spring of 1943 created an unforeseen demand for new divisions and supporting units which made a shambles of any systematic assembly of troops. Perhaps, under the circumstances, no planned procedure for activating nondivisional units would have worked. The spotlight glare fell not upon procedures but upon the misjudgment over the number of these units that would be required and the optimistic estimate of the time they would need to become proficient. Units which had been filled and partially trained were quickly cut to skeleton proportions to provide cadres. Innumerable transfers of fillers from one organization to another, as unit priorities changed, disrupted organized training.

It was not until mid-summer 1942 that the War Department came to the full realization that the mobilization machinery had not been designed to handle this load, that manpower for both old and new units could not be marshaled within the available time and within the prescribed limit of Army strength. But as early as the end of April the condition of AGF nondivisional units was plain. The Inspector General considered them to be in such an alarming state that Marshall felt obliged to direct McNair on 25 April to take some remedial action. An added spur came from SOS, which began to lay plans to take over the basic and technical training of all AGF nondivisional units until such time as the units might be ready for joint training with corps and armies.[11]

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[9] Ltr, CO 4th Engr Combat Bn to Bessell, 24 Jan 42, OCE 210.3, Engrs Corps of.

[10] Ltr, Bessell to CO 4th Engr Combat Bn, 27 Jan 42. OCE 210.3, Engrs Corps of.

[11] Memo, ExO O&T for Brotherton, 21 Apr 42, sub: Time Required to Train Corps, Army, and GHQ Engr Trps. OCE 353, Pt. 18.

By the end of May, AGF devised an experimental Headquarters and Headquarters Detachment, Special Troops, a supervisory group of 5 officers and 16 enlisted men, to take charge of all nondivisional units at stations where such troops numbered between 2,000 and 5,000. A larger detachment of 8 officers and 31 men would go to stations where these troops numbered above 5,000. Armies and corps could activate these detachments at their discretion, with a full colonel in command.[12]

The detachments worked well where correctly administered, as at Camp Shelby, Mississippi. The separate units had one organization responsible for supervision. With a colonel in charge, the detachment competed on a fairer basis for post services and facilities. If officers with suitable backgrounds had been plentiful and had been assigned with care the system might have worked better everywhere. Too often the colonels in charge were those who could be spared most easily from other organizations. Most of their assistants were young officers with little experience. The unprecedented number of engineer unit activations made Engineer officers particularly scarce for these assignments. One of the worst situations grew up at Camp Carson, Colorado, where much friction developed between the engineer units—including depot companies and a maintenance company—and the detachment staff because of the preponderance of basic training. Although half of the troops were engineers, not a single Engineer officer was assigned to the Carson detachment. In fact, the entire detachment, in charge of units from several technical services, had come from the Infantry.[13]

Active and intelligent supervision of nondivisional units was doubly important in the summer of 1942. Too few men and too little equipment made careful co-ordination all the more valuable. The formation of detachments did bring all nondivisional units at any one station together, but these were units of several services, not a concentration of troops from any one service. The normal association concept prevented the activation of more than two or three units of a kind at any one post. Although the shortage of manpower was the main difficulty, the scattering of nondivisional units throughout the entire AGF training establishment was also a factor which precluded any pooling of scarce equipment. The practice of giving some detachments more than one post to supervise reduced the effectiveness of their supervision.

Divisions continued to have priority. Task forces assembling for definite duty overseas had to be at full strength. The War Department, in an attempt to spread the remaining manpower, organized other units without basics—approximately 10 percent of unit strength—but continued to pull cadres and OCS candidates from this reduced number. Some units received cadres and nothing more while units of higher priority filled.

Near the end of June, AGF headquarters took a fresh look at the number of units still to be activated in 1942 and compared this information with the shortages in existing units. Despite the concern of G–3 for the new divisions yet to be activated during the year, G–4, Brig. Gen. Willard S. Paul,

[12] Unless otherwise noted, the information for this section came from the following files: (1) 320.2, Binder 6 (S); (2) 321, Engrs, Strength (S); (3) 353, Engrs, Tng, Binder 1; (4) 370.5, Engrs, Binder 2; (5) 320.2, Comparative Strengths, Binder 1 (S).

[13] Memo, OCE for Engr Sec AGF, 5 Nov 42, sub: Extract From Rpt on 478th Engr Maint Co. OCE 333.1.

was by this time perturbed over the "spare parts":

> I am in favor of drastic action of some sort. *We have non-divisional units of several months service without personnel or equipment.* This constant robbing of units is doing harm all around. Why not stop "kidding" ourselves? I believe every unit should be given an overstrength so that by sailing date it will have at least T/O strength. If necessary to raise the ceiling on the total strength of the Army to do this, let's do it. We are scraping bottom every time a service unit is asked for—due to lack of foresight in planning. . . . I am loathe to see such a well established system upset by stopping the activations of new divisions. However, if we don't stop pulling long enough to loosen the rope around our necks we'll choke to death.[14]

To postpone the activation of new divisions until existing nondivisional units could be filled was heresy, and Paul stopped short of a direct statement advocating this course. But some means had to be found to bring the number of activations and the available manpower into alignment. Nondivisional service units were in the worst shape. Engineer service units with a T/O strength of 46,706 men had only 28,090, but even so they had a fair share of the service fillers. Making up 28 percent of AGF's T/O service strength, they held 28 percent of the men allocated to all AGF organizations of this type. Plans to activate 83 engineer nondivisional service units during the latter half of 1942 brought the total number of engineer fillers to be obtained by the end of the year to 68,041.

Help seemed close at hand. AGF proposed to obtain basically trained men to fill existing service units from three branch immaterial RTC's. Assured by The Adjutant General that heavy calls by selective service would fill all units by the end of August, AGF made no adjustments. By the first of August it was evident that plans had miscarried. New selective service policies changed the bases for reclassification, and allowed leave to selectees from reception centers. An immediate shortage developed which could not be rectified until the end of September.

The same system of transferring trained men from units of low priority to units of high priority had to continue, and each such transfer set into motion a chain reaction affecting several units. At the end of August, for example, OPD tried to funnel trained men into the Engineer Amphibian Command since amphibian units were slated to go overseas at an early date. Accordingly, OPD pulled 590 untrained reception center men from the 532d Engineer Shore Regiment and sent them to the 36th Engineer Combat Regiment. AGF received a directive to refill the 532d with trained men from an engineer combat regiment. The net result was one trained battalion in the otherwise untrained 532d, one untrained battalion in the 36th. The 133d Engineer Combat Regiment was left short one battalion and under the circumstances could not hope to get refilled and retrained within twelve months. Of the ten AGF engineer combat regiments, three had barely organized. The remaining seven, which should have had a combined strength of 9,870 men, contained 5,271 trained or partially trained men and 1,430 newly assigned selectees. The 36th and 131st, earmarked for a task force, were under OPD control. Only the 39th and 40th Engineers, of the five still under AGF control, were halfway prepared for early deployment after the withdrawal of the battalion from the 133d.

[14] M/S, G–4 for Secy Gen Staff, 28 Jun 42, sub: Trp Unit Basis, 1942. 320.2, Binder 6 (S).

On 3 August McNair sent a strong statement to the War Department concerning the shortages and disruptions. The procurement of personnel must be accelerated to the full capacity of reception centers. Existing units must be filled to full T/O strength, including basics. The remaining units in the 1942 program should have a 15 percent overstrength upon activation. If possible, a reserve should be on hand for emergencies. If the reception centers could not handle this influx, then activations should be cut somewhere until units could be filled. Unaccountably, the War Department reply of 7 August did not get across the Potomac until 27 August, by which time McNair had worked out his own solution. To protect the divisions, he deferred the activation of all nondivisional units except those definitely earmarked for task forces. The War Department reply, when it did arrive, offered no different solution. The deferment of most of the nondivisional units was impractical since they would be needed soon. On the other hand, to postpone the activation of divisions was equally inadvisable. The War Department suggested that a number of units could be activated near the end of the year and filled during early 1943. AGF should meanwhile analyze its distribution procedures and draw up some formal system for activating nondivisional units.

The War Department believed that faulty mobilization procedures were to blame for the striking contrast between the preparation of nondivisional units and that of divisions. Accordingly, G–3 sent both McNair's memorandum of 3 August and the reply of 7 August to SOS, soliciting comments on possible procedures that would correct this deficiency in AGF. SOS took the opportunity to suggest on 15 September that all AGF nondivisional units be sent to SOS unit training centers through the thirteen weeks of basic and technical training under the control of the chiefs of services.

McNair refused to concede that SOS might be able to give more effective training to nondivisional units within centers:

> Training a unit technically in the SOS and turning it over to the Ground Forces for subsequent training is an application of the training center principle. This principle is well established and is deemed applicable to those cases where technical training is so special that it can not be given by the large units to which the unit being trained will be assigned eventually. Where it is practicable to train a unit, after activation, under the larger unit to which it will be assigned eventually, such procedure is definitely preferable, since the unit so trained grows up in its normal associations.
>
> For those units which may be assigned ultimately to either the SOS or AGF, it is deemed preferable that they be activated and trained under the Ground Forces, because teamwork is involved, as well as the support of combat units—considerations which deserve priority.[15]

The rivalry was an old one between AGF and SOS. Each sought control over several types of service units, such as the engineer general service regiments, which fell within the province of both commands. When the War Department made the responsibilities of each command more definite at the beginning of 1943 the intensity of feeling subsided. This bold attempt on the part of SOS, meanwhile, brought to an abrupt end a series of quiet negotiations between the Corps of Engineers and AGF to centralize the training of a part of the engineer units. AGF agreed that maintenance companies and equipment companies could best be trained at the Claiborne center, but no further centralization within the SOS train-

[15] Memo, McNair for G–3 WDGS, 30 Oct 42, sub: Service Units. 353, Gen Tng, Gen Corresp, 1943 (C).



ENGINEERS AT CAMP SWIFT, TEXAS, *push a bangalore torpedo under barbed wire entanglement during a training exercise, June 1943.*

ing establishment was conceivable after McNair reiterated the importance of teamwork and the necessity for support of normally associated units from the beginning of training.[16]

But there were those within the AGF organization who were less sure than McNair about the importance of early support and wanted some centralization. At AGF headquarters itself, McNair's own G–1, Col. Alexander R. Bolling, thought the center plan to be eminently practical:

> We have it for antiaircraft and Armored Force units. We were forced to it in the case of Tank Destroyer units. If the idea is sound for these three, it is certainly sound for nondivisional units. . . . No service unit can support anything at least for its first thirteen weeks of existence. After its basic unit training is completed it can then receive its training in its support role after it leaves a unit training center.
>
> The parent unit idea and the absence of the unit training center idea thus far has resulted in sending non-divisional units overseas whose state of training is subject to criticism.[17]

Bolling was therefore of a frame of mind to support the attempt of General Krueger, Third Army, to concentrate for training purposes certain types of units by branches. Bolling could be sure of the neutrality if not the active support of Paul, G–4, because of Paul's growing apprehension over the unprepared state of these units. But powerful opposition could be expected from G–3, Col.

[16] Ltr, Gorlinski to CG Claiborne EUTC, 8 Sep 42. OCE 353, ASFTC Claiborne, Pt. 1.

[17] M/S, G–1 for Plans, 16 Dec 42, sub: Activation of Nondivisional Units (initial sub: Pers and Tng Status of Units of the AGF). 320.2, Binder 6 (S).

John M. Lentz, who subscribed wholeheartedly to McNair's theory of decentralization.

In mid-September 1942 Krueger began to send a number of nondivisional engineer units to Camp Swift, Texas. A request on 14 September to move an engineer water supply battalion, at cadre strength, from Camp Maxey, Texas, to Swift, met with no opposition from Lentz. Believing his over-all plan to be approved, Krueger asked on 19 November to have two engineer heavy ponton battalions transferred from Maxey to Swift. At this point, Lentz acted. The Third Army plan, according to his understanding, had not implied that any existing units would be moved at full strength. Besides, the five engineer units at Maxey, with a total strength of 2,735 men, already constituted a concentration that should not be disturbed. Hughes interposed that mere concentration was not enough. The Swift site on the Little Colorado was much better than the Maxey location ten miles from the turbulent Red River. Despite the support of Paul, Hughes could not prevail. In the end he had to admit that ponton units could train at Maxey. Early in December Krueger had to abandon the whole project.[18] McNair decreed that "as to grouping similar units for training . . . I am not too strong for it even though the groups are under AGF."[19]

The training of nondivisional service units improved so little, despite the formation of the special troops detachments, that the War Department ran another check on them in November. On 5 December The Inspector General reported that AGF had made some progress and that any major shift in the current setup would be expensive and probably introduce more confusion than clarification. AGF had finally worked out an activation procedure for nondivisional units. Introduction of the group form of organization would bring related units of each service together in one tactical organization. The War Department therefore adopted a wait-and-see attitude.

The War Department had reason to be apprehensive, since the size of this training task at the end of 1942 had begun to approach that of divisions. AGF nondivisional strength stood at over 500,000 men and all indications pointed toward an increase in 1943. The 120 engineer nondivisional units in training in the United States at the end of December held almost 70,000 men as contrasted with 53 divisional units of battalion size.[20]

Flexible grouping of engineer units began early in 1943. On 20 January AGF notified its armies, separate corps, and separate commands that the engineer combat regiment would soon be reorganized into an engineer combat group headquarters and two separate combat battalions. Each group headquarters would have supervision over several combat battalions during training, as well as over a variable number of other engineer nondivisional units, and would remain thereafter in tactical control. The 31st, 132d, and 133d Engineer Combat Regiments were the first to be reorganized, forming the headquarters for the 1114th, 1118th, and 1104th Engineer Combat Groups, respectively, in early March. By the end of May 1943, as the result of reorganizing most of the 13 combat regiments and activating additional units, there

[18] First Draft of Ltr, AGF to Third Army, 29 Nov 42, sub: Transfer of 489th Engr Water Sup Bn to Camp Swift, Tex., with Memo for Record. 321, Engrs, Strength, Binder 2 (S).

[19] M/S, McNair for Gen Staff AGF, 28 Dec 42, sub: Activation of Nondivisional Units (initial sub: Pers and Tng Status of Units of the AGF). 320.2, Binder 6 (S).

[20] Memo, G–3 WDGS for CofS, 30 Dec 42, sub: Tng Sv Units. 353 Tng, Binder 3 (S).

were 22 group headquarters and 57 nondivisional combat battalions in the AGF training establishment. These new units held 37,434 men out of a total of 79,026 in all of the 202 engineer nondivisional units.[21]

OCE remained unconvinced of the benefits to be derived from the group organization and resisted a similar conversion of general service regiments in ASF. Sturdevant attacked the group concept on 1 May as "cumbersome, wasteful and probably unworkable." [22] This hostile statement, intended for the ears of ASF, reached AGF headquarters within the week. In the highly charged discussions which followed at McNair's headquarters, many of the staff labeled Sturdevant's remark "unwarranted, ill-considered, and unproven." [23] But many of his detailed criticisms had validity and forced AGF to re-examine the tactical employment of the engineer combat group, its overhead allotment, and the command and supply relationships between group and army and between group and corps.[24]

Although the Engineer Section agreed with OCE that the group concept should not be applied to ASF units, the section had welcomed the group idea in AGF as a method by which to provide some concentration and greater control in the training of nondivisional units. As Hughes testified later, "In view of the inability to obtain adequate supervision of training of separate engineer companies, water supply, topographic, and ponton battalions there were more factors in support of the group, generally constituted along the line of a general construction organization, than in retaining the combat regiment where it was impossible to get the regiment to accept unprejudiced supervision of attached units." [25] Moreover, the group was a tactical organization. Several increments of separate units could be attached for training without fear of criticism from those who insisted upon normal associations.

Mine Warfare

Early in 1943, just as the combat groups were being organized, AGF became acutely conscious of one of the major training deficiencies which had developed during the previous period of neglect.[26] Combat engineers, with only a few hours of instruction in lifting and placing mines, found this type of work one of their principal duties in North Africa. Accidents occurred when untrained men fused mines at dumps before loading and transporting them to the field. The drivers of vehicles could not recognize mined areas and drove into them blindly.[27] McNair took cognizance of the situation in a note to his chief of staff on 23 March 1943:

Mr. McCloy who recently returned from NATO, dwelt at considerable length on the proposition that our troops are nowhere near

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[21] (1) Ltr, AGF to CGs Second and Third Armies *et al.*, 20 Jan 43, sub: Orgn and Asgmt of Group Hq and Bns. OCE 322, Engr Combat Units. (2) Ltr, TAGO to CGs Eastern Defense Comd *et al.*, 5 Mar 43, sub: Redesig and Reorgn of Engr Combat Regts, with Incl 1, Redesig and Reorgn of Engr Combat Regts. Same file.

[22] Memo, Sturdevant for CG ASF, 1 May 43, sub: T/Os for Engr Gen Sv Units. 320.3, T/Os, Binder 1 (S).

[23] M/S, G–3 for CofS, 25 May 43, sub: Gen Sv Regts. 320.3, T/Os, Binder 1 (S).

[24] AGF 320.3, T/Os, Binder 1 (S).

[25] Ltr, Hughes to EHD, 28 Sep 55, with Incl.

[26] With the exception of those documents cited separately, this section is based upon: (1) 353, Engrs, Tng, Binder 1 (S); (2) 353, Engrs, Tng; (3) 352, Engr Sch.

[27] Incl, Rpt of Mil Obsvr [27 Jan–20 Feb 43] to Ltr, Lt Col J. R. Dryden to CGs Second and Third Armies *et al.*, 13 Mar 43, sub: Obsvr Rpt. AGF 319.1, Foreign Obsvrs, Binder 2 (S).

sufficiently mine conscious. The fighting over there is very loose—the battlefield looks very empty indeed; but actually the place is strewn with mines—thousands of them everywhere. The Germans are past masters at both sowing and reaping mines. He quoted our people as complaining that they need more engineers for mining, whereas he contended that every man of whatever unit or arm must be engaged in mine laying with both skill and speed. He classed the activity as virtually the introduction of a new arm on the battlefield.

. . . . . .

. . . we must continue to stress the use of mines in large quantities in our training—especially maneuvers.[28]

The general lack of mine consciousness among AGF troops stemmed from a War Department policy which delegated to engineer units the major responsibility for laying and removing mines. Infantry units had practically no familiarity with these devices. During 1942 only 80,000 metallic practice mines had been issued to units and 145,000 had been supplied for maneuvers. Although the Army Supply Program for 1943 called for 150,000 for units and 710,000 for maneuvers this amount was inadequate to cover the requirements for practice mines if instruction in mine warfare were to be extended to all AGF units. Nevertheless, the AGF staff determined to try. To the dismay of the Ordnance Section, Hughes took McNair at his word and requested a million nonmetallic practice mines. None were in production and no deliveries could be expected before the end of the summer. Only 268,000 metallic ones with nonexplosive dummy fuses could be had immediately.

Regardless of the types and quantities of mines available some training had to begin at once. By 19 April AGF had worked out a system for spreading this instruction as rapidly as possible down to the company level of each unit without disrupting other training. Two identical mine schools would be set up, one in the east and one in the west. A small quota of officers from each AGF unit would attend one or the other of the schools and qualify as instructors for courses which they would then conduct within their unit. G–3, AGF, set up a requirement for a basic one-week course in gapping mine fields to which all AGF units would send quotas. The men from engineer units would take an additional week of advanced work which would include laying and marking deliberate mine fields, and disarming enemy and Allied mines. The Engineer School at Belvoir was the logical focus for instruction in the east and the Desert Training Center was the tentative choice in the west. The big question, on which all the rest of the plan hinged, was whether or not the Corps of Engineers would supply the instructors for both schools. An assistant to G–3 surmised on 20 April that it was "questionable" whether the Engineers "will go with a school other than Belvoir which will put us up against it. However we will have to make the best of it." [29]

Three days later, contrary to expectations, the Engineers not only consented to take on the job but eliminated Belvoir from the plans altogether. Instead of two permanent schools, the Engineers suggested a single traveling detachment which would visit in turn the major concentrations of troops. Broadening the curriculum somewhat, the Engineer School added the laying of hasty mine fields and the neutralization of booby traps to the first week. The school selected thirteen instructors, gave them a

[28] M/S, CG for CofS, 23 Mar 43, sub: Mine Detection and Removal. 353, Engrs, Tng, Binder 1 (S).

[29] M/S, Col James H. Phillips for Ennis, 20 Apr 43, sub: Instr in Clearing Gaps in Mine Flds. 352, Engr Sch.



SOWING A MINE FIELD, *a phase of instruction in mine warfare.*

short refresher course, and sent them to the DTC in late May. Under the guidance of Maj. Theodore F. Astrella, the detachment conducted the first two-week course, ending on 12 June. Some 200 officers attended the first week and about 60 engineers remained for the second advanced week. In June and July the detachment repeated the course with the same number of students at the Tennessee Maneuver Area and at the Louisiana Maneuver Area, drawing quotas from the Second and Third Armies, respectively. By August, the turnover of units at the DTC justified a return to that area for a repetition of the first course. So popular did the school become and so well did the system work that this pattern became the accepted procedure for training AGF units in mine warfare. AGF considered the training valuable enough for it to allow units in advanced stages of preparation to send quotas to the course. Had the supply of foreign mines and demolition equipment been adequate the work of Astrella and his instructors would have been even more effective. The traveling detachment remained active until mid-April 1944, when it completed the indoctrination of AGF units and returned to the Engineer School.

Drop in Quality of Fillers in 1943

By the summer of 1943 the supervision and training of combat engineers had improved through the formation of the groups and through the work of the traveling mine detachment.[30] In June, the activation procedures which had been drawn up the previous November and made final in

[30] In addition to the citations which appear with the text, this section is based upon: (1) 327.3, Drafted Men; (2) 352, Engr Sch; (3) 341, Recruiting; (4) 352, Army Sv Schs and Staff Colleges (C).

March went into effect. These specified that officers and enlisted cadres be selected and trained for several months before unit activations, scheduled the arrival of the men and fillers at appropriate intervals, and indicated a definite percent of equipment that had to be on hand upon activation. Perhaps most important, personnel was temporarily more plentiful. Deferment of the plan to invade Europe allowed activations to proceed at a slower pace. Units filled within a reasonable length of time after formation. Training progressed in more orderly fashion following the publication of a twelve-week unit training program on 2 August.[31]

Although more men were available in the first half of 1943, their quality was alarmingly poor. New AGCT distribution figures computed in March showed that AGF units should expect 89 percent of Negro fillers and 43 percent of white fillers to fall in grades IV and V. AGF therefore welcomed the possibility that the voluntary induction program of the Corps of Engineers would leaven the mass with technically proficient men drawn from parallel civilian jobs.

The voluntary induction program called for the service commands to recruit 6,000 engineer specialists in March and 9,000 a month for the rest of the year. Of the March quota, AGF was supposed to get 2,321 in 31 different categories. The men for AGF were to collect at the ERTC's at Wood and Belvoir before assignment. But these specialists proved harder to draw into the service than had been anticipated. By the first of May the service commands had produced only 1,046, and OCE informed Hughes that AGF should expect at best no more than 1,000 a month.

Even with this reduced number, OCE and AFG could not agree upon procedures. Hughes, suspicious of the quality of these men, suggested they should go from reception centers to reclassification pools before assignment to units. The AGF Classification and Replacement Division objected to the use of Wood and Belvoir and recommended that three infantry centers, Fort McClellan, Alabama, Camp Robinson, Arkansas, and Camp Roberts, California, be designated as collecting points. Bolling liked Hughes' idea of running the men through a reclassification process but preferred that it be done after a period in one of the three infantry centers. In May the Engineers attempted to shift the AGF quotas from the ERTC's to the UTC at Claiborne, where ASF quotas were already going. McNair countered this move with a strong request that AGF quotas go to the three infantry centers. For two months the Engineers acquiesced, and AGF had undisputed control. By July, neither the Engineers nor AGF was pleased with the setup. AGF protested that it had got only 8 percent of the specialists it had been led to expect and only half of this number had any of the skills originally designated. OCE, on the other hand, accused AGF of sabotaging the voluntary induction program by failing to promote the men it did get. This situation in turn affected adversely the rate of induction, OCE charged. Accordingly, in July, OCE switched the AGF quotas to Claiborne where they entered a common pool from which, presumably, AGF and ASF requisitions would be filled in turn. While in the pool, the specialists obtained ratings. AGF did not like the idea of accepting men in grades determined by ASF, even though the men had above average AGCT scores. G–1,

[31] (1) M/S, G–3 for CofS, 12 Mar 43, sub: Plan for Activation of Nondiv Units. 320.2 (S). (2) MTP 5–4, Unit Training Program for Engr Units of AGF, 2 Aug 43.

AGF, for that reason wanted to limit them to 50 percent of T/O strength in new units and exclude them from cadre positions. Control of these men and procedures for processing them were still in a state of flux on 11 September when the War Department suspended the whole program. AGF benefited little.[32]

This minor skirmish over granting grades to engineer volunteers brought out quite clearly that AGF resented ASF's making any decisions affecting AGF personnel. Nevertheless, arrangements of a more permanent nature, involving a larger body of men, gave ASF control over several categories of engineers. AGF, like AAF, had no technical schools in which to train engineer specialists. Such men had to train at ASF installations under the direction of the Corps of Engineers. The number and types of specialists provided for AGF units could thus be manipulated within ASF. Getting sufficient allotments of AGF engineers into Engineer courses proved to be a continuous struggle for the Ground Engineer Section. In addition, the majority of Engineer officers came from the OCS at Belvoir, subject to no direction from AGF during the training period. ERTC-trained replacements for engineer nondivisional service units also came under ASF jurisdiction.[33]

The control of basically trained fillers from the ERTC's became involved in a larger issue between SOS and AGF early in 1943. In mid-January Bolling and an assistant met with representatives of the War Department General Staff to arrange for some decentralized system for distributing personnel. All agreed that each command should control the assignments of those graduates of its own RTC's which would go to units within its own jurisdiction. Left unsettled was the control of graduates of one command which would fill units of the other. On 29 January AGF heard unofficially that the Military Personnel Division (MPD) of SOS was setting up a control unit to make decisions upon such matters wherever SOS and AGF could not agree. Bolling was indignant, but telephone calls to the General Staff brought assurances that the control unit would not interfere with AGF. A second conference on 1 February, this time including SOS, confirmed that the War Department had all but decided to give this authority to MPD. The next day Bolling reported to the AGF chief of staff: "If this controlling agency goes through, I can see where we will finish in second place with the AAF tying for first with the SOS. . . . The weasel words in Circular No. 59, which state in substance that MPD is an operating agency of G–1, certainly should not be construed to permit the SOS to control personnel within the Ground Forces." [34] The Ground Adjutant General summed up the feeling in AGF, that "while it is not intended to charge any individual or agency with unfair practices, the personal equation must be recognized." [35] Nevertheless, on 13 February, MPD became the over-all controlling agency for allotting and distributing personnel, effective as of 1 March.

There matters stood until the second half of 1943. The landings on Sicily in July and on the Italian mainland in September stepped up the calls for overseas replacements. On 21 July AGF learned from The

[32] M/S, CofEngrs for CG ASF, 14 Apr 43, sub: Volunteer Induction for Engrs. OCE 344.3, Engrs Corps of, Pt. 1.

[33] Interv, Gilbert, 14 Sep 55.

[34] M/S, G–1 for CofS, 2 Feb 43, sub: Filler Repls, Results of WD Conf on. 341, Recruiting.

[35] M/S, Ground Adj Gen for CofS, 2 Feb 43, sub: RTCs. 341, Recruiting.

Adjutant General's Office that MPD had issued a new policy. The total output from the ASF RTC's would be assigned to replacement depots for shipment overseas or to ASF units in training. None would go to AGF units until a surplus existed—an unlikely occurrence. Alerted service units of AGF would have to fill to strength from units in a less advanced stage of training. Upon questioning, MPD protested that it intended no discrimination. The War Department had simply placed such high priorities upon so many ASF units that few of the units of low priority in either command could expect many RTC men. The Adjutant General's Office, however, insisted that its instructions from MPD were to fill ASF units, regardless of priority, before assigning any RTC men to AGF. An appeal to the General Staff resulted in a conference on 28 July at which MPD agreed that unit priorities would be the sole factor in making assignments. But as far as AGF engineer units were concerned the conference had little effect. Between the first of July and the last of September only 179 trained replacements from ERTC's entered AGF units. An upturn in numbers after that time brought the total during the last six months of 1943 to only 1,146, contrasted with 9,798 to ASF units and 11,510 to depots.[36]

During the same six months the War Department cut the allotments of AGF engineers to Engineer specialist schools. In place of the old allotment of 7,464 officers and men to the Engineer School, ERTC's, or to civilian institutions, a new allotment of 12 June allowed AGF to send only 1,638 officers and 4,218 enlisted men, or a total of 5,856. The actual numbers so trained came closer to 6,000 but by the end of 1943 a new quota for the next six months cut still deeper, to 3,048.

The lower quality of AGF personnel, the cut-backs in specialist quotas, and the higher priorities given to ASF units all contributed toward making the training of AGF engineer units more difficult. Granted, ASF units held a higher proportion of technicians than those of AGF, but demands for combat engineers by the end of 1943 had begun to swell the numbers of these units in the troop basis and therefore to raise the total demand for AGF specialists. By the end of the year, AGF engineers accounted for 172,223 of the total engineer strength in the Army as compared with 221,434 in ASF and 99,457 in AAF.[37]

Harvest of Confusion

By early 1944 demands from overseas confirmed a stand which Hughes had taken months before. The Army needed more engineer combat support. Accordingly, between February and July, inclusive, AGF activated 53 nondivisional combat battalions, making a total of 103 such units activated and in various stages of training at the end of July. Troops to fill these units again became scarce as preparations for the landings on the coast of France in June called for the services of every available man. A new system of classification sent the most desirable reception center men to infantry units.[38] Fillers for engineer units were particularly hard to obtain. By May, many of the combat battalions, activated for months, remained at cadre strength. The 286th Engi-

[36] Tng of Repls, Annex I.

[37] Incl, Tab A, Distr of Total Army Strength, to M/S, Plans for CofS, 13 Dec 43, sub: Trp Basis (1944). 320.2, Trp Unit Basis, 1943, Folder 5 (S).

[38] For a discussion of the Physical Profile System see Palmer, Wiley, and Keast, *op. cit.*, pp. 64–76.

neer Combat Battalion, activated in December 1943, received half of its fillers in March and the rest in April, making two disjointed training programs necessary. The 1272d, activated in April 1944, could not begin training until three months had passed. Fillers came from a variety of sources, including disbanded antiaircraft, coast artillery, and other types of units made superfluous by the course of the war. Chemical mortar battalions as well as engineer camouflage battalions found themselves overnight relabeled engineer combat battalions. Specialists from one type of unit did not necessarily convert easily into those of another. The reclassification system broke down completely under the strain. Adjustments in some cases were severe, and much good training had to be wasted. Even within the Engineer framework, the change from topographic unit to maintenance company or depot company was not easy.

The reduction of specialist quotas to ASF schools threw the major part of this work of retraining upon the thirty-five combat group headquarters and the individual units. Administrative loads and paper work piled up. To relieve the strain, AGF in July attached some of the groups to special troops headquarters detachments which had been increased in size to handle the larger task. This arrangement was particularly helpful in preparing troops for overseas movement. Group headquarters often shipped out ahead of their battalions and companies, leaving these units without supervision during a critical period.[39]

The new administrative setup did provide some help, but the acute need for nondivisional units in active theaters led the War Department to cut training time to a minimum. An accelerated training schedule, published on 14 July 1944, divided such units into three classes. A unit reorganized from another unit within the same branch or one which received the majority of its personnel from an RTC of the same branch had the shortest time in which to prepare. A unit converted from another branch had a longer period. Units with the longest training time were those filled from reception centers. For example, a combat battalion might train 23 weeks, 27 weeks, or 32 weeks, according to its classification. Group headquarters, topographic battalions, and all units of company size except combat companies were to have no joint training at all. The training time for group headquarters and for combat battalions with the same type of fillers did not correspond; group headquarters would ship out two months ahead of combat battalions organized at the same time.

Although the major part of AGF engineer activations had taken place by July 1944, those units already organized were affected by the accelerated program, being required to adjust the remainder of their time to the new schedule. The Fourth Army reported on 3 August that all 53 engineer units under its control, including 23 combat battalions, would complete unit training under reduced programs by the end of the year. An investigation of this anomalous situation revealed that the Fourth Army had misinterpreted the directive and had adjusted the total training time of several engineer units rather than shorten the remaining portions of the program. Hughes was particularly agitated over the 1696th Engineer Combat Battalion, a Negro unit filled with AAF personnel, for which no engineer cadre had been available. Thirteen weeks of unit training was the mini-

[39] (1) AGF Status of Equip and Pers as of 31 Jul 44. (2) Holmer, Hist of the Engr Sec Hq AGF.

mum amount of time required under any training program, he protested, and insisted that the Fourth Army comply more accurately with the new schedule.[40]

By fall of 1944 the filling and training of engineer nondivisional units reached a chaotic state. Just at this time, equipment, which had been reasonably plentiful for training purposes since the summer of 1943, again became scarce. Instead of shipping units with the equipment used during training, the War Department had established a policy of preshipping quantities of new equipment to a stockpile in Great Britain. Theoretically, the used equipment which the units left behind in this country would serve subsequent increments of units in training. By fall of 1944, however, the demands for engineer equipment so far exceeded expectations that ASF began to call in this used equipment for rehabilitation and reuse overseas. Specialist training within the units, with little time and less equipment, was next to impossible. The few thousand specialists which ASF still trained for AGF engineers spent very little time with their units beyond the few weeks of basic military training. Orders for the shipment of units at whatever stage of training became more frequent. The climax came in October with the call from ETO for 65 engineer combat battalions, no matter how well prepared they might be. The demand was so sudden that 1,800 specialists at ASF schools could not be recalled. Other battalions of lower priority were in such poor shape that few substitutes could be found. Fillers with no particular qualifications for these jobs had to be thrown in at the last minute to bring the units to strength before departure. The drop in quality of AGF engineers which observers noted in early 1945 occasioned no surprise in the Engineer Section.[41]

During 1945 the training of AGF engineers became progressively less important as units moved overseas to all theaters. By the first of August 1945 only 971 officers and 15,879 enlisted men remained in training, including units and individuals being redeployed from one theater to another or returned to the United States through the rotation plan.[42]

Of all the AGF engineer units, the most controversy over preparation and control centered upon the nondivisional combat battalions. Having less precise missions than such units as heavy ponton battalions, depot companies, or topographic units, nondivisional combat battalions were perhaps for that reason more easily diverted to duties for which they were not intended. In Europe, they performed heavy construction work and fought as infantry for extended intervals. In the Southwest Pacific, long a theater of secondary priority, the few engineer units available had to be versatile enough to accomplish whatever tasks happened to be most urgent. Nondivisional combat battalions served principally as construction battalions until the Philippines campaign. This theater persistently requested the Engineer Section to add more and heavier equipment to these units and reorganize them for three-shift construction jobs. Hughes accused the Southwest Pacific theater in particular of requesting the wrong types of units, but prepared special lists of

[40] 353.03, AGF Instr Visits (C).

[41] (1) Roland G. Ruppenthal, *Logistical Support of the Armies*, Volume I: *May 1941–September 1944*, UNITED STATES ARMY IN WORLD WAR II, (Washington, 1953), pp. 235–240. (2) AGF Bd Rpts, Sep 44–Mar 45.

[42] Strength of the Army, 1 Aug 45, p. 28 (C). AGO Special Reference Collection.

equipment to meet shifting requirements wherever needed. In the matter of control, OCE never accepted the flexible group idea in good grace. At the end of the war, the Chief Engineers in both the European and Pacific theaters still preferred the combat regiment and said so. Opinion at lower levels of command remained mixed, according to the experience of individual officers.[43]

Neither AAF nor AGF engineer units had the advantage of early centralization within unit training centers as did ASF units, but pressure for the formation of such centers grew strong in both commands. AAF and AGF experimented for a time with intermediate types of organizations to which a few units could be attached. AAF finally organized EAUTC's comparable to the ASF engineer centers, but AGF, under the domination of McNair, never went beyond the limited concentrations possible under the engineer combat group.

[43] (1) *Final Engr Rpt, ETO,* pp. 131, 135, 139–40. (2) OCE GHQ AFPAC, *Critique,* Vol. III, in *Engineers of The Southwest Pacific 1941–1945* (Washington, 1950), pp. 377–79. (3) Engr Sec Sixth Army, Engineer History, Ch. XI. MS, Lt Gen Samuel D. Sturgis files. (4) 319.1, Binder 1, 1945. (5) 319.1. (6) 319.1 (S).

CHAPTER XVI

A New Role in Amphibious Operations

Few officers in the United States Army of the 1930's could have foreseen the significant role which the Engineers would assume in amphibious operations during World War II. Relying upon World War I experience, the Army had based its plans upon debarkations at friendly ports, complete with docks, cranes, warehouses, and railroad sidings. Not until 1940 when the swift German advance across western Europe denied all Continental ports to Allied forces, were United States strategists jolted out of this limited conception. Realizing that a new phase of war planning had begun, the War Department in late June directed the 1st and 3d Infantry Divisions to add landing operations to their training programs. Fortunately, the Navy and Marine Corps had devoted considerable attention to the subject. It was to them that the Army turned for amphibious doctrine.[1]

Origins

The Marine Corps took the lead in formulating doctrine for amphibious assaults shortly after the Washington Conference of 1921–22.[2] From that time on, the Navy-Marine Corps planners assumed that any strike against Japan must be preceded by the assault and capture of enemy-held islands in the Central Pacific for the establishment of advanced naval bases. The Marine Corps within a few years roughed out its major strategic plans for the seizure of island bases in the face of enemy opposition, and delegated to itself the amphibious role. Since Army units were not trained for joint landing operations with the Navy, the Navy should have undivided command.

The first Marine Corps landing exercise of any consequence, in 1924, was a dismal failure. For nearly a decade thereafter the Marine Corps made no further advance. Then, in 1933, came a resurgence. Following urgent recommendations from the Marine Corps, the Navy set up in December of that year the Fleet Marine Force at Quantico, Virginia. This force of brigade strength was attached permanently to the United States Fleet and had for its primary purpose the capture of bases for the Navy. In 1934 the Marine Corps published a

[1] Four studies have been useful in preparing this chapter: (1) William F. Heavey, *Down Ramp! The Story of the Army Amphibian Engineers* (Washington: Infantry Journal Press, 1947); (2) Military Training in the Engineer Amphibian Command of the Corps of Engineers, May 1942–April 1944 (hereafter cited as Mil Tng in EAC, May 42–Apr 44), prepared in Hist Sec TIB OCE, in OCMH; (3) History of the Engineer Amphibian Command From Its Activation to 31 July 1943, prepared at Hq EAC, Pts. I, II, III; (4) Marshall O. Becker, The Amphibious Training Center, AGF Hist Sec, Study 22, 1946. Unless otherwise indicated, all files cited in this chapter are Engineer Amphibian Command files.

[2] The following discussion of the Navy-Marine Corps role in developing doctrine for amphibious operations is based upon Jeter A. Isely and Philip A. Crowl, *The U. S. Marines and Amphibious War* (Princeton, N. J.: Princeton University Press, 1951), Chs. I, II, III.

manual that covered the duties of the Fleet Marine Force in a landing operation. This manual formed the basis for all future amphibious doctrine.

In preparing the manual, the marines probed carefully into the probable effectiveness of various types and combinations of naval bombardment. They recognized the need of aerial support for reconnaissance, for spotting naval gunfire, for preinvasion bombing, and for protection against enemy planes. They emphasized that the ship-to-shore movement of small craft was a major tactical maneuver, not a simple ferrying job. Success or failure of a landing could well depend upon the rapid and correct loading of troops, the integrity of small units, the deployment of boats, and an orderly debarkation at the shore line. Special lighters would be needed to transport artillery and tanks. An amphibian tank would be ideal. Cargo vessels should be combat loaded so that all the matériel for any one unit would be together and arranged so that supplies needed first would be the most accessible. The logistical task did not end with debarkation. Troops and supplies must not be allowed to pile up at the water's edge, exposed to the enemy and impeding the landing of subsequent waves of the invading force. Special shore parties, accompanying the first waves, would mark the beaches for the flow of traffic, set up supply dumps, evacuate casualties, and make emergency repairs to boats. From ship to shore, the Navy beach party would be in charge; at the high-water mark the Marine shore party would take over. As far as the marines were concerned, no division of command occurred at the shore line, since the Fleet Marine Force was a part of the Navy. Elaborate radio and signal communications would smooth the whole operation.

Between 1935 and 1940 the Marine Corps engaged in yearly landing exercises with the Navy. To most observers, these maneuvers represented little improvement over the 1924 fiasco. Money was scarce. The Navy was reluctant to risk its small boats in dangerous operations for which they were obviously unsuited. The intricacies of amphibious supply were never tackled realistically. Cargo vessels were never combat loaded; supplies were instead placed ashore before each maneuver. Separate shore parties were never organized and trained beforehand. Orders became confused, boat units milled around aimlessly, got lost, and landed far from their objectives. In 1938, however, experiments with special equipment began to show results. The marines demonstrated a self-propelled tank lighter. In 1939, Andrew J. Higgins, a New Orleans boatbuilder, submitted the first model of his landing craft which, with some modifications, soon edged out all competition. In the same year the Marine Equipment Board purchased three Roebling amphibious tractors, forerunners of the LVT, commonly called the Alligator. By 1940, when the Army was forced to consider the necessity for training the 1st and 3d Divisions in landing operations, amphibious doctrine had been carefully worked out, and new and useful equipment was in sight. But lack of money, insufficient training, and faulty planning had hamstrung the development of techniques and procedures.

Before 1940 the Army had participated in Navy-Marine Corps maneuvers only once. In 1937, the 30th Infantry Regiment, augmented by artillery and engineer units, formed the First Expeditionary Brigade for joint exercises with the Navy. Recommendations from the commanding general of the Fourth Army that the Army continue

amphibious training and an invitation from the Navy to join in the January 1940 maneuvers went unheeded. It was not until 1941 that the Army's renewed interest in amphibious training resulted in another joint exercise.

Although the Army did not engage in the Navy maneuvers of 1940, the Corps of Engineers began to study its own functions in an opposed landing by running an Engineer School problem on this subject from late 1939 into 1940. The Army directive of June 1940 which ordered amphibious training for two Army divisions provided added impetus. At the Engineer School's second research course conducted early in 1941, a committee of three, including one Marine officer, was assigned to explore all possible duties which might fall to engineer troops in an amphibious assault.[3]

For four weeks this committee studied Marine Corps and British doctrine and techniques and the latest tactics of the Japanese and German Armies. The committee dismissed the unopposed landings of the Germans on the familiar soil of Norway as of little value either for formulating general principles or for evaluating the usefulness of engineer troops. British doctrine and techniques seemed too vaguely defined to be of much help. Apparently the British planned to include relatively few engineers in the first waves and restricted their duties to removing underwater obstacles, constructing landing facilities, supplying water, and establishing communications. The Japanese had the most practical knowledge of amphibious warfare. Information available to the committee indicated that Japanese assault forces were strongly reinforced with engineers. The existence of beach or shore parties could not be ascertained. In the final analysis there was little background except Marine Corps doctrine and experience.

The committee confined its study to ship-to-shore movements such as the marines had conducted in the past. Departing radically from existing Army doctrine, the committee sought to make engineer troops the basic soldiers in an amphibious attack. Instead of following the assaulting infantry, the engineer members of the combat team would form two waves of assault units which would hit the beach, with or without the protection of tanks and Alligators, and begin the destruction of fortifications some ten minutes ahead of the first wave of infantry. Each infantry division engaged in amphibious landings should have three engineer combat battalions instead of only one.

The division of responsibility which would occur at the shore line in a joint Navy-Army landing was of great concern to the committee. Without perfect co-ordination between the Navy beach party and the Army shore party the whole supply operation would break down. Current doctrine prescribed that the shore party should construct emergency roads, remove land mines and other obstacles, and provide hasty defensive works in case of counterattack, but that the beach party, interested in removing underwater obstacles and in providing temporary docks and ramps, should have control of both parties during the initial phase. A study of past maneuvers convinced the committee that the Navy could not be depended upon to furnish the necessary engineers and should therefore be restricted to handling boat traffic. An Army shore party, patterned after the Marine shore party, which was largely composed of

[3] See above, p. 21.

engineers and usually commanded by an engineer, should take over all beach and shore engineering functions. This recommendation clearly pointed toward an Engineer organization for this work.

The Navy was responsible for waterborne transportation between ships and beaches. Noting that the Army had for this reason left the development of landing craft to the Navy, the committee nevertheless suggested that the Army should develop some type of craft that might be suitable both for river crossing operations and for augmenting the Navy's craft in a landing if such a need should arise. The Army should also try to improve the design of the Alligator and the tank lighter. Finally, engineer combat units should receive training in maneuvering small boats in rough seas, in unloading equipment from ships, ferrying it ashore, and unloading it on the beach.[4] Early in April 1941 OCE sent a copy of the committee's report to G–3 and to selected engineer units for comment. G–3 appreciated the fresh approach to the subject and included some of the ideas in an Army field manual on landing operations.[5]

The joint Army-Navy amphibious exercises of late 1941 and early 1942 confirmed many of the findings of the Engineer School study. The forces were organized into a Pacific Fleet Amphibious Corps consisting of the 2d Marine Division and the 3d Infantry Division and an Atlantic Fleet Amphibious Corps containing the 1st Marine Division and the 1st Infantry Division, all under Navy control. Conspicuous among the deficiencies was the lack of a well-organized and trained shore party; co-ordination between beach and shore parties remained poor. Communications between the Army and Navy broke down. In the January 1942 exercise on the east coast none of the Army battalions was put ashore as a unit on the right beach, one was completely disorganized after being spread piecemeal over two miles of shore line, and another landed entirely outside the maneuver area. The Navy, being in command, bore the brunt of the criticisms.[6]

Strategic plans which were taking shape in the early months of 1942 for the prosecution of the war in both the Atlantic and Pacific depended increasingly upon the effective employment of amphibious techniques. At this stage of planning the offensive in Europe took precedence. Since the English Channel is a narrow body of water, a shore-to-shore amphibious attack on the coast of Europe rather than the customary ship-to-shore movement seemed feasible.[7]

Toward the end of February, Army General Headquarters, dissatisfied with the Navy's conduct of joint exercises, began to plan for an Army amphibious training center.[8] On 20 March, G–3 directed AGF (successor to GHQ) to select a site along the Gulf Coast that might be used for this center if and when sufficient landing craft could be obtained.[9] The site was to be large enough to hold one division at a time, the idea being to rotate divisions through a shore-to-shore amphibious program as a part of their regular training. Instruction

[4] Rpt 1, Landing Operations on Hostile Shores, 1 Mar 41, Second Research Course, 1 Feb–1Mar 41.

[5] OCE 352.11, Engr Sch (C).

[6] (1) Isely and Crowl, *op. cit.*, Ch. III. (2) Becker, *op. cit.*, p. 1.

[7] (1) Dwight D. Eisenhower, *Crusade in Europe* (New York: Doubleday, Doran and Company, Inc., 1948), pp. 28, 38–39. (2) Matloff and Snell, *Strategic Planning for Coalition Warfare*, pp. 99, 120–21. (3) Harrison, *Cross-Channel Attack*, p. 12.

[8] Greenfield, Palmer, and Wiley, *Organization of Ground Combat Troops*, pp. 90–92.

[9] Unless otherwise noted, the rest of this section on origins is based upon: (1) OPD 353, Amph Forces, Sec. 1 (S); (2) ABC 320.2, Amph Forces, Sec. 1 (3–13–42) (S).

would include "all phases of the operations of Army units involved in embarking troops and equipment in small boats from the land, the approach to and landing on a hostile beach, the establishment of a beach-head, and the preparation and initiation of an attack inland." [10]

Discussions which centered upon the composition and control of amphibious troops in the Pacific had as a background the struggle between the Army and Navy over which service should play the leading role in the subjection of Japan. Each had a different concept of the most effective disposition of forces and sequence of objectives to reach this goal. Each realized the importance of controlling a large number of troops trained for amphibious warfare. The decision of late March 1942 to separate the Pacific into the Southwest Pacific Area under General MacArthur and the Pacific Ocean Areas under Admiral Chester W. Nimitz did not settle the issue. The demarkation only served to set up two rival claimants for power.[11]

The Deputy Chief of Staff, General McNarney, conscious of service rivalry and concerned about the poor results of joint Army-Navy amphibious exercises, was convinced by early April that the joint Amphibious Corps under the control of the Navy were not working well. In casting about for a means to extricate the Army from the awkward relationship with the Navy, McNarney hit upon a geographical division of labor. The almost certain cross-Channel invasion of Europe would be followed by a prolonged land operation. For this task the Army division or corps would be best. In the Pacific, landings for the next year or so would probably be restricted to successive quick thrusts at small island garrisons, work for which the marines were peculiarly well suited. An Army amphibious corps for the Atlantic and a smaller Marine amphibious force for the Pacific should train separately. Each organization should develop independently for its own mission, by its own methods, with its own specialized equipment.

In submitting these observations to Admiral Ernest J. King, Chief of Naval Operations, McNarney left open any decision as to which troops would be employed under whose control during the later offensive phase of the war in the Pacific. Obviously, whenever strategy called for a move into the larger land masses of the Southwest Pacific, such as New Guinea or the Philippines, the proposed Marine amphibious force would be too small. Obvious as well was the fact that McNarney believed Army troops under Army control would be preferable in this area when the time came. The Navy, however, wanted to make this clear-cut Atlantic-Pacific geographical division permanent. Granted, the Marine Corps could not expand sufficiently to furnish the number of troops required, since by law the marines were restricted to 20 percent of the Navy's strength. Nevertheless, the Navy sought to maintain control of all amphibious forces, both Army and Marine, employed in the entire Pacific. The 3d Infantry Division should therefore remain under the control of the Navy. The Army should conduct only those amphibious landings projected against a continent.[12]

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[10] Memo, G–3 for CG AGF, 20 Mar 42, sub: Estab of an Amph Tng Center. OPD 353, Amph Forces, Sec. 1 (S).

[11] (1) For a discussion of this rivalry see Isely and Crowl, *op. cit.*, pp. 83–98; and Ernest J. King and Walter Muir Whitehill, *Fleet Admiral King: A Naval Record* (New York: W. W. Norton & Co., Inc., 1952), pp. 372, 381–89. (2) Matloff and Snell, *op. cit.*, p. 171.

[12] Memo, Col J. C. Blizzard for Col T. T. Handy, 17 Mar 42, sub: JPS 2/7—Amph Forces. ABC 320.2, Amph Forces, Sec. 1 (3–13–42) (S).

In the second week of April the United States and Great Britain agreed upon an emergency invasion of Europe in the late summer in case of German internal collapse or the disintegration of the Russian forces. Otherwise, a full-scale invasion would be pushed across the English Channel in the spring of 1943. Providing landing craft and crews for this offensive soon became a headache. The Navy, charged with the procurement of the boats, was concentrating its efforts upon replacing the larger elements of the fleet crippled by the Japanese in December. The expanding ship-to-shore amphibious program and the provision of crews for warships of the fleet absorbed all of the personnel that could be obtained under the Navy's policy of taking volunteers only. The Navy simply could not furnish and train the crews for any shore-to-shore amphibious operations projected against the European continent during 1942. Whether or not the British could furnish crews for the landing craft was still undetermined. Evidently, some arrangement had to be made to train U.S. Army boat crews.[13]

To the discomfiture of the Navy, the specific requirements for a cross-Channel attack intruded upon the deliberations of the Joint U.S. Strategic Committee which was preparing at this time a general study of amphibious forces. Following McNarney's line of reasoning, the Strategic Committee decided that the divergent tasks which were shaping up in the Atlantic and Pacific made different types of training imperative. Moreover, friction between the Army and Navy during joint training made a separation advisable. The marines should form an amphibious assault force for the capture of the smaller islands of the Central and South Pacific. Army amphibious troops should train in Army centers for the offensives in the Atlantic and in the Southwest Pacific. For the moment it seemed that the Army had won.

When the Strategic Committee placed this proposal before the Joint U.S. Staff Planners on 29 April it met with stout opposition from the Navy. The cross-Channel operation was a special situation which had unduly affected the thinking of the committee, the Navy held. For optimum results, one service should have full charge of all planning, equipping, and training. No decision could be reached, beyond the fact that the Army would be responsible for training boat crews for the European invasion.[14]

With this much to go on, G–3, on 9 May, issued statements of the Army's objectives to AGF, SOS, and AAF. By 1 February 1943, AGF was to train within the United States twelve divisions in shore-to-shore landings. The magnitude of this program led the War Department to suggest three locations for instruction. Four divisions might train at Camp Edwards, Massachusetts, six at Carrabelle, Florida, and two at Fort Lewis, Washington. Divisional training was contemplated at Camp Edwards from 15 July to 1 November 1942, and at the other two stations as soon as camps were ready and boats and crews available. SOS was to train sufficient boat crews, maintenance crews, and supply units to transport and sustain an eight-division lift across the Channel, plus a 50 percent reserve. Within SOS, the Corps of Engineers received the

[13] (1) Min of Joint U.S. Staff Planners, 22 Apr 42. ABC 334, JSP Min, Sec. 1 (2–13–42) (S). (2) Harrison, *op. cit.*, pp. 15–17. (3) Memo, King for Marshall, 5 Feb 43, sub: Army Engr Amph Boat Crews. 353, Tng (S). (4) Ltr, Capt B. G. Lake, USN, to EHD, 26 Feb 51.

[14] Min of Joint U. S. Staff Planners, 29 Apr 42. ABC 334, JSP Min, Sec. 1 (2–13–42) (S).

major part of this task. The immediate objective was to train enough boat units to permit divisional training to begin on 15 July.

By early June Army and Navy negotiators had arrived at some measure of agreement on over-all control of amphibious operations, although the Joint Chiefs had not yet given formal approval. All preparations for the shore-to-shore cross-Channel attack should be separate from those for ship-to-shore amphibious organizations and should be under the Army. The Navy would furnish landing craft and instructors for training Army boat crews. Craft of seagoing size would be manned and operated by the Navy. The reorganization of the ship-to-shore amphibious forces was a compromise. Within the Atlantic Amphibious Force, an Atlantic Amphibious Corps of Army divisions would be commanded by an Army officer. During 1942 this force would be employed in the Atlantic; after that it might be used in either the Atlantic or the Pacific. For the Pacific Amphibious Force, a Pacific Amphibious Corps composed of both Army and Marine divisions would operate in the Central Pacific under the command of a Marine officer. A South Pacific Amphibious Corps made up entirely of marines would work first in the South Pacific but might be shifted later either to the Southwest or Central Pacific. This left the exact composition of a Southwest Pacific Amphibious Corps in a nebulous state agreeable for the moment to both the Army and Navy.

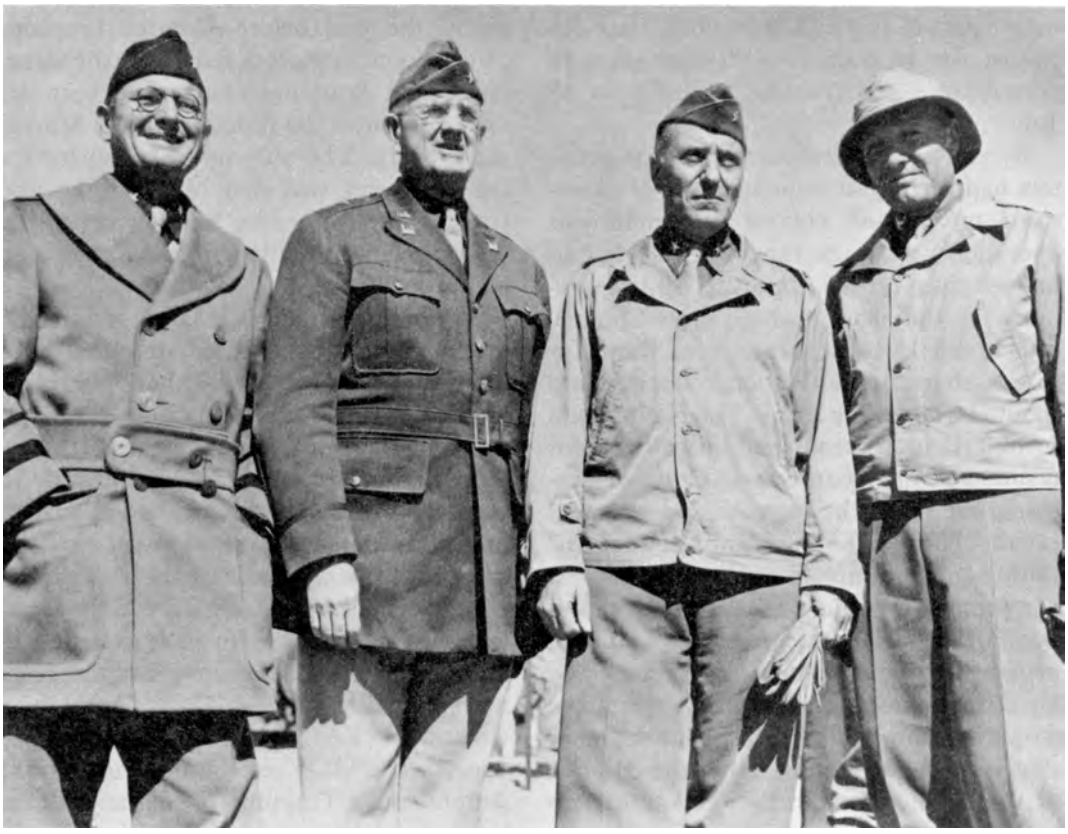
Early Organization and Training

The task assigned to the Engineers on 9 May 1942 was a narrow one compared to that envisaged by the Engineer School committee the year before. Combat functions of divisional engineers remained the same. No special Army units had as yet been devised to assume the functions of the Marine shore party. The only new assignment for the Engineers was that of providing and training crews for the landing craft that would be employed in the coming invasion of Europe.[15]

The assignment was a large one, nevertheless. The Army's immediate plans called for training about 48,000 men, organized into 18 engineer boat operating regiments and 7 engineer boat maintenance battalions. Since divisional training had to begin by 15 July, the Engineers had only two months to find a training site, make necessary improvements, form staffs, locate men with experience in small boats, organize units, start training, and prepare for joint exercises. In order to meet these requirements, the Engineers organized the Engineer Amphibian Command (EAC) at Camp Edwards on 10 June, while AGF established nearby the Amphibious Training Command, later known as the Amphibious Training Center.

Although the EAC was not formally organized until June, the Engineers brought a nucleus of the command together in Washington during May to do the required planning. Working under Sturdevant, this group was led by Col. Daniel Noce, who was to command the EAC, and Lt. Col. Arthur G. Trudeau, his chief of staff, later Director of Training, ASF. As executive officer of the

[15] Unless otherwise noted this section is based upon: (1) 353, Tng (C); (2) File 1 (S); (3) 333, Inspecs and Investigations by IG and Other Official Rpts; (4) Directives (S); (5) 220.01, Clas of Scores in Tests; (6) 353, Tng, 1942; (7) Ltr, CO EAC to CofEngrs, 1 Jul 42, sub: Progress Rpt, 319.1, Tng Rpts; (8) GOs, 1942; (9) Interv, Capt Walter C. Capron, USCG, formerly comdr of the Boat Unit Det, 14 Jun 50; (10) Becker, *op. cit.*, pp. 8, 39–45, 53–55, 63–65.



BRIG. GEN. DANIEL NOCE *(third from left), commander of the Amphibious Training Command, Camp Edwards, Mass., 1942. With General Noce are (from left) Brig. Gen. David A. D. Ogden and General Sturdevant; Col. Arthur G. Trudeau is on the right. (Photograph taken October 1942.)*

ERTC at Wood, Noce had valuable experience in setting up a new training center. Trudeau came to the EAC from an assignment as instructor at the Command and General Staff School at Fort Leavenworth.

Among the first tasks which Noce and Trudeau faced was defining in full the mission of the command. Recalling that well-organized and well-trained shore parties had been conspicuously lacking in amphibious operations up to that time, these officers determined to add the training of shore party units to the EAC mission. No existing unit had the proper specialist structure to accomplish the duties envisioned. Engineer combat regiments assigned to this work in the ship-to-shore maneuvers thus far had been unsatisfactory. In a shore-to-shore operation their duties would be even more complicated since this movement called for the assembling and loading of troops and supplies on the near shore as well as the unloading and reassembly on the far shore. The engineer combat battalion of the infantry division would have its hands full with engineer reconnaissance, demolishing un-

derwater and beach obstacles, and blowing up permanent fortifications. Borrowing from the ideas developed in the second research course, Noce and Trudeau drew up blueprints for a new Army unit that would incorporate the functions of both the Navy beach party and the Marine shore party. The organization which evolved was the engineer shore regiment containing three battalions, each having two far shore companies and a near shore company. The EAC staff proposed to integrate this shore regiment with a boat regiment and service units into a larger organization which would comprise an engineer amphibian brigade. The brigades would be able to transport troops and supplies, organize the beaches, evacuate the wounded and prisoners of war, and continue to supply the landing forces during the course of an invasion. Attached to infantry divisions they would assure the Army of unified command over amphibious operations. On 20 May representatives of AGF and SOS agreed to the new organization, and shortly thereafter G–3 approved a request from the Corps of Engineers for authority to activate eight brigades.[16]

The Engineers also had to clarify the extent of the command's responsibility for training. Originally G–3 proposed that the Engineers train individual crews which would then be assigned to AGF for unit and joint training. SOS objected to this system and Sturdevant on behalf of the Corps of Engineers carried the argument still further. The EAC, under SOS, should be responsible not only for organizing and training boat crews but also for their performance in action. Eventually the entire command should be transferred overseas, where it would continue to function under SOS until placed at the disposal of an invasion force. Sturdevant proposed that the organization, training, supply, equipment, and operation of this transportation service, and the training and equipping of shore parties, be placed under a single command, and that engineer units be attached rather than assigned to AGF for joint training. After AGF and SOS concurred, the War Department issued a final directive on 23 May incorporating these changes. AGF was charged with the development of doctrine, the training of divisions, and joint training.[17]

Probably the most troublesome issue in this preliminary stage, and indeed throughout the command's history, centered on the boats. The program was set up on the basis of the Engineers using 36-foot and 50-foot craft. On 9 May G–3 gave the boat requirements for the training of twelve divisions and necessary engineer units as 1,000 of the 36-foot landing craft and 225 of the 50-foot tank lighters—500 of the 36-foot craft and 125 of the 50-foot lighters to be delivered at Edwards by 30 July 1942. The others, intended for Carrabelle and Fort Lewis, were to be delivered during July and August. After the Engineers had an opportunity to examine their needs they revised these requirements upward to 1,550 craft of all kinds with 925 to be delivered by 15 July, but SOS soon found that the maximum production of boats would not satisfy the needs of the Army and Navy and requirements for Great Britain.[18]

[16] Arthur G. Trudeau, "The Engineer Amphibian Command," *Military Review,* XXIII (September, 1943), 13.

[17] Ltr, TAG to CG AGF, 23 May 42, sub: Responsibility for Amph Tng. Directives (S).

[18] (1) Memo, Somervell for Admiral Horne [16 May 42], sub: Alloc of Landing Craft for Tng in the U. S. EHD files (S). (2) For a discussion of production of landing craft during the war see George E. Mowry, *Landing Craft and the War Production Board, April 1942 to May 1944* [Historical Reports of War Administration, WPB Special Study 11] (Washington, Civilian Production Administration, 1944, reissued 1946), pp. 5–11.

The urgency of the situation became apparent on 20 May when Sturdevant conferred with Navy officials who agreed to turn over 300 of the 36-foot craft to the EAC during June and July, provided deliveries were on schedule. To carry on amphibious training even on a reduced scale, 150 more 36-foot boats and 50 more 50-foot tank lighters would have to be diverted from overseas shipments. Sturdevant estimated that this number of boats would suffice to train only one regimental combat team at a time, enable the EAC to continue training, and provide for replacement.[19] The Engineers doubted that a successful cross-Channel invasion could be mounted in the 36- and 50-foot boats. Representatives of the British, the Navy, the Coast Guard, and Marine Corps all agreed that the choppy waters of the Channel would subject troops in small boats to such a rough voyage that fighting effectiveness would be drastically reduced. But no larger craft had yet been authorized when the time came to activate the command.

In the midst of the discussions on the types of boats to be assigned and the numbers which would be available, the Engineer Amphibian Command pushed forward the practical task of organization. Pressure to get the project started had led the War Department early in May to designate Camp Edwards, Massachusetts, as the best available location.[20] The camp was an established post and provided access to beaches on Cape Cod which were suitable for amphibious training. This choice was later criticized because boat instruction could not be carried on so far north during winter months. Originally, however, the Army did not expect to use the camp after November. The Corps of Engineers planned to instruct five brigades at Camp Edwards before the approach of winter and to train the remaining three units elsewhere. Since the center at Carrabelle would not be ready before autumn, and in view of the training schedule, both the EAC and the Amphibious Training Center at first concentrated their activities at Edwards.

With the location fixed, the Corps of Engineers and AGF investigated Cape Cod to determine where shore facilities could be constructed. They concurred in selecting the south shore to the east of Buzzard's Bay. On 28 May the Corps of Engineers leased Washburn Island in Waquoit Bay as an amphibious training site, and on 1 June leased the Falmouth Marine Railway for maintenance facilities. Soon after training began the command acquired an area along Cotuit Bay for amphibious training, a strip on Popponessett Bay for antiaircraft instruction, and additional maintenance facilities at Osterville. At all these locations, bays had to be dredged, camp sites prepared, and roads, piers, and utilities built. By the end of July, $1,600,000 had been allocated for construction. Although docks and piers were ready at the end of June, some of the troops using these installations had to be transported to them by truck five to fifteen miles from Camp Edwards. After 1 August, there was sufficient housing for 8,000 men, and camp facilities existed for many more.[21]

On 10 June 1942, before much of this

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[19] Memo, Sturdevant for CG SOS, 21 May 42, P&T Div file 381, BOLERO, Folio 1.

[20] (1) Info Memo, CofS SOS for CG SOS, 8 May 42, sub: Decision Concerning Arrangements for Handling Opn and Maint of Landing Craft in Connection with BOLERO. OCE 381, BOLERO (S). (2) WD Gen Council Min, 4 May 42.

[21] (1) Memo, Maj R. R. Arnold, OCE, for Col Noce, OCE, 18 May 42, sub: Visit to Boston and Cape Cod Area on May 15 to 17, 1942. File 1 (S). (2) Mil Tng in EAC, May 42–Apr 44, pp. 9–13.

construction had been started, Noce activated the Engineer Amphibian Command. A tentative T/O divided its responsibilities for organizing, equipping, training, operating, and administering amphibian units among five directors: Administration and Personnel, Services, Training and Operations, Specialist Schools, and Procurement and Supply. The first two brigades, activated on 15 June and 20 June, had a T/O which called for 349 officers, 20 warrant officers, and 6,814 enlisted men organized into a boat regiment, a shore regiment, and supporting units. The boat regiment contained nine boat companies, each of which was capable of carrying the combat elements of a battalion landing team at one time, a lighter company to provide additional transportation, and a second echelon maintenance company. Three boat companies and a headquarters company constituted a battalion. The shore regiment, which was almost half the size of the boat regiment, consisted of three battalions, each able to support the crossing of a regimental combat team and each organized into a battalion headquarters, two far shore companies, and a near shore company. In addition, there were in the brigade a quartermaster battalion to supply such essentials as fuel and to repair motor vehicles, a medical battalion to evacuate casualties, a brigade maintenance company to do third echelon repair work on landing craft, an ordnance platoon to take care of armament, and attached medical personnel for distribution among brigade units. In July the War Department authorized a signal company, raising the total strength of the brigade to 363 officers, 21 warrant officers, and 6,898 enlisted men.[22]

Just as at Claiborne, the task was new and had to be accomplished with speed. To hasten the organization of the command headquarters and the 1st Brigade, the Army assigned to the control of the Chief of Engineers a number of engineer, quartermaster, and ordnance units. The search for additional men began in May. The Adjutant General's Office sifted personnel records for required skills. The Corps of Engineers sent some 6,000 circulars to yacht and boat clubs, shipyards, and boat owners, and published articles in boating and yachting magazines. Military Personnel, OCE, organized teams of officers who flew all over the country seeking out and interviewing men with marine experience.[23] Private industry and organizations such as the United States Power Squadron supplied the names of skilled men already in the Army. In this way the command recruited 1,300 enlisted men during the summer of 1942, and also obtained officers directly from civil life. Men from these sources were specially well-qualified additions to the EAC. Yet during the year and a half of its existence, out of a total of 2,899 officers, almost two thirds came from Reserve status and from officer candidate schools. Similarly, more than three fourths of the 37,651 enlisted men came from replacement training centers and reception centers. Although the OCS at Fort Belvoir gave particular attention to choosing graduates for the command, and undoubtedly some men were sent to the organization because of amphibious skills, many were completely inexperienced.[24]

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[22] (1) Ltr, Gorlinski to CG SOS, 22 May 42, sub: Orgn of EAC, with Incl, May 42. 320.3, T/Os. (2) EAC Tng Memo 1 (rev), 27 Jul 42. Tng Memos 1–30 (C).

[23] Incl to Ltr, W. W. Bessell, Jr., to C of Mil Hist, 16 Jan 54.

[24] (1) Ltr, Bessell to CG SOS, 24 Jun 42, sub: Transfer of Qualified EM to the EAC, CE. 220.31, Assignment. (2) Ltr, ACofEngrs (McCoach) to William L. Sayres, 11 Aug 42. OCE 210.3, EAC, Pt. 1. (3) Mil Tng in EAC, May 42–Apr 44, pp. 20–21. (4) Info from Maj James C. Summey, Pers Div OCE, 4 May 50.

The intelligence of the troops assigned, as measured by AGCT scores, was a matter of serious concern. Examining the scores of the first 2,788 men obtained from replacement training centers, the EAC discovered that only 49 percent had attained Grade III or better. The average figure for any normal sampling was supposed to be 69 percent. By late summer and fall the caliber of men had improved somewhat but still not enough to satisfy the command. In answer to the EAC's protests, SOS explained that it was difficult to obtain an equitable distribution from men in replacement training centers since the higher grade men were often assigned first to service schools, to officer candidate schools, or as cadre.[25]

Whatever the cause, this situation made the command's efforts to avoid dissipating the skills of personnel who were assigned all the more valuable. As a new type of unit, the brigade contained job classifications for which there were no provisions under Army regulations or which were unusual and difficult to fill. Among these were coxswains, marine enginemen, and seamen. The command, therefore, placed great emphasis on interviewing new arrivals about their experience in boat construction, operation, and maintenance. Particularly important in this respect were their hobbies, and, as the command found out later, the summer occupations of those classified as students.[26]

After men were assigned to their units, the classification office followed up to see that their skills were put to good use. At the beginning of October 1942, the classification office found insufficient correlation between the tasks for which specialists had been trained and their assignments in various units. As a result, the command decided that units might be justified in placing men in positions other than those for which they had been trained, if changes became urgent, but the command required reports in all instances where proper assignments could not be made. All specially trained individuals were to be given an opportunity to demonstrate their abilities. If there were no suitable openings in a unit, they were to be reassigned.[27]

When Noce activated the first two brigades in June, he had an eight-brigade objective to reach by February 1943. The crowded schedule allowed only four weeks for training by the EAC. The 1st Brigade had from 15 June until 15 July to organize and complete this instruction before being attached to AGF for joint training. The other brigades were to have more time for organizing but were also to be given only four weeks of instruction, according to plans drawn up in June. This program presup-

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[25] (1) Memo, Dir Mil Pers SOS for Somervell, 20 Jun 42, sub: Asgmt of EM From RCs. OCE 220.3, EAC (S). (2) D/F, Dir of Mil Pers SOS to OCE, 17 Jul 42, same sub. Same file. (3) 2d Ind, Dir Mil Pers SOS to CofEngrs, 28 Oct 42 (OCE 220.3, EAC, Pt. 1), on Ltr, CofS EAC to CG SOS, 28 Sep 42, sub: Distr of AGCT Grades. 220.01, Clas of Scores in Tests.

[26] Col. Henry Hutchings, "Classification and Assignment at the Engineer Amphibian Command," *The Bulletin* (AG Sch, Ft. Washington, Md.) II, (July, 1943), 24–27, 53.

[27] (1) Memo, Clas Off EAC for Col T. L. Mulligan G–1 EAC, 27 Aug 42, sub: Instrs on the Selection and Processing of Enl Pers for Spec Schs as Set Forth by G–1. 352, Schs, EM. (2) Rpt, Clas Off EAC [Oct 42], sub: Spec Schs Study. Same file. (3) Memo, Dir of Sch and Marine Maint EAC to Mulligan, 7 Oct 42. EHD files. (4) Ltr, Adj Hq EAC to CG 2d EAB, CO 411th Base Shop Bn, 12 Oct 42, sub: Spec Schs Study. Same files.

posed that the men would already have had basic military training.

Although the brigade was designed for both logistic and combat support, assault training received primary emphasis in the early period. This approach was partly due to the command's origin, in the need for boat crews to mount an invasion, and partly due to the necessity for hurriedly training enough boat crews to enable AGF to start instructing divisions in amphibious operations. Thus the boat regiments received preference in the assignment of personnel, and the logistic potentialities of the brigade were not completely developed until later. Even so, in the case of the boat regiments, the time was sufficient only for learning the technical aspects of handling boats. Forming the brigades into integrated units had to be left to the period of joint training with AGF troops from the Amphibious Training Center.

During the four weeks just preceding joint exercises, each unit of the brigade concentrated upon the special tasks it was to perform. Members of the boat companies learned the duties of coxswains, enginemen, and seamen. Instruction included moving in simple formation, maintaining positions in a landing wave, following other boats at night, and, finally, the process of delivering a combat regiment ashore, although without the actual troops. Since boatmen required much individual and expert attention, the command gave this training itself through its Boat Unit Detachment which contained a large number of coast guardsmen. Maintenance units received special instruction in the repair of engines and hulls at the installations along the shore and in schools conducted by the command. Quartermaster, ordnance, and medical units operated their own schedules under their unit commanders. The shore regiments, which trained under the supervision of the command, spent most of their time under the direct control of unit commanders practicing demolitions, rigging, road building, and general construction. Supply procedures remained relatively undeveloped because the shore regiments had little training in actually moving and storing supplies.

For new officers the EAC established special schools. Reserves called to active duty were given a one-week course while those directly commissioned from civilian life were given four weeks of basic instruction. In addition the officers in the boat regiment of the 1st Brigade had three days of basic piloting and navigation. Some studied advanced navigation for another week. After 21 July all officers of the boat and shore units received a one-week elementary course in navigation.

As at other Engineer training centers, the command relied on civilian and service schools. The original directives had suggested the course of instruction at the boat yard of Higgins Industries, Inc., New Orleans. Training in boat operation and engine maintenance began there in May before the command was activated. In July and August the command rapidly enlarged its use of outside agencies. It sent men to various factories to learn about diesel and gasoline motors, the construction of boats, generators, fuel injection equipment, and the repair of batteries. For training as blacksmiths, welders, armorers, cobblers, auto mechanics, and many other assorted jobs, men attended service schools outside the command. In the year and a half of its ex-

istence the command had approximately 5,600 officers and enlisted men instructed by other agencies.[28]

In the process of setting up a new training organization the command inevitably ran into problems which were aggravated by the speed with which results were expected. One of the most pressing in this early period was the scarcity of instructors. Since the Corps of Engineers could not begin to furnish all the specialists required for this complex mission, the command obtained qualified personnel wherever they could be found. The British Army and Navy provided staff officers. An officer from the U.S. Marine Corps headed the Shore Unit Section, one from the U.S. Coast and Geodetic Survey supervised the Navigation and Communications Section, and still another from the U.S. Coast Guard was in charge of the Boat Unit Section. The Coast Guard also supplied about one hundred enlisted men to give technical instruction in boat operation and maintenance. Infantry, Coast Artillery Corps, and Signal Corps officers directed respectively maintenance, weapons, and communications training. When recruits arrived without basic training—as they did in spite of plans to the contrary—instructors were obtained from the ERTC's at Fort Leonard Wood and Fort Belvoir. Because of the specialized nature of training, the scarcity of instructors, and a shortage of boats, the command conducted much of the training itself rather than leave it to the individual units. As a result, by September, personnel in command headquarters had increased to more than twice as many as the 683 authorized in May.[29]

All instructors were hampered because training had to begin before essential preparations could be made. Except for the boat regiment, T/BA's were not available at first, and organizational property came in slowly. A lack of training literature made it necessary to prepare this material as training progressed. Constructing training aids, assembling equipment, and improving camp sites took time, while constant attention to the organizational problems of a new installation hindered supervision. The necessity for training men who had previously been conditioned for entirely different tasks and who had to adjust to a new mission presented an intangible but nevertheless serious obstacle. The 1st Brigade obtained 2,269 men from existing units, the 87th Engineer Heavy Ponton Battalion forming the basis of the shore regiment and the 37th Engineer Combat Regiment of the boat regiment.[30]

By the end of June, both officers and men were discontented and confused. They complained of a "lack of knowledge of their immediate goal" and of "relative inefficiency in the work." Trudeau had to assure them that their training had a definite

[28] (1) Info from Col R. C. Brown, formerly CO of the 531st Boat and Shore Regt, 31 May 50. (2) Memo, Trudeau for Staff Offs EAC All Unit Comdrs, 21 Jul 42. 220.31, Assignment. (3) Ltr, Higgins Industries, Inc., New Orleans, La., to Maj H. W. Quinn, SOS, 1 Jun 42. EHD files. (4) Ltr, Dir Tng and Opn EAC to Det CO Lincoln Recreational Area, 4 Jul 42, sub: Higgins Boat Sch for Amph Comd Pers. Same files. (5) Memo, Dir Spec Tng EAC for G–4 EAC, 12 Aug 42. 352, Offs Spec Sch Course. (6) Incl 1, Offs and EM Who Have Completed Spec Tng to Date (Other Than EAC Schs) Final Rpt, 28 Feb 44, to Ltr, Hq EAC to CofEngrs, 1 Mar 44, sub: Final Rpt on Schs of the EAC. P&T Div file, EAC—Gen.

[29] (1) Memo, Maj V. D. Whatley, Tng Div SOS, for Dir of Tng SOS [30 Jun 42], sub: Tng Inspec, EAC, Camp Edwards, Mass. 320.2, EAC Activation. (2) Tel Conv, Bessell and Mulligan, 30 Jul 42. 320.2, Cadre. (3) Ltr, CO EAC to CG First SvC, 27 Jul 43, sub: Pers Authorization Limits, 320.2, EAC Activation and Orgn. (4) Memo, Dir Mil Pers SOS for CofEngrs, 29 May 42, sub: Allot of Grades and Authorized Strength, Hq and Hq Co, EAC. OCE 353, EAC (S).

[30] Memo cited n. 29 (1).

bearing on vital future operations, that the "entire project . . . merely expressed in a few paragraphs as an idea, and an incomplete one at that, only six weeks ago," had been developed so that "Tables of Organization, equipment, men, and installations have been set up and training is progressing at a rapid rate." He readily acknowledged the existence of problems in navigation and communications and solicited ideas on how to solve them. Cautioning against looking at the picture with a "worm's-eye-view," he urged full and complete co-operation.[31]

It was natural that the men should be disgruntled, considering the equipment shortages and the slow rate of speed with which training progressed. The 1st Brigade, aware that it had only four weeks in which to prepare for joint training with AGF troops, had its boat instruction cut in half during the first week for lack of boats. Moreover, the men had reason to believe that the types of craft assigned were not ideal for the mission. For a short time it had appeared that the EAC would be allowed to man the 105-foot tank lighter (LCT), a craft which was much larger than the small boats definitely authorized for the EAC and smaller than the seagoing vessels that would unquestionably be operated by the Navy. On 21 May 1942 the Corps of Engineers received word that the Navy had agreed that EAC crews should man this craft. But a week later, in a conference with Vice-Admiral Lord Louis Mountbatten in London, Somervell indicated that the Navy would man the LCT after all. On 11 June, one day after the activation of the command, the Engineers reopened the question of whether the EAC, charged with shore-to-shore operations, should not man the LCT. To their amazement, they learned that the Navy had issued instructions for the training of crews in all types of landing craft for the coming invasion. By mid-June Somervell reached an agreement with Admiral King that the Army would train boat crews for all landing craft except LCI's (153 feet) and LST's (316 feet). This agreement was short-lived. On 29 June the Engineers received word from SOS that the Navy would be charged with the "procurement, training of crews, manning, and maintenance of the 105 foot tank lighter." [32] They also learned that "as soon as possible, the Navy will infiltrate into the Army Amphibious Training Camps and if sufficient progress is made by the Navy, they may later take over the entire project." [33] Thus, by the end of its first month, the Engineer Amphibian Command had to face the prospect that the Navy might operate all boats in the invasion.

In addition to the uncertainty over when or whether the Navy would take over the operation of all landing craft, the command began to worry over shrinkage in the size of its task. The disappointing rate of production of landing craft had led AGF to revise its estimates of the total number of divisions it could hope to have ready by February 1943. The number of engineer amphibian brigades would necessarily be lowered. On 1 July 1942 the General Staff reduced AGF objectives from twelve to eight divisions. Two days later Sturdevant called for a clear statement of policy. Morale was endangered. The command had already been activated. Training had begun.

[31] EAC Cir 10, 3 Jul 42. Cirs—1942.

[32] 1st Ind, Brig Gen LeRoy Lutes, Dir Opns SOS, to CofEngrs 29 Jun 42, on Ltr, Sturdevant to CG SOS, 25 Jun 42, sub: 105-foot Tank Lighters (Navy YTL). File 1 (S).

[33] 1st Ind, Lutes to CofEngrs, 17 Jun 42, on Ltr, Sturdevant to CG SOS, 11 Jun 42, sub: Opn of 105-foot YTL Landing Craft. File 1 (S).

Several hundred thousand dollars had been spent for construction and more installations were planned. Two boat yards had been leased. Commitments had been made in recruiting officers and men. Sturdevant asked that all doubts as to the disposition of the command be removed. If changes were to be made, they should be executed promptly. If all action was to be stopped, then it should be stopped immediately. Although no definite answer was as yet forthcoming on who would man the landing craft in the cross-Channel attack, SOS informed the Chief of Engineers on 17 July that the command would henceforth train only three brigades plus a 50 percent reserve. The reserve was to be organized into two brigades, making the Engineer objective five instead of the eight previously authorized.[34]

Although the command faced a somewhat smaller task, it was still a difficult one. By 1 July the command had received 253 craft of various types, including 47 assorted secondhand boats purchased from private owners for employment as control craft. Ten days later it had 244 of the 36-foot landing craft and 5 obsolescent tank lighters, of which 60 percent were to be allocated to AGF training on 15 July. On 14 August there were in all 252 of the 36-foot craft, 30 tank lighters, and 47 control boats. This total, while close to EAC requirements, also had to be used during joint training.[35]

The boats were in such demand that there was little time for preventive maintenance. They were operated two or three shifts a day, sometimes at night, and even during off-duty hours, for the command wished its men to use them as much as possible during the brief training period. Furthermore, the 1st Brigade was so rushed that there was hardly enough time to give it instruction in the care of boats. A representative of The Inspector General suggested that maintenance procedures could be improved by fixing responsibility for each boat on one man. In August the command did assign responsibility to one coxswain and one engineman, but the constant use to which the craft were put made it impossible to hold any particular man or crew accountable. A further complication lay in the lack of standardization among the boats, which made the procurement of spare parts even more difficult in an already tight market. The 3d Brigade, activated at Edwards in August, just after the 1st Brigade shipped out, ultimately obtained enough craft but had difficulty keeping them running. More than half were out of commission in December, chiefly because there were no spare parts.[36]

The various hardships, such as shortages of equipment and the scarcity of instructors, took their toll on the organization. When the Inspector General's Department made an automotive and boat inspection near the end of July, the inspecting officer concluded

[34] (1) Memo, G–3 for ACofS OPD, 18 Jun 42, sub: Alloc of Landing Craft for Tng in U. S., with Incl, 7 Jun 42. OPD 353, Amph Forces, Sec. 1 (S). (2) Memo, G–3 for CG SOS, 1 Jul 42, sub: Orgn and Tng of Amph Forces. Same file. (3) Ltr, Lutes to CofEngrs, 17 Jul 42, sub: Amph Tng. File 1 (S).

[35] (1) Incl, 25 Jun 42, to Memo, ACofS EAC for OPD, 25 Jun 42. Misc Ltrs IV (S). (2) Ltr, Trudeau to CofEngrs, 11 Jul 42, sub: Availability of Landing Craft. 561.1, Requests or Requisitions for Vessels (C). (3) Rpt, Dir Tng and Opn EAC to CO EAC, 14 Aug 42, sub: Status of Boats, 14 Aug 42. 560, Vessels, All Kinds.

[36] (1) Ltr, Proc and Sup Sec Hq EAC to CO EAC, 15 Aug 42, sub: Boat Maint. 560, Boats, Barges, Vol. I. (2) Memo, Brig Gen D. A. D. Ogden for EHD, 8 May 50, sub: The EAC. (3) 6th Ind, Noce to CG SOS, 3 Feb 43, on Ltr, Noce to CG SOS, 23 Dec 42, sub: Failure of Sup Sources for Marine Engine Parts. 412.5, Engines, Motors, Parts of (S).



LANDING CRAFT OPERATED BY ENGINEER TROOPS *in a training exercise, Camp Edwards, Mass., 1942.*

that the whole command showed the effects of forced development. "Plans have not been well thought out far enough in advance of their execution," he observed. "The result has been general confusion and great expense. From results so far obtained, it is questionable whether the rapid development and expense involved are warranted." [37] In reply to The Inspector General, the command pointed out that even the best of plans could not be executed satisfactorily without thoroughly trained men, and noted with some pride that the 1st Brigade had moved overseas within six weeks of the time it was organized.

The 1st Brigade had become available for joint training with the Amphibious Training Center on schedule in mid-July, but its instruction had hardly begun when it was alerted for overseas movement to the United Kingdom. It moved on an emergency basis, with Somervell giving special attention to its equipment. There was some uncertainty in the command as to how the brigade would be employed. On the one hand, the 36-foot and 50-foot craft prescribed for it were not suitable for a cross-Channel invasion from the United States sector in Britain, the area from which they apparently would have to embark under existing plans. On the other hand, the brigade had not been trained in ship-to-shore operations, for which these craft could be used. Further training in England would be necessary, whatever the nature of the task assigned, and the EAC expected to continue to carry this responsibility through an advance EAC headquarters sent over with the 1st Brigade. But when the 1st Brigade arrived in the United Kingdom in mid-Au-

[37] Ltr, IGD to TIG, 10 Aug 42, sub: Automotive and Boat Inspec, EAC, Camp Edwards, Mass. 333, Inspecs and Investigations by IG and Other Official Rpts.

gust the whole picture had changed. Great Britain and the United States had given up the idea of any cross-Channel invasion in 1942, and agreed instead on a North African operation for which the Navy was to provide crews in a ship-to-shore movement. Eisenhower had placed the Navy in charge of all amphibious training in the European theater. The Navy could see no need for any organization larger than a battalion, nor for any additional brigades. Only with the strong backing of Army officials did the brigade headquarters avoid extinction. The 1st Brigade was never used as originally planned. The boat regiment was eventually disbanded, and the combat engineers who had become boatmen became in turn stevedores and finally combat engineers again. The brigade's major function was henceforth to be shore operations in North Africa, Sicily, Italy, Normandy, and finally Okinawa.[38]

As a result of the shift in operational plans, the War Department changed the EAC's objectives once again. On 17 August 1942, SOS informed the Corps of Engineers that instead of training five brigades they were to train only three. Of the two remaining in this country, one—preferably the 2d—would probably be assigned to AGF for training divisions. The other brigade would be employed overseas in any task forces that might be organized. If more brigades were ultimately needed, the AGF training unit could furnish cadres.[39]

Although requirements for engineer amphibian brigades had been reduced, this did not alter the tight time schedule for those brigades which remained authorized. In July, after only four weeks of instruction by the EAC, the 2d Brigade, still understrength, replaced the 1st in joint training at the Amphibious Training Center. After its activation in early August, the 3d Brigade had three months for training before being attached to AGF, but four weeks of this time were consumed in giving basic training to enlisted men, many of whom had come to the command from reception centers. Both the 2d and 3d Brigades suffered from the removal of large numbers of troops for the North African campaign. In this process the 3d Brigade's shore units were severely depleted in order to furnish replacements for the 2d. At the end of August the command extended the four-week training program under which it began instruction to five weeks in order to include general subjects suggested by OCE, but the time allotment was still insufficient to produce well-trained units.[40]

The withdrawal of partially trained troops to meet urgent overseas requirements concerned the Amphibious Training Center of AGF as well as the Engineer Amphibian Command. The instruction of divisions by the AGF center was dependent upon the boats, crews, and shore parties provided by the command. When the 1st Brigade moved overseas, the Amphibious Training Center

[38] (1) Memo, Noce for Lt Col R. R. Arnold, 30 Jul 42, sub: Status of the EAC in the U.K. 370.2, Obsvns Rpts on Trps (S). (2) Memo, Arnold for Noce, 25 Jul 42, same sub. Same file. (3) Interv, Trudeau, 3 Jun 50. (4) Memo, C of Engr and Dev Br OCE for Noce, 21 Aug 42, sub: Amph Tng. 353, Tng Rpts of (S). (5) ACofS EAC, Diary of Advance Echelon, 4–15 Aug 42. Personal files, Col Henry Wolfe. (6) Heavey, *op. cit.*, p. 37.

