U113
.2
TM
1942

TM 5-246

WAR DEPARTMENT TECHNICAL MANUAL

U.S. Dept. of Army

INTERPRETATION OF AERIAL PHOTOGRAPHS

WAR DEPARTMENT • 31 DECEMBER 1942

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

WAR DEPARTMENT TECHNICAL MANUAL

TM 5-246

INTERPRETATION OF AERIAL PHOTOGRAPHS

WAR DEPARTMENT • *31 DECEMBER 1942*

United States Government Printing Office

Washington : 1947

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

U113
.2
TM 5:246
1942

TECHNICAL MANUAL
No. 5-246

WAR DEPARTMENT,
WASHINGTON, December 31, 1942.

INTERPRETATION OF AERIAL PHOTOGRAPHS

CHAPTER 1. General terrain features.

SECTION		Paragraph
I. General.		
	Purpose and scope	1
II. Land forms.		
	Application to aerial photographs	2
	Development of topography	3
	Types of erosion	4
	Application of land forms to interpretation of aerial photographs	5
	Plains	6
	Coast lines	7
	Terraces	8
	Escarpments and faults	9
III. Aerial view.		
	General	10
	Farms	11
	Towns	12
	Industrial	13
IV. Scale and orientation of photographs.		
	Determination of scale	14
	Orientation and location	15
	Objects visible at various scales	16
	Area included at various scales	17
V. Tone and shadow.		
	General	18
	Tone	19
	Shadow	20
VI. Practical identification.		
	General	21
	Mountains	22
	Hills	23
	Inland lakes	24
	Rivers and streams	25
	Woods	26
	Deserts	27
	Fields and vegetation	28
	Flats and marshes	29
	Coast lines	30
	Sea walls and breakwaters	31
	Practical identification exercise	32

*This manual is supplementary to FM 21-25, 21-26, and 30-21. A knowledge of map and aerial photograph reading contained in those manuals is necessary to the study of this manual. It is published for the training of officers and enlisted men charged with the tactical interpretation of aerial photographs for both the Army Ground Forces and Army Air Forces. It provides a set of aerial photographs showing many types of military activities. Many of the photographs were taken during peacetime maneuvers and serve to point out the common camouflage mistakes made by untrained troops.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

CHAPTER 2. Military interpretation.

SECTION		Paragraph
I.	General.	
	Purpose and scope	33
	Photographs in war	34
	Photographic missions	35
	Recording photographs	36
	First phase interpretation	37
	Second phase interpretation	38
	Obliques	39
	Stereo studies	40
	Interpretation equipment	41
II.	Close studies.	
	Importance	42
	Means of study	43
	Scrapbook	44
III.	Comparative photographs.	
	Value of previous photographs	45
	Means of comparison	46
IV.	Camps and bivouacs.	
	Location and identification	47
	Command posts	48
	Size of units	49
	Type of unit	50
	Length of occupation	51
V.	Troop movements.	
	Value of photographs of troop movements	52
	Identification of units	53
	Motorized units	54
	Horse and foot movements	55
VI.	Supply installations.	
	Railheads and dumps	56
	Water points	57
VII.	Antiaircraft positions.	
	Location	58
	Identification	59
VIII.	Antimechanized defense.	
	Location	60
	Identification	61
IX.	Field artillery positions.	
	Characteristic positions	62
	Tracks	63
	Light artillery	64
	Medium and heavy artillery	65
	Wire communication	66
X.	Seacoast defense.	
	General	67
	Permanent gun installations	68
	Railroad guns	69
	Obstacles	70

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

CHAPTER 2. Military interpretation—Continued.

		Paragraph
SECTION XI.	Engineer activities.	
	Significance	71
	Equipment	72
	River crossings	73
XII.	Advanced landing fields.	
	Importance	74
	Construction	75
	Protection	76
XIII.	Camouflage.	
	General	77
	Study of own position	78
	Signs of occupation	79
	Dummy installations	80
	Break-down by photography	81
	Counterintelligence	82
XIV.	Reconnaissance from photographs.	
	General	83
	Route of advance	84
	Supply	85
XV.	Defensive positions.	
	General	86
	Characteristics	87
	Employment of photographs	88
		Page
INDEX		218

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

CHAPTER 1

GENERAL TERRAIN FEATURES

		Paragraphs
SECTION I.	General	1
II.	Land forms	2–9
III.	Aerial view	10–13
IV.	Scale and orientation of photographs	14–17
V.	Tone and shadow	18–20
VI.	Practical identification	21–32

SECTION I

GENERAL

	Paragraph
Purpose and scope	1

1. Purpose and scope.—*a.* The purpose of this chapter is to familiarize the student with the appearance of general terrain features on aerial photographs. This knowledge is essential for all those who use aerial photographs for tactical purposes as well as for the interpreter who studies them to discover information concerning the enemy.

b. This chapter is designed to give a clear picture of the general terrain features on ground not occupied by military forces. This knowledge is essential to the interpreter so that he will not waste time in trying to identify features of no military significance or importance.

SECTION II

LAND FORMS

	Paragraph
Application to aerial photographs	2
Development of topography	3
Types of erosion	4
Application of land forms to interpretation of aerial photographs	5
Plains	6
Coast lines	7
Terraces	8
Escarpments and faults	9

2. Application to aerial photographs.—A knowledge of how land forms are created gives many clues to the identity of the physical features shown on an aerial photograph and is invaluable to the interpreter.

3. Development of topography.—*a.* The grouping of land forms in any given area is its topography. These land forms are produced by the action of natural forces on the material of which the earth is made (rock and its decomposition products). To understand this action, the materials of which the earth is composed must be known.

b. Rock.—Rocks are divided into three main types: igneous, sedimentary, and metamorphic.

(1) Igneous rocks are formed by the cooling of molten rock. This generally takes place a considerable distance below the earth's surface except for lava extruded from volcanoes or fissures.

(2) Sedimentary rocks are formed by sediments being deposited, mainly in large bodies of water, and consolidated into rock by the pressure of more sedimentary deposits laid down on top of them. These rocks are layered or stratified, the thickness of the layers depending on the length of time the conditions of deposition remained constant.

(3) Metamorphic rocks are formed by the action of heat or pressure or both, on rock of either igneous or sedimentary origin.

c. Geologic processes.—The processes which produce topography may be divided into two main categories: internal and surface. These operate concurrently.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

(1) Internal processes are the result, usually, of readjustments in the earth's interior and take the form of folds, faults (breaks), and upheavals in the surface rock.

(2) Surface processes consist of the action of wind, water, weather, and glaciers on the rock whose initial relief is due to the internal geologic processes. Collectively, their action is called erosion.

4. Types of erosion.—*a. Water.*—(1) The action of water on the surface of the earth is the most important cause of erosion. Water falling on an area will flow into the natural depressions and the erosive action will widen and deepen them by the removal of particles of rock and soil. As this action continues, the ridges between depressions are slowly cut down and the ridge is eventually dissected into isolated hills. As the ridge is cut up, the valleys at the same time broaden and the depressions become wider and less V-shaped. As the valleys widen, the slope of streams lessens. Less material is transported by the streams and that which is carried is more easily deposited. This action builds up the lower reaches of the drainage system, the stream velocity slows even more, and a delta and flood plain are developed. On this flood plain the stream moves (meanders) by cutting on the outer curve of each bend and depositing on the inner. The eventual result of this process would be a nearly level surface if the earth remained static during the erosion cycle. However, because of internal adjustments, the uplift or sinking of the land relative to the sea often rejuvenates or drowns the streams and thus the complete erosion cycle is seldom achieved.

(2) Along certain coast lines (particularly where there are high cliffs) considerable erosion is accomplished by the sea. The wave and tide action undercut the cliffs, causing the upper portion to collapse. The broken material is further reduced in size and carried out to sea by waves and tide.



FIGURE 1.—Mountains showing result of erosion by streams to form gullies.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

b. Wind.—Erosion by wind, in most areas, is minor compared with that caused by water. However, where vegetation is sparse the scouring action of small particles of rock and soil carried by the wind is considerable.

c. Weathering.—In areas of considerable variation in temperature, the freezing and thawing of water in rock fractures increases the size and depth of these breaks, and eventually large masses of rock are broken off. The chemical action of the oxygen in the air and dissolved in water causes a change in rocks which results in a breaking or spalling off of the outer layers.

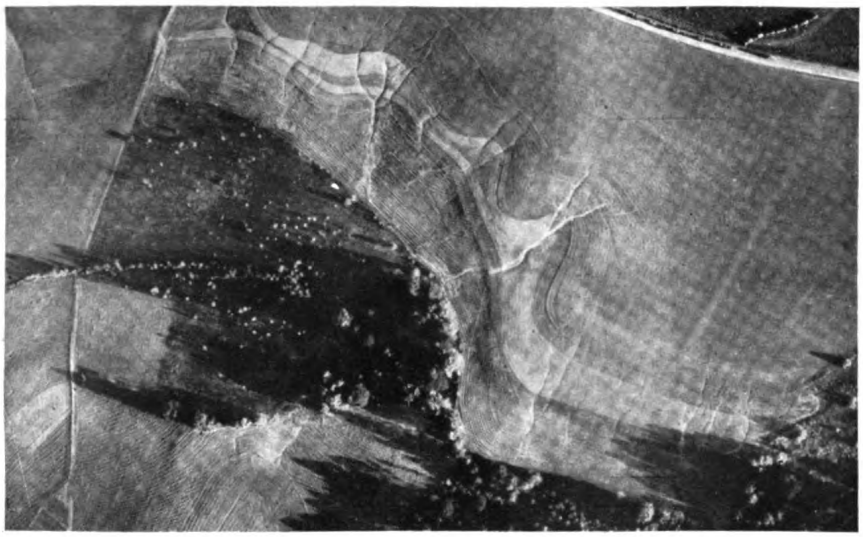


FIGURE 2.—Scale 1:5,000. Light streaks are a result of cultivation and are not to be confused with strata. Shadows resulting from early morning sun show the beginning of gully erosion in this field.

d. Glaciers.—Glaciers, although uncommon, accomplish a tremendous amount of erosion. While practically no material is pushed along by the glacier front, a great mass is picked up and carried in the ice mass to be dropped when melting removes the supporting ice.

5. Application of land forms to interpretation of aerial photographs.—*a. River and stream patterns.*—(1) From the patterns formed by gullies, streams, and rivers, the interpreter determines the ridge and stream line locations so important in military operations. Except in very old topography, the ridge lines form an interfingering pattern with the stream or valley pattern. This ridge line pattern lies generally midway between the stream lines and never crosses the streams.

(2) There are two common stream patterns: the more common is a fingerlike or treelike pattern in which the tributaries of the main stream branch from the main stream as the branches from the trunk of a tree; the less common is a rectangular pattern in which the tributaries join the larger streams at nearly right angles. The valleys formed in the second pattern are likely to be longer, straighter, and narrower than those formed in the first.

b. Rules for determining direction of flow of streams.—The following rules are helpful in determining the direction of flow of streams:

(1) The V formed by the junction of the main stream and any one of its tributaries points generally in the direction of flow.

(2) Islands and sand bars of a stream often have the general shape of teardrops, the sharp ends pointing downstream.

(3) Rapids make a characteristic pattern which indicates the direction of flow; the rough water is downstream.

(4) Normally a stream tends to cut its meanders off at the neck. The upstream side of this neck is cut deeper than the downstream side due to the deflection or the forward flow of the stream.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

(5) When a dike or other obstruction juts out into a stream, deposits will usually collect on the downstream side of the obstruction.

6. Plains.—*a. Flood plains.*—Flood plains are flats developed along rivers due to the deposit of sediment in time of flood. The width of a flood plain depends on the stream valley whose width in turn depends on the slope of the stream. A decrease in the slope reduces the velocity and scouring action. The lateral erosion or bank cutting then becomes the more important erosive action. By this lateral movement (meandering) the stream widens its valley. The stream cuts away its banks on the outside of the stream curves and deposits on the inside. This causes the bends to move outward in the shape of a circle; the stream finally breaks through the narrow neck of land and the circle is completed. Deposition on the inside of the curves then isolates the bend as an oxbow lake. (See figs. 3 and 75.)

b. Deltas.—A stream which flows into a large body of water with little or no current loses its carrying power and deposits its suspended material to form a delta. Topographically a delta consists of three parts: a broad, gently sloping upper surface, most of which is above the level of the quiet body of water; a steeper front slope which is submerged; and a gently rolling sheet of mud and clay which extends out from the foot of the front slope. Some deltas, such as that of the Mississippi, reach a large size. (See fig. 110.)

c. Peneplains.—A peneplain is a nearly flat or broadly undulated land surface produced mainly by the work of streams and atmospheric weathering. An active peneplain has the following visible characteristics: the relief is very low; and the streams meander at grade in broad, shallow valleys.

7. Coast lines.—*a. Rising.*—Rising coast lines are identified by great coastal plains, shallow bays, and large, low flats. They are usually accompanied by a fringe of sand dune islands. The coast of the Gulf of Mexico is an example of a rising coast line. (See fig. 109.)

b. Sinking.—Along a sinking coast line, good harbors, deep water, and many fjords and estuaries may be expected. Inland from these sinking coast lines will be wide, deep rivers. The east coast of the United States is typical of a sinking coast line. (See figs. 4 and 107.)

c. Estuaries.—Estuaries are formed by the drowning of river valleys on a sinking coast line, the higher interstream areas forming peninsulas. (See fig. 4.) Chesapeake Bay is an excellent example of an estuary.

8. Terraces.—*a. Field* (fig. 5).—Field terraces are used by the farmer, in cultivated areas in rolling hills, to reduce the velocity of run-off water and the consequent soil erosion of his field. Terraces approximate contours but usually have a gentle slope to allow the water accumulated behind the terraces gradually to run off the field without carrying soil.

b. Bench (figs. 22 and 98).—This type of terrace is seen on landscaped lawns and consists of a series of wide steps, the drop between steps being almost vertical. Bench terraces are also found in mountainous country which is intensively cultivated. They have been used in China and Japan for centuries and are common throughout Europe.

9. Escarpments and faults (fig. 6).—*a.* When a gradually sloping natural plain drops rapidly to another gradually sloping plain, the drop is called an escarpment. There are several erosional escarpments between Paris and eastern France and Belgium, and they have long been one of the greatest natural defenses of Paris. There is a fault escarpment that runs almost all the way across the State of Texas about 50 miles inland from the coast line. Fault or erosional escarpments form naturally strong positions for defense.

b. Slippage along fault lines (earthquakes) often results in escarpments. A line of hills between a plateau and low plains is probably the result of a fault. Many springs, and consequently good drinking water, are often found along faults. An extensive fault is found in the State of Texas and is recognized by the band of limestone hills across the State. San Antonio is situated on this fault line.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 3.—High altitude oblique of snow-covered, thin evergreen forest. The many meanders and oxbow lakes of the river are plainly visible on the river's flood plain.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 4.—Sinking coast line and location of estuaries and peninsulas.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

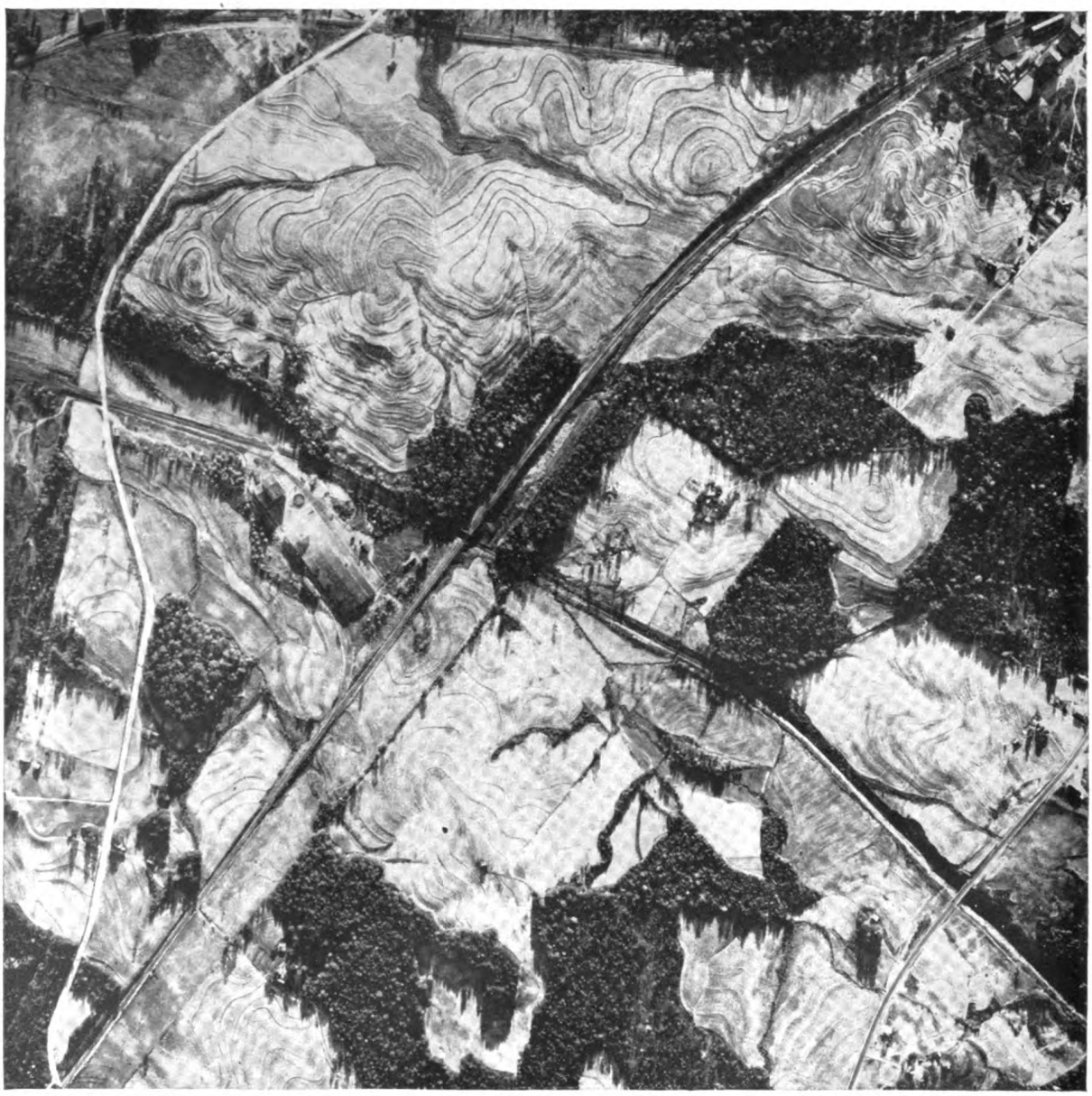
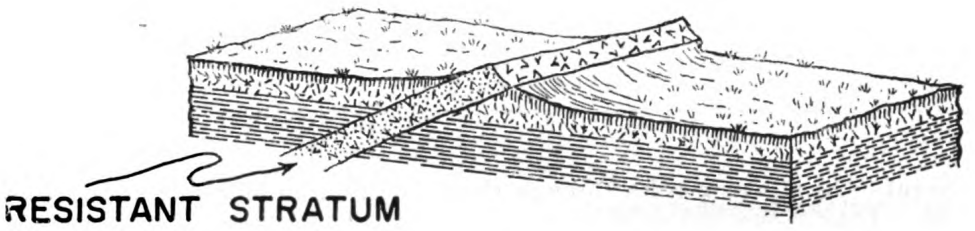


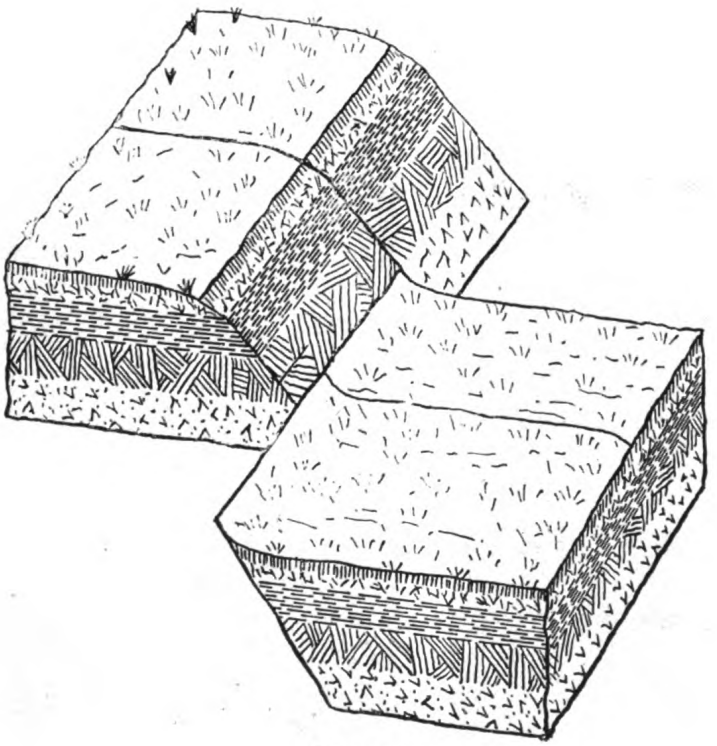
FIGURE 5.—Field terraces are used in hilly country to prevent soil erosion by reducing the velocity of run-off water. The bench terrace common in Europe and Asia can be seen in figure 98.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



① Erosional escarpment.



② Fault escarpment.

FIGURE 6.—Escarpments.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

SECTION III

AERIAL VIEW

	Paragraph
General	10
Farms	11
Towns	12
Industrial	13

10. General.—As a person rides through the country in an automobile his vision is selective and he sees only objects of special or momentary interest. This is because he is accustomed to such observation and the general view of common objects is not consciously recorded. When a vertical photograph is viewed by a person unaccustomed to seeing objects in plan, the whole photograph is apparently cluttered with strange appearing shapes. The following photographs show objects normally found in the United States and a few foreign villages. The interpreter should become familiar with the objects on these photographs so that he can immediately identify any one feature without having the others confuse him.

11. Farms.—No attempt is made here to give examples of all the types of farms that exist. Farms vary, depending on location, climate, crops, and character of the inhabitants. The interpreter should visit farms and villages in the country in which he is operating in order to become familiar with individual features as well as the general characteristic appearance of the farms.

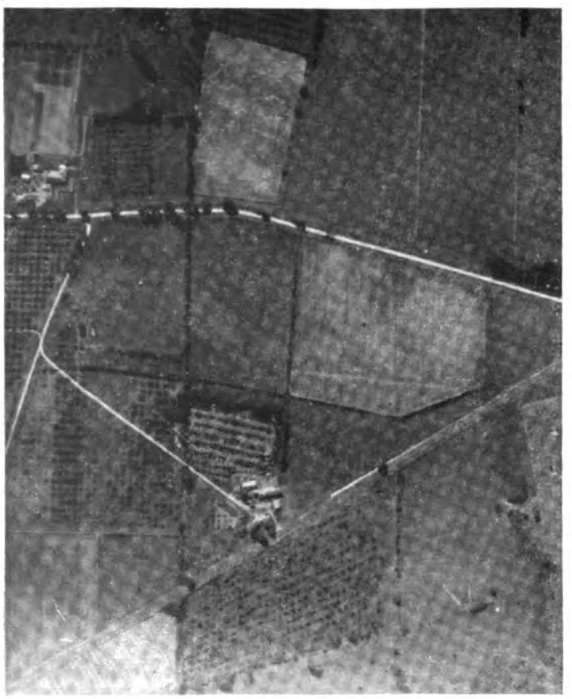


FIGURE 7.—Scale 1:8,000: Two farm groups showing orchards, clear fields, and grain in three stages of harvest.



FIGURE 8.—Scale 1:6,000: Virginia farm in early summer—pastures and low standing crops.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 9.—Midwest farm group. Scale 1:2,000.

1. Strawstack.
2. Windmill.
3. Wagons—wide beds.
4. Tractor.
5. 2½-ton truck.
6. Wagon frame.
7. 1½-ton truck.
8. Frame building construction.
9. Garden.



FIGURE 10.—Vertical, scale 1:5,000, of small farm with low crops in fields.

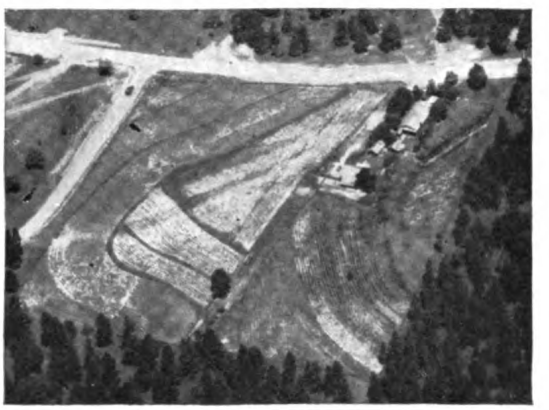


FIGURE 11.—Low oblique of small farm with low crops in fields.

12. Towns.—Towns vary, depending on the geographical location and the agricultural, industrial, or commercial activities which surround and support them. They are discussed further in section XIV, chapter 2.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 12.

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA



FIGURE 13.—In small towns, gardens often appear in residential sections. Note that each home has a driveway from front street to garage in rear.



FIGURE 14.—Scale 1:6,000. Planned residential developments will often appear symmetrical. The type above is more common to an Army post or college campus. City development is usually more compact.



FIGURE 15.—Athletic fields with marked baseball diamonds are a good landmark on aerial photographs of cities.



FIGURE 16.—Fleets of delivery trucks form the best key to identifying bakeries, laundries, dairy products distributors, etc., in a city. Laundries usually have larger stacks and power plants than others. Schools with buses lack loading platforms and have larger grounds around building.

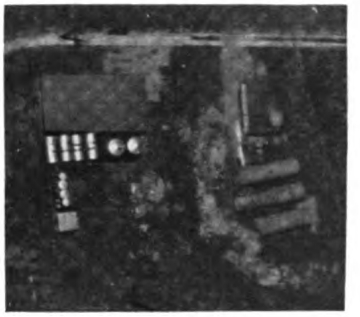


FIGURE 17.—Night photograph of an oil company wholesale distributor's tanks. Along railroads they are easily found on aerial photographs of towns.



FIGURE 18.—Scale 1:30,000. This small European town is typical of Europe and Asia where compact towns make more space for fields. Here the flood plain is intensively farmed, while the town is at the foot of a wooded hill. Evergreens at bottom stand out against deciduous woods without leaves.



FIGURE 19.—Small railroad yard. About half of this yard is used for coal.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 20.—Scale 1:13,000. European agricultural village very compactly located in intensive farming area. It will be noted that most foreign farms differ from those in the United States in that farm dwellings are grouped together in the village, whereas, in the United States a farmer usually lives on his farm. Bench terraces differ greatly from American field terraces. Drainage ditches are dark and often straight, while roads conform to terrain.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 21.—Small city in United States. Scale 1:9,000.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 22.—Small, compact Japanese city located in a fishing and farming center. The small fishing boats are a common sight in most Asiatic cities. The plan of farming is very similar to that practiced in many European countries. Note the bench terraces.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

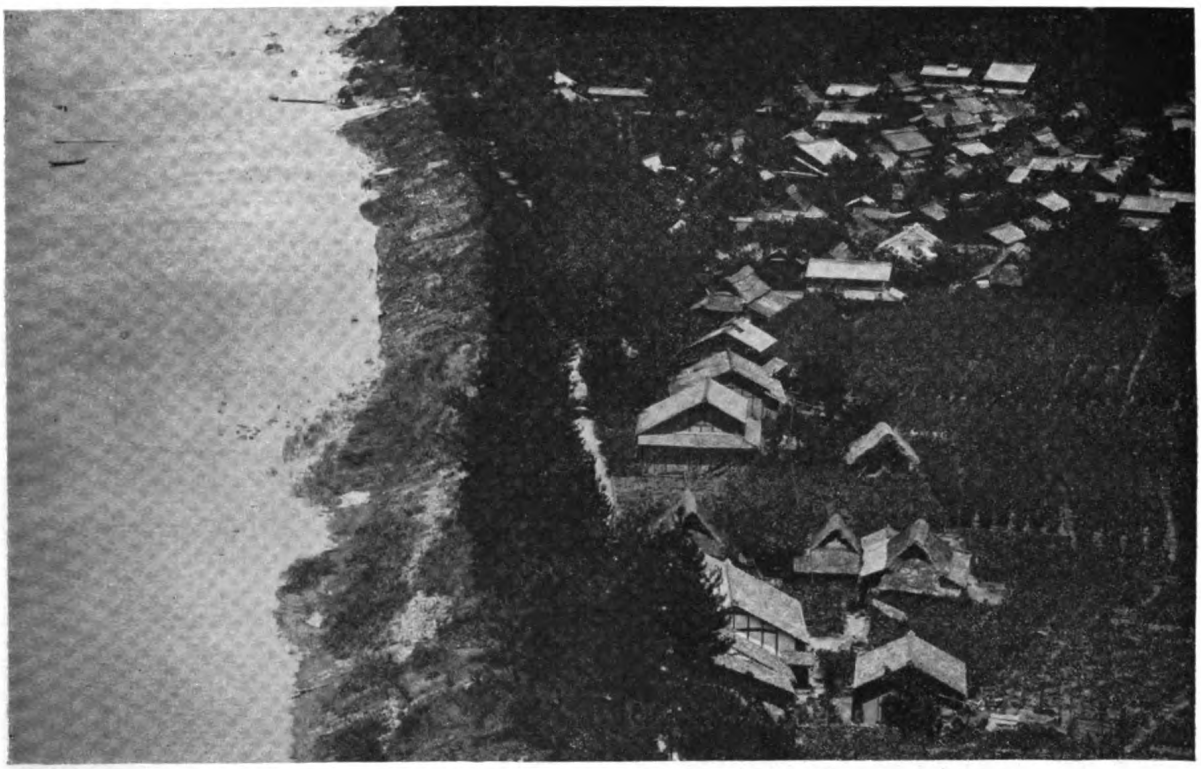


FIGURE 23.—Small Japanese fishing village. Note tea trees or shrubs in lower right-hand corner.

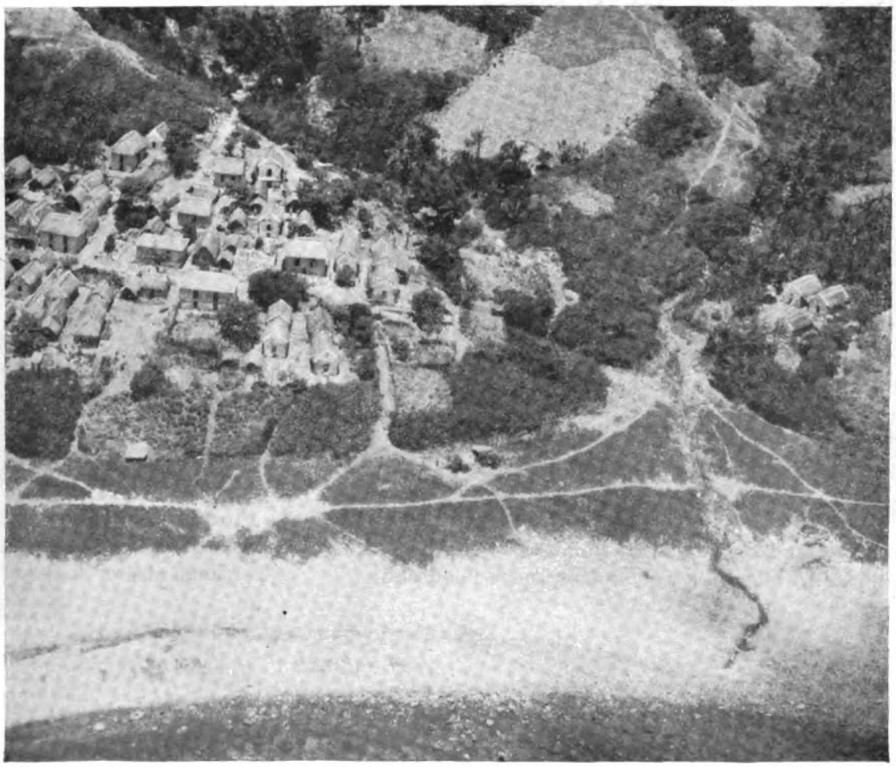


FIGURE 24.—Small village of South Pacific Islands.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

13. Industrial.



FIGURE 25.—In hilly country, railroads and industrial establishments are found along river lines. This European railroad yard and maintenance shops are concentrated in the river flood plain.



FIGURE 26.—Tanks for artificial gas serve as identification points in cities.

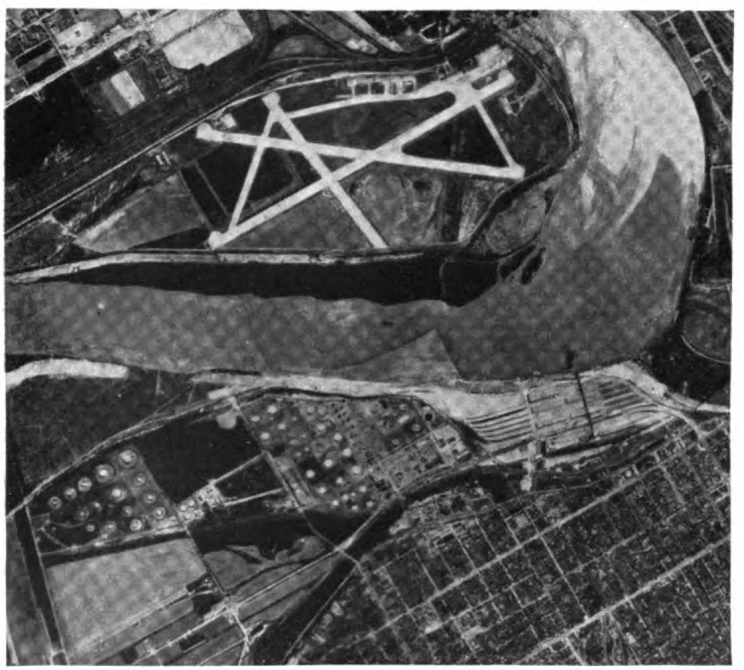


FIGURE 27.—Mosaic showing airport, railroad facilities, and refinery in flood plain. City in lower right is above flood plain.



FIGURE 28.—Scale 1:12,000. Industrial buildings seldom have any conventional size or shape.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 29.—Commercial buildings, residences, and parks of a large city.



FIGURE 30.—Scale 1:12,000: Concentrated industry connected with ship building. Steam and electric railroads; odd-shaped buildings and material piles.



FIGURE 31.—Small roundhouse with turntable.



FIGURE 32.—Industrial plant situated outside a town. Steam is used for power. Note artificial lake used for cooling condenser water. Employees' residences occupy a large part of area. Scale 1:9,000.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

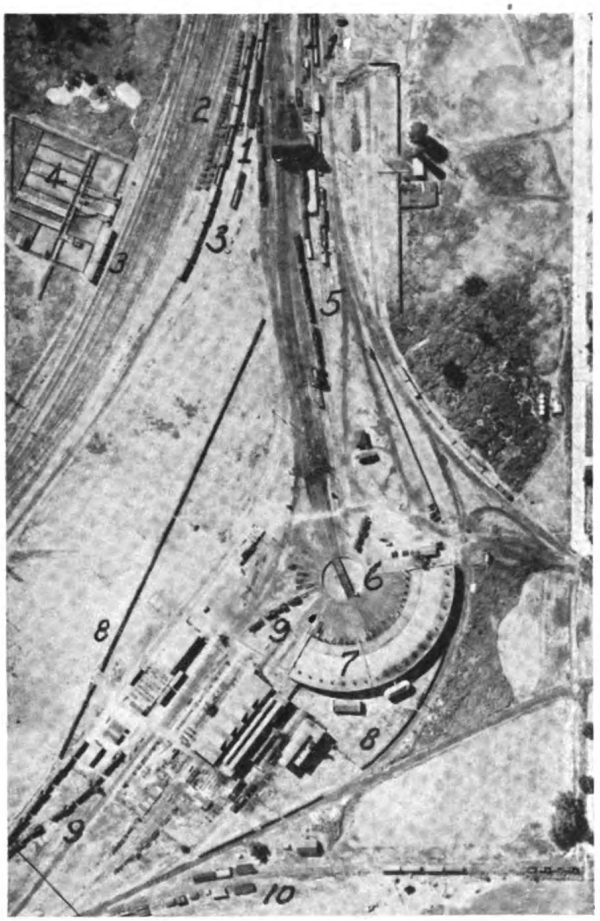


FIGURE 33.—Scale 1:5,000: Railroad maintenance shops in a small town. As proof of the value of close study, check this photograph with someone who is familiar with railroad shops and equipment.