[39] Ltr, Lutes to CofEngrs, 17 Aug 42, sub: Amph Tng. EHD files (S).

[40] 1st Ind, 17 Nov 42, on Ltr, C of O&T Br OCE to CG EAC, 12 Nov 42, sub: Senate Investigation of Amph Trps. 322, Orgn Activation Disbandment of Units (S).

had to rely upon the inexperienced 2d Brigade for joint training. Late in the summer the Amphibious Training Center faced a similar situation when men from the 532d Shore Regiment shipped out for the North African campaign. Although the EAC had no control over these troop movements, such transfers became a source of irritation between the two installations.

Even more irritating, from the point of view of the AGF center, was the EAC's practice of rotating boat and shore battalions for short periods during joint training. This arrangement stemmed entirely from the shortage of boats and was the only practical way that the EAC could provide instruction. Although the system served to train successive increments of the brigades, it meant that AGF troops never had a well-trained unit to work with. Each increment was as green as the one before.

The directive of 17 August had earmarked the 2d Brigade for assignment to the Amphibious Training Center for indefinite duty as a training adjunct to AGF. The Engineers, however, insisted that all of the brigades must have this experience, that none should be delegated for this duty alone. In view of the scarcity of boats, which made the rapid rotation of units unavoidable, the existing system must be continued. The War Department shifted once more to the support of the Engineers—for the time being.[41]

Beginning on 18 August the 2d Brigade engaged in a three-day exercise with the 45th Infantry Division. There were enough boats to carry only one regimental combat team and selected elements from the rest of the division. The results of this maneuver, closely paralleling the earlier experience of the Navy, were unsatisfactory. The brigade failed to land boats on the right beaches at the right time. The need for more intensive training, particularly in navigation, was obvious. In an effort to provide competent navigators, the EAC investigated U.S. Navy and British practices and established a school for officers at Harvard University. After conferring with leading American industrialists on the development of navigational aids, the EAC adopted extensive new equipment and laid particular stress on training in its use.[42]

Having acquired considerable experience in training for amphibious operations by the end of the summer, the EAC began to devote more attention to the selection of equipment and to the refinement of organization and techniques. There was dissatisfaction with the 36-foot boats. They should be faster. The personnel carrier, LCP, was particularly objectionable because its ramp was so narrow as to restrict the speed with which troops could unload, thus unduly exposing the men to enemy fire. Trudeau informed the Navy in August that the cargo carrier, LCV, was much preferred. The LCV was a seaworthy boat with maximum deck space and had an armor-plated ramp for frontal protection. Modified to provide even greater protection and to accommodate the ¾-ton weapons carrier, the LCV

[41] Memo, Asst Ground AG for CofS U.S. Army, 28 Aug 42, sub: Availability of Engr Trps for Amph Tng Comd, with 2d Ind, O&T Br OCE to CG SOS, 7 Sep 42. OCE 370.5, EAC (C).

[42] (1) Rpt, Lt Clarence A. Burmister U.S. Coast and Geodetic Survey, sub: Rpt on Results of Conf With U.S. Navy Officials at Washington, D. C., 16–27 Aug 42. File 2 (S). (2) Rpt, CG EAC, 26 Jan 43, sub: Rpt on Secret Mtg for Purpose of Obtaining Additional and Improved Navigational Aids for Shore to Shore Amph Opns. 413.44, Wireless Radio Instruments Supplies for (S). (3) Memo, Ogden for EHD, 8 May 50, sub: The EAC.



ENGINEERS PLACING SOMMERFELD TRACK ON THE SAND *as a road expedient for vehicles coming ashore from landing craft.*

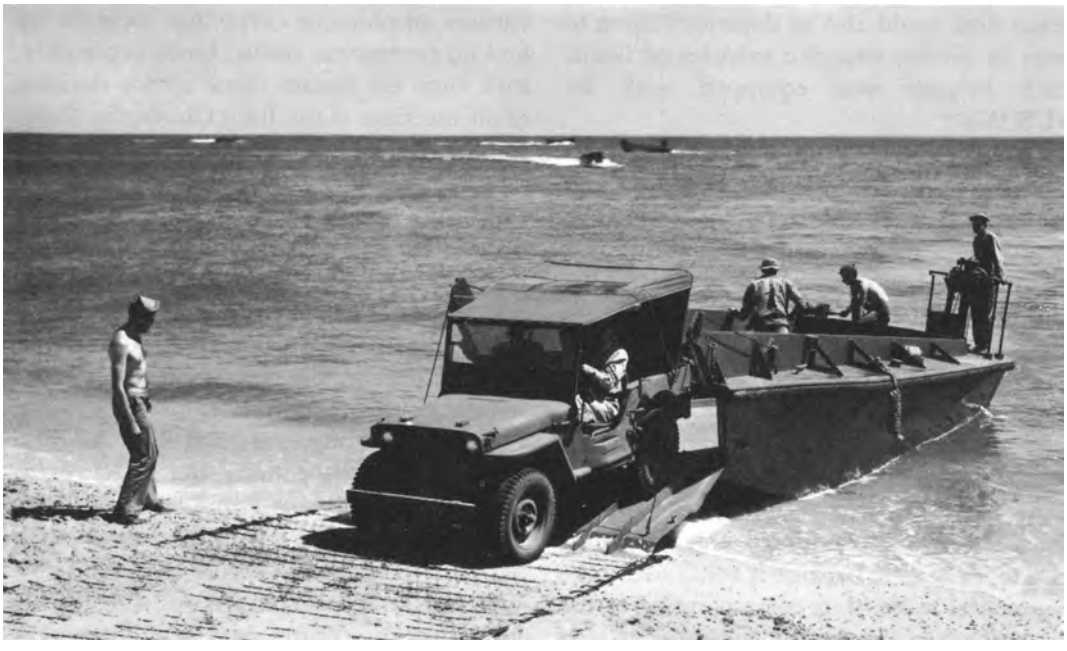
became the combined troop and cargo carrier, the LCVP.[43]

Late in August the EAC established the Development Section, which conducted a series of tests of equipment and procedures for bringing ashore great quantities of matériel and organizing its flow across the beach. Tracked vehicles could navigate across sand without difficulty, but trucks and jeeps required some expedient roadway. To provide such surfacing the Development Section compared various landing mat materials as to facility of transport, rapidity of laying, strength, durability, and ease of camouflage. Cyclone chain link fencing proved the most universally acceptable type of road expedient. In addition to the readiness with which it could be transported and handled, it had a resilience which obviated the need for fastening it down.[44]

Although most cargo would be discharged direct from landing craft onto the beach, it was realized that some craft might become stranded on offshore bars necessitating unloading their cargo and transporting it for a short distance through the water. For this purpose the Development Section tested two amphibians, the Alli-

[43] (1) EAC Dev Bd Rpt 123, 23 Dec 42, sub: Gen Rpt on Cargo Handling. (2) Memo, Trudeau for Noce, 28 Aug 42. 561, Acquisition and Constr of Vessels. (3) Memo, Trudeau for Gen Keating, 14 Sep 42. Same file. (4) Tentative Tng Guide 1, Hq EAC, Feb 43, sub: Engr Amph Trps, Gen. (5) 2d Wrapper Ind, Trudeau to CofEngrs, 1 Sep 42, and 6th Wrapper Ind, Trudeau to CofEngrs, 21 Oct 42, on Ltr, C of Trans to Vice C of Nav Opns, 10 Aug 42, sub: 1942 Rqmts of Standard Landing Craft for EAC. File 2 (S).

[44] (1) EAC Dev Sec Rpt 124 [15 Mar 43], sub: Test of Road Expedients. (2) Tentative Tng Guide 7, Hq EAC, May 43, sub: Engr Amph Trps, Orgn of the Far Shore.



JEEP LEAVING LANDING CRAFT *comes ashore over Sommerfeld track in a training exercise, Camp Edwards, 1942.*

gator, a tracked vehicle, and the DUKW, a wheeled vehicle, in addition to several other means of transport such as the standard assault boat and pneumatic cargo raft. The tests revealed the Alligator to be a very good vehicle, but the DUKW was even better. The DUKW had been developed under the guidance of the NDRC around the standard 2½-ton truck. It was thus basically a proven mechanism which was being produced in quantity, with which there was widespread familiarity, and for which there was a relatively plentiful supply of spare parts. Its tires were of a special design for rapid travel over sand. It was apparent as tests proceeded under the guidance of the NDRC that the DUKW would be extremely useful in unloading freighters anchored at some distance from the beach. In a final demonstration on 8 December 1942, eight DUKW's carried 80 tons of dummy cargo from a Liberty ship anchored one mile offshore to a supply dump some 1,900 yards inland. Speed through the water was slow, about five knots, but on land the DUKW could make 50 miles an hour carrying as heavy a load as its truck prototype. The fact that the DUKW could proceed with its cargo across the water, over the beach, and straight to a dump more than made up for its slowness in the water and conserved manpower which would ordinarily be diverted to unloading and loading at the waterline. The DUKW exhibited the precious military virtue of versatility. Equipped with an A-frame, as one in three eventually was, it could substitute for the less maneuverable standard truck crane. The DUKW's rear winch, most commonly employed to drag along extra cargo by

beach sled, could also be depended upon to assist in towing stranded vehicles or boats. Each brigade was equipped with 36 DUKW's.[45]

The command found during joint training with AGF that one boat battalion and one shore battalion were normally assigned to support a regimental combat team. By uniting the boat and shore elements, the command believed it could provide an integrated unit for the combat team leader. On 5 September 1942 Noce asked permission to reorganize one brigade experimentally into three amphibian regiments, each regiment to consist of a boat battalion, a shore battalion, and regimental headquarters. The EAC considered this organization more flexible because it contained three regimental staffs, thus corresponding to the infantry division's major subdivisions and facilitating independent operation by combat teams. Once an entire division had made a crossing, the brigade commander could unite all the shore battalions under a single command. The War Department authorized this reorganization first for the 2d Brigade, and then for the 3d Brigade when it was scheduled for joint training.

Continued Threat From the Navy

The EAC had grown out of the Navy's inability to assume the training of a large number of boat crews in a limited space of time for a specific operation.[46] The Navy continued to consider the operation of boats its proper sphere and thought of the EAC's shore-to-shore boat units as temporary, stopgap organizations. While affirming tentatively in early June 1942 that the boat units for the European invasion would be under Army control, the Navy would not make the agreement final. As a result, the various amphibious corps that were set up had no permanent status. Until September, each time the matter came up for decision at the meetings of the Joint Chiefs, the Navy, stalling for time, managed to defer any signing until the next meeting.

By mid-June the Navy felt confident that no shore-to-shore invasion of Europe would take place until 1943, despite the President's insistence that some offensive move should be made during 1942. Given this additional time, the Navy believed it could handle the training of shore-to-shore crews. On 12 June, King instructed Rear Admiral Henry K. Hewitt, commander of the Atlantic Fleet Amphibious Force, to assume this obligation and give it priority over all other activities. This was the order that had fallen with such weight upon the EAC shortly after its activation. Three days later Somervell reached a compromise with Vice Admiral Russell Wilson, in the absence of King, that the Engineers should continue with the training already started, including that for the 105-foot lighters. All plans for the Carrabelle center would be suspended while Army and Navy representatives worked out plans for a combined training program at Edwards. Since the Navy would not take drafted men, the transfer into the Navy of

[45] (1) For details on the DUKW, see James P. Baxter, III, *Scientists Against Time* (Boston: Little, Brown and Co., 1946), pp. 243–51. (2) Directive, Trudeau for Opns Off EAC, 3 Nov 42. 354.1, Provincetown (S). (3) Tentative Tng Guide 7, Hq EAC, May 43, sub: Engr Amph Trps, Orgn of the Far Shore. (4) EAC Dev Bd Rpt 123, 23 Dec 42, sub: Gen Rpt on Cargo Handling. (5) Rpt on Cargo Unloading by 2½-Ton DUKW.

[46] This section is based primarily upon the following files: (1) ABC 320.2, Amph Forces, Sec. 1 (3–13–42) (S); (2) OPD 353, Amph Forces, Secs. 1, 3; (3) 337, Confs Mtgs and Other, 1942–43 (S).

those units already organized by the Army would have to be arranged later.[47]

G–3 was confused. On 18 June Brig. Gen. Idwal H. Edwards requested OPD to clarify the muddle. Maj. Gen. Thomas T. Handy, chief of OPD, replied on 26 June that apparently both the Army and the Navy had assumed responsibility for training all landing craft crews for the coming invasion:

> The question as to whether the Army programme will be interrupted, in view of the instructions promulgated by the Navy, must be held in abeyance pending a decision by the Joint Chiefs of Staff. No conference on this point is contemplated until the week of July 6, 1942 pending the return of Admiral Hewitt from the U. K. The Army will carry on its programme without any change until such time as the J. C. S. settle the existing differences.
>
> The Navy is not in a position, however, to obtain crews for such a force with their present personnel procurement methods, and they realize that much depends upon the decision of the Joint Chiefs of Staff.[48]

By 27 June the Navy was prepared to furnish the crews for the 105-foot lighters and requested permission from OPD to do so. After consultation with Somervell and Sturdevant, all agreed that the Navy should take over. This left open for decision, pending Hewitt's return, the question of training crews for the smaller craft. At a conference held on 8 July in Handy's office, Hewitt reiterated that he was acting under orders from King to train all landing craft crews for the European invasion, but admitted that the Army would have to furnish some of the personnel. He presented a plan by which the Navy would train officers and men in boat operation, leaving the training of shore parties and divisions to the Army. Hewitt insisted that training boat crews was a function of the Navy, asserted that the British preferred naval personnel for this work, and expressed a fear that Army-trained personnel might not be able to cooperate fully with the Navy, particularly in communications and navigation. He also emphasized the difficulties of navigating the Channel in small boats. The SOS representative conceded that boat operation belonged to the Navy, but felt that before the Navy took over it should catch up with the Army.[49] Handy interposed rather testily that everyone seemed to agree that crew training was a responsibility of the Navy. "If this issue could have been settled six months ago, there would be no argument at all. However, it is now July, and the Army has progressed very satisfactorily on this project. It is not believed that it would be sound for the Navy to take over the providing and training of smaller craft at this time." [50] In the end the Navy was given the choice of both providing and training all landing craft crews or leaving the training in the existing divided system, with the Army providing and training the crews for the smaller craft.

The EAC had meanwhile begun to evolve a justification for its existence, a natural outcome of the development of an *esprit de corps*. The training process had created a group of men who were interested in maintaining their organization and who were

[47] (1) Matloff and Snell, *op. cit.*, pp. 221–22, 231–44. (2) Cline, *Washington Command Post*, pp. 163–64. (3) King and Whitehill, *op. cit.*, pp. 390–97. (4) Eisenhower, *op. cit.*, pp. 38–39.

[48] Memo, Handy for G–3, 26 Jun 42, sub: Alloc of Landing Craft for Tng in the U. S. OPD 353, Amph Forces, Sec. 1 (S).

[49] Memo, Mob and Opn Sec OCE for C of O&T, 9 Jul 42, sub: Conf in Gen Handy's Office, 7–8–42, re Amph Opn. OCE 353, EAC (S).

[50] Memo for Record, Lt Col Edward B. Gallant, 8 Jul 42, sub: Conf Amph Tng, 8 Jul 42. OPD 353, Amph Forces, Sec. 1 (S).

able to buttress their views through the experience they had gained. In the discussions of responsibility for amphibious training, Navy representatives had centered their arguments on the operation of boats, leaving shore operations to the Army. The Navy thereby provided the basis for the EAC's defense—unity of command. The EAC emphasized that brigades permitted the massing of large numbers of troops over small bodies of water with one organization responsible for transportation, organizing the beaches, and moving supplies inland. As Army units they could be integrated into a single command, whereas in combined Army-Navy operations the demarcation between Army and Navy functions at the shore line constituted a weakness at the most critical point. The Navy's doctrine in ship-to-shore operations violated the principle of unity of command on the far shore. While the naval section of a shore party was in the main answerable to the shore party commander, it reported directly to the naval force commander for certain functions. This made for divided authority on the enemy shore. Opposition by Marine Corps officers to this aspect of the Navy's doctrine strengthened the Engineer point of view.[51]

By 18 July the Navy had made its choice. At a joint Army, Navy, Marine Corps conference all consultants agreed that the *status quo* should be maintained. The EAC should train the crews for the 36-foot and 50-foot boats. The Atlantic Fleet Amphibious Force should train the crews for all larger craft. To insure co-ordination, Hewitt was to appoint a board consisting of officers from the EAC, the Amphibious Training Center, the Atlantic Fleet Amphibious Force, and the British Combined Operations Staff in the United States.

After receiving concurrence from Eisenhower in early August, the Joint Planners included this agreement in the revised overall amphibious plans that had remained unsigned by the Joint Chiefs since June. By 11 August the signing appeared to be a mere formality since Marshall and King had both unofficially approved. Steps had already been taken to form the various amphibious corps for ship-to-shore training and Hewitt was in the midst of appointing the board to co-ordinate all shore-to-shore training. But as the month of August wore on, King continued to ask for deferment and further study.

By early September when the Joint Chiefs finally signed the full plans for the organization of amphibious forces the strategy for invasion had shifted from a shore-to-shore operation against Europe to a ship-to-shore movement in North Africa. The Navy would obviously play the leading role. The controversial section on shore-to-shore training was deleted from the signed document and a very generally worded section took its place:

> Amphibious operations are essentially the responsibility of the Navy. Until such time as the Marine Corps can be expanded to fulfill necessary requirements for present and projected strategy, it is recognized that selected Army units must be made available for training and participation in amphibious operations.[52]

The wording of this document led to some confusion as to the status of the Engineer Amphibian Command. The Engineers

[51] (1) Arthur G. Trudeau, Amphibian Operations, lecture to 45th Div, Camp Edwards, Mass., 27 Jul 42. 350.001, Lectures. (2) Memo, Noce for CofEngrs, 16 Oct 42, with Incl, 15 Oct 42. 353, Tng Rpts of (S).

[52] Note by the Secretaries, Joint U. S. Chiefs of Staff, JCS 81/1, 5 Sep 42, sub: Distr and Composition of U.S. Amph Forces. ABC 320.2, Amph Forces, Sec. 1 (3-13-42) (S).

jumped to the conclusion that the Navy was to control shore-to-shore as well as ship-to-shore operations. Attempts by the command to obtain advice from the commander of the Atlantic Fleet Amphibious Force on training areas and types of instruction met with no response. In October, Trudeau found that Capt. Daniel E. Barbey, King's chief assistant for amphibious matters, interpreted the word "amphibious" to mean ship-to-shore operations only. The command requested immediate clarification. Meanwhile, the JCS enunciation of policy had led to some uncertainty in the War Department itself as to plans for the command's future.

Indecision in the War Department General Staff was apparent when it became necessary to find a training area for the 3d Brigade. Camp Edwards was not suitable for winter training. The Carrabelle camp was soon to be the home of the Amphibious Training Center with the 2d Brigade stationed there for joint training. The limited facilities at Carrabelle and other unsatisfactory conditions, such as the lack of surf, made another site desirable for the 3d Brigade. The EAC chose St. Catherine's Island, Georgia, and recommended it to the General Staff. Two factors militated against this proposal. AGF questioned the establishment of another base, and early in October G–3 indicated that there seemed to be no immediate need for the brigade. The inability of the General Staff to make up its mind on the disposition of the 3d Brigade led SOS on 17 October to order the winterizing of Camp Edwards. A week later growing indications of a demand for amphibian brigades in the Southwest Pacific culminated in a decision to ship the 2d Brigade to that theater. This action released space at the Carrabelle camp for the 3d Brigade but once again a green unit went into joint training with AGF. Although G–3 on 24 October confirmed the command's objective of three brigades and stated that it could not foresee the activation of additional units, the command realized that demands from the theaters of operations would determine future expansion.[53]

Emergence of the Southwest Pacific Requirement

The extreme likelihood that engineer amphibian brigades would be used in the Pacific was apparent from the very beginning of their organization.[54] Sturdevant had pointed out that they could be employed in that area for "envelopment of hostile flanks secured by coast lines and for crossing wide rivers and estuaries." [55] The War Department had indicated that it considered the twelve divisions which were originally to be given shore-to-shore training as providing for Pacific operations too.[56] But because over-all strategy was focused on the defeat of Germany, the EAC did not center its attention on the Southwest Pacific until plans for employment of the brigades in Europe had been scrapped.

At the same time that Allied strategy for the war against Germany shifted to the

[53] (1) Ltr, Noce to CofEngrs, 5 Oct 42, sub: Winter Tng 3d EAB. 353, Tng, 1942. (2) Tel Msg, Lt Col V. D. Whatley, SOS, for Trudeau, 17 Oct 42. 370.5, Asgmt Change of Station. (3) Memo, AC of S G–3 for CG SOS, 24 Oct 42, sub: Disposition of Amph Trps. Directives (S).

[54] Unless otherwise cited, this section is based upon: (1) SWPA (S); (2) 560, Vessels Boats Barges (S); (3) 322, Orgn Activation Disbandment of Units (S).

[55] Memo, Sturdevant for CG SOS, 2 Jun 42, sub: Rqmts of Sv Units Which Should be Activated by 31 Dec 42. EHD files (S).

[56] Min Joint Mtg Army, Navy, and British Offs on BOLERO, Washington, 5 Jun 42. File 1 (S).

employment of naval amphibious units, the war in the Pacific unexpectedly picked up momentum. The Joint Chiefs had not planned for any major offensive in the Pacific until 1943, but by midsummer of 1942 conditions were propitious for a drive against the island outposts of the Japanese. Here too the Navy had the primary responsibility for amphibious operations. The Army was at a disadvantage since the 1st Marine Division was the only unit in the Pacific that had the training and equipment for amphibious landings. Moreover, the naval plan to invade the southeastern Solomons and then begin a series of amphibious assaults against the islands of the Central Pacific became accepted strategy, with over-all control being vested in Nimitz. Amphibious operations in the Southwest Pacific under MacArthur would be dependent upon naval successes. The agreement on the composition and disposition of amphibious forces issued by the Joint Chiefs on 5 September which had made the Navy responsible for amphibious operations left unsettled the organization of amphibious forces for the Southwest Pacific. An Army amphibious corps of two divisions would probably be provided for ship-to-shore landings. Command was not specified. Units for shore-to-shore operations were not mentioned.[57]

The EAC, as an Army training organization, seemed doomed if the Navy was indeed to take over all amphibious instruction. But a chance bit of information picked up at just the right moment turned the EAC's efforts toward a plan which, if successful, would bring about a revival of the Army program. On the evening of 7 September Trudeau, on temporary duty in Washington, learned from Col. Walter E. Todd of OPD that the Navy proposed to send only sixty landing craft and crews each month to the Southwest Pacific in support of MacArthur. The number of boats was limited by the fact that they could not be stowed in the holds of any of the ships available. Deckloading this number each month on transports and freighters bound for Australia meant that at the end of a year MacArthur would have barely enough boats to move the combat elements of one division. The extensive island-to-island and outflanking maneuvers which the geography of the region dictated could scarcely be supported by such inadequate amphibious equipment.

Trudeau's agile mind immediately began to put this fortuitous piece of information to work in attaining his immediate goal of salvaging the EAC. By the morning of 8 September he was ready with an imaginative plan by which he believed the Army could furnish MacArthur with enough 36-foot boats for two divisions within 120 days. The boats would be prefabricated in sections and transported in ships' holds to an assembly plant which EAC personnel would establish somewhere in the Southwest Pacific.

After sending Somervell a skeleton outline of his plan, Trudeau spent the rest of the day contacting people who would have information on the number of small boat yards in Australia and the approximate amount of skilled labor he could rely upon there. To 1st Lt. Harry D. Hoskins he entrusted a secret mission to New Orleans, "ostensibly for an inspection of our training activities with Higgins Industries." But

[57] (1) King and Whitehill, *op. cit.*, pp. 382–89. (2) Isely and Crowl, *op. cit.*, pp. 86–98. (3) Note by the Secretaries, Joint U.S. Chiefs of Staff, JCS 81/1, 5 Sep 42, sub: Distr and Composition of U.S. Amph Forces. ABC 320.2, Amph Forces, Sec. 1 (3–13–42) (S).

"the real purpose of your mission is to find out for me the practicability of having all necessary materials, including hardware, boxed and crated for shipment overseas, with a view to assembling landing craft in any theater of operations." From observations at the Higgins plant, Hoskins was to decide whether sections of the boat could be "cut, baled and shipped" as Trudeau hoped, or whether uncut materials would have to be shipped in bulk. In either case Hoskins was to estimate how many men it would take to establish an assembly line capable of producing 10 to 25 boats a day. Trudeau impressed upon his emissary the magnitude of the scheme, the production of perhaps 2,000 boats, "rapidly and with assurance, if we are given the go ahead." Hoskins was to secure the information "without disclosing your purpose to Higgins Industries at this time, or to any of our personnel at New Orleans." [58]

By 11 September Trudeau had found out what he wanted to know about Australian facilities. A member of the Australian Purchasing Commission verified the fact that the few Australian boat yards were quite small, capable of building only two or three boats at a time. Neither boat yards of sufficient size nor skilled workmen in the numbers required would be available. A plant would have to be built or remodeled and labor familiar with assembly line techniques imported. The Australian advised the use of military units for this work, not American civilians.

Hoskins came back from New Orleans a few days later with rough sketches of the Higgins plant assembly floor, a wealth of statistics on employees, their skills, shifts and hours worked, and tools and techniques employed. He described to Trudeau in minute detail the step-by-step production of an LCVP from framing the wooden hull on templates to the final painting and welding on the metal ramp. Hoskins was convinced that the LCVP could be shipped in sections and assembled in the theater. With this knowledge at his command, Trudeau, back at Edwards, made up an impressive report which he sent to Somervell on 15 September, one week after submitting his first brief outline.

Trudeau estimated that by stowing the baled parts below deck, a single freighter could transport as many as 1,000 landing craft. Since it would be far too dangerous to entrust this much equipment to a single ship, the sections would of necessity be divided among several vessels. The same number of ships which were scheduled to deck-load 60 LCVP's could easily take 1,000 with plenty of hold space left over for other cargo. Larger landing craft could be carried on deck. About 700 men would be required to operate a three-shift assembly line, with a lesser number for subassembly work. Trudeau proposed to use the 411th Base Shop Battalion of 800 men augmented by about 160 specialists from Higgins, Chris-Craft, and other assembly yards. Setting up the plant would be a gradual process:

> An advance party could be sent to the theater of operations within 30 days from the date of authorization, followed by a construction crew for the assembly line, together with the first unit of 100 boats and an assembly crew in another 30 days. It is believed that within 90 days of authorization, that boats can be rolling from the ways and that within 120 days, a minimum of 300 boats per month can be assembled from a single assembly line.

[58] Memo, Trudeau for Hoskins, 8 Sep 42, sub: Directive to Off Going to New Orleans. SWPA (S).

After five months a rate of 500 boats a month should be possible.[59]

If the scheme were approved, the EAC staff could prepare lists of materials and equipment, devise a T/O for the assembly unit or units, begin time-motion studies, and draw up plans for assembly lines and launching areas. In short, the EAC was ready to take over this entire project just as soon as strategic and logistic considerations could be weighed and the number of boats and rate of delivery settled. SOS referred the project to the Transportation Corps, which found it feasible but stated that its inception should depend on the fixing of stable requirements. It was necessary to await the return of officers from the Southwest Pacific in order to determine the demand for landing craft above the 284 then established.

Early in October Trudeau was in Washington, busy with the details of moving the 3d Brigade to Carrabelle. But on Sunday evening, 11 October, he managed to have a long conversation with Admiral King and outlined for him the plan to assemble knocked-down landing craft in overseas installations. King was impressed and referred Trudeau to Captain Barbey, who showed great interest in the idea when Trudeau called on him Monday morning. It turned out that the Navy had previously considered such a plan, presumably the result of a cable from MacArthur to the War Department on 6 July 1942. "To economize shipping," MacArthur had cabled, "it is recommended if practicable that boats be shipped in a knocked down condition for assembly in Australia." [60] The Navy had discarded the plan because of the lack of yards and skilled labor in Australia, but Barbey agreed to study the matter further.

Later the same day Trudeau learned that Col. William L. Ritchie of the Southwest Pacific Theater Group of OPD had just returned from MacArthur's headquarters. Losing no time, Trudeau hurried over. Ritchie informed him that MacArthur was "most desirous of securing one brigade of Engineer Amphibian troops at the earliest practicable date, together with large numbers of landing craft." Trudeau urged Ritchie to call a conference immediately "to save him repeating and put this information where it would be used to the best advantage." In the ensuing talk with Col. Edward B. Gallant, Logistics Group, and Todd of the Southwest Pacific Theater Group, Ritchie stated that "his group was prepared to present a requirement for three such brigades, the first to be shipped in December and the other two to follow as soon as practicable." All agreed that a requirement for 2,600 LCVP's should be set up.[61]

Tuesday morning Trudeau returned to OPD to talk further with Todd, who showed him a draft of the requirement for three brigades for Australia. Trudeau recommended sending the 2d Brigade and the 411th Base Shop Battalion in December and an advance party in November to prepare the way. The future of the EAC seemed assured. Trudeau was ready to ask for another base shop battalion and for one LSD to be used as a floating machine shop and drydock in the theater of operations.

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[59] Incl, A Rpt on Problems Involved in the Assembly of Landing Craft in the TofOpns, to Ltr, Trudeau to Somervell, 15 Sep 42, sub: Assembly of Landing Craft. SWPA (S).

[60] Cable, MacArthur to AGWAR, No. C–32, 6 Jul 42. P&T Div file. There is no indication in the record that Trudeau knew of this study by the Navy before talking to Barbey on 12 October.

[61] Memo, Trudeau for CG EAC, 15 Oct 42. 322 Orgn Activation Disbandment of Units (S).

On 23 October the Navy approved the assembly of boats in the theater and the following day Hoskins was again on his way to New Orleans, this time with four assistants and with no need to disguise his purpose. Within a week this party had accomplished the major portion of the mission which Trudeau had assigned:

> . . . to secure a complete breakdown on tools, investigate the construction of the necessary jigs and templates, set up a system of crating and symbols together with a shipping point, make a plant layout together with the necessary computations for buildings and electrical installations, make a careful study of the assembly line with a view to organizing the personnel of the Base Shop Battalion along the proper lines, make an investigation and report on any prospective shortage of parts to meet our requirements, make necessary allowances for breakage during shipment and prepare a text and other instructional matter for our assembly crews.[62]

The 411th Base Shop Battalion, which had been developed at Edwards to provide 4th echelon maintenance of landing craft, was reorganized into a headquarters and headquarters company, a depot company, and three shop companies for three-shift operation, with a 10 percent increase in privates. On 1 November, 442 officers and men from the shop companies were dispatched to the Higgins yard where they went to work for about fifteen days on the assembly line. Films and slides of every step in the process were taken to be shown to the men on shipboard while they were en route to Australia. A smaller detachment from the depot company soon followed for a week of instruction in operating lumber yards and depots and in marking and crating sections.

OCE furnished space at the Lathrop Engineer Depot, near Stockton, California, as a consolidation point for boat sections, engines, and maintenance supplies. Officers from the EAC were stationed at Higgins, and at the Gray Marine Motor Company in Detroit to expedite the flow of boat sections and engines to the Lathrop Depot. From there other officers from the EAC undertook to supervise every step of shipment until the cargo was placed in the holds of the transports. During November, the depot was to expect the knocked-down sections of 100 boats as well as 125 engines and additional plywood and other supplies which were to be relayed to the Southwest Pacific during December. By the end of the year, twice that amount should arrive.

The formal directive which SOS issued on 10 November provided for the establishment of an assembly plant with a capacity of 500 landing craft a month. Trudeau stressed the crucial nature of the task in a letter to the men who were to expedite the flow of materials and to those who were to co-ordinate with the Navy and the Transportation Corps. "This project is the most important one yet undertaken by the Engineer Amphibian Command," he wrote, "and the success of this Command as well as [of the] theater of operations it is to support will probably depend to a very large extent on how efficiently the missions . . . are carried out." [63]

So important did Trudeau consider the developments in the Southwest Pacific that he went himself with the party which smoothed the way for the 2d Brigade and the 411th Base Shop Battalion. On 9 November, only two months after he had originally conceived this plan, Trudeau, accompanied by Hoskins and Capt. B. I. Grabau,

[62] Ltr of Instrs on Assembly of Landing Craft, Trudeau, 1 Nov 42. 560 Vessels Boats Barges (S).
[63] *Ibid.*

boarded a plane at Hamilton Field, California, bound for Australia. At four o'clock in the afternoon of 13 November their plane touched down at Amberley Field, near Brisbane. Advised by radio to report at once to advanced headquarters, Trudeau headed for Port Moresby, New Guinea, leaving his assistants to investigate possible Australian sites for the assembly plant.

Beginning on 15 November, Trudeau spent four days explaining the organization and capabilities of the brigades, convincing first MacArthur's staff and then MacArthur himself that the theater needed three brigades instead of one. The assembly plant in Australia would furnish sufficient boats to make the increase possible by early spring, but the brigades would have to be activated immediately in the United States if the men were to be adequately trained. A request should be sent through at once. Trudeau found MacArthur and his staff receptive for several reasons to the idea of using Army troops trained in shore-to-shore landings. The proximity of islands, the necessity for flanking movements along the coasts, the shallow, reef-littered water in which some of the operations would have to be conducted, and the suitability of small boats for lightering supplies and equipment provided ideal conditions for these units. There was also a general shortage of engineer troops in the theater. The shore elements of the brigades could perform some of the tasks usually assigned to general engineer troops or to engineer aviation units, and the boat elements contained men who were capable of maintaining and operating all kinds of internal combustion engines and port facilities.[64]

Perhaps not the least among the reasons for the ready acceptance of the brigades was the fact that their appearance in the theater would decrease the dependence of the Army upon the Navy. Trudeau found a "widespread feeling" among Army officers that the Navy "cannot and will not operate in constricted waters north of Australia." [65] The Navy was indeed reluctant, and with good reason. Strategy for the August offensive in the Solomons had in large part been based upon recommendations from the Navy. Planners felt there was too much danger inherent in MacArthur's plan, which would have committed major naval vessels to dangerous waters within reach of land-based Japanese planes. The Navy did not consider its fleet expendable, especially its fast carriers, and remained wary in its relations with MacArthur. The Army task of protecting Port Moresby and driving around the eastern end of New Guinea, and its goal of securing the northwestern Solomons and the New Britain–New Ireland area called for operations in waters in which the Navy would be extremely vulnerable. These brigades, then, offered an alternate means by which MacArthur might transport masses of men short distances in a shore-to-shore movement.[66]

With the assurance that MacArthur would request two additional brigades, Trudeau rejoined his assistants in Australia. They had confirmed Cairns as the most desirable site for the 411th Base Shop Battalion assembly plant. By 3 December, with sites for the 2d Brigade also secured, Trudeau's mission was accomplished. He might have returned to Edwards at this point flushed with success, realizing that he had helped to solve an important logistical problem and satisfied that the new training objective

[64] Incl, 14 Dec 42, with Memo, Trudeau for ACofS OPD, 14 Dec 42. 370.2, Obsvns Rpts on Trps (S).

[65] *Ibid.*

[66] (1) Isely and Crowl, *op. cit.*, pp. 88–98. (2) Matloff and Snell, *op. cit.*, pp. 259–62.

would extend the life of the EAC for several months to come. Just before leaving Australia, however, Trudeau learned that although MacArthur had requested the two additional brigades the War Department had refused them on the grounds that it first desired an appraisal of the units already committed. Leaving Grabau at Cairns to supervise the construction of the boats, Trudeau and Hoskins left Australia early in December, disturbed and disappointed.[67]

Upon his return to Camp Edwards, Trudeau found that matters had not gone well there either. During November the departure of the 3d Brigade for Camp Carrabelle and of the 411th Base Shop Battalion for the Southwest Pacific had depleted the Engineer Amphibian Command of all its units in training. In order to provide for the expansion which he hoped would result from Trudeau's mission, Noce requested personnel for an amphibious regiment of school troops who would also help to improve instructional methods and techniques of operation. G–3 disapproved, declaring the personnel estimates excessive. On 26 November 1942, SOS directed the Chief of Engineers to reduce EAC functions, as directed by G–3, to the maintenance of equipment and facilities at Camp Edwards, operation of a parts depot to meet requirements in the United Kingdom, and provision of a small nucleus for loss replacements and for additional brigades six months in the future.

Meanwhile, on 27 November MacArthur resubmitted his request for two more brigades, emphasizing that he wanted these units in the theater by June 1943. In late December the War Department reconsidered, accepting a compromise plan submitted by SOS. The 4th Engineer Amphibian Brigade would be activated as soon as practicable after the first of the year, take its basic training at Fort Devens, Massachusetts, and move to Camp Edwards on 1 April for another month of training. A fifth brigade might be activated later, but not until the 4th Brigade had completed its entire cycle. The maximum training load for the EAC was thus reduced to one brigade.

Final Objectives and Dissolution of the Command

Setting up a minimum requirement for the Southwest Pacific theater saved the command from liquidation early in 1943 when there were no brigades in training at Edwards.[68] On 5 February the Navy, which had just begun to augment its forces by taking men from the draft, proposed that this would be a good time for the Army to discontinue the training of amphibious boat crews. Existing crews and units composed of draftees could now be transferred to the Navy. The EAC was convinced, however, that the mission of the brigades was not compatible with the Navy's concept of amphibious operations. In order to emphasize that difference the command sought to employ a different type of craft from that used by the Navy.

The longer distances involved in shore-to-shore operations, the command reasoned, demanded a larger and faster boat. Early in 1943 the Development Section assigned Lt. Col. William F. Schultz, Jr., to work with Higgins on the design of an "Army" land-

[67] Memo, Trudeau for ACofS OPD, 14 Dec 42. 370.2, Obsvns Rpts on Trps (S).

[68] With the exception of those files which are cited separately hereafter, the remainder of this chapter is based upon: (1) 353, Tng (S); (2) 353, Tng; (3) Directives (S); (4) GOs; (5) 320.2, Activation and Orgn; (6) 320.3, TOs; (7) 322, Orgn Activation Disbandment of Units (S).

ing craft. The result was a 59-foot lighter with a speed, depending on load, of from 12 to 16 knots and a cruising range of 200 miles. The command proposed to replace both LCM (3)'s and LCVP's with this boat. The craft would take *any* divisional vehicle. It lent itself better to combat loading. Moreover a saving in personnel would be realized. Whereas it took 234 men to transport 3,390 in LCVP's and LCM's, 3,600 could be transported in the proposed boats by 184 men. The command continued to push for adoption of the 59-foot lighter well into the fall of 1943. But largely because the survival of the command itself remained questionable, these efforts were in vain. The LCVP and the LCM(3) were retained as the main components of the brigades' fleets.[69]

General Marshall was inclined to turn the boat crews over to the Navy provided the Navy was prepared to meet Army requirements for future missions. Theater commanders would meantime be consulted as to the effect of the change on their plans. The theater most directly concerned was the Southwest Pacific, and MacArthur raised strenuous objections. He drew a distinction between long-range operations by naval convoys culminating in ship-to-shore amphibious assaults, and short-range shore-to-shore movements. These last, he contended, were an extension of land operations. The word *amphibian* should be removed from the name of the brigades and be replaced by the word *special*. Training should be under Army control.[70]

MacArthur's views altered the cast of negotiations. On 8 March 1943, representatives of the War and Navy Departments agreed to retain the 3d and 4th Brigades under Army jurisdiction pending their movement to the Southwest Pacific. The Army consented to discontinue all other amphibious training, while the Navy promised to meet future Army requirements for boat crews and replacements. Upon completion of the instruction of the 3d and 4th Brigades, Army facilities and equipment were to be made available to the Navy. Control over amphibious units and activities overseas was left to the discretion of theater commanders.

The decisions reached on 8 March also settled the running controversy between SOS and AGF over the control of the brigades during joint training, and the withdrawal of these units from joint training for task force missions. Noce had recognized that the complaints of the AGF Amphibious Training Center had some justification but felt that what was needed was more time. In December 1942 he had written:

> We are in accord with the Army Ground Forces, that the constant replacement of green Engineer Amphibian Brigades for combined training is not a satisfactory solution to the problem, and the past rapid turnovers were due to the uncertainties of war and not to any desires of this Command. It is neither fair to the Infantry division being trained nor is it fair to this Command to expect well trained units to be turned out in 90 days or less. We have repeatedly stated that when fillers are furnished from Reception Centers, it is our opinion that a minimum of five months should be allowed from the time the organization

[69] (1) Ltr, Design Sec EAC to CG EAC, 3 May 43, sub: Addenda to Rpt on Landing Craft, Dated 3 Feb 43. EHD files (C). (2) Ltr, Lt Col William F. Schultz, Jr., to CO EAC, 23 Aug 43, sub: 59-Foot Experimental Tank Lighter. 400.112, Test Trials Analysis Investigation of Articles of Sup. (3) Ltr, Trudeau to Col C. T. Tench, 17 Jul 43. Trudeau file, Morale—Tench. (4) Ltr, Trudeau to Ogden, 16 Nov 43. Trudeau file, Gen Ogden. (5) Tentative Tng Guide 1, Hq EAC, Feb 43, sub: Engr Amph Trps, Gen.

[70] Cable, CINCSWPA to WD, 2 Mar 43. OPD cable files, CM-IN 747, 2 Mar 43 (S).

reaches its approximate Tables of Organization strength before a brigade is considered ready for either advanced combined training or actual operations in the field.[71]

While the Engineers sympathized with the AGF point of view on the state of training in the brigades, they strongly resisted its efforts to absorb the command early in 1943. On 5 January, G–3 issued two directives. One assigned the preparation of T/O&E's for the brigades to AGF. The other charged SOS with the activation and technical training of engineer amphibian brigades which were to pass to the control of AGF for joint training. Having secured this increased authority, AGF went one step further, suggesting that the task of preparing T/O's had been given to it because the brigades were "specialized combat units" and therefore should be under AGF control. The EAC existed solely for training the brigades. AGF therefore recommended that the EAC and all its activities be assigned to it.[72] On 1 February 1943, Sturdevant replied to the AGF proposal by asserting that the brigades were "specialized supply and transportation units" and that the Engineers could see no tactical reason for AGF to prescribe personnel, organization, and equipment. As a counter recommendation, he suggested the task of drawing up T/O&E's be returned to SOS. After the Army-Navy agreements of 8 March 1943, AGF was no longer responsible for any amphibious training. The AGF Amphibious Training Center was disbanded, and the preparation of T/O&E's reverted to SOS. Following MacArthur's suggestion, the War Department soon thereafter renamed the brigades "engineer special brigades" and the amphibian regiments "engineer boat and shore regiments."

AGF control of these T/O's from January to March 1943 delayed the publication of revised tables. In November 1942, the EAC had submitted for War Department approval a T/O which increased the size of the brigade by some 90 officers and over 860 enlisted men. McNair had already criticized the brigade as carrying too much strength, for it required the troops of half a division to move a division, and during discussions of these tables both SOS and AGF emphasized the importance of removing excess personnel. The EAC was in the process of making revisions when AGF took over the task. In March SOS reassumed this duty, and on 21 April 1943 the War Department approved a T/O based primarily on the November revision. It provided for 378 officers, 16 warrant officers, and 7,005 enlisted men organized into three boat and shore regiments, a boat maintenance battalion, a medical battalion, an ordnance company, a quartermaster headquarters and headquarters company, and a signal company. Quartermaster units were to be attached as needed. The command did not concur in all troop reductions, but it considered retention of the regimental organization, which AGF had proposed to abolish, an important victory. Through the regiment the command secured co-ordination of boat and shore elements.[73]

The various high level discussions which went on from September to March did not

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[71] Ltr, Noce to CofEngrs, 28 Dec 42, sub: Activation and Tng of Additional Engr Amph Brigs. 322, Orgn Activation Disbandment of Units (S).

[72] Memo, Actg ACofS G–3 for CG SOS, 5 Jan 43, sub: Sv Units. 320.2, Gen. (2) Memo, ACofS G–3 for GCs SOS and AGF, 5 Jan 43, sub: Responsibility for Tng of Sv Units, with Incl. 353, Tng (C).

[73] (1) Memo, Actg CofS EAC for File, 8 Dec 42, sub: Conf on T/Os, Engr Amph Brig, Held in Munitions Bldg, 7 Dec 42. 320.3, T/Os (C). (2) Min, 23 Dec 42, sub: Engr Amph Brig Conf. 337, Confs Mil Naval and Other Mtgs (S).

prevent the command from going ahead with its efforts to improve the caliber of its instruction. During the winter months, when there were no units at Edwards, Noce seized the opportunity to perfect training literature. In December 1942, he decided to publish command doctrine in informal training guides, emphasizing pictures, diagrams, and sketches, and presenting the Engineer amphibian mission as simply and graphically as possible. These volumes incorporated material from command training memoranda, from a formal training manual which the command had projected, and from various War Department field manuals. Tentative Training Guide No. 1, issued in February 1943, described the general employment of engineer amphibian troops and was meant for officers. Tentative Training Guide No. 2 for enlisted men, published in April, was concerned with the duties of boat crews.[74] Five others on marine maintenance; troops and operations; organization of the far shore; reference and logistical data; and intelligence, navigation, and communication rounded out the series. While publication of some was considerably delayed, the manuals provided the 4th Brigade with more training literature than any of the preceding units.

Shortly after 31 December 1942, when the War Department issued the directive authorizing the formation of the 4th Brigade, G–3 set the goal for completion of its unit training at three months from the scheduled activation date of 1 February 1943.[75] This time allotment caused some concern both to the command and to SOS, for 75 percent of the officers in the unit were to be recent OCS graduates without amphibious experience. The same percent of enlisted men were to come directly from reception centers. Furthermore, the remaining 25 percent of the enlisted men would not be available from replacement training centers until the end of February. As a result of protests by both the command and SOS, G–3 extended the target date for completion of unit training to 30 June 1943, thus allowing the five months' training period which the command considered essential.

Not only was the 4th Brigade fortunate in having adequate time for training, it was also provided with an excellent cadre from the 2d and 3d Brigades—well qualified in age, health, and AGCT scores. The men had been so carefully selected that only a small percentage had to be reclassified. It was, moreover, a source of satisfaction to the classification officer that a large proportion of recruits was to be obtained from the 1st, 2d, and 6th Service Commands, which supplied personnel he believed to be more highly educated and trained than men from other service commands.[76] Problems of time and personnel were, therefore, not as great as they had been when the command was first organized.

Training of the 4th Brigade contrasted with that of earlier units because of other factors also. The EAC had eight months of experience in perfecting its organization,

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[74] (1) Memo, 1st Lt Ralph M. Ingersoll, Public Relations Off EAC, for Col Henry, 30 Nov 42, sub: Discussion With CG on Tng Memos. 009, Tng Guides. (2) Memo, Ingersoll for Staff of Tng Guide Sec (No. 2), 4 Dec 42. Same file. (3) Tentative Tng Guide No. 1, Hq EAC, Feb 43, sub: Engr Amph Trps, Gen. (4) Tentative Tng Guide No. 2, Hq EAC, Apr 43, sub: Engr Amph Trps, A Manual For Boat Crews.

[75] Memo, ACofS G–3 for CG SOS, 10 Jan 43, sub: Disposition of Amph Trps. OCE 320.2, EAC (S).

[76] (1) Ltr, Clas Off EAC to CG EAC, 5 Feb 43, sub: Distr of Reception Center and RTC Filler Repls. 220.01, Clas of Scores in Tests. (2) Ltr, Clas Off EAC to CG EAC, 5 Feb 43, sub: Over-all Estimate of 3d Brig Cadre. 320.2, Cadre.

doctrine, and training facilities. One brigade, the 1st, had already participated in the North African invasion, performing boat maintenance and shore functions, thereby furnishing combat lessons for the new brigade. The boat shortage which had plagued the earlier brigades was somewhat alleviated by the longer training time allowed and by the transfer of landing craft from Camp Gordon Johnston (Carrabelle) after the dissolution of the Amphibious Training Center.[77]

As had been planned earlier, the 4th Brigade took its basic training at Fort Devens and moved to Camp Edwards in April for the completion of technical and specialist instruction and the beginning of tactical instruction. At this point the program came under the direct supervision of EAC headquarters. Boat battalions had four weeks of training in boat operation under the Boat Unit Detachment and two weeks of special weapons training under the Weapons Detachment. The Shore Units Section instructed shore companies for periods of four days each. During the remaining time, under the direction of their unit commanders, these companies learned road building, bridging, loading procedures, beach organization, and general engineer tasks. Maintenance companies were instructed by the maintenance shops of the command, which in addition provided a Marine Engine School, a Marine Machinist School, a Hull School, and a Welder and Wheel Repair School. Maintenance companies also had instruction in boat operation and weapons. Service units assigned and attached to the brigade carried on training under their individual commanders. In addition to conducting and supervising training of these various units the command gave courses for amphibious scouts, communications specialists, and amphibian truck drivers, and continued to send men to civilian schools. Within the brigade there were schools for camofleurs, clerks, truck drivers, and similar specialists.[78]

From 23 May to 30 June the brigade completed tactical training of individuals and trained progressively larger units as a team. The 4th Brigade remained at Edwards through August and was better trained than any of the former brigades. In September it moved to Camp Gordon Johnston for joint training with the 4th Infantry Division under the direction of the Amphibious Training Command, Atlantic Fleet.[79] The departure of the 4th Brigade reduced the training functions of the command to completing the instruction of enlisted replacements and of the 692d Base Shop Battalion. Although the command finished its task in December 1943, a small supply staff lingered on until April 1944 when it finally disbanded.[80]

The Engineer Amphibian Command's existence was relatively short—for all practical purposes, eighteen months. During this time it trained four brigades, only half as many as first anticipated. The original pro-

[77] Ltr, Trudeau to CofEngrs, 15 Jan 43, sub: Proc of Landing Craft. 400.1301, Priority of Sup (C).

[78] (1) Ltr, Dir Sch and Marine Maint EAC to CG EAC, 28 Jan 43, sub: Grades and Ratings. 221, Gen. (2) EAC Tng Memo 3, 27 Mar 43, sub: Tng Program 4th EAB, 12 Apr–22 May 43. EHD files.

[79] (1) Ltr, Asst Ground AG to CG Second Army, 25 Sep 43, sub: Amph Tng. 220.33, Transfers. (2) Memo, CO EAC for Dir of Tng ASF, 22 Aug 43. 333, Inspecs and Investigations by IG and Other Official Rpts.

[80] (1) 2d Ind, Lutes to CG EAC, 21 Jul 43, on Ltr, CO EAC to CG ASF, 17 Jul 43, sub: Rqmts and Tng of Repl and Overstrength Pers in the EAC. 320.22, Requisition for Enl Strength (S). (2) Ltr, CO EAC to CG First SvC, 3 Dec 43, sub: Movement of Engr Amph Comd. 370.5, Asgmt Change of Stations. (3) Tel Conv, Mil Pers Br OCE, 4 Oct 55.

gram was based on strategic plans for crossing the English Channel. Whether the Army could have accomplished this on an eight division front in small boats, as it seems to have contemplated, is now an academic question. The Army soon realized that it could not train sufficient troops for such an effort. The shortage of landing craft was primarily responsible for a change in objectives.

Joint training with ground forces units revealed that none of the first three brigades had sufficient time in preparation. On top of this the command experienced shortages of equipment, lack of facilities, scarcity of instructors, large percentages of grade IV and V men, and increasing numbers of recruits without basic training. The bulk of the command's instructional activities was confined to the first five months of its existence, when equipment and personnel problems were most acute. A lack of balance resulted from constantly changing objectives. The changes came in part from shifts in strategic plans but also stemmed from uncertainty in the General Staff over what to do with this organization in view of the possibility that the Navy would absorb it. Faced with this uncertainty, the EAC found a need for the brigades in the Southwest Pacific.

The extent to which the brigades were used overseas provides the ultimate basis for an evaluation of the command's accomplishments. The 1st Brigade participated in the invasions of North Africa, Sicily, Italy, Normandy, and Okinawa, performing shore operations only. Two more brigades, the 5th and 6th, were organized in Europe for shore duties in the Normandy invasion. Although these two brigades had no connection with the EAC and lacked the boat units that characterized the brigades in the Southwest Pacific, the organization of special shore units was command inspired. In the Southwest Pacific the 2d, 3d, and 4th Brigades performed both boat and shore functions. The 2d Brigade went into action in June 1943 at Nassau Bay, and by the end of 1943 had participated in landings at Lae, Finschhafen, Arawe, and Cape Gloucester. Early in 1944 the 3d Brigade joined the 2d for operations on New Guinea and New Britain. Later the same year the 4th Brigade joined these two. All three had a share in the Philippines campaign. When planning for the invasion of Japan, MacArthur asked for additional brigades, supported in this request by a most favorable opinion of these units from the Navy.[81] After the Lingayen landing on Luzon, a report from the headquarters of the Navy's Seventh Amphibious Force had conceded that "the Engineer Special Brigade as organized in the Southwest Pacific Area is the most efficient Shore Party organization now functioning in amphibious warfare." [82]

In the Southwest Pacific the brigades performed a twofold mission—transporting troops for amphibious assaults and getting supplies to them thereafter. Combat support had received strong emphasis in their training under the command. In the early period it had been the foremost consideration. Full realization of the logistic potentialities of the brigades came during their employment overseas. The command's significance lies both in its development of shore-to-shore transportation techniques which increased the mobility of MacArthur's land forces in the Southwest Pacific Area and in its perfection of shore party procedures which simplified the intricacies of supply in an attack against an enemy shore.

[81] (1) Heavey, *op. cit.*, pp. 189–98. (2) Interv, Trudeau, 3 Jun 50.

[82] Quoted in Mil Tng in EAC, May 42–Apr 44, p. 8.

CHAPTER XVII

Preparing To Reconstruct Ports

Contrary to World War I experience, when the ports of southern Europe had remained in Allied hands, the United Nations in World War II had to take over from the enemy the ports through which supplies would be fed.[1] What was captured turned out in most cases to be a mass of destruction. At Cherbourg, the "all-weather lifeline" on which the breakout from Normandy depended, "reconnaissance showed that 95 percent of existing quayage suitable for deep draft vessels was initially unusable. Craft in the harbor was sunk and passenger handling equipment was destroyed and tipped into the water." [2] At Le Havre, "the dock and warehouse area of the Port was subjected to heavy air bombing prior to its occupation by Allied Forces and the streets in this area, though not completely destroyed, were badly broken up and in most cases pitted with bomb craters and blocked by the rubble of bombed out buildings." [3] At Naples:

> The port was initially almost totally unusable. The pier installations and the adjacent commercial and industrial area had been severely damaged and most buildings wrecked by American bombing. The Germans had systematically sunk from 350 to 400 ships and lighters of all types in the harbor and berths and had demolished all cranes and machinery. Damage to piers themselves was not very great, bulk gasoline facilities had been damaged largely by bombing, and rail demolitions were not sufficiently complete to prove a major obstacle. However the entire area was covered with debris and rubble and was inaccessible to vehicles or ships.[4]

Between capture and utilization of a port lay a task of clearing and reconstruction demanding the utmost in knowledge, ingenuity, and expedition. The job called for close co-operation between the Army and Navy. The Navy's salvage operations had to dovetail with the Corps of Engineers' plans for dredging channels and rebuilding dockside facilities. For the swift rehabilitation of damaged wharves, cargo-handling machinery, ship repair facilities, and warehouses the Engineers employed a headquarters and headquarters company for a port construction and repair group, to be filled out in the theater of operations by a combination of other units such as the engineer general service regiment, quartermaster truck company, quartermaster service battalion, and engineer port repair ship crews. The headquarters and headquarters company contained a core of structural and mechanical engineers to design and plan this

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[1] For a discussion of plans to recapture and develop continental ports see Ruppenthal, *Logistical Support of the Armies,* Ch. IV.

[2] Booklet, Cherbourg Port Reconstruction, prepared by Office of C Engr ETO, p. 12. Army Map Sv (S).

[3] Hist Rpt 11, Liaison Sec Intel Div, Office of C Engr ETO, Port Constr and Repair, p. 32. AG Special Collection, Opn Rpts.

[4] Rpt, Col Percival C. Wakeman *et al.,* 28 Nov 43, sub: Rehabilitation of Naples and Other Captured Ports. KCRC, Rehabilitation of Naples and Ports (CE 381) (S).

specialized work, as well as skilled machinery operators, and divers for underwater demolition, rigging, burning, and welding. The divers would work close inshore to clear the tangle of steel, wood, and concrete from the sites for new wharves, piers, and drydocks, but farther out in the harbors was work requiring marine units for salvage, demolition, and dredging. The Engineers provided two floating auxiliaries, the port repair ship and the dredge.

The port repair ship could move around in a harbor to do the underwater cutting, welding, demolition, and rigging required in the removal of sunken debris from berths and anchorages beyond the reach of shore-based units. It was prepared by reason of its heavy bow lift to co-operate with the Navy in salvage work. It was also a floating repair and machine shop capable of manufacturing anything from 1-inch bolts to 1,000-pound anchors. Portable generators, welding machines, compressors, pneumatic tools, and cranes could be used on shore to supplement dockside projects.[5]

All of this work was useless if harbor channels remained too shallow for the drafts of heavily loaded troop and supply ships. To insure the passage of such ships to discharge points, the Engineers supplied seagoing hopper dredges with hydraulic suction drags capable of cutting through silt and small rubble to a depth of forty-five feet. Such ships stored the dredged material in huge hoppers and then dumped the load at some convenient point outside the traffic lanes.

Port Construction and Repair Groups

Doubtless because there had been no occasion for the rehabilitation of ports during World War I, the War Department gave no thought to the organization and equipment needed for such an effort until 1942 when the general strategy for reconquest began to take shape. During the winter and spring of that year American engineers stationed in Britain helped work out details for the Continental invasion then projected for the spring of 1943. In the course of these discussions, plans for the rehabilitation of the Channel ports had been recognized as a matter demanding immediate attention. It was also recognized that certain of the operations fell quite naturally to the Navy. Thus the Navy assumed responsibility for raising sunken craft and removing sea mines, while the Army undertook all dredging, the removal of obstacles other than ships and mines from the waters around the docks, clearance of land mines and rubble, and the reconstruction of docks and other port facilities.

At a meeting with British representatives early in July 1942 it was tentatively agreed that United States forces would provide for the rehabilitation of two major and five minor ports, leaving three major and five minor ports to the British. On 13 July, General Davison, Chief Engineer, ETOUSA, called for the organization of special port construction companies, and, picking up a British idea, the design of special plant such as port repair ships. That same day Eisenhower relayed Davison's request to Washington, suggesting that the strength of the port construction company should be about three hundred men.

[5] (1) FM 5–5, 11 Oct 43, pp. 171–74. (2) Ltr, ExO War Plans Div to CO 1069th Engr Repair Ship Co, 25 Jan 44, sub: Tng of Port Repair Ship Crews. 353, Engr Port Repair Ship Crews (C). (3) Ltr, Philadelphia Dist Engr to CofEngrs, 27 Aug 45, sub: Spare Parts and Supplies for Engr Port Repair Ships, with Incl, Hist of 1075th Engr Port Repair Ship. Proc Div file, Exec Office Gen Clas Corresp. (4) T/O&E 5–52, 10 Aug 43.

OCE's Operations and Training Branch, anticipating the receipt of some such request, had established a Port Unit in May under the supervision of Maj. Marcelino Garcia, Jr. Garcia was eminently qualified for this assignment. In civilian life he had been the operating manager of the steamship agents and operators firm of Garcia and Diaz. He had advanced to this position after graduation from the Massachusetts Institute of Technology with a degree in naval architecture and marine engineering and a year's apprenticeship in shipbuilding and repair.[6]

When Eisenhower's cable arrived, Garcia was making a general study. With the receipt of the request from the European theater, Garcia's work assumed more definite direction. He visited Merritt-Chapman & Scott and Johnson, Drake & Piper, the foremost marine construction contractors in the country, and discussed with their officials what equipment would be needed for port reconstruction. Like the aviation battalion, whose main job was also a special type of construction, the unit needed a wide variety of power machinery. Some of these machines—the air compressors, dozers, concrete mixers, shovels, cranes, pumps, and welding sets—Garcia assigned as organizational equipment. The rest—pile extractors; pile drivers; hoists; jacks; power hammers; a scow outfitted with a 15-ton derrick, a 3-drum steam hoist, a swing engine, a 20-foot bull wheel, double outside winches, and a 100-pound compressor complete with dock-building tools; and a deck scow which would serve as a base for divers—he designated special equipment. The destination of the unit would determine whether all of this special equipment, only a portion of it, or perhaps more, would be issued.[7]

As a part of the general study, OCE worked out a tentative unit organization. In September 1942 the Engineers proposed a port construction battalion to rehabilitate ports with the aid of general engineer units but this was disapproved by G–3, who followed Eisenhower in proposing a company. The next month OCE submitted new tables, one for a regiment, another for a port construction and repair group. The War Department rejected the regimental T/O for 1,295 officers and men because it did not desire a fixed unit but a flexible one to fit in with units of other branches. The Engineer recommendation for 504 officers and men in a port construction and repair group was cut down by the General Staff to 24 officers and 206 men with the title of headquarters and headquarters company, port construction and repair group.[8] Two of these units were activated toward the end of 1942 as advance charges against the 1943 Troop Basis. Four more were approved in February 1943 under tables calling for 17 officers and 230 enlisted men. The published T/O of August 1943 provided for 17 officers and 236 enlisted men. One hundred and ninety-eight of the men were concen-

[6] (1) Hist Rpt 11, Liaison Sec Intel Div, Office of C Engr ETO, Port Constr and Repair, pp. 1–4, and App. 2. AG Special Collection, Opn Rpts. (2) Info from Mil Pers Br OCE.

[7] (1) T/O&E 5–52, 10 Aug 43. (2) Incl, 1942, with Memo, ACofS for Opns SOS for CofEngrs, 19 Nov 42, sub: Special T/E for the Hq and Hq Co, 1051st Engr PC&R Group. 400.34, Engr PC&R Units. (3) Ltr, Actg C of WPD to C Engr ETO, 4 Jan 44, sub: Equip for Hq and Hq Co, Engr PC&R Group. 400.34, Engr PC&R Group.

[8] (1) Ltr, Actg C of O&T Br to CG SOS, 12 Sep 42, sub: T/O for Engr Port Constr Bn. 320.2, Pt. 33. (2) 1st Ind, 25 Sep 42, on same ltr. AG 320.3 (10–10–41) (3) Sec. 5, Bulky Package. (3) Ltr, C of O&T Br to Deputy Engr SOS ETO, 19 Oct 42, sub: Port Planning and Orgn Port Repair Ships and Dredges. 332, Gen (S). (4) Ltr, O&T Br to CG SOS, 7 Nov 42, sub: Orgn of Engr Port Repair Ship Dets 1 to 5. 332, Engrs Corps of (S). (5) AG 320.2 (10–30–41) (2) Sec. 5, Bulky Package.

trated in the construction platoon, which consisted of a divers section for underwater work, a shop section for the rehabilitation of damaged mechanical facilities, and two dock sections containing heavy equipment.[9]

Although the Engineers concentrated the training of many other units with heavy machinery at the EUTC at Camp Claiborne, they decided against this site for the port units.[10] Claiborne, lacking streams or lakes large enough for even elementary bridging and assault boat training, was completely unsuitable for marine units. For this training the Engineers selected Fort Screven, situated on Tybee Island about twenty miles from Savannah, Georgia. Six companies were in training there by spring 1943.[11]

Until August 1943 these companies obtained fillers through a voluntary induction and enlistment system similar to that used to fill the original construction units at the Claiborne PEOC. Men between the ages of eighteen and forty-five were eligible, and those above the top draft age of thirty-eight could be enlisted directly. Company officers could recruit men they knew personally. To obtain specific individuals they could promise definite and immediate ratings as high as technical sergeant. They made additional contacts through construction firms, railroad companies, labor unions, and universities to obtain the wide range of skilled workers needed, from pipefitters, stonemasons, blacksmiths, and riggers to electricians, structural steel workers, draftsmen, and surveyors. If subject to the draft, the men could ask for immediate induction, with assurances that they would be assigned to the particular company with which they had corresponded. If they had been inducted already, transfers could be arranged.[12]

Despite these efforts the companies did not at first receive men fully qualified to fill every position. A constant weeding out took place after the units reached full strength and the voluntary induction men continued to arrive. First the unqualified and inept were replaced and sent to general service regiments at Claiborne. Then the inexperienced but potentially good construction men were withdrawn and placed in a pool for future port repair groups. One unit of 236 men had over 630 men assigned to it at one time or another during its stay at Screven. When special recruiting stopped in August there was a surplus of 175 fillers on hand, many of them classified as potential construction men. These first companies were in the end made up largely of volunteers, many of whom were already acquainted with one another. One company reported in February 1944, shortly after moving overseas, that "most of the officers of the unit are men from the construction fields of the U.S.A. Some could be better but it is felt that we have the best obtainable. They are men with open minds . . . [and] hard workers . . . ." Of the noncommissioned officers, "some are high class tech-

[9] (1) Memo, C of O&T Br for CG SOS, 1 Feb 43, sub: Engr PC&R Groups. 322, Engrs Corps of (S). (2) Memo, ACofS OPD for CG SOS, 23 Feb 43, same sub. Same file. (3) T/O&E 5–52, 10 Aug 43. (4) FM 5–5, 11 Oct 43, pp. 171–74. (5) Rpt of Activities Mil Pers Br OCE for Period Ending 30 Sep 43. 020, Engrs Office C of.

[10] Unless otherwise cited, this discussion of port construction and repair groups is based upon: (1) Unit Tng, Annex I, p. 59; (2) KCRC, 1056th Engr PC&R Group Corresp files; (3) Screven, 353 Tng, 1056th Engr PC&R Group; (4) P&T Div file, Engr Diving and Salvage Sch; (5) Unit Hist, 1057th Engr PC&R Group. Army Map Sv.

[11] Unit Hist, 1071st Engr Port Repair Ship Crew. Army Map Sv.

[12] Ltr, AC of Mil Pers Br to Great Lakes Div Engr, 14 May 43, sub: Asgmt of Enl Specs to Ft. Screven, Ga. 341.3, Engrs Corps of, Pt. 1.

nicians and some are Engineer College Graduates. The privates . . . are largely from construction labor. We have also some really tough construction men, in fact, all of our field men are of this type." [13] Another boasted that "almost every member . . . came directly from civil life into this unit, and each was a specialist in some phase of Engineering or construction work." [14]

It was fortunate that these first units contained well-qualified men because the training at Screven was far from satisfactory. There was no attempt to introduce a unit training center organization with centralized instruction and a pool of equipment. The units were almost completely on their own, with unit officers as instructors and with organizational equipment. Since most of the officers had no more military experience than the men, basic military training was of an inferior quality. Contributing to this condition was the constant replacing of fillers to obtain qualified specialists of higher caliber, a process which in turn made basic training a continuous and almost individual process from activation until the time the units left for overseas. As late as December 1943, the last month that Screven was used for this training, none of the units had grenade launchers or machine gun mounts and one of the companies did not have a machine gun. The units did meet the minimum requirements, including firing a qualification course with the rifle, and each man experienced close overhead fire.[15]

Technical training at Screven was more effective because both officers and men knew more about the technical aspects of their work to begin with. Much of the three weeks of training consisted of lectures and brief demonstrations of equipment. Each company attempted to familiarize all of the men with all of the equipment, tools, and



DIVER COMING OUT OF THE WATER, *Camp Gordon Johnston, Fla., is engaged in underwater repair.*

materials. It was impossible to bring such heavy equipment as pile drivers and shovels from the depot at Savannah because bridges between Savannah and Fort Screven were

[13] Ltr, CO 1056th Engr PC&R Group to OCE, 7 Feb 44, sub: Info Concerning 1056th Engr PC&R Group with Incl, Résumé of Status of 1056th Engr PC&R Group. Screven, 353, Tng, 1056th Engr PC&R Group.

[14] Unit Hist, 1053d Engr PC&R Group (C). Army Map Sv.

[15] (1) Ltr, CO Ft. Screven to COs of all Engr PC&R Groups and Post Staff Offs, 1 Jun 43, sub: Tng Directives for the 1053d, 1054th, 1055th and 1056th Engr PC&R Groups, Ft. Screven, Ga. Screven, 353, Tng, PC&R Group. (2) Ltr, Dir Tng Ft. Screven to All EPC&R Groups, QM Bns, and Ship Cos, Ft. Screven, 29 Jun 43, sub: Special Rpt of Inspec. Same file. (3) Unit Hist cited n. 14. (4) Unit Hist, 1055th Engr PC&R Group (S). Army Map Sv.

not strong enough to support them. In order to demonstrate the cranes, hoists, and pile-driving rigs at Savannah, each unit had to travel between these two points at least twice. Little attention was given to developing within the units the few specialists which they lacked. Companies activated in August 1943 still did not have enough welders and riggers in December.

The divers in these companies were the only men who trained together under a centralized system, in a school established at Screven on 2 August 1943. Although most of the divers who came to Screven at this time had either civilian experience or seven to fourteen weeks of training in diving at the Navy Salvage Training and Diving School at New York, some had neither. All needed technical instruction in Army equipment and practice in the application of their skills in port reconstruction work. In the fall, when the Navy closed its salvage operations at New York, Screven was the only school remaining which could give engineer diving and salvage training. The school had two officers and four enlisted instructors. Officers from the units served as their assistants. The school taught the use of pneumatic tools, such as the chipping hammer, jack hammer, chain saw, and steel drill. The men learned something of the physics of diving and had some practical work with Navy and Army diving gear, shallow water face masks, diving floats and boats, and the decompression chamber. They learned the elements of damage control, burning and welding, steel patch work, caulking of both wood and steel, and underwater rigging. They made up charges of underwater explosives for steel, stone, concrete, and timber demolition. Instruction in pile driving and dock building was also included.[16]

Following the three weeks of technical training by each company, the commanding officer of Fort Screven assigned practical tasks to each company. Presumably, this was the period in which each unit was to learn to operate as a team under simulated overseas conditions. However, there was never an opportunity to test the full working capacity of these units, never an occasion to undertake a large project requiring the use of truck companies and general service regiments. Headquarters personnel had little to do since there was no co-ordination with other units and the group commanders gradually usurped the authority of the company officers. Training tasks, although not extensive, were numerous. One unit completed thirty-five such assignments, which included building trestle bent timber bridges on piles and on mudsills and posts, and a trestle bent pier with timber pilings and a salvaged steel superstructure. It constructed mooring dolphins, training barges, water pipelines, and a power line. Old pilings and bridge piers were demolished. Buildings were moved and others constructed both on land and on pilings, providing training in carpentry, stone masonry, plumbing, and concrete work. Mechanical and construction engineers received some training in the design and preliminary construction of a marine railway capable of handling 100-ton boats. Other tasks included establishing and operating a sawmill, and grading and surfacing roads. Part of one unit spent three months building an access road to the fort over swampy and sandy soil in an attempt to get heavy equip-

[16] (1) Ltr, C of O&T Br to CG Fourth SvC, 8 Jun 43, sub: Unit Tng of Divers, Engr PC&R Groups, and Engr Port Repair Ships, with Incl 1, Tng Program. 353, Engr PC&R Units. (2) Unit Hist, 1053d Engr PC&R Group (C). Army Map Sv.

ment to Screven. Another part of the same unit built a target range in sand with plank and piling bulkheads and concrete piers and footings, while still another section built a sea wall.

In September 1943 the Deputy Chief Engineer, ETO, strongly recommended that steel construction be given a prominent place in training. Plans for the repair of piers and quays at that time included only 33 percent timber and the rest V-trestling, unit steel cribbing, steel sheet piling, tubular scaffolding, structural steel, and reinforced concrete. V-trestling was a particularly important part of this steel construction, and training in its use was considered essential both by the Deputy Chief Engineer, ETO, and by OCE.[17] Yet no trestling had been furnished to these units prior to September 1943, and by February 1944 OCE faced the hard fact that "certain critical items which we had hoped to get for training purposes are now unobtainable due to the fact that the British are getting all available equipment. These items are the V-type trestling, tubular scaffolding, unit steel cribbing, and the Braithwaite tank pontons. . . . The training suggested in this equipment as shown in the training outline will have to be disregarded." [18]

One of the unit commanders, shortly after arriving overseas, agreed with OCE and the Deputy Chief Engineer, ETO, that his unit should have had more training in erecting V-type trestling, both day and night. He also pointed out some other deficiencies. Too little time had been given to the operation of all equipment, moving it into place at night, selecting difficult positions, and simulating air raids during operations. He believed that a more intensive technical program should have been conducted, even at the expense of basic military training, with barely enough of the latter to make the men recognizable as soldiers.

Much of his criticism was apt. Lt. Col. William W. Brotherton of O&T noted in December 1943: "An effort was made to carry on some training on the larger shovels and pile drivers in and around the Savannah ASF Depot. The work projects on which these units were engaged were spread all around the vicinity of Savannah and Fort Screven and close control and coordination was apparently difficult." He found that "none of the unit commanders had any information that the training period for units after activation had been extended to seventeen (17) weeks for all units activated after . . . [25 September 1943], with necessary changes in the training programs for units activated before that date." [19]

In late December 1943 the units moved from Screven to the ASF Training Center at Camp Gordon Johnston, near Carrabelle on the gulf coast of Florida. The new camp with its fifteen-mile beach frontage and its widely scattered housing was quite a change from Tybee Island.[20] One unit "was somewhat bewildered at the vastness of the new

[17] (1) Ltr, Deputy C Engr ETO to Sturdevant, 14 Sep 43. O&T Br file, Personal Ltrs to Gorlinski (S). (2) Memo, C of WPD for CG ASF, 18 Jan 44, sub: Special Tng for Engr PC&R Groups. 353, Engr Port Repair Ship Crews (C). (3) Memo, Garcia for Lt Col George H. Taylor, 23 Aug 43. O&T Br file, Personal Ltrs to Gorlinski (S).

[18] Ltr, C of WPD to CG Camp Gordon Johnston, Fla., 14 Feb 44, sub: Special Tng for Engr PC&R Groups. 475, Engr PC&R Units.

[19] Memo, C of Sch Br for C of Tng Br, 16 Dec 43, sub: Status of Tng—1057th, 1058th and 1059th Engr PC&R Groups. P&T Div file, Engr Diving and Salvage Sch.

[20] (1) Memo for Record, AC of Repl and Unit Tng Unit O&T, 11 Dec 43. P&T Div file, PC&R Group. (2) Memo for Record, C of P&T Div, 15 Aug 45, sub: Inspec Trip to Camp Claiborne, Camp Gordon Johnston, and Charleston Port of Embarkation. P&T Div file, Camp Gordon Johnston, Gen.



MEMBERS OF PORT CONSTRUCTION AND REPAIR GROUP *building docks at Cherbourg harbor, France, July 1944.*

location and found it quite different from the previous station, which was in an exceptionally fine location with all recreational activities easily accessible." [21] Johnston was about sixty-five miles from Tallahassee, with no communities of any size in the vicinity.

In contrast to the first units, which received competent fillers through voluntary induction, the six companies that trained at Camp Johnston in 1944 and early 1945 received a very poor quality of personnel. The last of these units, organized in the fall of 1944, had only one officer with any experience in dock construction and he was classified as limited service. Fillers consisted in the main of "a raft of shipyard workers who did some one job in a production line." [22] Men had to be trained in base schools for some of the most elementary positions and the commanding officer of the unit despaired of filling the many sergeant positions with qualified men.

There was much more wood pile construction in Europe than had been planned originally for these units. Part of this change in plans came about because of the unexpected availability of wood and the difficulty of shipping steel. The change was also due in part to the lack of familiarity of these units with nonwood materials and their consequent natural preference for wood

[21] Unit Hist, 1057th Engr PC&R Group. Army Map Sv.

[22] Ltr, CO EPC&R Group to Schweizer, 11 Sep 44. P&T Div file, Camp Gordon Johnston, Gen.



MEMBERS OF PORT CONSTRUCTION AND REPAIR GROUP *repairing a lock gate to a basin at the harbor, Le Havre, France.*

construction. Of the twelve companies—about three thousand men—that trained at Screven and Johnston, seven went to Europe and five to the Pacific. In the end, despite the fact that the units continued to train for a time overseas, their efficiency was more directly tied to the number of men in each company with previous civilian experience than to the amount or quality of unit training. The later units that had not benefited from the special recruiting campaign did not measure up to the others until they gained experience.[23]

Port Repair Ships and Crews

At the same time that Garcia was selecting the equipment for the port construction units, in early fall 1942, he was studying the feasibility of a port repair ship, as suggested by the European command.[24] Such a ship had been unheard of previously because it possessed no technical or economic

[23] (1) Analysis of the Present Status of the War Dept Trp Basis, 1 Jan 45, pp. 208, 209. AG Special Reference Collection. (2) *Final Engr Rpt, ETO* pp. 270, 271.

[24] Unless otherwise cited, the story of port repair ships and crews is based upon (1) 560, Engr Port Repair Ships (S); (2) OCT file 564, Repair Ships (Engr Port) (S); (3) OCT file 564, Repair Ships (Port) (S); (4) Unit Hist, 1071st Engr Port Repair Ship Crew, Army Map Sv; (5) O&T Br file, Personal Ltrs to Gorlinski (S); (6) 322, Engr Port Repair Ships (C); (7) 560, Engr Port Repair Ships; (8) 560 (S); (9) OCT file 565.4, Repair Ships (Army Air Forces) (S); (10) Proc Div file, Exec Office Gen Clas Corresp; (11) Unit Tng, Annex I.

worth in peacetime. Its advantages in the kind of military situation anticipated were readily discernible. Rigged with heavy derricks it would furnish the power necessary for lifting rubble from around the docks. Outfitted with machine, blacksmith, and carpenter shops, it would provide the facilities needed to cut and mold the timbers and steel for replacing the damaged portions of the docks themselves. To these two main functions Garcia added a third—transporting the construction machinery, tools, and materials assigned to the port construction and repair group. The port repair ship would thus contain all the essentials for beginning the operation and when one job was done would be ready to move on quickly to another. On 6 October 1942, OCE outlined the need for port repair ships and asked SOS to arrange to supply them. As the service in charge of the Army's shipping activities the Transportation Corps was assigned the job of procuring the vessels as specified by the Corps of Engineers.

On 16 December, Eisenhower followed up his original request. The landings in North Africa had convinced him of the need for such ships. The requirement was for medium-size vessels about 275 feet long which would have a shallow draft of 14 feet or less. He asked that five such ships be ready as early as possible. While ROUNDUP was foremost in his mind, he wanted the ships available for possible attacks other than across the Channel. He also served notice that the British might request conversion of two ships for their own use. In response to Eisenhower's cable, SOS asked the Transportation Corps to convert seven vessels into port repair ships.

The early and optimistic plans for the preparation of these crews and ships did not materialize. The Engineers in November 1942 had hoped to fill the first five crews by direct appointment and by enlistment of qualified civilians, and to have at least four of the crews available by 15 December, subject to call from the European theater commander.[25] A short organizational and basic military period at Claiborne was to suffice for their training. Restrictions upon the procurement of personnel, as well as the type of men attracted by the low grades in the table of organization, made a more extended training period imperative. Constant revisions in the readiness dates of the ships prolonged this period for the first five crews, scheduled to be sent to Europe, to almost a year and a half.

The demand for port repair ships could scarcely be heard in the clamor for ships and more ships that echoed from every side in the fall of 1942. A shipbuilding industry geared to the modest requirements of peacetime had been expanded to a point which caused the chairman of the Maritime Commission, the agency in charge of constructing merchant vessels, to warn over and over again that shipbuilding brains were being spread dangerously thin. All shipways—old and new—were filled, and would continue to be filled for months, perhaps years, to come. Under such circumstances it was out of the question to design and build a port repair ship from scratch. Instead, some vessels already built or in the process of building would have to be transferred from one service to another and converted to serve the new purpose.[26]

[25] Ltr, AC of O&T Br to CG SOS, 7 Nov 42, sub: Orgn of Engr Port Repair Ship Dets Nos. 1 to 5. 322, Engrs Corps of (S).

[26] (1) Frederic C. Lane, *Ships for Victory* (Baltimore: The Johns Hopkins Press, 1951), Chs. II, V. (2) Chester Wardlow, *The Transportation Corps: Responsibilities, Organization, and Operations*, UNITED STATES ARMY IN WORLD WAR II (Washington, 1951), Ch. V. (3) Leighton and Coakley, *Global Logistics and Strategy*, Chs. V, VI, VIII, IX.

The preparation of detailed plans by the Engineers for the layout of the ships had to wait upon allocation of vessels by the Transportation Corps. On the other hand, the more the Transportation Corps knew of what the Engineers wanted the more intelligent and expeditious would be its search for a suitable vessel. Garcia therefore began in January 1943 to compile a list of the equipment to be installed and transported in the ships. For assistance in this work he turned to the group within the Engineers which knew most about ships and shipbuilding, the Marine Design Section of the Office of the District Engineer in Philadelphia. This section, since it designed and supervised the construction of dredges and other craft used in rivers and harbors work, had formerly been located in OCE. It had been transferred to Philadelphia when its chief had been appointed District Engineer there, and it had remained in that location after his assignment elsewhere. Within the month the Marine Design Section had finished what was to become the first of many assignments in connection with port repair ships. Upon reviewing the list drawn up in Philadelphia, the executive officer of OCE's Development Branch suggested that the Engineer Board be consulted with a view to selecting standard equipment to the greatest extent possible. Early in February a representative of the Marine Design Section visited Fort Belvoir to secure the needed information. Thus revised, the preliminary list was forwarded to the Transportation Corps on 8 March 1943.[27]

Shortly thereafter the Transportation Corps suggested for conversion a Navy attack cargo ship, the N3–M–A1. Fourteen of these vessels, designed originally as coastal cargo ships, were being built under Navy contract. Four had been assigned to the British, five to the Navy, and the remainder, because the date when they were to be launched was so far off, had not yet been allocated. Garcia accepted the N3–M–A1's as entirely suitable. Accordingly, on 5 May ASF called on the Munitions Assignments Board to approve their allocation to the War Department.[28] Asked to comment, the Navy's Munitions Assignments Committee presented a decidedly cold front. Assuming that the assignments already made would remain unaltered, the committee put in a strong claim for those ships not yet allocated. The Navy suggested that the Engineers' needs might be met by transfer from the British of the requisite number of N3–S–A1's which differed from the N3–M–A1's only in that they were steam- instead of diesel-powered. In the eyes of the Engineers this was a big difference. So it was also, it seemed, in the eyes of other services. At a meeting of the Navy's Munitions Assignments Committee late in May the Army, Navy, and Royal Navy pronounced the steamers unsuitable. Any sort of substitution was thus ruled out.[29]

At this time—May 1943—the Navy began to question the Army's need for port repair ships at all. Many months had elapsed

[27] (1) Memo, Actg ExO Engr and Dev Br for Garcia, O&T Br, 23 Jan 43, sub: Repair Boat. 560. (2) Memo, C of O&T Br for C of Engr and Dev Br, 30 Jan 43, sub: Engr Port Repair Ship. Same file. (3) Telg, AC of Opns Br Constr Div to Philadelphia Dist Engr, 30 Jan 43. 475, Engr Port Repair Ship Units. (4) Memo, C of O&T Br for C of Water Div TC, 23 Oct 43, sub: Engr Port Repair Ship Equip. 560, Engr Port Repair Ships.

[28] See above, p. 183.

[29] (1) Memo, Comdr R. S. McIver, MAC (Navy), for ExO MAB, 6 May 43, sub: ASF Request for Alloc of N3–M–A1 Vessels. OCT file 564, Repair Vessels (Engr Port) (S). (2) Memo, McIver for ExO MAB, 7 May 43, sub: ASF Request for Alloc of N3–M–A1 Vessels for Conversion to Engr Port Repair Ships. Same file.

since the request; perhaps the theater no longer wanted such vessels. Or perhaps the Navy should man them. To back up this last point, the Navy produced a cable from its commandant of the Mediterranean area. On 29 May, ASF cabled Eisenhower for instructions. On 1 June Garcia was asked to call at the Navy's Bureau of Ships. There he was told that since no N3–M–A1's were available he might wish to accept some slow cargo vessels which were. He did not wish to. On 3 June Garcia's chief, Gorlinski, laid the matter in the lap of ASF's Assistant Chief of Staff for Operations: "In view of the foregoing synopsis of the action to date relative to procurement of these 7 port repair ships it is evident that there is a great possibility that none will be available for Army use when required, and that a dispute is brewing over the Service to be charged with this operation." [30] If the Navy had thrown a monkey wrench late in May, Eisenhower's reply to the cable from ASF amounted to a bomb. The theater was unable to find out who had originated the request for the five port repair ships. The theater wanted *three* ships by August. The theater thought they should be manned by the Navy. All of which caused Garcia to agree that ASF should not press the bid for the N3–M–A1's until further word came from the theater.

By 23 June word had come: the European theater wanted *five* port repair ships manned by Army Engineers. Fortified with this clear statement, ASF appealed to the Joint Military Transportation Committee—an agency of the Joint Chiefs of Staff—asking for advice on filling the requirement for seven ships, two of which were needed in the Pacific, and suggesting that consideration be given to the N3–M–A1's. The committee recommended applying to the Munitions Assignments Board for the four N3–M–A1's then assigned to the British and to the War Shipping Administration for three cargo vessels.

Despite all the uncertainties, the Engineers had activated five port repair ship crews at Fort Screven in February 1943 and had conducted basic training until mid-June. Although the crews were seagoing engineers who would presumably serve aboard ships, they were required to complete the standard basic program for all engineer units, including field bivouacs with exercises in field fortifications, camouflage, scouting, and patrolling. Two infantry officers from Fort Screven headquarters supervised this training for the enlisted men, and the unit officers organized themselves into a basic training class under one unit officer who had some previous military experience.

At the completion of basic training in mid-June, the units attempted the prescribed eight-week tactical and technical programs. Fort Screven proved to be completely devoid of any facilities for this training. The major part of the schedule, 238 hours out of 384, was supposed to be devoted to the use of organizational equipment, to seamanship, navigation, salvage, demolitions, and training as a crew.[31] A few men were sent to the nearby naval training station at Fort Pulaski for elementary training in seamanship, signaling, and splicing, a few others to a trade school in Savannah for training as welders, mechanics, and machinists. Some small tasks, such as road and dock building, could be parceled out to them in the near vicinity, but

[30] Ltr, C of O&T Br to ACofS for Opns ASF, 3 Jun 43, sub: Engr Port Repair Ships. 560, Engr Port Repair Ships (S).