1. Gondolas on both sides of coal hopper.
2. Ties and bridge timber.
3. Boxcars or stock cars.
4. Livestock pens.
5. Engines with tenders.
6. Turntable.
7. Roundhouse.
8. Board fence.
9. Nine engines with eight tenders on one side of shops and one engine with three tenders on other side.
10. Rails and timber.

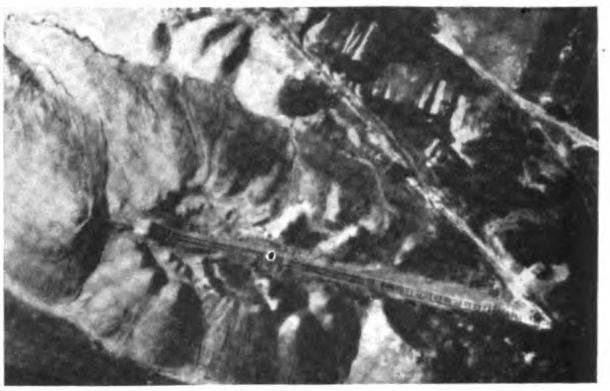


FIGURE 34.—Scale 1:4,000. Mine tailings form little mountains.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

SECTION IV

SCALE AND ORIENTATION OF PHOTOGRAPHS

	Paragraph
Determination of scale	14
Orientation and location	15
Objects visible at various scales	16
Area included at various scales	17

14. Determination of scale.—*a.* The scale of photographs is usually given as a representative fraction (RF) and written on one line (1:5,000). If a vertical photograph contains the altitude and focal length of the camera, the scale is obtained as shown in figure 35. (See FM 21–26.)

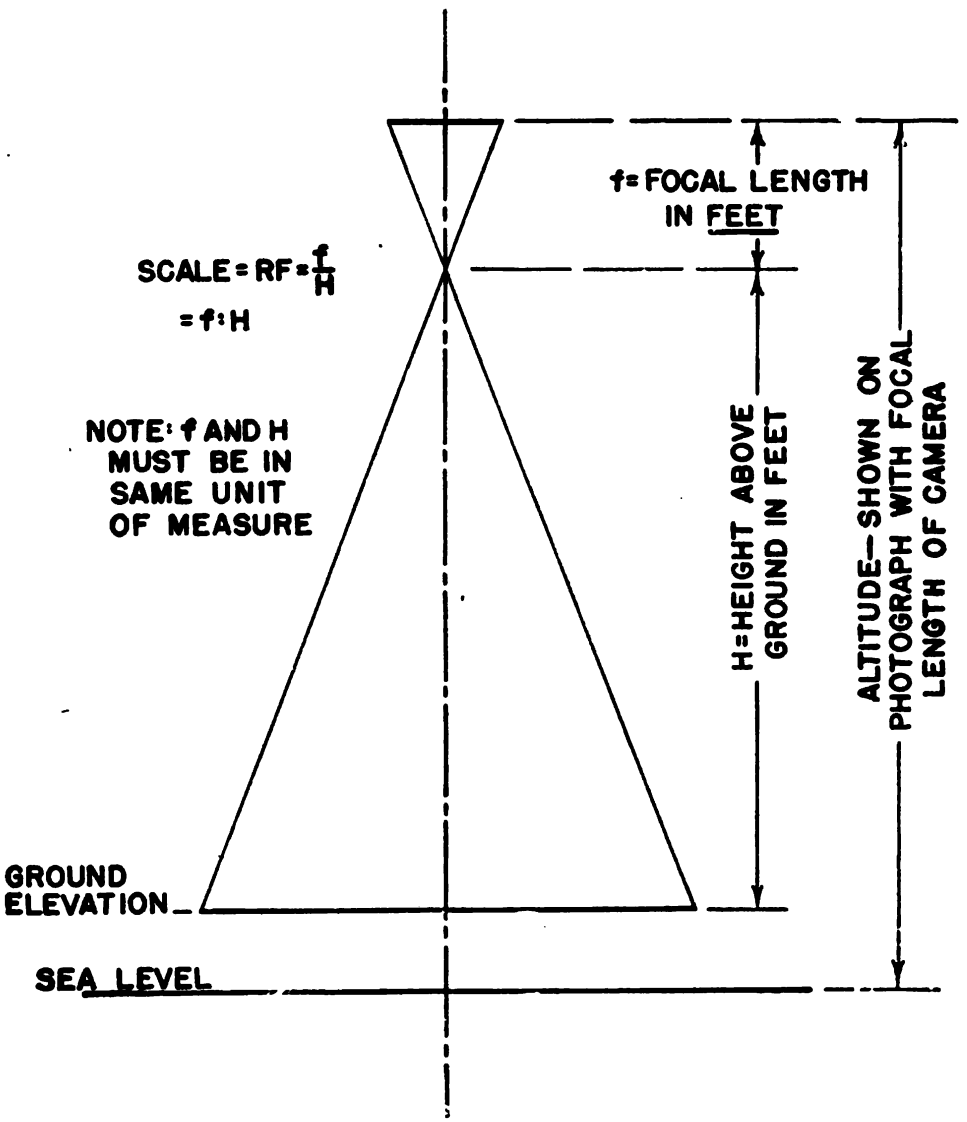


FIGURE 35.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

TABLE I.—*Scales for various altitudes and focal lengths*

Height above ground (feet)	Focal length of lens				
	6 inches	8¼ inches	12 inches	13½ inches	24 inches
	Scale	Scale	Scale	Scale	Scale
1,000	1:2, 000	1:1, 454	1:1, 000	1:889	1:500
2,000	1:4, 000	1:2, 910	1:2, 000	1:1, 778	1:1, 000
3,000	1:6, 000	1:4, 360	1:3, 000	1:2, 667	1:1, 500
4,000	1:8, 000	1:5, 820	1:4, 000	1:3, 556	1:2, 000
5,000	1:10, 000	1:7, 270	1:5, 000	1:4, 440	1:2, 500
6,000	1:12, 000	1:8, 730	1:6, 000	1:5, 330	1:3, 000
7,000	1:14, 000	1:10, 280	1:7, 000	1:6, 220	1:3, 500
8,000	1:16, 000	1:11, 630	1:8, 000	1:7, 110	1:4, 000
9,000	1:18, 000	1:13, 100	1:9, 000	1:8, 000	1:4, 500
10,000	1:20, 000	1:14, 540	1:10, 000	1:8, 890	1:5, 000
11,000	1:22, 000	1:16, 000	1:11, 000	1:9, 780	1:5, 500
12,000	1:24, 000	1:17, 450	1:12, 000	1:10, 670	1:6, 000
13,000	1:26, 000	1:18, 900	1:13, 000	1:11, 560	1:6, 500
14,000	1:28, 000	1:20, 360	1:14, 000	1:12, 450	1:7, 000
15,000	1:30, 000	1:21, 810	1:15, 000	1:13, 330	1:7, 500
16,000	1:32, 000	1:23, 270	1:16, 000	1:14, 220	1:8, 000
17,000	1:34, 000	1:24, 750	1:17, 000	1:15, 110	1:8, 500
18,000	1:36, 000	1:26, 200	1:18, 000	1:18, 000	1:9, 000
19,000	1:38, 000	1:27, 640	1:19, 000	1:16, 890	1:9, 500
20,000	1:40, 000	1:29, 080	1:20, 000	1:17, 780	1:10, 000
21,000	1:42, 000	1:30, 550	1:21, 000	1:18, 670	1:10, 500
22,000	1:44, 000	1:32, 000	1:22, 000	1:19, 560	1:11, 000
23,000	1:46, 000	1:33, 460	1:23, 000	1:20, 450	1:11, 500
24,000	1:48, 000	1:34, 900	1:24, 000	1:21, 340	1:12, 000
25,000	1:50, 000	1:36, 380	1:25, 000	1:22, 220	1:12, 500
26,000	1:52, 000	1:37, 820	1:26, 000	1:23, 110	1:13, 000
27,000	1:54, 000	1:39, 270	1:27, 000	1:24, 000	1:13, 500
28,000	1:56, 000	1:40, 750	1:28, 000	1:24, 890	1:14, 000
29,000	1:58, 000	1:42, 200	1:29, 000	1:25, 780	1:14, 500
30,000	1:60, 000	1:43, 650	1:30, 000	1:26, 670	1:15, 000
31,000	1:62, 000	1:45, 200	1:31, 000	1:27, 560	1:15, 500
32,000	1:64, 000	1:46, 600	1:32, 000	1:28, 450	1:16, 000
33,000	1:66, 000	1:48, 100	1:33, 000	1:29, 340	1:16, 500
34,000	1:68, 000	1:49, 500	1:34, 000	1:30, 230	1:17, 000
35,000	1:70, 000	1:51, 000	1:35, 000	1:31, 120	1:17, 500
36,000	1:72, 000	1:52, 400	1:36, 000	1:32, 010	1:18, 000
37,000	1:74, 000	1:53, 900	1:37, 000	1:32, 900	1:18, 500
38,000	1:76, 000	1:55, 400	1:38, 000	1:33, 790	1:19, 000
39,000	1:78, 000	1:56, 800	1:39, 000	1:34, 680	1:19, 500
40,000	1:80, 000	1:58, 300	1:40, 000	1:35, 570	1:20, 000

b. In figure 36, scale in RF is shown plotted against distance in feet. If the distance between two points on a photograph is desired, lay off the distance on the edge of a paper from the points on the photograph, place the paper on the horizontal line corresponding to the scale of the photograph, and read distance in feet from vertical curves.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

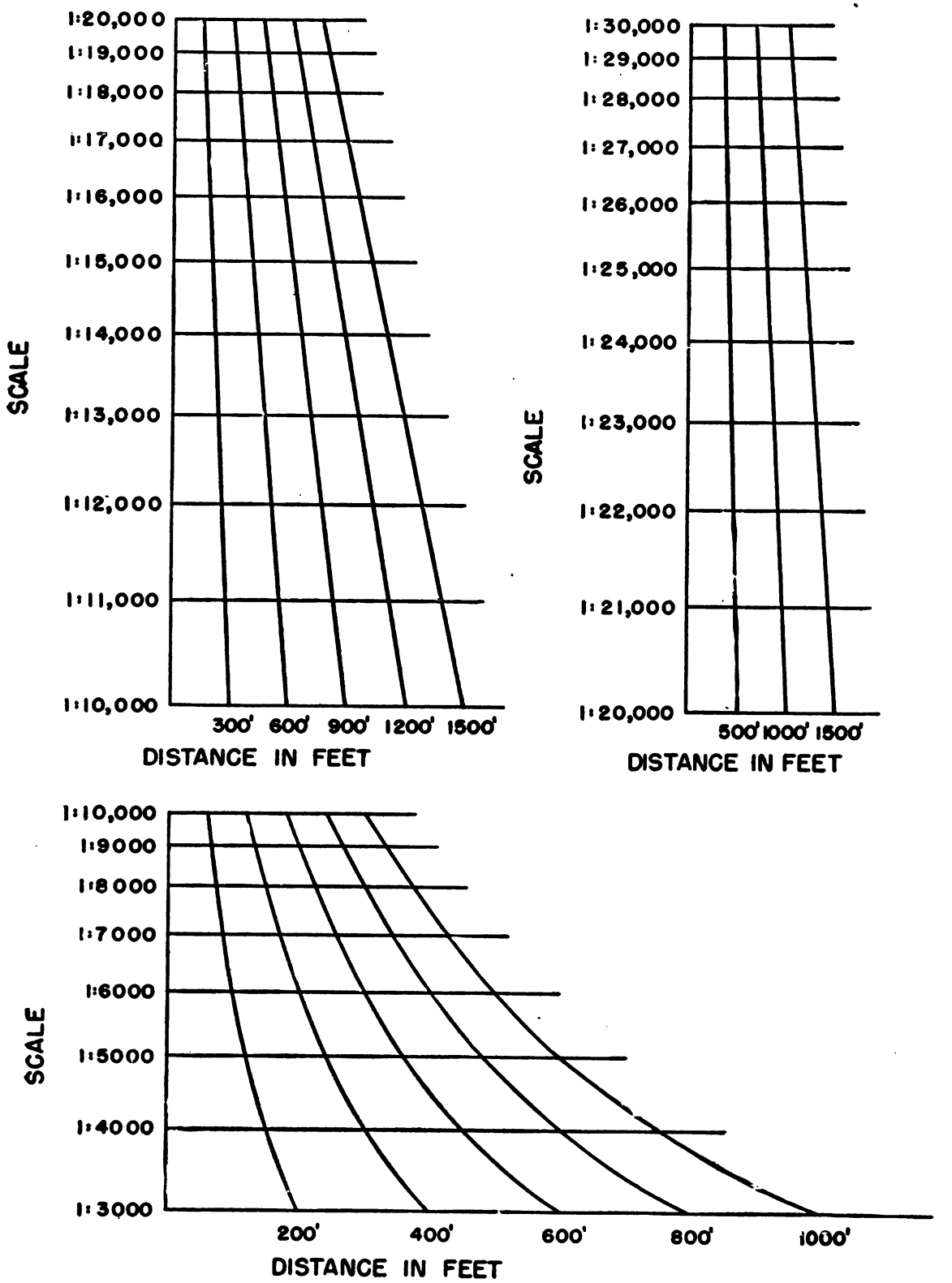


FIGURE 36.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

15. Orientation and location.—*a.* A perfectly interpreted photograph is of no value if the area covered by the photograph cannot be located. For example, small-scale photographs taken at some distance from a known point (town or lake, etc.) and in a terrain of even appearance are very difficult to locate. Obliques accompanying verticals for identification purposes often aid in location.

b. In locating the area covered by a photograph which is not properly identified the following steps should be taken:

(1) Determine north on photograph by an inspection of the shadows. Outside the Tropics and north of the Equator, shadows at noon fall due north and are of sufficient length to orient a photograph.

(2) Pick out main features or feature pattern of photograph, such as road net, railroad, or river.

(3) Estimate scale of photograph.

(4) Consult marginal data on photograph, if available, to aid in location.

(5) With a map and the photograph oriented to each other, look on the map for the main features or feature pattern of photograph.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

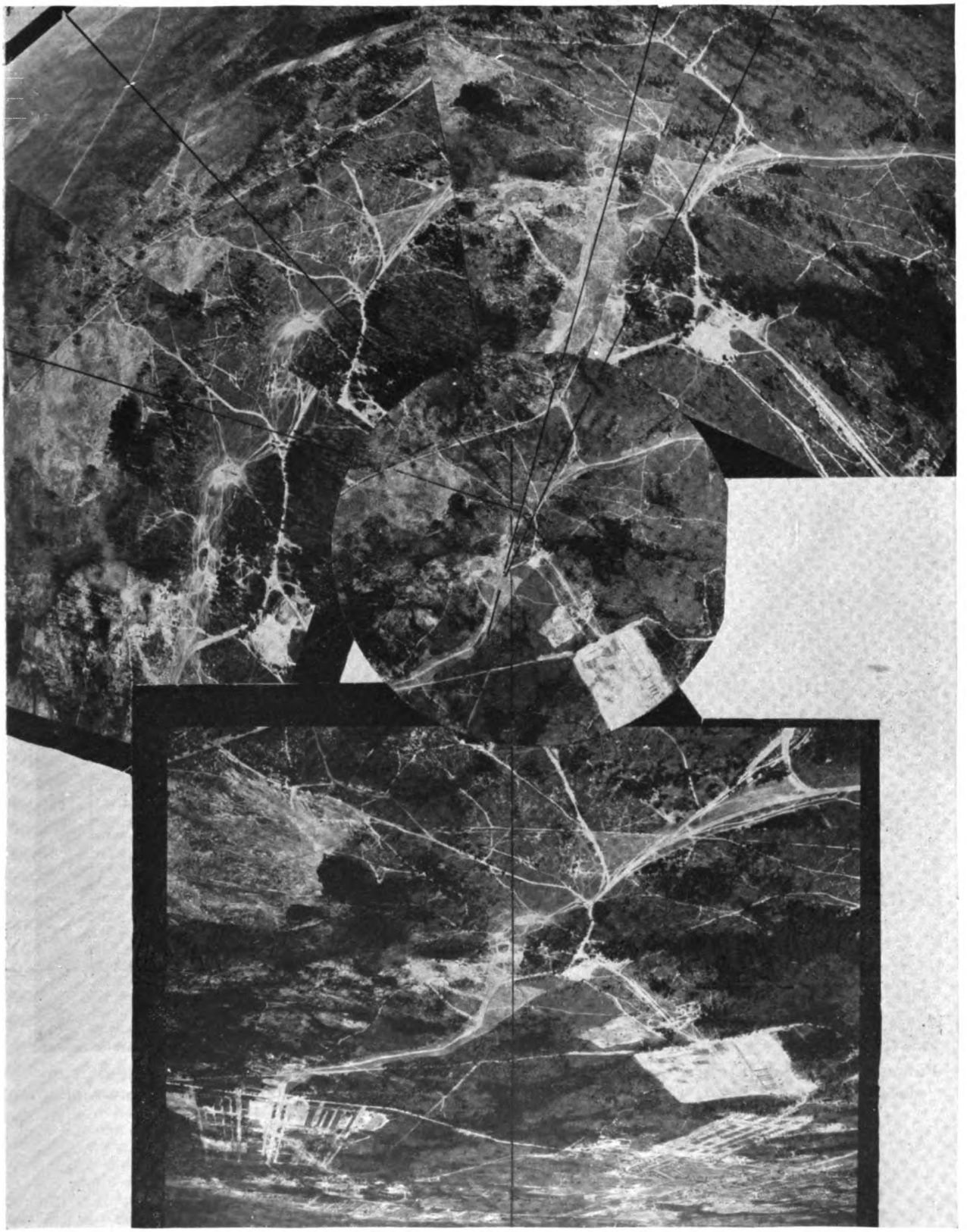


FIGURE 37.—Sections of five obliques radiating from a circular vertical. Extensions of center lines of obliques indicate center of bottom edge of oblique on the vertical. Obliques have the advantage over verticals in that they can show a close view in the foreground while the small scale of the background allows easy location. Low verticals may be very difficult to find on a map.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

16. Objects visible at various scales.—It is impossible to specify the smallest scale at which an object can be identified. Columns of marching men have been visible on a photograph of scale 1:20,000 and individual men have been identified on photographs of scale 1:10,000. Even with perfect photographic exposure, it is the background of an object or its shadow which determines its possibility of identification. (See sec. V, ch. 1 and sec. XIV, ch. 2.)