[31] MTP 5–1, 19 Jun 43.

nothing comparable to their intended duties. Thoroughly discouraged by his lack of success in filling these units with qualified men, Garcia reported upon their condition in August: "The technical abilities at the present moment of both the commissioned and enlisted personnel of these units are doubtful. This office does not at this time consider them qualified for the mission they are to perform. . . . The training of these units as a group has been seriously handicapped due to the lack of qualified personnel in the units, the lack of suitable vessels for them to train with and thirdly, the lack of suitable projects on which to train." [32] As one of the units summed up its predicament in July, "training facilities for our specialized unit were completely lacking at Fort Screven and our continued presence was becoming embarrassing." [33]

The situation was as embarrassing to the Engineers as it was to Fort Screven. It was apparent by July that the Transportation Corps would not have any repair ships ready for months. In the interim the crews had to be held together and kept busy at tasks that would give them experience in seamanship, the handling of deck gear, and the use of marine engines. The solution seized upon immediately was to turn the rest of this training over to the Transportation Corps until such time as the ships should be ready for the crews. Accordingly, in late July, three of the units were assigned to San Francisco and two to Seattle in order to take advantage of facilities which the Transportation Corps had at these ports.[34]

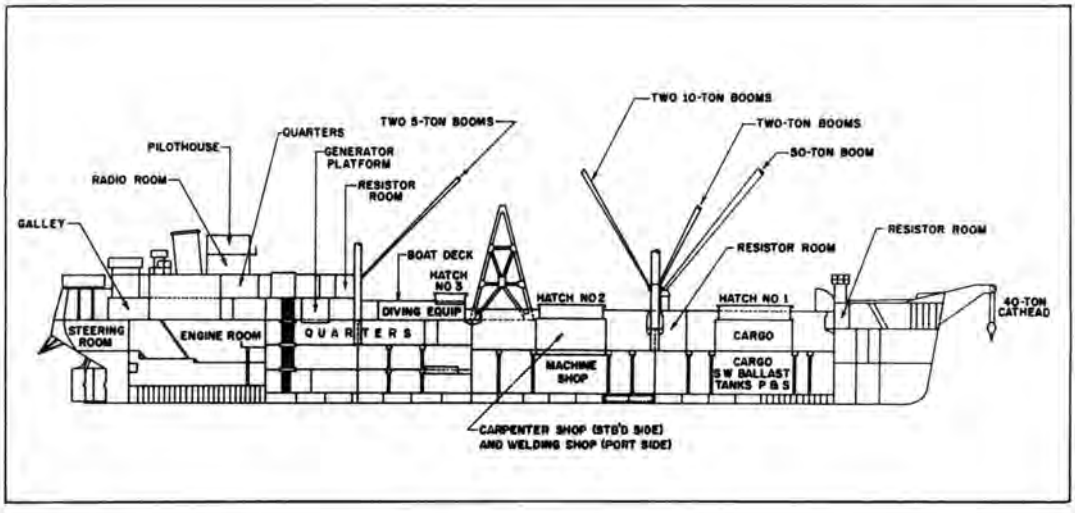
Attempts to obtain the N3–M–A1's for the crews ran into protracted opposition from the British, who, on 1 September, dissented from the Munitions Assignments Board's decision to reassign the four vessels building for them and on 7 October appealed to the Combined Chiefs of Staff for a reversal. Meanwhile Garcia had agreed to accept one cargo steamer from the War Shipping Administration. This ship, the *Josephine Lawrence,* was about one third the size of a standard ocean freighter, having a gross tonnage of about 3,000, a length of 277 feet, and a beam of 43 feet. It had a cruising speed of 10 knots, slower even than the admittedly slow Liberty ships.[35] Conversion of the *Lawrence,* later christened the *Junior N. Van Noy* for an Engineer private who had been posthumously awarded the first Congressional Medal of Honor given an ASF soldier, got under way on 11 September. A month later the British persuaded the Combined Chiefs of Staff that the N3–M–A1's would be essential in the cross-Channel invasion. Three of the vessels were therefore left in British hands and only one was transferred to the Army for conversion to a port repair ship. But shortly thereafter the Navy concluded it could afford to release three more N3–M–A1's. Conversion of these four ships, which were eventually named the *Thomas F. Farrell,* the *Madison J. Manchester,* the *Glenn G. Griswold,* and the *Robert M. Emery,* after Engineer officers killed during World War II, began at various east coast shipyards the second week in December 1943. The two ships allocated later to fill out the original request for seven vessels, as well as three more which ASF added to

[32] Memo, Garcia for Lt Col George H. Taylor, 23 Aug 43. O&T Br file, Personal Ltrs to Gorlinski (S).

[33] Unit Hist, 1071st Engr Port Repair Ship Crew. Army Map Sv.

[34] Memo, C of O&T Br for C of T ASF, 19 Jul 43, sub: Tng of Engr Port Repair Ship Cos. 353, EPC&R Units.

[35] Cable, CG USFET to WD, signed Lee, 20 Nov 45. 560, Engr Port Repair Ships (C).



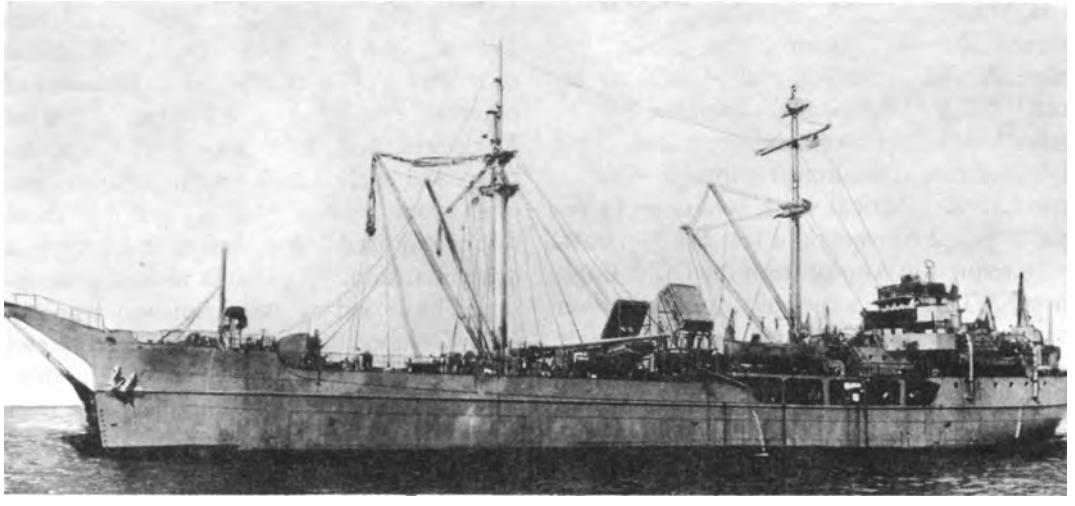
LAYOUT PLAN FOR THE ENGINEER PORT REPAIR SHIP

the program in February 1944, were also N3–M–A1's. The first of these was turned over to the Transportation Corps by the Navy in May and the last in October 1944.

With the acquisition of the ships, the Transportation Corps and the Engineers entered into a new set of relationships. In general, the Engineers had the say about the redesign of the vessels for their specialized function as port repair ships; the Transportation Corps passed upon such matters as seaworthiness. To carry out their part of the responsibility, the Engineers, represented by Garcia and the Marine Design Section at Philadelphia, drew up lists of materials and equipment and prepared layout plans.[36]

The N3–M–A1 had a gross tonnage of 2,483 and measured 291 feet from stem to stern and 42 feet at the beam. Two of its three holds (Numbers 1 and 2) were 56 feet long, while Number 3 hold was half that length. The Marine Design Section concentrated the shops in hold Number 2, locating the machine shop in the lower hold, the welding shop in the forward 'tween deck, the carpenter shop in the starboard 'tween deck, and electric generators and air compressors in its 'tween deck aft. Outlets for the welding machines and air compressors were provided on the main deck. Number 1 hold was reserved for transporting construction machinery. Hold 3 provided storage space for steel stock, portable generator units, refrigerator stores, and crew's quarters. The ship also carried about 75 tons of portable salvage equipment, including a ponton barge, 5-ton capacity crawler crane, 4-ton capacity stiff-leg derrick, and jacks with capacity ranging from 12 to 50 tons. What distinguished its outward appearance most, however, was the large amount of heavy lifting equipment installed on deck, equipment which included, in addition to booms ranging from 2- to

[36] Ltr, C of O&T Br to Philadelphia Dist Engr, 26 Oct 43, sub: Engr Port Repair Ship. 560, Engr Port Repair Ships.



THE ENGINEER PORT REPAIR SHIP

50-ton capacity, a 40-ton cathead derrick for raising debris and small sunken craft.[37]

Upon receipt of the plans, the Transportation Corps decided what shipyard was to make the conversion and assigned an inspector to see that the work was carried out diligently and according to specifications. Representatives of the Marine Design Section visited the shipyards regularly for the purpose of accepting or rejecting the work as it progressed. When the ship was ready for sea, they went aboard for its final trials and tests. Although the Engineers thus emerged in a role that was essential to the denouement, it was the Transportation Corps in its position of direct relationship with the shipyard management which played the lead. As time went on the Engineers sometimes felt their only function was to stand in the wings and wait.[38]

For a time, this was also the Engineer position in relation to the crews for these ships. The units arrived on the west coast in August 1943 and remained under the jurisdiction of the Transportation Corps until November. During these months, basic military training ceased, except that the men fired the familiarization course with the carbine upon arrival and ran an infiltration course just before leaving. The time was spent, instead, in improving the technical skills of the men, most of whom had no civilian background in comparable positions. The Samuel Gompers Trade School in San Francisco taught welders, machinists, mechanics, pipefitters, carpenters, and electricians the elements of their trades. Divers and tenders from all five units attended a seven-week course at Fort Law-

[37] (1) Photo Album, Engr Port Repair Ships, Gorlinski. 560, Engr Port Repair Ships, Bulky. (2) Incl, Description of U.S. Army Engr Port Repair Ships *Madison J. Manchester* and *Glenn G. Griswold*, to 1st Ind, ExO Philadelphia Dist to Cof-Engrs, 22 Oct 52, on Ltr, C of EHD to Philadelphia Dist Engr, 2 Oct 52, sub: Files Relating to Engr Port Repair Ship. EHD files.

[38] Ltr, AC of WPD to Philadelphia Dist Engr, 3 Jan 44, sub: Engr Port Repair Ships. 560, Engr Port Repair Ships (C).

ton, Washington. Marine oilers and firemen served aboard ships for on-the-job instruction. Radio operators and signalmen attended Signal Corps and Maritime Service schools. Both officers and men had some instruction in antiaircraft gunnery. A small amount of practical work was done in repairing and converting a few fishing boats.

A request in August from the Chief Engineer, ETO, for a petroleum distribution company, a port construction and repair group headquarters company, and a repair ship by September 1943 focused attention upon the relatively unprepared status of the ship crews as compared to the other two types of units. The request pointed out that:

> The quality of personnel in these three units and in those of the same type to follow is of primary concern to us because unless the officers and men are capable of carrying out their duties in a well qualified manner, preferably through experience in civil life and training, there will be little opportunity to train them here. . . . Incidentally, we are placing considerable dependence on these ships and the personnel which will use them.[39]

There followed a close examination of the officers and men assigned to the repair ship crews to determine their ability to handle a ship, once it was delivered. Garcia reported to Gorlinski in early September that two of the units did not have a full complement of officers and none had the required number of warrant officers. He did not know how many enlisted men were in the units nor what their grades or qualifications were. The information he had on the officers indicated that their grades and qualifications did not coincide with the table of organization. He pointed out that even though the records showed licensed masters, mates, and engineers, he had no information on their experience in these positions.

At Garcia's suggestion, OCE established investigating boards at Seattle and San Francisco to determine the qualifications of the men. The two boards, composed of officers from the Coast Guard, Corps of Engineers, and Transportation Corps, interviewed each man from the deck and engine room sections and any others whose duties required a knowledge of navigation or seamanship. The results were discouraging. The board at San Francisco reported on 4 October that none of the three crews at that port could be trusted with a ship. In fact, there were not enough capable men in all three units to make one qualified crew. Although each had a competent master, none had a qualified chief engineer. Two of the units had no mates who had ever served before in that capacity. Only one out of nine assistant engineer positions had been filled.[40]

After a futile long-distance attempt to straighten out these units, the Military Personnel Branch in early November finally held a three-day conference at Washington, D. C., with the commanding officers of all five units. The officers learned that all of the crews were to be brought back to the east coast to complete their training under the jurisdiction of the Chief of Engineers and that key vacancies were to be filled through appointments from civil life. Detailed plans were laid to separate the men with experience on diesel-powered ships from those with experience on steamers. Crews could then be reconstituted according to one or the other of these two types. Shifts were planned within all five units in

[39] Ltr, Deputy C Engr ETO to Sturdevant, 17 Aug 43. O&T Br file, Personal Ltrs to Gorlinski (S).

[40] (1) Ltr, ACofEngrs to Pac Div Engr, 15 Sep 43, sub: Engr Port Repair Ship Cos. 320.2, Engr Port Repair Ship Cos (C). (2) Ltr, Special Bd to CofEngrs, 4 Oct 43, sub: Engr Port Repair Ship Cos. Same file.

order to fill one crew with men able to take a ship overseas at an early date.

The units arrived at Belvoir in late November 1943 and reorganized in early December under a new table of organization allowing higher grades. Necessary transfers were made to place qualified men in the unit assigned to the ship nearest completion. Unqualified officers and men were gradually replaced in the other units and basic military training was resumed for the new men and for the two additional crews, slated for Pacific duty, which were activated at Belvoir in the middle of December. The basic program still included many subjects that were of dubious value for ship crews, including tent pitching, laying and passage of mines, defense against mechanized attack, village fighting, engineer reconnaissance, scouting and patrolling, and combat principles of squad and platoon.[41] For the intensive technical training required by these reconstituted crews the Engineers used specialist schools all over the east coast. Naval and Maritime Service schools trained officers and men in diesel engineering, convoy communications, and seamanship. Divers received excellent practical instruction in the salvage of the *Normandie* in New York Harbor. Mechanics, machinists, and electricians worked in shops at Belvoir.

Toward the end of December, ASF's Deputy Director for Plans reminded the Engineers that the ETO had asked for three ships in January and two in February 1944. Since the Transportation Corps had scheduled the *Van Noy* for delivery on 15 January, the *Manchester* and *Griswold* 15 February, and the *Farrell* and *Emery* 15 March, it would be impossible to comply with the theater's request. ASF set 1 April as the date for overseas movement of ships and crews. On 8 January the Transportation Corps announced that delivery of the vessels would be somewhat delayed. The *Van Noy* would not be ready until 1 February; the *Manchester* and *Griswold* not until 31 March; and the *Farrell* and *Emery* not until 30 April. Gorlinski quickly passed this information along to ASF, noting that it would now be impossible to meet the 1 April sailings.

The new completion dates allowed even more time for the instruction of the crews. Recognizing at last the special nature of these units, the Engineers prepared for them a more realistic seventeen-week basic and technical program in February, reducing or eliminating altogether some of the less useful subjects. Seamanship, splicing, lifeboat drills, and twelve hours of aircraft identification were added. Night operations were increased. There was no concurrent military training to be given in the technical period that followed the basic six weeks. Machine gun crews continued to be trained, however, despite the fact that the ships' armament was manned by naval gun crews.[42]

A complex of factors lay behind the failure to deliver the ships when promised. Although the Marine Design Section had the conversion plans ready in time, they were, as Gorlinski warned, subject to further study and perhaps to change. Frequently one change led to another. In forwarding a set of plans to the Transportation Corps in November 1943, Gorlinski noted that the lay-

[41] MTP 5–101, 25 Sep 43.

[42] (1) Ltr, C of WPD to CG Belvoir, 29 Feb 44, sub: Tng Program for Floating Units, with Incl, Tng Program. 353.01, Pt. 1. (2) Ltr, CNO to C of BuOrd, 4 May 44, sub: Penn Jersey Small Cargo Vessels, Ex–AK–81 to Ex–AK–89, Inclusive, Armament for (Doc. 115481). OCT file 564, Repair Vessels, 1943–45 (S). (3) Memo, Actg C of WPD for CG ASF, 10 May 44, sub: Movement of Engr Port Repair Ship Crews. 370.5, Engr Port Repair Ships (C).

out and arrangement of the shops might be altered and that these changes would in turn affect the Number 3 hatch opening and cargo handling gear. Changes demanded by the Engineers became so numerous and caused so much work to be ripped out and begun over again that in February 1944 the Transportation Corps served notice that it would tolerate no more of them.

But freezing the design eliminated only one source of trouble. The port repair ships were being converted in the midst of labor shortages, particularly skilled labor, and of materials and components. Most important perhaps, they were a very small part of the Transportation Corps' huge program, which in turn was only part of the ship repair and conversion program as a whole. As the chief of the Water Division, OCT, later explained:

> Based on the conditions of material and manpower early in 1944, estimates were made of the completion dates of these conversions. Subsequent to this time, difficulties arose in obtaining the critical materials and the manpower situation in the conversion yards steadily became worse. . . .
>
> The Transportation Corps has been continuously under pressure from the Surgeon General to complete the hospital ships under conversion. We have also been under constant pressure for the completion of . . . troop carrying vessels. The Commanding General of the Southwest Pac (*sic*) Area has exerted pressure for the completion of his marine repair ships. All of these conversions were in competition with battle damage to Navy vessels, the landing craft program of the Navy and voyage repairs to operating cargo ships and troop transports.[43]

To be sure, there was some difference of opinion as to whether blame should be laid to the shortage of labor, to labor inefficiency, which might in turn be caused by union rules preventing the firing of loafers, or to the lack of incentive to the contractor under a cost-plus-fixed-fee form of contract. There were differences of opinion, too, as to the reasons why materials and components were difficult to get hold of. As a procurement agency itself the Corps of Engineers understood these problems and had its own theories about them. As a spectator waiting for the Transportation Corps to deliver the port repair ships, the Engineers became progressively more impatient.[44]

In mid-February 1944 Gorlinski forwarded to the Director of the Planning Division, ASF, his latest information as to when the ships would be ready. The two previously scheduled for delivery last were still due on 30 April; of the remaining three, the *Van Noy's* delivery date had been delayed another month and a half, the *Manchester's* two weeks, and the *Griswold's* a month. Gorlinski asked "that deadline dates . . . be established based on commitment dates required by the Theater involved and that the Chief of Transportation be directed to take whatever action may be necessary to obtain priority at the shipyards concerned to insure completion . . . ." [45]

The Planning Division, ASF, persuaded that this was a case for the Joint Chiefs of Staff, drafted for the signature of ASF's Director of Plans and Operations a memorandum for the Operations Division of the General Staff. Delays now being encountered, the Planning Division emphasized, were no longer due to changes in design; they were caused by diversion of working

[43] Memo, C of Water Div for Brig Gen John M. Franklin, OCT, 16 Jun 44, sub: Engr Port Repair Ships. OCT file 564, Repair Ships (Engr Port) (S).

[44] Memo for Record, Lt Col John A. Sergeant, 8 May 44, sub: Port Repair Ships. OCT file 564, Repair Vessels (S).

[45] Memo, Actg ACofEngrs for War Planning for Dir Planning Div ASF, 16 Feb 44, sub: Engr Port Repair Ships—Commitment Dates, 560, Engr Port Repair Ships (S).

crews in shipyards to jobs of higher priority when labor is limited." [46] The Joint Chiefs of Staff should put a stop to this so that the latest deadlines could be met. ASF's Deputy Director for Plans and Operations was not inclined to sign this memorandum. "I shudder at referring this to JCS for any early decision," he wrote the Chief of Transportation. "What do you think?" [47] The Chief of Transportation agreed with him; he would push the matter through other channels. Those directly responsible for ship conversion within the Transportation Corps could see no point in this kind of pushing. The only way to speed up the delivery of the port repair ships, wrote the chief of the Water Division on 2 March, was to give them priority over hospital and troop ships. This was precisely what the Engineers would have liked. But the Transportation Corps could not agree to the wisdom of this course and ASF's Deputy Director for Plans and Operations, convinced that the Transportation Corps was doing its best, did not press the matter further.

The Engineers continued to lodge protests. The climax of their representations to ASF was signed by Robins on 9 June—five months after the delivery of the *Van Noy* had been originally promised and three days after the Normandy landings. Robins pointed out that on 8 April ASF had offered assurance that all the ships would be delivered by the end of that month. "Not one ship is ready at this time, 40 days since the date the final ship . . . was scheduled," he continued. Robins attributed the delays to "difficulties of dual responsibility as well as lack of knowledge of functional requirements of this equipment," presumably on the part of the Transportation Corps, and to the fact that the yards lacked authority "to make immediately necessary decisions." The Engineers should supervise the conversion of the vessels. "Unless this action is taken," he concluded, "no reliable estimate of the availability dates can be made and a continuation of the present unsatisfactory dual responsibility will result." [48]

Robins went rather far in stating that no ships had been delivered. As the Transportation Corps was quick to point out, the *Van Noy* had been completed on 19 April, but after operating it for a time the Engineers had discovered that the generators they themselves had specified were not powerful enough. New generators were therefore being installed at the time Robins wrote Somervell. The *Griswold* had also been completed—on 5 June—and would be delivered shortly. The next three of the original five ships would be finished before the end of the month, the Transportation Corps promised. ASF remained convinced that the Transportation Corps was doing its best; procurement of the vessels would remain with that service.[49]

As the Transportation Corps completed the conversion of the repair ships, the Engineers sent the crews from Belvoir to pick up the ships and take them to Philadelphia for final preparation for movement overseas.[50] The first such passage to Philadelphia was that of the *Van Noy* from Mobile, Ala-

[46] Incl, 28 Feb 44, to Memo, Actg Deputy Dir Planning Div ASF for Dir of Plans and Opns ASF, 28 Feb 44, sub: Port Repair Ships for ETO. OCT file 564, Repair Ships (Port) (S).

[47] Memo Routing Slip, Deputy Dir for Plans and Opns ASF for CofT, 28 Feb 44. OCT file 564, Repair Ships (Port) (S).

[48] Memo, Deputy CofEngrs for CG ASF, 9 Jun 44, sub: Engr Port Repair Ships. 560, Engr Port Repair Ships.

[49] Wkly War Plan Conf, 19 Jun 44.

[50] Ltr, C of WPD to Philadelphia Dist Engr, 15 Feb 44, sub: Tng of Port Repair Ship Crews. 353, Engr Port Repair Ships (S).

bama, in late April and early May 1944. The trip was a trying experience but perhaps more valuable in some ways than formal training. The soldiers quickly turned seamen. Between Mobile and Key West the crew learned to spit to leeward and talk in terms of decks, bulkheads, and ladders. Morale was not so high, however, among the more experienced officers who knew ships and had to run this one.

> The main engine throttle was operated with the aid of a three foot stilson wrench and an eight pound hammer; boiler feed pumps acted like old prima donnas; valves filled with welding slag; the generators wouldn't carry the load; the condenser, which had been robbed of stay rods, leaked and salted the boiler. On deck things were as bad; deck fittings and rigging fittings carried away, immediately causing the deck force to adopt safety measures that would have otherwise required months of training to instill. The ship was extremely tender; so much as to be unstable if ever her double bottom tanks were allowed to remain slack. Only half of the Coast Guard Inspector's recommended tonnage of ballast had been placed.[51]

Under the supervision of Col. Clarence Renshaw, Philadelphia District Engineer, the crews had a few weeks of intensive training aboard ship, including shakedown runs and small operating exercises to test the efficiency of ships, crews, and equipment. Nearby shipyards completed unfinished or unsatisfactory conversion details, aided substantially by the crew members. Port and sea watch bills were worked out. Frequent fire and boat drills accustomed the crews to shipboard routine. The location and removal of wrecks and other dangers to navigation in the Delaware River and Chesapeake Bay promoted confidence in equipment and personnel.

Two of the first five ships sailed for Europe in July and three in August 1944, six months later than the ETO request for three by January and two by February of that year. The crews had been activated since February 1943, but the shortsighted personnel policies and lack of ships and other training facilities for marine units had so crippled the training of these crews that there were difficulties with them until sailing time. An urgent radiogram from ETO demanding the repair ships immediately had precipitated another reshuffling within these crews in July in order to get the first ship started overseas early that month. Warrant officers had to be substituted for the second and third engineers and for the first, second, and third deck officers in the crew of this ship. Only one of the deck officers had ever done any celestial navigation and he admitted that he had never hit anywhere near his position on the chart. Subsequently, so many men were taken from two crews then in training for the Pacific to fill the other four of the five ETO crews that Gorlinski complained it left him in a hole for crews that were supposed to be ready in October and November.[52] Manpower problems plagued OCE until the last minute. An exasperated officer in Military Personnel asserted that "the supply of personnel to these units must be continuous until [the] ship leaves the 3 mile limit due to exceptionally heavy attrition losses." [53] In addition to the original five crews for ETO, Belvoir trained three crews which went to the Pacific; one left the United States in December 1944 and the other two in March and April 1945. The last two crews

[51] Unit Hist, 1071st Engr Port Repair Ship Crew. Army Map Sv.

[52] Wkly War Plan Confs, 3 Jul 44 and 10 Jul 44.

[53] Pencil note, 15 Aug 44, on Memo, C of WPD for C of Mil Pers Br, 15 Jul 44, sub: Port Repair Ships, 1072d, 1073d, 1074th, and 1075th. 370.5, Engr Port Repair Ships (S).

out of the total of ten were still in training at Belvoir as late as June 1945.

Dredges and Crews

The dredges which supplemented the work of the port units and repair ships were not new to the Corps of Engineers. River and harbor dredging was one of the continuous peacetime responsibilities of the civil works organization.[54] At the beginning of the war the Corps of Engineers had a fleet of twenty-five hopper dredges with a complement of fifty to sixty men each, operating in the Great Lakes and on the Atlantic, Gulf, and Pacific coasts. There were three types of seagoing hopper dredges used overseas, some taken directly from the Engineer fleet and a few constructed. The largest was the *Harding,* a 3,800-ton diesel with a 2,500-cubic-yard hopper capacity and a dredging depth of 65 feet. The smallest and newest was the *Hains* class, a diesel-electric ship with a displacement of 1,230 tons, a 700-cubic-yard hopper capacity, and a dredging depth of 36 feet. The latter had too small a hopper capacity to be used in any numbers by the civil works organization in peacetime. However, with modification to allow a dredging depth of 45 feet, it was the best suited for military purposes because of its shallow draft and was the type constructed during the war. Between these two types was the medium 1,500-ton diesel-electric ship such as the *Rossell* and *Marshall.* Because of the time required to build new dredges and the shortage of shipbuilding facilities and materials, the Under Secretary of War directed the Engineers to release the first few dredges needed from the civil works fleet and prepare them for military use. Five ships were subsequently transferred to military control in late 1943 and early 1944.

The Engineers at first proposed to send the hopper dredges overseas with their civilian crews, and three dredges with civilian crews eventually operated in the Pacific, principally in Hawaii. But the Deputy Chief Engineer, ETO, indicated that this arrangement would not be satisfactory for the three ships which he wanted in Europe by April 1944. Crews in uniform would be subject to stricter discipline.[55] On 17 August 1943 he wrote to OCE:

> Not long ago this office replied to an inquiry on whether or not civilian crews would be acceptable, stating that military crews were preferred. An important item in this respect is that the crews must be the most experienced obtainable because they will have to work in the early stages under extreme pressure and probably under stress due to enemy action, hence experience in performing their technical duties is vital. I would feel most secure if I knew that they were Engineer Department personnel selected for their individual qualifications.[56]

From that point on, complications developed. In order to comply with the ETO's wishes, the Engineers sought permission in August to commission the officers and induct the crews then operating the three ships. It was soon apparent that the existing crews could not be held together under

[54] Unless otherwise indicated, this section on dredges is based upon: (1) 353, Engr Dredge Crew Units; (2) 320.2, Engr Dredge Crews (S); (3) P&T Div file, Dredge Crews, Gen (C); (4) Unit Tng, Annex I.

[55] (1) Memo, C of Civil Works Div for Bureau of the Budget, 5 Feb 44, sub: Supplemental Estimate for Hopper Dredges. 560, Dredges, 1944–45. (2) Cable, Eisenhower to TAG, 8 Oct 42. 560 (S). (3) Ltr, C of River and Harbor-Flood Control Br to Philadelphia Dist. Engr, 28 Sep 43, sub: Constr of Seagoing Hopper Dredges. 560.

[56] Ltr, Deputy C Engr ETO to Sturdevant, 17 Aug 43. O&T Br file, Personal Ltrs to Gorlinski (S).

a military system. There were physical disqualifications. Permission could be obtained to recruit only key men. It soon developed that even under pressure from the masters of the ships and from the District Engineers such key men showed little enthusiasm for the commissions and grades offered, particularly since few of them were subject to the draft. The chief electricians were especially concerned. Although by custom their authority was equal to that of the first mate, the table of organization made them warrant officers and the first mates first lieutenants.[57] The warrant grade would have reduced their pay, prestige, and authority and they refused to accept appointment. They were in a powerful position to bargain because replacements were virtually unobtainable. Few private hopper dredges existed from which to draw such special skills. The table of organization was therefore revised.

By mid-October 1943, most of the key men had agreed to their positions within the military framework. At that juncture a new crisis developed. When appointments for the masters and chief engineers came through, some of them were lower than the major and captain commissions agreed upon. These men also refused to accept rank which they considered lower than their civilian positions. Since the key men were being held together chiefly through the influence of the master, the refusal of this officer to serve with a ship would have caused most of them to walk out. A delay would have been inevitable in the readiness of the ships. By stressing the importance of the mission of the dredges and emphasizing Somervell's keen personal interest in meeting the sailing dates, the Engineers got the commissions adjusted.[58]

Only the more responsible positions could be filled through direct appointment and enlistment. Less important members of the crew such as deckhands, oilers, and wipers were to be obtained from other Army units through transfers of enlisted men with experience in boats and machinery. All were to have completed the basic military program in order that their entire training time might be used for technical instruction on the dredges. During the same period, the technically proficient key men would receive military training. All would thus be ready for overseas service at the same time. Of the first enlisted men assembled at Fort DuPont, Delaware, in October 1943, those who had been selected for cadres were satisfactory, but the rest were obviously culls. Of the latter, only half could be used. Most of them had little or no military training, or any compensating marine or mechanical background. Most were far below average intelligence. Many were Italians who understood little English.

There followed at Fort DuPont, under the supervision of the Philadelphia District Engineer, a weeding out and training of the three crews activated in October and of two others added in November. Of these five crews, one left for the Pacific on 1 December 1943 and the other four trained at Fort DuPont until March 1944, when they went to the European theater. Unlike that of the port repair ship crews, the training time for the dredge crews was not dependent upon the availability of the ships but upon the readiness dates set by ETO. Since that theater had indicated that the dredges would not be needed until April 1944, the

[57] T/O&E 5-647S, 30 Sep 44.

[58] (1) Rpt of Activities Mil Pers Br for Period Ending 13 Oct 43. 020, OCE, Jul 43–Dec 43. (2) Min, Staff Conf ASF, 22 Oct 43, sub: Résumé of Staff Conf, 22 Oct 43, Convened at 1000. 337, Staff Confs ASF (S).

training schedule for the crews was set accordingly. In late November 1943 the training was interrupted by a notice from the theater that every effort should be made to get the dredges ready during January. The special training program sent from O&T to Philadelphia in October had been made flexible for just such a contingency. Military training and weapons instruction could be cut short when necessary. However, 15 February 1944 was the earliest date that training could be completed, even with the abbreviated program. After only a short training program at DuPont, the crews began to move aboard the dredges for technical instruction in December. Some of the crews had been aboard the ships for some time when the readiness dates were changed again, allowing additional time. The crews were sent back to DuPont in shifts to complete the full military program prescribed for other Engineer units, leaving a skeleton crew aboard for housekeeping duty. Just as was the case for the port repair ship crews, the basic military training included such extraneous matter as scouting and patrolling, camouflage, and antitank measures.[59]

The seven additional dredge crews which the Engineers trained before the end of the war went to CBI or to the Pacific. Three of the seven were for cutter dredges which operated from fixed positions offshore and were moved from place to place by towboats. The others were for four new *Hains* class hopper dredges, authorized for construction in September 1943 and March 1944.[60]

Only six officers, one warrant, and twelve enlisted men had to be selected and trained for the first cutter dredge, the *Raymond,* and its towboat crew. These were to be augmented later by personnel already in the China-Burma-India theater. Even so the Engineers were pessimistic, remembering the experience with the hopper dredge crews. No officers or warrants were readily available in late November 1943 when the effort to assemble the crew first began. It was predicted that it would take about two months to find them. A few experienced enlisted men could probably be obtained from the ERTC's, but most of them would require additional training. The first of February 1944 was the desired readiness date; the crew was to be trained at Belvoir. Two more partial crews for cutter dredges were added in late December, to be trained at Claiborne for Pacific duty. No more than five to twelve weeks training could be expected for these crews, needed in February and April 1944.[61]

The Engineers attempted to fill these crews by transferring technically qualified men who had already completed the basic military program. By 5 January, only three out of the ten officers needed for the two Claiborne crews had been definitely ob-

[59] (1) Memo, C of Civil Works Div for Philadelphia Dist Engr, 20 Oct 43, sub: Notes of Conf. 320.2, Engrs, Corps of, 1941–43 (S). (2) Ltr, Gorlinski to Taylor, 27 Nov 43. O&T Br file, Personal Ltrs to Gorlinski (S). (3) Ltr, Actg C of WPD to Engr Sec ETO, 13 Dec 43, sub: Col Gorlinski's Ltr to Col Taylor, Dated 27 Nov 43. Same file. (4) Ltr, AC of O&T Br to Philadelphia Dist Engr, 26 Oct 43, sub: MTP for Engr Dredge Crews. P&T Div file, Dredge Crews—Tng Scheds.

[60] (1) Analysis of the Present Status of the War Dept Trp Basis, 1 Jan 45, p. 220. AGO Special Reference Collection. (2) Ltr, C of River and Harbor-Flood Control Br to Philadelphia Dist Engr, 28 Sep 43, sub: Constr of Seagoing Hopper Dredges. 560 (S). (3) Memo, Garcia for Oglesby, 24 Mar 44, sub: Seagoing Hopper Dredges. 560 (S).

[61] (1) Memo, Actg C of O&T Br for CG ASF, 26 Nov 43, sub: Pers for Dredge "Raymond." 320.2, Engr Dredge Crews (C). (2) Memo, Deputy Dir for Plans and Opns ASF for CofEngrs, 19 Nov 43, sub: Dredge Operating Pers for CBI. F&T Div file, 12-Inch Cutter Type Dredge Crews (S).

tained, despite a high priority because of the early movement date. The Transportation Corps also needed men with marine experience and was not required to give them up. Promotions made some of the men ineligible for designated positions after selections had been made. The crews which finally assembled at Belvoir and Claiborne varied in proficiency, but most of the enlisted men in all three crews had only basic military training and required technical instruction aboard dredges. The crew at Belvoir subsequently received on-the-job instruction in February on a dredge then operating near Dahlgren, Virginia. The two crews at Claiborne trained aboard a dredge near Galveston, Texas, before assignment overseas.[62]

There was more time to assemble and train the crews for the four new *Hains* class hopper dredges, the *Lyman, Barth, Davison,* and *Hyde.* By January 1944 the estimated completion dates of the first three of these ships gave the Engineers nearly a year to provide crews. Nevertheless, there had been so much difficulty with the previous hopper dredge crews that Renshaw, at Philadelphia, began in that same month to urge the immediate activation of the units at Fort DuPont. But the four crews of fifty-five officers and men each did not begin training until much later, one in July and three in November. In order to take advantage of the basic military training facilities at the training center at Belvoir, these four crews went there first for six weeks. They then transferred to DuPont for eleven weeks of technical instruction. As the dredges were commissioned, the men moved aboard for six weeks or more of unit training.[63]

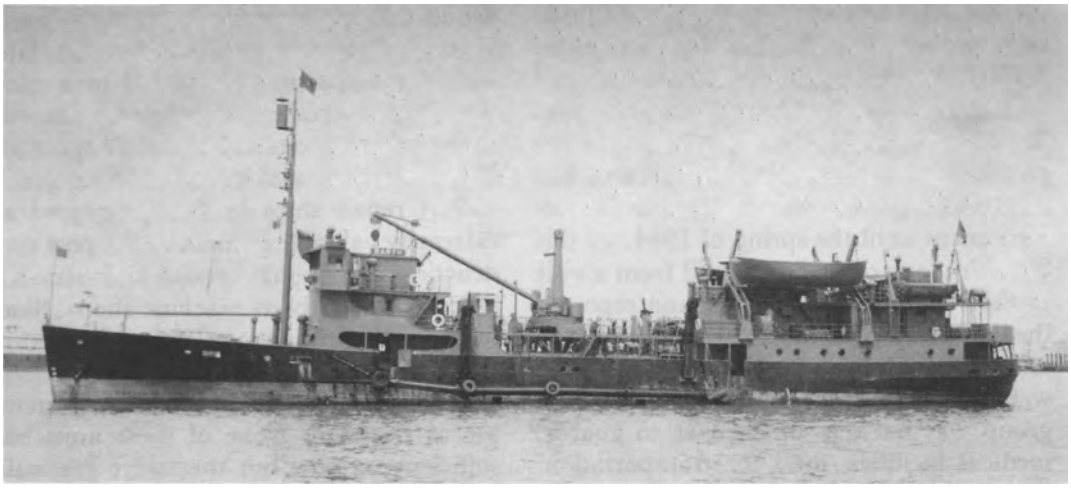
Although the instruction aboard the dredges was of a practical nature, the technical training ashore at DuPont was unsatisfactory. An inspection in early March 1945 revealed that "most of the technical training consists of classes in seamanship, chart reading, signaling, rigging, and international code. These subjects are repeated over and over again until all interest in them has ceased and the training has reached a 'mark time' status." [64] A more carefully planned program for shore technical training resulted, including orientation to shipboard life, the mission of the ship and the characteristics of its equipment, the duties of all members of the crew, basic seamanship, nautical nomenclature, watch standing, elements of navigation, radio and visual signaling, swimming and lifesaving, first aid at sea, vessel and aircraft identification, and abandon-ship drills on ropes and ladders as a part of physical conditioning. Drag tenders went to the Maritime School at Brooklyn and served for six weeks aboard dredges in the Philadelphia District.

Paradoxically, the personnel for these last crews was much improved over that furnished to the first hopper dredges. The crew of the *Barth,* for example, contained many capable men with mechanical background from the Belvoir training staff, released through the War Department policy of replacing instructors in training installations

[62] (1) Memo, AC of Mil Pers Br for CG ASF, 5 Jan 44, sub: Pers for Engr Dredge Crews, with 1st Ind, 12 Jan 44. 320.2, Engr Dredge Crews (C). (2) Msgform, ExO WPD to CG Eighth SvC, 5 Feb 44. 353, Engr Dredge Crews.

[63] Ltr, TAG to CG MDW, CofEngrs, 12 Oct 44, sub: Preactivation Tng for Type Engr Dredge Crews (DE–7) Beginning November 1944. 353, Engr Dredge Crews.

[64] Memo, Maj A. L. Dean and Capt O. E. Deberg for Dir Tng ASF, 21 Mar 45, sub: Rpt of Inspec of Engr Units at Ft. Mifflin, Pa., and Ft. DuPont, Del. P&T Div file, Dredge Crews, Gen (C).



BARTH, HAINS CLASS HOPPER DREDGE

with veterans of overseas service.[65] The combination of longer training time and better qualified men produced excellent crews. However, only three of the four *Hains* class hopper dredges left the United States for the Pacific before the war was over. The *Davison,* upon completion, was transferred to the civil works organization.

The Chief Engineer of the European Theater of Operations would have preferred dredges of shallower draft. Perhaps observing that the *Marshall* class, drawing 24 feet when loaded, could not operate in some harbors and estuaries at low tide, he came to the conclusion that a smaller ship would have been more useful.[66] But, as the experience of the *Marshall* had shown, the range of tides was so extreme in many European ports that not even the *Hains* class could have dredged continuously. The greater hopper capacity, the ability to dredge larger boulders, and the center suction pipe without overhang along the side enabled the *Marshall* to work close in to wet docks, remove submerged rubble that would have been impossible for the smaller ship, and make a long run to the dumping ground with a larger payload of silt and rock. At Antwerp and Bremerhaven the *Marshall* dredged at all stages of tide without grounding, although at Bremerhaven it did occasionally "plow through the silt on low tide." [67] In the Pacific, the dredges were useful in enlarging northern Australian ports and deepening existing channels to accommodate Liberty ships. Along the New Guinea coast there was too little time for dredging, but fortunately the precipitous nature of the coastline allowed large vessels to unload close inshore onto floating docks and temporary wharves. In the Philippines, the dredges became important again. The hopper dredge *Hains* and the cutter dredge *Raymond* removed a shoal bar across the channel into Tacloban Harbor, Leyte, and deepened the harbor itself. In Manila, where

[65] Information from A. Jelland, 1st Mate of the *Essayons* (formerly wartime commanding officer of the *Barth*), 13 May 1953.

[66] *Final Engr Rpt, ETO,* p. 272.

[67] Incl to Ltr, Lt Col William E. Miller to C of Mil Hist [Jan 54].

the whole harbor had silted up under Japanese neglect, five dredges removed some 3,250,000 cubic yards of sand and debris.[68]

The Engineers had been dissatisfied from the beginning with the organization of the port reconstruction units into groups, but had no tangible evidence against the arrangement until the spring of 1944. At this time Trudeau of ASF returned from a visit to the North African theater and reported that the 1051st Engineer Port Construction and Repair Group was short of men. Units were attached for only limited periods. The group was not self-sufficient as to guards, medical facilities, mess, or transportation. Worst of all, it could not operate its equipment on a two-shift basis. Gorlinski seized this opportunity to comment. The most objectionable feature of the group theory, he wrote ASF, was that success depended upon how many and what type of units were attached for a particular operation. To make the right decisions as to such units required full awareness on the part of the theater staff of the demands such operations entailed. As to inadequacies in equipment, Gorlinski noted that the group was issued a minimum amount with the idea that it would be supplemented to meet the needs of particular situations. Several months later the War Department assented to a nineteen-man increase in enlisted men—an addition that permitted two-shift operation of construction machinery and lifting gear.[69]

Port repair ships in Europe proved an extremely valuable adjunct to the port construction and repair groups and attached units, particularly as machine shops. Since the Navy performed most of the port salvage work, the heavy lifts with which the ships were outfitted did not come in for as much use as expected. None of these units had sufficient training but they were gradually brought up to standard in the course of operations. One of the key ports which these units helped to reconstruct, Cherbourg, was cleared for shipping in twenty-three days.[70]

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[68] *Engineers of the Southwest Pacific 1941–1945*, Vol. VI, *Airfield and Base Development* (Washington, 1951), pp. 296, 443–52.

[69] (1) Extract of Rpt on ASF Installations in North African TofOpns, 25 Mar 44, Incl with Memo, CofS ASF for CofEngrs, 12 May 44, sub: T/O&E 5–52, Engr PC&R Group, with 1st Ind, 3 Jun 44. 320.2, Engr PC&R Group (S). (2) T/O&E 5–52, 16 Sep 44.

[70] *Final Engr Rpt, ETO*, pp. 271–74.

CHAPTER XVIII

A New Mission: Petroleum Distribution

Of the many supplies which passed through reconstructed ports, petroleum products were among the most vital.[1] Gasoline and fuel oil accounted for more than one half of the tonnage shipped overseas during World War II. From 300,000 to 800,000 gallons a day were required by a field army or a tactical air force. To distribute such amounts by tank car or truck placed unwonted burdens on railways and roads, and, in case trucks were used, added considerably to the consumption of gasoline. Trucks delivering gasoline over the Burma Road consumed half of their load in making the trip.[2]

Beyond the port area, where tankers discharged their loads to bulk tank farms, the speed with which gasoline and fuel oil could be distributed to field armies and air bases in large part determined the tempo of offensive action. Rapid distribution was imperative. The Corps of Engineers developed for this mission a new type of unit, the petroleum distribution company. Such companies, equipped with lightweight, easily assembled pipes and storage tanks, and portable pumping stations, greatly reduced the logistic effort in time, tonnage, and manpower.

Pipelines did not replace completely the earlier methods of distribution. The Quartermaster Corps (QMC) distributed great quantities of petroleum products by tank, drum, and can. At any beachhead or landing point the initial supply was still lightered ashore in drums and cans and moved forward by the Quartermaster Corps. The Corps of Engineers meanwhile installed marine pipelines from floating tankers to bulk storage tanks ashore. From such tank farms the Engineers then ran pipelines to more forward QMC refilling points, extending the system of pipelines, pumping stations, and storage tanks inland as required by the advancing forces.[3]

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[1] Unless otherwise indicated, this chapter on petroleum distribution is based upon: (1) ERDL file, EB 143; (2) Col James E. McNary and Col Edson W. Berlin, Hist of Dev of Mil Pipelines, 28 Dec 45, typescript in EHD file, Hist of Dev of Mil Pipelines; (3) QMC 400.112, Pipeline, Portable; (4) 353, Engr Heavy Shop Units, Claiborne, Bulky; (5) 220.3, Engr Petroleum Distr Units; (6) Tel Conv, Lt Col Kenneth L. Treiber, 27 Aug 53; (7) 353, ASFTC Claiborne, Pt. 2; (8) 475, ASFTC Claiborne; (9) P&T Div file, Petroleum Distr Units (S); (10) Mech Equip Br file, Portable Pipelines, Shenandoah National Park; (11) S–3 Memos for File, EUTC Claiborne, 1943–44, EHD files; (12) Engr Bd Rpt 756, Final Rpt on Submarine Sea Loading Lines, 10 Jul 43; (13) Engr Sch Spec Text, ST–5–350–1, Military Pipe-Line Systems; (14) Hist Rpt 13, Liaison Sec Intel Div, Office of C Engr ETO, Petroleum-Oil-Lubricants. AG Special Collection, Opn Rpts; (15) Unit Tng, Annex I. (16) Ltr, Chauncey W. Karstens to C of Mil Hist, 29 Jan 54, with Incl.

[2] (1) Charles F. Romanus and Riley Sunderland, *Stilwell's Mission to China,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1953), Ch. I. (2) Joseph Bykofsky and Harold Larson, *The Transportation Corps: Operations Overseas,* UNITED STATES ARMY IN WORLD WAR II (Washington, 1956), Ch. IX.

[3] See Risch, *QMC: Organization, Supply and Services, Vol. I,* pp. 34, 35, 144–46.

Restricted Use of Pipelines by the Quartermaster Corps

Realizing the potentialities of this combination, a handful of officers, representing various services, had begun during the thirties to advocate pipelines as a supplement to and a partial replacement of distribution of petroleum by truck or rail. Those who argued for the Army's adoption of pipelines could point to precedents. The Corps of Engineers had used pipelines while building the Panama Canal. During World War I the Engineers had connected several tank farms to dock areas. During the same war a thirty-six-mile pipeline laid across Scotland from just south of Glasgow on the Clyde to Grangemouth on the Firth of Forth supplied the oil which otherwise would have had to be shipped in tankers through the submarine-infested waters of the North Sea.[4] After 1930 several large military airfields installed pipeline distribution systems. The Navy had used pipelines extensively for refueling ever since 1915 when it had switched from coal to oil. The petroleum industry, expanding rapidly after World War I, developed a field system to handle drilling mud and water, and to gather crude oil. Pipelines soon brought crude oil from field to refinery and short lines carried products from refinery to shipping points. But compared to other means of petroleum distribution, pipelines had been used very little. Their advocates could only point out that the success of the few systems installed argued for their military feasibility.

Until the late twenties petroleum pipelines had been constructed of sections of heavy pipe, screwed or welded together. Because of the difficulties of transporting, handling, and assembling, such a design did not lend itself readily to the needs of the military. By the beginning of World War II the petroleum industry had designed a lightweight, easy-to-assemble, pipeline system. A standard 20-foot length of 4-inch pipe weighed 186 pounds. A lighter 4-inch pipe, later called "invasion tubing," weighed only 68 pounds. Each could be fitted at either end with a nipple grooved to match what was commonly called a victaulic coupling, after one of its fabricators, the Victaulic Company of America. The victaulic, or similarly designed coupling, consisted of a synthetic rubber gasket held in place by two semicircular metal castings. Hydraulic pressure from inside the pipe caused the gasket to expand and form a joint that would, except in unusually rugged terrain, hold as tight as if welded. Unlike a welded coupling, the joint was not rigid but allowed about six degrees of flexibility. Although this type of coupling had been developed in Britain during World War I, it had not been used for years thereafter except in water and sewerage systems because no gasket material had been found that would resist for long the action of crude oil and refined products. With the introduction of synthetic rubber gaskets in the mid-1930's pipelines coupled in this manner became feasible.

In December 1939, the manager of the Transportation Department of the Shell Oil Company, Incorporated, offered the QMC, as the service responsible for the purchase and distribution of petroleum products, a study entitled "Transportation of Gasoline in the Theatre of Operations." The study was both imaginative and practical, applying the accumulated knowledge of the petroleum industry to a military require-

[4] Suggested Corrections, 12 Dec 45, by McNary to Hist of Dev of Mil Pipelines. EHD file, Hist of Dev of Mil Pipelines.

ment, at that time only vaguely comprehended. The study contained all of the major elements of the military pipeline systems that were to be used during World War II, including lines from ship to shore, bulk storage tanks beyond the water line, and a pipeline with pumping units leading right up to the front lines. During January and February 1940, the manuscript passed from one desk to another in the Transportation, Supply, and Construction Divisions, QMC, without causing much stir. Most agreed that the idea had merit, but there is no evidence that any action resulted beyond the sending of a copy of the study to the Army War College.[5]

After the maneuvers of 1940, the commanding general of the Armored Force joined the pipeline enthusiasts. But it was not until 1941, when the Motor Transport Division of the Quartermaster Corps began to examine a new concept of gasoline dispensing from railroad sidings, that the theoretical benefits of military pipelines began to approach reality.

On 26 February 1941 the War Department approved the military characteristics of a new gasoline dispensing system submitted by the Quartermaster Corps earlier that month. The QMC proposed to develop a pipeline as the primary means of delivering gasoline from tank cars to can and drum refilling points whenever tank trucks were not available or wherever features of terrain made the use of trucks impractical. All pipe, pumps, engines, hose, tools, and victaulic couplings were of standard commercial design. The pipeline was to extend for a maximum of five miles from railhead to final distributing point and was to deliver about eighty gallons of gasoline a minute.[6]

From March through May the Motor Transport Division laid plans for a five-mile test section of three-inch pipe to be built on the government reservation near the Military Academy at West Point. Two officers and one hundred enlisted men from the Holabird Quartermaster Depot were to construct the line. But during the course of the next few months this complicated project was curtailed. In the end, the pilot model consisted of only a quarter of a mile of pipe installed at the Holabird Depot.

This model was ready for inspection on 30 October. Representatives from the Corps of Engineers, among others, stood on a creek bank and watched the system pump water through 200 feet of hose laid across the creek on floats, and through a three-inch pipeline along the opposite bank to two multiple-hose dispensers. All observers agreed that the pipeline was a success. The Motor Transport Division, by this time completely convinced of the worth of its pipeline, suggested that the line might also be used to refuel planes and to span awkward ship-to-shore distances in the Panama area where docking facilities were not available for unloading barges.

Anxious to give the pipeline a field test, the Motor Transport Division moved immediately to insure that the system would have a tryout during the First Army maneuvers in November. The day following the Holabird test, 2d Lt. Carl D. Becker was on his way to Florence, South Carolina, to select a location for a general test of equipment and for premaneuver training of QMC troops. After his arrival at Florence, Becker decided to break the seven miles of pipe into several units in order to provide

[5] QMC 463.7, Misc, Compiled 1940.

[6] Ltr, Brig Gen J. E. Barsinski to TAG, 15 Feb 41, sub: MCE No. 2 Portable Pipeline Unit, with Incl, MCE No. 2, with 1st Ind, 26 Feb 41. QMC 400.1141, Pipeline, Gasoline Portable.

training under different situations. A complete five-mile system would be laid out later in the month during maneuvers wherever the General Staff dictated.

The site chosen by the General Staff extended from a railhead at Hydro, North Carolina, across the swift Pee Dee River, up the steep bank, and on to a refilling point for the First Army near Norwood. Forty-eight enlisted men from the 56th Quartermaster Regiment, divided into three working parties of sixteen men each, laid the pipe at a rate of one mile an hour. The centrifugal pumps delivered gasoline at the end of the line at a rate of about 4,000 gallons an hour. Supply valves, with three hoses each, could be cut into the pipeline at any coupling for refilling cans.

The QMC realized the potential of the pipeline for discharging an offshore cargo of gasoline but was still too closely tied to the original dispensing idea to see beyond the five-mile goal. One observer recorded his impressions in a magazine published by the Holabird Quartermaster Depot. Struck particularly by the floating section across the river, he attempted to force more ambitious claims from one of the QMC officers in charge:

> The officer pooh-poohed the romantic notion that the pipeline would stretch right up into the front line refueling the tanks and trucks hustling about the fields of combat. "The main use of it," he declared, keeping his feet on the ground, "is to break up the concentration of men, trucks, and fuel containers at base sources of supply. The line will make it easy to establish fuel dumps and keep them well supplied. That's the main use of it." [7]

Godfrey was intrigued by the demonstration and instructed Schull, then executive officer of the 21st Engineer Aviation Regiment, to give the pipeline a thorough inspection. Schull's report from Spartanburg on 30 November was detailed and enthusiastic. The pipeline might well be used for direct refueling of planes at an airdrome from a bulk source of gasoline safely hidden several miles away. He recommended that the 21st make further tests. On Christmas Eve, 1941, Godfrey relayed all of the information he had gathered to the Chief of Engineers, including the rumor that the QMC planned to organize a battalion of four companies around this equipment. Each company would carry four miles of pipe. While granting that "the Quartermaster General has initiated the development of this equipment," Godfrey was of the opinion that the pipeline was "also of interest to the Corps of Engineers." [8]

The Potential Realized by the Corps of Engineers

The Corps of Engineers, since November 1940, had been responsible for purchasing and installing permanent gasoline pipelines and storage tanks at airfields within the United States.[9] By the time Godfrey made his report, portable pipelines were also "of interest" to the Corps, but on a much larger scale than that envisioned by the QMC. In the fall of 1941, just as the QMC prepared to build its pilot model at Holabird, a request from the Chinese Government for lend-lease funds to purchase pipeline equipment precipitated Engineer testing of portable pipelines of heavier caliber. The Shell Oil Company, through Sid S. Smith, had

[7] Anon., "Portable Pipelines," *Army Motors*, II (December, 1941), 266–67.

[8] 2d Ind, Engr AF Combat Comd to CofEngrs, 24 Dec 41, on Ltr, ExO 21st Engr Avn Regt to CO 21st Engr Avn Regt, 30 Nov 41, sub: Inspec of Portable Pipeline. QMC 400.112, Pipeline, Portable.

[9] (1) 678. (2) Tel Conv, Roland Ost, 25 Jul 55. (3) Tel Conv, George B. Seeley, 25 Jul 55.

been urging since 1940 the construction of a 715-mile pipeline paralleling the Burma Road, but the War Department had refused to listen. Smith then turned to the Chinese and persuaded them to adopt this plan. Shell engineers under the direction of Smith designed a pipeline system for this road using reciprocating pumps and an arrangement of control equipment that had never been tried before, not even by the Shell Company. Smith compiled these plans into a small booklet titled, "Portable Pipe Lines." This was the system which the Chinese requested. Fortunately for those who had been advocating military pipelines, the Shell maneuver with the Chinese stirred interest at top levels, bypassing many who had turned a deaf ear to earlier suggestions.[10]

On 17 September 1941, Smith explained his pipeline system at a conference held in the office of Brig. Gen. John Magruder, Chief, Military Mission to China. Also present, in addition to members of the Military Mission, were representatives from the Corps of Engineers and the Asiatic Petroleum Company, as well as the president of China Defense Supplies, Incorporated. The Corps of Engineers was already deeply involved in defense aid to the Chinese. Procurement of materials had begun for proposed improvements to the Burma Road and for the construction of a railroad to parallel it. This background, coupled with the fact that the installation of such a pipeline along the Burma Road would be essentially an engineering construction job, explained the presence of the Engineer officers at the conference. Maj. Theodore T. Molnar, chief of the Defense Aid Unit, headed the Engineer delegation. To this assembly Smith pointed out the shortage in steel drum production in the United States and the impossibility of getting any drums from the British, who had already obligated for military purposes all steel drums that could be manufactured in Singapore, Rangoon, and other parts of Burma for months to come. The pipeline he described would take up less shipping space than the equivalent drums which would be necessary to move the quantity of motor fuel contemplated. Pipeline equipment would also offer less temptation to the Chinese populace, which had already acquired a taste for steel drums.[11]

The system which Smith described provided for "invasion tubing" grooved for victaulic coupling, and, as Smith asserted, there was nothing untried in the reciprocating pumps or the engines which drove them. The only untried part of Smith's design was his particular arrangement of automatic controls. The petroleum industry, according to Smith, already used similar devices which worked on the theory that "pressures in a pipe line can be used to functionally control the flows in the line so that it can, however long, however complicated, or however unlevel, be turned on and off at the delivery point like a garden hose, meanwhile functionally controlling all of its parts so that no dangerous pressures are generated by its stoppage nor dangerous runaways or voids created by its restarting." The Smith system provided means for slowing the engines and bypassing the flow

[10] Ltr, Karstens to Office of Tech Info OCE, 9 Nov 45, sub: Comments on Pipeline Articles. EHD file, Hist of Dev of Mil Pipelines.

[11] (1) Incl, Rpt of Conf in Magruder's Office Between the WD, Representatives of China Defense Supplies, Inc., and the Shell Oil Co., to Memo, C of Sup Sec OCE for C of Mil Mission to China, 22 Sep 41, sub: Proposed Pipeline To Be Constructed in China. 400.333, China, Pt. 2. (2) Leighton and Coakley, *Global Logistics and Strategy*, pp. 86, 87. (3) See above, pp. 100, 102.

around a station in response to pressures felt at a given point. For the delivery of 4,000 to 6,000 barrels a day over level ground, pumping stations would be installed at 20-mile intervals. Pumping stations were to be mobile so they could be shifted about as the military situation warranted. Smith estimated that provided "sufficient truck and stringing forces are properly organized and trained . . . there should be no difficulty to transport, lay, and have stations operating on up to thirty miles per day." [12]

A few days after this conference, Dr. T. V. Soong, president of China Defense Supplies, Incorporated, wrote to the home office of the Military Mission to China. Technically qualified people had confirmed the merit of the pipeline. Soong now proposed to send someone to Burma to "study local technical problems." He added that "since this pipe line project has been given such favorable consideration by eminent engineers, may we suggest that you refer it to the Chief of Staff of Army Engineers for his thorough study." [13]

General Magruder had already acted. He was uneasy over the fact that the control system was untested. The project involved about $5,000,000 and some 16,000 tons of steel. An investigation should be made before lend-lease agencies gave their full support to a project of this magnitude, involving large amounts of critical materials. On 18 September he requested the Corps of Engineers to make the study, adding that the Shell Oil Company was again presenting this portable pipeline to the Quartermaster Corps "as a rapid means of transportation of gasoline in the field." [14]

After a cursory study, the Engineers expressed considerable skepticism. On 3 October Kingman pointed out to Magruder that this portable pipeline was more complex and was to be laid over more difficult terrain than any of the permanent automatic pipelines then in existence. The forty pumping stations, with six automatic controls each, presented 240 possibilities for control failures. With the use of twenty-foot lengths of pipe with victaulic couplings, leaks could occur at some 200,000 points. Moreover, Kingman believed Smith's cost estimates too low and his rate of laying too optimistic. But he admitted that the line "appears to have sufficient merit, technically, in the opinion of the Chief of Engineers, to justify further investigation. A list of pipe line authorities has been prepared for consultation if such further investigation is assigned to the Chief of Engineers." [15]

Within the first few weeks of 1942 the Japanese invaded the Netherlands Indies, the capture of Singapore was imminent, and the closing of the Burma Road was a matter of time. The military situation, coupled with the critical attitude of the Corps of Engineers toward the Smith system, caused Magruder to stop all action on the project on 21 January.[16] Smith, however, having got so far, was not easily discouraged. The Burma Road had been uppermost in his mind before, but after the United States formally entered the war he turned his

[12] Pamphlet, Portable Pipe Lines, Shell Oil Co., Inc. (1941). EHD files.

[13] Ltr, President China Defense Supplies, Inc., to Col H. W. T. Eglin, 26 Sep 41. 400.333, China, Pt. 2.

[14] Memo, Magruder for CofEngrs, 18 Sep 41, sub: Oil Pipeline for Burma Road. 400.333, China, Pt. 2.

[15] 1st Ind, Kingman to Magruder, 3 Oct 41, on Ltr, Magruder to OCE, 18 Sep 41, sub: Oil Pipeline for Burma Road. 400.333, China, Pt. 2.

[16] (1) Memo, Eglin for CofEngrs, 21 Jan 42, sub: Gasoline Pipeline—From Bhamo, Burma, to Kunming, China. 400.333, China, Pt. 2. (2) Ltr, Molnar to C of EHD, 28 Jul 55.

efforts toward proving that his pipeline system was simple enough and rugged enough for general military use. The Chinese, despite Magruder's attitude, maintained an active interest.

In March, Smith invited the Corps of Engineers and the Chinese to send representatives to the East Chicago plant of the Shell Oil Company, where he had set up a pilot pipeline. This step proved to be the turning point. Baker, from the Engineer Board, laid plans at once for a large-scale test. On 8 April he proposed to OCE that the board build a 30-mile line of 4-inch pipe, complete with pumps and automatic controls.[17]

The matter was then up to OCE. Fowler favored the project, visualizing at once the possibilities. "This scheme, if workable," he noted to Chorpening on 10 April, "has great military value. The rate of installation would keep up with any reasonable offensive and thus take a lot of traffic off the roads." [18] But the question for immediate decision was whether this test should be combined with the purchase of pipeline equipment for the Chinese. Fowler thought it should.

> If the Chinese will have a place to lay the line by the time we can get it fabricated, we should order it at once, provided it has a reasonable chance of being shipped and working satisfactorily. . . . I believe this pipe line may mean much to the Chinese Army this year and that, if tested immediately as manufactured, any mechanical defects can be corrected before shipment.
>
> The Board should acquire the pipe, pumps and other equipment for test immediately. If purchased as part of the Chinese order, time and production costs will be reduced. The time for laying 30 miles of pipe is negligible. Two weeks of continuous operation should bring out the worst bugs. The Board should therefore be able to recommend changes within 30 days of delivery of the test equipment and the changes incorporated in later deliveries of the Chinese order. . . . I would say that we would be taking a small gamble in cost of alterations if we place the Chinese order now with the possible advantage of keeping the Chinese Army on its feet until more substantial help can arrive. Should the Burma Road be captured by the Japs this year, we would still have the pipe line to support some other force.[19]

Although Rangoon had just fallen to the invading Japanese, diminishing the likelihood that the Chinese would ever build a pipeline along the Burma Road, OCE decreed that the experiment should go through without delay. The Engineer Board, acting upon oral instructions from Chorpening, obtained on 11 April a quotation from Hanlon-Waters, Incorporated, of Tulsa, Oklahoma, on four pumping units and thirty miles of pipe. Confirmation of procurement authority came on 15 April.[20] On 30 April, Besson, chief of the Development Branch, outlined in more detail what the board was to do. Specifying that "the tests will be performed as an Engineer Board study in connection with the procurement of portable pipelines for the Chinese Government," he indicated there would also be a broader purpose. "Tests on the pipeline should include investigation as to the suitability of the operation by troop labor, speed of laying and moving the line, dependability of automatic control devices, and general suitability of all the component parts of the

[17] (1) Ltr cited n. 16 (2). (2) Ltr, Baker to Molnar, 8 Apr 42, sub: Preliminary Rpt on Portable Pipeline for Fuel Oils. 400.112, Pipelines.

[18] Memo, Fowler for Chorpening, 10 Apr 42, sub: Preliminary Rpt on Portable Pipeline for Fuel Oils. Intnl Div file, 678.

[19] *Ibid.*

[20] (1) Memo, Baker for Besson, 11 Apr 42, sub: Portable Pipeline Test. 400.112, Pipelines. (2) Ltr, Actg C of Sup Div to President Engr Bd, 15 Apr 42, sub: Portable Pipeline. 400.333, Pt. 3.

complete system." [21] The Engineers were ready to test a pipeline for general military use, Quartermaster Corps responsibility to the contrary.

The board placed in charge of the tests Chauncey W. Karstens, one of its associate engineers then assigned to the Water Supply Branch. In May 1942 Karstens, an Engineer Reserve officer, was ordered to active duty as a first lieutenant and became head of a newly formed Pipeline Equipment Section. Assisting him were 1st Lt. Ernest A. Slade, who had previously manufactured control devices for pipelines, 2d Lt. Kenneth L. Treiber, who had worked for nine years on pump designs and hydraulic problems, and John Elder, an employee of the board's Bridge Section, who had previous experience in installing pipelines.[22] OCE was particularly interested in determining whether or not the automatic controls would relieve the system if it were subjected to high static pressures. To this end, Besson suggested a testing site in the mountains of the Shenandoah National Park in Virginia.[23]

For a number of reasons, Karstens favored the use of troops rather than civilian labor on the project. The labor force would consist of types and grades of men to be expected in the field, it would be stable, and it would be subject to discipline. Estimates of construction time and recommendations regarding personnel would thus be more accurate. The work would provide valuable training. Karstens estimated that one company of a general service regiment would be required. But troops could not be spared for such work in the spring of 1942. After making a detailed survey of the site, the supervisory staff on 30 June set up camp on the Rapidan, near Herbert Hoover's fishing lodge, and began hiring civilian labor.

Meanwhile, a request from the European Theater of Operations had channeled the question of petroleum distribution toward a more definite objective. On 5 June, Clay of SOS asked the Engineers to make a study of means for supplying gasoline for the projected invasion of Europe.[24] On 1 July, OCE cabled SOS, ETO, as follows:

> Until a front is consolidated, approximately 30 miles inland, the supply will be in cans and drums for the first phase. During the second phase, supply will be made through pipeline to shore tanks by tankers. Light-weight and rapidly constructed pipelines which can easily be carried by men and laid at the rate of 20 miles or more per day will be used. Distribution from tanks will be made to six or more light-weight pipelines. To allow inter-connection and spread distribution, lateral lines will be laid at strategic points inland.[25]

This plan fitted in exactly with the thinking of British and American officers in England, where the development of military pipelines had been underway since the German break-through in France in May 1940. In fact, upon the very day OCE sent the cable to SOS, ETO, a cable incorporating the same general plan of distribution crossed the Atlantic in the opposite direction, from the British War Office to the British Army staff in Washington. By July, both OCE and the Engineers in the United Kingdom had

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[21] Ltr, C of Dev Br to President Engr Bd, 30 Apr 42, sub: Test of Experimental Pump Equip. 412.3, Pt. 2.

[22] Engr Bd Hist Study, Pipeline Equipment, p. 12.

[23] Ltr, C of Dev Br to President Engr Bd, 20 Apr 42, sub: Test of Experimental Pump Equip. 412.3, Pt. 2.

[24] Ltr, AC of O&T Br to Deputy CofS for Rqmts and Resources SOS, 17 Jun 42, sub: Gasoline Sup Plan for BOLERO. P&T Div file, 381, BOLERO, Folio 1.

[25] Quoted in Hist Rpt 13, Liaison Sec Intel Div, Office of C Engr ETO, Petroleum-Oil-Lubricants, p. 6. AG Special Collection, Opn Rpts.

begun to think in terms of a military organization to lay and operate the pipeline.

OCE was reluctant to make any recommendation until it had some evidence from the experimental tests in Virginia. A pipeline expert would be necessary to evaluate the experience and translate it into terms of men and equipment. For this job, OCE obtained Edson W. Berlin, in July 1942, from the construction department of the Socony-Vacuum Oil Company, Incorporated. To determine the best organization for the work, Berlin became a frequent visitor to the test site in the Shenandoah National Park.[26]

The first carload of pipe arrived at the park on 8 July and stringing it began immediately. With a crew that varied from ten to thirty-five, it took eighteen working days to install the first sixteen and a half miles of the system, complete with four pumping stations. On the whole, the process of installation proved simple. Contrary to expectations, a number of local farmers applied for jobs at laying and operating the test line. They proved willing and able workers, and the fact that they possessed little or no mechanical experience served to gauge the amount of time it might take to train similarly inexperienced troops. The main difficulty in laying the pipe was with defective couplings. The products of three manufacturers were installed. At first only those supplied by the Victaulic Company provided the tight fit necessary, but in a short time the Guston-Bacon Company remedied its product so that it, too, was completely satisfactory. By 1 August, Smith was on hand to supervise the adjustment of the automatic controls. The system was ready for operation.

The Corps of Engineers had by this time gone far beyond the original purpose—to test a pipeline for the Chinese. The distribution of petroleum products to the Army was a responsibility of the Quartermaster Corps. On 28 July, SOS held a conference to clear up the confusion. In effect, the *status quo,* based upon equipment either developed or under test, became official doctrine. The QMC would henceforth supply and maintain "portable pipe lines used in issue of gasoline," including dispensers and pumps. The Engineers would construct and operate "all pipe lines and storage facilities of permanent or semi-permanent nature." [27] Since the QMC considered anything larger than its three-inch pipe "semipermanent," this agreement amounted to an abdication by the QMC of any major role in petroleum distribution by pipeline. On 7 August The Adjutant General's Office elaborated upon this agreement. The Corps of Engineers was to make connections with floating cargo, erect storage tanks near the shore line, and from that point advance pipelines and storage facilities as the tactical situation permitted. The Quartermaster Corps would carry on from there with three-inch dispenser systems. By 17 September, when the War Department made a formal restatement of the development responsibilities of the various services, pipelines were allotted to the Chief of Engineers; dispensers went to the Chief of Ordnance.[28]

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[26] Ltr, Actg C of Dev Br Sup Div to President Engr Bd, 25 Jul 42, sub: Portable Pipeline. 400.112, Pipelines.

[27] Memo, Dir Opns Div Motor Trans Sv to Supply Div Motor Trans Sv, 29 Jul 42, sub: Responsibility in Trans and Storage of Liquid Fuels in Overseas Opns. QMC 463.7, Cross References Only, 1942.

[28] (1) Ltr, TAG to CGs AGF, AAF, SOS, *et al.,* 7 Aug 42, sub: Responsibility for Proc, Maint, and Opn of Gasoline Dispensing Facilities Overseas. QMC 463.7, Cross References Only, 1942. (2) WD Cir 317, 17 Sep 42.

Testing Equipment

Now vested with authority, the Engineers continued their experiment in the park. Once full-scale operations began, bugs in the pumping stations became apparent. The pistons of the reciprocating pumps wore out, causing frequent shutdowns for repairs. The group at Rapidan lost all faith in the Smith combination of reciprocating pumps and elaborate controls and safety devices. Treiber was sure that centrifugal pumps with manually controlled stations would be safer and more practical for a military pipeline. Part of the complication of the Smith system lay in trying to make a reciprocating pump do the work of a centrifugal pump. While reciprocating pumps build up pressure indefinitely until some part of the system gives way or a relief mechanism takes over, centrifugal pumps build up pressure only to a certain point and then churn without danger. Treiber therefore urged the substitution of the lighter, safer, pickup centrifugal pump, commonly called PUP, manufactured by the Byron-Jackson Company. With this pump, no automatic controls would be necessary.

There was no question but that the automatic controls were the most troublesome part of the system. They were almost constantly in need of adjustment. "In general," wrote Karstens on 30 September, "control performance has not come up to expectations. To adjust so that the desired performance is attained is one thing, but to retain such adjustment is another matter. . . . It is felt the system will work, but the question arises as to whether it is a little too complex for military field use." [29] The automatic controls were "too sensitive to minor misadjustments." Their use would require "the continuous attention of expert operators to maintain a uniform throughput rate under field conditions." [30] In strong support of Treiber and Karstens against the Shell Company's control system was Dr. Lester M. Goldsmith, vice-president of the Atlantic Refining Company of Philadelphia and chief engineer for the 24-inch cross-country pipeline, popularly termed the "Big Inch." Goldsmith was emphatically against the complicated control gadgets and spoke out vigorously for manual control of all stations and for centrifugal pumps. With this additional backing, Karstens recommended that the automatic controls be abandoned.

Some centrifugal pumps without automatic controls were ordered during the operations at the park but were not delivered in time to be tested there. Subsequent tryouts at Belvoir indicated that this type of pump, with some modification, would be well suited to the job. But the total industrial capacity for centrifugal pumps was at this time allotted to shipbuilding programs and the Engineers had to be content for some time with reciprocating pumps. Later, when some centrifugal pumps became available, the Engineers ordered them in great numbers. Despite the fact that the PUP did not turn out to be as sturdy as it should have been for continuous operation, the troops preferred it to the reciprocating type, even though in the end the latter was also manually operated. Since both were used, training in operation and maintenance had to be provided for both types.

[29] Memo, Engr Bd for C of Dev Br, 30 Sep 42, sub: Opns of Pipeline Sec, 14 Sep–20 Sep 42. ERDL file, EB 143.

[30] Rpt, Karstens [Dec 42], sub: Test of Smith Type Portable Pipeline. Mech Equip Br file, Portable Pipelines.

Taken as a whole, the park experiment showed that a pipeline system would prove a great boon to military operations. This conclusion, and similar encouraging reports made while the tests were in progress, served to confirm the Engineers in the course upon which by this time they were fully launched. Orders for pipe and pumping stations for the North African operation as well as for the build-up for BOLERO had been placed even as the tests were in progress. By mid-October, when testing at Shenandoah Park was discontinued, plans for the organization and training of petroleum distribution units were being worked out.[31]

The Engineers in Britain had at first thought in terms of a battalion for this work and drew up a tentative T/O on 12 August 1942. Concluding shortly that this unit was unsatisfactory, they drew up another T/O based upon a general service regiment. Objections to the size of this organization led to a compromise T/O on 13 September for a unit the size of an aviation battalion. Meanwhile, on 10 September, OCE submitted to the General Staff a T/O for a pipeline regiment. This was rejected on the ground that the organization of specialized regiments should be avoided if a standard unit augmented by a company or smaller unit could be used. In line with this policy ASF directed the Engineers to prepare a table for a company to augment a general service regiment. The first four petroleum units that were activated were finally designed as detachments, which when attached to general service regiments could construct and operate a 260-mile pipeline system. These organizations did not have regular T/O's, but were activated with special personnel charts.[32]

In October the Engineer Section of SOS, ETO, asked for additional investigations into methods of laying a ship-to-shore pipeline. Such sea-loading line would free an invading force from dependence upon supply by cans and drums in the absence of docking facilities, and would, the Engineers anticipated, be the usual means of distribution during the second phase of an invasion. With the coastal currents of the English Channel in mind, the Engineer Section, ETO, asked that heavy drill pipe be launched in a four-knot crosscurrent. The U.S. Coast and Geodetic Survey suggested several possible sites, one of which was an area off the north shore of Martha's Vineyard, Massachusetts. Among other desirable features of this location was the fact that it was near Camp Edwards, the headquarters of the Engineer Amphibian Command, which readily agreed to furnish men and equipment for the tests.[33]

While a decision about the site was being made, Colonel Berlin's Petroleum Section in OCE collected suggestions from petroleum companies and construction engineers on how to conduct the operation. At

[31] (1) Memo, C of Mob and Tng Sec for Maj Holt, Rqmts Br, 6 Aug 42, sub: Pipe Couplings for TofOpns. 412.2, Pt. 2. (2) Ltr, C of Sup Div to CG SOS, 23 Sep 42, sub: Portable Gasoline Pipeline Equip. 400.112, Pipelines. (3) Ltr, C of Engr and Dev Br to President Engr Bd, 15 Oct 42, sub: Tng of Pipeline Pers, with 2d Ind, AC of Engr and Dev Br to President Engr Bd, 9 Nov 42. Mech Equip Br file, Pipelines, Bk 2. (4) Ltr, A. D. Small to Capt Mesle, Office of Tech Info, 26 Nov 45. EHD file, Hist of Dev of Mil Pipelines.

[32] (1) Ltr, Actg C of Dev Br to President Engr Bd, 25 Jul 42, sub: Portable Pipeline. 400.112, Pipelines. (2) 1st Ind, 25 Sep 42, on Ltr, OCE to SOS, 10 Sep 42, sub: T/Os for Engr Pipeline Regt. AG 320.3 (10-30-41) (2) Sec. 5, Bulky Package. (3) Incl 2, with Ltr, Hq EUTC Claiborne to CofEngrs, 1 Jan 43, sub: Capacity of EUTC. 320.2, Claiborne (C).

[33] Memo, C of Mob and Tng Sec for C of Sup Div, 6 Oct 42, sub: Test of Submarine Sea-Loading Line and 4-Inch Pipeline. 400.112, Pipelines.

a meeting attended by Berlin, Karstens, Elder, and other interested persons on 3 April 1943, the Petroleum Section presented four methods which it had culled from the responses: (1) assembly from barge or landing craft; (2) assembly on land followed by floating line into position by various combinations of pulling and pushing; (3) assembly on land and moving line into position with amphibian trucks; (4) assembly on land and pushing along sea bottom with aid of tow. When it came to details, however, commercial practices differed sharply from those required in a military operation. Industry's objective being permanency, speed of construction was sacrificed. Slade and Elder, the board's representatives at Martha's Vineyard, and Karstens, their chief, learned somewhat more from a description of British experiments. But by and large these men were pioneers and were conscious of being so.

Men and materials began to arrive for the tests during the second week in May, and laying of pipe began the week after. The weight of the pipe—over 624 pounds per section—made it difficult and dangerous to handle. Although mechanical lifting devices could be used to some extent, final alignment had to be accomplished by manpower. It took sixteen men to lift one section of pipe. The sections were joined by screwing, since the victaulic coupling was not strong enough for this pipe, and welders with sufficient skill to join heavy wall pipe were rare in the Army. Such pipe had been selected by Berlin because of its ruggedness, durability being important because of underwater stresses. Leaks under water would not only be more likely to occur than on land but would be more difficult to locate and repair. However, after noting that it took 32 men seven hours to connect 35 joints of pipe, those conducting the tests questioned whether the advantage of ruggedness was not outweighed by the time consumed. If welders could have been trained or made available the work would have been accomplished more quickly. In the absence of such skilled men, the group at Martha's Vineyard could only recommend a compromise. The lightweight "invasion tubing" would not suffice, but standard weight victaulic-coupled pipe could be used in cross-currents of less than two knots.

All pipelines at the Martha's Vineyard tests were assembled on land. Assembly from barge or landing craft was not attempted. All four methods of launching worked but none was suitable for every situation. Attaching floats to a pipeline laid parallel to the shore, pushing the line into the surf with a bulldozer, and towing into position with an LCT proved fastest. But the fourth method proved to be the best. Two 5,000 pound anchors were lowered into the sea and attached to a winch line mounted on the forward end of a barge and the sea-end of the pipeline was attached aft. The barge was then winched toward the anchors, pulling the pipeline after it with the aid of tractors on shore. Because of slippage of the anchors during the tests, only 2,680 feet of pipe could be launched, but Slade and his assistants believed that with improvements in details of technique almost twice this amount could be handled. This type of launching, although complicated, was superior to the others because the pipeline was under closer control and the equipment required a draft of only three feet. The testing staff at Martha's Vineyard recommended that this method be used where shoals or reefs existed, in areas where

there was not space enough to assemble the complete pipeline on land, or in case the line had to be laid on a prescribed course.

Training Petroleum Distribution Companies

As with many other specialties, the Engineers did not at first contemplate any great amount of enlisted instruction in pipeline installation and operation, relying instead upon securing sufficient enlisted personnel with previous civilian experience. The experimental pipeline in the Shenandoah Park was to be used only for training a limited number of officers.[34] But it became apparent during the course of the testing in Virginia that troop training would be necessary after all. The Smith system included some features which would be unfamiliar even to experienced petroleum men, who would in any case have to learn to apply their knowledge to military situations. Accordingly, on 15 October the Engineers began the organization of two petroleum distribution detachments and OCE directed the Engineer Board to work out a short training program for these special troops. The testing officers recommended that the experimental pipeline system be removed to some southern location with adequate housing and supply facilities where there would be no necessity for winterizing the equipment. Since additional testing remained to be done, the board at first ordered the system installed at Belvoir, but by early November the original recommendations of the testing officers prevailed. Future testing would be conducted at the Claiborne EUTC. At the same time, the two petroleum detachments would train for early service overseas.[35]

The Engineers organized the Petroleum Section at Claiborne on 9 November 1942 under Maj. James L. Lake, Jr., with a staff of ten officers recruited from various War Department agencies. All of these men had civilian experience in the petroleum industry. Slade and Treiber, from the Engineer Board, remained for a short time on temporary duty. OCE retained close control over the section through the formative period of organization and testing which lasted through most of December. Berlin remained technical director of its activities. Elder, meantime, supervised the building of the first troop-constructed pipeline at the Desert Training Center near Yuma, Arizona, and contributed materially to knowledge of troop capabilities, heretofore based on scanty estimates.

The first four detachments which began to train in November and December 1942 were handicapped by the conditions at Claiborne. West Claiborne was still a tent camp with no buildings available for offices, classrooms, or shop maintenance work. Mess halls, chapels, and open fields served as classrooms. The experimental pipeline system brought from the Virginia testing ground and set up next to the EUTC demolitions area required continuous adjustment of the delicate and impractical automatic controls. Until the latter part of December, canvas water tanks had to be substituted for the metal bolted tanks which these units

[34] (1) Memo, C of Sup Div for SW, 7 Sep 42, sub: Use of the Shenandoah National Park for Tng Officers for Pipeline Bns. 353, Engr Petroleum Distr Units. (2) Ltr, SW to Secy Interior, 10 Sep 42. USW file, Misc and Subject, Pipe, Pipelines, etc.

[35] (1) Ltr, Adj EUTC to CofEngrs, 16 Dec 42, sub: Capacity of EUTC, with Incl 1, List of Units Now in Tng at EUTC. 353, Claiborne (C). (2) Ltr, C of Engr and Dev Br to Engr Bd, 15 Oct 42, sub: Tng of Pipeline Pers, with 2d Ind, AC of Engr and Dev Br to Engr Bd, 9 Nov 42, with Incl, Outline for Course of Instr for Mil Portable Pipeline. Mech Equip Br file, Pipelines, Bk 2.

were supposed to be able to construct. Conventional 2½-ton trucks were poorly designed for handling pipeline, and time had to be taken to convert ten of these by moving the winch from the front to the rear of the cab and adding a gin pole to the rear. A tentative technical manual in mimeographed form, completed by Slade and Smith at the end of October 1942, mentioned the PUP centrifugal pump but emphasized the reciprocating pump with automatic controls. Not until early in 1943 was Treiber detailed from Claiborne to Washington to revise and expand these original papers into a permanent manual. Still firmly convinced of the practicality of the centrifugal pump, Treiber insisted at that time upon inserting a chapter on the operation and maintenance of the PUP—eventually one of the most valuable chapters in the manual. Meanwhile, at Claiborne, training and testing programs and procedures were worked out and explanatory drawings and other training aids were improvised and improved.[36]

Although the first units that trained in the Petroleum Section filled slowly and training was delayed and sometimes shortened, they performed well overseas because they were composed largely of men from the oil fields. War Department policy prevented the enlistment of men between the ages of eighteen and thirty-eight but the Engineers obtained qualified men through the cooperation of numerous oil companies which supplied names of former employees who were in the Army. Such men could then be located and transferred. Civilian firms continued to aid the Engineers by advising their men when they came up for induction to contact OCE for details of a plan which would enable them to go directly from reception centers to petroleum distribution units. The supply of such men gave out much sooner than was expected. Later units were handicapped by inadequate civilian background.[37]

By the end of 1942 the Petroleum Section had set up the training program which it used through the spring of 1943. Each unit took its basic military training under the direct control of the EUTC and then transferred to the Petroleum Section. For two weeks all enlisted men took a primary orientation course which included an explanation of the purpose and probable missions of the unit, the ratings that would be open to those who qualified, the equipment which would be used, and some practical work on the construction and operation of pipelines. On the basis of an examination at the end of this course the men were divided into smaller groups of about forty each for specialized training. For greater flexibility in assignment and to provide for emergencies, each man received training in two types of work which included the operation of pump stations, pipe laying, the maintenance and repair of pumps, engines and controllers, and the erection of bolted steel tanks. Through the spring of 1943 most of this training was given within the EUTC area on a fixed pipeline system of eight pumping stations and the equivalent of eighty miles of pipeline. As in the Shenandoah Park, water rather than petroleum flowed through the system. To simulate the operation of a longer line, smaller pipe offering a higher resistance to

[36] (1) Ltr, C of O&T Br to Lake, 23 Nov 42, sub: Pipeline Tng Sch, EUTC Camp Claiborne, La. 353, ASFTC Claiborne, Pt. 1. (2) Technical Manual (Tentative) Portable Pipeline Systems, 1 Nov 42. EHD files. (3) Tel Conv, Treiber, 5 Jul 55.

[37] (1) 220.3, Engr Petroleum Distr Units. (2) Memo, G–3 for CG ASF, 28 Mar 44, sub: Tng of Engr Pers. 353, Engrs. (3) Draft of Memo, OCE for Dir Mil Tng Div ASF [1 Apr 44], sub: Tng of Engr Pers. 353, Engrs.

the flow of liquid was introduced. The area devoted to steel tank erection had six tanks of 250-barrel capacity each. In March 1943 the Petroleum Section obtained a theater of operations type of shop building in which to give instruction in maintenance and repair. Officers and key men made occasional trips to hilly country nearby in order to obtain barometric pressure readings for profiling theoretical pipeline systems and determining the locations of pumping stations. Most of the officers for the first units were well qualified for their jobs, needing only a short, intensive course on their specific duties. The first class began on 14 December 1942 with twenty-one officers. Subsequent enrollment ranged up to thirty-five, with each class running for about four weeks. Although there was some practical construction and operation, the main emphasis in officer training was upon theory, design, and organization.

Few of these units were organized until the spring of 1943. The first two detachments activated in October 1942 moved overseas in January, leaving at the EUTC only the two units activated in mid-December. No others began training until May 1943, after OCE and ASF settled their divergent views on organization. In March 1943 Berlin had expressed dissatisfaction with the detachment type of unit, tied to a regiment, and recommended the establishment of an independent company. He maintained that with 20 percent less personnel than the existing detachment and without the aid of additional manpower a company could construct and operate 120 miles of pipeline. As finally approved in May 1943 the engineer petroleum distribution company consisted of 7 officers and 221 enlisted men, divided into a headquarters platoon and an operating platoon. With organizational differences finally settled, it became necessary to start a greatly accelerated training program. By May, when the accelerated training began, Capt. Roe Gray had supplanted Lake as head of the Petroleum Section.[38]

As estimated in April 1943, at least four petroleum distribution companies would have to begin training in May and two each month thereafter for the rest of the year. With an average of twenty weeks or more training then envisioned, about ten companies would be in training at all times. Gray had to double the capacity of the fixed petroleum training area within the EUTC. More equipment had to be obtained for unit assembly and disassembly in some area outside the EUTC.

By early July 1943, Gray had enlarged the existing fixed system by adding one station and ten more miles of pipe and had installed another complete fixed system of seven stations and the equivalent of seventy miles of pipe on the adjacent former demolitions area. For field training he obtained two sets of unit equipment and additional pumps and pipe. The companies that trained after July had two weeks of field experience with their own unit officers in charge. Each transported a twenty-mile pipeline system from the EUTC to a training area near Claiborne. There each unit connected this pipeline onto a permanently installed twenty-mile system and operated the full forty miles with various rates of

(1) Ltr, O&T Br to ACofS for Opns SOS, 16 Mar 43, sub: Proposed T/O for Engr Petroleum Distr Unit. 320.2, Engr Petroleum Distr Units. (2) Office Memo, Berlin for Plans Div ACofS for Opns ASF, 19 Mar 43, sub: Rev T/O Engr Petroleum Distr Det. 320.2, Secret File 2. (3) T/O&E 5-327, 14 May 43. (4) FM 5-5, 11 Oct 43, pp. 174-79. (5) EUTC Highlights, 12 Apr 43, with Incl, Prov Orgn of Units, EUTC, 12 Apr 43. 320.2, ASFTC Claiborne.

flow, pressures, and temperatures. The twenty-mile system was then dismantled by the same unit and returned to storage at the EUTC for use by the next company. Since the topography was scarcely different from that of the fixed system in camp, and water was the liquid used, there was little realism in this field training.[39]

The training of most of the units took place during the period when equipment became more plentiful, but the manpower shortage was beginning to be felt. The Petroleum Section obtained training facilities sufficient for both fixed and field training for two new companies each month. Staffing the section called for ingenuity. In 1942 the section had been under the control of OCE, and part of its instructor personnel had been on temporary duty from the Engineer Board. Until OCE and ASF agreed upon the organization of these units in April 1943 there had been few such companies organized and the EUTC had placed only one officer from the section on its permanent staff. Ten others were kept indefinitely in the officers' pool at the center. Officer and enlisted assistants were also on a temporary basis. Units that finished technical training provided instructors for succeeding ones. With activations doubled, field training added, and organization settled, the section in May requested a permanent allotment of 25 officers and 125 enlisted men for its staff, 15 officers and 8 enlisted men for instructors, and the rest for maintenance and administration. Before the personnel could be allotted to the EUTC, the ASF directive of 11 June 1943 restricted the total personnel in training overhead and prohibited the use of pool officers for operational purposes. If rigidly applied, the directive would have stripped the section of all personnel but Gray. The directive had one loophole—additional personnel could be authorized for new or expanding activities. Upon this basis the EUTC finally gained a small increase in July. Qualified officers who had been procured for this particular work were allowed to remain in the pool until permanently assigned. The directive in effect curtailed training to specifically prescribed activities, allowing little experimentation.[40]

Activations ran far ahead of the April estimates. Gray learned in August that he must train twenty-two units by March 1944. Twelve had to be ready for overseas service by the end of 1943. Nine were urgently needed in CBI. A total of five companies in nine months had been trained and sent out from Claiborne by August 1943, leaving seven others which had been organized but not yet completely filled. Fifteen additional units were scheduled for activation during the month of August. Actual training of the twenty-two units was to be more gradual, however, since the pipeline school was not large enough for such numbers. One company was to begin each week, from August through mid-January, on an intensive six-

[39] (1) Memo, Brotherton for Gorlinski, 28 Apr 43, sub: Activation of Engr Petroleum Distr Units. P&T Div file, Inspec Camp Claiborne. (2) Memo, C of O&T Br for CG ASF, 19 May 43, sub: Increase in Allot of Commissioned and Enl Pers for the EUTC Camp Claiborne, La. 320.21, ASFTC Claiborne. (3) 2d Ind, ExO EUTC to CG Eighth SvC, 8 Jul 43, on Ltr, C of Mil Pers Br to CG Eighth SvC, 24 Jun 43, sub: Employment of Pool Offs at EUTC Camp Claiborne, La. 320.2, Engr Petroleum Distr Units. (4) Ltr, S–3 Petroleum Sec to S–3 EUTC, 9 Oct 43, sub: Pipeline Tng—Fld Problem Sched with Incls, Pipeline Tng Sched and Plan for Activating Fld Problem Routes. EHD file, Petroleum Units.