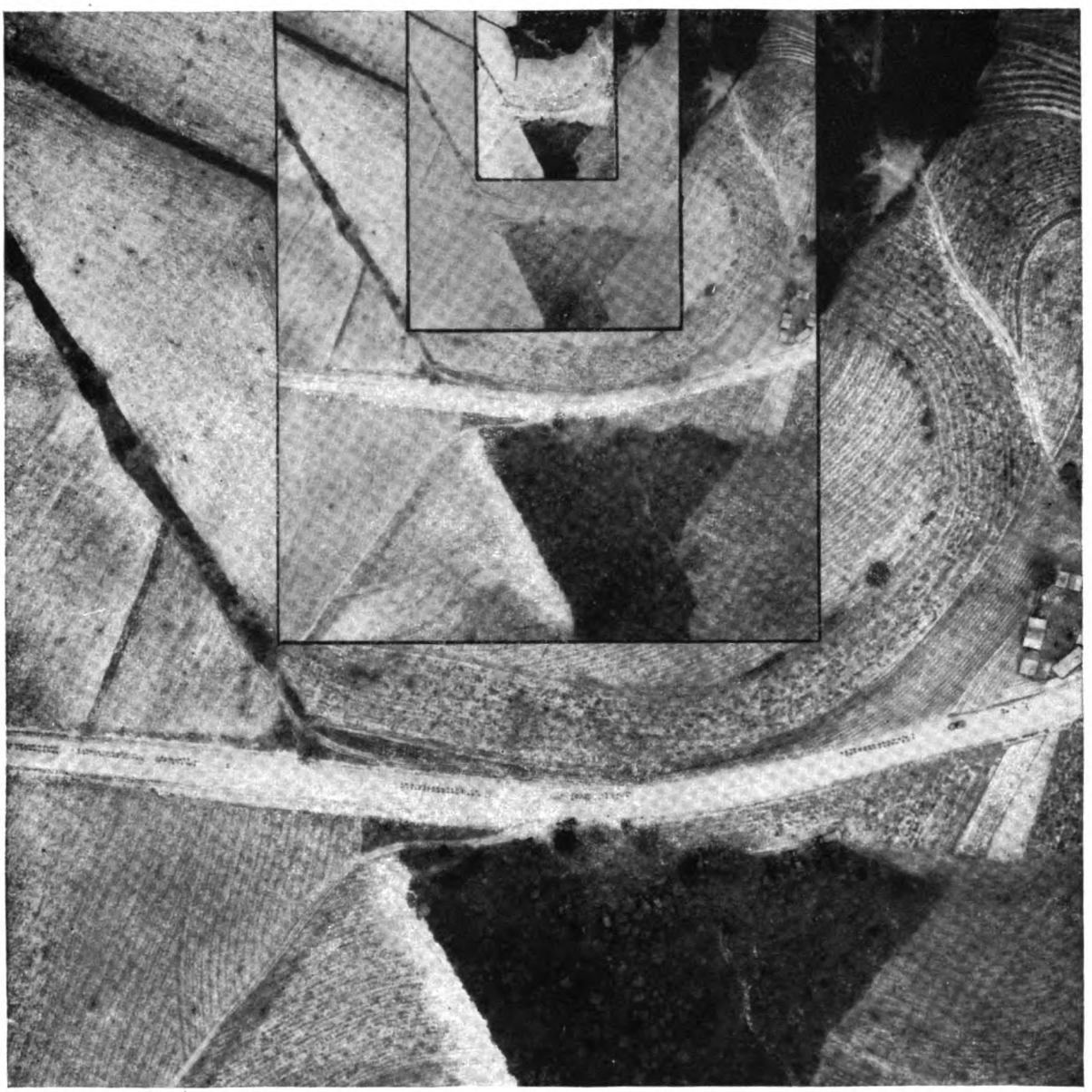


FIGURE 38.—Men marching, at scales 1:2,500, 1:5,000, 1:10,000, and 1:20,000. Since this page is reproduced by reduction and rephotographing, the detail is not as clear as it would be on a true photograph.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

17. Area included at various scales.—As an aid in locating and plotting photographs on a map, or another photograph, a template of transparent material may be made. The template is prepared for a negative of fixed dimensions (for instance 5 by 5 inches) for comparison with a map or photomap of a definite scale. The template shows, for various scales of the photograph, the areas which would be covered on the map.

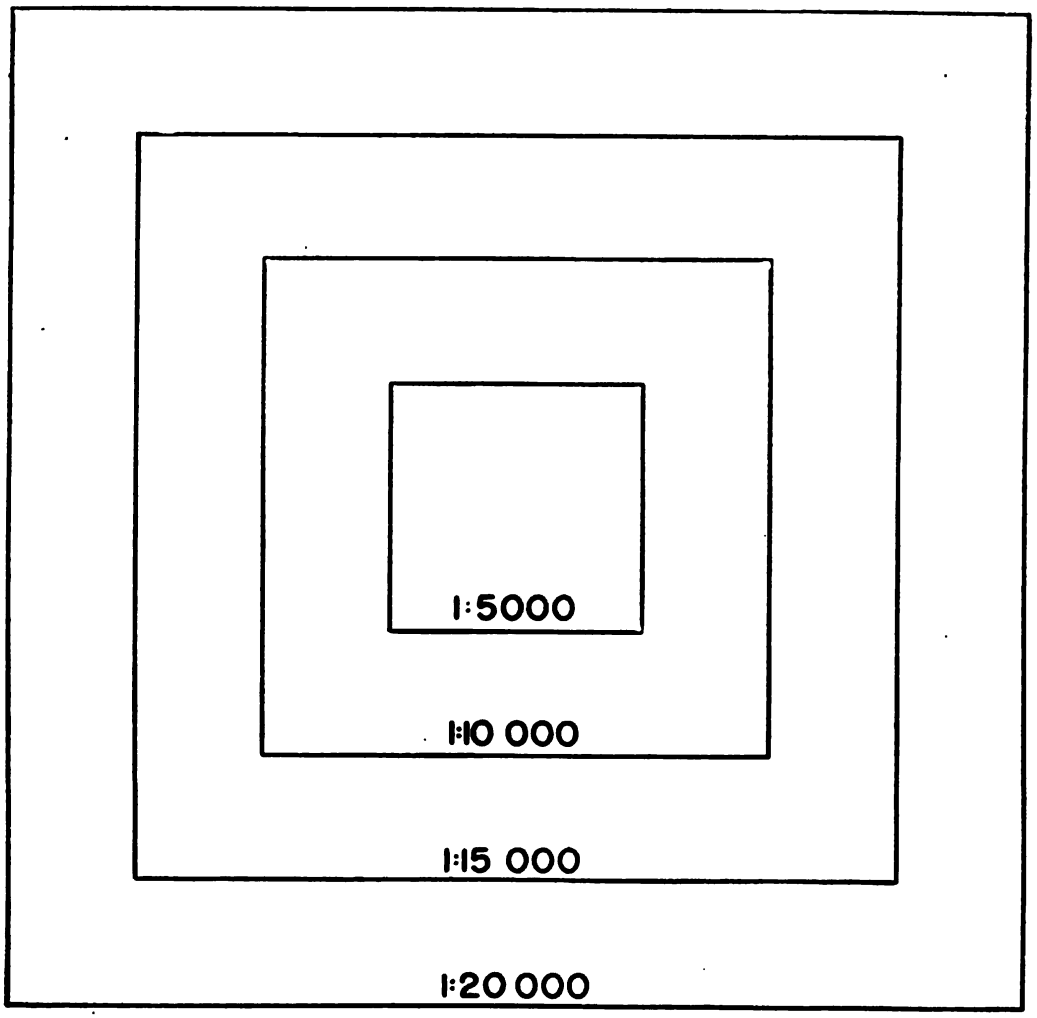


FIGURE 39.—Template for 5- by 5-inch negative for locating or plotting on a map of scale 1:20,000. To illustrate its use: If photograph is scale 1:5,000, then total area on it would cover an area, on the 1:20,000 map, of the size of the smallest square. If the photograph is scale 1:15,000, then the area covered on the map would be that of the 1:15,000 square.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

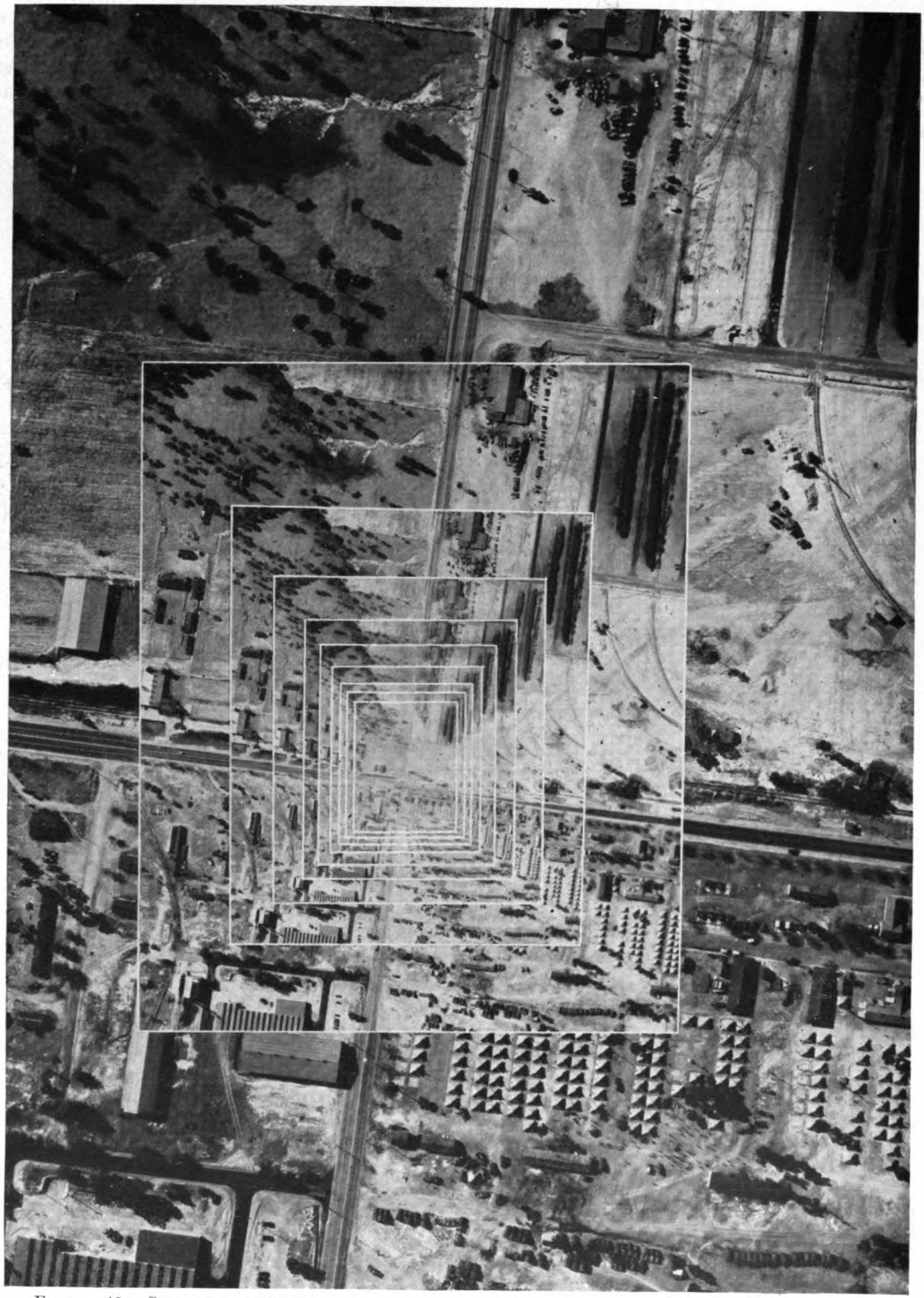


FIGURE 40.—Same area at different scales. Starting with scale 1:3,000, the scale decreases to 1:30,000 by 1:3,000 intervals. (Photograph 1:3,000 does not quite cover full area.)

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

SECTION V

TONE AND SHADOW

	Paragraph
General	18
Tone	19
Shadow	20

18. General.—*a.* Before reading this section, study thoroughly paragraphs 78 to 88, inclusive, FM 21-26.

b. As stated in FM 21-26, for the identification of individual objects or of areas that have a characteristic appearance, consider—

(1) Shape.
(2) Relative size.
(3) Tone, or shade of gray, in which it appears.
(4) Shadow which it casts.

19. Tone.—The tone or degree of gray appearing on a photograph is due almost entirely to the amount of light which is reflected to the camera by the object. The amount of light reflected depends on the nature and texture of the object and the angle at which it reflects light toward the camera. In figure 41, reflection and texture are illustrated.

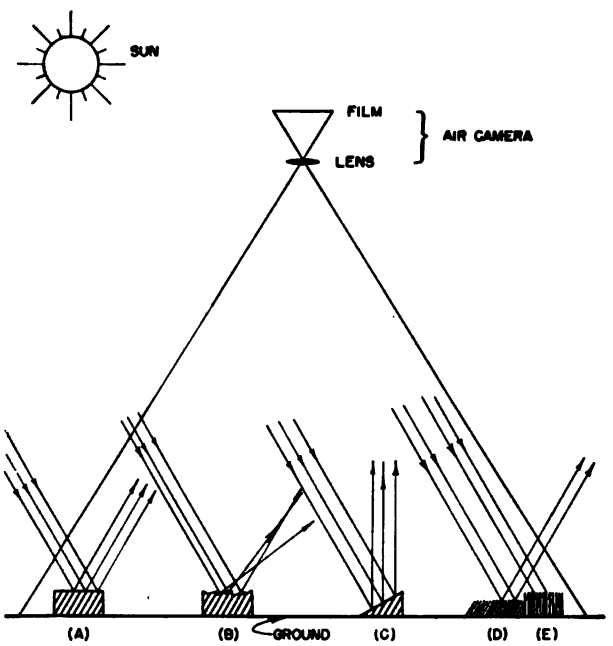


FIGURE 41.

A. Smooth surface.
B. Rough surface.
C. Slanting surface.
D. Flattened texture.
E. Rough texture.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

20. Shadow.—In the study of black and white photographs, shadow is of prime importance. Even though relief may be negligible, most objects cast shadows which denote the shape of the object far better than the vertical view of the object itself.

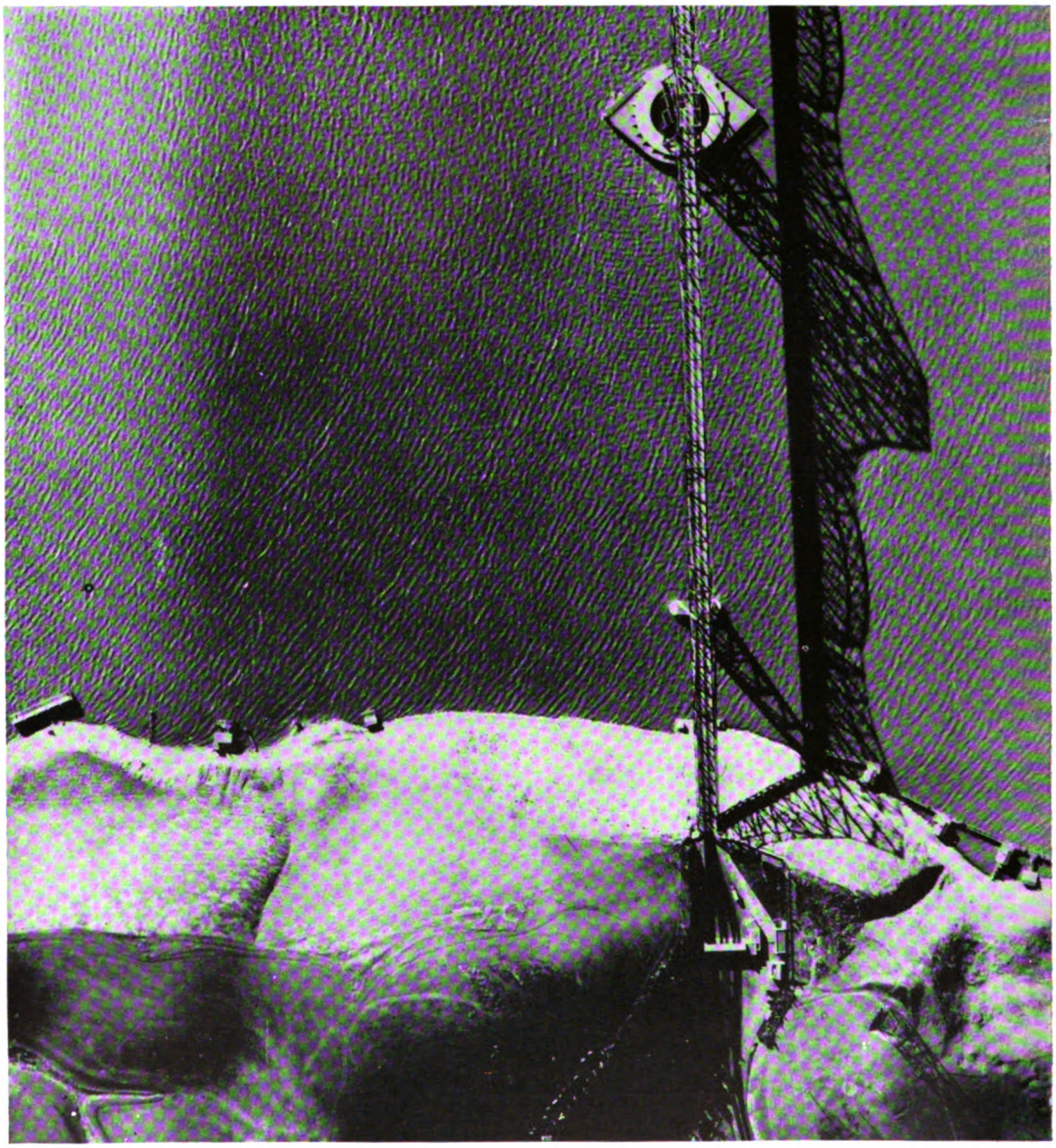


FIGURE 42.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 43.—Photograph correctly oriented for studying. Shadows on the ground should fall toward the viewer with the rays of light from a window or an artificial source striking the photograph from the same general direction as did the sun's rays on the ground.

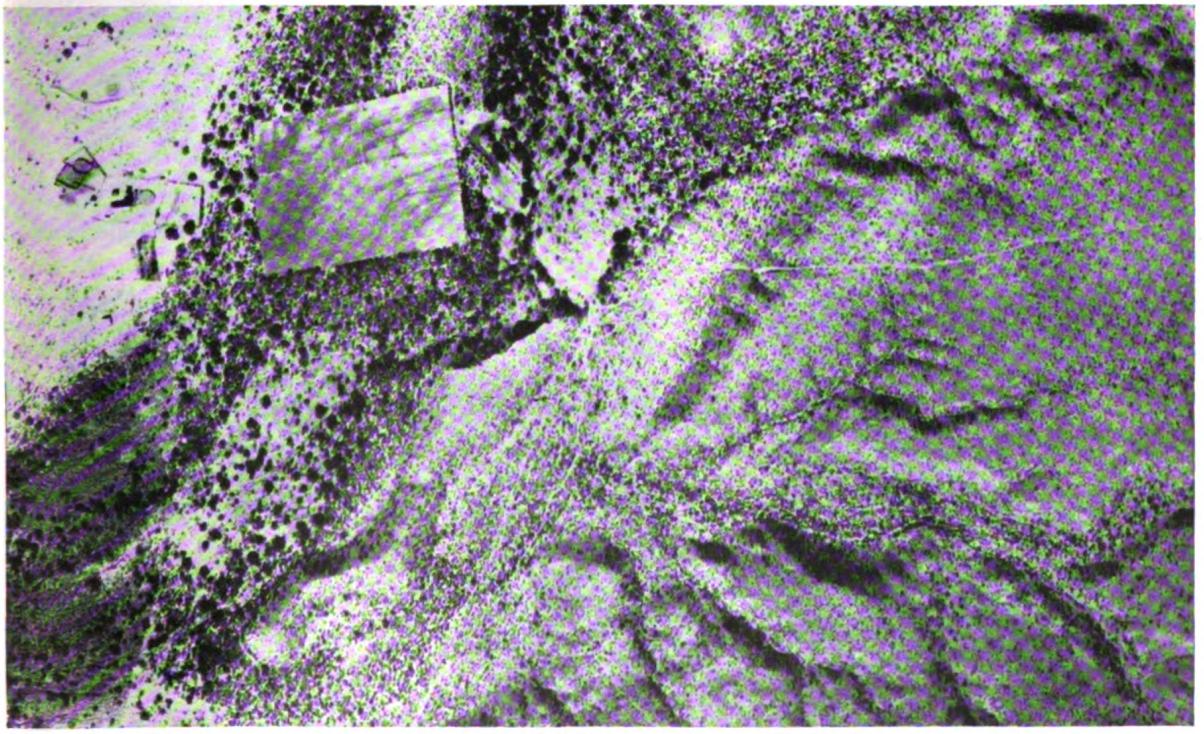


FIGURE 44.—Photograph incorrectly oriented for studying. The effect of light is contrary to that of nature and high ground appears to be a depression and vice versa.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 45.—Scale 1:5,000. Ground forms are easily identified from their shadows. Terraces in the fields conform roughly to contour lines, showing steeper slopes where they are closer together. Note length of shadows on higher terraces at right. Photographs on this page were taken in the early morning.

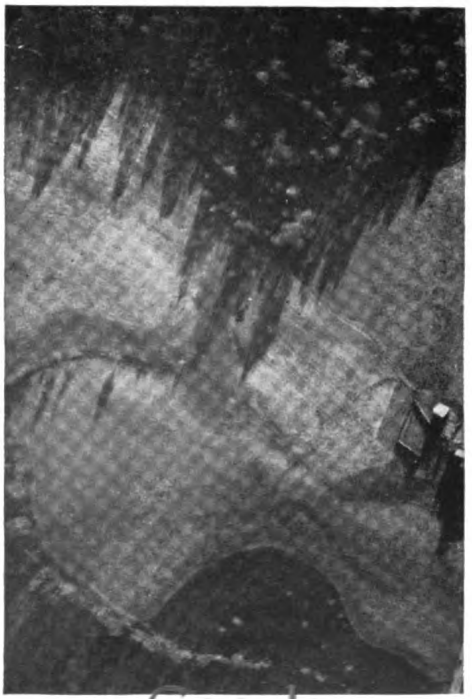


FIGURE 46.—Scale 1:5,000. In unterraced fields the ground shadows indicate the ground forms.

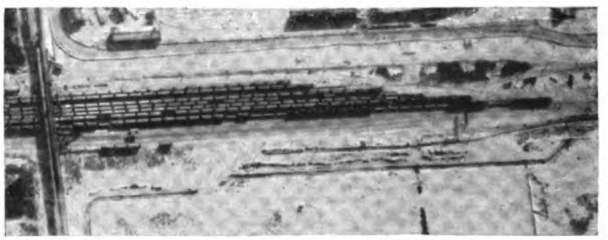


FIGURE 47.—Shadows on snow give great contrast.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

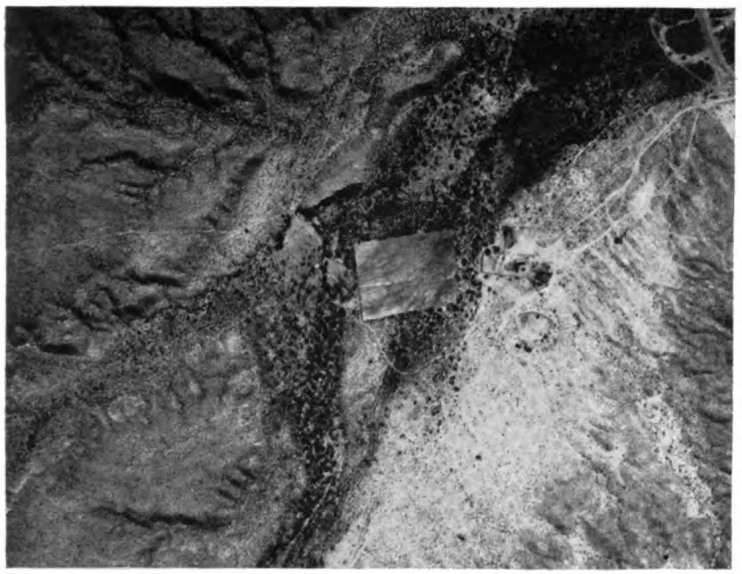


FIGURE 48.—In dry climates, streams are often intermittent but have very pronounced banks. Vegetation is sparse, and shadows show the outline of banks distinctly.

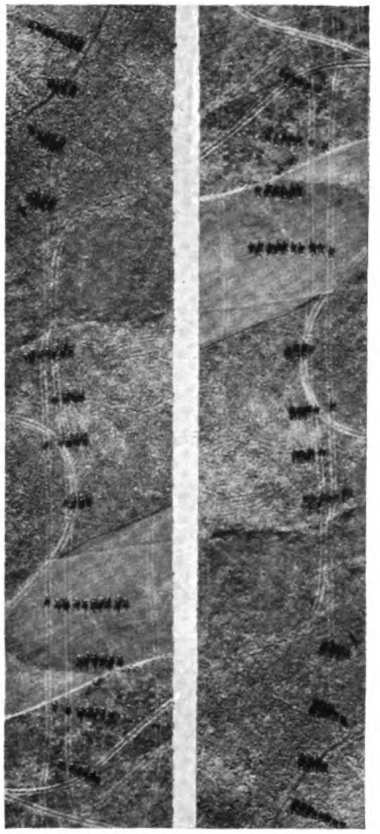


FIGURE 49.—Two prints from the same negative, arranged so that they are viewed from opposite direction. Note that individual objects (horses, mounted) are easily identified when the photograph is oriented so the shadow is right side up to the interpreter.



FIGURE 50.—Scale 1:4,000, a small junk yard at the right. The many shaped items such as wrecked cars, parts of cars, and piles of junk cast odd-shaped shadows, giving the whole area a confused pattern.

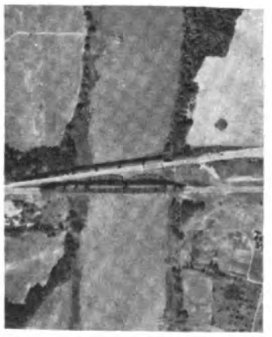


FIGURE 51.—Shadows on vertical photographs often give side elevations of objects such as bridges.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

SECTION VI

PRACTICAL IDENTIFICATION

	Paragraph
General	21
Mountains	22
Hills	23
Inland lakes	24
Rivers and streams	25
Woods	26
Deserts	27
Fields and vegetation	28
Flats and marshes	29
Coast lines	30
Sea walls and breakwaters	31
Practical identification exercise	32

21. General.—This section consists principally of aerial photographs illustrating many of the topographical and geological features and formations common on the earth.

22. Mountains.



FIGURE 52.—Olympic Mountains in Washington taken in middle of June. Shows clearly snow and timber line. Approximate altitude of mountain tops is 7,500 feet.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 53.—Alaskan mountain of volcanic origin.



FIGURE 54.—Mountains of northern Japan. Like most mountains of the Pacific Islands, these are of volcanic origin.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 55.—Alaskan glacier approaching the sea.

Figure 56 is a close view of the top of a glacier from 500 feet. A glacier is a field or stream of compact ice and snow which slowly moves downward from mountains and through valleys until, on the borders of the sea, it either melts or breaks off into icebergs. A vast amount of erosion accompanies the movement of the glacier.



FIGURE 56.—Close view of glacier.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 57.—Range of mountains in southwestern part of United States. Erosion caused by wind-blown sand is plainly seen on the horizontal streaks which are composed of hard and soft rock strata.

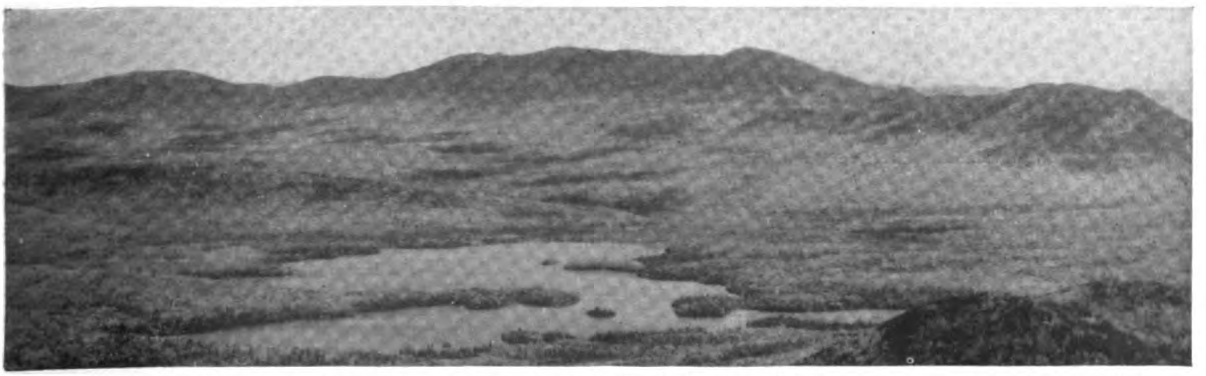


FIGURE 58.—Mountain range in eastern part of United States. The slopes are gentle and wooded.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

23. Hills.

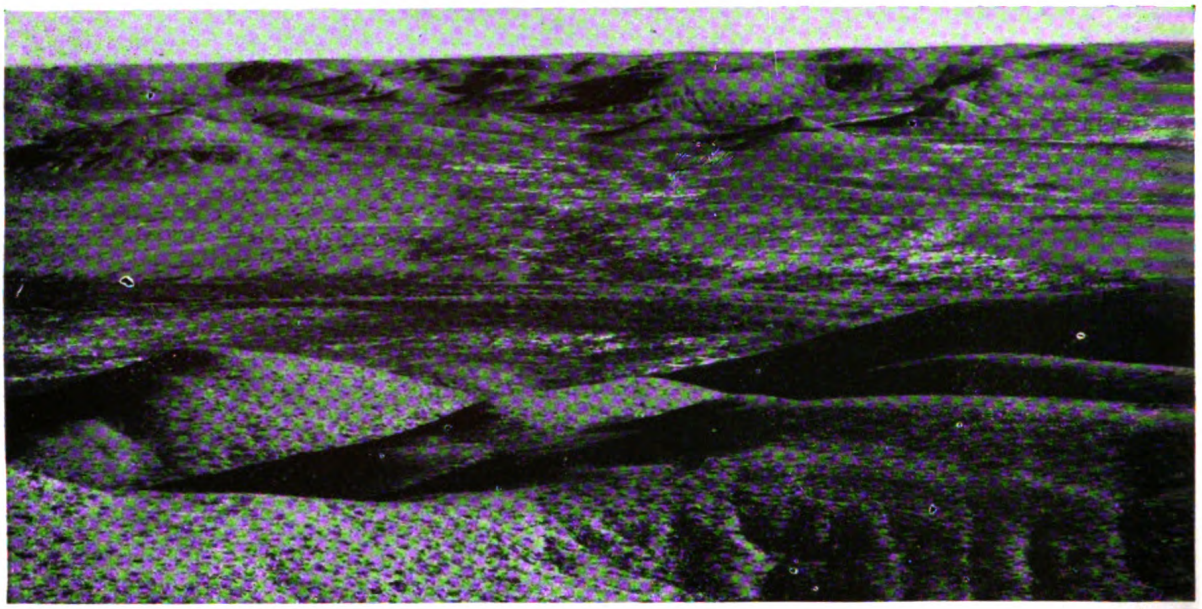


FIGURE 59.—Guadalupe foothills in western Texas.



FIGURE 60.—Continuation of the Guadalupe foothills.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

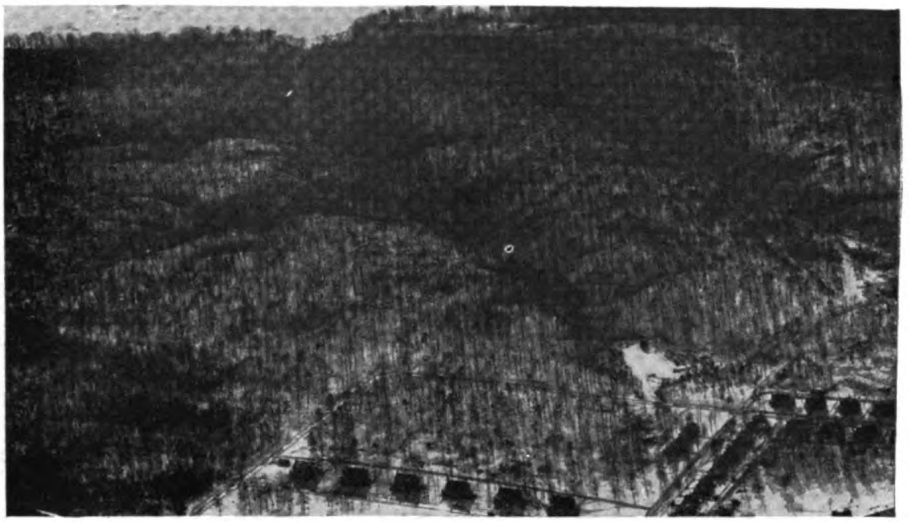


FIGURE 61.—Oblique view of hills.

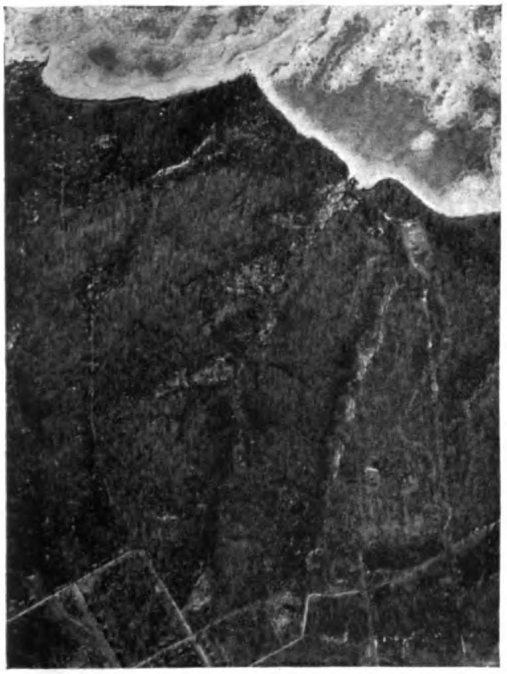


FIGURE 62.—Vertical view of figure 61.