[40] (1) Memo cited n. 39 (2). (2) ASF Cir 39, 11 Jun 43. (3) Ltr, CG EUTC to C of O&T Br, 6 Jul 43. 320 21, ASFTC Claiborne. (4) Ltr, CG EUTC to C of O&T Br, 17 Jul 43. 320.2, ASFTC Claiborne.



PREPARING FOR FIELD PROBLEM ON PIPELAYING, *Camp Claiborne. Men of an Engineer Petroleum Distribution Company load 4-inch pipe on a trailer.*

week program in order to have all of the companies prepared by March 1944.[41]

Such a tight schedule could not be maintained without the closest co-operation in providing fillers with proper qualifications at the exact times needed. To insure the early readiness of these units, Somervell directed that extraordinary efforts be made to fill them with experienced petroleum men, screened from the Army at large, and that all fillers should have completed thirteen weeks of basic training. Screening for these men began in early August but suitable fillers did not arrive. By the first of September the whole schedule was three weeks behind. Only fifty fillers had been received, and only twenty-nine were qualified for this duty and had as much as nine weeks or more basic training. Few were basically trained as engineers. Even if they had completed basic instruction in another branch of the service, the EUTC estimated that it would take another two weeks to qualify them as basic engineer soldiers. Many had not fired the rifle qualification course or the carbine familiarization course. None had any instruction in crew-served weapons and none had gone through the infiltration course.

A new schedule had to be drawn up on the basis of the fillers that this first screening produced. It allowed two weeks to make up military deficiencies, six weeks for pipeline training, and one week for processing. This was the bare minimum which the center believed would get the units past inspection. However, it was essential that five of the CBI units meet an early November sail-

[41] Ltr, CG EUTC to CofEngrs, 2 Aug 43, sub: Recommendations, Activation and Tng of Twenty-two Petroleum Distr Cos, with Incl 1, Proposed Sched of Activations. 322, Engr Petroleum Distr Units.

ing date. Only one would be ready at the proper time. Training for the other four units had to be further modified. Since the first and simplest task would be pipe laying, these four trained for this duty alone. The remainder of their instruction on pumping stations, tank terminals, and warehouses had to follow in the theater, with some instruction given on the troopship en route. Each of these four units left fifty-six specialists behind for an additional month of training at Claiborne. In answer to an anxious query from O&T on the status of the five CBI units, the EUTC replied it "would get them out, but that they should not be expected to be *good* units, as the training time necessary was not available to us." [42]

By January 1944, twelve of the twenty-two petroleum companies were ready for duty as originally planned. Three went to Europe and nine to CBI. Nine out of the remaining ten made the March deadline, one being delayed until April. Four of these ten went to CBI and three each to Europe and the Southwest Pacific. By June a total of thirty companies, or approximately 6,270 men, had trained at Claiborne. Six more companies organized by the spring of 1944 left the center for a port of embarkation by August.[43]

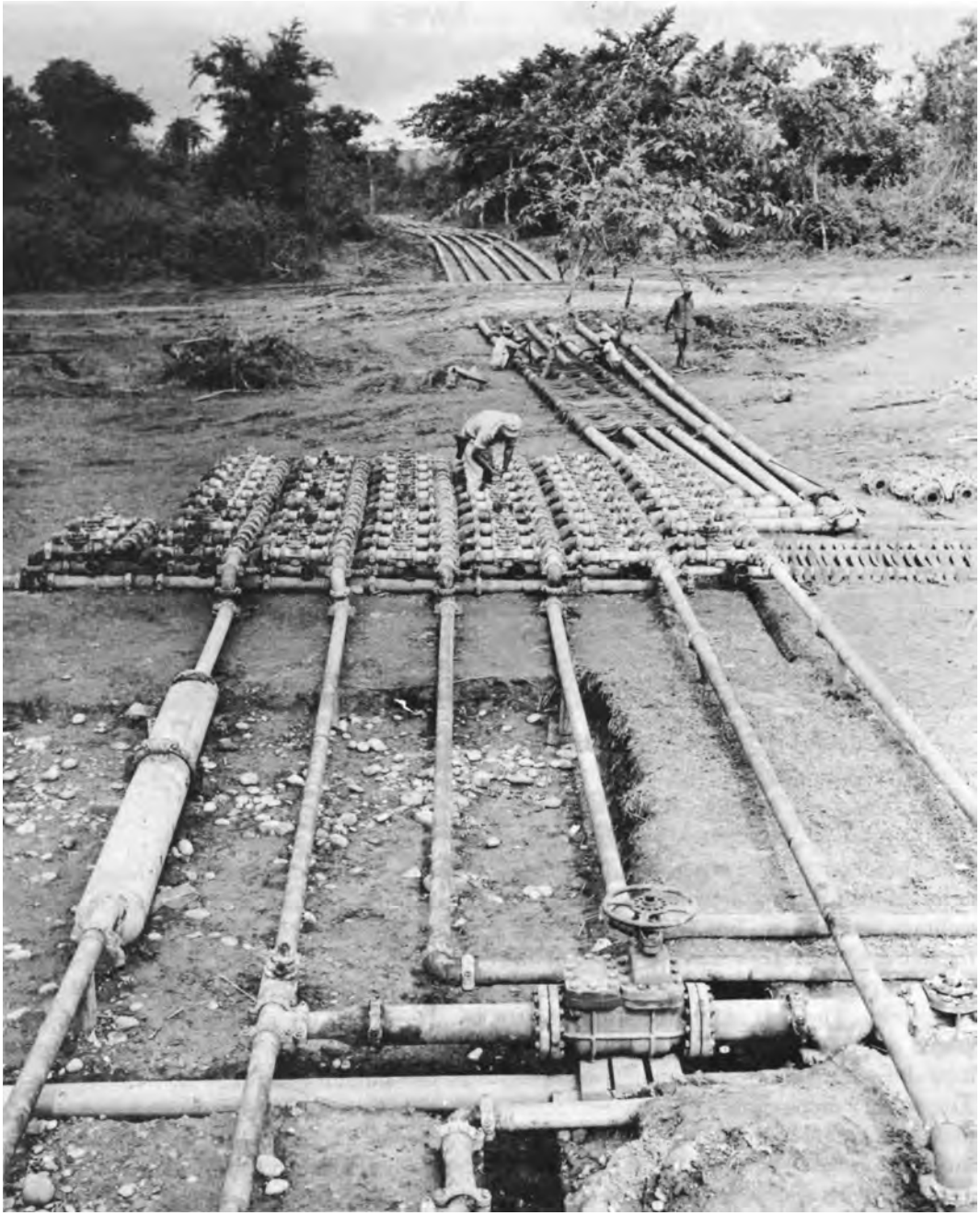
The short course at Claiborne could not prepare men with little previous experience for full and accurate participation in either the construction or operation of pipeline systems. All theaters complained of dirty pipe joints, loose couplings, and debris inside the pipes. The lack of large bodies of water at Claiborne limited exercises in river crossings and the laying of submarine lines—both important operations overseas. Until 1944 there was not enough practical work in the erection of tanks. Although safety precautions and practices were stressed at the center, the training at Claiborne was done with water, not 100-octane gasoline. Consequently, many of the men overseas continued to act as if they were still operating with water, with little realization of the extreme hazards. Beginning in early January 1944, one officer and fifteen men from each company were required to attend a ten-day course at the fire fighting school at Camp Pontchartrain, Louisiana. Conservation of bolts, nuts, and gaskets and the care of tools and equipment were well covered in the short time available. Discipline in the field was another matter. By 1944 there was general agreement that pipeline training could stand considerable improvement—but only at the expense of increasing the training time.

No theater had enough pipeline troops for optimum construction or operation. Because of the initial procrastination in training these companies, theater commanders had to accomplish pipeline work with engineer troops that had not been trained for the job. Engineer general service regiments, engineer dump truck companies, and quartermaster truck companies were continuously pressed into service, as well as native and prisoner labor. Construction delays, frequent repairs, and wasted fuel resulted.

The most serious deficiency proved to be the inability of the units to construct lines at the maximum rate of advance of the mobile forces that depended upon them. In the

[42] Memo for File, S–3 EUTC, 13 Oct 43, sub: Tel Conv with Gorlinski. S–3 Memos for File, EUTC Claiborne, 1943–44. EHD files.

[43] Analysis of the Present Status of the War Department Troop Basis, 1 Jan 45, pp. 214, 215. AG Special Reference Collection.



MANIFOLD VALVE INSTALLATION ON PIPELINE *paralleling the Ledo Road, China-Burma-India Theater, September 1944.*



WELDER JOINING TWO SECTIONS OF PIPE *on petroleum pipeline, France, September 1944.*

CBI, pipeline troops experienced no difficulty in keeping up with the slow pace of military operations, but in the European theater it was another matter. Many of the units employed were not seasoned pipeline companies. The port of Cherbourg, through which most of the vital oil was to be piped inland, was not secured as soon as planned. The supply of pipe and other construction materials was not well co-ordinated. Communication between constructing and operating elements was poor. Frequent breaks in the lines occasioned delays. But the main factor which caused the construction of the pipelines to appear to lag behind was the phenomenal speed of the advancing Allied forces after the Normandy breakout. These pipeline units laid pipe at the rate of thirty or thirty-five miles a week but still could not keep up. Gasoline, food and ammunition competed for available transportation as the pursuit gradually slowed.

Although the pipeline units failed to keep pace with Lt. Gen. George S. Patton, Jr., in his spectacular dash across France, this was no measure of their usefulness in modern warfare. These companies provided critical fuels to strategic points in every theater, sup-

porting well the striking power of the new mobile Army. During the course of the war, they laid over 3,000 miles of pipeline in each of three theaters, European, Mediterranean, and CBI, and lesser amounts in the Pacific. They performed particularly well in the rugged terrain of Italy as attested by the Chief Engineer of the Mediterranean theater who considered them among the best special engineer troops he had ever seen.[44]

[44] (1) Rad, CO Engr Dist 12 to CG Constr Sv SOS CBI, 15 Aug 44. Opns Br file, Constr Sv CBI (C). (2) Ltr, CO Engr Dist 12 to CG Constr Sv SOS CBI, 26 Aug 44, sub: Pipeline Safety and Security Program. Opns Br file, Constr Sv CBI (S). (3) Ltr, Actg ACofEngrs to C Engr USAF CBI, 3 Nov 44. Adm Br file, Constr Sv CBI. (4) Ruppenthal, *op. cit.*, I, Ch. XIII.

CHAPTER XIX

An Old Mission Expands: Mapping and Engineer Strategic Intelligence

The extent and variety of construction and reconstruction assigned to engineer troops the world over created a demand for information about terrain, climate, natural resources, and man-made facilities. Although other arms and services applied Engineer strategic intelligence to their own purposes in many cases, such data served mainly to aid the Corps of Engineers itself. Almost precisely the opposite situation was true in the allied field of mapping. Provision of maps was a service performed by the Engineers primarily for others. The two major battle areas, one containing territories hardly explored, the other crowded with the works of civilized man, posed highly different but equally complicated tasks for Engineer mapping and intelligence agencies. In the Pacific the total area to be covered was greater and the sources of information were sparse. By contrast, a deceptive wealth of data was available for the smaller area of Europe and the Mediterranean. The fact that maps and other information about highly civilized regions become out of date more quickly than those of primitive ones, requiring constant revision to keep abreast of the changes, further complicated the situation.

The Beginning of an Engineer Intelligence Collection

The Engineers had no need to collect strategic intelligence data before 1939. Except for defense of its overseas territorial possessions, the United States had no obligation to commit its armed forces abroad. Hence there was no pressing reason for accumulating data about the character of soil, the currents of rivers, and the capacities of ports on a world-wide basis. During the prewar years, Engineer intelligence consisted of gathering information about foreign military engineering that might affect doctrine and techniques, and even this included for the most part just whatever happened to filter through G–2 of the War Department General Staff into OCE's Intelligence Section. Concern over defense of the Western Hemisphere led to a broadening of interests. In the fall of 1940 the Intelligence Section began to prepare hemispheric studies which described terrain, natural and developed resources, and kindred matters of engineering interest in outlying areas of strategic importance. By the spring of 1941 research had extended into northwest Africa, Japan, and China as

well as to strategic islands in the Atlantic. Compiled by a few people from meager sources, these studies were preparatory outlines rather than detailed analyses.[1]

An all-out effort to improve the quality of future investigations began early in 1942. The Intelligence Branch approached this goal in two ways: by directly recruiting professional civilians and by enlisting assistance from other government agencies. Of the several existing organizations which might offer assistance, the U.S. Geological Survey, the Board of Engineers for Rivers and Harbors, and the Beach Erosion Board possessed knowledge and skills which were particularly needed. By summer 1942 each of these agencies had placed a group of its experts at the disposal of the Intelligence Branch. In peacetime these men conducted research for developing natural resources, improving inland waterways, and protecting beaches from erosion. In the course of this work they acquired much detailed and reliable technical information on such activities in foreign countries. Financed in large part by OCE, the Military Geology Section of the U.S. Geological Survey handled questions about water supply, construction materials, fuels, and weather. The Foreign Port Section of the Board of Engineers for Rivers and Harbors assembled statistical and descriptive data on foreign ports and terminals, including piers, unloading facilities, floating equipment, and warehouses. The Foreign Section of the Beach Erosion Board furnished information essential for amphibious operations. Although for years navies of the world had prepared hydrographic charts of deep-water areas, highly accurate inshore charts for the depths in which landing craft would operate had never before been required. However, from research already done abroad, one of the technical experts at the Beach Erosion Board, Dr. Martin A. Mason, could plot coastal terrain, showing configurations of beaches, inshore water depths, natural underwater obstacles, and other conditions. In August 1942, Mason induced Dr. William C. Krumbein, professor of geology at the University of Chicago and a Guggenheim Fellow, to collaborate in the study of beaches.

Valuable as the contributions of these agencies were, the city of Washington was limited in its resources. By contrast, the number of libraries in New York and the concentration there of firms with international connections provided an unexcelled reservoir of data on the engineering works of foreign countries. In May 1942, the Intelligence Branch took over a New York WPA translation project from the Soil Conservation Service, renaming it the Engineer Research Office (ERO) and placing it under the direction of Capt. John R. Vogler. Next door to ERO was the Engineering Societies Library, which subscribed to over 2,000 technical publications from forty different countries, and indexed every article. Just around the corner was the New York Public Library with its superb reference collection. At first ERO's only job was to feed information to the Intelligence Branch in Washington, and this type of work, often involving translation, continued as a major function throughout the war. Beginning in the fall of 1942, Vogler gradually prepared to take on the more difficult assignment of carrying an investigation through all the stages of research and writing before its submission to Washington. The WPA project was liquidated in January 1943, some of its employees transferring to ERO's civil serv-

[1] (1) Ann Rpts OCE, 1940, 1941. (2) Wkly Rpts Intel Sec, 1 Nov 40, 23 May, 6 Jun, 13 Jun 41. 020, Engrs Office C of.

ice payroll. Engineers, geologists, translators, and librarians had meanwhile been hired, bringing the staff at this time to a total of 106 civilians and 2 officers.[2]

Vogler and his executive officer, 1st Lt. Duane W. Ackerson, devised an assembly line system, dividing the work into research, bibliography, writing, and reproduction. One group combed the libraries of metropolitan New York to locate data on phases of engineering throughout the world. A staff of librarians cataloged and indexed this material according to subject, area, and author. Whenever the office started a new project or received requests for spot information, the library could furnish immediately a bibliography and a nucleus of source material. The research section then worked on the particular assignment and brought in books, periodicals, and documents to be photostated, translated, and filed for permanent reference. By the end of hostilities, the office had indexed over 140,000 entries by subject and country, 80,000 entries by author and title, and had collected great quantities of related reference materials. Normally the office worked on sixteen reports simultaneously, completing one each week and having the others in various stages along the assembly line. In June 1943 ERO submitted a four-volume report on French inland waterways, which was published as a finished Strategic Engineering Study. This marked the first of eighty such special studies prepared during the war.[3]

Other Strategic Engineering Studies, which covered the entire range of Engineer interests, were co-operative enterprises. A small unit in the Intelligence Branch in Washington contributed the chapters on railroads, roads, electric power, airfields, and other industrial facilities until ERO was able to assume this phase of the work in the summer of 1943. The U.S. Geological Survey assumed responsibility for the sections describing terrain and geology, the Beach Erosion Board for landing areas, and the Board of Engineers for Rivers and Harbors for ports and terminals.

Although intended primarily for the Corps of Engineers, Strategic Engineering Studies circulated widely throughout the armed forces. G–2 extracted terrain information. Naval Intelligence was particularly interested in the beach and port chapters, while the Army Air Forces used terrain studies to help locate enemy airfields, to determine what enemy facilities would make the best targets, and to choose suitable sites for its own bases. The Transportation Corps studied the engineering data on ports, roads, and bridges, while the Sanitary Corps of the Medical Department used material on water supply and sewerage. Civil Affairs and Military Government officers analyzed engineering reports in order to estimate their work loads in areas of varying degrees of industrialization. Overseas commanders supplemented these studies with other in-

[2] (1) Wkly Rpts Intel Sec, 20 and 27 Feb, 6 Mar, 24 Apr, 1 May 42, *et seq.* EHD files. (2) Ltr, ACofEngrs to NAD Engr, 26 Jun 42, sub: Estab of Strategic Studies Project Office in NYC. ERO file, O–2, Orgn (C). (3) Divs and Price List, Engr Index Sv, New York [1942]. ERO file, E–1, Engr Research Data. (4) Memo, Lt Col Joseph E. McCaffrey for Col Herbert B. Loper, 10 Jul 43, sub: Ann Rpt of Strategic Studies Sec for FY 1943, with Incl, Memo, Vogler for McCaffrey, 8 Jul 43, sub: Ann Progress Rpt as of 30 Jun 43. EHD file, Basic Mats for Ann Rpt OCE, 1943.

[3] (1) Memo, C of Intel Br for C of Mil Pers Br, 19 Oct 43, sub: 1st Lt D. W. Ackerson, SN O–366197. ERO file, Permanent Incoming Corresp (S). (2) Stat Rpt, Library ERO to Ackerson, 21 Sept 45, sub: References filed in Catalog; Totals by Countries. ERO file, 319.1–P, Library Br. (3) Priority Scheds. ERO file, 310.1–A (C). (4) Deadlines and Priorities. ERO file, D–1 (S). (5) Numerical List of SES. AMS file, Tech Sv Div (C).

formation at hand to reach decisions on the movement of troops and supplies.[4]

The Beginning of an Engineer Map Collection

In sharp contrast to the Corps' inexperience in collecting strategic engineer intelligence were its century-long mapping activities. Yet this traditional Engineer mission was also deeply affected by prewar concepts of defense. Emphasis before Pearl Harbor had been upon the development of equipment and techniques to exploit aerial photography. To the extent that such means could be applied no matter where the Army fought, this approach was altogether wise and logical. To the extent that the possibilities of the new techniques had been exaggerated, this approach invited disaster. Fortunately, by 1942 a good many realists had had their say. The catchy phrase, "The Army must map as it moves," was no longer taken seriously. Too much depended upon uncontrollable factors—weather, enemy activity, skill of pilot and photographer, range and maneuverability of photographic aircraft, and the rate of the Army's movement. Even during the maneuvers of 1940 and 1941, the main supply of maps had to be prepared well ahead of time. Topographic field units supplemented the major mapping preparations for these exercises by overprinting last-minute revisions, reproducing additional copies, and arranging for their distribution. From his observations, Colonel Loper, the chief of OCE's Intelligence Branch, concluded that the most practical solution to mapping vast potential combat areas would be a judicious combination of aerial surveys with map sources already in existence. Many areas of the world had already been mapped at tactical scales. Aerial photography would be used for revising these maps and filling gaps in coverage. Compilation of large-scale battle maps would still be required for key points of attack or defense. Close co-operation between the Air Forces and Engineers was therefore still indispensable to success.[5]

Indispensable also was a systematic collection of maps. When war came, the War Department had an accumulation, rather than a systematic collection, of foreign maps. The War Department Map Collection had been established before World War I when G–2 consolidated the holdings of various intelligence units. The Corps received custody of this collection in 1938, turning it over to the Engineer Reproduction Plant, which was located in Washington. Up to this time, the Engineer Reproduction Plant had sustained a precarious existence. Although set up to perform lithographic work for the War Department, it operated without direct appropriations. In order to retain a nucleus of about 100 trained employees, it undertook lithographic work on a repay basis for other federal agencies. The plant had equipment to reproduce multicolored maps of whole countries or continents, showing such features as natural resources, railroads, highways, cities, and industrial areas. Its presses were much larger than those assigned to topographic units. Primarily a print shop, the plant also employed cartographic draftsmen, and, beginning in 1938, supervised a WPA project

[4] (1) Memo, McCaffrey for Loper, 10 Jun 43, sub: Ann Rpt of Strategic Studies Sec for FY 1943. EHD file, Basic Mats for Ann Rpt OCE, 1943. (2) ERO Staff Mtg, 25 Oct 43. ERO file, 319.1, Staff Mtgs (C). (3) Wkly Rpts Intel Br and Mil Intel Div, 22 Oct 43, 27 Jan, 3 Mar, 10 Mar 44. ERO file, 319.1–P, Wash (C).

[5] See above, pp. 77–81.

which was compiling a large-scale map of the United States.

During 1940 and 1941, while Maj. Albert G. Matthews was in charge, the Engineer Reproduction Plant gradually relinquished job printing entirely in order to concentrate on maps of Army camps and maneuver areas. To assist in this work the plant organized fourteen more WPA offices. Matthews broke down complicated jobs normally performed by experts into tasks simple enough for novices to handle. A relatively few experts could then supervise the work on an assembly-line basis. Matthews also instituted a system of training understudies for higher positions so that in an emergency the plant could expand readily under experienced and responsible leadership.[6]

By hiring additional employees and acquiring new and faster presses the plant increased production, but its building was too small for efficient use of staff and equipment. Early in 1941 the Engineers received authorization to erect a new building on the outskirts of Washington. Ready for occupancy by spring of the following year, this facility was a black-out type of structure that permitted uninterrupted operations in event of an air raid, was carefully designed to facilitate the flow of work from one department to another, and was air-conditioned to prevent changes in temperature and humidity from affecting the dimensions of map paper. Upon moving into this modern establishment, the Engineer Reproduction Plant became the Army Map Service (AMS), a name which more aptly described its broadened responsibilities. Experience in organizing partly skilled workers in the WPA days proved beneficial during the war years. AMS persuaded some women's colleges to offer an elementary course in cartography which prepared students for jobs at the main plant and at field offices. AMS then trained them for library work, map research, map design, translation, computation, compilation, photomapping, drafting, and editing. By the middle of 1943 there were 300 more women than men among the 3,500 employed by the organization. Whereas the Engineer Reproduction Plant had been essentially a lithographic shop, AMS could execute a wide variety of steps in the mapping process. It lacked, however, the means to compile original maps from aerial photography, for it had no multiplex projectors until 1945.[7]

The mainstay for multiplex work was the base topographic battalion, but in an emergency other federal agencies stood ready to assume part of the load. Between the two world wars, about twenty federal agencies outside the War Department carried out some mapping in connection with their principal activities. Absence of co-ordination among them produced a wide range

[6] (1) Ltr, Maj G. H. Harding, Foreign Map Br, to Lt Col F. D. Sharp, G–2, 23 Oct 41. 061, Pt. 6. (2) Ltr, C of Mil Intel Div for Col F. H. Dryden, Control Div ASF, 31 Aug 45, sub: Postwar Mapping. 061.01 (C). (3) OCE, History of Mapping and Related Activities by OCE and AMS During World War II (typescript, n. d.) (cited hereafter as Hist of Map), pp. 59, 61. SWPA file, 1–17. (4) Ann Rpt Engr Reproduction Plant, 1941. AMS file, 319.2. (5) Memo, CofEngrs for CofS, 11 May 39. O&T file, Gen Folio 6 (S). (6) Ltr, ACofEngrs to TAG, 3 Aug 40, sub: Rev of Map Project for FY 1942. 061, Annual, Pt. 5.

[7] (1) Wkly Rpts Intel Br, 8 May, 19 Jun 42. 020, Engrs Office C of. (2) AR 300–15, Mapping and Charting, 1 May 42. (3) Ltr, CO AMS to CofEngrs, 27 Sep 43, sub: Ann Rpt of Opns, FY 1943. AMS file, 319.2, Ann Rpt AMS 1943. (4) Memo, Actg C of Geodetic Div AMS for C of Adm Div AMS, 9 Aug 45, sub: Ann Rpt for FY 1945 Geodetic Div. AMS file, 319.2, Gen Corresp for Ann Rpt AMS, 1945–46. (5) Memo, C of Photogrammetric Div AMS for C of Adm Div AMS, 8 Aug 45, sub: Ann Rpt for FY 1945 Photogrammetric Div. Same file.



WOMEN COMPILING FOREIGN MAP INFORMATION, *Army Map Service, January 1943. At right is Lt. Col. Frederick W. Mast, Executive Officer.*

of specifications and scales. During the same period, allotments for military mapping averaged $44,000 a year, limiting this work to training areas and such projects as could be arranged through agreements with the U.S. Geological Survey and the WPA. For some years the Geological Survey, in preparing basic topographic maps throughout the United States, had given priority to areas designated by the Chief of Engineers as of military importance. To avoid duplication of effort, the Engineers in turn coordinated their mapping projects with those of the Geological Survey. But until 1941 budgets were too small to push this domestic mapping program. At this time, Congress began to view an attack on the United States as a possibility and approved a three-year War Department project for mapping, at tactical scales, a strip of territory 200 miles in depth along the coasts and borders of the United States. To accomplish this work, Loper enlisted the aid of the U.S. Coast and Geodetic Survey, the Tennessee Valley Authority, and the U.S. Forest Service as well as the U.S. Geological Survey, all of which were well qualified to handle mapping assignments. The finished maps of the Geological Survey were based upon the triangulation network furnished by the Coast and Geodetic Survey which also prepared coastal and aeronautical charts. In

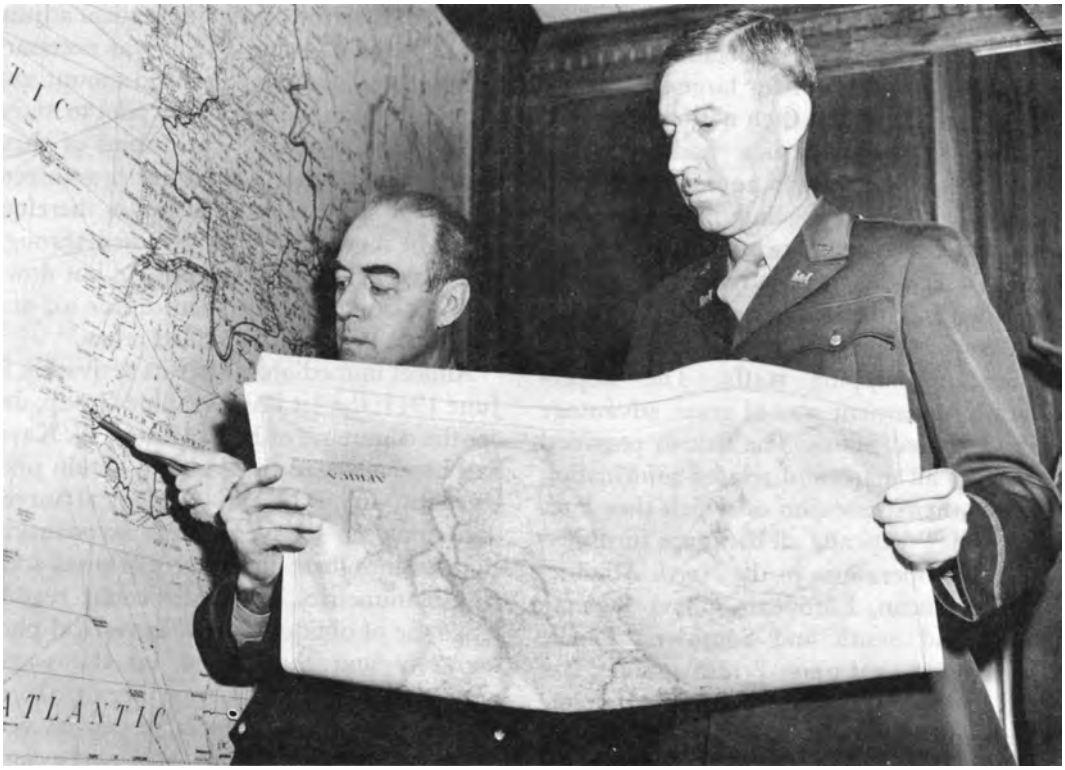
need of highly detailed topographic information for drainage basin studies, the TVA had mapped the Tennessee Valley watershed before starting to develop the resources of that region. In managing 160 national forests, the Forest Service had to map roads and trails in an area twice the size of California. The heads of these agencies agreed in October 1941 to mobilize their facilities and about 3,000 employees for the War Department's domestic mapping program. The foundation was thus laid for a unity of effort that could be directed, if necessary, to the compilation and revision of foreign maps.[8]

This pooling of mapping resources, combined with the modern facilities of AMS, placed the Engineers in a position to handle whatever maps and map sources came their way. Most of the maps that had been transferred to the War Department Map Collection and most of those received in the years immediately following came from military attachés and other G–2 officers. For want of money, many sets of maps were incomplete or obsolete. From British sources the Engineers strengthened the foreign map collection. With centuries of experience in international affairs, the British had developed map holdings for all parts of the world. On 26 December 1940, Maj. Michael Collins of the Geographical Section, General Staff (GSGS), the British War Office mapping organization, proposed exchanging data. On getting the approval of G–2, Loper sent representatives to discuss co-ordination of the map libraries of the two nations. In August 1941 Collins, in turn, visited OCE. That same month maps arrived from England. They included coverage for Iceland where American forces had recently landed.[9]

Once the nation was committed to war on foreign soil, Congress lifted budgetary restrictions that formerly had applied to the purchase of foreign maps. Early in 1942, G–2 and the Intelligence Branch, OCE, started a vigorous drive to increase the map collection. Through the co-operation of the British Dominions and colonial governments, American military attachés were able to send some maps home. But the days when one could order maps from abroad were practically over because of censorship imposed by war. To exploit local sources of information, intelligence agencies scoured the holdings of libraries throughout the country and set up map collection offices in seaport towns. Much valuable geographical information was acquired from

[8] (1) Ltr, C of Mil Intel Div to Dir Mil Survey British War Office, 7 Mar 44. 061.01 (C). (2) Memo, C of Mil Intel Div for Dryden, 31 Aug 45, sub: Postwar Mapping. Same file. (3) Joint Ltr, Secys of War, Commerce, and Interior to President of Senate, 23 Mar 39, sub: Surveys and Mapping in U.S. 061.3, Pt. 2. (4) Tab C, Survey of National Mapping in U.S., with Memo, ACofS G–2 for CofS, [c. Jul 39], sub: WD Policy on National Program of Mapping. Same file. (5) Ltr, Office C of Engr Reproduction Plant to CofEngrs, 21 Dec 39, sub: Compilation of Tactical Maps, with 1st Ind, 4 Jan 40. Same file. (6) Ltr, ACofEngrs to TAG, 31 Dec 40, sub: Map Project for FY 1943. 061, Annual, Pt. 5. (7) Wkly Rpts Intel Sec, 7 Feb, 23 May, 3 Oct, 16 Dec 41. 020, Engrs Office C of. (8) Ltr, ACofEngrs to TAG, 2 Jan 42, sub: Map Project, FY 1944. 061–A (C). (9) Ltr, ACofEngrs to CG SOS, 22 Jan 43, sub: Gen Mapping Program for CONUS. 061 (S).

[9] (1) Ltr, Collins to Lt Col Kenner F. Hertford, O&T Br, 26 Dec 40. 091, England, Pt. 7. (2) 2d Ind, C of Intel Sec to ACofS G–2, 12 Apr 41, on Ltr, Mil Air Attaché and Actg Mil Attaché to ACofS G–2, 14 Jan 41, sub: Liaison Between U. S. Survey Sv and GSGS. Same file. (3) Wkly Rpts Intel Sec, 20 Jun, 15, 22, 29 Aug 41. EHD files. (4) Ltr, C of Intel Sec to Maj S. C. Hudson, GSGS, 26 Aug 41. 091, England, Pt. 8. (5) Ltr, ExO OCE to ACofS G–2, 18 Jul 41, sub: Directive for Engr Obsvr in England. Same file. (6) Ltr, Hudson to C of Intel Sec, 31 Aug 41. 091, England, Pt. 7.



COL. HERBERT B. LOPER, *Chief, Intelligence Branch, OCE (right), planning a map project with Col. W. A. Johnson, Commanding Officer, Army Map Service, January 1943.*

sea captains, former tourists, shipping companies, and firms engaged in foreign trade.[10]

The GSGS of the British War Office nonetheless remained by far the most important source. In the spring of 1942, Col. Martin Hotine, its director, came to Washington to confer with Loper. The British were up to their necks in work and had lost part of their mapping plant in the London blitz. The Royal Air Force was not equipped to provide precision photography. The Americans lacked an adequate collection of existing maps. On 12 May representatives of the two countries signed what was commonly known as the Loper-Hotine Agreement, the cornerstone of the wartime mapping effort. It divided responsibilities for new mapping along geographical lines. The United States accepted responsibility for preparing all new maps for the Western Hemisphere, Australia, New Zealand, Japan, the Netherlands Indies, and islands scattered throughout the whole Pacific. With the aid of aerial photography furnished by the United States, Great Britain would supply maps

[10] (1) Speech, Loper to Mapping Conf, 17 Nov 43. AMS file, Tech Sv Div K–1–1 Proceedings CE Mapping Conf. (2) Ltr, Dir USGS to ExO OCE, 7 Apr 42. 061.05. (3) For correspondence relating to the acquisition of maps through military attachés and collection units, see file 061.4. (4) See file 061.07 concerning removal of USGS map stocks from the market.

for other areas—northwest Europe, west and northwest Africa, Indochina, Malaya, and Thailand. Except for large-scale maps of the United States, each nation agreed to furnish source materials and reference copies of all new maps automatically and to supply copies of existing maps on special request. To co-ordinate map supply overseas, OCE would assign representatives to serve with British mapping agencies, while GSGS would likewise maintain liaison with American mapping staffs. The Loper-Hotine Agreement was of great advantage to the United States. The British provided copies of all maps and related information then in their possession or which they later acquired. Practically all the maps furnished for initial operations in the North Atlantic, Mediterranean, European, China–Burma–India, and South and Southwest Pacific areas were based upon British sources. But even British sources were far from complete and far from perfect. For full and up-to-date coverage, mapping agencies at home and overseas depended upon the AAF to furnish aerial photography.[11]

The Conflict Over Aerial Photography

The AAF's photographic groups which were to perform mapping missions for the Corps of Engineers flew fighter planes that had been converted to photographic aircraft (F–4's and F–5's). The speed and altitude of these planes were satisfactory for this purpose. Their range was sufficient for Europe, although not for the Pacific. Otherwise these planes did not meet Engineer specifications. The F–4 and F–5 were single seaters. The Engineers desired a two or three-place plane to carry either a photo-navigator or else a photographer and navigator in addition to the pilot, with the photographer to keep the camera in vertical adjustment. In the F–4 and F–5 it was necessary to install the camera in a fixed mount and to depend upon the skill of the pilot to maintain a given position. The cabins of these planes were neither heated nor pressurized. The time spent at high altitudes therefore had to be short. The AAF proposed, through a new system of photography, to cut down on the amount of time spent in the air and to obviate the need for skilled crews.[12]

Almost immediately after its activation in June 1941, the 1st Photographic Group, under the command of Maj. Minton W. Kaye, had been assigned to Alaska to obtain photography which the U.S. Geological Survey undertook to convert into aeronautical charts. Since these charts were of small scale and planimetric, draftsmen could readily make use of oblique as well as vertical photography and thus speed up the work. Kaye's Photographic Group began, therefore, to mount one wide-angle camera vertically between two other wide-angle cameras tilted in opposite directions. This tri-metrogon mount took one vertical and two high oblique photographs which pictured an area from horizon to horizon. The tri-metrogon mount enabled pilots to space

[11] (1) Speech cited n. 10 (1). (2) Memo of Agreement on Mapping and Survey Policy Between War Office (GSGS) and U.S. CE (Intel Br), 12 May 42. App. 9, Liaison Sec Intel Div Office of C Engr ETO, Intel and Topo (cited hereafter as ETO, Intel and Topo). AG Special Collection, Opn Rpts. (3) 1st Ind, CofEngrs to ACofS G–2, 29 Aug 45, on Ltr, ACofS G–2 to CG AAF and CofEngrs, 17 Aug 45, sub: Postwar Mapping. 061.01 (S). (4) Ltr, CofEngrs to ACofS G–2, 17 Aug 45, sub: Exchange of Mapping Info with War Office. Same file.

[12] (1) Unless otherwise noted, this section is based upon correspondence in G–2 file, 061.01, and OCE file, 061.01 (S). (2) Craven and Cate, *AAF VI*, pp. 214–15, 616. (3) Engr Bd. Hist Study, Photomapping, p. 101.

their flight lines twenty-five miles apart as compared with the four-mile spacing specified by the Engineers for vertical, wide-angle photography. Because a few photographs covered such a large area, it was easy to determine tip and tilt and the pilot could vary his altitude and directions considerably.[13]

Having shifted to the T–5 wide-angle camera to avoid troublesome oblique photography and thus speed up the compilation process, the Corps of Engineers did not welcome the tri-metrogon mount. It still preferred the T–5, even though, with its elaborate system for recording tip and tilt, it had proved difficult to produce and to keep in adjustment. While waiting for the delivery of acceptable T–5's (which never came), the AAF installed wide-angle lenses in older, single-chamber cameras, and the Engineers changed over to wide-angle multiplex projectors. Just as the 1st Photographic Group was beginning its experiments with the tri-metrogon mount in Alaska, the Engineer Detachment at Wright Field, working from vertical wide-angle photography, mapped the vicinity of Dayton, Ohio. Results showed great improvement over previous tests and approached the specifications for battle maps desired by the Field Artillery. On the basis of output per man, it was estimated that a topographic battalion could complete the first map sheets in six days and could thereafter maintain a production rate of 600 square miles daily. In other words, by the use of wide-angle photography, under optimum conditions, a topographic battalion could attain greater accuracy in about one sixth the time previously required for making the battle map.[14]

The Engineers feared that the tri-metrogon mount, with its obvious advantages to the AAF, would deprive them of means for compiling precise, large-scale maps. Tri-metrogon photography could not be applied to all mapping needs of the ground forces because this type of photography produced some distortions which no known instrument could correct. Reduction in scale outward from the center of any picture makes it progressively difficult to determine the position and to identify certain features of the terrain. These difficulties were multiplied in the oblique photographs because features relatively close to the camera tend to mask those farther away. The larger the scale of the map drafted from such photography, the greater the error. Battle maps compiled from tri-metrogon photography would be inaccurate to the point of uselessness. For the preparation of tactical maps of undeveloped areas, tri-metrogon photography had its place, however. Draftsmen could hold errors of position to acceptable limits and could define bodies of water and other natural features on maps of this scale. But since innumerable errors were inevitable in distinguishing such details as highways and railroads, tri-metrogon pho-

[13] Ltr, Brig Gen C. W. Russell, CofS Hq AF Combat Comd, to CG AAF, 15 Dec 41, sub: Adaptation of AC Photo Charting System to CE Needs. 061, Pt. 2.

[14] (1) Ann Rpt OCE, 1936. (2) Ltr, ExO Engr Bd to CofEngrs, 19 Mar 42, sub: T–5 Cameras. 061.1, SP 205 E, Pt. 1. (3) Engr Bd Rpt 668, 10 Apr 42, sub: Wide-Angle Map Equip. ERDL file, SP 205. (4) Engr Bd Hist Study, Photomapping, pp. 76–79. (5) Ltr, CO Engr Det to Sup Sec, 29 Aug 39, sub: Test of the Fairchild 12-Inch Wide-Angle Camera. ERDL file, MP 205. (6) Memo for Files, Capt Thomas A. North, Engr Bd, 13 Sep 39, sub: Notes on Samples of Fairchild 90-Degree and T–5 Photos. ERDL file, MP 205. (7) Incl, Capt Frederick J. Dau for C of Photo Lab AC Matériel Div, 17 Oct 40, with Monthly Rpt, Engr Det. ERDL file, 319.1. (8) Ltr, Maj Herrington to Capt F. Z. Pirkey, C of Dev Br, 25 Aug 39. 061.1A, SP 205, Pt. 2.

tography could not be applied, even to tactical maps, in regions such as Europe.

Within the Corps of Engineers opinions differed as to the position to be taken on the AAF development. The Engineer detachment at Wright Field, emphasizing the threat to precise mapping, urged continued concentration upon the perfection of compilation from vertical wide-angle photography. But Dau, heretofore a strong advocate of this type of photography, faced up to the fact that topographers had better prepare to make the most of whatever the AAF furnished. From the Engineer Board, Dau advised the Wright Field detachment to study equipment and techniques for applying the new method. The board selected several of the devices used by the Geological Survey for plotting obliques, and the techniques of mapping from tri-metrogon photography were made an integral part of the training of topographic units.[15] This training was superimposed upon, rather than substituted for, instruction in the standard methods of compilation from vertical photography. In a memorandum written to the War Department in September 1942, Loper cited the limitations of the AAF's method and warned against "over optimistic conclusions" as to its value. The AAF was to take sharp issue with the Engineers' estimate of the worth of tri-metrogon photography, but not until after experiences overseas had added fuel to the quarrel.[16]

In 1942, while MacArthur was organizing the Southwest Pacific Area to defend Australia from invasion, the Intelligence Branch collected a nucleus of maps for his current and future needs. In addition to maps of British and Dutch origin, the branch sent him aerial photography and information acquired from oil companies and other private firms. AMS prepared small-scale maps for operational planning and forwarded bulk stocks to topographic units which arrived in Australia during the summer of 1942. Much of this coverage was poor to start with and difficult to improve for want of aerial photography. Tropical storms, haze, and great distances from air bases to photographic objectives impeded operations. The B–24, converted to the F–7, which became available in 1943, had the range the F–4's and F–5's lacked, but made a ready target for enemy interception.

In order to secure maximum coverage with extremely limited facilities, mapping pilots in the Pacific usually depended upon tri-metrogon camera equipment. At first engineer topographic units prepared only large-scale photomaps and medium-scale planimetric maps with form lines and rough contours. Later, through experience in working almost exclusively with tri-metrogon photography, topographic units were able to convey more detail at larger scale. Taking the surrounding sea level as the basis for determining elevations, they could plot the topography of small islands. In 1943 the Engineer Board began to alter the multiplex to accommodate oblique photography and by the end of the year was able to plot 100-foot contours with the equipment. Although

[15] (1) 1st Ind, 29 Sep 41, on Ltr, ExO OCE to President Engr Bd, 22 Sep 41, sub: Dev of Equip for Reduction of Oblique Aerial Photos for Mapping. 061.1A, SP 205, Pt. 1. (2) Engr Det Project Rpt No. 42, 29 Oct 41, sub: Investigation of Map From High Oblique Photos. Topo Br file, 061.1, SP 205F. (3) Memo, Asst ExO Engr Bd for 1st Lt Lewis A. Dickerson, Engr Det, 6 Nov 41. ERDL file, MP 205.

[16] Ltr, Loper to TAG, 24 Sep 42, sub: Test of Suitability of Aeronautical Charting Methods Employed by U.S. AAF for Preparation of Various Types of Mil Maps. Tab G, with Memo, Maj Gen Geo. V. Strong, ACofS G–2, for CofS, 17 Apr 43, sub: Centralized Control of Map and Chart Activity. G–2 file, 061.01.

this was still a long way from the degree of accuracy obtained by the use of the wide-angle vertical camera and standard multiplex sets, the tri-metrogon system, with its wide coverage, spelled the difference between maps and no maps in this area where pilots, planes, and good photographic weather were at all times scarce. The Southwest Pacific had, moreover, much in common with Alaska, the first proving ground for tri-metrogon photography, in that natural rather than cultural features predominated.[17]

The quarrel between the Air Forces and the Engineers over the type of photography to be furnished centered from first to last on the areas involved in the war against Germany. The spring 1942 decision to stage a cross-Channel invasion of Europe approximately a year thence earmarked the channel coast of France as a vital area for which large-scale maps would be required. Existing maps of this region were based upon old and inaccurate Napoleonic surveys, some of which had been "blown up" from 1:80,000 to 1:50,000 scale without appreciable correction. Shortly after evacuating Dunkerque, the British had set up what was known as the Benson Project for remapping the coast between Cherbourg and Calais to a depth of 60 miles at 1:25,000 scale. Operating from an airfield at Benson, the RAF had begun to take aerial photographs of this strip of land. Regrettably, Hotine informed G–2, the planes assigned to this mission were incapable of flying high enough to escape enemy interference for more than a brief period. The result was hundreds of hit-and-run sorties at varying altitudes and angles and a mass of unusable photography. Moreover, the British were unprepared to do photogrammetric work for they had no multiplex equipment.[18] The Loper-Hotine Agreement accorded first priority to the channel area in providing for American assistance "where this is outside the capacity or equipment of Photographic Reconnaissance Units of the R. A. F." [19]

On 13 May 1942, G–2 suggested practical arrangements to Marshall. Under the plan proposed, the AAF would convert four heavy bombers to photographic aircraft and furnish them with highly trained crews. One engineer photomapping company would proceed to England to assist the British in compiling maps by multiplex. Sufficient crews and specially equipped planes to form a complete mapping squadron and additional topographic units would augment this advance echelon as soon as possible in order to compile maps of other areas destined for offensive operations. In June, Maj. Herbert Milwit, who then commanded the 30th Engineer Topographic Battalion (GHQ), arrived in England to prepare for American participation in the Benson Project. Milwit did not minimize the difficulties to be faced in securing the precise vertical photography needed to make the assignment of American topographic units with their specialized equip-

[17] (1) Ltrs, Maj G. H. Harding to Office of C of Mil Intel Sv WDGS, 21 Mar and 8 Apr 42, sub: Map and Photo Info on Foreign Countries. 061.4. (2) Memo, Harding for All Foreign Map Sec Units, 13 May 42, sub: Map and Mapping Info Data. Same file. (3) Teleg, CofEngrs to CINCSWPA and C Engr SOS Hq SWPA, 3 Feb 43. 061.4 (C). (4) *Engineers of the Southwest Pacific,* Vol. III, *Engineer Intelligence,* (cited hereafter as *SWPA, Engr Intel*) pp. 25–28, 30–36. (5) Ltr, C of Intel Br to C Engr USAFFE, 5 Aug 43, sub: Maps and Mapping. 061.01 (C). (6) Ltr, Actg C of Trps Div to CG AGF, 7 Nov 43, sub: Rcn Map in SWPA and CBI. Same file.

[18] ETO, Intel and Topo, pp. 6–20.

[19] Memo of Agreement on Map and Survey Policy Between War Office (GSGS) and U.S. CE (Intel Br). App. 9, ETO, Intel and Topo.

ment worth while. He anticipated the necessity for fighter protection and the employment of diversionary tactics in order to safeguard the precious B–17's and their crews. Yet he thought the job could somehow be done. The AAF disagreed: it would be impossible to fly on a given straight line at a set altitude in the face of heavy enemy opposition on the Continent.

The B–17's were diverted to North Africa and, upon its arrival in England, the engineer photomapping company set aside its multiplex and went to work with the British in an attempt to make something out of the random photography available. Production of the entire force, including seven British companies, amounted to about 1,500 square miles of compilation a month. The engineer company alone could have doubled this output had wide-angle vertical photography been obtained. For the time being, however, these frustrations were submerged in the general effort to supply maps for the impending landings in North Africa.[20]

For the initial operations in this theater the British furnished sets of French maps dating from 1920 to 1939. The coast had been mapped at 1:50,000 scale, much of the remaining area at 1:100,000, and the entire theater from French Morocco through Tunisia at 1:200,000 and 1:500,000. The Intelligence Branch compiled an encyclopedic engineering report on North Africa in thirteen volumes. For this study ERO furnished extensive bibliographical and reference data which the staff in Washington utilized in writing three volumes on roads, railroads, airfields, electric power, and fuel. The Forest Service contributed a section on building materials. The Military Geology unit prepared two volumes of maps and tables which gave information about water supply, airfield sites, and road building materials. The Board of Engineers for Rivers and Harbors wrote detailed descriptions of ports and terminals, including facilities for unloading, repairing, and storing equipment. The Beach Erosion Board prepared maps and charts of strategic landing areas in French Morocco and Algeria, showing the depth of water to be encountered. In September, AMS printed fifty copies of this engineering report for the use of the Combined Chiefs of Staff, commanders of the expedition, and various planning and intelligence agencies. To meet additional demands during the campaign, a second printing was ordered in January 1943.[21]

The initial supply of maps and intelligence data provided the foundation upon which AAF photographic crews and Engineer topographic troops were to build. Adverse reports were not long in reaching the Intelligence Branch. There was the dramatic letter from an Armored Force commander:

> On the eve of going into action I feel that it is absolutely necessary to invite your attention to the fact that this command is going in without adequate photographic coverage of the terrain over which it is going to operate. Certain Air Corps pilots have done very valiant work in securing the photographs which we have, and all credit should be due them. However, the coverage is not only incomplete, but the copies furnished the troops are insufficient.[22]

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[20] ETO, Intel and Topo, pp. 6–20 and App. 12.

[21] (1) Memo, ACofEngrs for CG AGF, 5 Jun 42, sub: Maps of Foreign Theaters. 061.03 (S). (2) Topo Memo 1, Intel Br, 1943, sub: Topo Experiences in Foreign Theaters. KCRC, 061.20, Intel Rpts, Binder 4. (3) Numerical List of SES (C). AMS file, Tech Sv Div.

[22] Tab A, with Memo, Strong for CofS, 17 Apr 43, sub: Centralized Control of Map and Chart Activity. G–2 file, 061.01.

There was the more prosaic but weightier judgment from Lt. Gen. Dwight D. Eisenhower: AAF planes and crews were unequal to the job.

Armed with such reports from overseas, Loper felt justified in pressing the AAF to conform to Engineer standards of mapping photography. Pitted against Loper was Kaye who had risen from command of the 1st Photographic Group to Director of Photography, AAF. Kaye claimed the Engineers had failed to exploit fully the possibilities of tri-metrogon photography and asserted that the need for accurate large-scale maps had been greatly exaggerated:

> Modern offensive warfare, utilizing closely coordinated operations of aircraft with fast moving mechanized ground units and the striking power of aircraft on vital objectives far within enemy territory has completely revolutionized tactical map and chart requirements. . . . Trimetrogon photography and compilation is not the answer to all mapping problems, but, while developed primarily for small scale charts, the method has certain advantages which should not be overlooked when photography must be accomplished in combat areas and maps prepared rapidly for offensive operations.[23]

G–2 would accept none of Kaye's arguments. Tests conducted by the Corps of Engineers were conclusive. Mobile forces, being extremely sensitive to terrain, had to have precise information. Any improvements in equipment or techniques that would render tri-metrogon photography adaptable to precise mapping would be welcomed, but until research agencies made such improvements available, the AAF had to conform to Engineer specifications. The AAF could meet those specifications if it developed a special plane capable of sustained operations beyond the normal effective ceiling of enemy fighter aircraft. On 25 January 1943, the War Department directed the AAF to develop such a plane.

Now that he had an unequivocal endorsement of Engineer standards, Loper pushed his advantage in an effort to insure enforcement. On 25 February, Reybold reiterated his recommendation for centralized command of mapping activities. As finally worked out by G–2 in April, the proposed reorganization took its model from the British. The plan called for the creation, under the supervision of G–2, of a topographic survey directorate to control the organization, training, and employment of Air Forces and Engineer mapping and charting personnel; provide theater facilities for production and distribution of maps and charts; and co-ordinate supplies with the Navy, with civilian agencies, and with American Allies.[24]

Up to this time it had been extremely difficult to get the AAF to commit itself on future plans. There had been no response to the War Department's directive to develop a special plane. Comment on an Engineer statement of photographic requirements in Europe was not forthcoming for almost two months, and then only after OPD had sought AAF's reaction a second time. On 4 May, however, Brig. Gen. Thomas J. Hanley,Jr., Deputy Chief of Air Staff, issued two statements of policy. The first, addressed to key AAF officers, apparently signaled complete capitulation to the Engineers' demands. "Starting at once," Hanley ordered, "pictures required by the

[23] 2d Ind, Kaye to TAG, 21 Dec 42, on Ltr, Loper to TAG, 24 Sep 42, sub: Test of Suitability of Aeronautical Charting Methods Employed by U. S. AAF for the Preparation of Various Types of Mil Maps. Tab G, with Memo, Strong for CofS, 17 Apr 43, sub: Centralized Control of Map and Chart Activity. G–2 file, 061.01.

[24] See above, p. 78.

Ground Forces and the Engineers will be made according to the requirements for military mapping designated by the Engineers." It was Hanley's expressed hope that his order would put a stop to "the bickering" between the services, but his second memorandum, to G–2, contained the seeds of further discord.[25] The AAF opposed the development of a special photographic plane because in the two or three years it would take to get one into production the enemy would have matched it with fighter craft. The War Department's requirement could best be met by the expected transfer of a number of British mosquito planes which could carry a cameraman. With or without mosquito planes the AAF stood ready to obtain any photography deemed necessary. Hanley emphasized, however, that responsibility for determining necessity rested with the War Department and with theater commanders. The War Department should state the mapping requirements for each theater, indicating at the same time the priority to be assigned this task in relation to other military missions.

That the Director of Photography, AAF, had been banking heavily on a low priority for mapping missions was clear from counsel he made to the two ranking Air Forces officers in the ETO within four days of Hanley's memoranda. While admitting that an invasion force would find it "extremely costly" to operate with the antiquated maps on hand, Kaye nevertheless exhorted the Air Forces generals to "steadfastly recommend against the performance" of the photographic missions requested by the Engineers, encouraging the theater commander to "balance the extreme cost of performing this job against the absolute military requirement for this type of map." A "major effort" involving 40 or 50 B–17's, plus fighter protection and bombing diversions, was indicated. Yet the losses were bound to be heavy. Kaye asserted, moreover, that the Engineers would find it impossible to make timely use of the photography if they had it. The size of the area was "tremendous." Inexperienced in multiplex work, topographic organizations would become "absolutely snarled in compilation." Photographic aviation in the ETO must be expanded, not for actual mapping purposes, but in order to supply an invasion force with large-scale photomaps as the tactical situation demanded.[26]

A copy of Kaye's memorandum arrived in Washington at a time when the reorganization scheme seemed about to die for want of support. Not only was the AAF cold toward it, but other agencies involved had argued that G–2 had sufficient authority already and had called attention to the AAF's promise to do better.[27] In the light of the Kaye recommendations the Engineers felt justified in inquiring whether or not the AAF was playing a double game.

Kaye had greatly exaggerated the task, Robins wrote AAF. Coverage to be supplied amounted to but one eighth the estimate furnished. Specifications were far less rigid than pictured. Kaye was ignorant of the capabilities of engineer topographic units. Far from being inexperienced in multiplex work, these troops could compile maps by this method at the rate of 7,000 square miles per month. If this production proved insufficient, the Chief of Engineers would tap the services of skilled civilian

[25] Memo, Hanley for AC of Air Staff *et al.*, 4 May 43, sub: AAF Photo Activity. ERDL file, 319.1, Wkly Rpt of Aerial Photo Br Wright Fld.

[26] Memo, Kaye for Gens Edwards and Eaker, 8 May 43. G–2 file, 061.01.

[27] Ltr, Loper to Brig R. L. Brown, Dir Survey AFHQ, 18 Jun 43. 061.01 (C).

agencies. Did Kaye's memorandum represent official or personal opinion? Robins challenged the AAF to repudiate it.

The AAF endorsed Kaye's estimate of the current situation in the theater. It was impossible to obtain mapping photography at that time since fighter protection could not be provided for bombers and since F–5's were presumably incapable of meeting specifications. But taken as a whole Kaye's ideas were no longer deemed sound around AAF headquarters. The poor performance of all types of reconnaissance units in North Africa, the growing recognition of the importance of photography in strategic bombing, no less than outside pressure, convinced AAF policy makers that a major change was in order. Development of a special plane would begin at once, G–2 was assured on 1 June. Pending the receipt of the two-place, highly navigable mosquito planes, the F–5 might be used to some advantage. For long-range operations in the Pacific some of the new B–29's were to be provided with camera installations. Experienced reconnaissance officers were subjecting the training program to a thorough shake-up.[28] In AAF headquarters Kaye was replaced by Col. James G. Hall, whom the Engineers considered sympathetic with their objectives even though he could not always accede to their wishes.

On 22 June 1943, the AAF flew its first mapping mission in the ETO in F–5 planes. From then on there were many such missions, both in northern and southern Europe.[29] Topographers reported that the photography, although "not perfect" had "improved enormously." Some of it was "good." Loper was incredulous. "These are strange words around Washington," he remarked, "and we hope we won't wake up to find it was all a dream." [30]

To deliver acceptable photography with F–5 airplanes demanded more skill on the part of the pilot than if there had been room for a photo-navigator. The AAF assured the requisite skill by following through in its plans to improve the training of reconnaissance units, including those assigned to mapping photography. In the end everything hung on this. Mosquito planes were not transferred in any numbers. The special photographic airplane never got into production. Most photographic missions were flown in F–4's and F–5's by a small group of dedicated Air Forces officers, among whom Col. Karl L. Polifka rendered outstanding service, first in the Southwest Pacific and later in the Mediterranean theater.[31]

Convinced that the AAF had embarked on a comprehensive program to improve its photographic services G–2 suspended action on the reorganization scheme. Quickly Loper turned his attention toward having a comprehensive mapping directive sent out to the theaters.[32] On 18 August 1943, the War Department issued such a directive. It was not quite what Loper desired. He had recommended the establishment, in the theaters, of a staff agency endowed with power to direct the entire mapping effort. Instead of making such a provision, the War Department deferred to the AAF viewpoint that mapping was the direct responsibility of the theater commander, and that having knowledge of over-all demands, he "must weigh the relative importance of mapping

[28] Craven and Cate, *AAF VI*, pp. 221, 617.

[29] ETO, Intel and Topo, p. 29.

[30] Ltr, Loper to Lt Col Edward F. Kumpe, 10 Aug 43. 061.01 (S).

[31] (1) Craven and Cate, *AAF VI*, pp. 211–22, 617–19. (2) ETO, Intel and Topo, pp. 27–28. (3) Ltr, Loper to C of EHD, 17 Apr 56.

[32] Ltr, Loper to Hotine, 10 Aug 43. 061.01 (C).



LAYING OUT AERIAL PHOTOGRAPHS TO CHECK SEQUENCE. *Soldier is a member of an Engineer topographic battalion stationed in England.*

photography and indicate positive priorities." But the whole tenor of the memorandum emphasized the importance of accurate maps and made a sharp distinction between mapping photography and trimetrogon photography. Accurate maps could not be produced overnight. Photography must be obtained well in advance of operations. Map supply must, therefore, be included in the very earliest stages of planning. By the fall of 1943 the Engineers, despite the loss of a few battles, had won a war.[33]

Adjustments to Mounting Demands

The growing strength of the Allied offensive, together with the receipt of greater quantities of aerial photographs, put Engineer topographic organizations to a severe test. Topographic units had been devised to meet average requirements of corps, army, and GHQ. Experience overseas demonstrated the need for flexibility in organization and equipment. Basic map sources might be relatively plentiful for one theater, extremely scarce for another. Variations in the availability of aerial photographs were also to be expected. During the North African campaign two provisional engineer map depot detachments proved their utility. Similar detachments, or teams as they came to be designated, were organized in 1943 under the Engineer Service Organization, T/O 5–500, which contained numerous

[33] Ltr, TAG to CG AAF *et al.*, 18 Aug 43, sub: Map and Map Photo, G–2 file. 061.01.



SOLDIER USING MULTIPLEX *to determine the third dimension of aerial photography, England, January 1943.*

cellular units favored by Loper as being particularly applicable to mapping. Besides the map depot teams, T/O 5–500 made provision for survey teams, survey liaison teams, reproduction teams, photomapping teams, and model-making teams. These teams would either supplement the larger topographic organizations or would be combined in ways that permitted concentrating on whatever phase of mapping was most urgent.[34] To increase the adaptability of topographic units, the Intelligence Division assigned special equipment or encouraged variations from T/O's which, according to Loper, "frequently meant the difference between success and failure in accomplishing missions." [35]

The model-making teams were something new, an outgrowth of investigations into camouflage. A detachment of model-makers had been trained at Belvoir to make three-dimensional plaster-of-Paris models of military and industrial installations in order to devise ways to conceal the real thing from the enemy. For the North African and Sicilian landings this group prepared terrain models of ports and beaches, enabling busy task force commanders to grasp the situation at a glance. The models came in three-by-five-foot sections and although very heavy, they were flown to the Sicilian task force in

[34] See above, page 230. Unless otherwise noted, this section is based upon correspondence in: (1) 061.01 (S), (2) 061.01 (C), and (3) Numerical List of SES. AMS file, Tech Sv Div (C).

[35] Ltr, C of Mil Intel Div to ACofS G–2, 7 Mar 44, sub: TO&E's for Topo Trps. 320.2, Engrs Corps of, Pt. 2 (C).

the summer of 1943.[36] "I shudder to think of the amount of air transport we have used in getting the models into the theater," commented Loper, who at the time had difficulty in securing priorities for sending copies of maps overseas by air. To save cargo space and otherwise reduce strains in transportation, model-making teams were sent to the theaters.[37] Survey liaison teams filled a need felt at Engineer theater staff level for assistance in determining map requirements, supervising topographic battalions, and coordinating the exchange of grid data with the artillery. At first, theater Engineers had to improvise groups of experts by drawing them from topographic units or British Survey Directorates. Allowance for survey liaison teams in T/O 5–500 eliminated this objectionable practice.[38]

The increase in topographic troops provided under T/O 5–500 was more than offset by reductions of Engineer estimates for the 1944 Troop Basis. The Engineers had put in for five base battalions, nine army battalions, and eighteen corps companies. The General Staff, intent on cuts in manpower, proposed to eliminate two of the already existing four base battalions. In arguing against this action, Loper and Sturdevant pointed out that these units, equipped with the multiplex, were about to come into their own now that the AAF was beginning to deliver aerial photographs in quantity. The General Staff agreed to the retention of four base battalions, allowing the Engineers to choose other means for reducing personnel. New T/O's which became effective toward the end of 1943 eliminated one of the survey companies from the base battalion, substituted a photomapping company for the survey company in the army battalion, and reduced the strength of the headquarters and service, and reproduction companies of both units. The reduction in military forces meant that the Intelligence Branch would have to utilize AMS and civilian mapping agencies to a greater extent on long-range projects.[39]

In September 1943, while GSGS and overseas topographic units were supplying maps for the immediate requirements of the American Fifth and British Eighth Armies in southern Italy, Loper made arrangements for compiling new maps of northern Italy and Mediterranean France. The surveys of Mediterranean France had been made between 1815 and 1855 with instruments and methods of questionable reliability. Many of the bench marks had already disappeared by the 1890's when topographic maps of this region had been compiled at 1:80,000. Maps were better for northern Italy, covered at 1:50,000, but they had to be revised to improve accuracy of detail. During July and August 1943, the AAF had taken photographs of both areas, but the film was held in the theater until October. After at last receiving the film, Loper assigned northern Italy to AMS and southern France to the Fairchild Aerial Surveys, the U. S. Geological Survey, and the TVA, which up to that time had been engaged in domestic mapping for the War Department. By the

[36] Memo Route Slip, ExO Intel Br for Besson, Engr Div *et al.*, with Ltr, ACofEngrs to C of Activation Sec Trp Units Br Mob Div ASF, 31 Jul 43, sub: Orgn and Dispatch of Model-Making Det. 322, Engrs Corps of (S).

[37] Ltr, C of Intel Br to Col L. T. Ross, OCE Hq USAFFE, 23 Aug 43. 061.01 (C).

[38] (1) Memo, C of O&T Br for Trp Units Br Mob Div ASF, 27 Aug 43, sub: Activation of Engr Map Depot Dets. 322, Engrs Corps of (C). (2) Ltr, ACofEngrs to Trp Units Br Mob Div ASF, 28 Sep 43, sub: Reduction of Engr Topo Bns (Base). 320.2, Engrs Corps of (S).

[39] (1) Ltr cited n. 38(2). (2) T/O 5–55, Engr Topo Bn Army, 17 Nov 43. (3) T/O 5–185, Engr Topo Bn Base, 29 Dec 43.

end of 1943 AMS had revised 16,000 square miles, while the other agencies compiled 12,000 square miles of new 1:25,000 maps by multiplex.[40]

During the summer of 1943 the Joint Chiefs of Staff brought together all phases of intelligence in a single volume for planning military operations in a given area. They set up a board which assembled, edited, and published material submitted by the Army, Navy, and Office of Strategic Services in the form of Joint Army-Navy Intelligence Studies (JANIS). From the start the Engineers contributed chapters on landing beaches, ports, and terminal facilities, and in 1944 became more closely identified with this program through gaining representation on the JANIS Publication Board.[41]

Drs. Mason and Krumbein, landing beach experts, worked directly with the Joint Chiefs of Staff in preparing plans that were used in the landing at Salerno. ERO had already furnished them a considerable amount of various types of source material prepared by the Rockefeller Foundation, the German Navy, the Italian National Research Council, and the International Geographic Union. After investigations of malaria in Italy and Albania, the Rockefeller Foundation had published sixteen volumes showing where this disease was prevalent. Intended as a contribution to public health, these reports could be applied for military purposes because they offered a guide to terrain conditions along the shores. The German publication contained photographs and the others were scholarly monographs on the Italian coastline.[42]

For early operations on the Italian peninsula, the Intelligence Branch published ten volumes on landing beaches, ports, terrain, and water supply and a study on river currents to aid in planning for floating bridges. Engineers also required specifications of Italian bridges in order to estimate stockpiles of timber and prefabricated parts for repairing damaged structures. Upon urgent request, ERO prepared in twelve days a four-volume study on 364 highway bridges, based primarily on information taken from Italian engineering publications. By December 1943 ERO had compiled ten additional volumes on Italian railroad bridges and tunnels. Besides being of use for accumulating stockpiles of materials, these studies were valuable for traffic control and for selecting targets for aerial bombardment.[43]

Loper in January 1944 agreed to assist the Benson Project by compiling maps covering 16,000 square miles of northern France. He assigned the work to the U. S. Geological Survey and the TVA, and with aerial photography sent from England these agencies prepared 200 sheets at 1:25,000 scale. When the task of indicating

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[40] (1) Memo, ACofEngrs for CG AGF, 5 Jun 42, sub: Maps of Foreign Theaters. 061.93 (S). (2) Ltr, ACofEngrs to CG ASF, Attention Trp Units Br Mob Div, 28 Sep 43, sub: Reduction of Engr Topo Bns (Base). 320.2, Engrs Corps of (S). (3) Memo, C of Intel Br for ACofS G–2, 2 Oct 43, sub: Activation of Topo Orgns. 322, Engrs Corps of (C).

[41] (1) Wkly Progress Rpts Intel Br, 18 Jun, 9 Jul, 20 Aug 43. ERO file, P–3M, Washington Wkly Prog Rpt (C). (2) Outline Guide for JANIS, n. d. ERO file, 461 JANIS (C). (3) War Plan Wkly Staff Conf, 5 Jun and 28 Aug 44.

[42] (1) Memo, ExO ERO for McCaffrey, 13 Aug 43, sub: Rpts on Malaria Control in Italy and Albania, with list of rpts. ERO file, 091–R, Albania (C). (2) Memo, C of Strategic Intel Br for John Denton, 19 Oct 44, sub: Exceptional Meritorious Award for Dr. Mason. ERO file, 091–R, Gen Liaison (S).

[43] (1) ERO Staff Mtg, 25 Oct 43. ERO file, 319.1, Staff Mtg (C). (2) Ltr, C of Opn Div Office ACofAS Intel to Loper, 22 Oct 43, sub: Railway Bridges in Northern Italy. ERO file, 091, Italy (C). (3) Ltr, CO ERO to NAD Engr, 15 Oct 42, sub: ERO Special Rpt No. 57. ERO file, Misc Corresp (S).



SORTING MAPS FOR DISTRIBUTION *to men of the 35th Division, St. Lô area, France, July 1944.*

such fine but essential details as hedgerows threatened to delay completion of the maps until after the Normandy landings, the Intelligence Division reconciled the requirements for timely yet complete representation by backing up each battle map with a photomap of the same area. In April 1944 the Intelligence Division began to receive schedules from ETOUSA for reproduction of maps to support future Allied operations on the Continent. Guided by requisitions averaging 7,500,000 copies per month, AMS and private contractors printed about four out of every ten maps used in the theater. The rest were reproduced by the British, by overseas topographic organizations, and later by the French National Geographic Institute. The first shipment from AMS was ready in July 1944, a month ahead of schedule, and by the following April, this agency had shipped nearly 80,000,000 copies of maps that covered the area from Normandy to Berlin.[44]

While co-ordinating mapping activities for the invasion, Loper also reached an understanding on the division of responsibility for strategic intelligence. Like the arrangements in regard to mapping itself, this understanding was not to be rigidly adhered to, but in general British and Americans in the theater were to supply data on northern France and Germany, while the Intelligence

[44] (1) Wkly Rpt Mil Intel Div, 21 Apr 44. ERO file, 319.1–P, Washington (C). (2) Memo, ExO AMS for C of Mil Intel Div, 10 Jul 44, sub: Request for Additional Story on the Dalecarlia Distr Depot of AMS, with Exhibit A. AMS file, 319.2, Gen Corresp on Ann Rpt AMS, FY 1944. (3) ETO, Intel and Topo, pp. 70–71.

Division, OCE, worked on southern France and Asiatic-Pacific areas. The Intelligence Division had already completed various assignments preparatory to operations in France, including terrain, port, and beach studies. During the summer of 1942 the Beach Erosion Board had made a report on landing areas between Cherbourg and Dunkerque. This report, used as a starting point for more detailed studies which were made in the United Kingdom, described the OMAHA and UTAH beaches where the landings took place. The Beach Erosion Board prepared a similar study on the Mediterranean coast. During 1943, ERO, working from documents from the French Information Center in New York, had finished several reports on France, crowned by four volumes which dealt with inland waterways. Hence the remaining efforts for France were devoted to answering requests for spot information. By the fall of 1944, as the Allies reached the Siegfried Line, ERO had furnished twenty-three volumes on German waterways, bridges, and railway tunnels. For the Rhine crossings, the Intelligence Division investigated the possibility that floods might result from demolition of dams in the Rhineland, provided additional information on the current and condition of the river bed, and prepared "trafficability maps" which showed how weather conditions would affect the advance of tracked or wheeled vehicles over different types of terrain.[45]

The great distances to terrain objectives in the Pacific made advance field reconnaissance all but impossible, and for many regions intelligence preparations in the United States constituted a primary source of information until aerial photography could be secured. In planning strategy, commanders had to decide what islands were worth seizing and which could be bypassed. The Intelligence Division answered many requests for information about possible locations for airfield sites. If conditions on certain islands made it impossible to develop advance bases, these places would be bypassed in favor of more advantageous sites. Besides indicating the potential military value of many islands, geologists pointed out where construction materials and potable water were to be found. For some of the Japanese mandates, published geological reports were unavailable, but from information on vegetation which grew in these areas, geologists were able to predict the nature of the underlying terrain. Similarly, in the absence of other information, beach erosion experts developed means of determining beach gradients from wave studies.[46]

After the Teheran Conference in November 1943, the Intelligence Division focused more attention upon operations in the Pacific. MacArthur's plans for 1944 called for a series of amphibious landings at strategic points on the northern coast of New Guinea and its outlying islands, to culminate in the invasion of the Philippines. During the spring of 1944, the Joints Chiefs of Staff, in consultation with the Engineers, the AAF, and the Navy, issued a directive for the Philippines mapping program. The archipelago was divided into two topo-

[45] (1) Wkly Rpt Mil Intel Div, 17 Dec 43. ERO file, 319.1–P, Washington (C). (2) Memo, C of Strategic Intel Br for John Danton, 19 Oct 44, sub: Exceptional Merit Award for Dr. Mason. ERO file, 091–R, Gen Liaison (S). (3) Ltr, Capt A. R. Spillers, AC of Mil Intel Div, to NAD Engr, 17 Jan 44, sub: Request for ERO Rpts. ERO file, 091–R, Germany (S). (4) Memo, Spillers for ExO Mil Intel Div, 21 Feb 45, sub: Info for Gen Worsham's Trip to ETO. ERO file, 091–S, Gen (S).

[46] (1) Wkly Rpt Mil Intel Div, 26 May 44. ERO file, 319.1–P, Washington (C). (2) War Plan Wkly Staff Conf, 2 Oct 44.

graphic zones: one consisting of Mindanao alone, which received first priority because it was then indicated as the first strategic objective, and another, which embraced the remaining islands to the north. Photographic requirements for Mindanao involved a general coverage of 36,000 square miles by tri-metrogon photography, supplemented with 7,000 square miles of vertical photography for areas where intensive ground operations were expected.[47]

Topographic units in the Southwest Pacific had been unable to start remapping the Philippines before August 1944 because photographic aircraft based in New Guinea lacked sufficient range. Accordingly they looked to AMS to prepare the initial supply of maps. Existing coverage at tactical scales for the Philippines, which embrace over 7,000 islands, was confined mainly to the coastal fringes. Most of these charts had been made between 1903 and 1938 by the Navy and the Coast and Geodetic Survey by means of survey boats. The U.S.N. Hydrographic Office furnished AMS with hydrography for 469 sheets covering Luzon, Mindanao, and the Central Philippines. In peacetime the Corps of Engineers had also started to map some of the major islands at tactical scales, but limited funds prevented progress. AMS had some aerial photography of Luzon and the Sulu Archipelago dating from the late thirties. With these materials, AMS prepared to deliver, between August and December 1944, stocks of maps for the area south of 15°, with particular emphasis on Mindanao. Topographic units in the theater would revise these maps as soon as photography became available.[48]

While preparations for the invasion were proceeding according to plan, naval reconnaissance on 12 September 1944 revealed weakness in the defenses of the Central Philippines. Partly on the basis of this information, the invasion date for Leyte was advanced to 20 October, sixty days ahead of schedule. This abrupt change in strategy created untoward problems in the mapping program. Not until 1 October, when an airfield on Morotai became operative, was it physically possible for land-based photographic aircraft to carry out missions over Leyte. AMS had meanwhile furnished complete coverage of the island with 1:200,000 scale Coast and Geodetic Survey maps, which were fairly accurate along the coast, but which were very defective inland, and with several coastal sheets at 1:50,000 scale. Additional photography for the mountainous regions, where, on the maps, parts of the main supply road and many peaks were misplaced by several thousand yards, could not be obtained until late in the campaign. To remap this sector, where the hardest, most protracted resistance developed, Sixth Army topographers blew up the 1:200,000 scale map to 1:50,000 scale and periodically added information from captured Japanese maps, sketches by patrols, aerial photographs, and other sources.[49]

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[47] (1) *SWPA, Engr Intel,* p. 95. (2) Incl, Map, Map Photo, and Photo for Strategic Bombardment of Japan and Approaches Thereto, with Memo, Col Dau, WDGS G–2, for Secy Joint Intel Comm, 12 Apr 44, same sub. G–2 file, 061.01.

[48] (1) Wkly War Plan Staff Conf, 12 Jun and 16 Oct 44. (2) Memo, ExO AMS for C of Mil Intel Div, 18 Dec 44, sub: Cartographic Work Prepared By Other Government Agencies for AMS, FY 1944. AMS file, 319.2, Gen Corresp on Ann Rpt AMS, FY 1944. (3) *SWPA, Engr Intel,* pp. 75, 120–22, 202. (4) Rpt, C Engr SWPA, Aug 1944. EHD files, SWPA Br.

[49] (1) *Engineers of the Southwest Pacific,* Vol. I, *Engineers in Theater Operations,* p. 204. (2) *SWPA, Engr Intel,* p. 93, n. 16. (2) Hq Sixth Army, Rpt of the Leyte Opn, 17 Oct–25 Dec 44, n. d., pp. 161–62, 234. (3) Hq Sixth Army, G–2 Wkly Rpt 79, 7–14 Mar 45, pp. 38–39. EHD files, SWPA Br. (4) Intel Div OCE GHQ SWPA, Ann Rpt 1944. Same files.

For the Luzon campaign, which opened on 9 January 1945, AMS prepared aeronautical charts and a road map of the entire island, and, utilizing Coast and Geodetic Survey material and prewar photography, issued topographic maps at 1:25,000 and 1:50,000 scales. These maps were confined to the landing beach area and the central plain from Lingayen Gulf to Manila. Eighteen tons of maps were shipped by air so as to reach the theater in time for the invasion. The rest—some 300 tons—went by sea. Many of the sheets were old and inaccurate because of changes in culture, vegetation, and stream patterns. As at Leyte, the maps were adequate for the first thirty days of operations, when the Sixth Army rapidly swept over the central plain to Manila. Then, just as before, the rest of the campaign dragged out in the extensive unmapped or poorly mapped mountain regions which the Japanese defended with fanatical tenacity.[50] Noting the limitations of the sources with which AMS had to work, Matthews, who succeeded Loper as chief of the Intelligence Division, described the maps supplied for the Philippines as "very poor and somewhat embarrassing." [51]

In addition to maps, the Intelligence Division contributed fourteen volumes dealing with landing beaches, ports, roads, and communications of the Philippines, and nine other volumes about the other islands that had been considered for use as intermediate bases. In response to theater requests, the Intelligence Division sent a team of geologists and beach experts to the Southwest Pacific Area in the spring of 1944 and another to the Pacific Ocean Areas that fall. Serving on the staffs of the Chief Engineers, these teams gave valuable assistance in integrating strategic engineering data with information obtained in the theaters.[52]

Map coverage for Japan consisted of 1,700 sheets, scale 1:50,000, and 1,200 sheets, scale 1:25,000, that had been prepared by the Japanese Imperial Land Survey between 1902 and 1939. The smaller scale maps covered the home islands and extended south to Formosa and north to Siberia. During 1943 and 1944, after romanizing the legends and place names, AMS sent copies of both sets to the Pacific theaters for future reference. For security reasons, the Japanese had shown potential landing places on Kyushu and Honshu as complete blanks on these maps. Comparison with other documentary materials revealed that highway information was also misleading because Japanese maps customarily indicated widths between ditches or right of ways instead of paved surfaces. Other discrepancies appeared, but the Engineers needed aerial photography and geodetic data in order to correct them.[53]

Some of the most detailed information came from the files of the Japanese Embassy and consulates and those of the Mitsui and Mitsubishi trading companies, which the FBI had seized immediately after Pearl Harbor. Reckoning with the possibility that

[50] (1) *SWPA, Engr Intel,* pp. 109, 121. (2) Wkly War Plan Staff Conf, 16 Oct 44. (3) Hq Sixth Army, Rpt of the Luzon Campaign, 9 Jan–30 Jun 45, n. d., Vol. III, p. 19; Vol. IV, pp. 11–12. (4) Ltr, Lt Col H. E. Thomas, Advance Echelon OCE GHQ SWPA, to Lt Col R. Moore, Engr Intel Sec GHQ SWPA, 9 Feb 45. EHD files, SWPA Br. (5) Memo, Thomas for Record, 18 Feb 45, sub: Critique on M–1 Mapping. Same files.

[51] Ltr, C of Mil Intel Div to Dept Engr Panama Canal Dept, 30 Apr 45. 061.01 (C).

[52] (1) Wkly War Plan Staff Conf, 10 Jul, 30 Oct, 13 Nov 44; 5 Mar, 2 Apr 45. (2) Wkly Rpt Mil Intel Div, 21 Apr, 19 May 44. ERO file, 319.1–P, Washington (C). (4) Ann Rpt OCE, 1945.

[53] (1) Daily Log ERO, 24 Mar 44. ERO file, Gen Corresp, Mar–May 44 (S). (2) *SWPA, Engr Intel,* p. 195.

these records had been planted for the purpose of misleading American intelligence, the Engineers took precaution to check other sources. ERO contacted exporters of industrial and railroad equipment and investment bankers who had dealt in Japanese securities. Late in 1944 Vogler and three experts from ERO went to Paris to collect information on the Far East. In spite of the handicaps of doing research under wartime conditions, the Vogler team was able to send back a tremendous amount of microfilmed material, including a Japanese encyclopedia and several thousand aerial photographs and accompanying descriptions of the coastline of Indochina. For the translation of data written in Japanese, ERO received inestimable assistance from a Japanese-English technical dictionary which was being compiled by Stanley Gerr under the auspices of the Rockefeller Foundation. The only work of its kind, Gerr's dictionary contained approximately 130,000 entries, equivalent to several thousand pages of text. In the spring of 1945, after learning how critically this work was needed for research on Japan, the author loaned his manuscript, notes, and card index to ERO without charge.[54]

By this time, landings on Iwo Jima and Okinawa had brought American forces within 350 miles of Kyushu, southernmost of the main islands of Japan. As the Army and Navy converged upon the enemy's stronghold, MacArthur and Nimitz prepared to carry out plans for invasion. Photographic aircraft at last could reach Japan and secure coverage needed for revision and original compilation. At the end of May 1945, representatives of the War Department and the various Pacific commands held a conference at Nimitz' headquarters in Hawaii and formulated a program for photographic and mapping operations. Matthews, who served as chairman of the mapping committee, recommended the establishment of a single agency under MacArthur for co-ordinating the efforts of AMS and the topographic units scattered throughout the Pacific. Mapping requirements for the projected campaigns included beach areas at 1:10,000 scale, completely new coverage of Kyushu and Honshu at 1:25,000 and 1:50,000, and road maps for the entire archipelago at 1:250,000.[55]

As a result of the mapping conference, Army Forces in the Pacific requested AMS to reproduce and ship 27,000,000 maps by the first week of July and 33,000,000 more by October. This was by far the biggest order to be produced within such a short time, but with the aid of ninety-five lithographic and seven drafting firms, the deadline was met. The Intelligence Division furnished fourteen volumes on Japanese railroads as well as numerous terrain studies and prepared forty-six additional volumes of strategic information for possible operations on the Chinese mainland. After the surrender of Japan, two months before the projected

[54] (1) Ltr, Office of C ERO to D. B. Britt, C Midwest Office Dept of Justice, 15 Oct 43. ERO file, 091–R, Gen (S). (2) Ltr, Act C of ERO to Spillers, 12 Oct 44, sub: Request for Info. ERO file, 091–R, Formosa (C). (3) Daily Log ERO, 29 Jan, 9 Feb, 1 Mar, 18 May, 22 May, 14 Jun 45. ERO files, 319.1–P, ERO to NAD (S) and Misc Corresp, Mar–Apr 45 (S). (4) Interim Rpt of W. H. Stahl's Visits to Downtown New York Firms Dealing in Japanese Electric Power Securities Before the War. ERO file, 300.6, Research (C). (5) See ERO file 091–R, Gen Liaison, concerning information secured by the Vogler team in Paris. (6) Memo, CO ERO for McCaffrey, AC Mil Intel Div, 13 Jan 44, sub: Publication of Japanese Dictionary. ERO file, 091–R, Japan (C). (7) Legal arrangements for use of Gerr's dictionary are in ERO file, Japanese Dictionary of Technical Terms.

[55] *SWPA, Engr Intel,* App. XXXIX.

invasion, cushion stocks of maps that had been stored on Oahu, Guam, and Luzon were made available for the occupation.[56]

Time and again World War II experience demonstrated the importance of making advance preparations for supplying maps and strategic Engineer intelligence. The difficulty of furnishing detailed maps and terrain information for overseas theaters that practically spanned the globe proved beyond doubt the shortcomings of earlier concepts based upon wars of limited scope. In one respect only was the Army prepared. Engineer topographic units were equipped with the most modern means of compiling maps from aerial photography. These means were never completely exploited. Like the rest of the Army, the AAF tended at first to emphasize the development of fighting units to the neglect of supporting organizations. By the time photo reconnaissance aviation assumed its proper position in relation to fighting elements it was too late to make the radical changes that full exploitation of aerial photography demanded. But even had reconnaissance aviation not been the stepchild it was, the AAF could not have begun to supply the coverage required during World War II. Thanks in great part to the maps turned over to the United States by the British, the AAF's task assumed more reasonable proportions. Another significant aid in accomplishing the over-all mapping mission was the tri-metrogon system of photography. This method served well in the Pacific where numerous, uncultivated areas, widely separated, had to be covered. In Europe, where tri-metrogon photography could not be used, the AAF's inadequate photographic air craft threatened to cancel out the years spent in perfecting modern methods of map compilation and to interfere seriously with the timely delivery of maps. Both for want of aerial photography and as a result of break-downs in the system of distribution, shortages of maps occasionally did occur in Europe, but in general the right maps were on hand at the right time. The Engineers proved correct in their estimate of the demand for large- as well as small-scale maps. As long as the Army moved rapidly, it had no use for battle maps. In landing operations and in areas where the enemy had established strong defensive positions, there was an insistent call for large-scale, highly detailed maps.[57] Realizing that theater units could not supply nearly enough maps for the expeditionary forces, the Corps of Engineers enlisted the aid of civilian agencies and reorganized and strengthened the Army Map Service. Incidental to printing a total of 450,000,000 copies of 44,000 different maps, AMS developed into a complete mapping establishment with a collection that covered all parts of the world.

[56] (1) *Ibid.*, p. 196. (2) Hist of Map, p. 31.

[57] (1) Final Engr Rpt, ETO, pp. 98–104, 120. (2) The General Board U.S. Forces European Theater, Engineer Technical Policies, Study 73, [c. 1946], Ch. IV, p. 8. Twelfth Army Group files. (3) *SWPA, Engr Intel,* pp. 235, 349, 356.

CHAPTER XX

Improvements in Equipment

As in other aspects of the Engineer effort to ready troops for war, the attack on Pearl Harbor brought about no sudden break or shift in the program for developing equipment. Pearl Harbor found the Engineers in the midst of a number of studies that needed to be brought to a successful conclusion. On top of these came new assignments as a result of new Engineer missions. Although commitment of American troops overseas affected the program to some extent from the beginning, it was not until mid-1943 that battle lessons became the dominant influence.

The Over-all Program

During the war years the Engineer Board had a great deal more money to spend on the development of equipment than had been available previously. In the fiscal year 1943 the board expended over six million dollars—almost three times as much as it had been allotted in the eighteen months before Pearl Harbor. More employees could be hired. As of 30 June 1941 there were 38 officers and 453 civilians on duty; a year later the number of officers and enlisted men had increased to 124 and the number of civilians to 821. Facilities, too, were at last adequate. By July 1942, eighteen of twenty-four new buildings had been completed.

Some assignments of a specialized nature could be handled more expeditiously at locations other than Belvoir. By the summer of 1943 the Engineer Board had established field offices at the following locations: Desert Warfare Training Center, Camp Young, California (desert roads); Mountain Training Center, Camp Hale, Colorado (mountain warfare equipment); U.S. Naval Amphibious Training Base, Fort Pierce, Florida (beach and underwater obstacles); Martha's Vineyard, Massachusetts (amphibious equipment); Barrage Balloon Training Center, Memphis and Camp Tyson, Tennessee; Imperial Dam, Yuma, Arizona (bridge tests); and Seattle, Washington (camouflage studies).