Figure 61: Low oblique showing how hills and valleys stand out on this type of photograph. Note ice on river at top of photograph.

Figure 62: Vertical photograph of same area shown in figure 61. Scale 1:20,000. When sun is low on horizon, even the smallest fold on the ground throws a shadow.

Figure 63: Scale 1:10,000. To seek a low grade and eliminate cutting and filling, roads often wind around hills. Note how erosion control terraces approximate the contour lines of the hills.



FIGURE 63.—Vertical view of hills.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

24. Inland lakes.

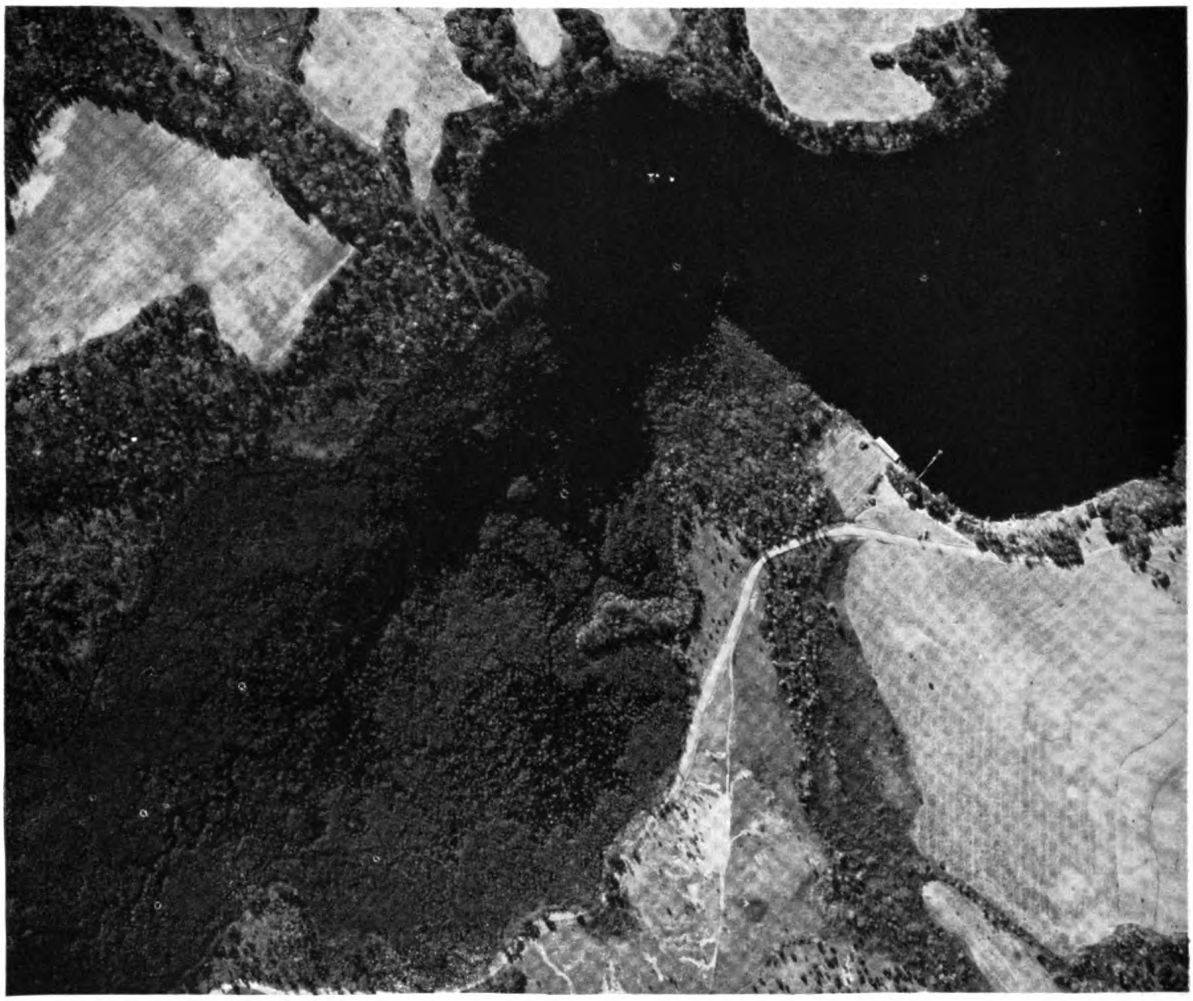


FIGURE 64.—Scale 1:8,000: Small man-made lake. The level of this lake depends on rainfall and therefore, in dry seasons, trees and other vegetation grow in the shallow sections where the water has receded.

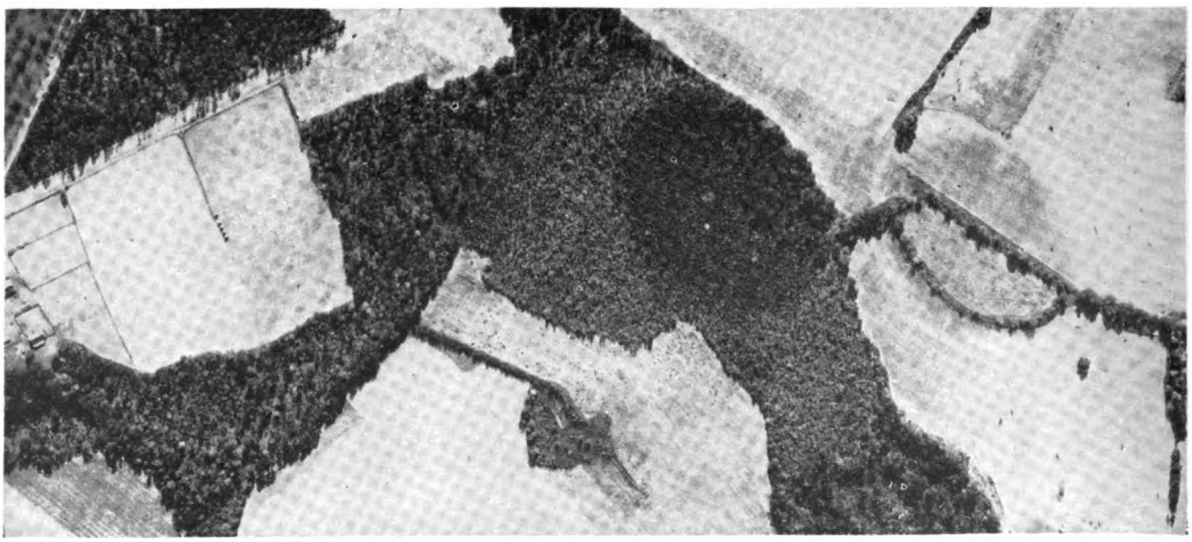


FIGURE 65.—Two small ponds or lakes which have dried, but difference in soil and vegetation shows their outlines. Evergreens occupy center of one pond which is surrounded by deciduous woods.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

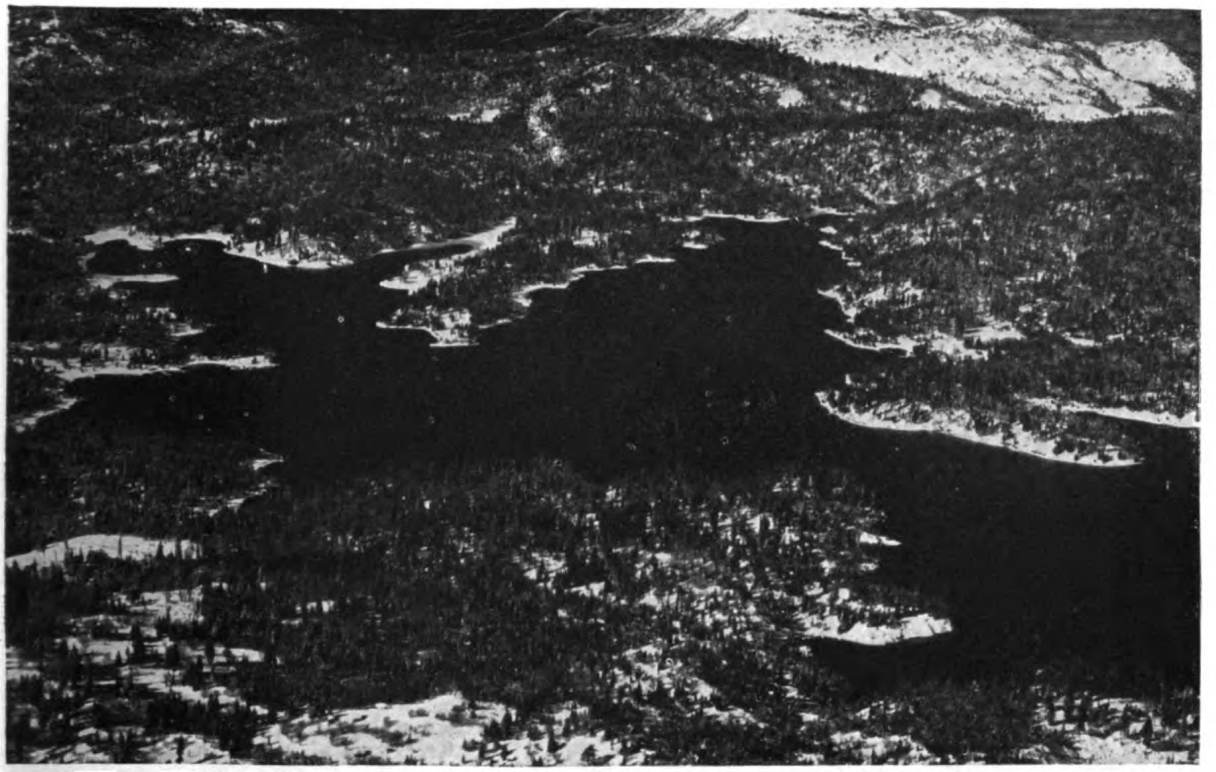


FIGURE 66.—Small inland lake with no inlet or outlet, being fed entirely by springs and with evaporation and seepage controlling its level. The outline of the shore is a contour line.



FIGURE 67.—Small inland lake in summertime. Note how vegetation grows to the water's edge, indicating a constant water level.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

25. Rivers and streams.



FIGURE 68.—Grand Canyon of Colorado River. Rivers with abundant supply of water, much sediment, and steep slopes will cut deep canyons which form natural barriers to travel.

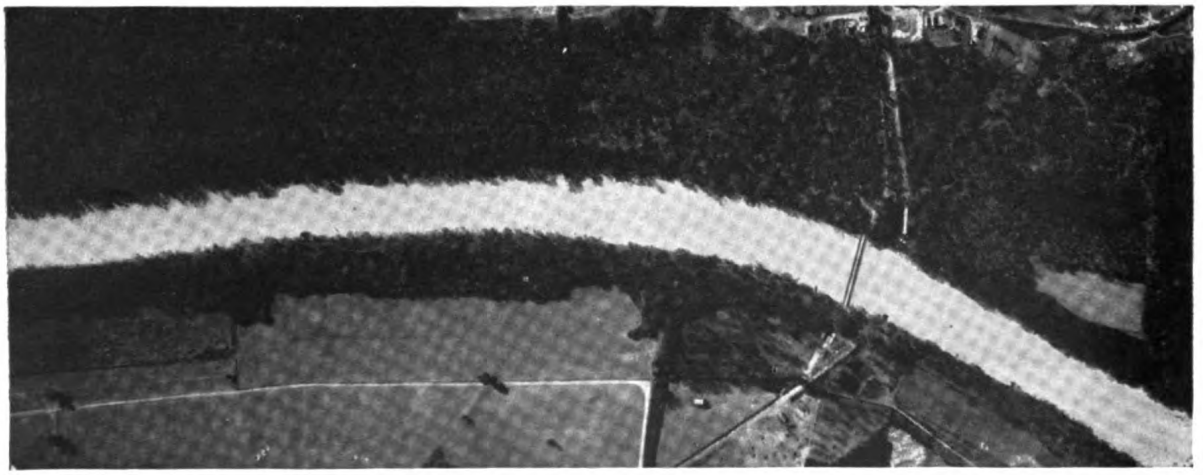


FIGURE 69.—Scale 1:10,000: A slow-flowing river with low banks. During floods these rivers overflow their banks and deposit sediment which forms flood plains. A flood plain exists on side of river nearest the bottom of photograph.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

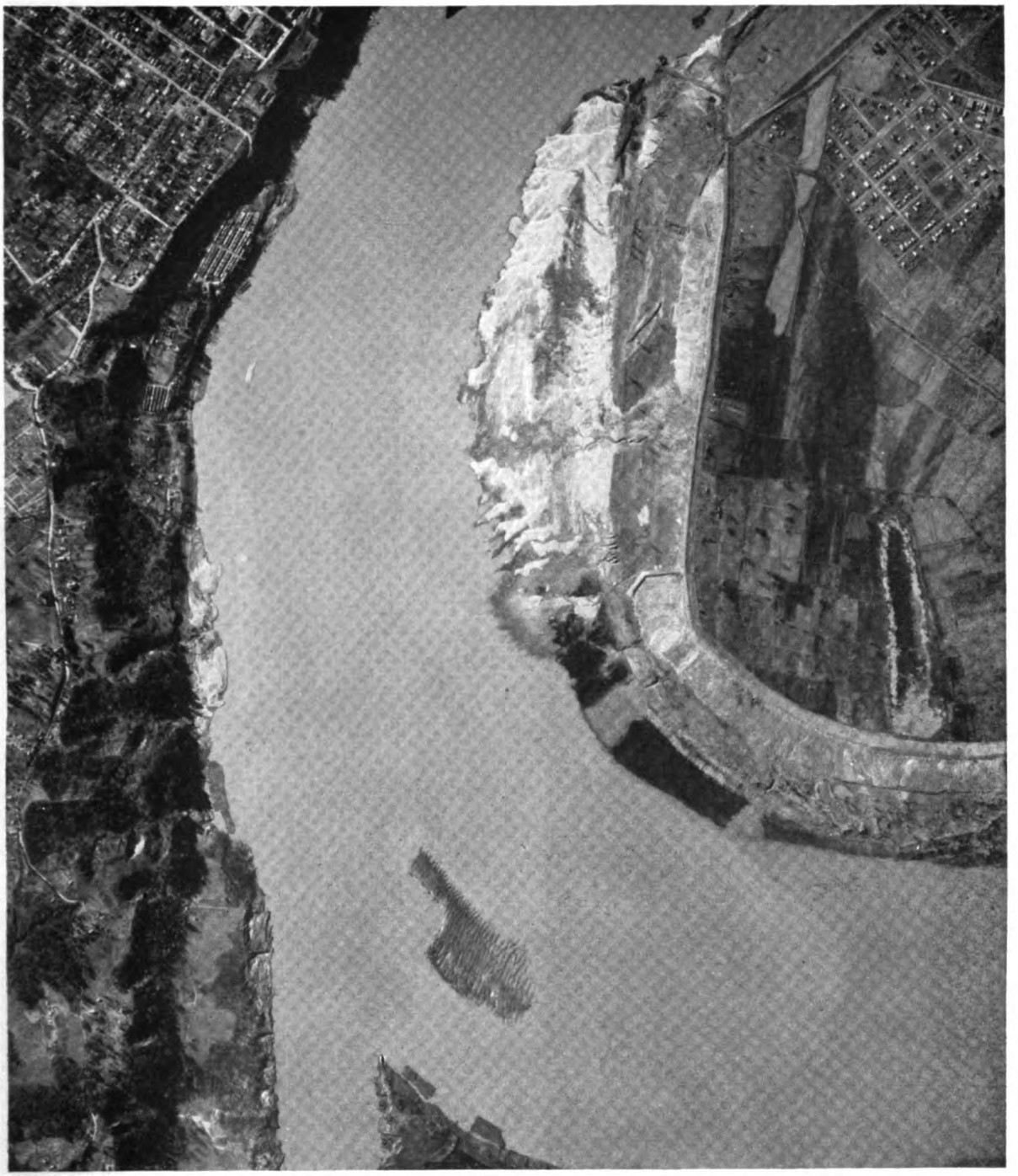


FIGURE 70.—Large, meandering river. Scale 1:20,000. The stream has cut away the bank on the outside of the curve and deposited on the inside. In this photograph, some of the deposits on the inside of the stream curve are man-made—the results of dredging.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

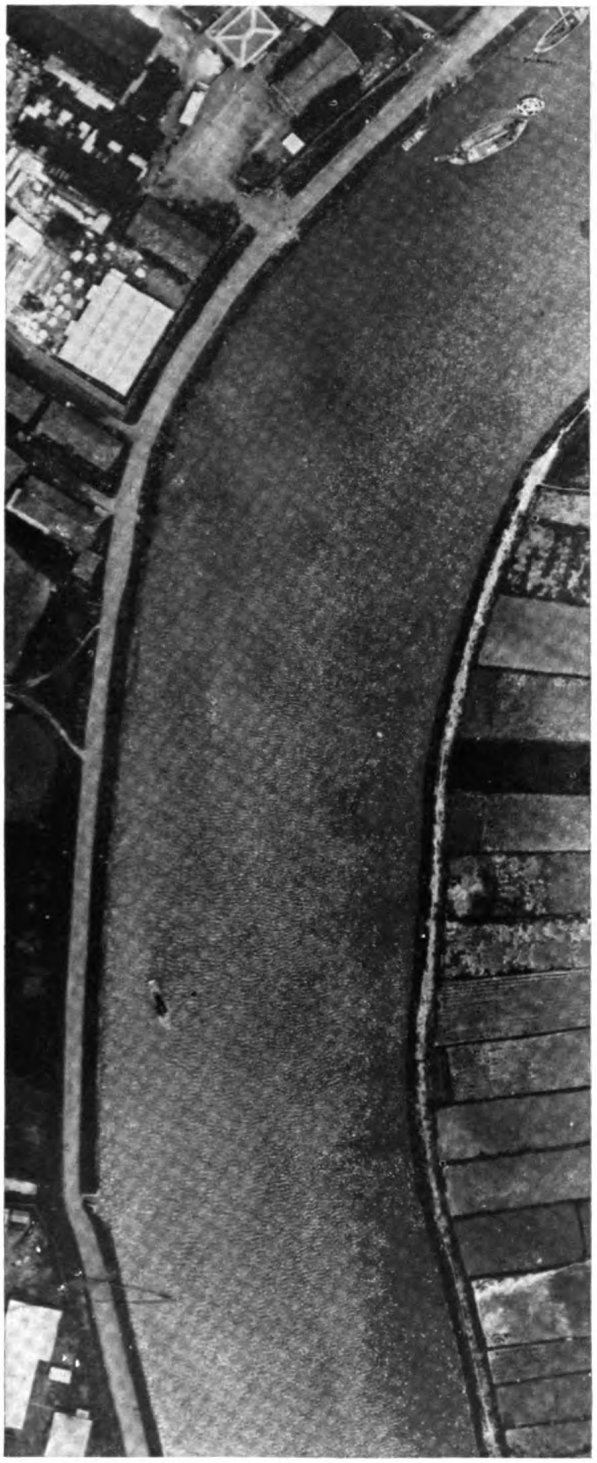


FIGURE 71.—Japanese river with reveted banks. If the revetment is maintained the river will not change its course and bank erosion is stopped. Note the intensive farming being carried on in the flood plain at the right.