Within this framework of more funds, facilities, and personnel, the Engineer Board looked forward to an expanding and urgent program. The number of development projects had increased slightly by June 1942 from the 99 remaining open at the end of the previous year to 117. This count was shortly thereafter artificially raised by a revision in the system of numbering. The new numbering system broke down the 117 projects into their components. Thus, what had been one project under MP 235, Organization and Equipment of Topographic Battalions, now became six, with project MP 235 A, Table of Organization and Table of Basic Allowances, project MP 235 B, Military Level, and so on. According to the new method of counting, the Engineer

Board had 600 active projects in the summer of 1942.[1]

About this time, various higher echelons of command began to challenge the desirability of an expanding development program and attempted to siphon off some of the energies being expended on it into the production of equipment already selected. In June 1942, the Army and Navy Munitions Board notified the Corps of Engineers that procurement of pilot models would be granted only AA–3 priority, the higher ratings to "be reserved for the production of end munitions items now urgently needed for the current conduct of the war." The ANMB turned a deaf ear to the Engineers' objection that this order would slow down their attempts to carry out the many assignments recently received. The outbreak of war made the search for new and better equipment a less important task than getting previously selected items into the hands of the troops.[2] Sounding a similar note a few months later, Fowler cautioned the Engineer Board against losing sight of the end-all of the development program—"the issuing of suitable equipment in quantity to the troops in the field. . . . Efforts should be directed not toward obtaining the best item in the world," he admonished, "but toward obtaining in quantity a suitable article. . . . Personnel working on development should continually ask themselves, 'Is this article good enough to be put in quantity production without further refinement?' " [3]

If the assignment of lower priorities and Fowler's restatement of principles served as a general indicator of the way the wind was blowing, the conclusions of a group of officers appointed to study the board's program in July 1942 definitely established the new trend—the contraction of the development program as a whole with an eye to the speedy completion of essential work. After reviewing all currently active projects these officers recommended the immediate closing of 208 out of 613. Although their recommendation was carried out and although the Engineer Board and OCE officials attempted to screen projects carefully, more officers continued to be assigned to the board and more civilians to be hired. By February 1943, with total active projects at 448, the number of civilian employees stood at 1,342, a 64 percent increase during the previous eighteen months. At this point SOS stepped in, demanding a cut not only in projects but in staff.[4]

In March 1943, representatives of OCE and the Engineer Board sat down with the chief of ASF's Development Branch to decide which projects could be dropped. The Engineers emerged from this conference having agreed to eliminate 183. By the end of May the board was carrying only 218 projects. Still ASF was not satisfied. On 31 July, Somervell called for further scrutiny:

> Prior to and during the early stages of the present war the matter of research and development was of the greatest importance because of the dearth of modern munitions. Because of the great progress that has been made in this field and the substantial production now being realized in up-to-date weapons

[1] (1) Ann Rpts Engr Bd, 1941, 1942. (2) Engr Bd Hist Study, Engr Research and Dev in World War II, Over-All Account, p. 46.

Unless otherwise noted, the remainder of this section is based upon correspondence in 400.112, Engr Bd, Pts. 1 and 2.

[2] Ltr, ExO Sup Div to ANMB, 9 Jul 42, sub: Priority Asgd Research Activities, with 1st Ind, 14 Jul 42. 400.1301, Pt. 5.

[3] Ltr, C of Sup Div to President Engr Bd, 21 Nov 42, sub: Instrs to Bd Pers on Relation Between Dev and Proc. 334, Engr Bd, Pt. 1.

[4] Ltr, Dir Rqmts Div SOS to Dev Br, 6 Oct 42, sub: Cancellation of Dev Projects, with Incls, Lists A, B, and C. ERDL file, BR 287.

and equipment, a review of the situation is indicated.

Although it is not desired to take any action which will curtail the development of those important items of munitions which give promise of substantially assisting in the war effort, it is considered imperative to restrict all future development to items of this category.[5]

In reply, Reybold insisted that all possible precautions were being taken to insure the attainment of ASF's objective. Before a project was assigned, the Troops Division first determined whether the proposed development was essential to the prosecution of the war. Clearance by the Technical Committee and authorization by ASF followed, and finally the Engineering Division reviewed the plan of development as proposed by the Engineer Board. In conclusion Reybold reviewed the substantial reduction that had taken place since the first of January. The Engineer Board was now carrying less than a third of its former work load. From 391 projects at the beginning of the year it had dropped to 123 as of the end of August. To be sure, reductions in staff had not kept pace with reductions in projects, but with a total of 966, the number of military and civilian employees was about the same as in June 1942. This, argued Reybold, was "an absolute minimum working strength" because the board's work encompassed more than development of new equipment. Its personnel conducted engineering studies, prepared plans and specifications, analyzed criticisms of equipment received from the field, and supervised service tests. Engineer participation in the drive to find substitutes for materials in short supply was centered at the board. About 25 percent of the board's work was on so-called service projects. Some of this work, the procurement of pilot models, for example, could be farmed out to field offices. Experiments toward this end had, in fact, begun. But Reybold pointed out the limitations of decentralization: a central authority had to co-ordinate and standardize the work done in the field and this authority was the Engineer Board.[6]

Although thus defending the operations of the board, the Engineers changed its topside administrative staff. Heretofore, the president of the Engineer Board had occupied another position of importance at Belvoir. Brig. Gen. Edwin H. Marks, who had been appointed president on 1 July 1942, was at the same time Commanding General, Fort Belvoir. In October 1943, General Schulz was transferred from command of the EUTC at Claiborne to the presidency of the Engineer Board. He had no other duties. The following month a new executive officer, Col. William J. Matteson, replaced Col. Peter P. Goerz, who had served in that capacity for about a year. Schulz and Matteson remained with the board until the end of the war.

The fact that the Engineers found it possible to cut back their program for the development of new equipment was a tribute to the work that had been accomplished during the years preceding the Japanese attack. Those years witnessed the revolution in equipment. The developments that took place during the war years were on the whole less basic in nature. Much time and effort on the part of the board, of OCE, and of manufacturing concerns was expended in designing acetylene, nitrogen, and oxygen generators after the Corps of Engineers was asked to form gas generating de-

[5] Memo, CG ASF for CofEngrs, 31 Jul 43, sub: Curtailment of Nonessential Dev Projects and Reduction of Dev Activities. 400.112, Engr Bd, Pt. 2.

[6] 1st Ind, 2 Sep 43, on memo cited n. 5.

tachments in the spring of 1942. Similar efforts went into the perfection of water supply equipment, the Engineer Board working closely with industry in the development of purification units, distillation units, storage tanks and trucks, pumps, and well drilling rigs.[7] Tests of landing mats continued, with particular emphasis upon the behavior of these mats under varying conditions of soil and weather. A group of experts from the Engineering Division, OCE, and from the Waterways Experiment Station at Vicksburg, Mississippi, lent much valuable assistance in the conduct of these tests. This group had investigated the subject of soil bearing capacity in an effort to provide permanent runways that would support the increasingly heavy bombers. Although mainly applicable to the construction undertaken by the Corps of Engineers for the AAF in the United States, the design criteria developed were also made available to theater Engineers.[8]

By spring 1943 the board's earlier decision to concentrate on developing one all-purpose mat had been vindicated. Theater commanders reported that all airfields had to support heavy as well as light planes. The Engineer Board continued to point out the deficiencies of the pierced plank mat. Precious steel was wasted in its fabrication. In wet weather, mud and water seeped onto its surface causing it to become dangerously slippery. The pierced plank mat had a tendency to bend and to curl at the edges after a relatively short period of use by heavy bombers. By March 1943 the board had become convinced that these deficiencies outweighed the fact that the pierced plank mat could be produced in greater quantity than any other type and took up less cargo space. Production of pierced plank mat should be reduced. Additional requirements were to be satisfied by the heavy bar and rod mat. This type took up a large amount of shipping space and had been known to break when subjected to unusual strain, but it possessed a higher strength-weight ratio, was easier to lay and to camouflage, and was more skid-resistant than the pierced plank mat.[9] Despite the board's recommendation the pierced plank mat continued to be the type requested by theater commanders. It was the type they knew most about, deficiencies and all. Even while listing its imperfections and calling for improvements after the war was over, the Engineers admitted that the pierced plank mat "turned in a creditable performance through-out the world." [10] In seeking to improve what theater commanders had found to be generally satisfactory, the Engineer Board indulged the naturally perfectionist, but time-consuming and expensive, attitude of the research agency, which ASF and OCE were attempting to curb. By and

[7] The following files contain information on the development of gas generating equipment: 451.2, 400.112, Oxygen Generating Plant Equipment, and office files of the Mechanical Equipment Branch. A summary of the development of water supply equipment is given in the following Engineer Board Historical Studies: Water Purification, Water Distillation, Water Distribution and Storage, and Water Pumps and Wells.

[8] (1) Fine and Remington, CE, Military Construction in the United States. (2) Memo, C of Soil Mech Unit for C of Engr and Dev Br, 22 Sep 42, sub: Performance Tests on Landing Mats. ERDL file, Air Corps, 318. (3) Memo, Engr and Dev Br for Files, 23 Sep 42, sub: Résumé of Conf on Relation Between Bearing Capacity of Soils and Various Types of Airplane Landing Mats. Same file. (4) Ltr, C of Engr Div to President Engr Bd, 11 Jun 43, sub: Traffic Tests on Airplane Landing Mats. Read file, Gayle McFadden, 1943.

[9] Engr Bd Rpt 735, 15 Mar 43, sub: Fourth Interim Rpt, Emergency Landing Mats for Airfields.

[10] Ltr, C of R&D Div to CG ASF, 5 Sep 45, sub: Future Dev of Airplane Landing Mats. 400.112, Landing Mats, Pt. 2.

large, however, the board's work during the war years arose directly out of needs resulting from the character of operations overseas.

Among the predictions which the Engineers had made as to the tactical nature of mobile warfare none turned out more nearly true than the ones on employment of obstacles to impede the advance. Months before American troops were committed to combat, the Army knew what to expect. From the Russian front and from the British in North Africa the evidence piled up: land mines were being used extensively and effectively by armies in retreat. American experience in North Africa offered further unhappy confirmation. Rommel had strewn large numbers of antitank and antipersonnel mines which enabled him to keep ahead of his pursuers for a long time. In Italy the enemy, grown more desperate, resorted to all the delaying tactics that terrain and available resources permitted. There, as Eisenhower described it in his memoirs, the German, in yielding "even a foot of ground . . . made certain that every culvert and bridge on the miserable roads was blown out; every shelf road cut into the steep mountainsides was likewise destroyed." [11] In the Pacific theater nature itself had provided so many obstacles that the Japanese were saved the trouble of creating a large number of artificial ones, but by exploiting to the utmost what was ready-made, they were able to maintain a formidable resistance to the American advance.

Clearance of Land Mines and Other Obstacles

The Corps of Engineers pursued several lines of investigation in an effort to provide means of clearing a passage through land mines, barbed wire, and similar defenses which the enemy prepared and which he normally covered by artillery or infantry fire. The problem in dealing with land mines was not, of course, simply one of clearance. Since land mines were usually buried, a large part of the work of clearing them was discovering their exact location. Development of a portable mine detector—SCR 625—had been all but completed before Pearl Harbor and procurement of the first 1,000 units began early in 1942. Time was to show that SCR 625, while basically a good instrument, could not always be relied upon even to perform tasks for which it was specifically designed. But in the early months of 1942 techniques for detecting mines were far ahead of techniques for clearing mine fields and other obstacles under hostile fire.[12]

The greatest progress in clearance techniques had been in the area of explosives. Late in 1941, learning that the TVA wished to destroy several bridges and other structures, the Corps of Engineers sought and received permission to carry out this work. A company of engineers under the command of Lt. Alfred G. Hoel, Jr., who was to become the Engineer Board's principal demolitions expert, spent a month in the Tennessee Valley trying out and keeping a detailed record of the types, amounts, methods of placement, and relative effectiveness of various explosives. Bangalore torpedoes seemed the best of the lot.

The bangalore torpedo, invented by a British Army officer in Bangalore, India, before World War I, was a metal tube which could be made up in various sizes and filled in the field with various combinations of

[11] Eisenhower, *Crusade in Europe*, pp. 201–02.

[12] Engr Bd Hist Study, Metallic Mine Detectors, p. 16. For accomplishments before Pearl Harbor, see above, pp. 53–55.

explosives. After the test in the Tennessee Valley, the Engineer Board's Demolition and Obstacle Branch worked closely with the Ensign-Bickford Company, the Niles Steel Products Division of Republic Steel Corporation, the American Can Company, the Atlas Powder Company, and DuPont in an effort to determine the ideal size and content of explosive. By the spring of 1942 this co-operation had resulted in a prefabricated bangalore torpedo five feet long and two inches in diameter, containing about 8½ pounds of ammonium nitrate, and fitted with a copper well for the reception of a blasting cap or other detonating device. In addition to spurring the effort to improve the design of the bangalore torpedo, Hoel's work in the Tennessee Valley contributed much useful information about the proper use of blasting caps, the hooking of circuits, and safety precautions.

Interest next shifted to Aberdeen Proving Ground, Maryland, where Ordnance and Engineers co-operated in erecting an antitank obstacle course. The Engineer Board's report of the tests at Aberdeen contained detailed instructions for demolishing as well as for constructing log blocks, tetrahedrons, hedgehogs, and steel sheet and timber piling.

More dramatic in background and more productive of new methods of demolitions was a highly secret project to parachute a force into Norway and destroy its power plants. The personal interest of Roosevelt and Churchill and their assistants, Harry L. Hopkins and Mountbatten, caused an extraordinary amount of activity in the late spring and summer of 1942. Before the Norway enterprise was canceled several new explosives had been discovered, methods of packaging explosives vastly improved, and a well-nigh foolproof delay detonator developed.[13]

While these general investigations were under way, the Engineer Board directed attention to the more specific problem of clearance of mine fields. At this time troops were being taught to loosen mines with a probe and either to remove them one by one by hand or explode them one by one with TNT, a slow and dangerous method. What was desired was a means of removing a number of mines at once without exposing troops either to the mines themselves or to the enemy's covering fire. A beginning in this direction was reported on 4 March 1942 by Maj. William F. Powers, chief of the Demolition and Obstacle Branch. Following a British lead, Powers proposed to join together a number of bangalore torpedoes to be pushed onto the mine field from a covered position, then detonated.[14]

Adoption of a special vehicle, or a special attachment for a standard vehicle, equipped either to excavate or explode mines remained a possibility in the spring of 1942. But the Engineers, while eagerly examining many proposals along this line, had found nothing worth investigating seriously. The Corps of Engineers shared this responsibility with the Ordnance Department, Ordnance being generally in charge of the

[13] (1) Engr Bd Rpt 682, 30 Mar 42, sub: Demolition of Structures. (2) Engr Bd Rpt 672, 4 Mar 42, sub: First Interim Rpt on Detection and Destruction or Removal of Antitank Mines. (3) Memo, Hoel for Maj Powers, 20 Mar 42, sub: Bangalore Torpedoes. ERDL file, GN 316. (4) Ltr, Hoel to C of Engr Hist Div, 3 Mar 53. (5) Incl with Ltr, Hoel to OCMH, 4 Jan 54. (6) Engr Bd Rpt 716, 4 Sep 42, sub: Constr and Test of Tank Obstacle Course at Aberdeen Proving Ground, Md.

[14] Memo cited n. 13 (3). Unless otherwise indicated the following discussion of mine detectors and mine field clearing devices is based upon correspondence in ERDL file, GN 316, and Engr Bd Rpt 672, 4 Mar 42, sub: First Interim Rpt on Detection and Destruction or Removal of Antitank Mines.

development of mechanical, and the Engineers, explosive, means for clearing mine fields. Ordnance had made little progress either. Models of two mechanical mine exploder devices had been produced, but neither was acceptable.

A year later, the Army was only slightly better off. Tests of the bangalore torpedo had, to be sure, confirmed the British report of its effectiveness against the type of German mines so far encountered, but it proved incapable of clearing a sufficiently wide gap when employed against the more blast-resistant mines already adopted by the American Army. Because the Germans might put a highly blast-resistant mine into the field also, the Engineer Board began, in January 1943, to experiment with a Canadian mine clearing device called a snake. The snake packed more explosive into its three-inch pipe than had the series of bangalores and since it was designed to be pushed forward by a tank, provided greater protection against defensive small arms fire. In addition to procuring a facsimile of the Canadian snake, the Engineer Board called upon several manufacturers to suggest ways to improve it. The Armco International Corporation devised a specially shaped snake made of longitudinally corrugated sheets into which cartridges of explosive were to be packed and bolted in the field. The Armco snake outperformed the Canadian prototype in firing the German mines, but also lacked effectiveness against American mines.

Even with this defect, the snake was the best device offered in July 1943 when representatives of NDRC, Ordnance, and Engineers sat down to review the status of their work. The best that could be said for the various appendages developed by the Ordnance Department for tanks—disk rollers, drums, drag weights, and a flail device modeled on the British scorpion—was that some showed promise.[15]

The possibility of excavating instead of exploding mines had also been tried out. In January 1942, 1st Lt. George M. Hays of the Coast Artillery School had suggested mounting a bulldozer blade on a tank. The advantages were significant—rapid operation by a small crew with gun protection. Maj. Karl F. Eklund, who supervised the Mechanical Equipment Section at the Engineer Board, believed the tank dozer would be a long time in the making, if, indeed, it could be developed at all. He had been following the attempts of the Desert Warfare Center to mount V-shaped blades on tanks for road construction work and had noted that all their experiments had resulted in failure. The fundamental idea had so much merit, however, that he and others at the board recommended that it be attacked from another angle as well. The British, whose bulldozer operators had had to work under fire, had already embarked upon a program to armor tractors. Accordingly the board requested authorization to develop armored tractors at the same time it was collaborating with Ordnance on the development of the tank dozer. SOS did not assent. Steel plate was so scarce in the summer of 1942 as to make it improbable that any could be diverted for this purpose, Clay observed in

[15] (1) For a discussion of the mine exploding devices developed by the Ordnance Department see: Constance McLaughlin Green, Harry C. Thomson, and Peter C. Roots, *The Ordnance Department: Planning Munitions for War* (Washington, 1955), UNITED STATES ARMY IN WORLD WAR II, pp. 387–94. (2) Engr Bd Rpt, 18 May 43, sub: Engr Rpt on Tests of Snake Devices for the Destruction of Enemy Mines at Ft. Knox, Ky. (3) Ltr, Capt David C. Apps, Ord Dept Hq Armd Force, to Armd Force Engr, 4 Jun 43, sub: Mech Type Mine Field Clearing Devices. ERDL file, ME 264 (S).

refusing to approve the project, but work on the tank dozer should continue.[16]

Working first with the producers of tractor blades—LeTourneau and LaPlante-Choate—Eklund and the board's project engineer, William J. Murwin, next enlisted the aid of the Ordnance Department in mounting various blades on tanks. By the spring of 1943 the co-operation of industry and of the two services had resulted in two models, one produced by LaPlante-Choate and the other by LeTourneau. Both of these excavators were V-blades with teeth, and thus operated more like a plow than a bulldozer. Despite much improvement in operation over the V-blades tested at the Desert Warfare Center, these tank dozers appeared scarcely more promising than the snake, the scorpion, or any of the other mine field clearing devices still under consideration. Yet the fact had been established that the medium tank could handle the dead load of a dozer blade and that its traction enabled it to knock over substantial barriers.[17]

The importance of an armored bulldozer was highlighted almost as soon as its capabilities were discovered, when, during the summer of 1943, reports like the following one from New Georgia began to come in:

> . . . the blazing of Jeep trails was of prime importance. Construction of these trails through the jungle allowed food, ammunition, and supplies to be carried up to the most advanced Infantry lines.
>
> A platoon of combat Engineers was assigned to each Infantry Combat team, for this purpose. . . . Due to the type of fighting in this area, the "front-lines" at times were everywhere, and at times the dozer operated in *front* of the Infantry lines. It soon became a special target for Jap snipers and Jap machine gunners, who waited for its appearance in ambush, or sniped from a distance.
>
> In the first few days of operation several dozer operators were killed or wounded. In order to combat this, shields were hastily made, using armor plate taken from beached Jap barges. This afforded some protection to the operator, particularly from snipers who infested every trail and every rear area. . . .
>
> Quoting a remark overheard from an infantryman along the trail, "The Dozers and Jeeps won this battle." [18]

If any confirmation were needed, Somervell supplied it when he returned from a tour of the Pacific theaters. "The roads must be pushed up behind the leading elements," he wrote Marshall. "Some form of armor is recommended by most of the Division commanders because heavy casualties occurred to the operators." [19] From North Africa came further confirmation:

> . . . considerable losses in personnel have been caused by detonation of mines and booby traps when operators of construction equipment rolled over them. This was particularly true of craters in such places as roads and airdrome runways which the retreating enemy mined knowing that they would be filled in.[20]

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[16] (1) Memo for Record, with 13th Ind, Dir Rqmts Div SOS to CofOrd, 10 Jun 42, sub: Use of Specially Equipped Tanks to Counteract Tank Obstacles (basic missing). 470.8, Pt. 3. (2) 1st Ind, 1 Jul 42, and 3d Ind, ACofS for Matériel to Cof Engrs, 28 Jul 42, on Ltr, ExO Dev Br to President Engr Bd, 15 Jun 42, same sub. Same file. (3) Engr Bd Rpt 774, 6 Oct 43, sub: The Engr Tank Dozer.

The remainder of this discussion of the tank dozer is based principally upon this Engineer Board Report and correspondence in ERDL file, ME 264 (S).

[17] Engr Bd Rpt, 20 May 43, sub: Mech Devices for Removal of Enemy Mines.

[18] Incl, 21 Aug 43, with Memo, C of Trps Sv Subsec EFMO for C of Engr and Dev Div, 15 Dec 43. Mech Equip Br file, Armd Protection for Constr Equip.

[19] Memo, C of Equip Br Trps Div for Rqmts Div ASF, 15 Oct 43, sub: Armd Protection for Tractor Operators. Mech Equip Br file, Armd Protection for Constr Equip.

[20] Ltr, Godfrey, Air Engr Hq AAF, to Engr and Dev Br, 16 Apr 43, sub: Protection Armor on Constr Equip. App. A, Engr Bd Rpt 859, 26 Aug 44, sub: Protection Armor on Constr Equip.



BULLDOZER CUTTING ROAD THROUGH JUNGLE, *New Georgia, 1943. Vehicle is a tractor with bulldozer attachment.*

Looming ahead was the greatest amphibious operation ever undertaken—the cross-Channel attack. The Dieppe raid of August 1942 served to point up the serious consequences of failure to overcome obstacles placed on the beaches and in the surf. In December 1942 Hoel had returned from England full of information about what happened at Dieppe and what the British were doing as a result. The Dieppe raiders had encountered steel spikes designed to impale landing craft, barbed wire, concrete walls and blocks, antitank ditches, and mines—all covered by persistent enemy fire. The casualty rate among engineers had been extremely high. To make certain that future invading forces would be equipped and trained to gain the beachhead without excessive losses, the British had constructed an elaborate beach obstacle course and had assigned high priority to the development of special armored vehicles.

Shortly after his return to the United States, Hoel recommended that the Corps of Engineers sponsor a similar investigation. Army Ground Forces gave its approval in February 1943, suggesting co-ordination with its own Amphibious Training Center, the Engineer Amphibian Command, and the Amphibious Force, Atlantic Fleet. The assumption of all amphibious training by the Navy a few months later removed the first two organizations from the picture, but the Amphibious Force, Atlantic Fleet, worked closely with the Engineers throughout the course of their experiments. To as-



ROAD CUT THROUGH HILLS AND JUNGLE *is used by troops in New Georgia, July 1943.*

sure this co-ordination the Engineers selected a site near the Navy's Amphibious Training Base at Fort Pierce, Florida. By the first of July 1943 construction of the obstacle course had progressed to a point where tests could begin. Hoel, in charge of the Fort Pierce experiments, was assigned several officers and a company of combat engineers.[21]

The opening of the Fort Pierce testing area coincided with the production of a tank dozer which, thanks to the unorthodox activities of Eklund and the continued interest of LeTourneau and LaPlante-Choate, exhibited every mark of a successful machine. In June 1943 funds hitherto available to the Corps of Engineers for development of the tank dozer had been cut off. The Ordnance Department was directed to assume exclusive control in this field. But Eklund,

[21] (1) Ltr, Engr Bd to CofEngrs, 20 Mar 43, sub: Review of Landing Area Rpt, Cherbourg to Dunkerque and Dieppe Rpt Concerning Obstacles. 400.112, Beach and Underwater Obstacles, Pt. 1 (C). (2) Incl., n. d., Brief Review of Dieppe Raid, with Ltr, C of Engr and Dev Br to CG ASF, 29 Mar 43, sub: Passage of Beach and Underwater Obstacles. Same file. (3) Incl, 11 Jan 43, with Memo, ExO Engr Bd for All Members, 11 Jan 43. ERDL file, GN 316. (4) Ltr, AGF to CofEngrs, 21 Feb 43, sub: Dev of Technique of Passage of Underwater and Beach Obstacles, with 2d Ind, ExO Engr and Dev Br to Engr Bd, 8 Mar 43. 400.112, Beach and Underwater Obstacles, Pt. 1 (C). (5) Engr Bd Rpt, Passage of Beach and Underwater Obstacles, 1 Jul 43–1 Aug 43. (6) Ltr, CofEngrs to Comdt Engr Sch, 3 Aug 43, sub: Passage of Underwater and Beach Obstacles. App. A, Engr Bd Rpt, Passage of Beach and Underwater Obstacles, 1 Oct 43.



BEACH AND UNDERWATER OBSTACLES, NORMANDY, FRANCE, *6 May 1944. Photograph was taken one month before D Day.*

now fully convinced that combat engineers needed a tank dozer to reduce obstacles other than mines, and that he was on the verge of obtaining one, tried and succeeded in getting the work done for nothing. He persuaded LeTourneau to construct a pilot model at no cost to the government, and shortly thereafter, LaPlante-Choate, with an eye on this competitor, followed suit.

The standards of performance set down for the tank dozer by Eklund and his civilian aide, William J. Murwin, were high. Wishing to produce a unit that could be as readily controlled as a bulldozer, they switched to a straight toothless blade.

When the LeTourneau model was tried out at Belvoir in June 1943, its earth-moving capacities were reported to compare favorably with those of a D–8 tractor. Still with no money, but even more convinced that he had something extraordinarily valuable, Eklund shipped the tank dozer to Fort Pierce, using funds available from the project for clearance of beach and underwater obstacles.[22] The LeTourneau tank dozer gave an outstanding performance under a series of exhaustive tests at Pierce, easily overcoming "obstacles previously classed as rendering 'Direct assault . . . useless.' " In subsequent tests the performance of the LaPlante-Choate unit was equally praiseworthy.[23] Procurement of a tank dozer which combined the best features of each model began immediately and the first units arrived in

[22] (1) Memo, Eklund for Col Horace F. Sykes, Jr., ExO to ACofEngrs for War Planning, 25 Mar 44, sub: Medium Tank Dozer Dev. Mech Equip Br file, Tank Dozers, Pt. 2 (S). (2) Engr Bd Monthly Rpt on Dev, Jun 43. ERDL files.

[23] Ltr, Actg ExO Engr Bd to CofEngrs, 14 Sep 43, sub: Use of Especially Equipped Tanks to Counteract Tank Obstacles. ERDL file, ME 264 (S).

Italy in plenty of time for the spring 1944 offensive. In that campaign Eisenhower recalled, the tank dozer was "a godsend." [24]

Sturdevant had been watching the work at Pierce with much interest, and early in August directed the Engineer School to take advantage of the setup there to test techniques and doctrine and to bring tactical considerations to bear upon the board's work. The school assigned Lt. Col. James E. Walsh to Pierce. Walsh stressed the fact that, unless American doctrine were changed, the infantry would precede the arrival of tanks by several waves. The infantry must be prepared to surmount obstacles using simple expedients such as wire cutters and ramps. Any large-scale use of explosives at this stage would result in heavy casualties among friendly troops. Wide gaps through obstacles need not be provided until the tanks landed. Neither could they be provided until the infantry had silenced the enemy's fire. Nevertheless Walsh believed that much profit could be expected from further investigation of hand-placed charges and from the study of the effectiveness of rockets. And, since rockets appeared from the preliminary work at Pierce to show so much promise, Walsh encouraged Hoel's group in its efforts to develop an engineer armored vehicle equipped with a rocket launcher.[25]

During the succeeding months formulas and methods for placing charges by hand were improved upon. On the assumption that air and naval activity would precede an amphibious landing, the Fort Pierce group, with the co-operation of the Navy, and while host to many observers from the Army and Navy, tested the effectiveness of various bombs and projectiles against various types of obstacles, reporting their conclusions monthly to the Engineer Board. Encouraged by the successful tests of the tank dozer, Hoel and his assistants persisted in developing a more versatile engineer armored vehicle.[26]

Both the projected engineer armored vehicle and the tank dozer were special purpose machines. The work power of the tank dozer was not nearly so great as that of the standard tractor-mounted dozer. The tank dozer was difficult to maneuver and subject to more frequent breakdowns. A disadvantage of the standard tractor-mounted machines, on the other hand, was vulnerability. There were many occasions, as reports from overseas showed, when operators of bulldozers and other construction machinery required protection from small arms fire, even though they did not need a tank gun. Because of this, and also because it was doubtful whether or not medium tanks would be shipped to the Pacific, the Engineers designed armored cabs for tractors and other construction machinery at the same time they were developing the tank dozer.

Lt. Col. Grant E. Beverly of the board's Mechanical Equipment Section, and his civilian aides, George Weidner, James A. Cobb, and Miller L. Coe concluded from the outset that for advice they should lean heavily upon both the Ordnance Depart-

[24] Eisenhower, *Crusade in Europe*, p. 201.

[25] (1) Ltr, CofEngrs to Comdt Engr Sch, 3 Aug 43, sub: Passage of Underwater and Beach Obstacles. App. A, Engr Bd Rpt, Passage of Beach and Underwater Obstacles, 1 Oct 43. (2) Ltr, Walsh to C of Demolition Sec Engr Bd, 23 Sep 43, sub: Tactical Comment on Tests of Methods of Removing Beach and Underwater Obstacles. Same file.

[26] (1) Engr Bd Rpt, Passage of Beach and Underwater Obstacles, 1 Jul 43–1 Aug 43. (2) Ltr, Hoel to C of EHD, 3 Mar. 53. (3) Incl with Ltr, Hoel to OCMH, 4 Jan 54.

The group at Pierce also investigated, with no conspicuous success, techniques for overcoming underwater obstacles. For information on this activity, see the various Engineer Board Reports on the passage of beach and underwater obstacles.

ment and the Caterpillar Tractor Company. The experts on armor plate and on the ballistic effects of various details of design were to be found in the Ordnance Department. The manufacturers themselves were the ones most familiar with the dimensions and strengths of their products and would be most likely to offer good advice about the effect of proposed changes.

The aim was to afford maximum protection to operators while preserving the efficiency of the machines. At either extreme these objectives were incompatible. The heavier its weight, the more rounded its silhouette, the fewer its openings, the greater the protection; the lighter its weight and the greater the visibility achieved by portholes and angular construction, the greater its efficiency. Sacrifices had to be made on both sides. The half-inch armor plate chosen was the thickest it was possible to adopt without overloading the machine, yet this plate would not withstand the normal impact of ammunition larger than .30-caliber at 2,300 feet per second velocity, and even this amount of protection resulted in some loss of efficiency in operation. The silhouette of the armored cabs was quite angular; otherwise operators could not have performed their work. The cabs were designed to facilitate assembly in the field with standard tools.

The Engineer Board, with the invaluable assistance of Ordnance and Caterpillar, completed this investigation less than three months after it was assigned. It was many more months before the Pacific theaters received any armored cabs from the United States. Engineer troops continued to improvise shields when necessary. But for the most part, the strategy employed during the early months of 1944 relieved bulldozer operators of the dangers to which they had hitherto been exposed. During this period MacArthur's command concentrated upon capturing island steppingstones where the Japanese were least strongly entrenched. American task forces were composed of fewer men, and troops did not attempt to penetrate far into the interior so that less road building was required. An armored bulldozer sent from the States was used effectively on Morotai beach in September 1944. More were available for the Philippines campaign, where they were used in the extensive road building in northern Luzon. In Europe, armored bulldozers were considered a mixed blessing. The operator was protected from small arms fire but might because of confinement in the cab, receive severe head injuries if he struck a mine.[27]

Provision of armor for bulldozers and the development of the tank dozer had been a detour around the problem of mine field clearance, which was still awaiting a satisfactory solution in the fall of 1943. Meeting on 6 October of that year, representatives of the General Staff, ASF, AGF, the Canadian Army Technical Development Board, the Ordnance Department, and the Corps of Engineers agreed that all the devices tried so far were either too heavy, too complicated to project into a mine field, too slow, or too lacking in dependability. The Armco-type snake and the Aunt Jemima, the latter a disk roller device developed by Ordnance, were merely the best of the group—not a real solution. Pressure to provide something better in the way of detection as well as clearance increased early in 1944 as the Allies,

[27] (1) Ltr, Col Lacey V. Murrow to CG SOS, 6 Oct 43, sub: Armor for D–7 Tractors. ERDL file, MES 264 (S). (2) Engr Tech Info Bull 7, GHQ SWPA, OCE, 3 Nov 44 (C). (3) Hq Sixth Army, Rpt of the Luzon Campaign, p. 164. (4) Info from historians preparing volume, CE: The War Against Germany.

pushing north in Italy, encountered the ultimate in German ingenuity in the use of mines and booby traps. The portable mine detector, SCR 625, had performed well in North Africa but proved unreliable in Italy, first, because the soil contained so much iron, and second, because the Germans planted many more antipersonnel mines there than they had in Africa, and some of these mines contained little metal.[28]

These defects in performance served to emphasize the other shortcomings of SCR 625. Operators tired quickly while sweeping an arc with an instrument weighing seven and a half pounds. Often when it was most needed, SCR 625 broke down. Most failures occurred during rainy weather, but the delicate construction of tubes, transformers, and other parts accounted for a good share of them. Since operators had to stand while using SCR 625, they were exposed to fire during daylight and at night found it impossible to locate the trip wires of antipersonnel mines which had to be felt for. Under the supervision of Maj. George A. Rote, the Engineer Board investigated four different devices—a vehicular-mounted detector, a detector for nonmetallic mines, a combination metallic and nonmetallic detector, and a detector with a shortened arm.[29]

Development of a detector mounted on a vehicle had begun in December 1941, following a request from the Armored Force Board. For the first two months the Engineer Board experimented with the same type of circuit used in SCR 625, but in February 1942 the board learned that J. G. Doll and Maurice Lebourg, two former lieutenants in the French Army now in the States, had been working on a vehicular detector at the time France capitulated and had completed a pilot model. The detection mechanism of this unit consisting of four electronic induction bridges, was mounted seven feet in front of the vehicle. The indicating mechanism consisted of dial lights, which registered when the detecting mechanism passed over a mine, at which point the vehicle automatically braked. Impressed with the possibilities of the Doll-Lebourg model representatives of the Armored Force Board recommended mounting it on a jeep. The details of such a mounting proved complicated and time-consuming because the boom was too heavy for the light vehicle from which it was controlled. Efforts to design a lighter boom for the Doll-Lebourg device continued over the next few months, but as an alternative Rote experimented with another device, which came to be known as the prairie dog. The prairie dog consisted of a light-wheeled tractor, trailed by a detector unit controlled by a half-track. Its detecting system was similar to that of the Doll-Lebourg unit.

Spurred on in the spring of 1943 by requests from the North African theater for a vehicular-mounted detector, Rote arranged a demonstration so that a choice between

[28] (1) Ltr, Actg ExO Engr Bd to CofEngrs, 19 Oct 43, sub: Passage of Antitank Mine Fields. ERDL file, GNS 316. (2) Engr Bd Hist Study, Passage of Mine Fields, p. 27. (3) Green, Thomson, and Roots, *op. cit.*, p. 387. (4) Wkly War Plan Conf, 15 May 44. (5) Engr Bd Hist Study, Metallic Mine Detectors, pp. 85–86.

[29] (1) Hist Study cited n. 28 (5), p. 24. (2) Ltr, 2d Lt Hilmar J. Schmidt, Office of CSigO, Hq ComZ, NATO, to CSigO, 30 Oct 43, sub: Mine Detector, SCR 625, Limitations and Recommended Improvements. ERDL file, XR 508. (3) Ltr, same to same, 15 Dec 44, sub: Rpt on Mine Detector SCR 625. 400.112, Mine Field Clearing Devices, Pt. 1. (4) Ltr, C of Dept of Pioneer Instruction Engr Sch to Comdt Engr Sch, 8 Dec 43, sub: Interim Rpt on Short Arm Mine Detectors. ERDL file, XR 508. (5) Incl, CG AGF to R&D Div ASF, n. d., sub: Short Arm Mine Detector, with Memo, Asst Engr Hq AGF for Dir Tech Div II Engr Bd, 18 May 44. Same file.

the two units could be made. The Doll-Lebourg model, called AN/VRS–1, was selected, for although the prairie dog swept a wider path and could be operated 100 feet ahead of the control vehicle—an advantage which eliminated the necessity for an automatic braking system—it was more complicated to maneuver and maintain, was extremely vulnerable to fire, and would be costlier and more difficult to produce.

Another year elapsed before any AN/VRS–1 detectors arrived overseas. In service tests at the Desert Warfare Board early in 1944, the AN/VRS–1 gave some false readings over magnetic types of soil so that procurement in quantity was held up pending alterations which eliminated this defect. Production of the first fifty sets did not begin until a month before D Day and it was fall before any arrived in Europe.

Even had vehicular detectors been available sooner and in greater quantity, their usefulness would have been as sharply limited as was that of SCR 625 because of the Germans' gradual approach toward a completely nonmetallic mine. Fully aware of the urgent need for an instrument to detect nonmetallic mines, the Engineer Board was equally aware of the difficulties of developing one. Wishing to spare its staff from spending time in what it anticipated would be fairly long-drawn-out preliminary research, the board sought the help of the National Defense Research Committee in January 1943. During the next six months, Rote, in co-operation with NDRC, encouraged investigations which attempted to detect the presence of mines by comparative measurements of electric current, sound, or solidity. None of these was outstandingly effective, reported Rote on 1 February 1944. With the exception of the electronics instrument developed by the Radio Corporation of America, which registered the presence of a solid object, all methods were generally dependent upon dissymmetry in the ground.[30] The RCA device operated with fair success over relatively nonconductive soils. But it could not be relied upon to pick out mines buried in highly conductive soils, and it also lacked the ruggedness desirable in military equipment. Yet so urgent was the demand that in January 1944 representatives of the interested arms and services recommended its procurement as AN/PRS–1. Overseas, the performance of AN/PRS–1 was more of a disappointment than had been anticipated. It was very heavy—19 pounds. Only after a great deal of experience could operators distinguish between live mines and rocks or roots. AN/PRS–1 was not designed to handle the small antipersonnel mines that were sown in such great numbers by the Germans. Efforts to improve this detector and to evolve other means of detecting nonmetallic mines continued, but none had been developed to the point of procurement by V-J Day. Similar results marked attempts to develop an instrument capable of detecting both metallic and nonmetallic mines. Although some devices showed promise, victory was achieved before pilot models were produced.[31]

Faced with the failure to develop a detector capable of registering the presence of antipersonnel mines, AGF, in June 1944, proposed something of a compromise.

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[30] (1) Engr Bd Rpt 751, 23 Jun 43, sub: Interim Rpt on Dev of Vehicular-Operated Anti-tank Mine Detectors. (2) Engr Bd Hist Study, Metallic Mine Detectors, pp. 37–38, 42–44. (3) Engr Bd Rpt, 1 Feb 44, sub: Dev of Port Anti-tank Non-metallic Mine Detector.

[31] (1) Engr Bd Rpt cited n. 30 (3). (2) Engr Bd Hist Study, Nonmetallic Mine Detectors, pp. 36, 43, 54–58. (3) Baxter, *Scientists Against Time*, p. 103.

Reasoning that simplifying the location of the trip wires so often attached to these mines would greatly increase the safety of the soldier searching a mine field, AGF suggested the development of a detector that could be used while kneeling or lying flat and which would permit one hand to be free to search for such wires. Accepting wholeheartedly the need to supply something of the sort at once, the Engineer Board plunged into the work of modifying SCR 625 as the quickest means of accomplishing the purpose. At the same time the board took advantage of the opportunity afforded by this opening of the subject to propose a complete redesign of SCR 625 in order to make it lighter, more rugged, and waterproof.

In pursuit of the board's first aim, that of modifying SCR 625, Rote got in touch with representatives of the Horni Signal Manufacturing Corporation, one of its producers, which made the desired changes. The amplifier and search coil were retained in the new model. A short rod for operation in a prone or kneeling position could be connected to a longer one for operation while standing. With a view toward lightening the instrument, the visual indicating meter (never very dependable) was eliminated, making it possible to attach the control box to the operator's belt rather than to the instrument's rod, and making detection completely dependent on aural controls. The new set thus produced, the SCR 625(H), while maintaining a standard of performance equal to SCR 625, was four pounds lighter, yet so slight were the differences between the two that one could be converted into the other in the field upon receipt of a kit containing the new parts. Early in October 1944, the Engineer Board recommended that procurement of conversion kits as well as of complete units of the modified detector begin, but because of the dissatisfaction of the Signal Corps with the drawings and specifications furnished, no units were ordered until January 1945. As a result, few arrived overseas in time to be of service.

The best detector developed—the redesigned SCR 625 which the International Detrola Corporation agreed to work on in August 1944—never got overseas at all. Utilizing the same principles of operation as those of SCR 625, Detrola's design engineers and Rote and his assistants produced a unit, AN/PRS–3, that (1) could be operated in a prone, kneeling, or standing position; (2) was more than ten pounds lighter; (3) was more ruggedly constructed; (4) was waterproof; and (5) was more efficient in detecting antipersonnel mines. While not all that could have been wished for, since the problem of detecting nonmetallic mines remained unsolved, AN/PRS–3 thus overcame many of the deficiencies of SCR 625. Recognizing this fact, representatives of AGF, Signal Corps, NDRC, OSW, and Engineers agreed early in January 1945 to switch to procurement of this type. Orders were canceled after V–E Day, however, because supplies of SCR 625 were sufficient to meet the needs of the Pacific theaters, where mines were never extensively employed.[32]

Although detectors were the first step, if not the key, to clearance of mine fields, and thus failure to produce anything approaching a foolproof detecting instrument went a long way toward spelling lack of success in

[32] (1) Engr Bd Rpt 874, 3 Oct 44, sub: Short Arm Mine Detector. (2) Engr Bd Hist Study, Metallic Mine Detectors, pp. 30, 83. (3) Memo, Rote for Files, 2 Aug 44, sub: Visit to International Detrola Corp. ERDL file, XR 508. (4) Ltr, President Engr Bd to CofEngrs, 16 Jan 45, sub: Conf on 11 Jan 45. Same file.



SOLDIER REMOVING AN ENEMY MINE, *North Africa, April 1943.*

this effort, development of more efficient means of clearing paths through mine fields might have made up somewhat for detection failures. For this reason, in February 1944 Army Ground Forces urged the Engineers to conduct an all-out drive to provide something superior to the snake. In reply the Engineers requested a better testing area and the assurance of sufficient personnel. Army Ground Forces offered space at the A. P. Hill Military Reservation, not far from Belvoir. But it was June before all details had been straightened out, and even after that the Engineer Board experienced difficulty keeping enough troops on hand to carry on its program.[33] In the months that followed, the group at A. P. Hill tested more than twenty-five different devices such as detonating cord, plywood and neoprene rollers, fiberglass neoprene-coated hose filled with liquid explosive, and carpet roll torpedoes. In addition, Ordnance, at the suggestion of the Engineers, developed a means of launching rockets from a trailer towed behind a tank.[34]

Despite these intensive efforts, the Engineers failed to develop any clearing device which they considered superior to the snake. The snake, to be sure, could be depended upon to clear a lane through a mine field. But on the edge of the path, so troops in the ETO discovered, there remained mines that had been affected although not detonated by the snake's blast. These "tender" mines were the source of potential casualties, yet were extremely dangerous to remove. Bangalore torpedoes had the same tenderizing effect. The Ordnance Department, under great pressure to provide something, sent thirty scorpions overseas in the spring of 1943. They were discarded as useless by engineer troops in Italy. The driven-disk exploders which Ordnance provided later were little, if any, better. They had a tendency to bridge the mine, were not mechanically dependable, and were heavy and slow. Engineer troops operating in western Europe preferred the scorpion. In the end most mines were discovered and removed by soldiers, crawling on hands and knees and equipped

[33] (1) Memo, Actg Dir Tech Div I Engr Bd for ExO Engr Bd [c. 20 Feb 44], sub: Wkly Rpt of Nonroutine Events. ERDL file, GNS 316. (2) War Plan Wkly Staff Conf, 5 Jun, 11 Sep, 9 Oct, 13 Nov 44. (3) Engr Bd Rpt 842, 15 Jul 44, sub: Equip for Passage of Enemy Mine Fields.

[34] (1) Engr Bd Rpts 842, 15 Jul 44; 850, 1 Aug 44; 861, 1 Sep 44; 875, 1 Oct 44; 888, 1 Nov 44; 894, 1 Dec 44; 905, 1 Jan 45; 928, 1 Apr 45; 949, 1 Jul 45, sub: Equip for Passage of Enemy Mine Fields. (2) Engr Bd Rpt 946, 27 Jul 45, sub: Clearance of Land Mines by Aerial Bombs. (3) Engr Bd Rpt 892, 27 Nov 44, sub: Preliminary Rpt, Dev of Launcher, Rocket, Multiple, 10.75-Inch, T59, and Rocket, HE, 10.75-Inch, T91. (4) Green, Thomson, and Roots, *op. cit.*, p. 393.

only with probes, and the tank dozer remained the combat engineers' closest approach to an assault vehicle.[35]

The engineer armored vehicle designed at Fort Pierce was an elaboration of the tank dozer, basically "a medium tank with some of the guts removed, with doors on the sides, and a dozer blade." [36] A rocket launcher was substituted for the standard 75-mm. gun. A trailer, or pallet, for carrying extra demolitions could be attached at the rear of the vehicle, a snake at its front. On its blade could be carried a doozit, a device for placing explosives mechanically. All of these accessories possessed limitations. Those of the snake were well known. The rocket launcher had to be brought quite close to the target in order to assure accuracy. Both the launcher and the doozit were extremely vulnerable to fire. Yet the Engineer School's representative at Pierce, at the time the engineer armored vehicle was tested in the spring of 1944, believed that, with its accessories, the vehicle added up to a reasonably efficient piece of equipment which afforded good protection to its operator.[37]

The most formidable block in the way of getting the engineer armored vehicle adopted was the organization and doctrine of the American Army. When the Engineers cast about for a place to assign this specialized piece of equipment, they were forced to conclude that the armored battalion was the only unit that could absorb it. Undaunted, Engineer School and Board joined in recommending that *"consideration . . . be given to the forming of special Engineer units to exploit the apparently excellent possibilities of this multi-purpose weapon."* To back up their position they appealed to British practice. The British had such a vehicle and had organized special assault brigades around it.[38] General Worsham, chief of OCE's War Plans Division, expressed no enthusiasm for this idea. "I can't quite see forming a new organization to fit a particular vehicle," he remarked at a staff meeting. "A vehicle of this kind would be useful to many types of engineers if they are attacking a fortified place, not only beachheads." Worsham wondered why the vehicle could not be issued as the tactical situation demanded. It could not, he was advised, because operators would have to be specially trained to handle it. Worsham was impatient. "You would never get any place," he closed the subject, "establishing a new organization to employ one implement of war." [39] These arguments turned out to be largely academic. Engineer armored vehicles were not developed in time to be issued to units participating in the cross-Channel attack, where they might have been employed to greatest effect.[40] For this operation, combat engineers were to have been supplied with tank dozers, in addition to wirecutters and explosives.

Unfortunately, of the sixteen tank dozers assigned to combat engineers in the Normandy landings at OMAHA beach, only six were delivered ashore and one of these with its blade missing. Most of the tank

[35] (1) Engr Bd Rpt 951, 11 Sep 45, sub: Evaluation of Mine Field Clearing Devices. The Engineer Board added that "the 10.75-inch Rocket, T-91, is equivalent and possibly more desirable [than the snake], because it does not produce a crater." (2) Green, Thomson, and Roots, *op cit.*, pp. 388, 389–90, 392. (3) Baxter, *op. cit.*, p. 104.

[36] Memo, Capt A. L. Hendry, Engr Sch, for Maj Brewer, Hq Engr Sch, 22 Apr 44, sub: Engr Tank. ERDL file, DM 460 (C).

[37] (1) *Ibid.* (2) Engr Bd Rpt 835, 4 Jul 44, sub: Engr Armd Vehicle.

[38] Rpt cited n. 37(2).

[39] Wkly War Plan Staff Conf, 29 May 44.

[40] On V-J Day, two engineer armored vehicles with crews and instructors were at the port of embarkation. Engr Bd Hist Study, The Passage of Beach and Underwater Obstacles, p. 66.

dozers—like the amphibious tanks which Bradley planned to land ahead of the infantry—sank in the stormy waters of the Channel. Although naval support proved invaluable as the battle progressed, initial air and naval bombardment were quite ineffective. German resistance was unexpectedly heavy. These adverse circumstances and the crowding of friendly troops on the beach made it impossible for the engineers to open exits through the obstacles as scheduled. Tasks that had called for courage now demanded heroism. Engineer casualties reached 40 percent on D Day on OMAHA. More tank dozers would have served the engineers in good stead. Certainly the German defenders had great respect for these vehicles, singling them out as prime targets and succeeding in knocking out all but one.[41] The tank dozer was, however, only moderately effective against the hedgerows of Normandy. For the specific purpose of overcoming these obstacles, a tank sergeant invented the highly efficient hedgecutter, a toothed blade for attachment to the tank. After the break-through the tank dozer continued to serve as it had in Italy. Issued to armored as well as engineer units, it combined the fire power of a military weapon with the work power of an industrial machine, and as such was the fighting tool par excellence of the combat engineer.[42]

At least one foreign writer has criticized the American Army for failing to follow the British lead in adopting more specialized armored vehicles. This writer claims that the crabs, an improved scorpion, which plunged ahead flailing away at mines, and the AVRE's (Assault Vehicles Royal Engineers), which threw their peculiar charges at pillboxes and walls, turned the trick on the British sectors of the beaches despite the fact that these vehicles were quickly knocked out by the Germans. Hoel also remained convinced that the authorities placed too much emphasis upon perfection. Hoel and his followers would have settled for a device that could clear out sufficient mines to get a large percentage of vehicles through.[43]

Reflecting on the failure to put a really effective mine detector in the field, a member of the NDRC laid most of the blame on weaknesses in the "system"—inadequate facilities for testing, poor co-ordination between research agencies, and failure to arrive at an understanding of precisely what was required under what conditions.[44] The same could have been said for the system employed to develop mine clearing devices. In both areas, many persons, within and without the military establishment, working at widely separated localities, were involved. Meeting together, exchanging visits, corresponding, although undertaken with the utmost good will, could not compensate for the lack of an over-all co-ordinated program. Yet while more efficient organization would doubtless have been beneficial, it would not have assured success. Dealing with land mines, which were used extensively for the first time in World War II, was an extremely complicated matter. The difficulties inherent in the undertaking, in combination

[41] (1) Gordon A. Harrison, *Cross-Channel Attack* (Washington, 1951), UNITED STATES ARMY IN WORLD WAR II, p. 300 ff. (2) Info from historians preparing CE: The War Against Germany.

[42] (1) Omar N. Bradley, *A Soldier's Story* (New York: Henry Holt and Co., 1951), pp. 341–42.

[43] (1) Chester Wilmot, *The Struggle for Europe* (New York: Harper & Bros., 1952), pp. 264–66, 269–73. (2) Incl, with Ltr, Hoel to OCMH, 4 Jan 54.

[44] Memo, Actg AC of Applied Electronics Br Engr Bd for files, 30 Jul 45, sub: Trip to Philadelphia . . . to Attend Monthly Meeting of Sec 17.1–17.2, NDRC. ERDL file, XR 554 (S).

with the late start of the investigation as a whole, in all probability had a greater determining effect upon the outcome than the scattering of responsibility. There was, moreover, for better or worse, the practice, somewhat modified as the war progressed, of relying primarily upon the infantryman in the initial assault. This doctrine was undoubtedly responsible for the late start in developing mechanical clearing devices, and doubtless had a retarding effect upon the investigations once they were started.

Bridging

The investigations into bridging equipment were in striking contrast to those in the field of mine detection and clearance. Responsibility was centralized. Experience was long and continuing. In the months immediately following the declaration of war the specter of increasing weights which had previously haunted the Engineers seemed to have disappeared. In February 1942, the Ordnance Department stated that the Army's main reliance was still on the Sherman tank, in the 30-ton class. Production of a tank in the 35- to 40-ton class, while under study, was so remote a possibility as not to "warrant any change in the procurement planning . . . for bridging equipment." [45] Although Besson, now chief of the Development Branch, OCE, expressed some mistrust of this statement, the Engineers planned no revision in their program but concentrated instead upon perfecting the floating equipage designed for 30-ton loads, namely, the 25-ton ponton and steel treadway bridges.[46]

The Sherman tank had crossed the treadway bridge successfully on several occasions, but no measurement of stress had been made. The Engineer Board felt, therefore, that not enough was known about this bridge. In April 1942 Howard H. Mullins, the board's senior engineer for bridge design, supervised the accumulation of such data in a series of tests on the Chattahoochee River. His measurements reinforced the conclusions arrived at previously: the bridge was safe for the passage of 30-ton tanks, provided the drivers maintained a 100-foot distance between them.[47]

Armored Force engineers, proud and enthusiastic about the treadway bridge itself, were completely dissatisfied with the bridge truck on which the rapid erection of the bridge was so dependent. The truck was designed to carry out the two operations of transporting and unloading the treadways onto the floats. It had been developed during the summer of 1941 by the Four Wheel Drive (FWD) Auto Company under the direction of the Engineer Board. The device for handling the treadways was attached to a bumper at the front of the truck and, when not in use, extended back over the cab and almost the length of the truck. When erected it formed a tripod, or A-frame, which supported a single hoist controlled by cables. Similar to the devices used by telephone companies for unloading poles, it lacked the rigid control necessary to handle the bulky treadways with economy of manpower and safety to men and equipment. Its operation was very slow: it took from five to fifteen minutes to place the handling device in position, and roughly another fifteen minutes

[45] 2d Ind, AC of Industrial Sv Research and Engr Ord Dept to TAG, 4 Feb 42 (basic missing). Structures Dev Br file, SP 287, Pontons for 23-Ton Ponton Bridge, Pt. 1.

[46] Memo, C of Dev Br for ExO Sup Div, 4 Mar 42, sub: Medium Tank. Structures Dev Br file, SP 336.

[47] (1) Engr Bd Rpt 711, 11 Aug 42, sub: Tests on Steel Treadway Bridge. (2) Ltr, ExO Engr Bd to CofEngrs, 7 May 42, sub: Tests on Armd Force Bridge. 653, SP 340, Pt. 1.

to place each length of treadway on the floats.[48]

After the Carolina maneuvers in the fall of 1941, Stanley called on Cowley to work out something that would be powerful enough to remove two treadways from the truck at one time in five minutes. The result was the so-called "bullwheel" device, which consisted of two parallel arms mounted on the rear of the truck and joined by a cross member to which chain hoists were attached. The unit was controlled by means of a gear-operated power take-off. Stanley asked the board to investigate the bullwheel device in September 1941 and the board in turn forwarded the idea to the FWD Company for an opinion, with the proviso that the A-frame trucks already ordered were to have priority. What with the rush of work on the original order no more than a preliminary drawing had been made by January 1942.

Late that same month Capt. Frederick J. Bogardus went to Fort Knox to review the status of the bridge truck. The best anyone could say for the A-frame gear was that it was "better than nothing." Procurement should continue only until the bullwheel lift had been perfected. Toward this end Bogardus and Cowley applied themselves, making sketches and even cardboard models, until they concluded that hydraulic controls would offer great advantages over the gears which regulated the mechanism as then designed. No winches would be necessary if this change turned out to be practicable and the entire operation was bound to be speeded up. The following week the "ideal" bridge truck was described to Herbert O. Day of the Daybrook Hydraulic Corporation. Daybrook produced a design which struck Bogardus' assistant, Glenn D. Ferguson, as having "considerable merit." It did. The hydraulic ram produced by Daybrook could lift three connected treadways (approximately forty-five feet) at once. Time consumed in pickup and laying was one and a half minutes. The hydraulic lifting device provided a link between the treadway bridge and its transportation which was not present in any other bridge.[49]

Provision of an efficient bridge truck served to heighten the enthusiasm for the steel treadway bridge within the Armored Force. But AGF and the Corps of Engineers continued to regard it as specialized equipage. Nothing had occurred to call into question the reasoning that lay behind their preference for the 25-ton ponton bridge for infantry units. Infantry did not require a bridge that could be constructed as rapidly as the treadway, particularly at the addition of so much cost and at the sacrifice of so much ruggedness. But it had been made clear from a series of tests, begun in the fall of 1941, that the 25-ton ponton equipage would have to be strengthened in order to carry the Sherman tank. The addition of standard pontons would provide the desired increase in capacity, but would also add considerably to the already long bridge train. The board adopted instead 12-ton pneumatic floats, placing one in each span. Thus reinforced, and with practically no increase in transportation, the bridge safely supported 40 tons. The Engineers showed

[48] Unless otherwise noted the discussion of the treadway bridge truck is based upon correspondence in ERDL file, BR 340, and Structures Dev Br file, SP 340.

[49] (1) Engr Bd Hist Study, Steel Treadway Bridging, pp. 25–29. (2) Booklet, W. E. Cowley, Dev of Engr Bridge Truck for Transportation and Erection of Armd Force Steel Treadway Bridge. Personal file, William Eugene Cowley. (3) Memo, Oliver for Johns, 27 Jan 47. EHD files. (4) Interv, Cowley, 7 Mar 51. (5) Memo, Ferguson for Files, 5 Feb 42, sub: Armd Force Bridge Truck. ERDL file, BR 340. (6) Ltr, C of EHD to Bogardus, 6 Jul 55 and reply, 10 Jul 55.



BRIDGE TRUCK WITH HYDRAULIC LIFTING DEVICE. *This device could lift three connected treadways at one time providing a link between the treadway bridge and its transportation.*

no concern about the fact that construction time was lengthened for they did not expect to reinforce most of these bridges. Tanks would not always be present.[50]

As tests on the 25-ton ponton bridge were being completed, news came in that American engineers in the British Isles who were taking part in planning the invasion of the Continent (then scheduled for the spring of 1943) might prefer the floating Bailey.[51] Although such a choice seemed logical in view of the serious shortage of cargo space, Besson warned AGF against a hasty decision:

> My tour of duty in England last summer taught me that the British are overly optimistic, not only on the capabilities of their own equipment but also in their production planning. They are prone to seize admitted advantages and extrapolate unwarranted conclusions with a complete disregard for various disadvantages. Based on my observation, I strongly recommend against complete reliance upon the British to meet all of our bridge requirements.[52]

Any such decision should await "an analysis of capacity, transportation and construc-

[50] (1) Engr Bd Rpt 697, 15 Jul 42, sub: Interim Rpt on Tests of Medium (25-ton) Ponton Bridge. (2) Memo, AC of O&T Br for Lt Col Hamilton, 12 Aug 42, same sub. 400.112, Bridges, Pt. 1.

[51] Ltr, C of Sup Div to CG Ft. Belvoir, 9 Jul 42, sub: Engr Bd Tests on Bridging. 400.112, Pt. 17.

[52] Ltr, C of Dev Br to Col J. B. Hughes, AGF, 29 Jun 42, sub: Additional Data on Bailey Bridge. 653, SP 341, Pt. 1.

tion." [53] The Engineer Board on 9 July 1942 was asked to make such an analysis, comparing the Bailey's performance to that of standard American bridges.[54]

In August, Besson and Capt. George W. Howard of the board's bridging section went to London, where they found Col. Frank O. Bowman, Engineer, II Corps, not nearly so enthusiastic about the Bailey bridge as they had expected him to be. Reporting to his chief, Maj. Clayton E. Mullins, on 10 August, Howard noted "that the 25-ton ponton equipage still is very much in evidence. Frank's [Besson's] worries have now changed from the fact that they would not use the equipment to whether so much equipment should be allotted to this Theater." [55] Bowman granted the superiority of the fixed Bailey for construction in rear areas where time was not of so much consequence. He would eliminate the H–10 bridge because it would have to be shipped in. He wished to retain the 25-ton ponton as a tactical bridge because it could be constructed more rapidly than the floating Bailey. Agreeing wholeheartedly with Bowman that the Bailey's usefulness was confined to rear locations, Besson argued for inclusion of the H–10 bridge and succeeded in setting up requirements for a few units. As the final recommendations stood when Besson left England, the Bailey, instead of replacing all American medium and heavy bridging, had replaced only the H–20.

Again with an eye on savings in shipping space, Bowman proposed to substitute pneumatic floats for 10-ton pontons. Assault boats and pneumatic floats for ferrying troops and vehicles of 8 tons and under would carry the first waves across the river. Division troops would then build the 12-ton capacity pneumatic (infantry support) bridge, and following this, Corps troops would construct either a trestle bridge or a pneumatic floating bridge with trestle balk to carry 18-ton loads. Substitution of floats for 10-ton pontons had been under consideration in Washington since early summer, and in September the board concluded that this move was desirable. The bridge thus evolved was composed of the standard 10-ton superstructure mounted on 12-ton floats. It replaced not only the 10-ton ponton but also the infantry support bridge and the special motorized battalion bridge.[56]

By the fall of 1942 the Engineers were, if anything, oversupplied with bridges. This situation was in process of being corrected when the storm broke. In the course of five weeks, beginning in mid-September, four serious accidents occurred while tanks were crossing the treadway bridge. Hard upon these disasters came news that tanks would become both heavier and wider.

The first accident on the treadway bridge took place at the Desert Training Center where the 22d Engineer Armored Battalion of the 5th Armored Division was training.

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[53] Memo, C of Dev Br for Hughes, 27 Jun 42, sub: British Bailey Bridge. Structures Dev Br file, SP 341.

[54] Ltr, C of Sup Div to CG Ft. Belvoir, 9 Jul 42, sub: Engr Bd Tests on Bridging. 400.112, Pt. 17.

[55] Ltr, Howard to Mullins, 10 Aug 42. ERDL file, BRs 341 E.

[56] (1) Incl, Ltr, Bowman to CG II Army Corps, 6 Aug 42, sub: Bridging Equip for American Forces, with Memo, C of Engr and Dev Br for ExO Sup Div, 23 Aug 42, sub: Bridging Equip for ETO. ERDL file, BR 305 C. (2) Ltr, Bowman to CG II Army Corps, 18 Aug 42, sub: Bridging Equip for American Forces. Personal file, Maj Gen Arthur W. Pence, Bridges–ETO–1942 (S). (3) Engr Bd Rpt 720, 10 Sep 42, sub: Rpt on Orgn and Issue of Pneumatic Bridging. (4) Engr Bd Monthly Rpt of Opns, Jul 42. ERDL files. (5) 1st Ind, 10 Oct 42, on Ltr, ExO Engr Bd to CofEngrs, 11 Sep 42, sub: Rpt on Orgn and Issue of Pneumatic Bridging. 400.112, Bridging, Pt. 1.

The bridge spanned the turbulent Colorado River from the California to the Arizona border. A medium tank was almost across on its return trip to the California side when its treads began to climb the curb. The bridge tipped, the tank fell on its side into the water, and three floats slid out from under the bridge. No lives were lost. The second accident took place at Fort Benning on the Chattahoochee, again in a swift current. The commanding officer was experimenting with distances between tanks. When the distance was cut to 20 yards, the floats submerged and the bridge twisted, causing two floats to slide out. Again no lives were lost but one tank was submerged in the process of towing it to shore. During maneuvers in Tennessee the third accident occurred, on a bridge across the Cumberland River constructed by the 24th Engineer Armored Battalion of the 4th Armored Division. Most of the 37th Armored Regiment had crossed when one tank driver stopped and another closed in to a distance of about 15 yards. This section of the bridge then submerged, twisted counterclockwise, and released five or six floats. Both tanks were thrown into the water. Six men drowned.[57]

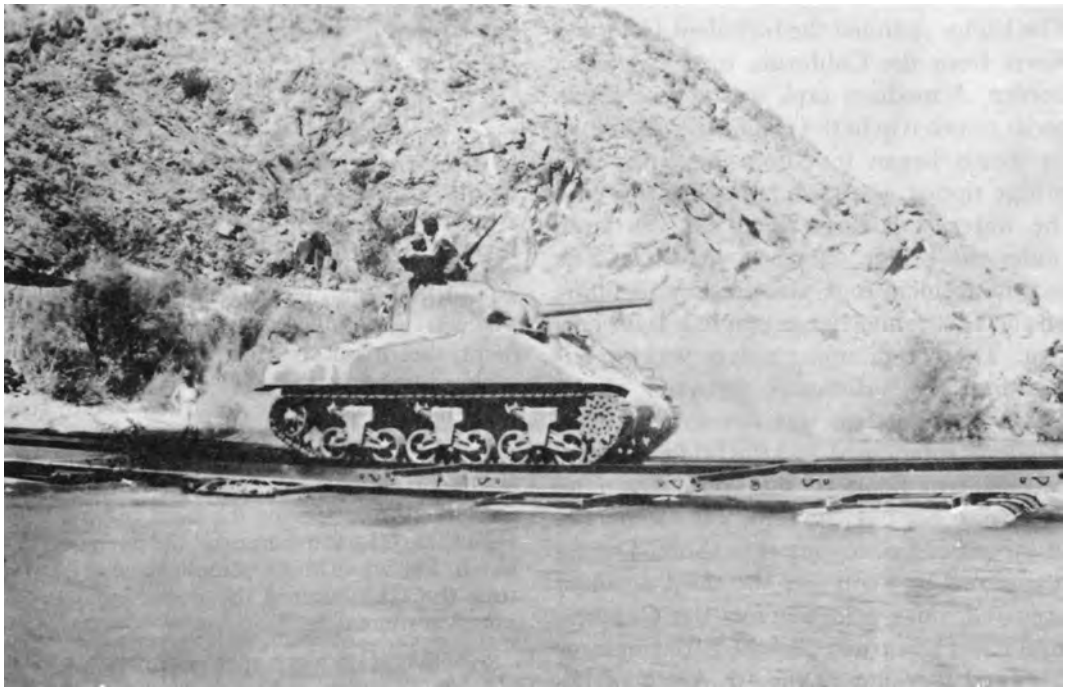
The fourth accident took place at the same site as the first during tests to determine the cause of the others. It was described by Major Mullins who was in charge of the tests:

> The right track of the tank was held against the right (downstream) curb throughout the test [according to instructions]. At no time did the tank treads climb the curbs. . . . The fourth or fifth float was the first to be submerged. At the seventh or eighth float, it was noted that these floats were submerged two to three inches, with the water running up on the saddles. At about the 13th or 14th float, the water was completely over the saddle structure and was touching the bottoms of the treadways. The bridge, at this time, appeared level. Shortly thereafter, when the tank was on the 17th or 18th treadway, the bridge developed a slight list toward the upstream side. This list seemed to be caused by the downward forces created by the tension in the anchor cables and the current piling up on the upstream side of the saddles and floats. At this point, the driver was instructed to accelerate his tank to see whether or not the list could be lessened or held static. At about the 19th treadway, it was apparent that the list was gradually increasing. At this moment, the driver was instructed to leave the tank. The driver came forward approximately one-half to one treadway length further and brought his tank to a stop, at which time he was ordered to leave the tank immediately. The driver was either caught or restrained from leaving the tank and made at least three efforts to come out the open driver's hatch. He was almost completely out by the time the tank entered the water but he was not seen thereafter.[58]

A wave of concern spread through OCE, the Engineer Board, the Armored Force, and Army Ground Forces as news of the four accidents came in. But Armored Engineers clung to their bridge. Typical of their reaction was that of Col. Bruce C. Clarke who had been one of the first to complain

[57] (1) Ltr, Div Engr 5th Armd Div to CofEngrs, 23 Sep 42, sub: Rpt of Bridge Accident. ERDL file, SP 340. (2) Ltr, Corps Engr Hq VII Corps to CofEngrs, 24 Sep 42, sub: Failure of Heavy Rubber Ponton Bridge Under Mark IV Medium Tank. 417.112, Pt. 10. (3) Ltr, CO 55th Armd Engr Bn to Engr Armd Force, 2 Oct 42. Armd Center file, 823, Bridges, Pt. 1. (4) Ltr, Asst Engr Armd Force to Engr Armd Force, 19 Oct 42, sub: Rpt of Treadway Bridge Accident on Cumberland River. Same file. (5) Incl, Rpt, Unit Umpire D Co, 24th Armd Engr Bn, n. d., sub: Obsvns of Failure of Pneumatic Ponton Bridge Over Cumberland River, with Ltr, Engr Fld Hq XI Corps to ExO Engr Bd, 21 Oct 42, no sub. ERDL file, BR 340 F. (6) Proceedings of Bd of Offs, 22 Oct 42. Armd Center file, 823.76, Failure of Steel Treadway Bridge.

[58] Ltr, Asst ExO Engr Bd to ExO Engr Bd, 25 Oct 42, sub: Failure of Steel Treadway Bridge. ERDL file, BR 340.



MEDIUM TANK CROSSING TREADWAY BRIDGE *over the Colorado River, 17 September 1942. A few minutes later the vehicle fell into the river.*

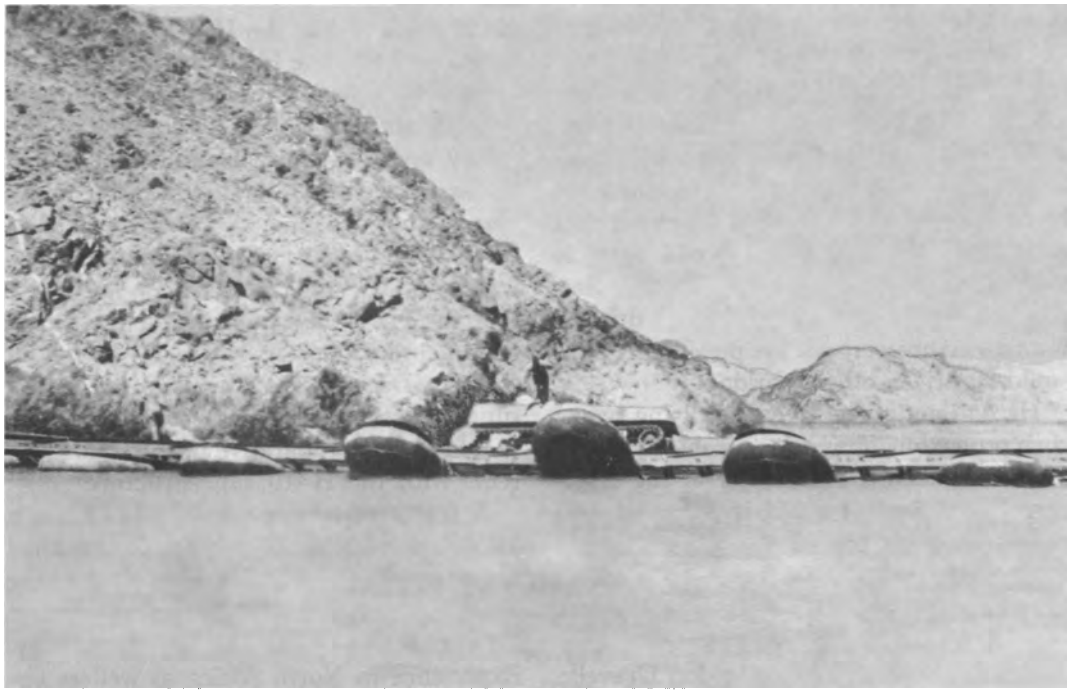
about the standard bridging and who had initiated some of the early experiments at Fort Knox. Clarke, at this time commanding the 24th Engineer Armored Battalion which had been associated with the most serious accident, blamed the disaster entirely on personal error.[59] His opposition to attempts to make the bridge foolproof were strongly endorsed by his commanding officer, Maj. Gen. John S. Wood:

> This . . . bridge has been crossed many times by the 4th Armored Division with all types of vehicles. It is possible that redesign or additional attachments may lessen the probabilities of accidents. However, it must be realized that additions to the bridge will add materially to the amount of transportation necessary . . . and the time necessary to construct it. Any increases of this kind will lessen the many advantages now possessed by this bridge over other types.[60]

Typical of Washington's reaction was that of Lt. Col. Paul W. Thompson, then executive assistant of the Troops Division, who wrote Sturdevant immediately after the first accident: "It underlines the fact that we have adopted and issued a bridge which is essentially untested. . . . There is no time for recrimination, but the present instance illustrates the pitfalls which seem invariably

[59] (1) Ltr, Asst Engr Armd Force to Engr Armd Force, 6 Nov 42, sub: Rpt on Recent Trip Made to Camp Forrest, Tenn. Cowley file. (2) Interv, Cowley, 7 Mar 51. (3) See above, p. 44.

[60] 1st Wrapper Ind, CG 4th Armd Div to CG Armd Force, 26 Oct 42, on Proceedings of Bd of Offs, 22 Oct 42. Armd Center file, 823.76, Failure of Steel Treadway Bridge.



TANK FALLING INTO THE COLORADO RIVER *after its treads climbed the curb, tipping the bridge. Note three floats sliding out from under the bridge.*

to develop when a tried and true item of equipment (i. e., the 25-ton ponton bridge) is supplemented by an item which looks so good at first glance." [61]

But neither Thompson nor anyone else proposed to discard the bridge. The accidents had revealed some weaknesses. Systematic tests might reveal more. After the facts were in, these weaknesses could probably be corrected. Responsibility for conducting the engineering phase of the tests was assigned to Major Mullins; that for the service tests to the Ground Engineer of AGF, with the Armored Force Engineer to maintain close liaison. The site chosen was a side channel of the Colorado River extending downstream from a sluice gate of the Laguna Dam in Arizona—an ideal spot because currents could be changed by operation of the dam's gate. Mullins began his tests on 23 October and ended them on 16 December.

The most obvious weakness which the accidents had revealed in the treadway bridge was its lack of buoyancy. Whatever the initial cause or combinations of causes—climbing of the curbs, tanks following each other too closely, panicky drivers, or swift current—some floats were submerged and subsequently were torn out from the bridge in all four accidents. Mullins' primary aim therefore was to provide sufficient buoyancy, but he wished also to provide other safeguards. By 25 November he could report

[61] Memo, Thompson for Sturdevant, 5 Oct 42, sub: Failure of Treadway Bridge. ERDL file, BR 340.

that a 17- to 18-ton float, 31 or 32 feet long (as against the 12-ton, 15-foot float of the original design) with upraked ends seemed safe for loads of 33 to 34 tons. Less progress had been made in designing a protective curb for the treadways—4 inches additional height would make it difficult but not impossible for the tank to climb out. Mullins thought the best answer to the climbing problem lay in better training of drivers. Human errors were always possible. A tank could be driven off any bridge.

He had not given up on supplying better curb protection, however, and shortly thereafter Lt. Richard R. Stander of the Engineer Board devised a 1¼-inch round drill rod, welded on top of the treadway and projecting about ⅛ of an inch inward. This proved highly efficient in preventing the tank treads from mounting the treadway. At the same time, 1st Lt. Gordon Gravelle conducted various experiments with lights and markers, with the result that traffic crossing the bridge was safely speeded up. These three improvements transformed the steel treadway bridge into a safe structure without sacrificing any of its efficiency.[62]

This conclusion was reached just about the same time that the board was considering the results of comparative tests of the Bailey with the standard H–10 and H–20 bridges. The great advantage of the Bailey bridge, Howard pointed out, lay in its flexibility as regards capacities and spans, but its many parts made for slower construction and more transportation. A minor disadvantage of the Bailey was the fact that it could not be readily widened as could the H–10 and H–20. The Troops Division, OCE, had assured the board, however, that widths of vehicles would be held to the limit the Bailey could accommodate. In his presentation to the Engineer Board, Howard recommended that the H–10 bridge be retained and that the H–20 be retained in all but the European theater. With Thompson arguing strongly for the adoption of the Bailey and Crawford insisting that it had not as yet been thoroughly tested, the board was unable to come to a definite conclusion. Its tentative recommendations submitted to OCE on 12 December 1942 were that the H–10 be retained and the Bailey be procured in place of the H–20 for all theaters. Decision as to the use of the Bailey superstructure as a heavy ponton bridge should await comparative tests in swift currents with the H–10 superstructure.

A few weeks later what had seemed a minor disadvantage in the Bailey assumed rather serious proportions, and so far as the treadway bridge was concerned raised even more serious questions as to its suitability. Experience in North Africa as well as observation of the trends in foreign armies gave rise to complaints about the capabilities of the Sherman tank. The American Army needed a tank with greater fire power, greater maneuverability, greater speed, and greater crew protection. While the Corps of Engineers, through participation in the

[62] (1) Ltr, Ground AG to CG DTC, 27 Oct 42, sub: Stability Tests of the Armd Force Bridge. 653, SP 340, Pt. 1. (2) Engr Bd Rpt 732, 12 Jan 43, sub: Emergency Test of Steel Treadway Bridge. ERDL file, 340.

Oliver recalls that he and Stanley were worried about the tank treads climbing the curbs but were encouraged not to make any fundamental change in the design lest deliveries of the bridge be delayed. They experimented with drill rods also but decided against their adoption after tank drivers assured them they could "feel" the tank begin to climb in plenty of time to take corrective action and since the rods increased the weight of the treadway slightly and made stacking on the truck more difficult. Ltr, Oliver to C of Mil Hist, 31 Dec 53. For decision to eliminate the drill rod on the curb see Ltr, Oliver to Chorpening, 6 Jun 41, in Structures Dev Br file, Ponton Equip, Misc.

Ordnance Department's Technical Committee, was aware of this need and of the conviction in Ordnance that it could be met only by providing a heavier, wider tank, the Engineers were also aware that AGF headquarters had not favored the development of heavy tanks in the past. The Corps professed surprise if not shock, therefore, when Ordnance announced in January 1943 that the new medium tanks of the M–4 series would be 114 inches wide; the T20, 122 inches; and the T23, 124 inches, as compared with the 96-inch limit prescribed by the formal Army regulation and the actual 99-inch already present in the Sherman tank. Ceilings on weights would also be lifted somewhat to 17 or 18 tons for infantry divisional vehicles and to 35 or 40 tons for armored divisional and army vehicles.[63]

These increases in weights and widths would affect every bridge on the books. The M–3 pneumatic ponton bridge would have to be reinforced and widened before it could pass 18-ton divisional loads and even then traffic would be required to proceed at a slow rate of speed. The 25-ton ponton bridge was wide enough, but the amount of reinforcement necessary to provide a normal capacity of 35 tons made its use questionable. The steel treadway bridge was much too narrow, having two 33-inch treads on a total width of 106 inches. The introduction of wider tanks would necessitate widening the treadways themselves—not simply spacing them farther apart—because the inner edges of the treadways would need to be near enough to accommodate trucks and other vehicles. Longer and heavier chess would be required for the H–10 and H–20 bridges. The Bailey bridge came closest to being adequate. Its capacity could be readily increased, and with a clear deck of 129 inches, was wide enough, if only barely so. Provision of a guard rail should give sufficient guidance for drivers. The Engineers were not greatly worried about modifications in design. These could be accomplished with relative ease. Their most serious concern was the fact that quantities of bridging equipment in stock would be obsolete and that it would take months for procurement to catch up with the new requirements.[64]

Much as they deplored the changes announced by Ordnance, the Engineers saw neither hope nor justification in opposing them. The limitations formally prescribed, and in many cases already exceeded, were obviously too restrictive. What the Engineers did want, Reybold informed Somervell, was a quick decision and some protection against sudden revisions in the future. But revision of regulations should be undertaken at the same time that new designs were proposed so that the Corps of Engineers could prepare for the change. To insure that this was done Reybold recommended that a committee composed of representatives of the General Staff, Army Ground Forces,

[63] (1) Green, Thomson, and Roots, *op. cit.*, pp. 275–87, 301–02. (2) Engr Bd Rpt 729, 5 Dec 42, sub: Panel Bridge (Bailey Type), H–10 and H–20 Bridge. (3) Min of Engr Bd, 9 Dec 42. ERDL Records Sec. (4) Memo, Deputy C of Tech Div Ord Dept for CG SOS, through CofEngrs, 14 Jan 43, sub: Bridge Equip. ERDL file, BR 340 F. (5) Incl, Preliminary Study of Clear and Weight Limit on Tanks, with Ltr, Engr and Dev Br to President Engr Bd, 20 Jan 43, same sub. Mech Equip Br file, Misc Book 2.

[64] (1) AR 850–15, 28 Aug 43. (2) Memo, C of Engr and Dev Br for Chm for Rev of AR 850–15, 30 Jan 43, sub: Preliminary Draft for Rev of Par. 5 of AR 850–15, with Incl 6, Table I, and Incl. 2, Preliminary Draft of 1st Ind, CofEngrs to CG SOS, 30 Jan 43, on Memo, Deputy C of Tech Div Ord Dept for CG SOS, through CofEngrs, 14 Jan 43, sub: Bridge Equip. ERDL file, BR 340 F, and Structures Dev Br file, Ponton Bridging Equip, Misc, Pt. 2.

Army Air Forces, Ordnance, and Engineers be placed in charge of revising the applicable Army regulation. Ordnance and Engineers were to maintain direct and continuous liaison "with a view to keeping the design of development models within the capacity of bridges in quantity production and, when this is impracticable, to enable the Engineers to work out modifications in the bridging program which can be placed in quantity production by the time the new Ordnance equipment is produced." The Ordnance Technical Committee was to be restrained from recommending the adoption of any equipment "unless it can be clearly shown that the bridging program . . . meets, or can be modified in sufficient time to meet, the requirements which would be imposed by the proposed new equipment." [65]

SOS felt the Engineers were screaming before they were hurt. Brig. Gen. Walter A. Wood, Jr., director of its Requirements Division, pointed out that the Corps was now informed of the proposals and that its comments, along with those of AGF, would be taken into account by the General Staff. Since it would take several months before the wider tanks would be produced in quantity, bridges to support them could presumably be designed.[66] On 6 February, Clay turned down all three of Reybold's suggestions. A committee was now revising the Army regulation. No standing committee was necessary. Liaison between Ordnance and Engineers could be accomplished through the already functioning Technical Committee, but the Chief of Engineers might assign a representative to the Tank-Automotive Center if he desired. The regular channels—Technical Committee, Chief of Service, Commanding General, SOS, and so on upward—were deemed sufficient to assure protection of all interests.[67]

While Reybold was attempting to insure the Corps against the future, Besson, Thompson, and the bridge experts at the Engineer Board were considering various means of overcoming the present crisis, among which were scrapping the treadway bridge entirely or radically changing its character by decking it over. In back of these proposals lay uncertainty as to whether American bridging would be required to carry the British Churchill (45-ton) tank or an American equivalent. The treadway bridge, even the Armored Force agreed, reached its practical limit at 35 tons.[68]

One thing was certain. The Armored Force still wanted the treadway. Overseas, it had already proved itself. If, moreover, a treadway bridge capable of carrying 35 tons could be developed quickly, it might be used as an argument to hold weights to this limit. By 6 February, the program included experiments with both wider treads and a

[65] Ltr, CofEngrs to CG SOS, 13 Jan 43, sub: Coordination of Vehicle Design with Capacities of Mil Bridges. Structures Dev Br file, Ponton Bridging Equip, Misc, Pt. 2.

[66] Incl, Memo, Dir Rqmts Div SOS for Clay, 14 Jan 43 (typographical error 1942), sub: Coordination of Mil Design with Capacities of Mil Bridges, with Memo, ACofS for Matériel for CofEngrs, 16 Jan 43, same sub. 451, Pt. 1.

[67] 1st Ind, ACofS for Matériel to CofEngrs, [c. 5 Feb 43], on Ltr, CofEngrs to CG SOS, 13 Jan 43, sub: Co-ordination of Vehicle Design with Capacities of Mil Bridges. 451, Pt. 1.

[68] (1) Memo, Thompson for Sturdevant, 13 Jan 43, sub: Situation re Heavy Ponton Bridges. Structures Dev Br file, BR 287, Pt. 2. (2) Ltr, C of Engr and Dev Br to President Engr Bd, 12 Jan 43, sub: Bridging Possibilities. Same file. (3) 1st Ind, ACofEngrs (Sturdevant) to CG SOS, 4 Feb 43, on Ltr, Deputy C of Tech Div Ord Dept to CG SOS, through CofEngrs, 14 Jan 43, sub: Bridge Equip. 417, Pt. 13. (4) Ltr, ExO Engr Bd to Engr and Dev Br, 21 Jan 43, sub: Bridging Possibilities. Same file.



BAILEY BRIDGE *over bypass on Highway 7 near Sessa Aurunca, Italy, April 1944.*

decked-over treadway bridge, and the design of a guardrail for the Bailey.[69]

The treadway bridge, M–2, designed by Col. Clayton E. Mullins, Howard H. Mullins, and assistants at the Engineer Board with the help of Cowley, was a product of the fall 1942 accidents and the demand that both the old and the new tanks be accommodated. The Armored Force did not want a completely decked bridge because of the greater time required in construction and because such a bridge could not be readily transported in the trucks already available. The desired capacity was attained in the M–2 bridge by adopting larger (33-inch wide, 33-foot long) pneumatic floats and shorter and wider (12-foot long, 45½-inch wide) treadways. Procurement of the M–2 treadway bridge began in June 1943.[70]

By this time the steel guardrail which would render the Bailey bridge safe for the wider tanks had also been designed. Still partly undecided was the extent to which the Americans would follow their British al-

[69] (1) Tel Conv, Col K. B. Schilling, Engr Armd Force, and Col Hughes, Ground Engr, 6 Feb 43. Armd Center files, 823, Bridges, Pt. 1. (2) Ltr, Engr Armd Force to Besson, 8 Feb 43. ERDL file, BR 340. (3) Memo, C of Engr and Dev Br for ExO Engr Bd, 6 Feb 43, sub: Bridging Dev. ERDL file, BRs 341 E. (4) Ltr, Engr Armd Force to ExO Engr Bd, 9 Feb 43. ERDL file, BR 340.

[70] (1) Engr Bd Rpt 747, 24 May 43, sub: Steel Treadway Bridge. (2) Engr Bd Rpt 786, 26 Nov 43, sub: Final Rpt on Steel Treadway Bridge. (3) Engr Bd Hist Study, Steel-Treadway Bridging, p. 106.

lies in adopting the Bailey as an all-purpose bridge. The tendency to do so was strong, for American engineers in the ETO were by this time fully convinced of the Bailey's advantages. In February 1943, the Supply Division had notified the Engineer Board that the Bailey would supplant the H–10 as well as the H–20 in meeting the requirements for fixed bridging, and that should tests of the Bailey as a floating bridge prove successful, the H–10 would be dropped entirely.

The new limitations on weights and widths of vehicles were formalized on 28 August 1943. Vehicles measuring 18 feet or less between axles and assigned to infantry divisions could weigh as much as 18 tons loaded and measure 108 inches in width. In the few cases where the measurement between axles exceeded 18 feet, thus providing greater distribution of load, gross weight could slightly exceed 18 tons. Vehicles measuring 18 feet or less between axles and assigned to armored divisions or armies could weigh as much as 39 tons loaded and measure 124 inches. A greater gross weight was also allowed for those armored division and army vehicles which measured more than 18 feet between axles. The modifications made in the Bailey and steel treadway bridges made these structures safe for the increased weights and widths.[71]

But the Engineer Board's success in adapting the treadway and Bailey bridges to the new requirements did not satisfy Army Ground Forces. As Headquarters, AGF, viewed the bridging equipage available to infantry units in September 1943:

> . . . the reinforced five boat infantry support raft will ferry combat team loads up to a gross of ten tons in a stream of velocity of 3.5 miles per hour. The M–3 bridge, fully reinforced will pass eighteen ton tank loads with restricted movement in currents of velocities up to 4.8 ft. per second, but will not pass the four ton truck with trailer and bulldozer in velocities over about one mile per hour. The twenty-five ton heavy ponton bridge, when fully reinforced with metal pontons, will carry a safe load of only thirty tons with restricted movement in a stream of velocity 5 miles per hour.[72]

This situation, concluded AGF, demanded a complete revision in floating bridge equipage.

Wishing to depart from current dependence on a different bridge for each different set of loads, AGF specified that the new bridging components be the same for all bridges. This condition could be met, AGF suggested, through the use of half-boats—placed singly in the division bridge, joined end to end to form supports for the army bridge, and spaced closer together to carry exceptionally heavy loads. The bridge was to be fully decked and all parts light enough to be put in place by hand. Construction time for the divisional bridge was set at one-half hour plus three feet per minute; for the army bridge, two hours plus two feet per minute. These conditions could be met if both boats and balk were constructed of light metals such as aluminum, which by this time was in less critical supply and for which AGF was prepared to request AAA priority.[73]

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[71] (1) Engr Bd Hist Study, The Bailey Bridge, p. 30. (2) Ltr, ExO Engr and Dev Br to President Engr Bd, 18 Feb 43, sub: Transmittal of Rpt 729. ERDL file, SP 341. (3) AR 850–15, 28 Aug 43.

[72] Ltr, Asst Ground Engr to Rqmts Div ASF and CofEngrs, 1 Sep 43, sub: Dev and Rqmts of Div and Army Floating Bridges. 400.112, Bridges, Pt. 1. Cf. reports of Engr Bd that reinforced with pneumatic floats the 25-ton ponton bridge would carry 40 tons.

Unless otherwise noted, the discussion of the division-army bridge is based upon correspondence in 400.112, Bridges, Pts. 1 and 2, and Engr Bd Rpt 821, First Interim Rpt on Dev of Div and Army Floating Bridge Equip.

[73] War Plan Wkly Staff Conf, 29 May 44.

Lacking sufficient staff to develop the division-army bridge as quickly as AGF desired, the Engineer Board sought the aid of civilian firms. By 4 November, the naval architects, Sparkman & Stephens of New York, had agreed to design a ponton and superstructure, and the consulting engineers, Howard, Needles, Tammen, and Burgendoff of Kansas City, to design a superstructure. Shortly thereafter the Allison Steel Company also contracted to work on a superstructure. But the five months allotted these designers to fulfill their contracts had not elapsed when requirements changed.[74]

On 19 February 1944, G–4 announced that allowable weights for divisions would be raised from 18 to 25 tons and for armies from 38.9 to 50 tons. The roadway of division bridges should measure 128 instead of the former 108 inches and that of army bridges 150 instead of 124. If the 25-ton ponton was approaching the obsolete before, it was clearly out of the picture now. The Engineering and Development Division urged the Engineer Board to push the division-army bridge.

There was, to be sure, an alternative—the Bailey, which, if widened, could carry the increased loads. Tests of the floating Bailey had convinced the board that it was superior to the 25-ton ponton as well as the H–10.[75] Colonel Howard, in charge of testing the division-army bridge, was not impressed with the preliminary designs:

> Once the Panel Bridge . . . is erected, it is believed to be a better bridge, except for its width limitations, than any of the experimental bridges now being procured. . . . If a means was provided to adjust the floor width of the Panel Bridge, and to lighten the members, it is believed that this type of bridge would be a much better solution to the present problem than the superstructure now proposed.[76]

AGF disagreed. Its representatives were pleased with the division-army bridge. Although the Engineer Board designed a Bailey bridge with a clear roadway of 150 inches, beginning this job in March and completing tests in September 1944, the Bailey was never regarded as a substitute for the division-army bridge.[77]

The superstructure of the division-army bridge, which followed the Sparkman & Stephens design, looked more like the 25-ton ponton bridge but was actually closer, structurally, to the treadway. It looked like the 25-ton ponton bridge because it was fully decked. It was structurally similar to the treadway because balk and chess were combined. While the "treadway" was a three-sided section which formed a channel, the "deck-balk" designed by Sparkman & Stephens had four sides. Fitted together, these hollow aluminum sections provided an articulated connecting system, and flooring as well. The components that proved most troublesome to perfect were the half-boats and the approach which spanned the distance from shore to the point where the water became deep enough to float the first ponton. By mid-August 1944, two attempts had been made and a third was under way to design a half-boat combining the desired strength and lightness. Writing from the Yuma Test Branch, Howard urged still further modifications: "It is time that it be made clear to the designers that the primary

[74] Ltr, Asst ExO Engr Bd to Equip Dev Br, 4 Nov 43, sub: Consultants for Div and Army Floating Bridge Equip. ERDL file, BR 336.

[75] Engr Bd Rpt 792, 15 Feb 44, sub: First Interim Rpt on Floating Panel Bridge (Bailey Type).

[76] Ltr, C of Yuma Test Br Engr Bd to Dir Tech Div IV Engr Bd, 19 Feb 44, sub: Div and Army Bridge. ERDL file, BR 473.

[77] Ltr, ExO Engr Bd to Equip Dev Br, 30 Sep 44, sub: Widened Panel Bridge (Bailey Type). ERDL file, BR 341 E.

consideration is to secure a ponton capable of carrying 50-ton loads, and secondarily, to hold the weight to a minimum," he wrote his superior at Belvoir.[78] Indeed, by this time AGF had conceded that pontons capable of supporting the load would perforce be too heavy to handle by manpower, and had therefore consented to the use of cranes for loading and unloading them.

Although the bridge was far from perfect when tested, the over-all design proved so excellent that AGF accepted it on 15 November 1944, subject to assurances that use of a stronger aluminum alloy in the balk would correct the weakness in the approach span, that the 50-ton trestle then being fabricated was satisfactory from an engineering standpoint, and that the ponton would be strengthened.[79]

The adjustments thus made turned out well. In December, the site for service tests was switched from the placid Sabine River in Texas to the turbulent Columbia near Rufus, Oregon, where it was found that the new bridge (now called the M–4) would support 50-ton loads in currents up to 10.4 feet per second.[80] Construction time—two hours plus one foot per minute—exceeded the rate demanded by AGF.[81]

Getting the M–4 overseas in time to be of service was something else. One hundred and sixty-eight sets of bridges had been ordered in November 1944, but lack of materials had slowed production. The War Plans Division—worried about the impending Rhine crossing—saw no hope of any deliveries before 1 April.[82]

The Rhine was crossed, thanks in part to German failure to blow the bridge at Remagen, and thanks to the steel treadway bridge which American engineer troops had completed before the Remagen bridge collapsed. At the Rhine, as in so many other crossings, the treadway bridge was more than adequate for the job. With the treadway and the Bailey—both radical departures from proven designs—British and American troops kept pressing hard at the enemy's heels. With Army Corps consisting of two infantry and one armored division and with tank battalions attached to infantry, bridging had to pass tanks at all times. By September 1944 only three reinforced 25-ton ponton bridges had been erected in the European theater. The decision to produce the Pershing tank came so late in the war that few got overseas. As it turned out, the Engineers kept abreast of Ordnance, and while in the impatience which is so often a product of anxiety to do one's best, each service on occasion fell short of fully comprehending the other's point of view, both succeeded in accomplishing the job in a satisfactory manner.

The experience of the Corps of Engineers in the development of new equipment was typical of the Army as a whole. With few exceptions the Army fought with weapons and supplies that had been developed or partially developed before the United States became involved in combat. It was possible, of course, as in the case of the atomic bomb, to invest large amounts of money, materials,

[78] Ltr, C of Yuma Test Br to Dir Tech Div IV Engr Bd, 26 Aug 44, sub: T–4 Aluminum Ponton. ERDL file, BR 473.

[79] (1) Conf on Div-Army Bridge (15 Nov 44), 17 Nov 44. ERDL file, BR 473. (2) Engr Bd Rpt 883, 1 Nov 44, sub: Sixth Interim Rpt, Dev of Div and Army Floating Bridge Equip. (3) Engr Bd Rpt 897, 15 Dec 44, sub: Seventh Interim Rpt, Dev of Div and Army Floating Bridge Equip.

[80] Memo, Capt Robert O. Swain for Dir Tech Div IV Engr Bd, 16 Mar 45, sub: Service Tests of the Floating Bridge, M–4. ERDL file, BR 473.

[81] War Plan Wkly Staff Conf, 29 Jan 45.

[82] (1) *Ibid.*, 12 Feb 45. (2) Engr Bd Hist Study, Heavy Floating Bridging, p. 79.



STEEL TREADWAY BRIDGE *from Simbach, Germany, to Braunau, Austria, replaces the one destroyed by retreating Germans, May 1945.*

and talent in order to win the race against time. But since such investigations could be made only by sacrificing production of items already in the field, they had to be of a most compelling nature. Perhaps a greater investment in the field of mine detection and clearance might have paid substantial dividends. Perhaps, too, the Engineer Board and OCE were slow to grasp the potentialities of the Bailey and treadway bridges and to discard other, less suitable, types. This hesitation in choosing between the tried and the untried was costly in terms of precious technical talent. Yet in the face of the accidents which occurred on the treadway, the board went ahead successfully to convert this bridge into a safe structure. This improvement in bridging, together with the development of the tank dozer, were outstanding achievements made under great pressure for time and other handicaps common to a war economy. Partly as a result of these accomplishments, but even more as a result of the firm foundation laid during the period before Pearl Harbor and the wise decision to concentrate upon production, the engineer soldier was well equipped to carry out his work.

CHAPTER XXI

Production in High Gear

Failure to deliver the M–4 bridge to the European theater in time for the Rhine crossing was an atypical experience for the Engineer procurement and supply organization during the last months of war. The trend in the previous two years had been toward a sufficiency, in many cases even a plentiful store of supplies. This store was accumulated and distributed within the confines of controls that had become so rigid that it proved well-nigh impossible (as witness the matter of the M–4 bridge itself) to program successfully the production of new items.

The turn of the tide in favor of the United Nations, the shift from a defensive to an offensive position, was grounded in the victories of 1942 at Midway, in North Africa, at Stalingrad, and on Guadalcanal. By the end of the summer of 1943 the Allies had mapped out their grand strategy in Europe and, to a more limited extent, in the Far East, encouraged not only by past successes but, more particularly, by the assurance of a steady flow of men and matériel from the United States. The number of Americans trained and deployed overseas and the quantities of matériel produced and shipped during the last two and a half years of war proved sufficient to win decisively, with but temporary reversals, and this despite the fact that the quantity of men and matériel thrown into the conflict was considerably less than had been projected in the early months of 1942. In the fall of 1942 the administration was forced to face the fact that it could not attain the goals set forth earlier. What emerged was a more realistic program that represented a superior balancing of manpower, matériel requirements, and production. It was a program which the logisticians felt was within their power to make good on and yet which permitted the strategists to assume a posture for victory.

The Search for a Balanced Supply Program

The lowering of mobilization goals in the fall of 1942 resulted from a number of factors—the postponement of the cross-Channel attack, the continued shortage of shipping, and, most important, the unqualified pronouncement by the WPB that the $93,000,000,000 worth of military procurement projected for 1943 was beyond the industrial capacity of the country. It will be recalled that in October the President authorized an Army of 7,500,000 enlisted men for the coming year, a reduction of about 300,000 from the previous goal. This lowering of the troop basis was fundamental to the cut in the Army Supply Program that had been dictated by production possibilities. Drastic reductions in the area of international aid and some savings by way of lowered replacement factors allowed further tailoring of requirements to industrial capacity. After the slashing was finished the ASP (Ground) for 1943 totaled $18,950,000,000 as against the earlier program of

$24,000,000,000—a reduction of 21 percent.[1]

The way was paved for large reductions in international aid by agreement between Somervell and the British representative, General Sir Ronald Weeks, in November 1942, when Weeks agreed to scale down British requirements to "the minimum necessary to cover the deficit which cannot be supplied from production under British control" with the understanding that "these requirements . . . do not exceed the British capacity to man or operate as far as their own troops and allies for whom they are responsible are concerned." [2] Somervell promised in turn that the British would get what they asked for. This settlement marked the end of the long controversy in which the British had held out in favor of a genuine pooling of production with allocation of supplies by theater. The controversy was resolved in favor of the American position that the American Army had first call upon American production.[3]

It took some time for the significance, let alone the effects, of the Weeks-Somervell agreement to filter down to the Supply Division, OCE. Fowler, who had guarded American equipment most zealously against the more liberal attitude of Molnar's International Branch, let out a new blast at the common stockpile toward the end of December 1942. Fowler, pessimistic about the chances of meeting the ASP, continued to urge that international aid be cut and suggested that the common stockpile be abolished. One year later Fowler himself was to argue successfully for continuation of the common stockpile in opposition to the secretary of the Munitions Assignments Committee (Ground), who recommended its abolition in the interest of uniform control. Insofar as the common stockpile was concerned, the Secretary of MAC(G) contended, the Corps of Engineers was arriving at decisions on the basis of incomplete information as to military operations, military justifications, theater stocks, and other factors about which the International Division, SOS, was well briefed. Requisitions by the British for noncommon items as well as for the needs of the Russians were attended to without relation to the common stockpile, sometimes with wasteful results.[4] Fowler's defense of the stockpile was comprehensive and firm. The interests of the United States were being carefully guarded. "The adoption of the recommendations can only serve to slow up a procedure which is now working satisfactorily," he concluded.[5] Fowler's shift from a lukewarm supporter to a strong defender of the common stockpile is an interesting commentary both upon the extent to which British requirements were cut and upon the relative success of the Engineer procurement program. The common stockpile endured until November 1944.[6]

The reduction in international aid was absorbed almost entirely by the United

[1] For a detailed account of the reduction in the ASP see (1) Leighton and Coakley, *Global Logistics and Strategy*, pp. 602–11, 632–36, and (2) Smith, The Army and Economic Mobilization, Ch. III, pp. 77–88.

[2] Quoted in Leighton and Coakley, *op. cit.*, p. 283.

[3] *Ibid.*, pp. 270–74, 277–85.

[4] (1) Memo, Molnar for C of Intnl Br, 29 Dec 42, sub: Confs, Tuesday, 29 [Dec] 42. Intnl Div file, 400.333, Australia. (2) Memo, Molnar for C of Intnl Br, 30 Dec 42, sub: Confs on Wednesday, 30 Dec 42. Intnl Div file, 400.291, Stockpile U. S.-U. K. (3) Memo, Secy MAC(G) for Chm, 22 Nov 43, sub: Discontinuance of Engr Stockpile Procedure. 400.291, Pt. 9.

[5] Memo, ACofEngrs Mil Sup for Chm MAC(G), 4 Jan 44, sub: Discontinuance of Engr Stockpile Procedure. 400.291, Pt. 9.

[6] Ltr, Actg Dir Intnl Div SOS to CofEngrs, 8 Nov 44, sub: Rescission of Engr Stockpile Procedure. Exec Office Rqmts Div, Read file.

Kingdom. The President had placed the Russian Protocol on his "must" list in view of the importance of the winter campaign in that country. The Russian program was, moreover, relatively small compared to Britain's. Though resigned to the cut in the Engineer portion of the program, Brigadier Blood remarked upon its severity. The reduction as it stood late in January 1943. Blood informed the International Branch, OCE, was entirely in noncommon items. He had estimated requirements in this category (Section III of the ASP) at $137,000,000. After allowances were made for prior commitments only about $30,000,000 would remain. The total dollar value of international aid in the 1 February ASP was $237,904,694.[7]

Adjustments in replacement factors provided a third means of reducing total requirements. Such allowances were henceforth based upon an estimated average overseas strength rather than an anticipated terminal strength as had been the case previously. In addition, certain areas, such as Hawaii, heretofore considered active theaters, were reclassified so that factors were the same as for the United States. Still SOS continued to hammer away at replacement factors, convinced that greater efforts could be made to arrive at more realistic percentages, and suggesting early in 1943 that teams be sent overseas to get at the facts. Four Engineer teams were dispatched to major theaters in the summer, poorly briefed, it was later claimed, and given a cool reception upon arrival at their destinations. Orders from ASF, rather than reports from overseas, were to result in a substantial lowering of replacement factors as the year ran out. In the early months of 1943, however, the Engineers were dominated by a fear of not having put in for enough. High replacement factors served as a cushion against this possibility as well as an assurance of additional matériel in the theaters.[8]

Drastic as were the reductions, the 1943 program promised to tax the nation's industrial capacity. Determination to make stated requirements stick, to establish the ASP as a ceiling upon procurement action, was part and parcel of the plan to tailor requirements to production possibilities. The whip in the new dispensation was the Controlled Materials Plan, a system for distributing raw materials announced by WPB in the fall of 1942, to go into effect the following year. The Controlled Materials Plan put it up to the procurement agencies to state well in advance just how much would be needed and when. There would be little leeway for slipping in additional emergency requisitions. The Engineers, with their uniquely large demands for Class IV matériel, suffered unusual strains in adjusting to the policies established in 1943.

As access to raw materials became more closely tied to firm statements of requirements, the Supply Division exhibited increasing concern about forecasting Class IV needs. Typical of this feeling was Fowler's complaint in September 1942 that the Operations and Training Branch, to which the Supply Division had to look for guidance on requirements for Class IV matériel, "provides us with no information which will

[7] (1) Ltr, C of Engr BAS to C of Intnl Br, 25 Jan. 43. Intnl Div file, 400.192, ASP. (2) ASP Sec. I, 1 Feb 43. (3) ASP, Sec. III, 1 Apr 43.

[8] (1) SOS Memo S 7000–9–43, 20 Feb 43, sub: Determination of Distr and Maint Factors. 400.314. (2) Memo, C of Rqmts and Stock Control Br for Fowler, 27 Aug 43, sub: Rev Maint Factors. Exec Office Proc Div file, Engr Equip—Spare Parts No. 1. (3) Memo, C of Fld Sv Sup Div for C of Sup Div, 16 Sep 43, sub: Maint Factors. Rqmts and Stock Control Br, Read file. (4) See below, p. 523.

result in advance procurement but only calls on us for materials after definite war plans have been put into effect." He added that "frequently these plans call for early sailing dates which necessitates the rapid assembly of a miscellaneous set of equipment and many shortages." [9] It was a British proposal, heartily endorsed by Fowler, to establish a joint planning committee which would be fed information by the Combined Chiefs of Staff. On the basis of such data the common stockpile could be enlarged, both as to type and quantity, and the Engineer Subcommittee of MAC(G) could make more intelligent recommendations on assignments. The Engineer Advance Planning Committee, with Brigadier Blood, General Fowler, Colonel Gorlinski, and Col. Lewis T. Ross, Troops Division, as well as representatives of the Operations Division and the Transportation Service, SOS, was duly established in September 1942. Shortly thereafter a Class IV Requirements Board was set up within OCE, composed of representatives from the Operations and Training, Requirements, and Development Branches.

The Advance Planning Committee failed to gain access to the requisite information. Lacking such information, the Class IV Requirements Board felt severely handicapped. Approximately how many airfields were to be built? How much port construction was indicated? What geological conditions were likely to be encountered? These were some of the more pressing questions that the Requirements Board felt must be answered if requirements were to be accurately computed and purchase by requisition avoided.[10]

Although the Engineer stockpile had been invaluable, Reybold wrote Somervell on 16 February 1943, it had been necessary all too often "to scour the country for non-anticipated materiel as requisitions were received." The Chief of Engineers felt that "at best" such procedures left "too much to chance" and emphasized the increasing difficulty of securing steel and other materials on short notice. Reybold did not mince words. He invited Somervell's attention to "the dangerous situation which may develop due to lack of knowledge . . . of contemplated strategic and tactical plans." [11] Reybold could not have addressed a more sympathetic ear. The Commanding General, SOS, was doing his utmost at this time to acquire a seat in the councils of the General Staff, to demand for logistics something more than its traditional advisory voice in the determination of strategy.[12] For their part, the Engineers were quite willing to settle for information—"any information which may be of use . . . for the purpose of procurement planning based on strategic considerations." [13]

In the relatively more immediate plans of theater staffs there existed a second source of valuable information to which the Operations and Training Branch and the Sup-

[9] Memo, Fowler for Gorlinski *et al.*, 11 Sep 42, sub: Plan-Proc for Engr Equip for TofOpns. Intnl Div file, 334, Intnl Sup Subcomm.

[10] (1) Memo, Deputy Dir Proc SOS for C of Sup Div, 28 Sep 42, sub: CE Prod Program Conf. 337, Pt. 1. (2) Opns Sec Rqmts Br Diary, 24 Oct 42. (3) Memo, C of Rqmts Br for C of Sup Control Sec, 9 Nov 42, sub: Adm Devs. 020, Pt. 1. (4) Memo, Chm Class IV Rqmts Bd (Dawson) for Chm British Engr-U. S. Engr Strategic Subcomm (Fowler), 22 Feb 43, sub: Proc Planning for Engr Class IV Matériel. 400.12, Pt. 1.

[11] Memo, Reybold for Somervell, 16 Feb 43, sub: Proc Plan for Engr Non-T/BA Equip. 400.12, Pt. 114.

[12] For detailed accounts of the Somervell effort see (1) Cline, *Washington Command Post,* pp. 269–78, (2) Leighton and Coakley, *op. cit.,* pp. 649–55, and (3) Millett, *Organization and Role of the ASF,* pp. 111–23.

[13] Memo, Reybold for Somervell, 16 Feb 43, sub: Proc Plan for Engr Non-T/BA Equip. 400.12, Pt. 114.

ply Division sought access. More and more the group of officers at home felt a sense of alienation from their fellows overseas. Temporary liaison officers sent by overseas theaters to Washington on specific missions did not provide a bridge of understanding, Col. Robert H. Burrage of O&T pointed out to his chief, Gorlinski. What a liaison officer knew was confined to his own theater, and often his knowledge even of this area was all too narrow. Burrage continued:

> Similarly, it may not be hoped that liaison can be maintained by letter or cable. Answers to specific questions can usually be obtained sooner or later, but rarely is the reply either complete or satisfactory, for neither end knows how the other end is thinking. The theater Engineer is capable and knows what he wants, but rarely does he know what other theaters want or need, whether what he wants is available or will work in with what we must send, nor does he fully appreciate the situation as to procurement, stock-piling and shipping space. On this end, we cannot know all his problems, nor can we learn much of how the equipment we send him is working out. Reports from the field are notable for their absence. This is not strange, for on both ends each has a thousand things to do and no time to go into detail with the other fellow, desirable as it is to do so.

Difficulties of communication loomed all the more serious when coupled with the hard fact that only nine of O&T's forty-two officers had ever seen an active theater and these nine not for twenty-five years.[14]

Yet the prospect for improvement in long-range forecasting of Class IV requirements was not altogether negative. Although information on future strategy was never forthcoming to the extent desired by OCE, much less by ASF, plans for operations against Germany became firm and available to the logisticians in 1943. The decision to go into Sicily and thence into Italy was made at Casablanca in January. The TRIDENT conference, held in Washington a few months later, fixed 1 May 1944 as the date for the Normandy invasion. At Quebec in August 1943 the landing in southern France was agreed upon. Such decisions eased the total burden, delimiting the area of guessing largely to the Pacific where strategy remained opportunistic. Regardless of the firmness of strategic and tactical plans, visits to theaters by Reybold, Fowler, Somervell, and other officers from OCE and ASF were of great assistance in clearing up bottlenecks and misunderstandings. Monthly reports from the Chief Engineers of the European and Southwest Pacific theaters were valuable aids to communication. First issued in the spring of 1943, these reports described all facets of organization and procedures in the Engineer section of theater headquarters, noted deficiencies in supply and supply planning, and set forth the activities in which engineer troops were engaged. Yet valuable as were these informal sources of information they did not provide the real stuff from which to build statements of Class IV requirements. For this basic data the Engineers looked to the formal channels established by the War Department.[15]

Soon after the invasion of North Africa, ASF, working with the War Department General Staff and the Army Air Forces, developed a number of assumptions as to future strategy in the Mediterranean area for OCE's use in stockpiling Class IV sup-

[14] Memo, Burrage for Gorlinski, 8 Mar 43, sub: O&T Responsibility re Railway Bridging. 417, Pt. 13.

[15] (1) The monthly reports of the Chief Engineer, ETO, are in AMS files; those of the Chief Engineer GHQ SWPA are in EHD files, SWPA Br. (2) For trips overseas by Somervell and his aides, and for a summary of high level conferences, see Millett, *op. cit.*, Chs. IV and V.

plies. OCE compiled a bill of materials covering various construction and reconstruction projects which it was thought would be needed in the theater. Forwarded to North Africa for review in January 1943, this bill of materials was filed away and forgotten until inquiries from the United States became persistent. Finally returned to ASF in June 1943, the theater's version showed drastic cuts in estimates. Yet months before this, quantities in the ASP had been increased to cover the original bill of materials. At this stage of the war, what was surplus to one area could usually be diverted to another. Such exchanges would be less feasible as stocks of supplies were built up and there were limits even at this time upon the readiness with which Class IV supplies could be switched from one theater to another. For all these reasons it was mandatory to improve the accuracy of Class IV estimates.[16]

A new approach, begun early in 1943, put it up to the theaters to make their own assumptions and to develop requirements covering the next twelve or eighteen months. ASF was prepared to authorize stockpiles of Class IV matériel on the basis of such estimates. Responses were disappointing. The submissions varied in scope and contained numerous gaps in data. O&T was inclined to question the usefulness of many items listed. Other items would have to be broken down into their components before procurement could start.[17]

Soon ASF tried another tack, one that though far from perfect was nevertheless to endure. By cable on 1 June 1943, overseas commanders were directed to submit a comprehensive list of major projects anticipated during 1944 and any expected during 1943 which had not been covered in previous estimates. Each project was to be briefly described and assigned a number—for example, "Project A 16: Rehabilitation Ports of Manila and Olongapo, including construction of 7 piers, 400 X 80 ft." The theater could, if it preferred, compile its own bill of materials for each project or could request that the technical service do this. A bill of materials received from the theater would include only those supplies which would have to come from the United States. If the bill was to be drawn up in the United States, the theater was to indicate what supplies need not be imported because they could be assembled in the theater itself. Projects would show the date when supplies should arrive at the port.

Upon receipt from the theater, projects went first to the Operations Division, War Department General Staff, which was the group best able to relate them to the strategic and tactical plan of the theater concerned and to the over-all strategy of the war. OPD approved the project if it fitted in with these plans and policies. Planning Division, ASF, conducted another review, geared more to logistical considerations, satisfying itself that the project was in general conformity with policies of the War Department and checking for possible duplication in the ASP. The technical service

[16] Plan Div, Office of Dir Plans and Opns ASF, History of Plan Division, ASF (multilithed, n. d.), Vol. II, Pt. IV, pp. 213–14. Unless otherwise noted, the remainder of this section is based upon this study, pages 216–20, and upon (1) *Engineers of the Southwest Pacific*, Vol. VII, *Engineer Supply*, pp. 44, 103–04, 142, 144, 147–48, (2) Liaison Sec Intel Div, Office of Engr ETO, Hist Rpt 3, Supply, pp. 18–35, and (3) Maj Harry F. Kirkpatrick, Development of Supply Planning for Engineer Class IV Supplies (typescript, 20 Dec 45), pp. 11–22.

[17] (1) Memo, ACofS for Opns ASF for Cs of Svs and Staff Divs, 2 Apr 43, sub: Opns Stockpile. P&T Div file, 381, Task Forces, Folio 3. (2) Ltr, AC of O&T Br to CG ASF, 15 Apr 43, sub: Engr Class IV Rqmts. Same file.

concerned (the Transportation Corps and Corps of Engineers were usually the ones concerned) scrutinized the project in more detail. Was it necessary and adequate from both a technical and a tactical standpoint? What, if any, changes were indicated in the bill of materials? At this point the ASP could be revised to include additional requirements. General recommendations and the edited bill of materials were to leave the technical service within 30 days. Final approval by ASF followed and theater and port supply officers were notified that requisitions for noncontrolled items bearing the number of the approved project would be honored automatically. Requisitions for controlled items remained subject to approval by the technical service. Because of the manner in which requirements were to be matched up with, or keyed to, specific operations, this procedure for handling Class IV supplies, formalized by the War Department on 20 September 1943, was known as the "keyed projects system." The keyed projects system was not merely a means of revealing Class IV requirements. It was, in addition, a means of limiting requirements.

Neither in the theaters nor in OCE did the keyed projects system generate enthusiasm. It was recognized, of course, that something of the sort must be done. The Chief Engineer, ETO, had in fact set his staff to work on estimates of Class IV needs for operations on the Continent in November 1942 at which time the cross-Channel invasion was scheduled to occur in 1943. Using twenty-two categories of Engineer activity, the staff was to make up unit bills of materials, showing, for example, requirements for a so-many bed hospital, a so-many man camp, for various types of airfields, maintenance shops, and the like. The number of hospitals, airfields, and other "units" were to be estimated for the first sixty days of Continental operations as a preliminary step to the final computation of Class IV requirements. Substantial progress was made on these estimates over the next few months. Of particular value was the basic data, set down in the form of staff tables, which could be applied to any future strategic plan. After the Normandy invasion was postponed, the Chief Engineer, ETO, called for new estimates, but they had not been completed before the arrival of ASF's cable inaugurating the keyed projects system. The office of the Chief Engineer, ETO, submitted twenty-eight projects to the War Department, most of them during July and August 1943, covering Class IV requirements in two phases, phase A for the first 90 days of operations on the Continent and phase B for the subsequent 150 days, a total of eight months' supplies. In October 1943, the theater understood that the War Department would have processed all projects by the 25th of that month. In December, however, it was learned that OPD would not, in the absence of an over-all tactical plan, consider any projects which were scheduled during phase B. The ETO Engineers became alarmed. "It may be considerable time before an operational plan for the second phase has been received in Washington and approved," wrote the Deputy Chief Engineer, ETO, in protest. "Meantime, it appears that plans for production should go forward or the material will not be available to support the operation beyond D+90 when requisitions are placed for the second phase." [18]

Such worries were minor compared with those of Engineer officers in the Pacific, where the fluidity of strategic plans, time and distance factors, and an accumulation

[18] Quoted in Hist Rpt 3, Supply, p. 34.

of shortages rendered detailed forecasting infinitely more difficult. The overriding fear, understandably more extreme in the Pacific, but evident in Europe as well, was that too much time would be consumed in the review and approval of projects and that the theaters would be held too strictly accountable for estimates which had been made before plans had been fully mapped out.

OCE was not long in lining up with the theaters in opposition to the keyed projects system. The procedure had the virtue of putting theater commanders on notice that supplies were not inexhaustible and forced them to focus attention on planning. Submissions of data did bring into the hands of O&T and of the Supply Division a quantity of valuable, long-sought-after information. But the data were neither detailed enough nor submitted far enough in advance of operations to serve as a firm basis for requirements. Descriptions of projects were frequently sketchy; bills of materials, incomplete. Although projects were supposed to be forwarded to the War Department "sufficiently far in advance of the time of execution of the project" to allow for procurement and shipment of the items requested, almost always requisitions accompanied the projects themselves or arrived at the port at the same time that approvals were processed through the War Department. To withhold procurement action until projects had been approved was to invite shortages. The Supply Division therefore made it a practice to make changes in the ASP upon receipt of the project on the assumption that approval would subsequently be forthcoming. Still lacking were the long-range estimates on which to base calculations of materials requirements.

On 17 December 1943, Fowler, just back from a tour of Pacific theaters, discussed the current dissatisfactions with members of his staff. In the Engineers' view, the original purpose of the keyed projects system—understood to be that of initiating procurement in time to assure availability in the theater—was being broadened to encompass control of shipments. This was wrong, the Engineers argued. Estimates supposedly drawn up a year or more in advance were not sufficiently firm to form the basis for issue of supplies. Review of projects might serve a useful purpose to OPD in its overall control of theater activity, but policing should be left to The Inspector General rather than to the technical services. OCE could not pass judgment on the technical and tactical adequacy of projects unless allowed an increase in staff and access to considerably more information about the theater's plans.[19]

The basic change in procedure which OCE advanced to ASF a few days after the conference in Fowler's office was complete divorcement of requirements computations, procurement action, and shipment of supplies from the keyed projects system. The function of keyed projects would be narrowed so as to provide general information. Under this conception, keyed projects need be descriptive only; no bill of materials was necessary. For purposes of computing requirements for inclusion in the ASP, the Engineers suggested that theaters submit a

[19] (1) Memo, Actg C of Fld Sv Sup Div for ExO Sup Div, 10 Nov 43, sub: Procedure for Handling Rqmts of Special Operating Sup. Rqmts Br, Read file. (2) Memo for File, 20 Dec 43, sub: Conf, 17 Dec 43. Exec Office Proc Div file, Adm Memos, Interoffice. (3) Ltr, ExO OCE to Dir P&O Div ASF, 18 Dec 43, sub: Procedure for Handling Rqmts of Special Operating Sup. 400.314.

net bill of materials, by quarter, for five quarters in advance.

The Engineers got a good measure, but not all of the changes desired. The quarterly estimate system went into effect on 31 January 1944, with the first bill of materials to cover five quarters beginning 1 July 1944 due from the theaters on 1 May. In submitting projects for approval, the theater would describe the job (its approximate size, type of construction, number of buildings, length of runways, and so forth), indicate its place in the logistical plan, and list only the major items (those in short supply) that would have to be shipped from the United States. But quarterly estimates remained tied to keyed projects. The theater was to indicate by project number on its five-quarter bill of materials the projects covered therein. Theaters were informed, however, that the War Department realized the difficulty of forecasting several months into the future. Detail and accuracy were expected for the first two quarters. Figures submitted for the succeeding three quarters would be treated as estimates to be used in procurement planning but subject to revision. In other words, requirements for the first two quarters were to consist of approved current operational projects; requirements for the remaining three quarters, based on anticipated projects, were to be used by OCE as the basis for procurement.[20]

The quarterly estimate system put into the hands of the Supply Division statements of requirements covering a longer period of time than had been forthcoming under the keyed projects system. But OCE continued to feel that there was too close a tie between keyed projects and requirements computations.[21] Was it not unreasonable to expect the theaters to key their requirements to operational projects even for the first two quarters of estimates? Quarterly submissions were due 60 days in advance. Sixty days was therefore the shortest notice the theaters could give. Equally accurate data was expected for the next 180 days. This was not an impossible task in Europe. But in the Southwest Pacific, Sixth Army had on an average about 60 days' notice of specific operations. In preparation for the landings on Leyte, Sixth Army was given roughly 150 days' notice under the original schedule. A decision to advance the date of the Leyte landings from 20 December 1944 to 20 October reduced the time available for planning to 90 days. The Luzon campaign opened within 120 days of the decision to invade. The Engineer, Sixth Army, was adamant that "in a moving situation such as exists in SWPA where enemy weakness is being timely exploited, careful advanced logistical planning cannot be given in detail or by the project method prescribed." He believed, however, that "the general facilities required in several objective areas—that is during a six or nine months period—will add up about the same if all the localities are totaled." [22] In other words, quarterly estimates should suffice and requisitions against them be honored.

OPD took quite another view of the matter. Review of projects enabled the War Department to balance demands in a two-front war. Review of projects provided a

[20] (1) Memo, Deputy Dir P&O ASF for CofEngrs *et al.*, 28 Dec 43, sub: Sup Proposals Presented by CofEngrs, with Incl. 475, Engr Equip, Pt. 2. (2) WD Memo W 700–44, 31 Jan 44, sub: Engr Class IV Materials and Sup.

[21] (1) Memo, ACofEngrs for CG ASF, 15 May 44, sub: Special Operating Sup. 400, Pt. 2. (2) *Engineers in the Southwest Pacific*, Vol. VIII, *Critique* (Washington, 1951), p. 388. (3) *Final Engr Rpt, ETO*, p. 225.

[22] Memo, Col S. D. Sturgis, Jr., Engr Sixth Army, for CofS Sixth Army, 10 Nov 44. EHD files, SWPA Br, Sixth Army.

means for the War Department to check upon standards of necessity, simplicity, and economy. If the War Department had not instituted the projects, the theaters would have established something very like them for their own use, OPD argued. In the case of the Southwest Pacific theater, OPD noted that projects had been approved far in advance of available cargo space. Indeed it was lack of shipping, within the theater as well as to and from it, that proved the most delaying factor in supply to Pacific areas. At the time of the Leyte operation, for example, the Southwest Pacific theater was well stocked with engineer supplies. The trouble was that these stocks were scattered in such a way as to make it almost impossible to concentrate them in the vital area.[23]

Final judgment as to the efficacy of the keyed projects and the quarterly estimate systems must await a more detailed analysis of theater experience. OCE would have preferred, as did the theaters, less emphasis on projects. But OCE did not have the broad responsibilities of ASF and OPD. For all the checking and rechecking, the projects never attained a high degree of accuracy. Engineers in the Southwest Pacific prepared them on a typical rather than a specific basis. In all theaters, assumptions had to be made. The ETO figured that port facilities would be 75 percent destroyed, bridges on major routes 100 percent destroyed, and roads 10 percent damaged. OCE became fairly well reconciled to established procedures after the introduction of the quarterly estimate system, for this did fill the Supply Division's major need—a reasonably accurate estimate of Class IV supplies well in advance of the time they would be needed. By the time the quarterly estimate system went into effect, moreover, the entire procedure for computing requirements was in the process of being radically overhauled. During 1944 ASF was to place increasing weight upon past experience in the consumption of supplies as a measure of future requirements. It was possible to do this because production in nearly all categories had more than caught up with demand.

The Administrative Reorganization of January 1943

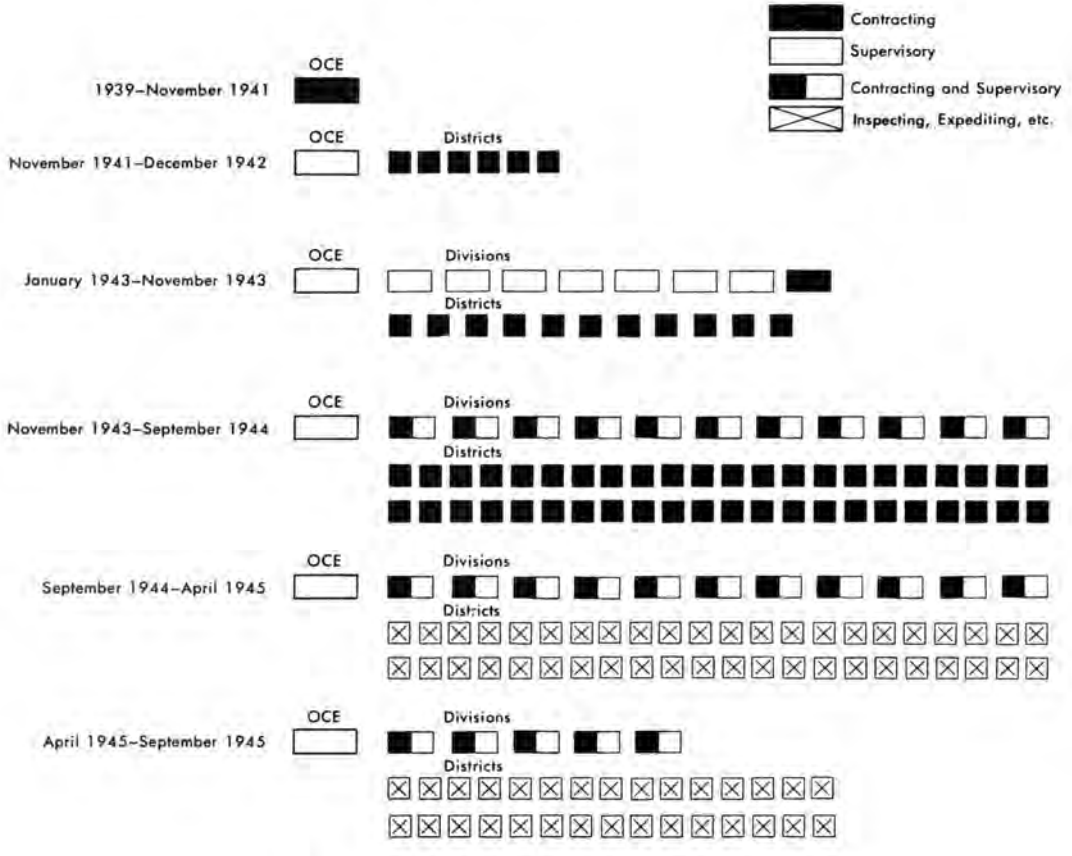
The Engineer portion of the 1 February 1943 ASP was valued at $1,616,000,000. Thanks to the lowering of the troop basis and the reduction in international aid it was smaller than had been projected earlier. Yet it represented over $1,000,000,000 more than the value of Engineer deliveries in 1942. In order to complete the 1943 program, deliveries would have to average over $100,000,000 a month. In only two months previously—August and December 1942—had they reached $90,000,000. The average for the last six months had been $77,000,000.[24]

The main hope of attaining the desired acceleration was offered by the prospect of an increase in the supply of steel and by a change in the method of distributing this scarce material. Steel production was expected to increase approximately 7 percent during 1943. The Controlled Materials Plan (CMP) would have replaced the unpopular Production Requirements Plan as a method of distribution by summer. CMP imposed upon the procurement agencies a host of new responsibilities hitherto assumed by the WPB. But neither these new responsibilities nor the character or volume

[23] Ltr, Maj Gen H. A. Craig, Actg ACofS OPD, to Maj Gen Edmond H. Leavey, Deputy Comdr and CofS USAFWESPAC, 14 Jul 45. Dawson personal file.

[24] ASP, 1 Feb 43.

CHART 7—ORGANIZATION AND PROCEDURES FOR HANDLING PROCUREMENT OF SUPPLIES: 1939–45



of Engineer procurement seem sufficient to have dictated the unique organization established to administer them. There were five major reorganizations of field procurement offices during the war years—two of them in 1943. (*Chart 7*) At the peak of procurement activity the Corps of Engineers had fifty-five field offices in operation. The Signal Corps, whose volume of buying most closely approached that of the Engineers, had three field offices. The Quartermaster Corps, which like the Engineers bought a large variety of commercial articles but in much greater quantity, managed with twenty-eight. In the opinion of some observers, concern for the fortunes of the Engineer Department decreed the size and shape of the Engineer procurement organization.

In the fall of 1942 the Engineer Department employed 70,000 civilians in eleven division and forty-four district offices. Except in the Mississippi Valley where flood control was the determining factor, geo-

graphical boundaries of Engineer divisions conformed to those of ASF's service commands. The Engineer Department had figured in procurement plans from the beginning but only in a minor way, as a source of personnel by way of an expected diminishing of the civil works program. The transfer of military construction to the Corps postponed the tapping of this reservoir. Meanwhile the procurement organization had been tied into the Engineer Department in an unexpected manner. Yet the tie was a weak one. The six District Engineers who doubled as chiefs of the procurement districts reported directly to the Supply Division, OCE. The procurement organization resembled the plans of the thirties much more than it did the structure of the Engineer Department. This resemblance seemed perfect when the Procurement Branch, OCE, relinquished all contracting to the field in the fall of 1942, but it was precisely at this time that the plans of the thirties ceased to have influence.

The Engineer Department was fast approaching the point where numbers of persons could be made available to the procurement program. Military construction projects were to be relatively few in the future. Civil works had already shrunk appreciably and were destined for further decline. The position of the Engineer field organization was rendered yet more precarious by the expansionist tendencies of SOS service commands. The Chief of Engineers could scarcely believe himself appointed to preside over the dissolution of the Engineer Department, to see its experienced construction men lost, perhaps permanently, to the civil works and military construction programs of the future. Thus several years after the event did old-line employees of the Procurement Division sketch in the background of a change which came to them as a complete surprise and which they regarded as unwise. Since the Engineer Department needed business and the procurement program needed personnel, so ran the logic of those who made the decision, the two organizations should be welded more closely together.[25] But not too closely. On 1 January 1943 the number of procurement offices was increased modestly from six to ten:

North Atlantic Division
  New York District
  Philadelphia District
Middle Atlantic Division
  Baltimore District
South Atlantic Division
  Atlanta District
Ohio River Division
  Pittsburgh District
  Cincinnati District
Great Lakes Division
  Chicago District
Upper Mississippi Valley Division
  St. Louis District
Southwestern Division
Pacific Division
  San Francisco District

As outlined by Fowler in October 1942 and as put into effect in January, Division Engineers would be kept in the background. The Supply Division, OCE, would continue to conduct the day-to-day business by direct contact with procurement districts. District, not division, offices would handle all

[25] (1) *Industrial Mobilization for War,* pp. 641, 663. (2) Millett, *op. cit.,* pp. 305–07, 319–29. (3) Management Br Control Div OCE, Organization for Engineer Procurement (typescript, 7 Oct 47) (cited hereafter as Orgn Engr Proc). EHD files. (4) Memo, C of Proc Div for ACofEngrs Mil Sup, 26 Mar 48, sub: Orgn of the CE for Proc of Mil Sup. Exec Office Proc Div file, Orgn CE. (5) Incl, with Memo, C of Constr Control Sec for Reybold *et al.,* 30 Sep 42, sub: Div and Dist Employees. Groves files. (6) Ltr, CofEngrs to Div Engrs, 27 Oct 42, sub: Reorgn of Engr Divs. Exec Office Proc Div file, Proc Dists. (7) For previous organization see above, pp. 177–78, 221.

contracting. In line with previous practice, all 44 districts of the Engineer Department would assist procurement offices by inspections and expediting. Division Engineers would concentrate upon improving administration in the procurement districts. Policies and procedures would be laid down in Washington. For procurement purposes, moreover, geographical boundaries took on a different contour from those of the Engineer Department, the groupings of industrial facilities dictating the areas of responsibility. For example, the North Atlantic Division supervised military construction projects and allied activities in New York, New Jersey, and Delaware only, but was assigned cognizance over procurement activities in the New England states and part of Pennsylvania as well.[26]

Seybold, the chief of the Procurement Branch, and his assistant, Col. George K. Withers, had expressed a preference for departmental boundaries. Indeed Withers believed, and so informed Fowler, that the deviations destroyed "the one advantage" of the reorganization, namely, direct chain of command. Delay and disruption, Seybold and Withers agreed, would result from any change.[27]

If the Procurement Branch, OCE, was lukewarm to the reorganization, the Purchases Division, SOS, opposed it outright. The Purchases Division thought the Engineers had been off the track from the beginning in fostering a territorial breakdown of procurement operations. The Corps should set up three procurement offices, New York and Chicago to carry the main load, and San Francisco the rest, all items to be earmarked for purchase by one or the other. Commodity buying would insure lower prices. Commodity buying would lessen the burdens of the Procurement Branch which now had the voluminous and complicated task of assigning requisitions to ten offices.[28]

As a matter of fact, much the greater dollar volume of Engineer procurement had in the past been accomplished by commodity buying and this practice was preserved under the new organization. When requirements approached or exceeded overall industrial capacity, Reybold explained to the Purchases Division, ASF, the Engineers purchased by commodity rather than by area. On the other hand, Reybold insisted, geographical procurement was eminently suited to some 27,000 common varieties of items bought by the Corps. It was in the purchase of such articles that the Engineers could offer contracts to small business, channel orders to areas where labor was more plentiful, and discover and utilize new facilities in accord with current policies of the production authorities. Reybold believed it fairer to the taxpayer to spread business than to get the most out of every dollar. Moreover, the closer the location of procurement offices to sources of supply the better would be the administration of the Controlled Materials Plan and the more efficient the handling of production problems.[29]

[26] (1) OCE GO 51, 17 Dec 42. (2) C/L 2241, 14 Jan 43, sub: Mil Sup—Procedures. (3) Memo, Fowler for Tulley, 29 Oct 42, sub: Proc Load on Proc Dists. Exec Office Proc Div file, Misc Corresp. (4) Orgn Engr Proc.

[27] (1) Memo, Actg C (Withers) of Proc Br for Fowler, 16 Nov 42, sub: Placing Proc Dists Under Div Engrs. Exec Office Proc Div file, Proc Dists. (2) Memo, Seybold for Fowler, 19 Nov 42, sub: Reorgn of Proc Dist—Div Engrs. Exec Office Proc Div file, Misc Corresp.

[28] Survey Rpt, Purch Div SOS, 15 Jan 43, sub: Special Proc of Trp Sup by the CE. 400.12 Pt. 1 (C).

[29] Memo, CofEngrs for Dir Purch Div SOS, 29 Jan 43, sub: Special Proc of Trp Sup by CE. 400.12 Pt. 1 (C).

The Controlled Materials Plan

Certainly the major task set before the procurement organization at the outset of 1943 was the administration of the Controlled Materials Plan. CMP recognized three materials—steel, copper, and aluminum—as dominating the nation's production. Like the Production Requirements Plan, and unlike the priorities system, CMP was pledged to allot no more of these materials than was available in any one quarter. The concept of distribution under CMP was vertical in contrast to the horizontal system which had characterized PRP. Under PRP the individual manufacturer had applied for his share of materials and WPB had made the allotments. CMP allowed a limited number of "claimant agencies," such as the Army, Navy, and Maritime Commission—seven in all—to bid for their contractors' shares on the basis of established war production programs. The Army got its steel allotment in a lump and parceled it out to the technical services, which divided it among their prime contractors who saw to it that their subcontractors were supplied.

The research, mathematical calculation, and discussion that attended CMP was staggering in its quantity. The prime contractor supplied the claimant agency with a unit bill of materials for his product. The claimant agency extracted the quantity of steel, copper, and aluminum and multiplied this by the number of units scheduled to be produced each quarter. "Lead time," the number of months required from date of shipment of raw materials to delivery of the finished product, was figured into production schedules in order to establish the date when controlled materials were to be made available to the manufacturer. All this data had to be digested and ready three months in advance of the applicable quarter for presentation to the Requirements Committee, WPB, on which sat representatives of all the claimant agencies. The Requirements Committee looked at the production forecast of steel, copper, and aluminum and rationed out the quantities after due consideration to "must programs," strategic plans, and logistical factors. Each claimant agency then adjusted programs and delivery schedules to conform to its own bulk share. Manufacturers received the revised schedules along with allotments of materials.

The Army was willing, even anxious, to assume this vast burden because CMP afforded to it so much more control over the procurement program than had the priorities system or the PRP. Indignation followed dismay therefore when the WPB widened the door to admit a large number of exceptions. Certain products were clearly unsuited for inclusion under CMP, a vertical system of materials control. These were the so-called shelf items or general industrial supplies—bolts, bearings, motors, and other components. The fabricators of such supplies were general suppliers or vendors rather than subcontractors. They received orders from innumerable producers of end items and would have to depend, if included in a vertical system of allocation, on similar innumerable allotments of controlled materials. CMP left room for use of a horizontal system where administration would be thus rendered chaotic. The Army had no quarrel with this principle. What gave rise to the dismay and indignation was the announcement by WPB that all civilian-type end products would be classed as "B" products along with shelf items and industrial supplies. Commercial items, so the WPB reasoned, were being ordered by

numerous claimant agencies. To avoid administrative chaos, allocation should be by WPB upon application from the manufacturers. The claimant agencies would inform WPB either of the number of units or of the dollar value of B products required. The WPB would then calculate the amounts of material needed in their manufacture.[30]

This decision hit the Corps of Engineers where it hurt. Some 80 percent of the items procured, including tractors, cranes, shovels, air compressors, and the whole long list of more specialized construction machinery, were B products. The first agonized scream of protest went up to SOS on 21 October 1942:

> The Corps of Engineers is unwilling to jeopardize its procurement program by allowing other agencies to make decisions which may affect drastically the ability of this office to fulfill its obligations.[31]

And again on 28 October:

> The entire question of the handling of Class B products is extremely unsatisfactory. The list of Class B products has apparently been prepared without an underlying philosophy as to the selection of items to be included.[32]

The Corps was to renew its pleas for modification of the B list some months later after CMP had gone into operation.

Meanwhile, following the guidance of ASF, the Supply Division began in November 1942 to gear its administrative machinery to the new materials distribution system. The focal point of CMP management in OCE was the Central Planning Section, Procurement Branch, which was established in December with a nucleus of 100 persons from the Materials Section, including J. M. Wright who retained his position as chief. Intensive recruitment of personnel followed. By March the section had almost 300 on the payroll and the procurement districts had also built up a specialized staff. Training sessions, conferences, visits by Wright and others to field offices, quantities of printed matter—all contributed to the necessarily vast educational process. But work had to begin before the staff understood the job very well.[33]

On 26 November 1942, less than a month before requirements for the second quarter of 1943 were due in SOS, the Supply Division, OCE, instructed procurement districts to secure bills of materials for Class A products. Nothing like complete coverage was achieved in time to be useful. Furthermore, those bills that did arrive on time were incomplete, inconsistent, and lacking in uniformity. The Central Planning Section perforce fell back upon engineering estimates, and in some cases even upon engineering estimates prepared for similar products. In most cases bills of materials and engineering estimates of A products contained the amounts of materials that went into B components, and the Central Planning Branch was only partially successful in segregating one from the other. Additional arbitrary figures had to be set down because information on lead time was imprecise. Uncertainties about Class IV supplies introduced another major element of inaccuracy, since these first CMP estimates were compiled

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[30] Unless otherwise noted, the remainder of this section is based upon (1) *Industrial Mobilization for War*, pp. 633, 663–66, 670, 674–79, (2) Smith, The Army and Economic Mobilization, Ch. VIII, pp. 140–46, 163–81, 185–97, and (3) Corresp in Management Br Proc Div file, Corresp.

[31] Ltr, C of Sup Div to Dir Prod SOS, 21 Oct 42, sub: Comments on CMP. Management Br Proc Div file, Read file, Capt William E. Dierdorf.

[32] Ltr, C of Sup Div to Dir Prod SOS, 28 Oct 42, sub: Comments on Rev Draft of CMP. Management Br Proc Div file, Jan–Dec 42, Corresp.

[33] CMP and Materials Sec OCE, History of CMP Operations in CE, 1942–1945 (typescript, 17 Sep 45). EHD files.

some months before ASF called upon the theaters for forecasts of Class IV requirements or for keyed projects. When all these possibilities of error were taken into consideration, SOS Control Division concluded that the initial statement of materials requirements submitted by the Corps of Engineers was "only a fair estimate." [34]

The Engineer effort was typical of the first run of an extremely complicated process. When the WPB faced up to the job of reviewing the submissions as a whole, it found them replete with confusing data. WPB was particularly concerned about the large quantity listed by the Army to cover contingencies, noting particularly that 33 percent of the Corps of Engineers' requirements—to cover unknown demands for Class IV supplies—fell into this category. WPB had no choice at this stage but to provide a substantial reserve for emergencies. But allowances for large unspecified quantities could not continue, for the main idea behind the new allocations system was to assure the flow of materials to approved war production programs. And approved war production programs could not be simply interpreted as just anything the Army might decide to put in for.

The second stage in the CMP process, that of dividing up the materials, was hardly an improvement over the first. WPB had overestimated the supply of steel by half a million tons. There was not enough to go around and cuts had to be made. Allotments forced the following reductions in Engineer programs:

Item	*Percent*
Tractors, tractor-mounted equipment, cranes and shovels	10
Miscellaneous construction equipment and construction material processing equipment	15
Mixers, scrapers, and graders	30
Spare parts	20

By late April 1943 there were indications that third quarter cuts would be even more severe. Processing in WPB's Construction Machinery Branch, which was responsible for the major portion of the Corps' B products, was slow. It was late February—two weeks after producers of A products had received allotments for the entire quarter—before construction machinery plants received allotments for the month of April only. Allotments to B producers for May and June rollings were not forthcoming until late March by which time mill schedules were so set up that a number of emergency rulings were required to assure delivery on the allocations. In April the Construction Machinery Branch, with no steel in reserve, was faced with the need to provide some for emergency requirements. The Engineers had to find the steel. The Supply Division attributed these failures in the system to the inability of the Construction Machinery Branch to identify military orders. Too much steel was flowing to nonessential production, the Engineers claimed, and this was bound to be the case as long as construction machinery remained on the B list, out of reach of those who understood what was needed and when.[35] Construction machinery should be transferred to the A list:

> The Chief of Engineers is held responsible for fulfillment of Army Supply Program objectives as regards construction machinery. These objectives are not constant. They shift not only among themselves but in relation to other Army Supply Program items. Since the purpose of the Controlled Materials Plan is to channel materials and production for maximum military effectiveness through a type of

[34] Rpt, Control Div SOS, Feb 43, sub: Survey of CMP. EHD files.

[35] Memo, C of Sup Div for Control Br, 30 Apr 43, sub: ASF Staff Conf. Management Br Proc Div file, Confs and Mtgs.

budgetary balancing process, control over grants of material must be retained by the Chief of Engineers so that his objectives may be achieved by a consideration of total requirements on the one hand and total material available on the other.[36]

Speaking for the other technical services as well as for the Corps of Engineers, ASF had ranged itself against the lengthy B list from the beginning. This viewpoint having found considerable support among WPB officials themselves, by mid-May that part of the B list the Engineers had found so objectionable was on the way out. The first step in this direction was the designation of a group of "Class A Civilian Type End Products," which claimant agencies could elect to handle by vertical allotment. The following month WPB restored the B list to its original concept. Beginning in the fourth quarter only components would be allocated on a horizontal system.

Despite the mountain of work created and despite the problems resulting from the original composition of the B list, the Engineers stoutly maintained their faith in the essential soundness of CMP. The Supply Division noted in June 1943 that while in the past allotments had not served as an absolute guarantee of receipts of controlled materials, there were signs that they would so serve in the future. The Supply Division applauded the discipline that CMP had imposed upon all involved in procurement operations, from contractors, through field offices, to OCE. Improvements in scheduling production were already apparent. More data would be forthcoming on Class IV supplies. The mechanics of the job would be perfected as time went on.[37]

Study of the first two computations made under CMP revealed, for example, that 85 percent of controlled materials were being consumed in the production of some 250 items. Wright and his assistants in the Central Planning Branch therefore decided to concentrate upon attaining greater accuracy in this group. In the summer of 1943 the Analysis Section rechecked the unit weights previously assigned to this equipment, obtaining, as necessary, new bills of materials. The relatively small amount of materials needed for the thousands of minor items procured was arrived at by employing a statistical factor. The Scheduling Section then entered on a requirements transmittal sheet the schedule of monthly deliveries, bracketed these by three-month periods, and made appropriate adjustments for lead time. Unit weights multiplied by unit deliveries equaled total materials requirements.

When total quarterly allotments of controlled materials were received from ASF they were posted in a general materials ledger and subdivided into programs. The first step in withdrawals from this account was taken by the prime contractor who submitted a statement of his estimated quarterly requirements to the CMP group in the appropriate procurement district. There his request was scrutinized in terms of his production schedule and bill of materials. If his estimate appeared reasonable, it was forwarded to the Central Planning Branch where it was subjected to further scrutiny. Did the proposed production schedule agree with the ASP and with the schedule established by the Scheduling Section? What was the relative urgency of the item? The amount of the allotment was thereafter determined, the field notified, and the con-

[36] Ltr, ACofEngrs (Fowler) to ACofS for Mat ASF, 28 Apr 43, sub: CMP Treat for Constr Mach. Management Br Proc Div file, Corresp.

[37] Proc Activities. EHD file, Basic Mats Submitted for Ann Rpt OCE, 1943.

tractor's grant prepared. The Engineers did not invariably receive the quantities of steel applied for under CMP, but, once granted, an allotment could be counted upon and could be distributed and controlled to accord with the best interests of the Engineer program. The order and stability of operations under CMP had, by the fall of 1943, combined with an actual increase in the supply of steel to end the most serious and most persistent cause of production delays.[38]

The Shortage of Components

Until the summer of 1943 the shortage of steel had partly concealed the existence of a shortage of components. So long as there was not enough steel for tanks and trucks and ships there seemed to be plenty of engines. With steel suddenly become relatively plentiful, engines and other components emerged as the nation's number one bottleneck in war production. Never so serious as the steel shortage, the scarcity of components continued until well into 1944. The WPB, anticipating difficulties in this area in view of the greatly increased production programs of 1943, began a timely attack on the problem early that year.

Regulating the production and distribution of components, as the WPB set out to do, called forth a set of techniques different from that needed in regulating the production and distribution of raw materials. A steady and adequate flow of materials to manufacturers of components was essential, of course. The WPB assumed sole responsibility for assuring this under the horizontal system of allocations provided for B products. But components were not solely consumers of raw materials. To a large extent components consumed other components. Once fabricated they were in turn consumed in countless end items—tanks, planes, tractors, trucks. Ball bearings, crankshafts, carburetors, and magnetos were all needed by the engine manufacturer. In the case of components therefore the WPB had to concern itself not only with the flow of materials but also with the flow of the components themselves, to see that components, as well as materials, were available at the time and place dictated by the needs of various war production programs.

In a move designed to provide an accurate estimate of the quantities of raw materials required and to ascertain whether or not there was sufficient plant for the manufacture of components, the WPB, on 20 January 1943, directed that orders be placed by 6 February for thirty-two so-called critical common components if delivery were desired prior to 1 July. Orders for the last six months of the year were to be on manufacturers' books by 1 March. It took five days for the WPB directive to arrive in the Supply Division, OCE, which was just then in the process of computing requirements for the February ASP. Fowler and other spokesmen for the Engineers were at immediate pains to point out the changes that would be forthcoming upon approval of the ASP and to express concern over future Class IV requisitions. Instructed to do the best they could, they flashed word to the field on 25 January. All requisitions now on hand in district offices must be covered by contracts immediately. All contractors and their subcontractors must be impressed with the necessity for compliance. Procurement districts must stand ready to place additional orders within the next few days after the Supply Division completed the Engineer portion of the ASP. Notices would be in-

[38] Hist cited n. 33.

formal; standard requisitions would follow as time permitted.

On 26 February, WPB took a second and more important step to assure adequate production and distribution of components. Under General Scheduling Order M–293 which became effective on 1 May, some three dozen components were singled out for special treatment. Manufacturers of the larger and relatively less critical group, which included such items as gasoline and diesel engines, crankshafts, and magnetos, were to file with the WPB their production schedules. Acting upon the advice of the procurement agencies, the WPB would adjust the schedules to conform to those of prime contractors in accordance with the relative importance of the various end products. Once approved, schedules were to remain frozen unless changed by WPB. As applied to the seven most critical components, comprising such items as compressors and dry vacuum pumps, heat exchangers, and turbo-blowers, General Scheduling Order M–293 stipulated that manufacturers of end items seek approval of WPB before placement of orders. Numerous other items were brought under general control by the requirement for filing informational reports. In all three groups WPB reserved the right to cancel, reschedule, or take other action deemed necessary.[39]

Although the Engineers had an interest in nearly all the critical common components which were embraced by General Scheduling Order M–293, it was engines and the components of engines that concerned them most. Their needs centered on the heavy duty, slow speed, so-called industrial engines, as compared with the lighter, high speed automotive type for which the nation had more peacetime productive capacity. Suppliers of gasoline powered industrial engines were the Buda Company, the Waukesha Motor Company, and the Hercules Motors Corporation. Engineer orders absorbed about 20 percent of the production of these three firms. The Navy and the Ordnance Department took most of the remainder. The Engineers looked to the Detroit Diesel Division of General Motors, where Ordnance and Navy were even more deeply intrenched, to supply engines for tractors and generator sets. The facilities of Detroit Diesel had been expanded twice since Pearl Harbor and in early 1943 were being further enlarged to create a production capacity of 8,000 units per month. Production in February was but 3,753—approximately 1,000 units below forecast. In view of the vital programs which were dependent upon the output of this plant—tanks, landing craft, tractors—the Requirements Division, SOS, had sponsored an informal committee which made recommendations on the allocation of engines to MAC(G). Mid-February brought official recognition in the establishment of the Diesel Engine Sub-Committee of MAC(G), on which the Corps of Engineers was represented by Hassinger. The Diesel Engine Sub-Committee attacked its work in a spirit of intelligence and fairness which won friends both inside and outside the service.

[39] (1) *Industrial Mobilization for War*, pp. 682–88. (2) Notes of Conf, 25 Jan 43. Exec Office Proc Div file, Salvage and Surplus Mats. (3) Ltr, C of Sup Div to Div and Dist Engrs Having Proc Responsibility, 26 Jan 43, sub: Prompt Placement of Orders Required for Critical Common Components. Exec Office Proc Div file, Proc Policies and Procedures. (4) General Scheduling Order M–293.

Unless otherwise noted the remainder of this section is based upon correspondence in 004.03, Pt. 1, and Exec Office Proc Div file, Engr Equip, Misc Engines.

Company representatives frequently attended its meetings. The WPB, impressed with the smoothness of its operations and noting the fact that no civilian production was involved, allowed the Diesel Engine Sub-Committee to direct the scheduling as well as the allocation of the product. The activities of the Diesel Engine Sub-Committee and the controls imposed by General Scheduling Order M–293 undoubtedly prevented a headache from developing into a crisis. Nevertheless, by summer the Engineers were attributing all their production troubles to the shortage of components.[40]

It must be emphasized that the production difficulties experienced in the summer of 1943 were not nearly so great as those encountered the previous year. The total volume of deliveries remained high. Yet the slippage in the Engineer procurement program was sufficiently large to cause concern at all levels. After a rather unimpressive start in January 1943 when deliveries had totaled but $83,385,000 and February when they reached but $85,071,000, the Engineer program had seemed to be reaching its stride. Deliveries in March passed the $100,000,000 mark and in April reached $115,000,000. The following month there was a drop, and although a rise occurred again in June, July, and August, when deliveries reached $119,000,000, the increase was not sharp enough to warrant the hope that the full year's requirements under the ASP—by this time valued at $1,749,300,000—could be attained. In August the forecast for the year was 92 percent of requirements.[41]

Just what conclusions to draw, just how badly off the Engineer procurement program was, depended to a certain extent on who was looking at the figures and for whom they were being interpreted. On 1 July Fowler admonished the field offices that the trend must be reversed immediately:

> The situation is serious—action of the most vigorous sort is called for both in initiating a program and following up to assure that it is carried out. All means such as subcontracting, developing additional facilities, partial cancellation and replacing orders with manufacturers who can produce, as well as the usual means of expediting, securing materials, demanding full use of facilities, securing required manpower, etc. should be called upon.[42]

Early in August the field received another pep letter. Yet engineer matériel was piling up in the depots. At the end of June approximately 80 percent of the items in the common stockpile had reached maximum reserve levels. The paradox of scarcity in the midst of plenty was explicable in terms of distribution. Some products had been delivered considerably ahead of schedule and were, in the parlance of the supply experts "overprocured." By July seven out of eleven major groups of equipment were ahead of schedule. Searchlights, barrage balloons, landing mat, precision instruments, boats and bridging, motorized shops, water supply equipment, nearly all of which had caused some difficulties the year before, fell into this "overprocured" category. More productive capacity, more experience in the fabrication of special military items, more steel and aluminum—these were the factors

[40] (1) Memo, CofEngrs for CG ASF, 16 Jun 43, sub: Engine Sup for Engr Prod. 400.12, Pt. 114. (2) Memo, C of Liaison—Mach Tool—Facility Expansion Sub-Sec for C of Tractor and Crane Sec, 19 Mar 43, sub: Rpt on Detroit Diesel Engine Mtg, Mar 19, 43. Management Br Proc Div file, Engines, Diesel Detroit 1945, Mach and Equip (C). (3) Intnl Div ASF, Lend-Lease, pp. 476–83.

[41] ASF Stat Review, p. 78.

[42] Ltr, ACofEngrs to Div Engrs, 1 Jul 43, sub: Deficiencies in Mtg 1943 ASP for Engr Equip. 004.03, Pt. 1.

largely responsible for the upsurge of deliveries. The easing of the aluminum shortage put the mapping equipment program on its feet. Early in the year the Eugene Dietzgen Company, principal source of precision instruments, completed a Navy contract. Thereafter the Engineers had available to them all of the transits manufactured by this firm. Deliveries of searchlights began to soar in February when General Electric's plants got into full operation. Low altitude barrage balloons had been easy to procure even in 1942.[43]

Delivery of so many costly items in such large quantities tended to inflate the over-all dollar value of Engineer deliveries. When cutbacks in these categories of supplies began, the over-all program appeared to have slipped more than was actually the case. In June, with the possibility of aerial attack all but removed, production of searchlights was slowed down to 100 units a month. A second mirror plant at Mariemont, Ohio, on which construction had begun the previous summer, closed in August 1943 without ever having been put into full operation. For the same reason production of low altitude barrage balloons ceased after delivery of 3,212 against an original requirement of 4,130 although production of very low altitude barrage balloons to aid the defense of ships at sea and of amphibious forces continued throughout the year. Although the two types of balloon were similar, the lighter winch required for the very low altitude balloon kept its deliveries behind schedule. One manufacturer of winches lost engineers to the draft, another had difficulty locating a suitable power plant, and another produced a number of unsatisfactory units. Although delivery of the new type of balloon did not lag seriously enough to affect the over-all record appreciably, it did not serve to boost it either. Even landing mat, for which demand remained high, came in for drastic cuts. The February ASP called for delivery of 230,000,000 square feet of pierced plank mat and for a total of 142,000,000 square feet of Sommerfeld track, Irving grid, and other less popular types. The first four months of 1943 saw delivery of 83,074,000 square feet of pierced plank mat and of 59,259,000 square feet of all other types combined. Thereafter production was planned at a considerably lower level. In May and June the Supply Division diverted almost 8,000 tons of steel from the landing mat program to construction machinery manufacturers. In the fall, 100,000 tons were withdrawn to absorb some of the over-all cuts made in the Army's steel allotment. In August requirements for pierced plank for the year 1943 stood at 206,000,000 square feet; other types at 117,000,000. Purchase of sandbags ceased altogether in August. The Procurement Branch made much of these cuts in explanation of the apparent failure to maintain the degree of acceleration attained in the early months of 1943. The program as it stood, the branch pointed out, was overloaded with problem items—portable generator sets, petroleum pumping stations, motorized shops, refrigerated warehouses, and, most important, construction machinery, all of which

[43] (1) Memo, Opns Sec Rqmts Br for C of Rqmts Br, 1 Jun 43, sub: Stockpile Procedure. 400.291, Pt. 2. (2) Memo, C of Sup Div for Chorpening *et al.*, 23 Mar 43, sub: Balancing of Proc and Control of Stocks. Intnl Div file, 310.1, Intnl Div. (3) MPR, Sec. 6, 31 Jan 43, 28 Feb 43, 30 Jun 43. (4) Memo, C of Liaison—Mach Tool—Factory Expansion Sub-Sec for C of Proc Control Sec, 23 Jan 43, sub: Transit Prod at Dietzgen. Exec Office Proc Div file, Prod. (5) Memo, K. M. Skuggs for Maj Thomas B. Gilchrist, Jr., 9 Jan 43, sub: Status of Mach Tools for Gen Electric Co Searchlight Program. Management Br Proc Div file, Gen Electric.

contained engines and other components that were in short supply.[44]

When the shortage of engines began to assume serious proportions, the Procurement Branch reached into the standard bag of tricks to increase its supply of engines to contractors. With an eye to securing exact information for pleading the Engineer cause under General Scheduling Order M–293 and in the Diesel Engine Sub-Committee, the Procurement Branch in March directed the field to submit a monthly report showing the requirements, delivery schedules, and inventory of each prime contractor. The results were disappointing. Reports omitted many purchase orders which according to OCE records were still active. Failure to give order numbers made it impossible to identify a large percentage of Engineer orders on engine builders' schedules. Engine model numbers were confused with those of end items. Totals were inconsistent. In a further effort to get on top of the engine shortage, resident expediters were assigned to the Buda, Waukesha, and Hercules plants. Since engine builders needed eight to ten months' lead time in order to assure themselves of a steady flow of bearings, carburetors, and other subcomponents, Fowler asked Clay's authorization to contract for end items containing engines as listed in the 1944 ASP. With a word of caution against overprocurement in view of expected downward revisions during the last six months of 1944, ASF approved Fowler's proposal in June.[45]

The Procurement Branch was convinced, however, that the best prospect for a relief of the shortage of components lay in an expansion of facilities for the production of industrial engines. Buda and Waukesha were but "overgrown job shops," Reybold informed Somervell in June. Serious consideration should also be given to the possibility of expanding the foundry industry and to allocating facilities in that industry. The foundries should be allowed to raise wages so that workers would be better compensated for the unavoidably unpleasant working conditions and so induced to remain on the job. Skilled foundry workers should be more effectively protected from the draft, and in fact the entire labor force should be built up so as to keep the industry operating on three shifts.[46]

Having made strenuous representations

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[44] (1) Ltr, AC of Proc Br to Dir of Rqmts ASF, 25 May 43, sub: Proc of Searchlights. 470.3 (C). (2) OCE, Record of Factory Expansions Jun 40–Mar 43, WD Financed or Sponsored Through DPC, [c. Aug 43]. Exec Office Proc Div file, Plant Expansion Rpt. (3) Memo for File, 17 Aug 43, sub: Transfer Mirror Plant 2, Mariemont, Ohio. Same file. (4) MPR, Sec. 1–A, 31 Jan 43, 28 Feb 43, 30 Aug 43, 31 Dec 43. (5) ASP, Sec. 1, 1 Feb 43, 1 Aug 43. (6) Engr Bd Hist Study, Balloons, pp. 3, 24. (7) Engr Bd Hist Study, Winches, pp. 21–26. (8) Ltr, AC of Central Plan Sec Proc Br to Priorities and Alloc Review ASF, 9 Feb 43, sub: Distr of Landing Mat Carbon Steel Tonnage for 1st Quarter 1943. 411.5, Pt. 2. (9) Memo, Maj Charles A. Allen, ASF, for C of Steel Sec ASF, 15 May 43, sub: Semimonthly Rpt. 319.1, Semimonthly Rpts. (10) Ltr, AC of Proc Br to CG ASF, 20 May 43, sub: Mats Available for Advance Allot. Management Br Proc Div file, Corresp. (11) Memo, C of Opns Br Proc Sv for C of Proc Sv, 10 Aug 43, sub: Analysis of Recent Prod. Exec Office Proc Div file, Misc Corresp. (12) Memo, C of Proc Control Sec, 16 Aug 43, sub: Special Memo for Use of CofEngrs at ASF Staff Conf of 17 Aug 43. Same file.

[45] (1) Ltr, C of Proc Br to All Div Engrs Having Proc of Mil Sup Functions, 22 Mar 43, sub: Monthly Rpt on Gas and Diesel Engines. 412.5, Pt. 1. (2) Ltr, ExO Proc Br to Various Div Engrs, 24 Jun 43, sub: Monthly Rpt on Gas and Diesel Engines. Management Br Proc Div file, Central Plan Br Directives. (3) Ltr, Fowler to Clay, 8 Jun 43, sub: Immediate Proc of 1944 ASP Engr Items Which Require Internal Combustion Engines, with 1st Ind, 16 Jun 43. Constr Mach Br Proc Div file, ASP Cranes 1944.

[46] Memo, CofEngrs for CG ASF, 16 Jun 43, sub: Engine Sup for Engr Prod. 400.12, Pt. 114.

to the field to improve the quality of its reports, having drawn on the talents of expediters, having got permission to insure the future, and having recommended the enlargement of facilities, the Procurement Branch declared that all possible angles had been exhausted. The branch cast a doubtful eye upon the possibility of substituting one engine for another, a step that was being urged upon the Corps by the ASF in view of idle capacity at the Chrysler factory. As Reybold interpreted the Procurement Branch's position to Somervell in June:

> It is true that there is considerable additional engine capacity, but this consists almost entirely of high speed automotive and tank engines. Few of these would be suitable for Engineer equipment. Investigation also discloses that in most cases it would take until next October or November to get a substitute engine into production due to the lead time required for the component parts. Every effort is being made to meet our deficiencies by this method and several substitutions have already been made, but it is not believed that this method will solve the entire problem.[47]

Unconvinced by these arguments, the Production Division, ASF, took the initiative in discussions with Chrysler. In July representatives of the Chicago and Detroit Engineer Districts accompanied Col. James P. Crowden of ASF to the company's plant where the ins and outs of engineering and production were gone into in detail. Crowden returned to Washington with no real question in his mind but that substitutions were feasible. Chrysler promised delivery of substantial quantities of engines within thirty days, even more within the next two to three months, since the plant had a large inventory of subcomponents on hand. Fowler was persuaded that the automotive engines would prove satisfactory for shovels and cranes at least.[48] By mid-August the Procurement Branch had ordered over 7,000 Chrysler engines and Reybold was referring to the substitution as "the most far-reaching step thus far taken toward the solution of the component difficulty." [49]

Although long-term results were to confirm the truth of this statement, the changeover gave rise to unexpected complications and delays. Crane and shovel manufacturers, with reputations to protect, hesitated and had to be talked to firmly by procurement officials before they could be moved to forsake the old and tried. Further discussion and compromise was in order when the crane and shovel people submitted twenty-six variations on Chrysler's standard product, and crane and shovel models had to be altered to conform to the four or five types that Chrysler would agree to furnish. Chrysler itself found out that it took longer to prepare drawings, patterns, and so on, than its salesmen had estimated. Once committed to the substitution the Procurement Branch pushed it with the vigor born of confidence that here was a real opportunity to break the engine bottleneck, at the same time continuing to urge wage and price adjustments in the casting and forging industry and to suggest that its products be allocated. The Corps felt constrained to

[47] *Ibid.* See also Memo, ExO Mil Sup for Actg CofEngrs, 22 Dec 43, sub: Use of Chrysler T–126 Engine in 30 KW Generator Sets. Exec Office Proc Div file, Engr Equip Misc Engines.

[48] (1) Memo, ExO Mil Sup for Actg CofEngrs, 22 Dec 43, sub: Use of Chrysler T–26 Engine in 30 KW Generator Sets. Exec Office Proc Div file, Engr Equip Misc Engines. (2) Memo, ExO Proc Sv for Col Forney, 15 Jul 43, sub: Substitution of Chrysler Engine in Engr Equip. Same file. (3) Memo, Deputy C of Mats and Prod Br Prod Div ASF for Dir Prod Div ASF, 17 Jul 43, sub: Substitution of Automotive Type Engine for Industrial Type Engine. Same file.

[49] Memo, CofEngrs for CG ASF, 16 Aug 43, sub: Jul Prod. 004.03, Pt. 1.

point out also that the full impact of the use of Chrysler engines would not be felt until 1944.[50]

The Administrative Reorganization of November 1943

In memorandum after memorandum the Corps of Engineers hammered away at the scarcity of components in explanation of slippage in its procurement program. This correspondence contained no suggestion of administrative failures or of complaints about the field organization. To judge by its silence ASF was similarly content with the administrative set-up. The purchase of tractors, searchlights, barrage balloons, and other key items on a commodity rather than a territorial basis, had insured the flow of contracts mainly to the Chicago and New York Districts, the very offices where ASF's Purchases Division had previously suggested that the work be centralized. The value of allotments made to division offices during fiscal year 1943 showed this picture: [51]

Total	$1,312,641,044
Great Lakes	595,008,902
North Atlantic	347,769,265
Ohio River	199,977,032
Southwestern	48,678,412
South Atlantic	39,961,510
Upper Mississippi Valley	36,771,834
Middle Atlantic	29,873,743
Pacific	14,600,346

In view of the seeming satisfaction with the performance of field offices, the second reorganization of 1943, like the first, came as an unwelcome surprise to employees of the Procurement Branch, OCE. Unfriendly critics of the change were convinced that the needs of the procurement program had again been unnecessarily subordinated to what higher echelons believed was the general good of the Corps. In the summer of 1943 the Engineers had more reason to feel threatened than previously. This was the summer when plans were afoot in ASF headquarters to abolish the technical services. On 24 August, one month before these plans appeared in the newspapers, but certainly not before some rumors had circulated, OCE announced its intention to bring the entire Engineer Department into procurement operations. If the determination to maintain the integrity of the Corps be accepted as the motivating force in both reorganizations, the basis of reasoning had certainly changed by the summer of 1943. In January OCE had presumably sought to protect the civil works organization from disintegration by assigning it procurement business. In August the Corps sought presumably to use the river and harbor organization, which had many friends in Congress, as a bulwark against the anticipated raid on its procurement activities and subsequently upon the Corps itself.[52]

The announced purpose of the reorganization was to obtain direct channels of responsibility and straight-line control to improve deliveries, and to increase production. Boundaries would conform to those of the Engineer Department, thus assuring uniformity of command in supply, military construction, and civil works. The additional advantages of proximity to contractors and access to experienced personnel were urged upon ASF as products of the change. But Maj. Frank W. Xiques of ASF's Purchases Division registered strong disapproval of the reorganization. It was time, he thought, for the Corps to show substantial reductions in

[50] *Ibid.*

[51] Ann Rpt OCE, 1943.

[52] (1) See above, pp. 508–10. (2) Orgn for Engr Proc. (3) Memo, C of Proc Div for ACofEngrs Mil Sup, 26 Mar 48, sub: Orgn of CE for Proc of Mil Sup. Exec Office Proc Div file, Orgn—CE.

its field staff. Xiques predicted that with fifty-five offices engaged in procurement, responsibility was going to be spread very thin. Clay expressed some reservations about the plan to split contracting functions between division and district offices.[53] On the whole, however, the Engineers found Clay, an Engineer officer, receptive to the main argument they produced, namely that the new administrative arrangement "takes full advantage of the entire organizational strength of the U. S. Engineer Department . . . for supply matters as well as construction work." [54]

Under the reorganization which took place between 1 September and 1 November 1943, Division Engineers for the first time assumed an active role in procurement operations. Hitherto they had merely supervised the districts. Now they were to secure the contractor and issue a letter purchase order to him. Negotiation of the final contract, expediting, and inspections would be done by the district in which the contractor was located. For small purchases and for items having single sources of supply, the Division Engineer could, if he chose, allow the district to handle the entire sequence. Again, provision was made for commodity purchasing:

Great Lakes Division	Cranes, shovels, crawler tractors
North Atlantic Division	Camouflage equipment, firing devices, searchlights, water purification equipment
Ohio River Division	Boilers, Bailey bridges, prefabricated steel buildings, gas cylinders, landing mat, machine tools
Southwestern Division	Asphalt for shipment to east coast and Gulf ports, petroleum testing laboratories, bolted steel tanks
South Atlantic Division	Wood barracks, assault and storm boats, lumber and plywood for shipment east of the Rocky Mountains
Upper Mississippi Valley Division	Steel bridges
Middle Atlantic Division	Calcium carbide, laboratory field and soil testing equipment, all items from Canada
Pacific Division	Asphalt, lumber and plywood for shipment west of the Rocky Mountains, ponton lumber by the Seattle District

Unlike previous commodity assignments, those made in the fall of 1943 did not retain all procurement operations in one office. Instead, the work was divided between divisions and districts.[55]

Deliveries: 1943

In the month of October (before the reorganization had been completed) deliveries of Engineer equipment turned sharply upward, reaching $136,865,000 worth or more than $17,000,000 over those of Au-

[53] (1) C/L 2516, 24 Aug 43. (2) Memo, Xiques for Col Phillips W. Smith, 28 Oct 43, sub: Modification of Proc Procedure for Engr Equip and Sup CE. Exec Office Proc Div file, Proc Policies and Procedures.

[54] Memo, Actg C of Sup Div for Dir Mat ASF, 10 Nov 43, sub: Approval of Modification of Proc Procedure for Engr Equip and Sup. 400.12, Pt. 114.

[55] C/L 2578, 13 Oct 43.

gust, the previous peak month. November saw the value of Engineer deliveries climb to $139,384,000; December, to $143,106,000. When the final score was totaled up, the Corps of Engineers had met 96.4 percent of the ASP. But by December the ASP was some $200,000,000 lower than at the end of the summer when the forecast had stood at 92 percent.[56]

Much the greater part of this large reduction in the ASP resulted from drastic cuts in replacement factors which ASF ordered late in August. Reports from the fact-finding teams had not yet come in. As a matter of fact, these reports were never put to use, the stated reason being that they were unreliable. The Engineers never appointed an adequate full-time staff to investigate the subject thoroughly. For a time two civilians sandwiched the study of replacement factors in between other duties; when one of them entered the service in March 1944, the other carried on by himself, still on a part-time basis. The Engineers pointed to low personnel ceilings as the cause of this neglect. But while restrictive policies on hiring doubtless played their part, there is no evidence that the Supply Division pushed for authorization to assemble an adequate staff. Rather the Supply Division seemed content, throughout the war, to let matters drift in much the same way as objected to by Lieutenant Davis in 1942, and for much the same reason, in the belief, according to an officer in the Requirements Branch, that replacement factors provided a "comfortable margin" in the face of shortages.[57]

Although unreasonably high replacement factors had inflated requirements in many cases, in others, notably tractors and shovels, requirements had been realistic enough in terms of need but fantastic in terms of productive capacity. Yet so long as the steel shortage persisted, the Supply Division considered it impractical to seek additional plant. At the beginning of 1943, moreover, those officials who would have passed upon a request for expansion of manufacturing facilities had focused their attention on the store of surplus machinery in the hands of the Construction Division. Clay and Michael J. Madigan of Secretary Patterson's office had been referring to this source for months. On 13 February 1943 they instructed representatives of the Supply and Construction Divisions to show results. The Construction Division had in its possession at this time approximately 85,000 pieces of equipment, including over 30,000 trucks. Some of this equipment would have to be retained by the Construction Division, Clay agreed, but most of it, and certainly the machines in better condition, was to be released to the Supply Division. The original understanding was that the use of second-hand machinery would be confined to training centers and to construction in noncombat areas, but provision was soon made to send some used equipment to theaters of operations.[58] As criteria for selection were

[56] (1) Crawford and Cook, Statistics, p. 15. (2) MPR, Sec. 6, 31 Dec 43.

[57] (1) Memo, C of Rqmts Br for C of Sup Div, 27 Aug 43, sub: Rev Maint Factors. Exec Office Proc Div file, Engr Equip—Spare Parts No. 1. (2) Memo, CofEngrs for CG ASF, 16 Oct 43, sub: September Prod. Exec Office Proc Div file, ASF. (3) Memo, AC of Rqmts Br for ACofEngrs Mil Sup, 11 Oct 44, sub: Repl Factors. EHD files. (4) Memo, ACofEngrs Mil Sup for CG ASF, 11 Oct 44, sub: Determination of Repl Factors. 400, Pt. 2.

[58] (1) See above, p. 182. (2) Memo for File, 13 Feb 43, sub: Mtg in Gen Clay's Office This Date. Exec Office Proc Div file, Salvage and Surplus Mats. (3) Memo, C of Tractor and Crane Sec for File, 28 Sep 43, sub: Notes on Mtg with Col. Needles, re Rebuilt Constr Mach. Constr Mach Br file, Program Determination 447.

spelled out for Division Engineers on 26 February, equipment destined for overseas should "preferably" be "new, substantially new, or in excellent condition after reconditioning. That slated for shipment to off-continent construction projects should be in "very good or good condition" after reconditioning with only a moderate quantity of spare parts. Troops in training should receive standard makes and models that were in "working condition." [59] The Supply Division prepared a list of machines desired (tractors and shovels were the most desperately needed) and worked up quantities of each type to be rebuilt, reconditioned, or simply certified as suitable for troops in training. The first batch of secondhand machines received at the training centers was universally poor. Tractors arrived without power control units and with attachments that did not fit. Much of the equipment would not run at all without extensive repairs.[60] Early in June when it became evident that deliveries of new construction machinery would be less than scheduled, the Supply Division abandoned all attempts to transfer standard makes and models to the centers. Troops in training in fact had to release standard machinery in their possession for shipment overseas. Division Engineers were urged to make a special effort to round up nonstandard machines to replace those leaving the centers. The field should see that the machines were in "working condition or better." [61] Admonitions to Division Engineers to furnish better machines were of no avail. Early in August the Construction Division found it necessary to do away with the term "working condition" altogether. Henceforth each machine would go into the shop for cleaning and repair before shipment to troops in training. As of 15 November when more than 11,000 power machines and trucks had been turned over to the Supply Division, over half of this equipment was still in depots awaiting the receipt of spare parts and attachments. Two thousand machines had been issued to training centers and another 2,500 sent overseas. Although acquisition of this relatively small number of miscellaneous makes and models spelled the difference between something and nothing for many a troop unit in training and overseas, neither in quantity nor in quality was the surplus machinery adequate to meet the present, much less the long term need. The vast treasure that Clay and Madigan pictured simply did not exist. By June 1943 Fowler had concluded that additional manufacturing facilities must be provided.[62]

The light construction machinery that had been chosen with a fast-moving tactical situation in view had not filled the bill overseas where engineer units had been engaged

[59] Ltr, ACofEngrs (Robins) to Div Engrs, 26 Feb 43, sub: Disposal of Excess Constr Equip. 410, Pt. 2.

[60] (1) Ltr, ACof Mats and Equip Br Constr Div to Missouri River Div Engr, 22 Apr 43, sub: Selection and Shipment of Constr Equip for Trp Use. 475 Engr Equip, Pt. 2. (2) Teletype, Mats and Equip Br Constr Div to All Divs, 25 May 43. 413.8, Pt. 16.

[61] Memo, Rqmts Br for C of Mats and Equip Sec Constr Div, 4 Jun 43, sub: Used Constr Equip. Rqmts Br file, 400.17.

[62] (1) Teletype, Mats and Equip Br Constr Div to All Divs, 7 Aug 43. 413.8, Pt. 17. (2) Draft Memo for Dir Prod Div ASF, 26 Nov 43, sub: Reply to Memo on "Sale of Surplus Mats." Redistr and Disposal Br file, Misc Regulations. (3) Memo, Withers for Rosenberg, 25 Jun 43, sub: Expansion of Facilities for Making D–7 Tractors. Constr Mach Br Proc Div file, Caterpillar Tractor Expansion Program.

for the most part on extensive construction jobs. The universal call was for more and heavier machines. The European theater preferred D–8 tractors for Class IV issue. In the future general service regiments were equipped with D–6's instead of D–4's. The number of D–7's assigned to aviation battalions was increased from eight to eleven.[63]

In the opening months of war the choice had been unhesitatingly tanks over shovels, and shovels had inevitably got hurt, as Knudsen had predicted. Eighteen months of tank production and drastic lowering of requirements for tanks had radically altered the relative positions of the items concerned. About the same time that Chrysler's facilities opened up for engine production, the Engineers were offered the use of three plants which had been turning out tanks, and plans were laid to convert two of them to tractor and one to shovel production, the first machines to come off the assembly line early in 1944. Since it was obvious that during 1943 requirements for tractors and shovels had been considerably at variance with production possibilities, ASF allowed the Engineers to lower the ASP.[64]

After this adjustment had been made, only the light tractor appeared grossly behind schedule. Since demand for this type had been falling steadily, facilities and materials had been frequently diverted from its manufacture to that of heavier machines. Next to tractors, shovels lagged most seriously behind stated requirements at year's end. Other types of construction machinery were thrown substantially on schedule by the lowering of replacement factors. (*Table 11*) Deliveries of bridges (except for the treadway) and boats, mapping equipment, and landing mat were generally in line with stated requirements. (*Table 12*) Redesign and test of the steel treadway bridge following the accidents in the fall of 1942 had taken many months. Fabrication of the new treadway bridge did not begin until summer. Lost time would be recovered early in 1944.[65]

The year 1943 was marked by steady progress toward systemization in procurement of supplies. Requirements were stated with more authority and were related more realistically to the quantity of steel and components available. While somewhat short of stated goals, the delivery of $1,388,000,000 worth of Engineer supplies in 1943 was more than double the value of deliveries in 1942. The value of transfers to international aid was almost 33 percent more than the year before, amounting to $57,325,000.[66]

[63] (1) Memo, Fowler for Hassinger, 30 Apr 43, sub: Tractors. Constr Mach Br file, Trp Rqmts 43. (2) T/O 5–415, 1 Apr 42. (3) T/O&E, 5–415, 15 May 44. (4) T/O 5–21, 1 Apr 42. (5) T/E 5–22, 26 Oct 43. (6) Ltr, Dir of Base Sv Hq AAF to CofSup Div OCE, [c. Jan. 43], sub: Increased Alloc of D–7 Caterpillar Tractors for Avn Engr Bns, with 1st–4th Inds. 451.3, Engr Avn Units, 1943.