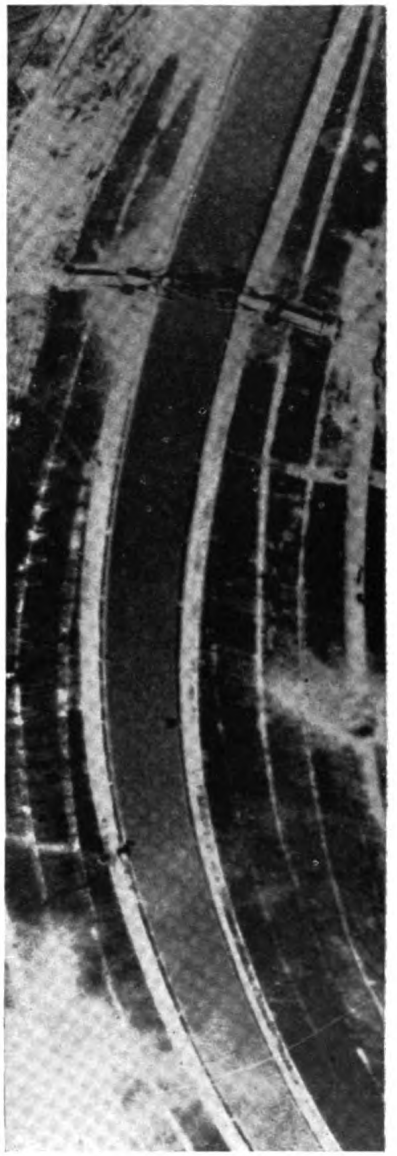


FIGURE 72.—European river with reveted banks. This type of river control is common in Europe and Asia. The bridge at the top of the photograph was destroyed in the second World War.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 73.—Meandering stream. The direction of flow can be determined from this photograph as at the center meander the upstream side of the bend is cut more deeply than the downstream side. White sand bars caused by deposition are found on the bank opposite the cutting bank, and they have a tendency to be streamlined into the shape of teardrops, with the sharp ends pointing downstream. This type of stream action is peculiar to flat land where the slope of the stream is small. This stream is flowing from left to right.



FIGURE 74.—A small, meandering stream (left), flowing from bottom to top of photograph. Scale 1:10,000. The size and shape of the meanders depend on the volume and slope of the stream and the type of soil through which it flows.



FIGURE 75.—The stream has cut a meander off at the neck, but there is not sufficient sediment deposited to fill the entrance to the old channel. Instead, the stream merely splits, leaving an island.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

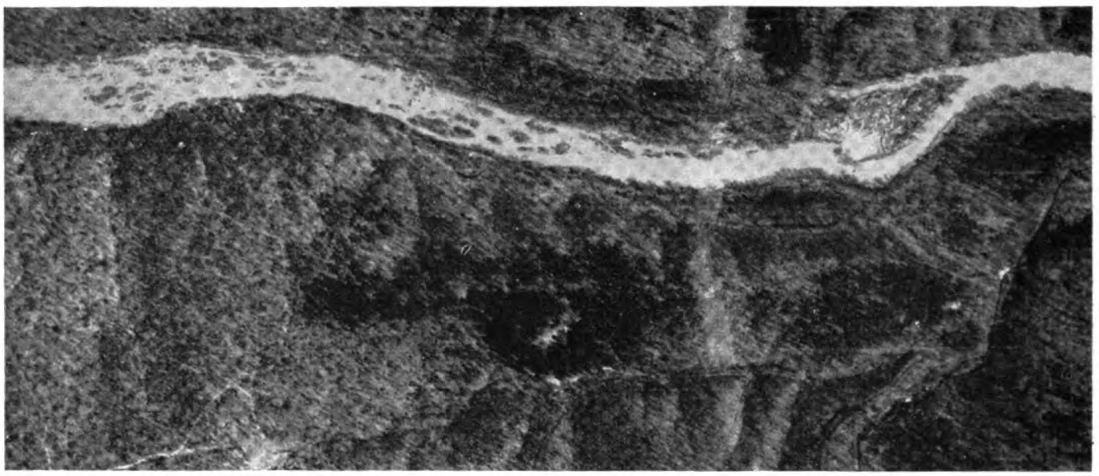


FIGURE 76.—Streams flowing with great velocity usually follow a rather straight course. This stream has a steep gradient. Note the exposed rock in the center of the bed. Very little bank erosion exists here. Also note the teardrop shaped island which is pointing downstream.

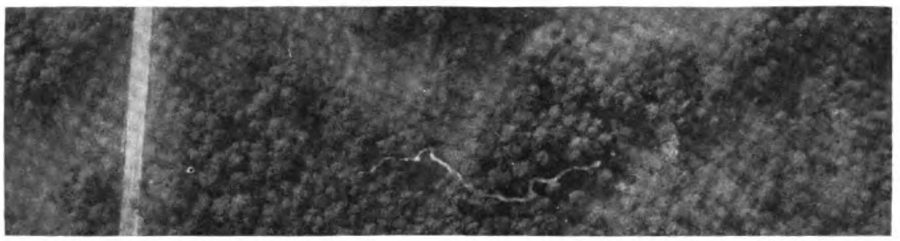


FIGURE 77.—Streams in woods often show as intermittent white streaks.

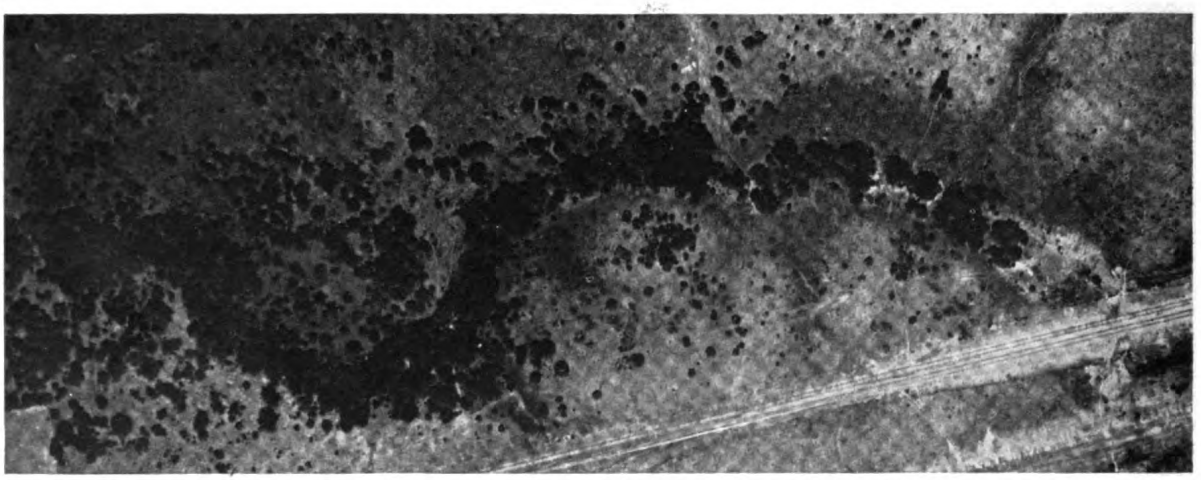


FIGURE 78.—Intermittent or continuous streams are often bordered by trees. This is particularly true in desert terrain. On this night photograph, the ground is low and flat, the woods have been cleared by lumbering, and the growth of trees has been more rapid along the stream.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

26. Woods.



FIGURE 79.—Winter (no snow). Heavy deciduous woods in winter and summer. Even with woods in full foliage as in figure 80, the drainage pattern can be seen. The field in which the orchard is located is much lower than the wooded area and is in the flood plain of the river.

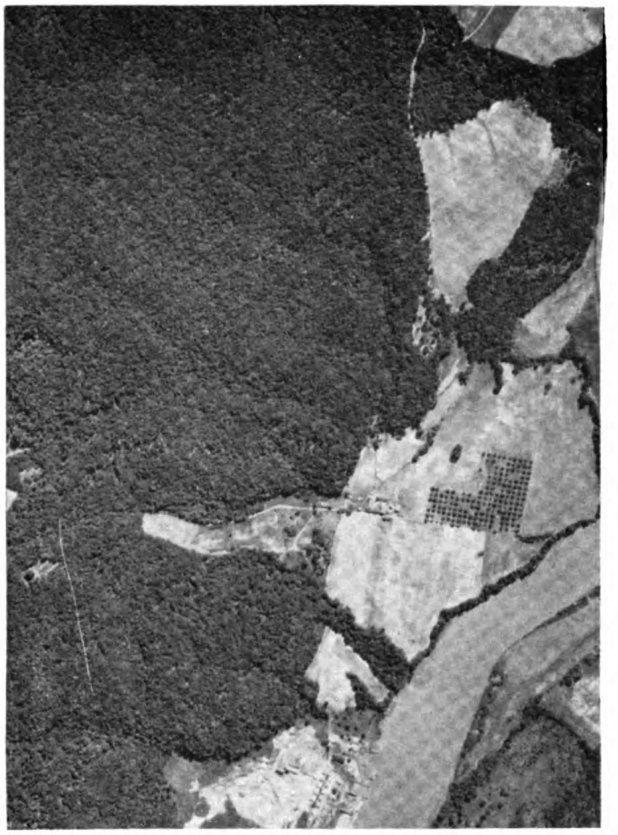


FIGURE 80.—Summer.



FIGURE 81.—Scale 1:3,700: Woods have been partially cleared and burned. Many charred, limbless trees stand and cast shadows; many have fallen but have not decayed. All are pines. At low altitudes thinly scattered longleaf pines have the appearance of deciduous trees.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 82.—Summer 1940.



FIGURE 83.—Winter 1941 (no snow).

Heavy deciduous woods shown in summer and winter. Scale 1:5,000. Note how the evergreens stand out on the winter photograph but are not noticeable on the other. A greater amount of terrain information is obtainable from a photograph of deciduous woods taken in winter. The construction work had not started when the summer photograph was taken.

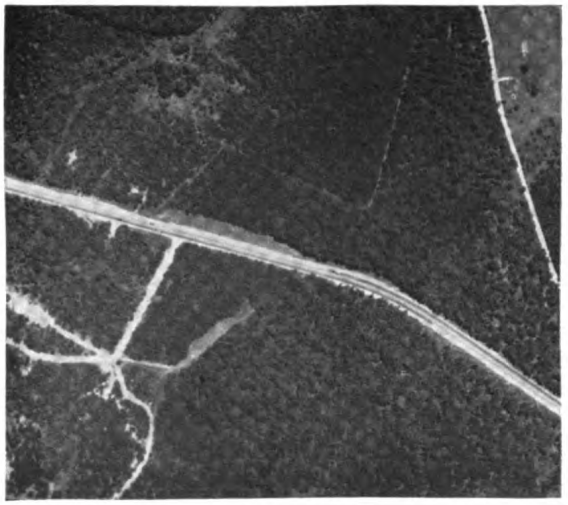


FIGURE 84.—Summer 1941.



FIGURE 85.—Winter 1940 (no snow).

Both deciduous and evergreens are shown on above photographs. Scale 1:10,000. Note the smooth texture of the evergreens on the summer photograph as compared to the deciduous trees.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 86.



Tropical forests of the Philippine Islands, consisting principally of giant fern trees, bamboo, and many types of jungle bushes.

FIGURE 87.

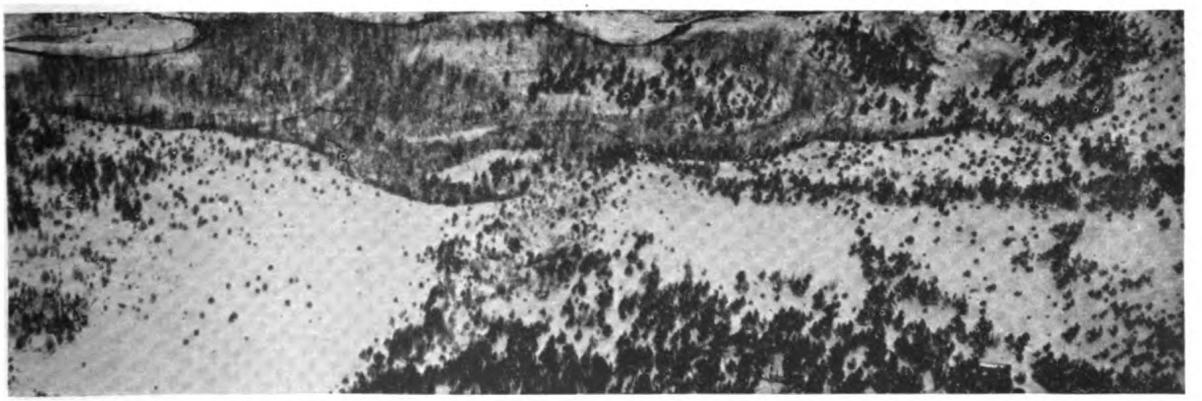


FIGURE 88.—Low oblique of deciduous and evergreens in winter with snow on the ground. Note how the evergreens stand out against the white background. Note also buildings at the bottom of photograph.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

27. Deserts.



FIGURE 89.—Desert valley in southwestern part of United States. The streamlike appearance in center of valley is caused by shifting sand. Blowing sand may have more erosive action than streams.



FIGURE 90.—Close view of sand dunes on the floor of a desert.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 91.—Low oblique of a desert. It is common belief that deserts are expanses of constantly shifting sand dunes, but this is far from true. There are extensive tracts of sand dunes, but there are also bare plateau tops, exposed rock ledges, barren mountain slopes, and deep gullies and ravines. The gully was at one time an old stream bed. Although the stream has dried up, the wind and sand have deepened and widened the gully.

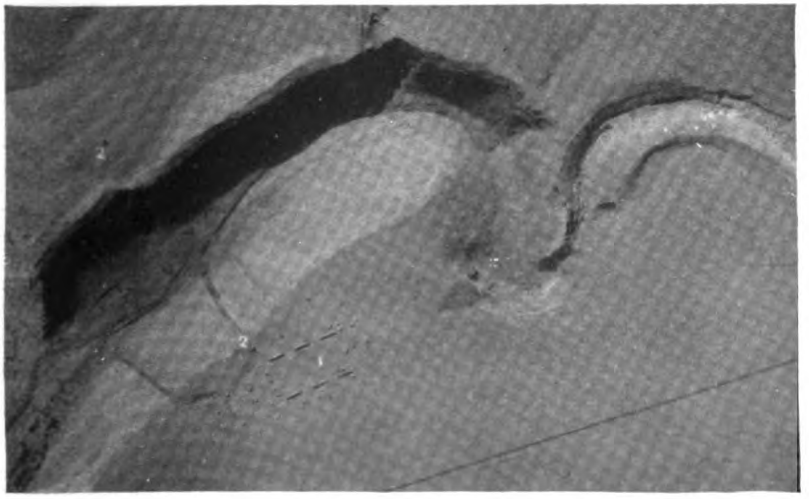


FIGURE 92.—Scale 1:15,000: A gully several hundred feet deep, in the desert of North Africa. Note the hospital (1) and the elevated water tanks (2).

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

28. Fields and vegetation.

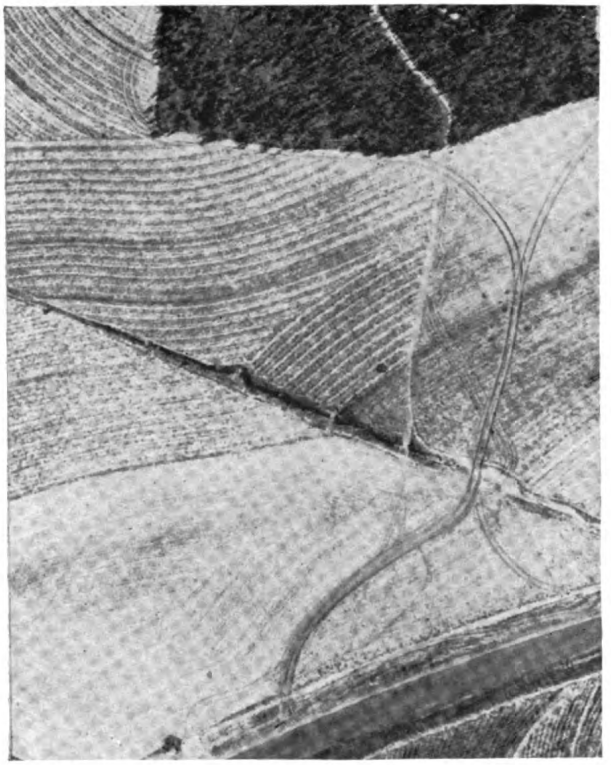


FIGURE 93.—Cornfield.

Scale 1:2,000: At this scale the field appears to be bare, with top part rougher than lower part. From the ground view below it is seen that the lower part is bare, but the upper part is an old cornfield with the dead cornstalks still standing.