[64] (1) Ltr C of Proc Br to Great Lakes Div Engr, 28 Jun 43, sub: Additional Crane and Shovel Purch From Lima Locomotive Works, Inc. Constr Mach Br Proc Div file, Lima Locomotive Works. (2) Ltr, C of Tractor and Crane Br to C of Sup Div, 24 Jul 43, sub: First Progress Rpt Caterpillar—American Car and Foundry D–7 Expansion. Exec Office Proc Div file, Misc Corresp.

[65] (1) Memo, CofEngrs for CG ASF, 16 Oct 43, sub: September Prod. Exec Office Proc Div file, ASF. (2) Memo, Fowler for Reybold, 18 Dec 43, sub: Computation of Rqmts and Ann Delivery for Year 1943, CE. Exec Office Proc Div file, Adm Memos. (3) See above, pp. 486–89. (4) 1st Ind, 12 Jul 43, on Memo, ExO Sup Div for C of Fld Sv, 5 Jul 43, sub: Treadway Bridge Rqmts. Rqmts Br Read file.

[66] (1) Crawford and Cook, *op. cit.*, p. 15. (2) Whiting, *Lend-Lease*, p. 11.

TABLE 11—CONSTRUCTION MACHINERY: ANNUAL REQUIREMENTS AS OF FEBRUARY, AUGUST AND DECEMBER 1943 AND ACTUAL DELIVERIES IN 1943

Item	Requirements			Deliveries 1943	Over or Short December Requirements
	February	August	December		
Auger, earth, skid mounted, gasoline engine driven	280	280	250	268	+18
Compressors, air:					
Trailer mounted, pneumatic tires, diesel engine driven, 315 cubic feet per minute	609	609	465	497	+32
Truck mounted, gasoline engine driven, 105 cubic feet per minute	2,270	2,270	2,270	2,234	−36
Crane, tractor operated, non-revolving, 20-ton, 20-foot boom	293	293	263	267	+4
Cranes and shovels, crawler mounted:					
½-cubic yard, 5- to 6-ton, Class II	1,489	1,490	1,179	1,322	+143
¾-cubic yard, 7- to 10-ton, Class III	322	945	722	837	+105
1- to 1½-cubic yard, 20- to 30-ton, Class IV	27	411	350	325	−25
1¾- to 2-cubic yard, 30- to 40-ton, Class V	72	195	215	240	+25
2½-cubic yard, 45- to 60-ton, Class VI	15	85	40	55	+15
3- to 4-cubic yard, 65- to 75-ton, Class VII	8	54	41	17	−24
Cranes and shovels, rubber tired:					
⅜-cubic yard, 4- to 8-ton, Class X	531	641	652	535	−117
¾-cubic yard, 8- to 12-ton, Class XI	200	790	245	218	−27
¾-cubic yard, 14- to 18-ton, Class XII	(a)	310	592	310	−282
¾-cubic yard, 20-ton, Class XIII	(a)	134	92	95	+3
Single engine driven, self-propelled, 8- to 15-ton, Class XIV	(a)	467	290	220	−70
Crushing and screening plant, 2-units, gasoline engine driven, semitrailer mounted, 25 cubic yards per hour	390	193	185	186	+1
Distributor, bituminous material, trailer mounted, 1,250-gallon	254	254	254	254	0
Ditching machine, ladder type, crawler mounted, gasoline engine driven, digging depth 8 feet, width 18 to 24 inches	315	315	315	321	+6
Graders, road:					
Motorized, diesel engine driven, 12-foot moldboard	2,115	2,275	2,275	2,598	+323
Towed type, leaning wheel, hand controlled, 12-foot moldboard	723	723	723	773	+50
Mixers:					
Concrete, gasoline engine driven, trailer mounted 14-cubic foot	361	802	802	787	−15
Pugmill, with dryer and soil stabilization unit, semitrailer mounted	135	135	135	135	0
Rollers, road:					
Gasoline engine driven, 3-wheel, 10-ton	908	908	838	952	+114
Gasoline engine driven, tandem, 2-axle, 5- to 8-ton	315	345	345	354	+9
Towed type, sheepsfoot, 2-drum-in-line	532	532	532	534	+2

TABLE 11—CONSTRUCTION MACHINERY: ANNUAL REQUIREMENTS AS OF FEBRUARY, AUGUST, AND DECEMBER 1943 AND ACTUAL DELIVERIES IN 1943—Continued

Item	Requirements			Deliveries 1943	Over or Short December Requirements
	February	August	December		
Rooter, road, cable operated, 3-tooth	535	535	535	620	+85
Saws:					
Chain, portable, pneumatic, 24-inch blade	[a]	[a]	[a]	5,375	----------
Chain, gasoline engine driven, 36-inch blade	4,820	4,820	4,820	4,820	0
Circular, woodworking, portable, penumatic, 12-inch blade	[a]	[a]	[a]	4,171	----------
Scrapers, road:					
Motorized, cable operated, 12-cubic yard	99	575	390	409	+19
Towed type, cable operated, 6-cubic yard, Type II	[a]	[a]	[a]	250	----------
Towed type, cable operated, 8-cubic yard, Type III	2,001	2,001	2,001	2,045	+44
Towed type, cable operated, 12-cubic yard, Type IV	445	445	445	445	0
Semitrailer, low bed, rear loading, with dolly, 20-ton	464	464	464	490	+26
Tractors, crawler type, diesel engine driven, complete with accessories:					
91 to 140 drawbar horsepower, Class I	3,848	3,848	3,125	2,972	−153
61 to 90 drawbar horsepower, Class II	4,000	4,000	3,200	[b] 3,178	−22
46 to 60 drawbar horsepower, Class III	2,400	2,400	2,000	[b] 2,049	+49
36 to 45 drawbar horsepower, Class IV	9,000	9,000	8,000	[b] 7,396	−604
Trailers, full, low bed:					
8-ton	1,526	3,918	3,152	3,152	0
16-ton	2,685	2,685	2,504	2,577	+73
20-ton	149	271	204	256	+52
Welder, electric arc, gasoline engine driven, 300 amp, skid mounted	526	921	1,022	1,318	+296

[a] Requirements not shown in available records.

[b] These figures differ from those in Crawford and Cook, *Statistics*, which have been adjusted to include procurement by Ordnance Department.

Source: (1) ASP, Sec. 1, 1 Feb 43 and 1 Aug 43, (2) MPR, Sec 1-A, 31 Dec 43, 31 Jan 44, 29 Feb 44, (3) Crawford and Cook, *op. cit.*, pp. 25–27.

TABLE 12—MISCELLANEOUS EQUIPMENT: ANNUAL REQUIREMENTS AS OF FEBRUARY, AUGUST, AND DECEMBER 1943 AND ACTUAL DELIVERIES IN 1943

Item	Requirements			Deliveries 1943	Over or Short December Requirements
	February	August	December		
Boats					
Assault, M–2, without paddles or canvas bag	17,696	19,725	19,725	19,899	+174
Landing, pneumatic, rubber, 10-man	(a)	3,274	3,274	820	−2,454
Reconnaissance, pneumatic, canvas, 2-man, without paddles	1,952	4,135	4,135	4,089	−46
Storm, plywood	1,607	1,607	1,392	1,407	+15
Utility, gasoline powered, 18-foot	451	451	451	457	+6
Motor, outboard, with chest and spares, 22 hp	3,286	3,406	3,406	4,044	+638
Motor, outboard, with chest and spares, 50 to 55 hp	2,748	2,892	2,892	2,505	−387
Bridges					
Fixed, steel, panel, Bailey type, M–2, widened roadway	500	500	500	520	+20
Ponton, steel, 25-ton	2,748	2,748	2,748	2,858	+110
Semitrailer, special, drop frame, 25-ton, ponton	1,250	1,730	1,730	1,979	+249
Treadway, M–2:					
Floats, pneumatic, with emergency kits, 18-ton, M–1, with carrying case	(b)	2,760	2,760	437	−2,323
Saddle, steel, treadway, knockdown type, M–1, 18-ton	(b)	(b)	(b)	827	
Truck, cargo, 6-ton, 6 x 6	1,391	1,391	1,391	688	−703
Mapping Equipment					
Alidade, miniature, telescopic, Type B, with leather case and accessories	(a)	., 300	(c) 950	890	−60
Alidade, telescopic, with stadia arc, Type A	1,272	1,272	c 1,170	1,110	−60
Camera, copying, 24 x 24-inch	44	44	63	65	+2
Compasses:					
Lensatic, luminous dial, liquid filled, 5 degree, 20 mil graduations (thousands)	195	337	337	337	0
Watch (thousands)	540	(a)	(a)	(d)	
Wrist, liquid filled (thousands)	(a)	1,065	(a)	1,365	
Level, small engineer, with tripod and accessories	1,033	(a)	1,033	1,295	+262
Press, lithographic, offset, motor driven, 110 V, 60 cycle, AC, 20 x 22 ½-inch size	75	75	160	161	+1
Stereocomparagraph	221	229	303	303	0
Stereoscope, magnifying mirror, with binoculars and case	4,864	4,864	6,049	6,463	+414

TABLE 12—MISCELLANEOUS EQUIPMENT: ANNUAL REQUIREMENTS AS OF FEBRUARY, AUGUST, AND DECEMBER 1943 AND ACTUAL DELIVERIES IN 1943—Continued

Item	Requirements			Deliveries 1943	Over or Short December Requirements
	February	August	December		
Mapping Equipment—Continued					
Transit, small, engineers:					
Night illumination, 1-minute reading, with accessories and tripod, Type I	2,412	2,412	2,230	2,237	+7
Night illumination, 20-second reading, with accessories and tripod, Type II	1,930	1,930	1,930	1,930	0
Mat, airplane, landing, steel, pierced-plank type, in bundles (thousand square feet)	230,000	206,000	189,700	197,006	+7,306

[a] Requirements not shown in available records.

[b] New model under development.

[c] MPR, Section 1-A, for December, combined the two types with total deliveries of 1,110. In January 1944, Type B was given for the first time, with delivery of 890 in 1943. MPR's prior to December 1943 gave Type A only, with deliveries higher than could be possible if 890 Type B were made and 1,110 was actually the combined figure.

[d] This was the actual delivery total in May, the last time the watch compass was reported. At that time, over-procurement to a total of 1,021,387 had been authorized.

Source: (1) ASP, Sec. 1, 1 Feb. 43, 1 Aug 43. (2) MPR, Sec. 1-A, 31 May 43, 30 Nov 43, 31 Dec 43, 31 Jan 44, 29 Feb 44. (3) Crawford and Cook, *op. cit.*, pp. 25, 27–28.

CHAPTER XXII

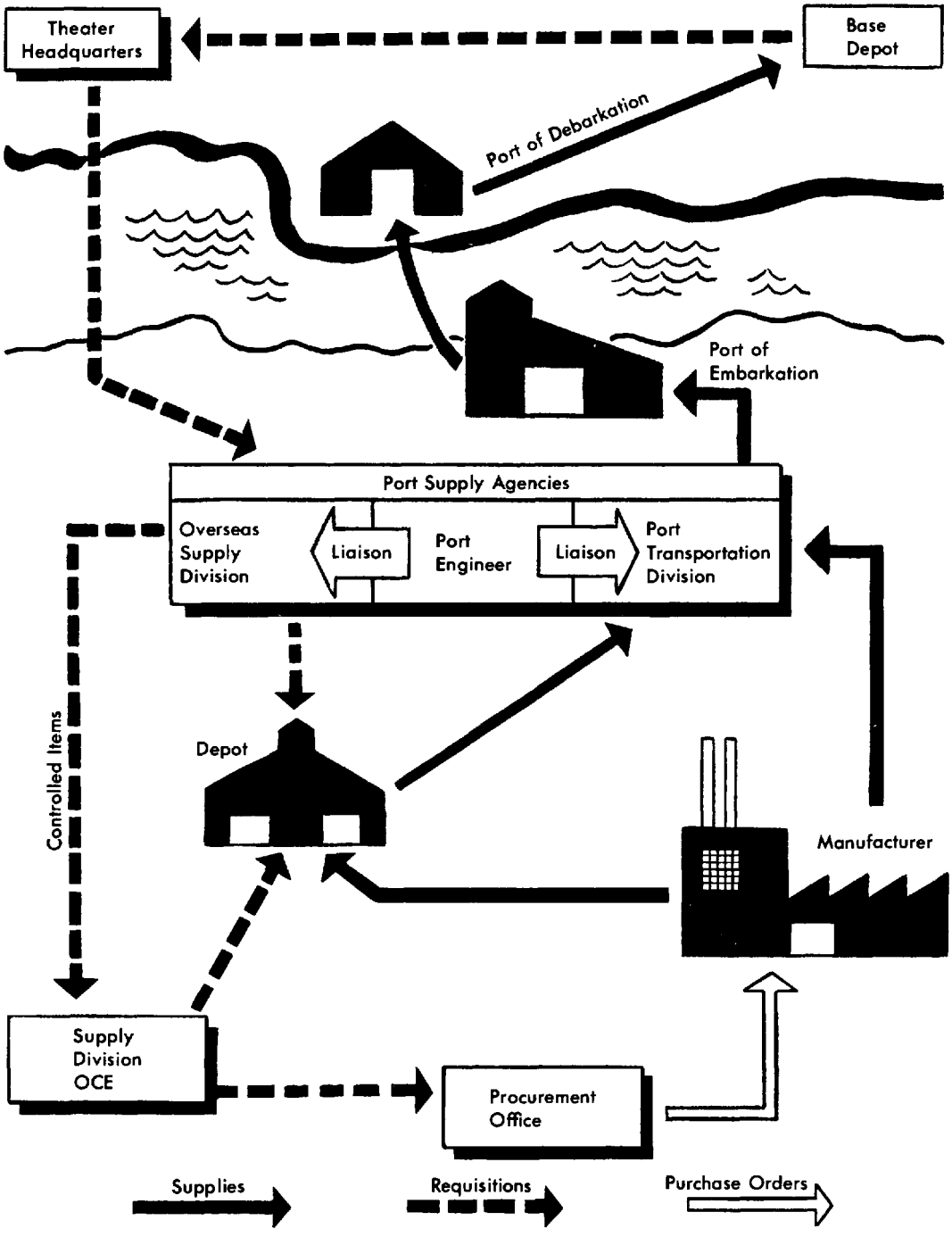
The Flow of Supplies

The ultimate result of the great upsurge in deliveries that began in the fall of 1942 was the gradual easing of shortages of supplies in the theaters. The demands from overseas were of course much greater than in the early months of war. Less than 63,000 engineer troops were stationed outside the United States in July 1942; a year later there were that many in North Africa alone. Beginning in December 1943 the number of engineer soldiers overseas surpassed the number at home, increasing month by month until in April 1945 there were 582,935 officers and enlisted men serving in the overseas commands, the pattern of engineer troop deployment following, as would be expected, that of the Army as a whole. (*See Chart 5.*)

Evolution of the Supply System

The immediate result of more plentiful stocks in all of the technical services was the emergence of an orderly system of distribution. Although in 1943 there were still instances of last-minute purchases to fill shortages of units alerted for overseas movement and to satisfy unexpected Class IV requisitions, this method of supplv became less common as the year wore on. During 1942 many needs had perforce to be met on a retail basis. Purchase by requisition and shipment direct from factory to newly activated unit or to port was a common occurrence. In 1943 production made possible the desired conversion to wholesale operations. Only at the very end of the supply pipeline did retail activities continue. Elsewhere matériel was handled in bulk, flowing from factory to designated depot in the United States whence it was called forward at the appropriate time for shipment to troop unit or to theater. Control of that part of the matériel that was moving overseas was largely in the hands of the major ports, which had been assigned responsibility for the supply of particular theaters or bases. For the vast majority of items the requisition channels were direct from theater to port to depot. A selected group, in general those known to procurement staffs as "critical" items, became, for the purpose of distribution, "controlled" items. Requisitions for controlled items went from port to technical service for a check upon theater priorities, rather than direct from port to depot. (*Chart 8*) With the maturation of the wholesale system, the depots—heretofore small depositories for slow-moving, largely obsolete equipment—came into their own. Their importance, first apparent in relation to the distribution of matériel, was to grow as the quantities of supplies in storage and the rate at which they were being issued

CHART 8—ORGANIZATION AND PROCEDURES FOR DISTRIBUTING SUPPLIES



Source: Engr Supply Procedures, Mar 45, EHD files.

became the major determinants in the computation of the Army's requirements.[1]

In developing its storage system the Corps of Engineers was guided by policies set forth by the War Department and, more particularly, by ASF, which looked in turn to the Quartermaster Corps as the most experienced "supplier" in the Army. The Engineer supply system was in Dawson's bailiwick, which, it will be recalled, was the Requirements, Storage and Issue Branch. Those officers and civilians whose concern was storage and issue had attempted, during 1942, to provide the fundamentals of an efficient system. Their first concern had been the acquisition of space itself. In July 1941 the Engineers maintained storage facilities in five depots administered by The Quartermaster General for the War Department: at Brooklyn and Schenectady, New York; Columbus, Ohio; San Antonio, Texas; and San Francisco, California. Total space available was well under a million square feet. During the succeeding twelve months there was but a modest expansion of storage areas to somewhat over 5,000,000 square feet. The greatest additions occurred in the last six months of 1942. By January 1943 storage facilities under the control of the Corps had reached 36,900,000 square feet. By the summer of 1943, when distribution and control of stocks began to assume a position of importance equal to that of procurement, the Engineers had 42,900,000 square feet of storage space available to them. Over the course of the next twelve months the Corps added another 18,000,000 square feet. Engineer storage installations were, moreover, scattered all over the country in eight Engineer depots and eight ASF depots administered by The Quartermaster General. (*Chart 9*) At the end of the war storage space totaled 64,000,000 square feet.[2]

No problem of identification or location of stocks had arisen in the old days. Simple manual bookkeeping sufficed to keep track of what was on hand and what was shipped in or out. Frequent physical inventory was entirely feasible. With thousands of items due to be stocked over large areas and to be moved rapidly when and where called for, such country store procedures had to be replaced by modern business practices. The new system of stock control was built around the use of electric accounting machines, commonly known as IBM machines after the International Business Machines Corporation, which supplied most of them. The IBM machines could do all sorts of tricks, but they were less than human. They could supply the correct answer only if correct data were fed into them. The machines could not know, as did an experienced depot clerk, that a tractor, heavy, 70 horsepower, and a tractor, D–7, were one and the same. It was essential therefore that each item handled be assigned a standard name and number.

But Dawson was not at first convinced of the necessity for complete coverage. He believed the Engineers could get along with

[1] See Leighton and Coakley, *Global Logistics and Strategy*, Ch. XIII, and pages 642–48, and Wardlow, *Transportation Corps, I*, 95–111 for exposition of the supply system with particular reference to the duties of the port. Risch, *Quartermaster Corps, I*, Ch. IX, contains much detail on storage operations. These sources have served as a basis for much of the discussion that follows.

[2] (1) Monthly Rpt of Depot Opns, Jul 41. Distr Div file. (2) MPR, Sec. 2–H, Supplement Storage Opns, 30 Sep 42–31 Dec 45. (3) Speech by Dawson, 8 Feb 43, sub: Depot Relations (cited hereafter as Dawson Speech). Intnl Div file, 400.24.

a catalog which listed only Class II supplies. This had been the practice in the past, of course, because the Corps carried no Class IV items in stock. The 1942 catalog, like previous ones, was divided into three parts—Part I, an alphabetical listing of sets with their component items; Part II, an alphabetical listing of items (including components of sets); Part III, a listing of organizational sets of spare parts for machinery. Omitted from the catalog entirely (unless they occurred also in Class II lists) were Class IV supplies and nonstandard equipment, even though the latter might be offered as a substitute for a standard item. The spare parts listed were similarly selective. A nine-digit stock number was assigned each item in Part II of the catalog; no stock numbers were assigned to spare parts. The Tabulating Section of the Storage and Issue Branch, which was in charge of seeing to the installation of the IBM system, prepunched sets of machine records cards and forwarded them to the depots.[3]

The 1942 catalog was hardly off the press before serious shortcomings became apparent. Nomenclature was anything but standard. Listings on the T/BA differed from those in the catalog and listings in one part of the catalog differed from those in another. The spread of stock numbers was insufficient to allow orderly insertion of the many new items being adopted for issue. The Corps had nothing like a complete accounting of stocks on hand.[4] Depots were carrying items on back order when perfectly acceptable substitutes were in stock. As one officer noted in August 1942:

> No system seems to be in existence whereby depots are informed of substitutions. Since the editing of incoming requisitions is performed by lower bracket employees who in many instances do not know whether the item has wheels or can be put in the vest pocket, an intelligent substitution cannot be made without a guide.[5]

Dawson, persuaded by this time that stock control was an all-or-nothing proposition, agreed that the only thing to do was "to wash the slate clean and start all over again." [6]

Starting over again and doing a thorough job was a formidable task. Capt. Coleman P. Cook, the chief of the Tabulating Section, reported the state of affairs in mid-September:

> The task of setting up complete nomenclature on cards for . . . Parts I and II of the catalog is proceeding. Cards have been punched through the letter "E." . . . Colonel Holt [of the War Planning Section] has approved bringing the cataloging of new items to a temporary halt until the catalog group can digest recent heavy influx of new equipment in connection with War Aid, barrage-balloon equipment, searchlight cleaning and preserving materials, motorized shop equipment, reproduction equipment, amphibious force supplies, T/O equipment and non-standard items actually on hand at depots.

Pressure of work had prevented the catalog group from putting out a complete list of items cataloged so far.[7]

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[3] (1) Dawson Speech. (2) CE Sup Catalogs, 1941, 1942. (3) Ltr, ExO Sup Div to Engr Sup Off Utah Gen Depot, 30 Dec 41, sub: Listings of Pts I and II of New Engr Sup Catalog. 400.34. (4) Memo, C of Rqmts Br for C of Requisition Sec, 8 Jul 42, sub: Catalog Number. Constr Mach Br file, Standardization of Tractor. (5) Ltr, AC of Rqmts Br to Engr Sup Officer Columbus Gen Depot, 13 Feb 42, sub: Engr Catalog, Pt. 2. 400.291, Pt. 7.

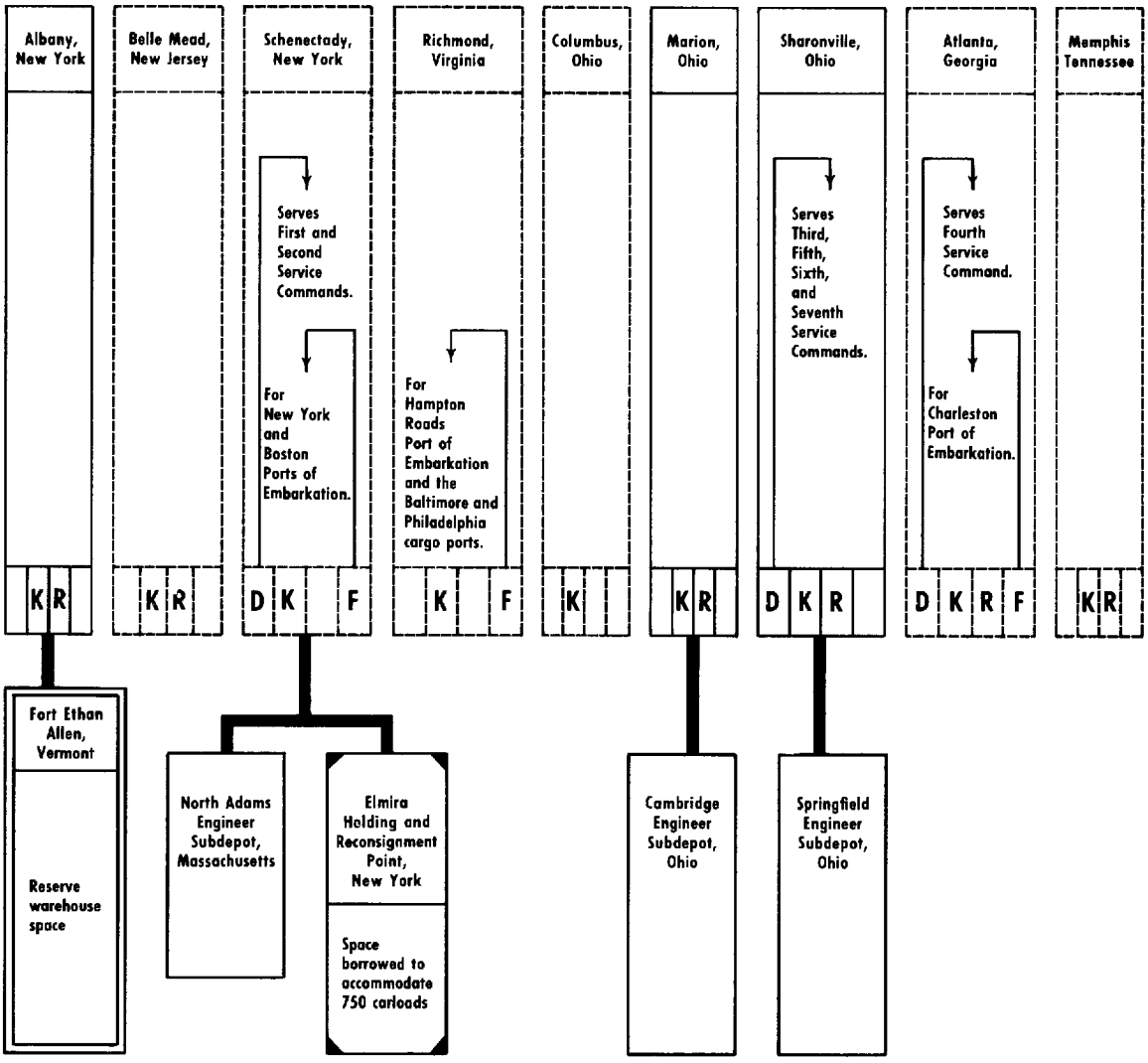
[4] (1) Dawson Speech. (2) Memo, C of O&T Br for Sup Div, 3 Aug 43, sub: Nomenclature. 400.34, Pt. 43. (3) Tabulating Sec Diary, 4 Aug 42, 16 Sep 42. Rqmts Br file.

[5] Tabulating Sec Diary, 20 Aug 42.

[6] Dawson Speech.

[7] Tabulating Sec Diary, 16 Sep 42.

CHART 9—ENGINEER



Explanation of Depot Symbols:

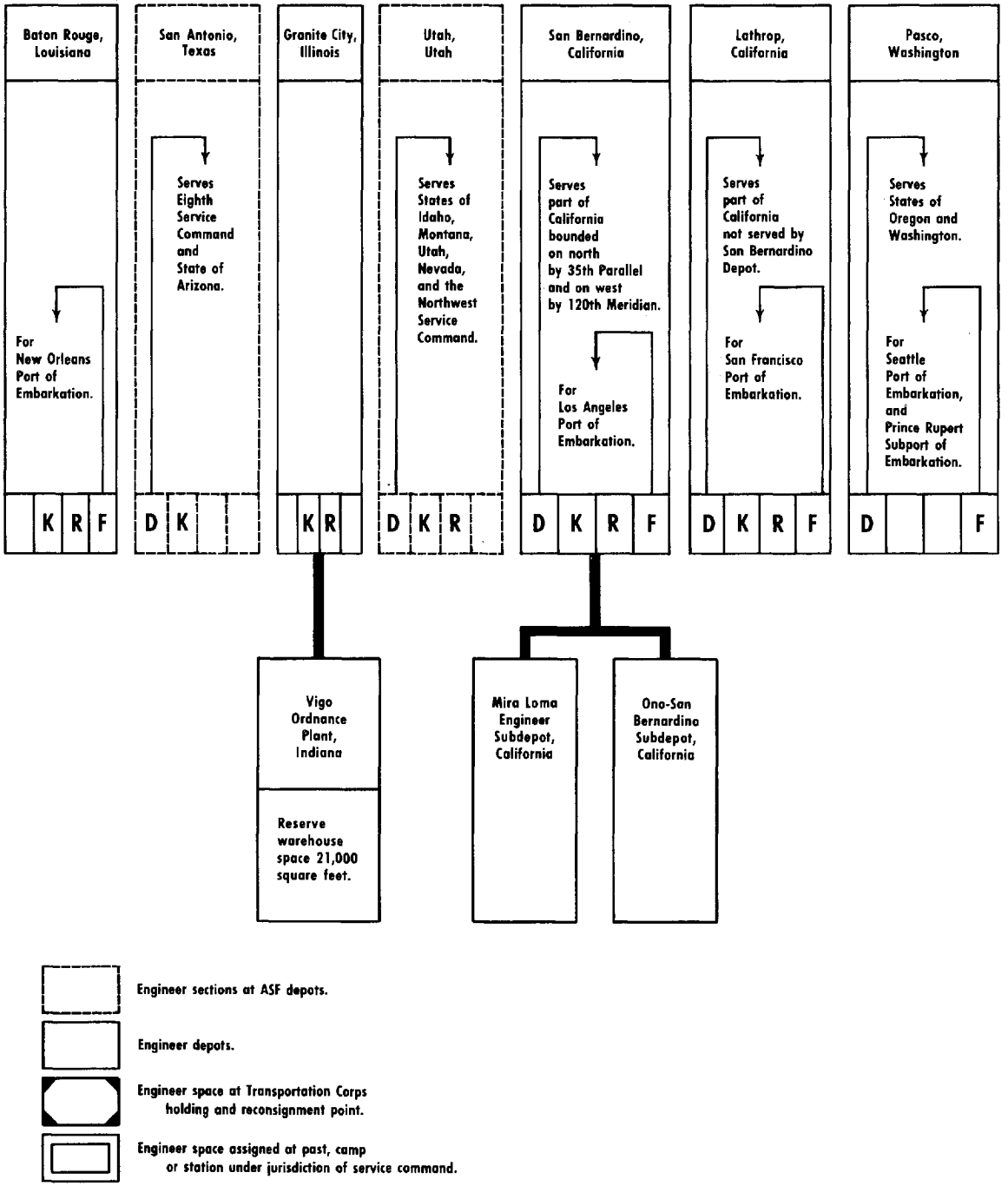
D — Distribution depot: A depot set up for the supply of certain items to a specified continental area in accordance with an established plan.

K — Key depots: A depot designated for the purpose of centrally storing selected items to supply stations, other depots, and ports.

R — Reserve depot: A depot storing designated items in bulk for special purposes as well as supplies in excess of current needs. Generally such depots made bulk shipments to other depots and ports of embarkation.

F — Filler depot: A depot designated to store and issue supplies to ports of embarkation for filling overseas requisitions or supplying last minute shortages.

DEPOTS: JULY 1944



Expansion of the Engineer supply system got under way during the period when the shortage of officers was most acute and came into full operation just as civilian manpower was becoming difficult to obtain. A large force of officer-managers, civilian clerks, and common laborers suddenly had to be built up from scratch to carry out duties with which the Corps of Engineers had almost no experience and which were regarded in some quarters as of little importance. Fowler sensed trouble ahead as early as March 1942. So far, he complained to Military Personnel, the officers assigned to supply duties had been too young, too inexperienced, and too few. This trend should be reversed. Urging that "supply duties should be put on an equal basis with troop duty and construction duty," he asked for twenty qualified officers a month beginning 1 May.[8] Military Personnel found it impossible to keep up with the demand for supply officers. In August Military Personnel was planning to assign about 150 officers from the Engineer Officer Replacement Pool, the hopper that contained Reserves, men commissioned direct from civil life, and OCS graduates. The hope was that most of these men would have an opportunity to attend the Engineer supply school at Columbus Depot before assignment, but "the urgency of personnel requirements" might make it necessary to train them after they arrived on the job at port or depot.[9]

The "urgency of personnel requirements" was evident. Dawson was asking for 282 additional officers at this time. The new depots at Granite City, Illinois, and at Marion and Sharonville, Ohio, went for weeks without officers. By early 1943, however, every Engineer installation had its commanding officer, every port its Engineer. All told there were at this time approximately 275 officers and 15,000 civilian employees at Engineer depots. The total of 11,459,000 square feet of warehouse and shed space was 54 percent occupied; the 25,443,000 square feet of open storage area, 43 percent occupied. Engineer depots had 111 fork-lift trucks, 97 towing tractors, and 88 cranes. The month before, 197,821 tons of matériel had been received and 57,598 tons shipped out.[10]

The Engineer Field Depot Office (EFDO) which had been located at Columbus, Ohio, in accordance with the general policy of decentralization, assumed primary responsibility for supervision of depot activities early in 1943. Under the direction of Maj. Stonewall J. Beauchamp, EFDO worked out the necessarily detailed procedures for receipt and shipment, packing and marking, transportation, records keeping, and utilization of space. The Depot Operating Procedure Manual, published early in 1943, provided a step-by-step analysis of the principles of good warehousing. Trouble shooters from EFDO and from ASF traveled about from depot to depot, inspecting, suggesting, trying to discover ways to speed the movement of supplies. Everywhere that Beauchamp and his assistants went they emphasized "flow," particularly the flow of paper. For handling requisitions one representative left at the Utah Depot

[8] Memo, C of Sup Div for C of Mil Pers Br, 21 Mar 42, sub: Pers for Engr Sup Function at Div Camps. 400, Pt. 1.

[9] (1) Ltr, C of Mil Pers Br to CG SOS, 4 Aug 42, sub: Engr Off Repl Pool at Depots and Ports. Storage Br, Read file. (2) Ltr, TAG to Cs of Arms and Svs *et al.*, 20 Feb 42, sub: Off Filler and Loss Repl. 320.2, Pt. 31.

[10] (1) Memo, C of Rqmts Br for C of Mil Pers Br, 6 Aug 42, sub: Off Pers Rqmts for Engr Depots. Storage Br, Read file. (2) Memo, C of Sup Div for C of Mil Pers Br, 2 Oct 42, sub: Allot of Offs for Newly Activated Depots. 210.3, Pt. 1. (3) Dawson Speech. (4) MPR, Sec. 2–H, Sup Storage Opns, 30 Sep 42–31 Dec. 45.

fifteen pages of instructions detailing every step, starting with the time the mail should be picked up.[11] Late in June, after he had compared the filling of requisitions and back orders during selected one-week periods over the last six months, Beauchamp concluded that the depot system was performing in an excellent manner, and even ASF conceded that considerable improvement had been made. On the average, it was reported, it took fourteen working hours to fill a requisition.[12]

Development of a comprehensive stock control program was also thought to be progressing satisfactorily. The model was the ASF stock control manual which laid down basic principles and uniform procedures looking toward the closer alignment of stocks on hand with the Army Supply Program. Reacting to an advance copy of the manual, Fowler named Lt. Col. Charles R. Rodwell, Jr., Director of Stock Control, to act as staff officer to Dawson. Rodwell wanted a small, high-powered staff. He was able to select one or two experienced employees from other offices of the Supply Division, but it took him three and a half months to fill all of the ten established positions.[13]

Despite this shortage of personnel Rodwell's office plunged into the work immediately. By early May it had got out an Engineer edition of the ASF stock control manual for stations and depots. The new procedures for the first time called for the establishment of stock levels. Station supply officers were to estimate quantities sufficient to cover a 90-day period and were to reorder when one third of the stock had been issued. Depots were to police the stations within their area. Each quarter the Engineer station property officer was to prepare a report showing for each item stocked its maximum level, balance on hand as given on stock record cards and as shown on a memorandum receipt account, quantities due in and due out, and cumulative issues for the quarter reported. Comparison of quarterly stock status reports would enable the depots to revise station levels, subject to review by the Director of Stock Control. Stock levels at the depots themselves were fixed at the quantity issued over the last five months (January–May 1943). Any balance over and above this amount became a reserve subject to the control of OCE. Revision of depot levels would be a joint responsibility of the depot and the Director of Stock Control. Replenishment by direction of the Storage and Issue Branch would ordinarily be automatic, but depots were to notify that office if stocks of any item fell below 50 percent of the authorized level.

The primary instrument for maintaining and adjusting stock levels was the consoli-

[11] (1) GO 6, 14 Jan 43. (2) Ltr, ACofEngrs (Fowler) to All Concerned, 29 Apr 43, sub: Stock Control Procedure. EHD files. (3) Memo, Lt James M. Roche for Beauchamp, 5 Mar 43, sub: Final Rpt Engr Sup Sec Utah QM Depot, with Incl, Depot Flow of Requisitions and Ship Tickets. 333.1, Pt. 1.

[12] (1) Memo, Beauchamp for Dawson, 28 Jun 43, sub: Comparative Sum of Requisitions Received and Back Orders Released. Storage Br, Read file. (2) Ltr, C of Storage Br for Plans and Analysis Br Storage Div ASF, 10 Jul 43, same sub, with 1st Ind, 17 Jul 43. 400.312, Pt. 8. (3) Memo, Dir of Stock Control for C of Inventory Control Br, 30 Jul 43, sub: Proposed Monthly Depot Space and Operating Statement. 400.242, Pt. 2

[13] (1) Memo, Fowler for Chorpening *et al.*, 23 Mar 43, sub: Balance of Proc and Control of Stocks. Intnl Div file, 310.1. (2) Memo, Dir of Stock Control for C of Sup Div, 17 Apr 43, sub: Orgn and Immediate Objectives of the Office of Dir of Stock Control. Exec Office Proc Div file. Adm Inter-Office Memos. (3) Memo, Dir of Stock Control for C of Fld Sv, 5 Jul 43, sub: Progress of Dir of Stock Control. 400.291, Pt. 3.

dated stock status report. As of the close of business on Friday each depot listed the number, nomenclature, and maximum stock level of every item stocked, noted cumulative issues since the beginning of the year, and gave quantities on hand, due out, and due in. The individual reports were forwarded to the Granite City Depot where the former Tabulating Section, still under Major Cook, was now located. As put into final form by Cook's section, the consolidated stock status report served also as a basic tool in directing the flow of supplies to troop units and ports.[14]

If the depots had been stocked up to prescribed levels at all times the flow of supplies would have been automatic. Thus some installations, designated "distribution" depots, carried a balanced stock for the supply of troop units stationed within a prescribed geographical area. Others, the so-called "filler" depots, maintained supplies for shipment overseas upon call of a particular port. "Reserve" depots kept on hand stores which were drawn upon by distribution and filler depots and occasionally by the ports. Certain supplies—topographic equipment, for example—were concentrated in "key" depots. All of the Engineer depots served in more than one of these capacities. (*See Chart 9.*)

Although the flow of supplies was through designated points of the depot system to stations in the United States and through the ports to the theaters of war, the flow of paper which determined the movement of supplies passed through other points as well. The whole process can best be described by following a theoretical unit from the time of its activation to its overseas station. About 1 July 1943 the Organization and Equipment Section, located at the Granite City Engineer Depot, received notice that X General Service Regiment would be activated at Camp Claiborne on 1 October 1943 and prepared an "initial activation requisition," forwarding three copies to the Engineer Section of the San Antonio ASF Depot for the supply of noncontrolled items, and one copy each to the commanding general of the Eighth Service Command, the Claiborne station supply officer, the commanding officer of the X General Service Regiment, and the Operations Section of the Requirements, Storage and Issue Branch, OCE. Upon receipt of the requisition from Granite City, the San Antonio Depot "edited" it to determine which items were and which were not in stock, shipping those on hand to Claiborne and sending one copy of the annotated requisition to the station supply officer. Those items out of stock but due in the San Antonio Depot within seven days were placed on "back order" to be shipped to Claiborne later. Those items out of stock and not due in within the week were "extracted" back to Granite City. Granite City, upon examination of the consolidated stock status report, found that the missing items were available at the Atlanta ASF Depot and directed Atlanta to forward them direct to Claiborne. Meanwhile, the Controlled Equipment Subsection of the Operations Section, Requirements, Storage and Issue Branch, had determined that the priority assigned the unit by the War Department was not sufficiently high to warrant the unit's receiving its tractors immediately. The unit would train with tractors from the equipment pool at Claiborne. Between the 1st and the 20th of September (not sooner than 30 days nor later than 10 days before

[14] (1) Ltr, ACofEngrs (Fowler) to All Concerned, 29 Apr 43, sub: Stock Control Procedure. EHD files. (2) Ltr, ACofEngrs to Stock Control Div ASF, 21 Jul 43, sub: Depot Stock Levels. 400.291, Pt. 9.

activation of the unit) all available equipment to which X General Service Regiment was entitled arrived at the camp. About midway in its 26-week training period X Regiment's commanding officer received notice of the unit's having been scheduled for movement overseas and of its consequently higher priority for equipment. Claiborne's supply officer filled in what shortages he could from station stocks and then requisitioned San Antonio, which forwarded supplies on hand and extracted missing items to Granite City. The Controlled Equipment Subsection, OCE, had meanwhile authorized Granite City to obtain for the regiment the tractors and other controlled items due it. Having arrived in the British Isles just before D Day, the X General Service Regiment subsequently participated in the reconstruction of the port of Cherbourg. The list of Class IV supplies needed for this operation had been submitted to the War Department by the theater in the form of a keyed project in August 1943. Some months later the New York port received the actual requisition for supplies. The Engineer Section of the port edited the requisition, referring controlled items to OCE and noncontrolled items to the Engineer Section of the Schenectady ASF Depot. The field liaison office of the North Atlantic Division kept tab on movements, contacting as necessary OCE, the depots, and the Engineer Section of the New York port until matériel had been loaded and shipped.[15]

In summarizing the steps taken to install the new system, Rodwell offered a few words of warning to his colleagues:

> There is a tendency among many in the Supply Division today to expect wonders by merely stating, "Now that we've got Stock Control . . . ." We do not have Stock Control! However, we do have an apparently sound stock control plan, and the continual application of this plan will lead to correctly adjusted stocks. If all concerned aggressively and industriously apply this plan, kept constantly current with changing conditions, we can hope to approach "stock control." [16]

Stock Control in the Measurement of Requirements

The approach to stock control proved full of pitfalls, the most serious of which were names and numbers. Dawson's new start resulted in the publication on 1 March 1943 of a standard nomenclature list (SNL) which included: (1) standard troop equipment appearing on T/BA's and T/E's either as components of units of equipment or as items of separate issue; (2) theater of operations equipment; (3) international aid supplies; (4) barrage balloon equipment; (5) maintenance equipment and supplies; and (6) miscellaneous, nonstandard, and obsolete equipment. Omitted from the list were spare parts procurable only from the manufacturer of the particular machine, one-time purchases, emergency purchases, and certain international aid supplies. Items had been grouped under the Federal Standard Stock Catalog Classification, resulting in a twelve-digit decimal system.

Publication of the SNL and of a revised

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[15] (1) Ltr, ACofEngrs (Fowler) to Engr Sup Offs QM Depots *et al.*, 26 Mar 43, sub: Transfer of Certain Functions to Granite City Engr Depot. 323.3, Granite City Engr Depot. (2) Ltr, ACofEngrs to All Concerned, 29 Apr 43, sub: Stock Control Procedure. EHD files. (3) C/L 2248, 2 Jul 43, sub: Activation of Fld Liaison Office NAD. (4) Ltr, C of Fld Sv to COs Engr Depots *et al.*, 16 Jul 43, sub: Back Orders for Overseas Shipment. 400.291, Pt. 2. (4) Ltr, ACofEngrs to NAD Engr, 14 Apr 43, sub: Estab of Engr Port Liaison Office. Rqmts Br Noncontrolled Equip Sec file, 320.2.

[16] Memo, Dir of Stock Control for C of Fld Sv, 5 Jul 43, sub: Progress of Dir of Stock Control. 400.291, Pt. 3.

catalog in October 1943 fell far short of solving the problem of identification. The habit of referring to items by their trade name or old stock number persisted in spite of formal orders that every document in the supply chain carry the standard name and number. A two weeks' survey in September revealed that 57 percent of the requisitions issued from OCE were without a stock number. Disinclination or inability to match up nomenclature used in the ASP or on papers from overseas with the SNL accounted for this situation in part. The main reason for it was the fact that the SNL was out of date. A good many persons in the Supply Division believed that the group charged with this work—one officer and twelve civilians including typists—was entirely too small to handle the job. Rodwell asserted, however, that the SNL would be put on a current basis within a short time and would thereafter be kept so. Recommendations for enlarging the staff were disapproved.[17]

Some 3,300 unnamed items continued to float through the Engineer supply system. The depots assigned them temporary numbers and referred a description to the Storage and Issue Branch for positive identification. Late in August EFDO dispatched representatives to the depots in an effort to reduce the number of items carrying temporary numbers. In November the Supply Division launched another "concentrated drive." This time representatives of the depots were to come to Washington to work with the chief cataloger. The hope was to clear the books by 1 January 1944.[18]

A large part of the confusion in the depots resulted from the poor caliber and inexperience of officers and civilians. Ultimately a few warehousemen turned up for direct commissions, but the bulk of officers at depots and ports of embarkation were OCS graduates. Some of these younger men were not without experience, of course. Some of them, in fact, knew more than their seniors. But to most Engineer officers assignment to supply was the equivalent of exile to Siberia. There were no brigadier generals in depots. By and large OCS candidates of outstanding promise were siphoned off to troop units. Employment in Engineer depots averaged 20,000 persons over the last six months of 1943; 23,000 during 1944. If these workers had been experienced and steady, depots would have been adequately manned. Actually the depots suffered acutely from the so-called manpower shortage—a shortage not so much a lack of bodies as a scarcity of skills aggravated by a high rate of turnover and absenteeism among the labor force.[19]

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[17] (1) CE SNL, 15 Apr 43. (2) C/L 2358, 7 Jul 43, sub: Use of Standard Stock Numbers and Nomenclature in All Transactions Affecting Engr Sup for Trps. (This was but one of a series of such pleas issued to the field.) (3) Memo, D. P. Kuntz for Comm on Sup Procedures, 18 Sep 43, sub: Asgmt of Standard Nomenclature and Stock Numbers. Intnl Div file, 323.41–323.45. (4) Memo, Lt Col L. G. Flick for Col David H. Tulley, 25 Sep 43, sub: Comm on Sup Procedures: Rpt on Mtg of 23 Sep 43. Same file. (5) Memo, Maj C. G. Strong for Comm on Sup Procedure, 6 Oct 43, sub: Proposed Action re Standard Nomenclature Program. 020, Pt. 2. (6) Memo, C of Rqmts Sec for Rqmts and Stock Control Br, 8 Oct 43, sub: Reorgn of Standard Nomenclature Subsec and Allow and Catalog Subsec. Rqmts Br, Read file. (7) Memo, ExO Sup Div for C of Sup Div, 10 Apr 44, sub: Nomenclature and Catalog Sec. Same file.

[18] (1) Ltr, C of EFDO for COs Engr Depots *et al.*, 21 Aug 43, sub: Program for Identification of Depot Stocks. Opns Sec Storage Br file, Lt. Seaton. (2) Memo, Capt Davis, Rqmts Br, for Workman, EFDO, 27 Nov 43, sub: Unidentified Items in SNL. Rqmts Br, Read file.

[19] (1) Depot Opn and Changes. Basic Mats Submitted for Ann Rpt OCE, 1943. EHD files. (2) MPR, Sec. 2-H, Sup Storage Opns, 30 Sep 42–31 Dec 45.

On the west coast where vast new war industries had been created, the situation was particularly acute. "This office," wrote Maj. Sidney F. Bostick, commanding officer of the Lathrop Engineer Depot in January 1943, "has spent considerable time surveying the manpower shortage and is utilizing every conceivable method to procure help:

(1) Use of women laborers, white, black, Filipino and Chinese.
(2) Use of men under draft age, over draft age, any creed, color or religion.
(3) Use of paroled convicts.
(4) Sending trucks into the country to pick up Oakies, Arkies, or any other person who can make a mark or walk.
(5) Contacting every Government Agency available, including Chambers of Commerce in adjacent towns, requesting them to send laborers to this Depot for employment.
(6) Use of machines to offset the need of manpower.
(7) Transportation of employees to and from work."

Bostick was convinced "that this Depot has for laborers, the finest conglomeration of morons of any depot of the United States and that 98% of them having predicated their wants and needs on W. P. A. and relief salaries will not work when it rains or until they have spent their money after each pay day. As they can get a position in town at 40¢ an hour over their present salary, no disciplinary action can be taken with them." [20] By no means could all of the turnover and absenteeism be attributed to shiftlessness. Self-advancement in the form of higher pay remained an American ideal even in wartime. Sickness occurred more frequently among the older workers who had replaced younger drafted men. Many women found it difficult to hold down two jobs on a full-time basis.

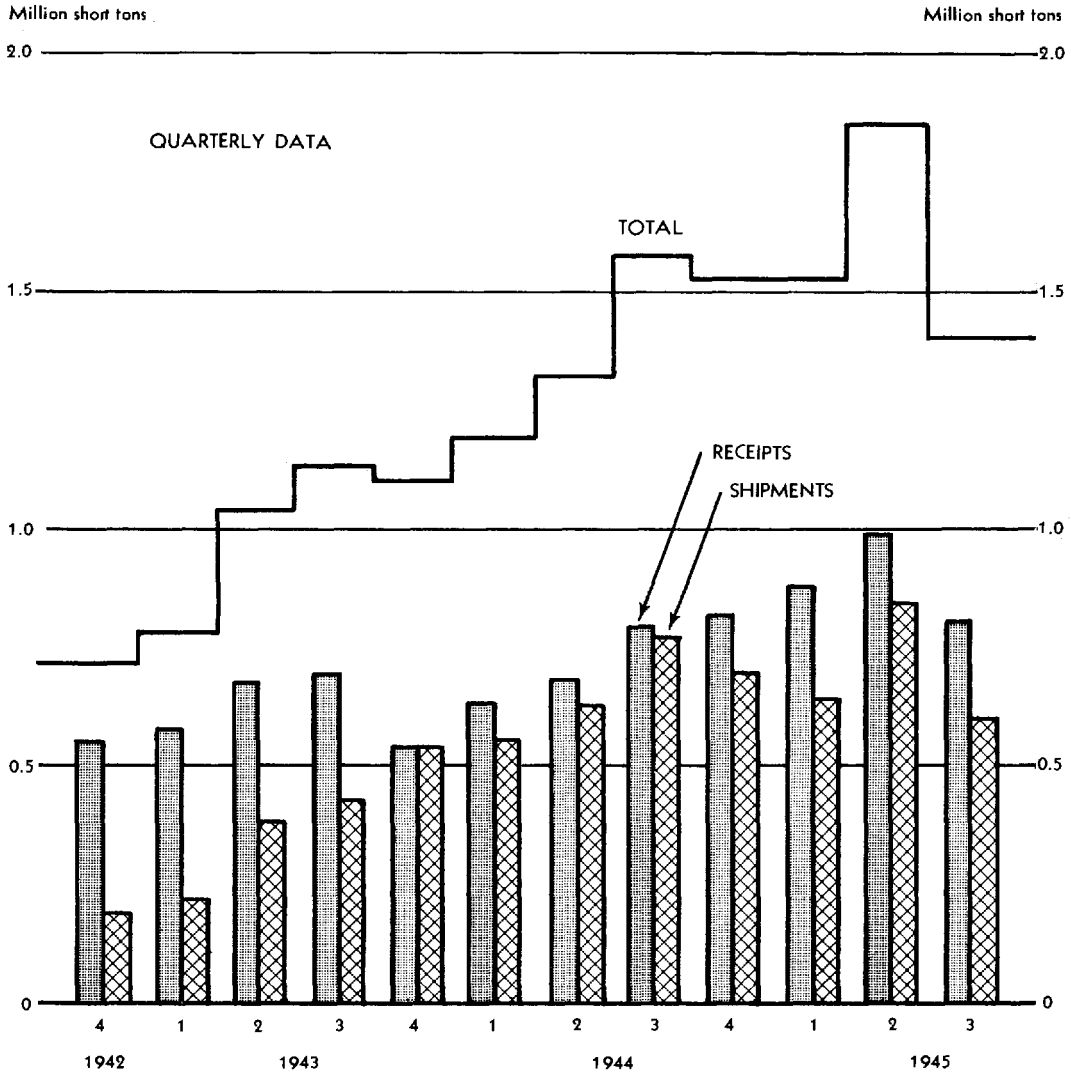
The manpower shortage hit the depots hardest when it came to finding IBM clerks and supervisors. The IBM industry itself was young. Those who knew it were young, too. It took most persons three to four years to qualify as supervisors. In an effort to provide replacements for IBM experts called to service, the Engineers transferred employees from depot to depot and sent many to IBM schools and the AGO "brush-up" course, concentrating the while on women workers. In time some of the young men who had been drafted, particularly those who had been classified for limited service, were assigned as enlisted men to IBM work in the depots. Italian Service Units (prisoners of war) finally eased the shortage of laborers in depots in the west.[21]

Incompetence in the ranks of management and labor and lack of an airtight system of identification of stocks all but ruled out the possibility of efficient operations. Fortunately the supply system could absorb a great deal of inefficiency. By spring 1943, Engineer depots were handling over 300,000 tons of supplies a month. More significantly, shipments, rather than receipts, accounted for the greater part of the increase in work load. Total tonnage handled rose by 53 percent from the fall of 1942 to the fall of 1943. During this same period the volume of shipments increased 150 percent. (*Chart 10.*) Above all, the shortages of matériel which had everywhere prevailed during 1942 began in 1943 to be overcome in certain areas. By the end of 1943 stocks were being assembled in the United Kingdom at the rate

[20] Ltr, CO Lathrop Engr Depot to C of Rqmts Br, 25 Jan 43, sub: Survey of Civilian Pers Situation, Lathrop Engr Depot. Storage Br file, Fld Sv.

[21] (1) Memo, ACofEngrs (Fowler) for Deputy CofEngrs, 10 Feb 44, sub: Scarcity of Trained Pers for EAM Opns in Depots. Storage Br, Read file. (2) Ltr, Engr Sup Off Utah ASF Depot, 17 Jun 44, sub: Monthly Depot Space and Operating Rpt, Reporting of Hours for Italian Sv Units. Same file.

Chart 10—Tonnage Handled by Engineer Depots: September 1942–September 1945



Source: MPR, Sec 2–H, Supplement Stor Opns, 30 Sep 42–31 Dec 45.

deemed necessary to prepare for the cross-Channel invasion. In the Italian campaign engineer troops could have used many more dump trucks but otherwise were adequately equipped. In the Southwest Pacific, where construction in the jungles of New Guinea imposed tremendous demands upon power machinery, engineer troops were still having to get along with very little. In January 1944 only 5 percent of Class II equipment was adequately stocked. Whereas in July 1943 the theater had 45 days' supply of construction machinery on hand, by the following November stocks had shrunk to 10 days of supply and in February 1944 were still at that level. It was a fact nevertheless that even in that distant, low priority theater, operations were no longer subject to the extreme delays that had occurred at the beginning of the New Guinea campaign because more troops and more equipment were on hand than formerly.[22]

The Corps of Engineers was to point to this apparent success at the far end of the pipeline as deficiencies in the supply system became daily more obtrusive. Execution of the work was slow. Gone were the days, if indeed they had ever existed, when fourteen hours was the average time spent per requisition. ASF had set six days as the maximum processing time. In the fall of 1943, a large percentage of requisitions were taking a long time to process and backlogs and back orders were piling up. Countless hours were being wasted looking for things because stock location files were incomplete. Some depots were complying with the requirement to notify ports when extracts were made; others were not. Stock records were inaccurate. As a spot check the Storage and Issue Branch had the depots take an inventory of one item on a specified date and compared this count with figures in the consolidated stock report. The variations were shocking:[23]

Depot	*Percentage of Requisitions Processed in 7 Days or More*
Granite City	24
Marion	37
Columbus	22
Richmond	25
Utah	65

Requisition Line Items

Depot	*Processed*	*Pending at End of Month*	*Percent*
Albany	1,285	488	38
Granite City	6,687	2,188	33
Lathrop	4,149	2,186	53
Marion	2,036	1,469	72

Requisitions

Depot	*On Hand*	*Submitted*	*Released*	*Held Over*
Baton Rouge	11	4	2	13
Granite City	545	31	120	456
Marion	57	3	21	39
Sharonville	377	530	287	620
Atlanta	343	41	214	170
Columbus	490	14	316	188

. . . in some cases, EAM [IBM] report showed stock on hand of almost double the quantity shown on special inventory report . . . . EAM report also showed stocks on hand that had not appeared in the special inventory reports, and the special reports showed stocks on hand that were not reflected in the consolidated stock report.

Since similar inconsistencies had frequently come to light in the normal day's work, the

[22] (1) Info from historians preparing volume, The Corps of Engineers: The War Against Germany, for the series UNITED STATES ARMY IN WORLD WAR II. (2) *Engineers of the Southwest Pacific, VII, Engineer Supply,* p. 112.

[23] 1st Ind, Dir Stock Control to C of EFDO, 18 Dec 43, sub: Stock Control Data—Monthly Depot Space and Operating Rpt. 400.291, Pt. 3. Figures are for November.

Storage and Issue Branch had to conclude that the results of the spot check were typical of the accounts of several thousand items. In a strongly worded letter to all concerned, Fowler called for immediate reform.[24]

The proven inaccuracies of Engineer stock records were the more alarming because of ASF's determination to key future purchasing to amounts on hand and past rates of issue. The new approach was the essence of stock control and had therefore been in the wind ever since the inauguration of the stock control program in the summer of 1943. Reports of gross overprocurement on the part of the Army had not been borne out by investigations, but sufficient evidence existed to indicate that the time had come to think in terms of establishing lower ceilings upon the procurement program.[25] Clay sounded the keynote of the new approach in January 1944:

> The first and major phase of our war production . . . called for the provision of the initial or capital issue for a rapidly expanding Army of 7,700,000, the provision of similar equipment for our Allies, and the provision of replacements, spares and operational requirements for the relatively small number of troops engaged in overseas operations in 1942 and 1943.
>
> The provision of initial equipment on time necessitated establishing high production rates. This phase of war procurement is approaching completion and, except for comparatively few items, procurement for the future must be designed and scheduled to meet estimated replacements and operational requirements; production must closely approximate expenditures. Obviously, a still closer procurement control is essential to assure the requisite supply being available on time and to avoid the accumulation of surpluses. A high degree of coordination is essential between the branches responsible for the calculation of requirements, the scheduling of production, and issue and storage.[26]

It was a major part of Rodwell's job as the Engineers' Director of Stock Control to achieve the requisite co-ordination between requirements, procurement, and storage and issue.[27] As delineated in August 1943 and as applied to the 1943 procurement program, only Rodwell was to recommend extension or cancellation of contracts, or a revision of the ASP, "bearing in mind that a revision of the ASP is preferable to small changes in present procurement." [28] Although there were a number of cancellations and cutbacks during 1943, the Procurement Division tended to take as much as manufacturers offered and apply any resulting surpluses toward the 1944 ASP. The main consideration was to get the 1944 program as set up in the August 1943 ASP under contract as quickly as possible. So shortage-conscious was the Supply Division that Fowler requested ASF's permission to place orders to cover deliveries through December 1945 upon approval of the 1 February 1944 ASP. Fowler wanted to be able to assure Engineer contractors of future work so that they could hold onto their labor force, and he emphasized the fact that lead time for many items was from twelve to eighteen months. ASF was not persuaded. Special arrangements had been made to take care

[24] Ltr, ACofEngrs to Div Engrs *et al.*, 31 Dec 43, sub: Responsibility of Depot in Adequate Performance of Engr Sup. Opns Sec Storage Br file, Lt. Seaton.

[25] For a discussion of the investigations of the summer of 1943, see Smith, The Army and Economic Mobilization, Ch. III, pp. 89–97.

[26] Memo, Dir Mat ASF for Dir Purch Div ASF *et al.*, 28 Jan 44. Doc. 119 in Lt. Col. Simon M. Frank, The Determination of Army Supply Requirements. MS, OCMH.

[27] C/L 2359, 12 Apr 43, sub: Estab of the Office of the Dir Stock Control.

[28] Memo, C of Sup Div for Dir Stock Control, 17 Aug 43, sub: Proc of 1943 and 1944 ASP Rqmts. Exec Office Proc Div file, Adm Memos.

of items with inordinately long lead time. Otherwise procurement contracts would be limited to required production through December 1944.[29]

Although these and similar ASF pronouncements were rather clear indications of the way the wind was blowing, it was not until January 1944 that the matter took on hurricane proportions and the Procurement Division's world began to topple. On 12 January at 4:45 p. m. that office received from the Control Division, ASF, a copy of a report which charged the Corps of Engineers with thirty-two cases of having contracted for more than the total quantity authorized by the 1943 and 1944 programs combined. The Procurement Division thought the charge unwarranted. Half of the items said to be "overprocured" were merely "overrequisitioned." Orders might be canceled long before deliveries materialized. In other cases authorization to increase requirements was pending. But there was no blinking the fact that ASF's Production Division held strong convictions about the way the Engineers were handling their procurement program. Not a few weeks previously, the Procurement Division had been told informally that percentagewise on the basis of total program the amount of the Corps' overprocurement was greater than that of any other technical service. But Fowler believed the Engineers had an excellent general defense in the obvious difficulty of estimating requirements for Class IV supplies.[30]

ASF was not impressed. Procurement must be brought into immediate alignment with the ASP and kept there.[31] When the Engineers compared the quantities in the 1 February 1944 ASP—quantities that had been reduced by about 25 percent as a result of the recomputation of replacement factors ordered by ASF—with the quantities on order, they discovered "many instances" where 1944 required production had "already been exceeded." [32] ASF permitted the Corps to reschedule many contracts into 1945 because engines were involved. Even so the Procurement Division was faced with the necessity for canceling or cutting back more than 200 contracts.[33]

Stricter regulations for welding together the determination of requirements, the scheduling of procurement, and the stockage and rate of distribution of matériel were in preparation. On 7 March 1944 ASF inaugurated the Supply Control System, which gradually replaced the Army Supply Program as the primary statement of requirements. The Supply Control System recognized two categories of items. Principal items (P items) took in all the former criti-

[29] (1) *Ibid.* (2) Memo, ACofEngrs (Fowler) for CG ASF, 6 Sep 43, sub: Proc of Munitions. 470, Pt. 2. (3) Memo, Actg Dir Mat ASF for Fowler, 23 Sep 43, same sub. Same file. (4) Memo, Dir Mat ASF for CofEngrs *et al.*, 3 Aug 43. Same sub. OQMG file, 471.

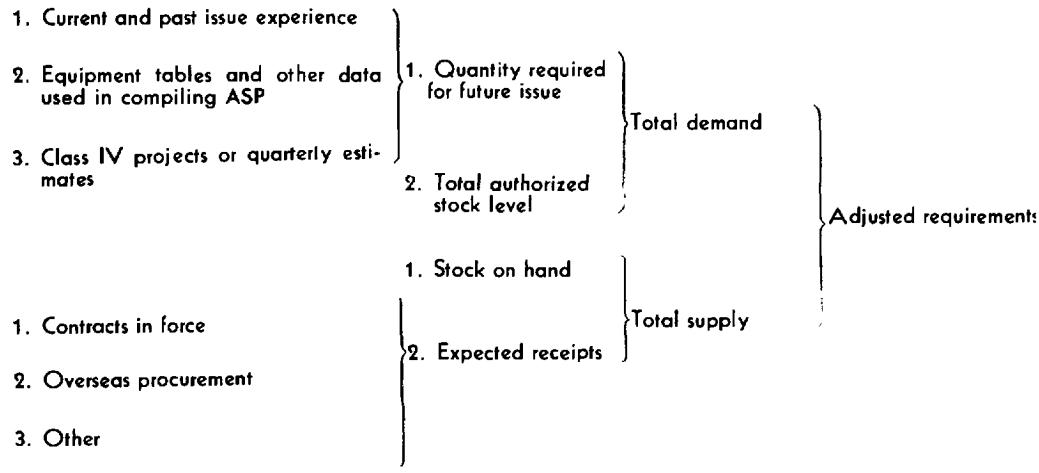
[30] Memo, ACofEngrs (Fowler) for Actg CofEngrs (Robins), 12 Jan 44, sub: Rpt. of Maj Xiques, ASF, as to Overproc of Engr Items. Exec Office Proc Div file, Engr Equip, Misc 3.

[31] Memo, Dir Prod Div ASF for CofEngrs *et al.*, 29 Jan 44, sub: 1944 ASP—Policies Affecting Prod. Exec Office Proc Div file, Cancellations or Cutbacks to Jul 44.

[32] (1) Memo, C of Alloc and Contract Br for C of Proc Div, 20 Mar 44, sub: Mtg of Div Engrs on 28 and 29 Mar 44. Exec Office Proc Div file, Divs or Dists, Misc to All. (2) Memo, C of Rqmts Br for C of Sup Div, 27 Aug 43, sub: Rev Maint Factors. Exec Office Proc Div file, Engr Equip—Spare Parts 1.

[33] (1) Memo, ACofEngrs for Mil Sup (Fowler) for Dir Mat ASF, 8 Feb 44, sub: 1944 ASP—Policies Affecting Prod. Exec Office Proc Div file, Cancellations or Cutbacks to Jul 44. (2) Speech, C of Proc Div, 28 Mar 44, sub: Procedures with Respect to Cutbacks, Rescheduling and Cancellations. Exec Office Proc Div file, Divs or Dists, Misc to All.

CHART 11—ELEMENTS OF SUPPLY AND DEMAND STUDIES, SUPPLY CONTROL SYSTEM



cal or controlled items as well as newly adopted equipment or equipment on which for other reasons there had been little opportunity to accumulate issue experience. All items not P items were designated secondary items (S items). The computation of requirements for P items and the resulting adjustment of procurement schedules had to be undertaken at least once a quarter as compared with the semiannual revision of the ASP. S items were studied at less frequent intervals and in less detail. The requirements computations, known as "supply and demand studies," were derived from the information shown on Chart 11.[34]

As interpreted by Col. Fred G. Sherrill, chief of the Procurement Division, to a conference of Division Engineers, the Supply Control System was aimed at "the almost impossible task of always having enough supplies on hand without ever having a surplus . . . ." Cancellations and cutbacks were "a necessary evil" which would "have an unhealthy effect" on contractors. Predicting that it was going to be more difficult to meet the ASP in 1944 than it had been in 1943, Sherrill warned the conference against allowing the new policies to interfere with the main job, which was still the attainment of high rates of production.[35]

The Procurement Peak

The Engineer portion of the 1 February 1944 ASP was valued at $1,772,000,000—an amount some $400,000,000 more than the value of total deliveries in 1943. At the time Sherrill spoke, in March 1944, the shortage of engines, transmissions, axles, and other components was continuing to have an adverse effect upon production and it was becoming harder and harder to hire competent labor. In other areas, however, there

[34] Smith, *op. cit.*, Ch. III, pp. 97–99.

[35] Speech, C of Proc Div, 28 Mar 44, sub: Procedures with Respect to Cutbacks, Rescheduling, and Cancellations. Exec Office Proc Div file, Divs or Dists, Misc to All.

had been marked improvement. Manufacturing capacity—thanks particularly to the opening of the new tractor and shovel facilities—was at last ample, the supply of materials was more plentiful, and the use of Chrysler engines was beginning to pay off.

The essentiality of construction machinery was no longer questioned. After production of tractors dropped seriously in February 1944, General Knudsen, director of War Department production, helped the Engineers to get more favorable consideration from WPB. In May, WPB assigned crawler tractors, trailers and dollies, truck bodies, and items destined for immediate shipment overseas, a 100 percent AA–1 priority. Heavy tractors were put on the production urgency list, a step that made not only the tractor manufacturers but also those producing components eligible for higher manpower priorities. High priorities on materials, components, and labor, plus increased productive capacity, enabled the Engineers to procure 28,785 tractors, thereby exceeding by more than 2,000 the number originally scheduled for production in 1944 and meeting the goal established later in the year. Yet in spite of the record number of tractors produced in 1944, the supply of heavy types was insufficient to satisfy demand at the end of the year, and continued short through January 1945. After that month requirements fell and production was gradually cut back. The first cranes and shovels came off the assembly line of the new facility at Lima, Ohio, in March 1944. The Lima plant eventually produced 61 cranes and shovels per month. During 1944, a total of 4,682 crawler-type cranes and shovels were delivered to the Corps of Engineers. Requirements and production were the same or almost so in all types.[36] (*Table 13*)

Although the unfilled demand for other types of construction machinery increased in the last month of 1944 and the first month of 1945, deliveries were large and generally in line with requirements. (*Table 14*) The situation as a whole was so much better in 1944 that in the latter half of that year the Engineers curtailed the used equipment program. In April 1945 the Redistribution and Salvage Branch directed the Great Lakes Division to confine its repairs to standard machines with a remaining life of not less than 75 percent that of a new machine.[37]

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[36] (1) C/L 2995, 5 May 44, sub: Asgmt of Priority Ratings to Mil Sup. (2) Memo, C of Proc Div for C of Opns Br, 9 Mar 44, sub: Mtg with Gen Knudsen on Prod of Tractors, Cranes, and Shovels. Exec Office Proc Div file, Engr Equip, Misc 3. (3) Ltr, Dir Constr Mach Div WPB to R. G. LeTourneau, Inc., 5 May 44. Management Br Proc Div file, R. G. LeTourneau, Inc., Pt. 1. (4) Hist of Constr Mach Div WPB, p. 42. (5) See above, p. 525.

Tractor deliveries in 1944 cannot be compared with earlier figures. In January 1944 the War Department redefined the division of responsibility for procurement of tractors. The former arrangement whereby the Ordnance Department bought prime movers and the Corps of Engineers construction-type tractors had resulted in the two services getting production off the same lines in many cases. Under the January 1944 arrangement the Ordnance Department procured tractors operating over twelve miles per hour; the Corps of Engineers, those operating up to and including twelve miles per hour. The new arrangement increased the Engineer program. Maj. Ralph L. Appleton, History of Construction Machinery for Overseas Supply (typescript, c. 1945), pp. 47–48.

[37] (1) MPR, Sec. 6, 31 Jan 45. (2) Ltr, C of Redistr and Salv Br to Great Lakes Div Engr, 4 Apr 45, sub: Repair of Used Equip for Trp Issue. 400.5, Pt. 2. (3) Memo, C of Constr Mach Br for C of Proc Div, 29 Dec 44, sub: Daily Log 152, 28 Dec 44. Tech Br Proc Div file, Daily Log Dec 44. (4) Wkly War Plan Staff Conf, 6 Nov 44.

TABLE 13—TRACTORS, CRANES AND SHOVELS: ANNUAL REQUIREMENTS AS OF SELECTED DATES AND ACTUAL DELIVERIES

Item	1944			1945		
	Requirements		Deliveries	Requirements		Deliveries
	February	October		February	June	
Bulldozer, tank mounting for M-4, A-1, A-2, A-3 tank, hydraulically operated	500	1,400	1,398	0	0	0
Crane, tractor operated, non-revolving, 20-ton, 20-foot boom	0	300	325	357	257	178
Cranes and shovels, crawler mounted:						
½-cubic yard, 5- to 6-ton, Class II	1,386	1,670	1,692	615	615	615
¾-cubic yard, 7- to 10-ton, Class III	2,327	2,219	2,200	2,011	1,661	1,205
1- to 1½-cubic yard, 20- to 30-ton, Class IV	575	371	345	590	511	348
1¾- to 2-cubic yard, 30- to 40-ton, Class V	238	372	350	331	325	140
2½-cubic yard, 45- to 60-ton, Class VI	85	51	52	10	10	10
3- to 4-cubic yard, 65- to 75-ton, Class VII	47	43	43	0	0	0
Cranes and shovels, rubber tired:						
⅜-cubic yard, 4- to 8-ton, Class X	779	772	775	1,364	1,150	456
¾-cubic yard, 8- to 12-ton, Class XI	566	473	471	696	0	439
¾-cubic yard, 14- to 18-ton, Class XII	720	683	693	639	[a]	300
¾-cubic yard, 20-ton, Class XIII	160	132	132	59	54	26
Single engine driven, self-propelled, 8- to 15-ton, Class XIV	559	558	474	752	290	290
Tractors, crawler type, diesel engine driven, complete with accessories:						
91 to 140 drawbar horsepower, Class I	3,238	2,983	3,130	3,484	3,484	1,986
61 to 90 drawbar horsepower, Class II	9,702	9,189	9,747	14,143	11,223	8,480
46 to 60 drawbar horsepower, Class III	4,787	4,776	6,433	5,702	3,469	3,153
36 to 45 drawbar horsepower, Class IV	8,930	9,436	9,475	5,792	4,648	3,525

[a] Requirements not shown in available records.

Source: (1) ASP, Sec. 1, 1 Feb 44, 1 Oct 44. (2) MPR 22-G-X, 28 Feb 45. (3) MPR 22-G, 30 Jun 45. (4) Crawford and Cook, *op. cit.*, p. 25.

The Procurement Division met the needs for many types of new construction equipment only by using gasoline as well as diesel engines. Once production got under way the Chrysler plant maintained its schedules. Theater Engineers found gasoline engines much inferior to the sturdier industrial types and complained frequently on this score. But the die had been cast. In 1944 it was a choice between gasoline engines or much less construction machinery. Perhaps some officers would have chosen to get along with less machinery. Perhaps better maintenance facilities would have rendered complaints from overseas less numerous.[38]

As the United Nations pushed the offensive in Europe, requirements for all types of bridges rose. Canvas for the large numbers of pneumatic floats needed for the popular treadway bridge was in critically short supply. Various canvas and rubber crises were overcome in 1944, and the shortage of labor was relieved by the establishment of a pneumatic float making plant in an area of labor surplus. By the end of the year deliveries of 18-ton floats were just about equal to demand. On the basis of 144 treadways per set, the Engineers received 82 complete bridges in 1944 with additional replacement quantities of floats and saddles. In May 1944 the H–20 bridge was suddenly reinstated in the procurement program in order to supply bridging over the Ledo Road in Burma. The suddenness of the demand and delays in letting contracts made it difficult to secure steel for these bridges even with an emergency WPB directive. With the first H–20's not delivered until September, only 128 were received in 1944 against a requirement for 220. Production for 1945, scheduled farther ahead, was adequate, and 253 were made in the first eight months. The Engineers in 1944 also began once more to buy the H–10 bridge, this time in a knockdown version which made for easier shipping. Requirements were known far enough in advance so that the full demand of 200 was met by the end of the year. By the time Japan surrendered, the Engineers had purchased 160 additional H–10 bridges.[39]

A success statistically, procurement of Bailey bridges was to all practical purposes almost a complete failure. Bailey bridge parts not only had to be interchangeable with each other but also with those parts made in England. The Chicago Ordnance District bought the gauges for the Engineers in 1942. Although inspected by the British representative, the gauges proved inaccurate, and reports that the parts were not interchangeable began to come in during 1943. The Engineer Board found that the master gauge could not be altered, and it was not until August 1944 that a new one was ready. Gauges were then altered and inspectors given instruction that was long overdue. In 1944 the Engineers bought 850 Bailey bridges, a quantity that was more than sufficient to meet overseas demands.

[38] (1) Memo, C of Components Sec Tech Br for C of Tech Br, 22 Aug 44, sub: Catalog Order Bd—Crane and Shovel Production. Management Br Proc Div file, Components. (2) Memo, AC of Components Sec for C of Tech Br, 16 Aug 44, sub: Engine Substitution. Exec Office Proc Div file, Engr Equip, Misc, Engines. (3) Memo, ACofEngrs War Planning for ACofEngrs Mil Sup, 6 Jan 45, sub: Expansion of Catalog Engr Production, with 1st Ind, 17 Jan 45. Management Br Proc Div file, Engines.

[39] (1) Engr Bd Hist Study, The Conservation of Critical and Strategic Materials in the Development of Engineer Equipment, pp. 66–67. (2) Ann Rpt OCE, FY 1945. (3) Memo, Robert F. Wise for C of Cen Planning Br Proc Div, 28 Jun 44, sub: Proc H–20 Bridges on Requisition EP–84729. Exec Office Proc Div file, Engr Equip, Misc 3. (4) MPR 20—ENG, 30 Nov 44. (5) Daily Log, Rqmts Br, 27 Jul 44. Rqmts Br file, Daily Log.

TABLE 14—CONSTRUCTION MACHINERY: ANNUAL REQUIREMENTS AS OF SELECTED DATES AND ACTUAL DELIVERIES

Item	1944			1945		
	Requirements		Deliveries	Requirements		Deliveries
	February	October		February	June	
Auger, earth, skid mounted, gasoline engine driven	234	191	206	231	231	117
Compressors, air:						
Trailer mounted, pneumatic tires, diesel engine driven, 315 cubic feet per minute	680	680	680	561	384	233
Truck mounted, gasoline engine driven, 105 cubic feet per minute	3,100	3,122	3,112	1,335	922	922
Crushing and screening plant, 2 units, gasoline engine driven, semitrailer mounted, 25 cubic yards per hour	221	229	267	540	383	255
Distributors:						
Bituminous material, trailer mounted, 1,250 gallon	146	150	150	370	129	129
Water, truck mounted, 1,000 gallon	200	250	234	273	313	242
Ditching machine, ladder type, crawler mounted, gasoline engine driven, digging depth 8 feet, width 18 to 24 inches	350	324	324	371	174	143
Graders, road:						
Motorized, diesel engine driven, 12-foot moldboard	1,825	1,825	1,825	2,088	2,411	1,154
Towed type, leaning wheel, hand controlled, 12-foot moldboard	634	541	541	537	291	149
Mixer, concrete, gasoline engine driven, trailer mounted, 14-cubic foot	500	291	364	801	452	352
Rollers, road:						
Gasoline engine driven, 3-wheel, 10-ton	600	628	592	804	346	310
Gasoline engine driven, tandem, 2-axle, 5- to 8-ton	480	309	309	808	461	278
Towed type, sheepsfoot, 2-drum-in-line	665	605	629	709	367	294
Rooter, road, cable operated, 3-tooth	280	220	220	298	159	63
Saws:						
Chain, portable, pneumatic, 24-inch blade	3,084	2,321	3,144	86	39	39
Chain, gasoline engine driven, 36-inch blade	4,054	4,054	4,054	4,560	1,738	1,738
Circular, woodworking, portable, pneumatic, 12-inch blade	5,559	5,451	5,232	248	1,581	1,451

TABLE 14—CONSTRUCTION MACHINERY: ANNUAL REQUIREMENTS AS OF SELECTED DATES AND ACTUAL DELIVERIES—Continued

Item	1944			1945		
	Requirements		Deliveries	Requirements		Deliveries
	February	October		February	June	
Scrapers, road:						
Motorized, cable operated, 12-cubic yard	389	383	383	352	537	262
Towed type, cable operated, 3½-cubic yard, Type I	557	498	498	168	91	91
Towed type, cable operated, 6-cubic yard, Type II	584	402	404	133	83	83
Towed type, cable operated, 8-cubic yard, Type III	1,430	1,337	1,336	1,747	890	716
Towed type, cable operated, 12-cubic yard, Type IV	500	500	526	1,075	560	540
Semitrailers:						
Front loading, without dolly, 20-ton	(a)	400	1	8,914	6,207	2,082
Rear loading, with dolly, 20-ton	3,872	3,732	3,614	255	255	255
Trailer, full, low bed, 60-ton	55	51	51	74	74	69
Welder, electric arc, gasoline engine driven, 300 amp, skid mounted	2,700	2,821	2,068	2,200	1,752	1,020

[a] Requirements not shown in available records.

Source: (1) ASP, 1 Feb 44, 1 Oct 44. (2) MPR 22-G-X, 28 Feb 45. (3) MPR 22-G, 30 Jun 45. (4) Crawford and Cook, *op. cit.*, pp. 25–27.

In the European theater, however, these American Baileys had to be set aside or carefully segregated from those of the British bridges because corrections in the gauges had come too late to provide the desired interchangeability. (*Table 15*)[40]

During 1944, the canvas shortage as well as a lack of engines interfered with production of water supply equipment. In order to produce 3,000-gallon water tanks, Engineer contractors needed the heaviest weight canvas. Partly because replacement rates were high in the Pacific, 1944 requirements were far greater than in 1943. Even with delivery of over 16,500 tanks, shortages of canvas cut the supply to more than 1,350 below required production at the end of 1944. Because of the difficulty in getting canvas and because fungus growths in the Pacific caused canvas tanks to deteriorate rapidly, the Engineers turned to glass fiber cloth as soon as this fabric had been developed. Through the use of both canvas and glass fiber cloth—contracts for which were let in the fall of 1944—supply caught up with demand in

[40] (1) Incl, 31 Mar 44, with Memo, C of Proc Div for C of Prod Sv Br ASF, 10 Apr 44, sub: Monthly Rpt of Prod Difficulties. 400.12, Pt. 1 (C). (2) ERDL file, BR 341E.

TABLE 15—BOATS AND BRIDGES: ANNUAL REQUIREMENTS AS OF SELECTED DATES AND ACTUAL DELIVERIES

Item	1944			1945		
	Requirements		Deliveries	Requirements		Deliveries
	February	October		February	June	
Boats						
Assault, M–2, without paddles or canvas bag	377	377	377	10,639	4,823	2,657
Landing, pneumatic, rubber, 10-man	1,494	1,272	1,238	9,829	8,316	3,710
Reconnaissance, pneumatic, canvas, 2-man, without paddles	10,095	10,095	10,695	13,182	9,974	7,700
Storm, plywood	0	0	0	2,658	3,124	2,502
Utility, gasoline powered, 18-foot	873	523	546	1,800	1,824	537
Motor, outboard, with chest and spares, 22 hp	3,296	2,916	2,863	6,000	4,792	2,402
Motor, outboard, with chest and spares, 50 to 55 hp	2,407	2,074	2,618	2,892	2,600	1,386
Bridges						
Fixed, steel:						
Panel, Bailey type, M–2, widened roadway	700	856	850	604	396	385
Box girder, H–10, knockdown type	200	200	200	167	160	160
Box girder, H–20	150	220	128	364	250	252
Treadway, M–2:						
Float, pneumatic, with emergency kit, 18-ton, M–1, with carrying case	10,622	10,837	10,553	21,948	14,000	9,920
Saddle, steel, treadway, knockdown type, M–1, 18-ton	6,105	7,294	7,264	14,665	10,000	5,294
Truck, cargo, 6-ton, 6 x 6	1,500	1,292	1,143	2,499	1,204	773
M–3:						
Float, pneumatic, with emergency kit, 13-ton, M–3, with carrying case	8,699	8,908	9,098	3,628	4,617	4,617
Ponton:						
Steel, 25-ton	130	147	147	0	0	0

Source: (1) ASP, 1 Feb 44, 1 Oct 44. (2) MPR 20–ENG, 31 Dec 44, 31 Aug 45. (3) MPR 22–G–X, 28 Feb 45. (4) MPR 22–G, 30 Jun 45. (5) Crawford and Cook, *op. cit.*, p. 25.

1945 with deliveries of 20,760 in the first eight months.[41]

The Engineers' largest requirement for canvas was for covers and doors for portable airplane hangars. In the fall of 1944 the Engineers also revised these specifications to allow the use of glass fiber cloth. Because there were no further requirements for catenary-supported hangars by the end of 1944 and deliveries were satisfactory no covers were produced from glass-fiber cloth. Production limitations, however, resulted in an unfilled demand for 141 structural steel hangars, 130 by 160 feet. Although fiber glass doors were authorized to replace canvas in 1944, the Procurement Division was unable to get any deliveries until May 1945 because of deficiencies in the design. In the meantime, sufficient canvas was obtained so that by March supply caught up with demand.[42]

The success of the Engineer procurement program thus varied according to the item being bought. In the first half of 1944 deliveries were but 42.7 percent of the 1943 program, with monthly receipts well below the high set in December 1943. Then in August the Corps attained a record delivery of $150,579,000. Increasing deliveries each month to a wartime peak of $192,632,000 in December, the Engineers by purchasing equipment valued at more than $1,778,000,000 met 96.1 percent of their 1944 procurement objective.[43]

This impressive record was achieved with an administrative organization which gave constant evidence of inefficiency. Disputes over prices and delivery schedules occurred frequently after the reorganization of November 1943, which split responsibility for contracting between divisions and districts. Requests for permission to cross over division boundaries in search of production facilities became common. Procedures and practices varied from one division to another. On 1 September 1944 the Engineers reorganized once again in an effort to relieve the procument program of these burdens. This time territorial boundaries were erased. All major items—over 2,500 in number—were earmarked for commodity purchase by one of the eleven Division Engineers, who were to handle the contracting process from start to finish. District Engineers, acting on appointment as agents of Division Engineers, would take care of production and shipping matters. Potentially each District Engineer had eleven bosses and each Division Engineer forty-four offices to supervise.

The Procurement Division considered the reorganization of September 1944 a forward step. As ASF had predicted almost two years earlier, commodity purchasing proved far superior to procurement on a territorial basis. Another aid to simplification occurred when several Division Engi-

[41] (1) Engr Bd Hist Study, The Conservation of Critical and Strategic Materials in the Development of Engineer Equipment. (2) Engr Bd Hist Study, Water Distribution and Storage. (3) ASP, Sec. 1, 1 Feb 43. (4) Memo, J. I. Horn, Canvas Unit, for C of Management Br, 11 May 45, sub: Rpt on Mr. Horn's Two-Day Fld Trip to NAD, May 2 and 3, 1945. Management Br Proc Div file. (5) Ann Rpt OCE, 1945.

[42] (1) Study cited n. 41 (1). (2) MPR 20—ENG, 31 Dec 45; 31 Mar 45. (3) 1st Ind (basic missing), Exec Asst Sup Div Ohio River Div to Gen Items Br Rqmts Div, 4 Jun 45, sub: Receipt of Incomplete and Unissuable Items of Engr Sup From Proc. Exec Office Proc Div file, Divs and Dists, Misc 1945.

[43] (1) MPR, Sec. 6, 30 Jun 44. (2) Crawford and Cook, *op. cit.* (3) Ltr, ACofEngrs for Mil Sup to Great Lakes Div Engr *et al.*, 16 Jan 45, sub: Mil Sup Status. Exec Office Proc Div file, Proc Policy and Procedures. (4) 1st Ind, 20 Nov 44, on Memo, Dir Sup ASF for CofEngrs, 20 Nov 44, sub: Availability of Engr Supplies and Equip. Storage Br, Read file.

neers asked to be relieved of procurement functions. By the spring of 1945 the organization was operating with six division and thirty district offices. But administration was still far from smooth.[44] Consider the typical case of the District Engineer who reported that his office was required to handle contract modifications in three different ways.[45]

Complaints about the procurement organization were confined to those who had to work with it day in and day out. Not unnaturally higher echelons of the Chief's office concluded that nothing much could be wrong with an organization which month after month reported steadily mounting deliveries of engineer matériel. Such evidence led Reybold to pronounce the organization "truly sound" even as he called attention to numerous areas of confusion and dissatisfaction.[46] Brig. Gen. Rudolph C. Kuldell, who replaced Fowler as Assistant Chief of Engineers for Military Supply in June 1944, was a good deal more reserved in his judgment. "While, of course, we can get results by the present organization and methods," Kuldell wrote in December 1944, "it is impossible to compete in speed and performance with other services who are organized on a nation-wide scale according to a standard, pre-determined organization and who use identical methods and procedures in handling all phases of the procurement program." [47] Yet it was not in the actual purchase of supplies but in carrying out its part in the Supply Control System that the supply organization fell down most seriously.

Inefficiency in the Midst of Plenty

Responsibility for preparing the supply and demand studies required by the Supply Control System was assigned to the Requirements and Stock Control Branch, J. M. Wright transferring from the smoothly operating CMP group in the Procurement Branch to become its chief. Dawson had gone to the Southwest Pacific in the fall of 1943 and Col. Lyle Rosenberg took his place as chief of the Supply Division. The Office of the Director of Stock Control having been abolished, Rodwell served for a time as head of the Engineer Field Depot Office, replacing Beauchamp who came back to Washington to head the Storage Branch of the Supply Division. Dissolution of the Engineer Field Depot Office itself came early in May 1944. Division Engineers then stepped into the role of immediate supervisors of warehousing operations, following guide lines established by Beauchamp's Storage Branch. Capt. Richard H. Workman accompanied Beauchamp back to Washington to co-ordinate the stock reports received from the field with Wright's Requirements and Stock Control Branch. Preparation of the consolidated stock report was assigned to the Engineer Central Stock Control Agency. CENSTOCK, which was located in St. Louis, Missouri, became the extract point for processing overseas requisitions,

[44] (1) Orgn for Engr Proc. (2) C/L 3271, 30 Aug. 44, sub: Reorientation of Proc Function—Centrally Controlled Items. (3) Memo, C of Proc Div for ACofEngrs Mil Sup, 26 Mar 48, sub: Orgn of CE for Proc of Mil Sup. Exec Office Proc Div file, Orgn CE.

[45] Memo, C of Proc Div for CofEngrs, 8 Mar 45, sub: Contract Modification. Exec Office Proc Div file, Proc Policy and Procedures.

[46] Ltr, CofEngrs to NAD Engr *et al.*, 20 Jan 45, sub: Clarification of Proc Procedures. Exec Office Proc Div file, Divs and Dists, Misc.

[47] Memo, Kuldell for C of Control Br, 23 Dec 44, sub: Standardization Method of Proc. Exec Office Proc Div file, Proc Policy and Procedures.

taking over this function also from the Granite City Depot.[48]

In March 1944 OCE directed the depots to reset stock levels, allowing a 45-day supply for zone of the interior and a 60-day supply for overseas issues plus a 30-day in-transit time. Reserves would be stocked in amounts equal to one half the level established for overseas issue. The depots were expected to use past issues as a guide in arriving at final estimates, but were instructed to examine other sources such as projected troop strengths for the area or theater served. The Inventory Control Section of Wright's Requirements and Stock Control Branch would review the levels, which would be changed as experience indicated. Three Regional Control Offices (Western, Southern, and Northeastern) were assigned responsibility for the replenishment of stocks up to established levels. Distribution and filler depots forwarded replenishment requisitions to the appropriate Regional Control Office which ordered transfers from reserve stocks within the region, procured noncontrolled items locally, or, in the case of controlled items, forwarded the requisition to OCE.

Life under the new dispensation was extremely hard for the Engineers. Fowler's January 1944 call for immediate improvement, despite close follow-up by the Engineer Field Depot Office, did not bring forth the desired reform.[49] The following comments are typical of what was being said about depot operations months later:

> The inspections revealed a marked deficiency . . . in the matter of accurate stock location records and location procedure.[50]
>
> The book inventory at this depot appears to be in a bad condition. Warehouse refusals on general engineer equipment have averaged 50 per day for the first 20 days of the month.[51]
>
> There is an absence of a training program for electric accounting machine operators. . . . It was noted that there had been inadequate follow-up . . . concerning proper methods of reporting issues, specifically in the transfer of issue balances to key depots and the elimination of extraneous issue balances for non-standard items.[52]

Statistical reports revealed other signs of weakness. At the end of September seven depots reported between 11 and 19 percent of their requisitions unprocessed for reasons presumably within their control. Additional requisitions had been held up because of failure to receive transportation releases or because items were out of stock. Extracts were running between 9 and 32 percent of shipping work loads, owing largely, the depots claimed, to insufficient stocks. There had been a large increase in shipments immediately after D Day. (See *Chart 10.*) All the services found themselves short of stocks in July and August. But Beauchamp suspected that success as measured by overseas shipments was not the sole cause of

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[48] (1) Orgn Chart Sup Div, 10 May 44. (2) C/L 2981, 28 Apr 44, sub: Transmission of Tri-Wkly Stock Balance Rpts on Critical Items to Engr CENSTOCK. (3) C/L 3032, 19 May 44, sub: Transfer of Responsibility of Dir Stock Control.

Strictly speaking, Dawson had never been chief of the Supply Division, but the Supply Division at this time was the equivalent of the old Requirements, Storage and Issue Branch. See above, pp. 94, 532.

[49] (1) C/L 2800, 26 Feb 44, sub: Engr Trp Sup. (2) C/L 2888, 23 Mar 44, Same sub. (3) Memo, C of EFDO for C of Sup Div, 23 Feb 44, sub: Summary Rpt on Inspec Made as a Result of Sup Div Ltr 111. Opns Sec Storage Br file, Lt. Seaton.

[50] 1st Ind, C of Storage Br to NAD Engr, 4 Sep 44 (basic missing). Storage Br, Read file.

[51] Memo, C of Procedures Sec Storage Br for C of Storage Br, 29 Sep 44, sub: Visit, Granite City Engr Depot. Storage Br, Read file.

[52] Ltr, AC of Storage Br to Pacific Div Engr, 20 Oct 44, sub: Rpt of Visit of Capt R. H. Workman to Depots of Pacific Div. Storage Br, Read file.

failure to measure up to established standards of efficiency. Stocks would not have been so low, Beauchamp believed, unless the depots had been laggard in submitting replenishment requisitions or unless some responsible agency had neglected to fill them.[53]

Late in November ASF's Distribution Branch noted that for the past several months Engineer depots had been able to furnish only about 75 percent of items on initial requisitions. ASF granted that this fact was no proof that troops were suffering for want of engineer equipment. Diversion of requisitions to other supply points might have assured the timely flow of supplies. ASF did contend that the high percentage of depot refusals proved that "stock control has not been made effective to the extent which will generally preclude unwarranted rehandling of requisitions with the consequent loss of time and efficiency." [54] The Engineers called for another look at the figures, claiming that the total picture was being distorted because of the admittedly "acute problem" of procurement of spare parts. More than 83 percent of general items of equipment had been supplied by the original source in October. The trend of availability for this group had been steadily upward for the last five months.[55]

The Corps was also quick to take umbrage at ASF's judgment that the "general performance" of the Engineer supply organization "has not been on a par with that attained by a majority of the other Services." Let ASF compare the Engineers' work load with that of the others, Kuldell protested on 18 October. Procurement records showed that Engineer deliveries were 55 percent greater in the third quarter of 1944 than in the first quarter of 1943 as compared with a 10 percent increase experienced by all the services combined. Let ASF consider the increase in total tonnage shipped by the Corps—367 percent more in the third quarter of 1944 than in the first quarter of 1943. Finally, let ASF note that no theater had reported serious shortages of engineer equipment. Kuldell did not voice Beauchamp's suspicions that failure to reorder might account for the widespread out-of-stock position reported. Rather Kuldell argued that since Engineer procurement deliveries had increased five and a half times more than the average and since stocks in Engineer depots were low, it should be concluded that the demand for engineer supplies was five and a half times greater than that for supplies in general. "Had the increase in demand for engineer equipment been only equal to the other Services and the Procurement remained the same," he asserted, "the Corps of Engineers' depots would have been fully stocked with all items late in the year of 1943 and Supply performance would have been simple, quick and flawless." [56]

Unquestionably the Engineer work load—whether measured by procurement deliveries or tonnages shipped—increased by a greater amount percentagewise than that of the services as a whole from the first quarter of 1943 through the third quarter of 1944. Reference to statistical reports compiled after the end of the war and presumably more accurate than those used by Kul-

[53] (1) Memo, C of Storage Br for C of Plans and Analysis Sec, 18 Oct 44, sub: Analysis of Sup Opns Rpt, Form 814. Opns Sec Storage Br file. (2) ASF Stat Review.

[54] Memo, Dir Sup ASF for CofEngrs, 20 Nov 44, sub: Availability of Engr Sup and Equip. Storage Br, Read file.

[55] 1st Ind, 27 Nov 44, on memo cited n. 54.

[56] Memo, ACofEngrs Mil Sup for Dir Sup ASF, 18 Oct 44, sub: Analysis of Distr System Employed by CE. 400, Pt. 2.

dell reveals indeed that the increase in Engineer deliveries was 61.5 percent rather than the 55 percent cited by him in October 1944, and this was against an over-all increase of only 11.9 percent. Although the increase in tonnages shipped by the Engineers during the same period appears to have been somewhat less than Kuldell claimed, it was still substantial, 268 percent. The corresponding increase in tonnages shipped by all services was but 84.5 percent. It must be remembered, however, that the Engineer procurement program did not pick up momentum until the second quarter of 1943. Taking this quarter as a starting point, Engineer deliveries show an increase of 31.3 percent through the third quarter of 1944. But all services showed an increase of only 7.0 percent during this time. By the fourth quarter of 1943 the disparity between the Engineer experience and that of the other services began to narrow; in fact, if shipment by line items rather than by tonnage is taken as a measurement during this period, the Engineer increase was less than the average, as indicated below:

	Procurement Deliveries		Tonnages Shipped		Line Items Shipped	
	Engineers	All Services	Engineers	All Services	Engineers	All Services
1st Q 1943 – 3d Q 1944	61.5	11.9	268	84.5	(a)	(a)
2d Q 1943 – 3d Q 1944	31.3	7.0	106	41.6	(a)	(a)
3d Q 1943 – 3d Q 1944	24.4	1.2	79.6	33.3	(a)	(a)
4th Q 1943 – 3d Q 1944	5.7	−3.3	41.9	48.9	18.3	28.4
1st Q 1944 – 3d Q 1944	12.0	2.6	38.8	35.8	8.3	21.2

[a] Not available.

Kuldell admitted that the performance of Engineer depots had been substandard in shipments on initial requisitions. Low stocks were one cause of this. The other—and this was confessing a good deal—was stock misplaced. He claimed, however, that CENSTOCK had been able in almost all cases to locate the needed items somewhere. The record on second extracts was 95 percent. Final delivery was well over 95 percent because some supplies were still being shipped direct from factory to port. A 95 percent record on second extract could hardly have impressed ASF which had set the standard at 95 percent on first extract.[57]

When Kuldell referred to misplacement of stocks in partial explanation of the poor record made by the depots in filling initial requisitions, he was referring to a condition that had, as well, an adverse effect upon keeping accurate stock records and consequently upon the preparation of the supply control sheets which were the stuff from which requirements were now being computed under the Supply Control System. Time and again the depots were told that accounts must correspond to what was physically available for distribution. But records continued to show stocks that were misplaced and therefore for all practical purposes did not count.

The rules of the names and numbers game were being violated in all echelons of supply despite general improvement in catalogs. As revised in February 1944 to conform to the presentation prescribed by ASF, the Engineer standard catalog consisted of eleven parts, six on general items and five on spare parts. In addition the

[57] (1) *Ibid.* (2) Ltr, C of Rqmts and Stock Control Div to NAD Engr, 15 Dec 44, sub: Short Rpts as an Indication of Out-of-Stock Condition. Exec Office Rqmts Div, Read file.

Engineers published in June a handbook commonly called the "Pink Book." Issued bimonthly, the Pink Book listed the approximately 10,000 standard items of Class II and Class IV supplies. The Pink Book listed the office responsible for procurement of each item, its procurement status, the region or depot responsible for storing it, cross-referenced substitutions, and in other ways provided a ready reference for untangling the maze of functions and the offices which performed them. But the various catalogs and lists were never brought into complete conformity. At all times some group somewhere along the line lacked current information on changes. Depots had been told to use the Pink Book in making up stock reports. But CENSTOCK, the agency which had to work with the reports, was nearly always a step ahead of the current edition of the Pink Book. Procurement officials were particularly remiss about entering the correct name and number on documents forwarded to depots. They had their minds on other matters. In October, Workman reported from the Storage Branch that an on-hand quantity of almost 34,000,000 for 2,052 items from bolts to tractors had been omitted from the Consolidated Stock Report because of various discrepancies in identification.[58]

In view of the well-known inaccuracies in the basic data, persons like Workman and Wright could not have been greatly surprised when the chief of the Requirements Branch, ASF, pronounced the supply control sheets prepared by the Corps of Engineers "the worst of all the Services." But officially the Corps fought back. In relation to volume of procurement, the Corps was required to produce many more sheets than the services to which it had been unfavorably compared: Ordnance, with procurement for November valued at $981,452,000, produced 413 sheets; Quartermaster, with procurement at $572,138,000, produced 315. The Corps of Engineers produced 409 sheets on procurement valued at $201,515,000.[59] The job was formidable:

> Preparation of the sheets requires availability of data as to past production, future production schedules and issues as of the end of that month. Much of these data must come from depots and procuring districts in the field, and experience has shown . . . the information cannot be made available in OCE until at least the sixth of the month. Through working many hours of overtime and diverting to the task numerous employees from other units . . . it has been possible . . . to deliver the . . . sheets on the 11th of the month. The speed required is so great, however, as to put out of the question any except the most routine checking. . . . Subsequent to the delivery of sheets, this office must compile within 72 hours and 144 hours, respectively, the exhaustive dollar volume summary tabulations. . . . Upon the receipt of the published MPR–20 ENG, usually about the 15th of the month, copies are studied for about two days by all interested divisions of O. C. E. Thereafter informal conferences are held . . . at which . . . it is *for the first time* possible to form . . . considered recommendations as to . . . particular items of supply. . . . Decisions thus reached are . . .

[58] (1) Engr Sup Procedures, Mar 45. (2) Memo, Dir Mil Sup for OCE Suggestion Comm, 23 Jun 45, sub: Suggestion 183. Exec Office Rqmts Div, Read file. (3) Ann Rpt OCE, 1945. (4) Memo, AC of Storage Br for ACofEngrs Mil Sup, 13 Jan 45, sub: Control Br Survey of Engr CENSTOCK. Storage Br, Read file. (5) Ltr, C of Rqmts and Stock Control Div to NAD Engr, 16 Jan 45, sub: Changes in Stock Nos. Exec Office Rqmts Div, Read file. (6) Memo, C of Stock Accounting Sec Storage Br for ACofEngrs for Mil Sup, 11 Nov 44, sub: Relation of Uniform Stock Identification to Performance of Engr Sup. Exec Office and Coord Sec Rqmts Div, Read file.

[59] Memo, ACofEngrs for Mil Sup for Dir Rqmts Div, 19 Dec 44, sub: Sup Control Sheets. 400, Pt. 2.

submitted on the 21st of the month. Following its combination with the agenda submissions of interested ASF divisions, decisions as to procurement action are taken at the agenda meeting [ASF] on the 27th and 28th of the month. Following receipt of approval of these decisions . . . they must be implemented by the issue of . . . procurement requisitions. Before the completion of the requisitioning process, the sixth of the following month, bringing with it the new compilation of supply control sheets, is usually at hand.[60]

The Supply Control System was unpopular within the Procurement Division, its chief, Colonel Sherrill, protesting what he termed procurement on a "30-day stop and go basis." "I am not unmindful of the fact that the conduct of the war and its progress has a material bearing on what is needed at any given moment," he told Kuldell. "Nevertheless, it seems to me to be bordering on the fantastic to say on 31 December that we need a definite number of Item X which cannot come to hand for six months and then on 31 January say we need less or more of Item X, still four to six months away." Sherrill favored launching a movement "which will have as its objective the fixing of a policy . . . to take everything within the scope of a given contract which industry can produce, pay full prices up to 'VJ Day' plus six months and to do converting or tapering off during that six months' period." [61] In a more practical vein Kuldell himself admonished ASF that "issue history must be given relatively little weight when firm requirements, such as theater quarterly estimates [for Class IV supplies], large changes in the troop basis, or large International Aid commitments are at hand." [62] Persons on the procurement side were understandably embarrassed at having to call for all-out production one day and cancellation of a contract the next. Had the Engineer supply control sheets been more accurate, fluctuations in the procurement program would have been neither so frequent nor so violent: [63]

Required Production 1945

31	January	$2,136,988,000
28	February	1,923,254,000
31	March	2,316,368,000
30	April	1,869,191,000
31	May	1,607,329,000
30	June	1,850,050,000
31	July	1,572,575,000
31	August	1,114,854,000

Greater accuracy in statements of requirements might also have precluded the large inventories of supplies held in Engineer depots at the end of the war.

Spare Parts

All the troubles which plagued the procurement and supply system, troubles that had their roots in the shortage of steel, of components, of manufacturing capacity, and of experienced officers and civilians, were present to an exaggerated degree in the effort to provide spare parts for engineer equipment. The report of the chief of the Maintenance Section on the status of spare parts supply at the end of 1942 had been generally optimistic. Although promising Fowler no miracles, Smith had expressed faith in the soundness of the Engineer maintenance system. He was encouraged by signs that the Procurement Branch

[60] Memo, CofEngrs for Dir Plans and Opns ASF, 15 Dec 44 sub: Sup Control Rpt MPR—20 ENG. Exec Office and Coord Sec, Read file.

[61] Memo, C of Proc Div for ACofEngrs Mil Sup, 29 Jan 45, sub: Term and Cutbacks. Exec Office Proc Div file, Cancellations, Cutbacks, and Term.

[62] 1st Ind, 8 Feb 45, on Memo, Dir Plans and Opns ASF for C of Rqmts and Stock Control Div, 17 Jan 45, sub: Results of Sup Control Action Conf. Exec Office Proc Div file, MPR—20 ENG, Sup Control.

[63] (1) MPR–22 G, 31 Jan 45, 31 Mar 45–31 Aug 45. (2) MPR–22 GX, 28 Feb 45.



STACKS OF ENGINEER SUPPLIES *at a depot in Luzon at the end of the war.*

was going to buy fewer different makes and models. He was hopeful that with production in full swing a better balance could be struck between the delivery of end items and of spare parts. He had been convinced, moreover, that certain administrative changes scheduled to go into effect early in 1943 would prove beneficial.

Basic to these forthcoming administrative changes was the decision to concentrate the storage of spare parts in the Engineer Section of the Quartermaster Depot at Columbus, Ohio. Ideally, spare parts, like general items of equipment, should have been stored in several locations, close to the ports of embarkation and near the training camps. But dispersion of the relatively small store of parts would have resulted in a multiplication of depot refusals, extracts, and transporting back and forth. Under the circumstances, central storage promised speedier operations. The Columbus depot appeared particularly suitable because it was located in the heart of the construction machinery industry—close to suppliers if distant from most of the installations to be supplied.[64]

[64] (1) Unless otherwise noted, this section is based upon correspondence in 400, Pt. 2; 460, Pt. 1, and Exec Office Proc Div file, Engr Equip Spare Parts. (2) See above, p. 214. (3) Route Slip, Dawson, 10 Nov 42. Intnl Div file, Defense Aid 451.31, 23 Apr 40–13 Mar 42. (4) Memo, Fowler for All Concerned, 11 Nov 42, sub: Spare Parts for Defense Aid. Same file. (5) Route Slip, Smith to Molnar, 12 Nov 42. Same file. (6) Interv, Brig Gen C. Rodney Smith, 25 May 55.

About 5 percent of spare parts was stored at Ogden, Utah (searchlights), and Granite City, Illinois (nonstandard tractors, cranes, and shovels).

The decision to store all spare parts at the Columbus depot coincided with SOS' pressure to transfer as many activities as possible out of Washington. In January 1943, Smith's section, its name changed to the Engineer Field Maintenance Office though it was still part of the Requirements, Storage and Issue Branch, OCE, moved into an office in downtown Columbus. The move presaged no change of function. The Engineer Field Maintenance Office remained the agency for the determination of requirements and the initiation of procurement requisitions for spare parts and maintenance equipment for mobile and fixed shops, the preparation of parts catalogs and maintenance manuals, and field supervision over depot and unit maintenance activities. The move to Columbus offered the advantage of closer contact with the Spare Parts Branch of the Engineer Supply Section of the depot, which prepared the first, second, third, and fourth echelon lists of spare parts that served as a primary source of procurement requisitions in much the same way as the T/BA served for general items.[65]

In devising the original lists of spare parts, Colonel Harrison and his staff of civilian technicians in the Spare Parts Branch had to rely almost entirely upon their civilian experience. They could predict quite accurately the life expectancy of a particular part under peacetime conditions. What they could not predict was the kind and amount of usage the machines would be subjected to in the theaters or the frequency and efficiency of resupply. The plan was to revise the lists as such information became available from overseas. Under the policy in effect at the beginning of 1943, fourth echelon spare parts sets (stocked in overseas depots run by Engineer spare parts supply companies for issue to lower maintenance echelons) were replenished automatically every six months. Such a policy, Smith and Harrison realized, should not continue indefinitely because some parts would, for one reason or another, turn out to have a low rate of demand, and surpluses would result. In February 1943, Smith proposed a change. There would be one automatic issue of a twelve months' supply. Further replenishment was to be made on the basis of need as set forth in requisitions from the theaters. On 22 March, the War Department placed Smith's recommendations in effect.[66]

During 1942 spare parts procurement lists had not only been furnished to the procurement districts but had also been used to a large extent by the Spare Parts Branch itself, for during that year the branch had done a great deal of purchasing direct from suppliers. Production problems had then been so serious that Smith feared the procurement districts would neglect spare parts. Procurement direct from Columbus counterbalanced this tendency. All things being equal, however, it made for efficiency and ease of supervisory control if procurement of spare parts was done by the same office that was purchasing the end item. By the beginning of 1943, with deliveries of engineer equipment more nearly on schedule, less risk was involved in allowing the regu-

[65] (1) GO 53, 29 Dec 42. (2) Memo, Smith for All Concerned, 5 Jan 43, sub: Transfer of Engr Maint Sec to Columbus, Ohio. Exec Office Proc Div file, Adm Interoff Memos.

[66] (1) *Investigation of the National Defense Program, Hearings,* Pt. 26, pp. 11712, 11729–30. (2) Ltr, Fowler to CG ASF, 19 Feb 43, sub: Sup of Spare Parts for Engr Equip. 475, Engr Equip, Pt. 1. (3) WD Memo W700–15–43, 22 Mar 43, sub: Sup and Proc of Spare Parts for Engr Equip. (4) Interv, Gen Smith, 25 May 55.

lar procurement organization to take over all of this work. The Columbus Spare Parts Branch then began to bow out of procurement. A directive issued on 8 December 1942 made it incumbent upon the procurement districts to see to it that spare parts were an integral part of every contract. The Spare Parts Branch was to furnish the procurement district with the requisite spare parts lists within ten days of receipt of notification of the impending negotiation of a contract.[67]

Although the Spare Parts Branch did not immediately achieve this goal, by spring 1943 the procurement districts were receiving the lists in plenty of time to carry out their part of the job, and the spare parts sections of supply catalogs were either published or well on the way toward publication. Changes were constant, however. The Spare Parts Branch was attempting to cover items that had been procured previously without spare parts and to avoid ordering parts for which stocks on hand or due were sufficient. Quantities varied therefore with the negotiation of each contract. So, in many cases, did types. The shortage of materials, of engines, and of other vital components made it impossible for procurement offices to insist that manufacturers adhere to the list of Standard Components of Standard Makes and Models that had been published in the fall of 1942. The changeover to Chrysler engines brought about the most far-reaching modification as to types, but throughout the war manufacturers were forced to make use of whatever happened to be available. Substitutions of one material for another, although properly encouraged because of the same long-run advantages that were present in the switch to automotive engines, added to the complexity of the maintenance program and increased the work load of maintenance troops the world over.[68]

In the face of such changes, a "standard" model delivered in 1943 might differ considerably from one purchased a year later. And even within the limits of this broad definition of "standard," the Corps never arrived at the point of ordering standard makes and models to the exclusion of all others. The general scarcity of production facilities encouraged such lapses on the part of the procurement organization. Perhaps a factor of greater importance in the later years of the war was the persistence of Engineer theater commands in what the maintenance organization could not fail to regard as sinful ways. Although inclusion of Class IV items in supply catalogs served to cut down requisitions for nonstandard equipment, the practice never entirely ceased. In April 1944, at the time the new Class IV catalogs were distributed, about 32 percent of the requisitions received from Pacific theaters (including those for spare parts) and about 25 percent from Europe were for nonstandard items.[69]

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[67] (1) Interv cited n. 66(4). (2) See above, pp. 212–13.

[68] (1) Memo, Maj Walter S. Shoffstall for Seybold, 3 Apr 43, sub: Average Time for Securing Spare Parts Lists, with Incl. Personal file, M. S. Denman, Proc of Spare Parts. (2) Memo, Maj Gen LeRoy Lutes, ACofS for Opns SOS, for CofEngrs, 9 Mar 43, sub: Rpt on Columbus QM Depot, Jointly Occupied, Engr Sup Sec, with Incl, 5 Mar 43. 400.242, Columbus Gen Depot.

[69] (1) Memo, Fowler for ACofEngrs for War Plans, 17 Mar 44, sub: Use of Standard Engr Equip. Exec Office Rqmts Div, Read file (S). (2) Memo, ExO Sup Div for C of Sup Div, 28 Apr 44, sub: Rpt on San Francisco Fld Liaison Office. Exec Office Rqmts Div, Read file. (3) Draft Ltr, Kuldell, ACofEngrs for Mil Sup, to CG ASF, 16 Apr 45, sub: Requisitioning of Engr Sup and Equip. Exec Office Proc Div file, MPR 20—Engr Sup Control.

STORAGE SPACE AT COLUMBUS ASF DEPOT

Service	*Total*	*Warehouse*	*Shed*	*Open*
Engineers	4, 519, 940	1, 335, 290	319, 050	2, 865, 600
Quartermaster	2, 388, 304	2, 197, 304	.....	191, 000
Ordnance	3, 806, 494	1, 138, 814	867, 680	1, 800, 000
Medical	294, 463	294, 463	.....	.....

The Engineers had committed themselves to keep completely in repair only the approximately 10,000 standard types. For the rest they planned to supply only 1st echelon repair sets or at the most very small quantities of depot stocks. Columbus was said to stock about 200,000 different parts.[70] Actually this figure included many parts that were identical but were carried on the records as unique because of the practice of matching parts to particular machines. The Engineers knew that parts common to several machines should be assigned Federal Catalog numbers and stored together, but since experts were required to do this time-consuming work, most parts were identifiable only by manufacturers' numbers, which were themselves unstable.[71]

In the face of a shortage of certain key components, procurement of spare parts amounted to considerably more than seeing to it that they were covered in the contract. For what were spare parts if not components? Since in many cases a choice had to be made, procurement officers, being human, tended to push the delivery of end items. Spare parts possessed no glamor and promised little glory. Only end items appeared on the Monthly Progress Reports.[72]

Smith's hope—expressed to Fowler at their showdown conference in December 1942—that spare parts supply would emerge from the "critical" stage in the next few months, failed to materialize. Factors already mentioned—the continued purchase of nonstandard equipment, lags in deliveries of many spare parts themselves—contributed to a generally unsatisfactory state of affairs at Columbus depot. Unfortunately, additional evils were generated within the depot itself.

Many of the difficulties that arose at Columbus stemmed from the physical setup. As in similar installations, storage facilities assigned to the technical services by the Quartermaster officer in command consisted of warehouses, sheds, and open areas. Although in January 1943 the Corps of Engineers occupied more space in the depot than any of the other three services involved, over half of its allotted area was uncovered. Storage of spare parts took up comparatively little of the Engineer allotment—less than 300,000 square feet in one warehouse and five sheds. Spare parts was but one of the many things that the inexperienced Engineer supply officer, Col. David L. Neuman, had to think about in January 1943. But spare parts forced themselves more and more to his attention, for it was not long before the storage and issue of spare parts

[70] As used here and below, "Columbus" and "the depot" stand for the Engineer Section of the Columbus ASF Depot.

[71] (1) Engr Sup Procedures, Mar 45, p. 1. (2) Engr Catalog, Pt. III, Sec. CE–15. (3) *Investigation of the National Defense Program, Hearings,* pp. 11692–93, 11717–18. (4) Memo, Lt Col J. J. Winn, Jr., Exec Office Rqmts and Stock Control Div for ExO Mil Sup, 29 Jan 45, sub: Rpt on Spare Parts Gen Situation. Exec Office Rqmts Div, Read file.

[72] Ltr, Rosenberg to CG ASF, 12 Jun 43, sub: Schedule of Spare Parts Shipped Concurrently with End Items. Exec Office Proc Div file, ASF.

dominated Engineer operations at Columbus.[73]

Despite the fact that deliveries of spare parts were running seriously behind schedule, the growth of business done at Columbus was, according to Smith, the man who should have shown least surprise, "almost unbelievable." [74] Smith's figures showed that from September 1942 through February 1943 the monthly volume of spare parts increased from 3,056,126 to 15,000,000 pounds. Work was carried on in cramped quarters. Not only was there insufficient over-all space, but in the opinion of Beauchamp of the Engineer Field Depot Office, Neuman and his staff had not made the most of what space was available. Estimates of the number of bins required for storage had been based upon the dollar value of parts under order, a most imprecise means of figuring how many bins to construct. The idea was to store items by manufacturer and by size, but there were so few empty bins that constant shifting was necessary. Lack of bins was causing serious delays in putting away parts, a process that averaged about three weeks from railside to bin in the spring of 1943.

In records keeping also, Columbus got off to a poor start. In February 1943 the depot was stocking parts from over 300 manufacturers for a total of 782 different machines. Only seven suppliers had been picked up on the IBM system. Although the parts furnished by these seven constituted about half the work load, Smith predicted it would take months to finish the conversion from manual to machine bookkeeping, even with the additional clerks and machines that Neuman had by this time succeeded in rounding up.

At Columbus, as elsewhere, it was difficult to hire and keep competent clerks and sturdy, dependable laborers. Engineer depot companies and spare parts supply companies assigned to the depot for training proved a boon. But the labor problem was never completely solved. In March 1943 Columbus employed 4,688 civilians, almost twice as many as Granite City, the depot having the next largest number of employees. Firm supervision of such a large force was essential. The Engineer Supply Section had a staff of 75 officers, 57 on regular assignment and 18 from the replacement pool, many of them green. Perhaps because experience was so lacking, Neuman delegated little responsibility to his subordinates.[75]

On 1 May 1943, an incredulous Dawson telephoned Smith about an urgent shipment of spare parts:

Dawson: They tell me that it'll take the Depot thirty to sixty days to get them out . . . .

Smith: Well, the average time now is about 30 days. . . .

Dawson: That's terrible.

Smith: I know it. . . . The chief reason is lack of parts. All the back orders, the fact that availability has to be determined, back orders set-up, stuff packed without complete shipments.[76]

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[73] (1) Figures for the Engineers include space at two subdepots. Memo, C of Depot Sec for C of Rqmts, Storage and Issue Br, 26 Jan 43, sub: Rpt on Columbus QM Depot. Storage Br, Read file. (2) Ltr, Neuman to Rqmts Br, 30 Jan 43, sub: Reply to Info Questionnaire Dated 16 Jan 43. 323.3, Columbus Gen Depot.

[74] Ltr, Smith to Rqmts Br, 11 Mar 43, sub: Study of Spare Parts Br at Columbus. 400, Pt. 2.

[75] (1) Memo, Dawson for O&T, 22 May 43, sub: Asgmt of Depot Cos to Engr Depots and Engr Secs of ASF Depots. Storage Br, Read file. (2) Memo, Dawson for C of Mil Pers Br, 16 Jun 43, sub: Asgmt of Offs. 210.01. (3) Incl, 20 Mar 43, with Ltr, Mil Pers Br to CG SOS. 290, Manpower. (4) Ltr, Col D. G. White, Actg C of Fld Sv Sup Div, 5 Nov 43, sub: Tng of Depot Cos and Parts Sup Cos. 353, Columbus Gen Depot. (5) *Investigation of National Defense Program, Hearings,* pp. 11697–701.

[76] Tel Conv, Dawson and Smith, 1 May 43. 400.333, Pt. 1.



CONVERTING STOCK RECORDS OF PARTS *from manual to machine bookkeeping, Columbus, Ohio, October 1943.*

Although Smith laid the main cause for inefficiency at the door of procurement, he and everyone who had anything to do with the Columbus depot agreed that more space was desperately needed. On 29 April, Dawson entered a formal request for construction of another warehouse, which was promptly authorized. Although this expansion proved insufficient, it was nevertheless the last one. A brake had been applied to new construction. Other means for providing more space would have to be found. Neuman, strongly supported by Smith, had been advocating other means in addition to new construction for some months. His efforts had led to the transfer elsewhere of various activities, among them an officers' supply school. He had shifted quantities of spare tires to the depot at Marion, Ohio. He had recommended further diversion of general engineering stocks. In mid-July 1943, Dawson directed the gradual removal of all general items from Columbus, the shift to be accomplished in 30 to 90 days. It seemed logical and economical to make the transition gradually. Instead of a sudden emptying of the warehouses with all the paper work and transportation involved therein, Columbus would simply continue to fill requisitions for general items for a time. As fast as the general items moved out, spare parts would move in. It took the full 90 days to "complete" the removal of general items from Columbus, and as late as March 1945, 100,000 square feet of warehouse space was still oc-

cupied by some of this equipment. The piecemeal acquisition of space necessitated much more moving about of spare parts than if clearance had been effected at one time. Neuman needed elbow room. Unpredictable expansion made an over-all plan for orderly storage impossible.[77]

In June 1943, the Supply Division increased the tempo of its attack on what Smith considered the root of the problem, namely, the lagging procurement program. Interest was whipped up by the announcement of a drive on the part of Columbus for the shipment of 6,000,000 pounds of spare parts that month with a steady increase monthly to 10,000,000 pounds in October. The June drive was successful. Receipts at the depot were the highest on record and the goal of shipping 6,000,000 pounds of spare parts was met. By fall Neuman claimed substantial progress. The IBM system was almost wholly installed. Thousands of bins were being constructed and rearrangement of stocks was under way. Shipments, although short of the goals announced in June, had increased steadily to more than 8,000,000 pounds in September. The depot presented quite a different picture to the officer from The Inspector General's Office. He noted a backlog of 10,000 requisitions amounting to 20,000,000 pounds in shipments while 8,000,000 pounds of parts awaited unpacking and storage. Stocks appeared seriously out of balance. Orders representing 2,400 different Caterpillar tractor parts remained unfilled because these items were not on hand, but the depot contained $500,000 worth of cabs, chassis, and other heavy units for which practically no demand existed.[78]

On 15 October, Col. Roy D. Burdick replaced Neuman at Columbus. Burdick had been in charge of the Engineer Section of the Utah Quartermaster Depot for the past year. Otherwise he had had no experience in supply. ASF, conducting an investigation of its own shortly after his arrival, left with the understanding that the backlog would be cleared up in about four months. Naturally, the burden of responsibility did not fall solely upon Burdick. Production of certain spare parts—for tractors, graders, shovels, engines, and chain saws—had to be increased. According to Smith, however, the depot contained two thirds of the parts involved in the backlog. His answer was more labor. To Beauchamp success hinged on an all-out effort to rearrange the stocks, followed by a complete physical inventory. His investigators discovered some parts in as many as thirty different places. No wonder it was difficult to keep up with what was on hand. Cross-referencing of interchangeable

[77] (1) Ltr, Dawson to Col Albert B. Drake, Dir Storage Div ASF, 29 Apr 43, sub: Additional Warehouse Space Columbus QM Depot, with 2d Ind, Gen Wood, Dir Rqmts Div ASF, to CofEngrs, 8 May 43. 400.242, Columbus Gen Depot. (2) Ltr, Dawson to Engr Sup Off Col ASF Depot, 18 Jul 43, sub: Transfer of Engr Br Columbus ASF Depot. Same file. (3) Ltr, Rosenberg to Ohio River Div Engr, 12 Jan 44, sub: Spare Parts Activities of Engr Sec Columbus ASF Depot. 323.3, Columbus Gen Depot. (4) Ltr, Col Thomas B. Morris, C of Sup Div Ohio River Div to CofEngrs, 22 Mar 45, sub: Gen Engr Stock Engr Sec Columbus ASF Depot. Storage Br, Read file. (5) *Investigation of National Defense Program, Hearings,* pp. 11666, 11674–75. (6) Comments, Smith for EHD, 16 Apr 56.

[78] (1) Ltr, Rosenberg to NAD Engr *et al.,* 2 Jun 43, sub: Delivery of Spare Parts. Exec Off Proc Div file, Divs or Dists, Misc to All. (2) Ltr, Withers, Actg C of Proc Sv, to Great Lakes Div Engr *et al.,* 3 Jul 43, sub: Delivery of Spare Parts. Same file. (3) Ltr, Neuman to Fowler, 4 Oct 43, sub: Rpt on Plans of Engr Sup Off of Engr Sec Columbus ASF Depot. 323.3, Columbus Gen Depot. (4) Ltr, Lt Col Allen G. Raynor, Office of IG to TIG, 23 Sep 43, sub: Special Inspec of Spare Parts Br and Maint Unit Repair Activity Engr Sup Sec Columbus ASF Depot. Storage Br file, Spare Parts.

parts, supposed to serve as a stopgap for conversions to federal stock numbers, had fallen behind. So had the revision of spare parts lists and catalogs. Aside from the injection of a noticeable sense of urgency, the diagnoses and remedies of late 1943 bore a striking resemblance to those advanced earlier. By the beginning of 1944, however, the drive to get the situation in hand had produced a new theory as to the cause for the disorder.[79]

As pressure was exerted to step up procurement of spare parts and as Columbus fell further and further behind in shipments, the Supply Division for the first time challenged the requirements as set forth in Smith's office. Try as it would, the Spare Parts Branch could not obtain sufficient information from the theaters to keep abreast of the rate of consumption. Statements of requirements, designed to furnish automatically a year's supply of parts, continued to be based upon theoretical assumptions. Fowler and his advisers in the Supply Division believed that certain parts were piling up overseas just as at Columbus and that the procurement, handling, and storage of quantities of these parts diverted materials and labor away from the effort to provide critically needed parts. Reybold, just returned from a tour of the Pacific theaters, asserted that an adequate supply of spare parts had begun to arrive, but were lying around unpacked for lack of trained personnel. While O&T sought authorization for an increase in the numbers of maintenance units, the Supply Division determined to arrive at a more realistic estimate of the types and quantities of spare parts to be supplied.[80]

On 24 February 1944, Fowler announced the first step in a move to eliminate automatic supply to the greatest extent possible—to rely instead upon the theaters to requisition what they needed. The Maintenance Office was to examine each requisition in the backlog at Columbus and cancel those covering items for which an "appreciable" quantity of parts had already been shipped. The depot would fill the remainder if possible; all that could not be filled would be canceled. To insure against future inflation, Fowler ordered the Maintenance Office to make a 50 percent reduction in the quantities of each item on spare parts lists. A week later the Supply Division instructed Columbus to suspend all back orders three months old or older and to notify the theaters to requisition these items if they still wanted them.[81]

The wholesale cancellations ordered by the Supply Division bespoke a desperate attempt to prevent another crisis at Columbus. The attempt failed. Cancellations, suspensions, and reviews of spare parts lists took time. By mid-April the backlog in automatic shipments had reached 45,000,000 pounds—more than twice the total six months before when Burdick took over. Fifty railroad cars of spare parts bore witness to the slowness with which stocks were being moved into storage. Warehousing was

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[79] (1) *Investigation of National Defense Program, Hearings,* p. 12224. (2) 1st Ind, 12 Nov 43, on Memo, ExO Control Br for C Engineer Field Maintenance Office, 8 Nov 43, sub: ASF Study of Spare Parts. Control Div file, Folder A–Z. (3) Ltr, Beauchamp to Burdick, 20 Dec 43, sub: Examination of Procedures Within Storage Div Engr Sec Columbus ASF Depot. Storage Br file, Fld Sv.

[80] (1) Ltr, Fowler to Engr Sup Officer Columbus ASF Depot, 24 Feb 44, sub: Procedure with Respect to Processing Spare Parts Requisitions. 400.312. (2) Memo, CofEngrs for CG ASF, 2 Feb 44, sub: Provision of Adequate Maint and Parts Sup Orgns in Overseas Theaters. 320.2, Engrs, Corps of (S).

[81] (1) Ltr cited n. 80 (1). (2) C/L 2823, 1 Mar 44, sub: Filling Spare Parts Requisitions and Canceling Back Orders.

still haphazard. Burdick, like Neuman before him, had delegated little authority. Morale was poor. Under what he termed "considerable pressure" to show results, Burdick appealed to his subordinate officers to spend more time working and less time drinking coffee and relaxing with feet on the desk. "Don't just look alive; be alive," he counseled.[82]

The pressure Burdick referred to was from Col. James M. Barclay of the Storage Division, ASF, who had arrived at Columbus with the intention of staying until it began to operate on a current basis. Although Barclay acknowledged the fact, later confirmed by the theaters, that there was a large surplus of heavy parts such as grader blades, he denied that requirements had been grossly inflated. From his observations in North Africa, Sicily, Italy, and England, Barclay concluded that spare parts on hand were sufficient, but only because, with the cross-Channel invasion postponed, the timetable of operations had slowed down.[83] Referring to the backlog in automatic requisitions he declared there was "no question about it that these supplies should have been over there." [84]

Barclay remained at Columbus six weeks, and during this time brought in Lt. Col. Paul H. Startzman and several additional officers with creditable civilian and military supply experience to replace Burdick and his top assistants. Altogether about 25 officers and 400 civilians were removed. Making little change in the form of the organization, Barclay distributed responsibility from top to bottom and inaugurated a training program for the entire staff. With duties thus clarified and with some rearrangement of stocks and improvements in procedures for handling the flow of paper and materials, Barclay expected the depot to reach a monthly shipping capacity of 20,000,000 pounds by 1 July, about double the volume attained in the past. An all-out effort to put stocks in order was to begin late in July and be finished in six months. The backlog should be cleared by 1 September.

Despite Barclay's acknowledgment that the requisitions on hand when he arrived at Columbus represented a fairly realistic picture of overseas needs, the drive to cancel them was intensified as the only practicable means of getting off to a new start. The month of May saw 700,000 such cancellations, compared with slightly over 100,000 in April and again in June. By the middle of August the backlog had vanished. Operations were current.[85]

The Special Committee Investigating the National Defense Program, which had become interested in Columbus during the depot's most troublous times but which had agreed to postpone its inquiry until ASF instituted its reforms, attributed much of the improvement evident in September to the cancellations. In insisting that an increase in efficiency had been largely responsible, Barclay stated that most of the cancellations had been temporary and that when the theaters confirmed many of the old requisitions with new ones, the new ones were handled expeditiously, in a matter of days. Columbus could now ship 20,000,000 pounds monthly, if need be, and had shipped 13,800,000 pounds in August. So much had in fact been accomplished to speed the flow of spare parts in and out of

[82] Memo, Burdick for All Offs Engr Sec, 17 Apr 44, sub: Deficiencies. *Investigation of National Defense Program, Hearings*, pp. 12213–14.

[83] *Investigation of National Defense Program, Hearings*, pp. 11637, 11644, 11646–48.

[84] *Ibid.*, p. 11647.

[85] (1) *Ibid.*, pp. 11645–46, 11664, 11666, 12215–24, 12227.

the depot that Startzman declared it unnecessary to carry out further rearrangement of stocks. As a result of prompt storage of incoming goods and more accurate stock location records Columbus had gone a long way toward extricating itself from the anomalous position of piling up unfilled orders for stocks physically on hand. Since, however, many items of common hardware remained tied to particular makes and models and since the only action resembling a real inventory had been a one day affair in April 1944, the depot continued to report false shortages.[86]

Analysts attributed some of the steady rise in back orders at Columbus, from 150,000 in September, to 194,000 in October, to 210,000 in December, to these false shortages, the rest to actual lack of stocks of particular parts that had been requisitioned by theaters. The Supply Division's assault upon automatic supply had been successful. This assault had in fact dovetailed perfectly with the change in methods of estimating requirements under the Supply Control System. In March, Smith transferred to ASF headquarters to assist in bringing spare parts for the entire Army under this system and by early June details had been worked out. With some few exceptions, automatic procurement and issue were henceforth limited to first echelon sets. The remainder of the procurement program was to be established after weighing stocks on hand and on order against the trend of demands overseas.[87]

In applying the Supply Control System to spare parts the Engineers faced a far more complicated task than that demanded for principal items. Failure to identify common parts swelled the volume of records to be kept at the same time that it created a false impression of what was on hand and on order. In the fall of 1944 the drive to consolidate parts numbers began in earnest. The work, although promising, was slow. As of the end of the year, 28,000 parts numbers, a small fraction of the total, had been consolidated into 8,000. Supply and demand studies, the necessary preliminary to procurement programs, had to be made using the old numbers. This work, begun in June 1944 under a manual system, was completed after a change to IBM by the Spare Parts Control Office (successor to the Engineer Field Maintenance Office) at the end of November. Procurement requisitions were then forwarded to the districts. These requisitions did not represent a true statement of requirements because the Spare Parts Control Office had left it to the districts to make adjustments after studying orders already placed. Protesting that the Spare Parts Control Office had sufficient data on hand to make the necessary adjustments, the Procurement Division refused to allow this work to be unloaded on the already overburdened districts. In view of the mounting back orders at Columbus and of Startzman's confident assertion that 20,000 items were in short supply, Sherrill ordered procurement offices to place under contract all requisitions calling for deliveries through the first six months of 1945. Checking against orders already

[86] (1) *Ibid.*, pp. 11644, 11656, 11675–76, 11684–86, 12214. (2) Ltr, Startzman to Ohio River Div Engr, 28 Oct 44, sub: Rev of Opn Plan 2, Columbus ASF Depot. Storage Br file, Lt Col James M. Barclay. (3) Ltr, Majs E. W. Downard and C. E. Keiser, Opns Br Distr Div ASF, to CG ASF, n. d. [c. 31 Jan 45], sub: Obsvn of Stock Control Opns at Engr Sup Sec Columbus ASF Depot . . . During Period 25–31 Jan 45. 400.291 Columbus Gen Depot, Pt. 3.

[87] (1) *Investigation of National Defense Program, Hearings*, p. 11675. (2) Ltr cited n. 86 (3). (3) WD Cir 227, 7 Jun 44, sub: Spare Parts Rqmts, Proc, and Issues.

placed and necessary cancellations would follow.[88]

Neither this order nor subsequent directives to expedite procurement succeeded in bringing about a balanced stock at Columbus. Deliveries of the so-called fast-moving parts lagged behind if for no other reason than that they were urgently needed as components of end items in great demand. In March 1945, an analysis of approximately one third of the parts carried on the books at Columbus revealed 15 percent out of stock, 12 percent below established levels, 48 percent surplus, and 25 percent between established and surplus levels.[89]

The Engineer task overseas, primarily a task of construction, could not fail to be hampered by the chronic disorders which characterized the effort to furnish spare parts for engineer equipment. In the theaters, moreover, these disorders were aggravated by too few maintenance troops.

In the spring of 1943 Smith had begun to press for more spare parts personnel in all echelons. The measure of his success was AGF's willingness to incorporate parts supply platoons in maintenance and depot companies. Meanwhile OCE urged the War Department to consider the entire maintenance picture. Assuming a coverage of about 200 tractors, air compressors, or similar machinery per company, all 34 maintenance companies in the troop basis plus an additional 5 had to be assigned to support engineer AGF units. In August Gorlinski requested 20 maintenance companies for ASF and estimated that engineer aviation units would require the support of 45 companies. On the assumption that the heavy shop company could provide fourth echelon maintenance for 1,000 items, Gorlinski fixed the ratio of heavy shop companies to maintenance companies at 1:5 and recommended 5 more heavy shop companies. About a week later, Sturdevant pointed to the deficiencies resulting from division of responsibility for maintenance units among the three major headquarters, each command pleading its own needs to the neglect of the others. This campaign bore some fruit, for the War Department approved an increase of 21 maintenance companies and two heavy shop companies in the October 1943 Troop Basis. At the same time AAF projected the organization of 16 engineer aviation maintenance companies, which seemed to the Air Engineer a fair allotment in view of the reduction of aviation construction units and the self-contained shops in the aviation battalions. Tentative plans for the 1944 Troop Basis called for 10 additional companies for ASF.[90]

In November 1943 the Supply Division, after considering evidence presented by the

[88] (1) See above, pp. 545–46. (2) Teletype, Sherrill to Upper Mississippi Valley Div Engr *et al.*, 30 Nov 44. Exec Office Proc Div, Read file.

[89] (1) Ltr, Kuldell to Great Lakes Div Engr, 11 Dec 44. Exec Office Proc Div file, All Divs 1943–44 Addresses. (2) Ltr, Lt Col Harold U. Andreae, Engr Sup Officer Columbus ASF Depot, to Ohio River Div Engr, 26 Mar 45, sub: Stock Status Engr Sec Columbus ASF Depot, with 1st Ind, 29 Mar 45. 400.291 Columbus Gen Depot, Pt. 3.

[90] (1) Memo, Smith for Asst Engr AGF, 6 May 43, sub: Activation of Parts Sup Plats or Dets. Mob Br file, Parts Sup Co (S). (2) 3d Ind, C of O&T Br to CG ASF, 14 Aug 43, on Memo, Dir Mob Div ASF for CofEngrs, 25 Jun 43, sub: Additional Engr Maint Units for Trp Basis. Mob Br file, Maint Cos (S). (3) Memo, ACofEngrs for CG ASF, 21 Aug 43, sub: Authorization of Engr Sv Units in Trp Basis. Mob Br file, Engr Sv Units (C). (4) 4th Ind, Dir Mob Div ASF to CofEngrs, 14 Oct 43, on Memo, Dir Mob Div ASF for CofEngrs, 25 Jun 43, sub: Additional Maint Units for Trp Basis. Mob Br file, Maint Cos (S). (5) R&R Sheet, Comment 2, Air Engr to AC of Air Staff Opns, Commitments and Rqmts Programs Br to AC of Air Staff MM&D Air Engr, 9 Sep 43, sub: Additional Engr Maint Units in Trp Basis AAF. AAF 321–B, Engr Corps (S).

theaters, estimated that in the Southwest Pacific the engineer maintenance effort was 25 percent adequate; South Pacific, 50 percent; China-Burma-India, 75 percent; North Africa, 25 percent; and United Kingdom, 75 percent. At the same time Gorlinski pointed out that the October 1943 Troop Basis did not include engineer aviation maintenance companies. In all he claimed a shortage of 22 maintenance companies (55 in the troop basis as compared to 77 needed) and a surplus of one heavy shop company (18 in the troop basis). Early in 1944 it seemed to the Engineers that they would obtain sufficient maintenance companies. There was, however, a shortage of parts supply companies and platoons.[91]

After a resurvey of the troop basis, Sturdevant submitted new recommendations in March 1944. Changing the ratio of heavy shop companies from 1:5 to 1:4 and assuming that a parts supply company could serve 30,000 troops and a parts supply platoon 15,000, he recommended that the number of maintenance companies be increased from 72 to 100, heavy shop companies from 20 to 25, parts supply companies from 15 to 19, and parts supply platoons from 13 to 27. By May 1944 the troop basis had provided for 24 heavy shop companies, 19 parts supply companies, and 23 parts supply platoons. However, the maintenance companies, which were an AGF responsibility, remained at 72. AGF refused to act. In June the Engineers informally urged the return of maintenance companies to ASF, but without success.[92]

In urging an increase in the number of maintenance units in February 1944, Reybold had stressed the illogic of furnishing large quantities of construction machinery without providing means for keeping it in operation. Reybold's statement was, of course, as applicable to spare parts as it was to troops. Failure to supply sufficient men and parts to maintain the construction plant spelled waste and frustration. Waste was, moreover, not simply the product of shortages. Surpluses must also be counted. To cite an extreme but instructive example, in April 1945 the Corps of Engineers found itself with $4,000,000 worth of rock bits and drill steels to be disposed of. Some of this excess, perhaps three quarters of a million dollars worth, represented international aid stocks, which for one reason or another had not been shipped. But most of the surplus had resulted from gross miscalculation and lack of co-ordination. Bits and drills had been procured both as primary items (on requisitions made up by the Procurement Division) and as spare parts (on requisitions made up by the Maintenance Division). Both offices had set requirements far too high, assuming apparently that hard rock would be encountered whenever engineer construction troops set out to build a road or an airfield.[93] Such miscalculations arose from a desire to err on the safe side, for error was inevitable in a field where experience was so slight. Shortages of spare parts were due not so much to underesti-

[91] (1) Memo, Actg C of Sup Div for CG ASF, 1 Nov 43, sub: Maint. 320.2, Engrs Corps of (S). (2) 5th Ind, C of O&T to CG ASF, 3 Nov 43, on Memo, Dir Mob Div ASF for CofEngrs, 25 Jun 43, sub: Additional Engr Maint Units for Trp Basis. Mob Br file, Maint Cos (S). (3) Memo, Mob and Trp Units Sec Theater Br WPD for C of Theater Br WPD, 15 Jan 44, sub: Study of Engr Maint and Parts Sup Units in TofOpns. 400 (S).

[92] (1) Memo, ACofEngrs for CG ASF, 24 Mar 44, sub: Engr Maint and Parts Sup Orgns. 320.2, Engrs Corps of, Pt. 2 (S). (2) Wkly War Plan Staff Conf, 29 May 44, 5 Jun 44.

[93] Memo, Col White, C of Rqmts and Stock Control Div, for C of Redistr and Salvage Br, 23 Apr 45, sub: Excess Stocks of Rock Bits and Drill Steels. Exec Office Rqmts Div, Misc Read file.

mates, although underestimates did occur, as to lags in the procurement program which were in turn part of a larger complex which involved shortages of facilities, raw materials, and components. The realities of this complex removed standardization of makes and models to the plane of a vainly sought ideal. And lack of standardization made for difficulties in warehousing and stock control.

Although the Chief of Engineers could truthfully assert in December 1944 that "in general, the Engineer stock situation as regards spare parts is satisfactory except in the Southwest Pacific and China–Burma–India Theaters where low priorities obtain," [94] the supply of spare parts was not then nor had it been previously entirely adequate in any theater. Even the high priority European theater experienced persistent shortages of gears and valves, and sometimes of capscrews, nuts, and washers. The Southwest Pacific especially suffered from grave deficiencies throughout most of the war despite noted improvements beginning late in 1943. At the end of 1944 this theater reported about 2,000 parts in short supply, and pointed out that 30 percent of its machinery was continuously out of order as a result.[95]

The end of the war found the Engineers in possession of large quantities of matériel. A month after the defeat of Germany Kuldell noted that "for the past twelve months the Corps of Engineers has never procured in excess of its approved procurement program, but has nevertheless increased its inventory at an alarming rate throughout the entire year due to the fact that the theaters did not, or could not, draw out in shipments the total tonnage which had been procured for them and placed in depots for their use, in accordance with computed requirements and estimated projects." [96] Insofar as surpluses can be attributed to circumstances overseas rather than to inefficiency in stock control, the answer in the case of the European theater was "did not." Supplies in the ETO, which held first priority on shipping as well as matériel, were generally plentiful from D Day onward. On the Continent, engineer troops did not encounter the wholesale destruction anticipated. Conversely, they were able to obtain many supplies locally. In the Southwest Pacific, it was a case of "could not." Mainly because of the tremendous distances from the United States to the theater and within the theater itself, nothing like abundance was ever approached in that area. Only after the surrender of Germany did supplies begin to reach MacArthur's engineers in ample quantity.[97]

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[94] Memo, CofEngrs for CG ASF, 20 Dec 44, sub: Engr Sup Opns. 400, Pt. 2.

[95] (1) Incl, Problems Connected with Parts Sup in ETO, with Ltr, Maj Gen Cecil R. Moore, C Engr ETO, to Kuldell, 17 Aug 44. Intnl Div file, 475, Spare Parts. (2) *Engineers of the Southwest Pacific*, Vol. VII, *Engineer Supply*, pp. 71–73, 132–36, 200–01.

[96] Ltr, Dir Mil Sup to Div Engrs, 18 Jun 45, sub: Mil Sup for May 45. 400, Pt. 3.

[97] (1) Info from historians preparing volume, The Corps of Engineers: The War Against Germany. (2) *Engineers of the Southwest Pacific*, Vol. VII, *Engineer Supply*, p. 195.

CHAPTER XXIII

Retrospect and Prospect

Compared with World War I or with the plans of the thirties it took a long time to bring the war decisively home to the enemy. In view of the total accomplishment, the mobilization of the U. S. Army in World War II was a speedy one. With the Corps of Engineers as with other branches of the Army, some phases of mobilization were well advanced during the early stages of the war. Most of the equipment used overseas had been selected before the attack on Pearl Harbor. Although one significant change in the structure of troop units was made as late as December 1943, all other major questions about the organization and duties of engineer troops had been answered well before then. Training troops and supplying them with equipment was a longer, more continuing process. Training activities reached their peak in the summer of 1943, while the high point in delivery of engineer supplies did not come until December 1944.

The Army of 1941 was much better prepared for war than the Army of 1917. During the period before Pearl Harbor it had grasped the opportunity to modernize its growing forces, to develop tactics consonant with its increased mobility and firepower. Much had also been learned about the complexity of supply, both for the modern Army and in aid of friendly governments.

There was one serious flaw in plans and preparations. Tactically and logistically the Army was readying itself for a blitzkrieg against the German forces on the continent of Europe. An American blitzkrieg did occur when Bradley's armies drove across France to the frontiers of Germany. But that was 1944. Earlier offensives against the German forces, although terminated successfully, were not nearly so swift or so sure, while on the other side of the world American troops had to fight another kind of war altogether.

The Japanese attack and strategic decisions following the attack forced the Army to enter a new stage of plans and preparations, to turn from its preoccupation with tactics to reckon with logistics on a much larger scale than anticipated. The minimum number of service troops authorized by the Army would have sufficed for a mobile force operating over a relatively small area close to its base of supply. World-wide deployment, and in particular the movement into the Pacific, multiplied the need for service troops out of proportion to that for combat forces. The service most in demand was construction—for airfields, roads, ports, petroleum pipelines, for quarters, warehouses, and hospitals. The extent of the demand took even the Corps of Engineers by surprise.

Underestimation of the future construction task was a logical outgrowth of the Army's refusal to entertain the possibility of waging a truly global war. An underlying factor was its predilection for regarding itself exclusively as a fighting force. Within the Corps of Engineers the tendency to exalt

combat over service functions has been notable. Prior to the 1942 reorganization of the Army the War Department officially recognized the engineer combat tradition by designating the Corps an arm as distinguished from a service branch.

Given the expanded role of logistics and of air power, the 1942 reorganization of the Army into three commands was all but inevitable, but granting to air and logistics an equality with ground forces did not end the struggle for power among these elements. For the Engineers the wartime organization proved a mixed blessing. The change of designation from "arm" to "service" and the insertion of a layer of command between the Corps and the General Staff struck a blow at pride and prestige but otherwise occasioned little embarrassment. Where a given activity fell clearly and completely within the province of one of the three commands, as did engineer supply within ASF, administrative arrangements improved. Where the activity was scattered, as was the training of engineer troop units, the system became at times barely workable.

In the person of the Commanding General, AGF, who had considerable influence upon organization and training from the beginning of the emergency, the Engineers encountered a tactician who was an embodiment of the combat tradition and who regarded the new mobility as almost pure asset. To keep units lean, to travel light, to develop fighters was, in his view, to assure that the battle be joined quickly and concluded successfully. The Engineers' own preoccupation with combat engineering during the period before Pearl Harbor was intensified by his challenge to their position in the new scheme of tactics.

To the extent that the Corps emphasized combat at the expense of the service function, future hardships in mobilization were unwittingly created. But in pointing out weaknesses in the new tactics the Corps said something that very much needed saying. Mobility depended on substantial engineer support. Before the validity of the argument could be demonstrated, however, engineer soldiers had to be supplied with modern equipment for overcoming natural and artificial obstacles. Construction machinery excepted, the Corps lacked such equipment when the war began in Europe and for many months thereafter.

This lag between words and deeds can be traced primarily to the small military budgets of the peacetime years. Perhaps, too, being forced to do with so little for so long left too great a residue of caution at the Engineer Board. A disposition to modify rather than to scrap and start all over explains in part the waste of time and talent in the provision of suitable emergency bridges. An equally potent influence in this particular case was the somewhat naive faith held by OCE and the Engineer Board that limits upon vehicular weights would remain fixed. To have looked abroad to the armor of foreign countries and to have concluded that the Ordnance Department must furnish heavier tanks would have shown an uncommon though extremely profitable sagacity. A similar insularity was evident in the skepticism with which OCE and the Engineer Board viewed ideas which came to them from outside the organization. The alacrity with which mapping instruments were adopted from German models was an acknowledgement of the supremacy of Germany in this field. Where an American model or a tried technique came into question, the organization exhibited consider-

ably less hospitality to change, a fact that was most clearly demonstrated in the matter of steel treadway and Bailey bridges.

But skepticism and perfectionism are not equivalent to rejection. The man who is without responsibility is gloriously free to dream, to experiment, to make claims for his inventions. The man who is accountable for failure is fettered by the necessity to reflect, to test, to prove. In the end the Corps of Engineers was greatly indebted to Great Britain not only for designing the Bailey bridge but also for armoring construction machinery and devising the first type of landing mat. The idea for pneumatic floats came from the enemy, Germany. Yet the Corps received its most substantial help from American industry, which offered excellent construction machinery and assisted in developing landing mat, mine detectors, petroleum pipelines, and other basic equipment.

Because military engineering involves the conversion of intrinsically civilian techniques to the needs of warfare the role of the Engineer Board often boiled down to a selection of the most suitable commercial product. During the prewar years the emphasis upon combat engineering placed a premium upon light and maneuverable construction machinery. Although these early models could not furnish enough power for the large-scale construction jobs which were to comprise the Corps' greatest contribution to victory, commitment to machinery signaled the Corps' modernization in concert with the Army as a whole, the first hint that the Engineers would make good on their claim of essentiality to the new infantry division and that they would be able to render the construction service ultimately required. Reliance upon power machinery meant that a job could be done faster and with fewer men. Large as was the total strength of the Corps in World War II, engineer troops accounted for a smaller percentage of the Army in that conflict than in the earlier one. Unexpectedly, the advantage offered by savings in manpower threatened to be offset by the complications which the adoption of machinery introduced into the training and equipping of troops.

Despite its strong combat tradition the Corps of the thirties had a firm base from which to expand its service role. Many of its small but select group of Regular officers held advanced degrees in engineering and had, through assignments to civil works and federal projects, kept abreast of the latest construction techniques. A large Reserve was made up primarily of men from the construction industry. Contacts with that industry were nationwide, promising ready co-operation in recruiting skilled men and securing modern equipment.

The war plans of the twenties and thirties contemplated a relatively small amount of military construction in the United States. The eleven billion dollar program undertaken during World War II made unexpected inroads upon Engineer Reserve and Regular officers long before the Corps assumed formal responsibility for this construction. Skilled men who would have been drafted or recruited for duty with engineer troop units were deferred until camps and munitions plants were completed. Civilian employees of the Corps, slated to turn their talents to supply activities, formed instead the administrative backbone of the construction program. The construction machinery industry delivered great quantities of its products to government contractors rather than to troops.

The question is academic whether during

the defense period the Corps of Engineers or even the Army could have overcome the various powerful forces which opposed the full-scale conversion of the American economy to war production. Still the opportunity to prevent the acute shortage of construction machinery was present in the months before Pearl Harbor. A small stockpile of machinery could have been accumulated if the industry had been operating at full capacity and civilian consumption had been reduced. Failure to appreciate the significance of the switch from hand tools to power machinery, gross miscalculation of future construction activity, and a widespread belief that commercial products could be had for the asking combined to insure the loss of the opportunity. By early 1942 the Engineer procurement program was at a disadvantage in competing for steel against the claims of ships, tanks, and industrial construction. The gap between deliveries and requirements was so wide that all manner of makes and models and much used machinery were forced into service in face of obvious injury to the supply system as a whole.

By gaining a large measure of authority over the procurement and distribution of key items of engineer equipment, the Corps succeeded in mitigating shortages. The ultimate solution to the complex problems of supply was to be found, of course, in the more general administrative and economic controls established by WPB and ASF. Since the aim of both the civilian and the military agencies was to balance supply and demand, accurate statements of requirements were obligatory. The Engineers, with the bulk of their needs tied up in relatively unpredictable quantities of Class IV matériel, faced unusual difficulties in arriving at such statements. No method employed proved satisfactory to all concerned. Having been continually trapped by last-minute information about strategy and having stifled in the confined atmosphere of scarcity for so long, the Engineers favored a less constricted system, a shifting of responsibility for estimating requirements to the theaters, with procurement to be initiated without question by the Supply Division. This anomalous suggestion did not jibe with the thinking of the General Staff which had to evaluate requests from all fronts.

The very real obstacles which the Engineers encountered in getting equipment into the hands of troops were magnified by a dearth of supply experience within the Corps and by a widespread disdain among Engineer officers for such work. Grades for supply officers were low. The structure of the supply organization was subjected to frequent changes, not all of which were for the better. Under these adverse circumstances ASF Headquarters was of incalculable value. The Corps was at times justifiably critical of the paper work and of the ceaseless drive for managerial efficiency coming down from ASF, but effective guidance through the maze of operations that characterized the wartime economy more than balanced the needling and bureaucracy.

Long after the shift to mechanical power the Engineers continued to be mistaken for an organization of common laborers. The mass of enlisted men assigned were unskilled, and a large percentage scored low on the Army General Classification Test. One of the main reasons for the deficiency in skills and the preponderance of low scores was the high proportion of Negroes allocated. The segregation policy forced a concentration of poorly qualified individuals within certain units, making it almost im-

possible to raise those units to a desirable level of efficiency. True, the Engineers could absorb more slow learners, both Negro and white, than some of the other branches of the Army, but not to the same extent as in World War I. Had the pick and shovel remained the identifying symbols of the Engineers, such men could have been assimilated easily. For the operation of a bulldozer—the trademark of the Engineers in World War II—a somewhat better educational or mechanical background was mandatory.

Only gradually, after an accumulation of evidence from overseas, did the Corps begin to find acceptance as a body of skilled and semiskilled workmen. One measure of this acceptance was the great freedom allowed the Engineers to recruit men from the construction industry. Engineer units serving with ASF acquired many ready-made occupational specialists from this source, although never in the numbers that had been thought possible. AGF units fared less well, in part because of the rivalry between ASF and AGF. AAF concentrated the small number it got into a very few units, thereby losing the full potential of men whose practical knowledge should have been disseminated during the period of training. The men obtained by voluntary induction furnished a leavening hard to overvalue. If a small portion could have been channeled into supervisory positions in the segregated Negro units their contribution would have been even greater.

Corresponding to the drive for enlisted volunteers with special backgrounds was the effort to locate men who had bossed construction jobs or who were otherwise qualified to become Engineer officers. Although disappointingly small in number, the group commissioned directly from civil life brought to troop units a better grasp of engineering principles than did the youthful and hasty product of OCS. Too frequently the OCS classes contained men whose previous education and work were unrelated to the job ahead. Too frequently the compulsion to turn out quantities of officers forced a lowering of standards for graduation. The inferior quality and inexperience of many OCS graduates, coupled with the diversion of many officers of proven ability to the military construction program, made doubly valuable those who entered the Corps from civilian positions closely akin to military tasks.

In a nation so highly industrialized the frustrating search for men with mechanical and engineering experience developed unexpectedly. During World War I the U. S. Army had depended upon the Allies for much of its matériel. Reversal of this situation during World War II meant that a large portion of the labor force, technically subject to the draft, remained on the farms and production lines. Another sizable quantity of those supposedly eligible for military service was rejected because of substandard health. Fewer of the nation's adult males could be inducted than had been anticipated; even fewer could fill positions calling for specific skills.

More deeply affected by the manpower pinch than AAF or ASF, AGF capitalized further upon the increase in firepower and mobility, introducing the flexible group system of small units which could be combined and recombined, employed in the rear or brought forward quickly as occasion demanded. The Engineers were particularly opposed to the extension of this type of organization to service units. Construction jobs in rear areas were usually of such magnitude as to require a force of at least regi-

mental size. Other arguments, far from frivolous, advanced against the group system were loss of regimental commands for Engineer officers and of *esprit de corps* generally. The sense of belonging to an organization large enough to accomplish significant tasks was no less real for being intangible, and no organization can attract and keep good men unless it offers opportunities for advancement. From top to bottom, in fact, mechanization of engineer work implies higher grades and ratings than were offered during World War II. The construction battalion, authorized at the end of 1943, contained almost as many men as the general service regiment it was designed to replace and accorded greater recognition to their skills. Not fully tested during World War II, the adequacy of the battalion as the basic construction unit and the practicability of applying the group principal to engineer units, combat as well as service, remained to confront postwar organizational experts.

While bowing to pressure for manpower economies, the Corps of Engineers emerged from World War II with a greatly altered troop unit structure, the most obvious characteristic of which was variety. Some specialization was evident before the war—certain units being assigned to fast jobs of a temporary nature in forward areas and other units to more complicated and permanent work in the rear—but this was only a beginning. In several instances engineer units came into being or under the control of one of the three commands not so much because of diverse duties but because a command desired to acquire or retain power. Little real difference in functions could be discerned between various types of supply units. The clear-cut line originally drawn between ASF construction units and engineer aviation units gradually blurred and led to jurisdictional disputes overseas. In the United States, division of control over these and other units confused planning for the troop basis and hampered efforts to simplify organization and standardize training.

The large size of the construction task in World War II, on the other hand, made some breakdown both feasible and economical. The war itself brought certain construction operations to the fore for the first time. New and special units for laying petroleum pipelines and for the reconstruction of ports helped fill the growing list. The multiplicity in types of units which arose naturally in consequence of easily differentiated missions eased the burdens of training. Such skilled and semiskilled men as were made available to the Engineers were apt to be familiar with only one aspect of construction and therefore could be assimilated more quickly in a specialized organization. Recruiting drives could be aimed at particular civilian occupational groups in order to fill particular units. Men with limited abilities could learn a few simple skills quickly. To a large extent engineer troops trained as specialists for assignment to specialist units.

This was not a training pattern which the Engineers preferred, but one dictated by the exigencies of time, equipment, and manpower. Even within units with the most restricted functions the Corps desired each man to be grounded thoroughly in all phases of the Engineer mission. The soundness of this goal was demonstrated time and again after the units reached their overseas destination. Seldom did any theater have enough engineers. Special functions were impossible to keep separated. Engineer units of whatever type had to fall to at any engineering task.

The shortage of time, of equipment, and of seasoned officers prompted the Engineers early in the war to decide that closely supervised centers would provide optimum conditions for training engineer units as well as individual replacements. Familiarity with machinery and practice in working as a gang were of more value to most engineer units than a precise comprehension of their place in large-scale military operations. If maneuvers afforded the latter experience, so much the better, but with the exception of divisional combat battalions a less elaborate field period was an adequate substitute. Training at engineer centers offered the advantage of closer control, a better chance to carry out an orderly program with uniform standards.

Standards differed markedly in the three commands. Only for those troops serving with ASF did the Engineers effect a desirable amount of centralization. AGF would not bring similar units together for instruction because of definite policy; AAF did not largely through neglect. Although the Corps had many differences with higher authority in ASF, these altercations were never so serious as those with AAF and AGF. Most of the disturbances to the training programs at ASF centers were common to the Army as a whole. ASF never questioned the importance of the logistical task as did AGF. Within ASF there was never any quarrel as there was in AAF over the recruit's indoctrination as an engineer soldier. A lack of appreciation of the training required by engineer units to assure satisfactory performance overseas compounded the difficulties in both AAF and AGF.

Despite the disparate influences of the three commands and the makeshift arrangements which resulted from the scarcity of essential construction machinery, the Corps might still have transformed most of the men into versatile engineer soldiers if only there had been more time, or at least a predictable amount of time. The War Department could not, however, devise a training formula that would apply under all circumstances, but issued instead a series of regulations designed to produce the best product consistent with current strategy. The squeeze which strategy exercised upon time reduced the scope of Engineer subjects in the preparation of both units and replacements and repeatedly burdened units with basic training. Instances multiplied when a choice had to be made between giving the recruit a general course of engineering training or one in a limited field of specialization. To man the new equipment, great numbers of recruits had to be given the more restricted training. Not until mid-1943, when the peak training load had already been reached, was it possible to establish schedules of sufficient length for the Corps to approach its ideal training goal.

In general, the programs which OCE prepared for the various units showed a high order of planning and were flexible enough to allow commanding officers ample latitude to make changes. Units which made poor showings were often those which were unable to complete the full schedule. Some faulty programming did occur, notably in the case of crews for ships and dredges, but OCE showed itself far better qualified to judge the technical requirements for engineer units than did the training staffs of any of the three commands.

Zealously, but not always successfully, the Corps of Engineers asserted its prerogative as an organization of experts to define its mission, to determine the quantity and quality of its members, to choose its

equipment, to decide how it must be organized and trained. In defining and redefining its tasks, in adjusting to the new Army and to the demands of global warfare, the Corps exhibited an admirable degree of flexibility, imagination, and ingenuity. The ease with which the Engineers took hold of amphibious doctrine and carried it beyond the training of boat crews to the development of shore parties is but one instance of a ready assumption of new duties. In the performance of more traditional functions the Corps displayed no less ability. Mapping, for example, was approached in full realization of the limitations as well as the potentialities of aerial photography. That the Engineers handled with distinction many assignments both new and old was owing largely to the high caliber of its officers. In the future as in the past, the preparedness and effectiveness of the Corps of Engineers will depend primarily upon the ability of its officers to provide the necessary bridge between the latest developments in civilian engineering and the most advanced techniques in warfare.

Bibliographical Note

The bulk of the source materials for this book are contained in records of the Corps of Engineers. *Federal Records of World War II,* Volume II, *Military Agencies,* prepared by the General Services Administration, National Archives and Records Service, The National Archives (Washington, Government Printing Office, 1951) is a good introductory guide to Engineer records as well as to those of other agencies of the War Department which yielded information essential to the preparation of this history. Since records are subject to reduction and relocation in accordance with policies of the Department of the Army,[1] *Federal Records of World War II* must be regarded primarily as a starting place.

Policies on preservation of records are subject to change. This note, which proposes to furnish an accurate guide to future research may therefore become outdated.[2] But by and large the collection of Engineer records now in existence should remain as described below because it has been subjected to the authorized screening process.

The physical location of records is a matter separate from their preservation. Army records remain for a time in their office of origin and are then retired for several years to one of the records depositories maintained by The Adjutant General's Office. Permanent deposit then follows in The National Archives. This note locates the records as of December 1956.

Of the Engineer records used in the preparation of this book, two of the fifteen series of central files maintained by the Office of the Chief of Engineers (OCE) provided material on all subjects covered. One of these two, the Subject Series,[3] is arranged according to the War Department's decimal file system.[4] The other, the Military Series, is set up in a combination alphabetical-decimal system. Except in Chapters XIV, XV, and XVI, where most of the source materials were found elsewhere, lack of identification before the file designation means that the file is in OCE central files. Thus 320.2 will be found in OCE Subject Series; 320.2, Engineers Corps of, in the OCE Military Series. All OCE central files falling in the World War II period are deposited in the Technical Services Records Section, the Departmental Records Branch, The Adjutant General's Office, Alexandria, Va.

Files accumulated by administrative units of OCE (convenience files) contain much informal correspondence which served to supplement the central files. Convenience files are identified in the footnotes by the name of the office that accumulated them. Those that have been preserved intact—

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[1] For policy on the preservation of records, see DA Memo 345–5, 5 Sep 56, sub: Records.

[2] A few collections cited in this volume, including some private papers, are not mentioned specifically in this note because they were used only incidentally. The bibliographical file in Engineer Historical Division locates these records.

[3] Not to be confused with the "Subject Series" referred to on p. 351, *Federal Records of World War II.* Series referred to above is not described in *Federal Records of World War II,* Volume II, *Military Agencies.*

[4] *War Department Decimal File System* (Revised Edition) compiled under the direction of The Adjutant General of the Army (Washington: Government Printing Office, 1943).

namely those of the International Division, the Research and Development Division (Mechanical Equipment Branch and Structures Development Branch), the diaries of sections and branches of the Supply Division, certain Requirements Branch files (The General Staff, G–4; USW; The Budget Officer; and Engineer Supply Notes), and the Operations and Training Section (except Personal Letters to Gorlinski) are in the Departmental Records Branch. Material from the files of the Plans and Training (P&T) Division not duplicated elsewhere has been integrated with OCE central files. Most of the files originated by various administrative units of the supply organization (Procurement Division, Requirements Division, Storage Branch, and Fiscal Liaison Section) have been destroyed as have those of the War Plans Division (Mobilization Branch) and the Intelligence Division (Topographical Branch).[5] Since many of the research notes for this volume are in the form of Photostat or typed copies of documents, much of the essential information from these destroyed files has been preserved in the Engineer Historical Division.

The records of pertinent Engineer field installations (identified in the footnotes by name of installation) furnished a significant block of source materials. Files accumulated by training centers and project files of the Engineer Research and Development Laboratories (ERDL) are in the U. S. Army Kansas City Records Center, Kansas City, Missouri. ERDL has a complete collection of Engineer Board reports. Kansas City Records Center holds some of the Headquarters files of the Engineer Amphibian Command; the remainder are in U.S. Army AG Records Center, St. Louis, Missouri. Engineer Research Office files are in the Departmental Records Branch. Army Map Service files are with that agency.

Both OCE Library and the Engineer Historical Division have a good collection of General and Special Orders, Circular Letters, and Field and Technical Manuals. War Department Circulars, Memoranda, and other publications are in the Department of the Army Library and The National Archives. The Engineer Historical Division has a fairly complete collection of such material as well as of Engineer T/BA's and T/O&E's.

Although in general Engineer records contained the essential information on the various topics covered, the main sources for some subjects were elsewhere. Many points also had to be clarified by research in the files of other Army agencies. Information on the training of Engineer Ground Forces units and Engineer Air Forces units was gathered almost entirely from the records of these two organizations. As pointed out on page 337 n., many Army Ground Forces Headquarters files have been destroyed. What remains, including the McNair papers, is in Departmental Records Branch, The Adjutant General's Office, Alexandria, Va. The Army Air Forces central files dated after November 1942 are with the Departmental Records Branch. Earlier files are in The National Archives. Air Force Historical Division files are at Maxwell Air Force Base, Montgomery, Ala. Material on Air Forces training centers can be found in the Air Forces Section of the Kansas City Records Center. Central files of The Adjutant General's Office, of various divisions of the General Staff, and American-British Conversations (ABC) files are in Departmental Records Branch. Army Service Forces files,

[5] See Bibliographical file, EHD, for lists of files destroyed.

including statistical reports (Army Supply Program and Monthly Progress Reports) are in The National Archives. Statistical reports issued by the Office of the Under Secretary of War (Expediture Program and QMG–Eng–Med Weekly Status Report) are in Departmental Records Branch. Records of the Office of The Quartermaster General and the Office of the Chief of Transportation are in the Departmental Records Branch.

In the Engineer Historical Division are copies of correspondence and notes of interviews with officers and civilians who participated in events described in this volume. Engineer Historical Division files also contain reports, historical studies, and research notes.

The footnotes of the original draft were unreasonably long. They have been reduced by citing a file rather than the individual documents within that file wherever a file contained a concentration of material essential to the preparation of some portion of the text. Copies of the original draft, with citations in full, are in Engineer Historical Division files.

A number of special studies and general works, both published and unpublished, served to place the Engineer activities described in this volume within the larger framework of the War Department and the nation. Some in the series UNITED STATES ARMY IN WORLD WAR II were used so extensively as to merit special mention: Kent Roberts Greenfield, Robert R. Palmer, and Bell I. Wiley, *The Organization of Ground Combat Troops* (Washington, 1947); Richard M. Leighton and Robert W. Coakley, *Global Logistics and Strategy, 1940–1943* (Washington, 1955); R. Elberton Smith, The Army and Economic Mobilization (MS); Robert R. Palmer, Bell I. Wiley, and William R. Keast, *The Procurement and Training of Ground Combat Troops* (Washington, 1948); Mark S. Watson, *Chief of Staff: Prewar Plans and Preparations* (Washington, 1950); and Theodore E. Whiting, Statistics (MS).

Glossary

AA	Antiaircraft
AAF	Army Air Forces
AAFBU	Army Air Forces Base Units
AAFPGC	Army Air Forces Proving Ground Command
AAFTC	Army Air Forces Training Command
AAFTTC	Army Air Forces Technical Training Command
A/B	Airborne
AC	Air Corps, Assistant Chief
ACofAC	Assistant Chief of Air Corps
ACofEngrs	Assistant Chief of Engineers
ACofS	Assistant Chief of Staff
Actg	Acting
Adj	Adjutant
Adm	Administrative
AEF	American Expeditionary Force
AFCC	Air Force Combat Command
AFHQ	Allied Force Headquarters
AFTAI	Air Forces Technical Air Intelligence
AG	Adjutant General
AGCT	Army General Classification Test
AGF	Army Ground Forces
AGO	Adjutant General's Office
AIC	Army Industrial College
Alloc	Allocation
Allot	Allotment
Allow	Allowance
Amph	Amphibious
AMS	Army Map Service
ANMB	Army and Navy Munitions Board
Ann	Annual
AP	Transport
Armd	Armored
ASF	Army Service Forces
ASFTC	Army Service Forces Training Center
Asgd	Assigned
Asgmt	Assignment
ASP	Army Supply Program
Asst	Assistant

ASTP	Army Specialized Training Program
ASW	Assistant Secretary of War
ASWAAF	Arms and services personnel with the Army Air Forces
Atchd	Attached
Avn	Aviation
AVRE's	Assault Vehicles Royal Engineers
AWOL	Absent without leave
BAS	British Army Staff
Bd	Board
Bn	Battalion
BOLERO	Build-up of U. S. forces and supplies in United Kingdom for cross-Channel attack
Br	Branch
BR	Bridge
Brig	Brigadier, Brigade
Bull	Bulletin
BuOrd	Bureau of Ordnance, Navy Department
C	Chief
CofAC	Chief of the Air Corps
CBI	China–Burma–India
CofCav	Chief of Cavalry
CE	Corps of Engineers
CofEngrs	Chief of Engineers
CG	Commanding General
CandGS	Command and General Staff
Chm	Chairman
Cir	Circular
C/L	Circular letter
Clas	Classification
CMAB	Combined Munitions Assignments Board
CMP	Controlled Materials Plan
CNO	Chief of Naval Operations
CO	Commanding Officer
Co	Company
Comd	Command
Comdt	Commandant
Comm	Committee
ComZ	Communications zone
Conf	Conference
Conserv	Conservation
Constr	Construction
CONUS	Continental United States
Corresp	Correspondence
CofS	Chief of Staff

DA	Defense aid
DCofS	Deputy Chief of Staff
Dept	Department
Desig	Designate
Det	Detachment
Dev	Develop, development
DF	Disposition form
Dir	Director
Distr	Distribution
Div	Division
Doc	Document
DPC	Defense Plant Corporation
DRB AGO	Departmental Records Branch, Adjutant General's Office
DTC	Desert Training Center
DUKW	2½-ton 6x6 amphibian truck
EAB	Engineer Amphibian Brigade
EAC	Engineer Amphibian Command
EAM	Electric accounting machine
EAUTC	Engineer Aviation Unit Training Center
EFDO	Engineer Field Depot Office
EFMO	Engineer Field Maintenance Office
EHD	Engineer Historical Division
EM	Enlisted men
Engr	Engineer, engineering
Enl	Enlisted
EOC	Engineer Organization Center
Equip	Equipment
ERDL	Engineer Research and Development Laboratory
ERO	Engineer Research Office
ERTC	Engineer Replacement Training Center
Estab	Establish, establishment, establishing
ETC	Engineer Training Center
ETO	European Theater of Operations
ETOUSA	European Theater of Operations, U. S. Army
EUCOM	European Command
EUTC	Engineer Unit Training Center
Exec	Executive
ExO	Executive Officer
Fld	Field
FY	Fiscal Year
G–1	Personnel section of divisional or higher staff
G–2	Intelligence section
G–3	Operations section

G–4	Supply section
Gen	General
GHQ	General Headquarters
GS	General Staff
GSGS	Geographical Section, General Staff
H	House of Representatives
HD	Historical Division
HE	High explosive
Hist	History
HP	Horsepower
I&S	Iron and Steel
IBM	International Business Machines
IGD	Inspector General's Department
Incl	Inclosure
Inf	Infantry
Info	Information
Inspec	Inspection
Instr	Instructions
Intel	Intelligence
Interv	Interview
Intnl	International
JANIS	Joint Army-Navy Intelligence Studies
KCRC	Kansas City Records Center
LCI	Landing craft, infantry
LCM(3)	Landing craft, mechanized, Mark III
LCP	Landing craft, personnel
LCT	Landing craft, tank
LCV	Landing craft, vehicle
LCVP	Landing craft, vehicle and personnel
LSD	Landing ship, dock
LST	Landing ship, tank
Ltr	Letter
MA	Military attaché
MAB	Munitions Assignments Board, Washington
MAC(G)	Munitions Assignments Committee (Ground)
Mach	Machine, machinery
Maint	Maintenance
Mat	Material, matériel
Mech	Mechanical, mechanics
Mecz	Mechanized
MG	Machine gun
Mgt	Management
Mil	Military

Min	Minutes
Misc	Miscellaneous
MIT	Massachusetts Institute of Technology
Mob	Mobilization
MPR	Monthly Progress Report
M/S	Memorandum Slip
Mtg	Meeting
MTP	Military Training Program
Mtzd	Motorized
NAD	North Atlantic Division
NATO	North African Theater of Operations
NCO	Noncommissioned officer
n. d.	No date
NDAC	Advisory Commission to the Council of National Defense
NDRC	National Defense Research Committee
NG	National Guard
OASW	Office of the Assistant Secretary of War
Obsvn	Observation
Obsvr	Observer
OCofAC	Office Chief of Air Corps
OCE	Office Chief of Engineers
OCMH	Office of the Chief of Military History
OCO	Office Chief of Ordnance
OC&R	Operations Commitments and Requirements
OCofS	Office Chief of Staff
OCT	Office Chief of Transportation
Off	Officer
OPD	Operations Division
OPM	Office of Production Management
Opns	Operations
Ord	Ordnance
Orgn	Organization
OSW	Office of the Secretary of War
O&T	Operations and Training (Section) Branch, OCE
OTS	Officer Training School
Par	Paragraph
PC&R	Port Construction and Repair
PEOC	Provisional Engineer Organization Center
Pers	Personnel
Photo	Photography
P/I	Program of Instruction
PL	Public Law

Plan	Plans, planning
Plat	Platoon
PMP	Protective Mobilization Plan
P&O	Plans and Operations
POA	Pacific Ocean Area
POM	Preparation for Overseas Movement
Proc	Procurement
Prod	Production
PRP	Production Requirements Plan
P&T	Plans and Training Division
Pt	Part
Purch	Purchase, purchasing
QMC	Quartermaster Corps
RA	Regular Army
RAINBOW	Various plans prepared between 1939 and 1941 to meet Axis aggression
R&D	Research and Development
RC	Reception Center
Rcn	Reconnaissance
Regt	Regiment
Rep	Representative
Repl	Replacement
Res	Resolution
Ret	Retired
Rev	Revised, revision
ROTC	Reserve Officers Training Corps
ROUNDUP	Plan for major U. S.-British attack across the Channel in 1943
Rpt	Report
Rqmts	Requirements
RTC	Replacement Training Center
S–2	Military intelligence section of a unit not having a general staff
S–3	Operations and training section of a unit not having a general staff
Sch	School
Sched	Schedule
Sec	Section
Ser	Serial, series
SES	Strategic Engineering Study
SHAEF	Supreme Headquarters Allied Expeditionary Force
SNL	Standard Nomenclature List
SOS	Services of Supply

Spec	Specialist
SPOBS	Special Army Observer Group in London
Squad	Squadron
SSN	Specification Serial Number
Stat	Statistics, statistical
Sub	Subject
Subcomm	Subcommittee
Sup	Supply
Sv	Service
SvC	Service Command
SW	Secretary of War
TAG	The Adjutant General
T/BA	Table of basic allowances
TCC	Troop Carrier Command
Tech	Technical
Tel Conv	Telephone conversation
Telg	Telegram
TIB	Technical Information Branch
TIG	The Inspector General
Tng	Training
TNT	Trinitrotoluene
T/O	Table of organization
TofOpns	Theater of Operations
Topo	Topographical
Trans	Transport, transportation
TRIDENT	International conference at Washington 12–25 May 1943
Trps	Troops
TVA	Tennessee Valley Authority
U.K.	United Kingdom
USAF	United States Air Force
USAFWESPAC	United States Army Forces in the Western Pacific
USAR	United States Army Reserve
USCG	United States Coast Guard
USMA	United States Military Academy
USN	United States Navy
USW	Under Secretary of War
UTC	Unit Training Center
WD	War Department
WDGS	War Department General Staff
WDSS	War Department Special Staff
Wkly	Weekly
WPA	Works Progress Administration
WPB	War Production Board

WPD	War Plans Division
WRB	War Resources Board
YTL	Tank lighter. This was the designation of an early version of the LCT, which was also known at one time as tank landing craft (TLC)

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 of Ground Combat Troops*

The Army Service Forces
- *The Organization and Role of the Army Services Forces*

The Western Hemisphere
- *The Framework of Hemisphere Defense*
- *Guarding the United States and Its Outputs*

The War in the Pacific
- *The Fall of the Philippines*
- *Guadalcanal: The First Offensive*
- *Victory in 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 Services 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 Employment of Negro Troops
Manhattan: The U.S. Army and the Atomic Bomb

Pictorial Record

The War Against Germany and Italy: Mediterranean and Adjacent Areas
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