FIGURE 94.—Ground view of figure 93.

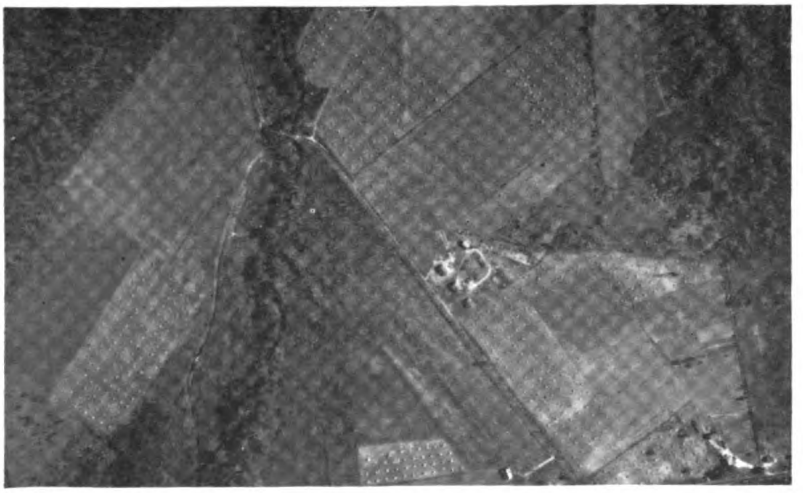


FIGURE 95.—Scale 1:10,000: Harvested crops, probably corn in shocks. Note the regularity with which they are stacked.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

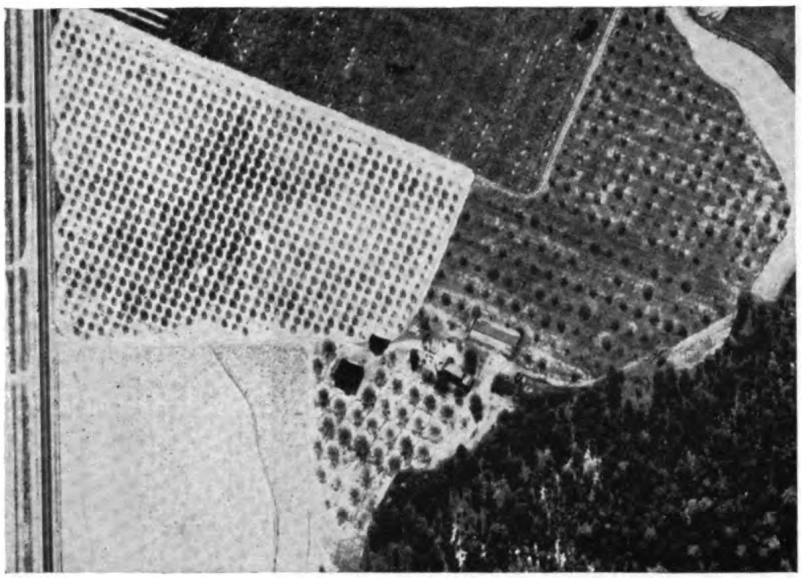


FIGURE 96.—Scale 1:5,000: Peach and apple orchards. The peach trees in the upper left-hand corner are much smaller and closer spaced than the apple trees. Both orchards have lost their leaves.

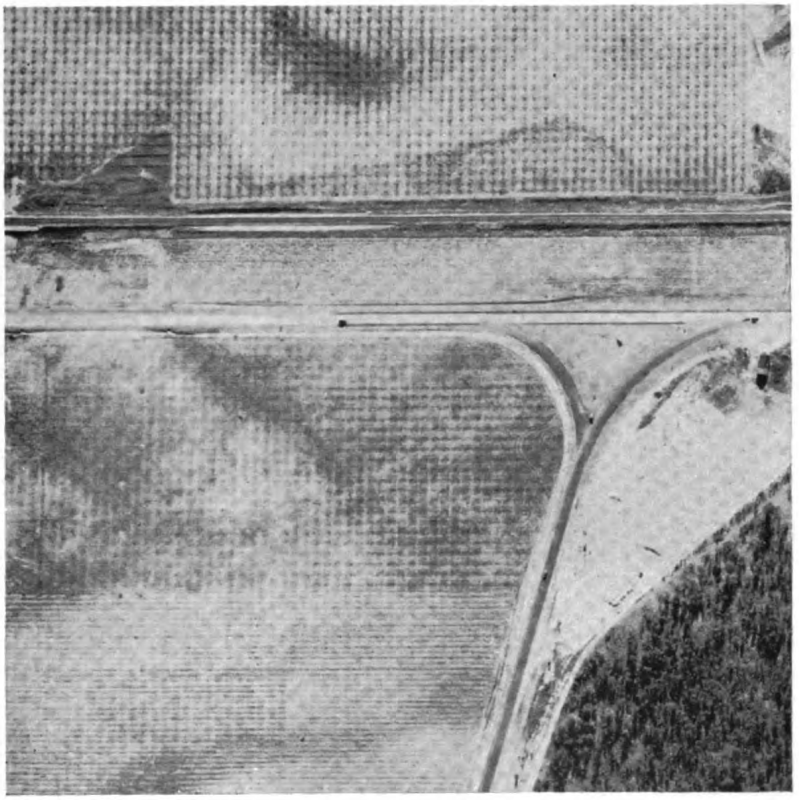


FIGURE 97.—Scale 1:5,000: Former peach orchards which no longer contain trees. In upper part of photograph, trees have just recently been removed, while in lower part they have been gone for many years and a number of cultivations have nearly obliterated the characteristic pattern.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 98.—Scale 1:13,000: European fields showing bench terraces. The many types of crops and vegetation cause the light- and dark-toned patches. Notice how evenly the steep hills and deep ravines are farmed.

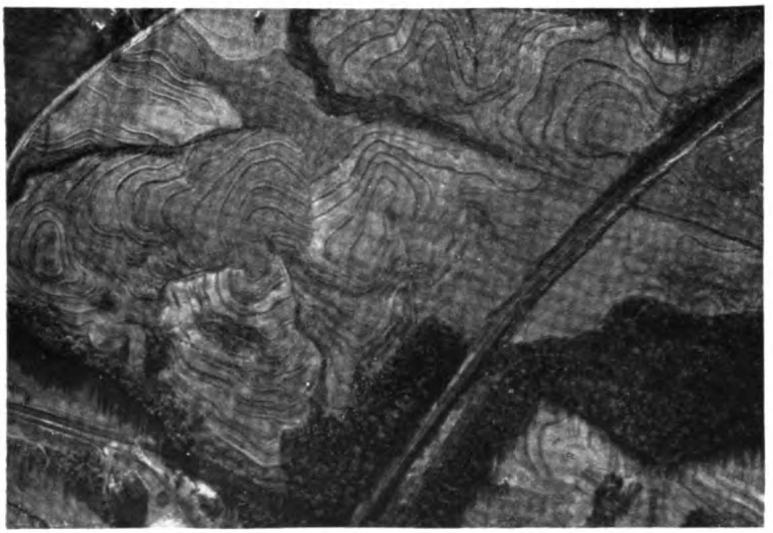


FIGURE 99.—Scale 1:10,000: Field terraces found in the more hilly sections of this country. Crops are planted to conform with these terraces.

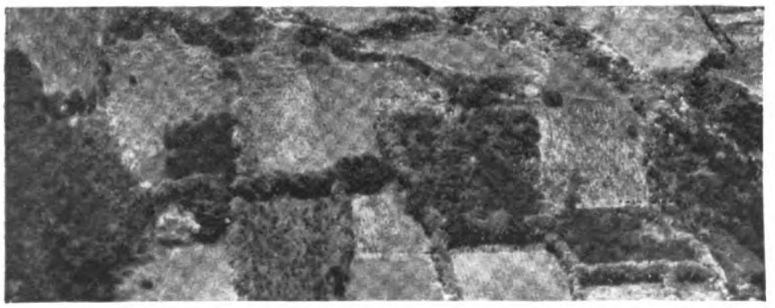


FIGURE 100.—Low oblique of small fields farmed by natives of the South Pacific Islands.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

29. Flats and marshes.

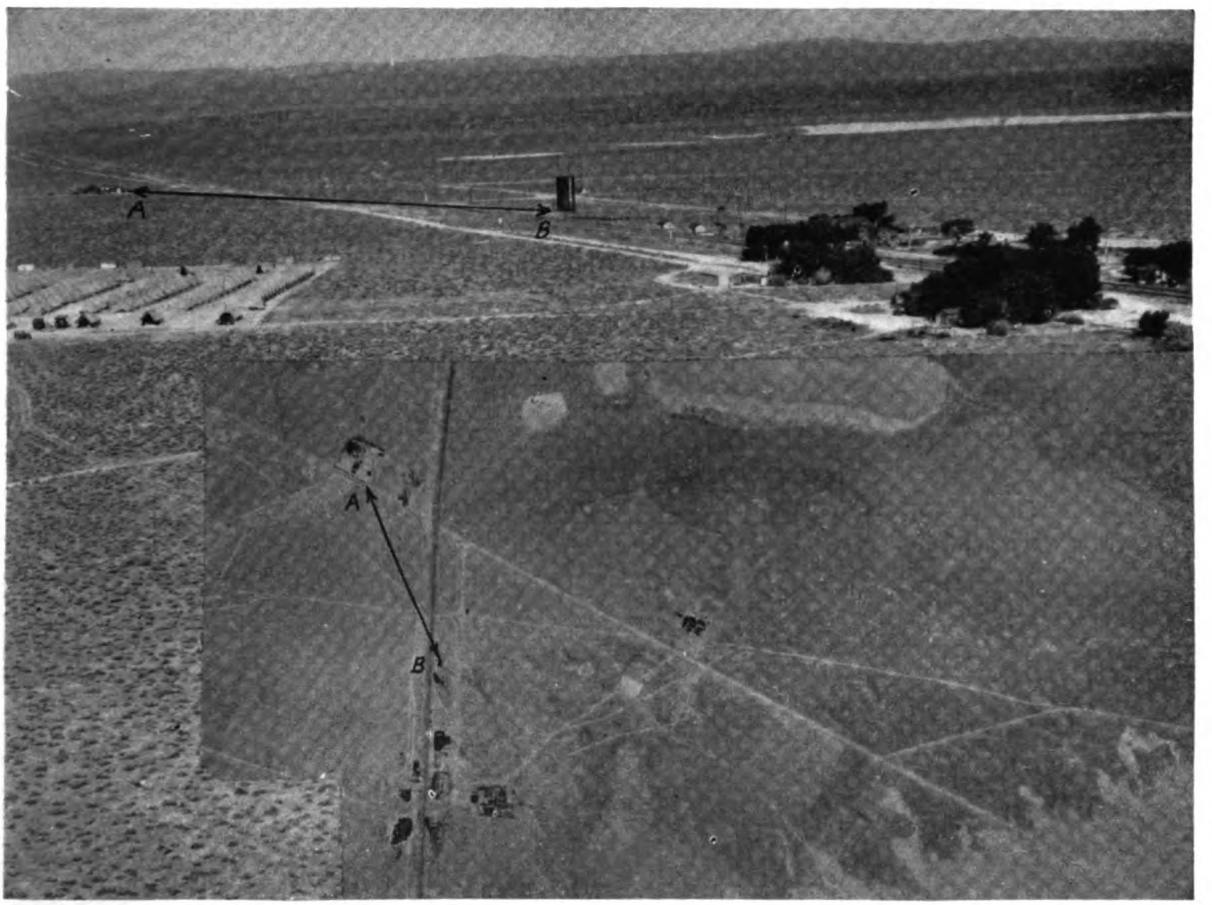


FIGURE 101.—High oblique photograph with inset of high vertical of California coast flats, showing characteristic texture. Orient by means of line A–B.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

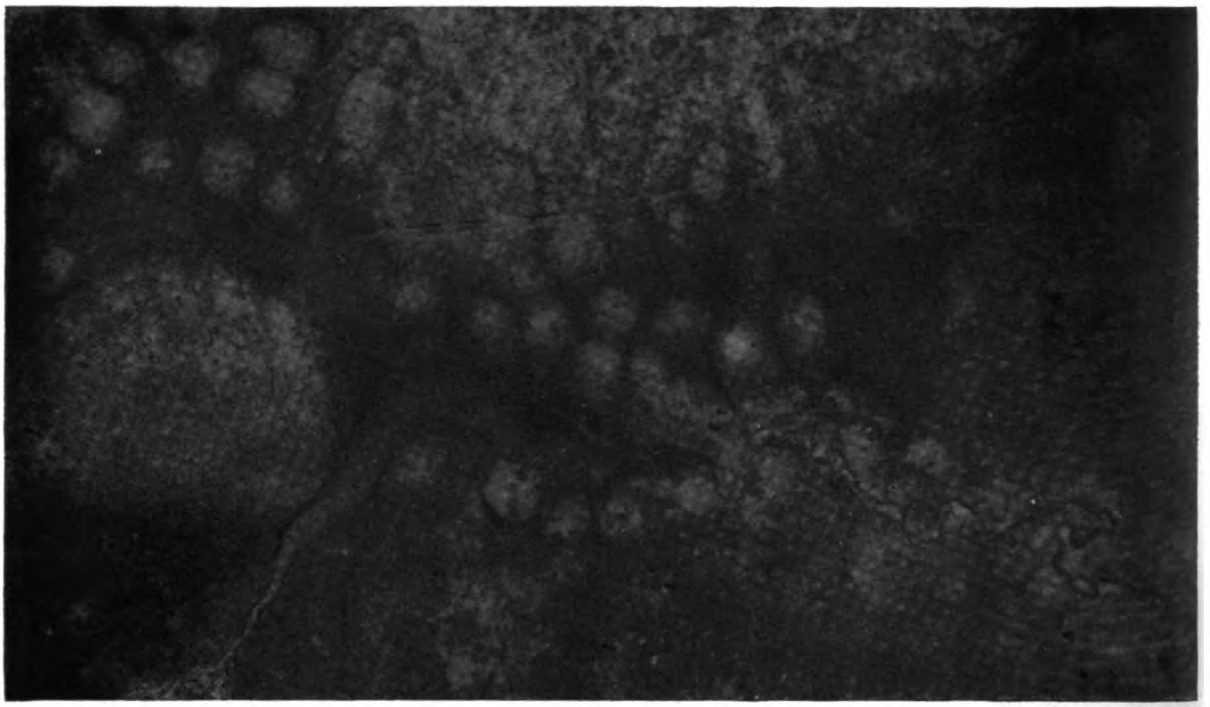


FIGURE 102.—Flat, ill-drained ground will be indicated by moisture spots, standing water, and meandering streams. Light colored spots in this night photograph are drier spots. This is not delta land but is within the Mississippi Flood Plain.

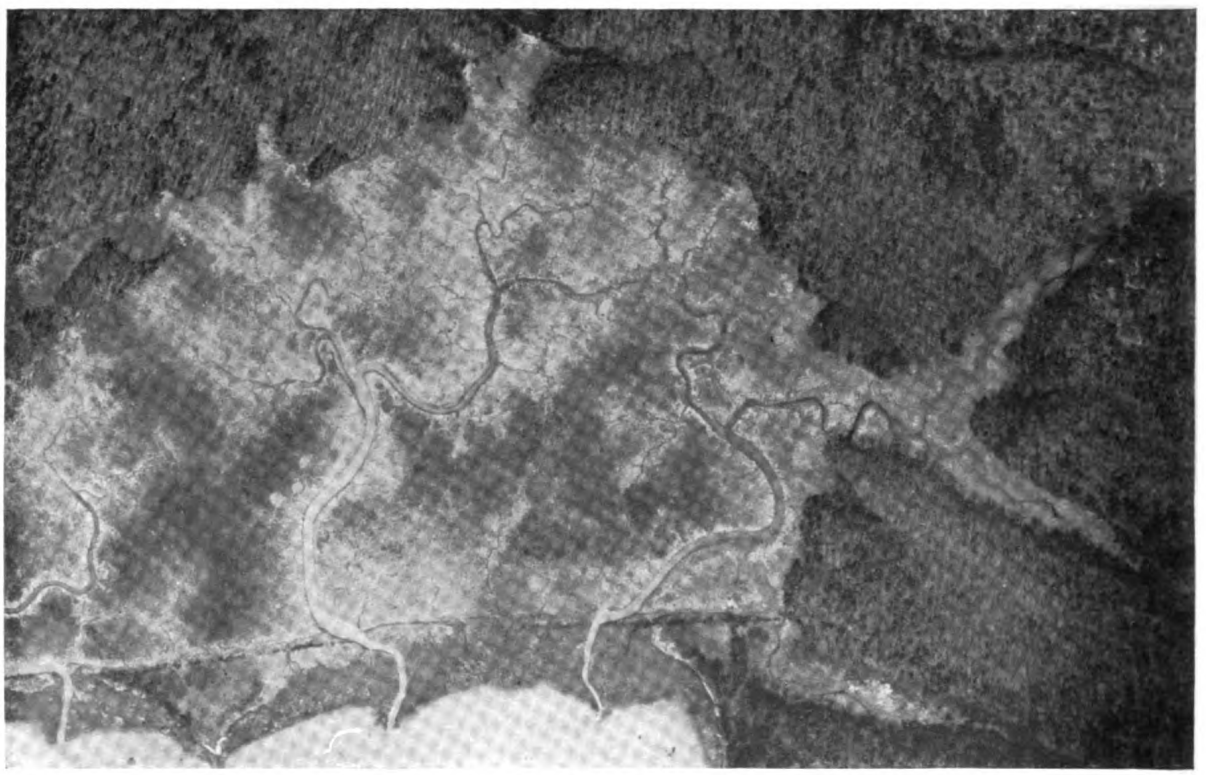


FIGURE 103.—Tidal flat at low tide, showing drainage channels. Trees do not grow where ground is intermittently covered with water, except in areas containing trees native to swampland. Dead water plants exist over the entire flat.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

Figures 104 and 105 are the same tidal flat taken in winter and summer at low tide. Note how vegetation covers the flat in summer.

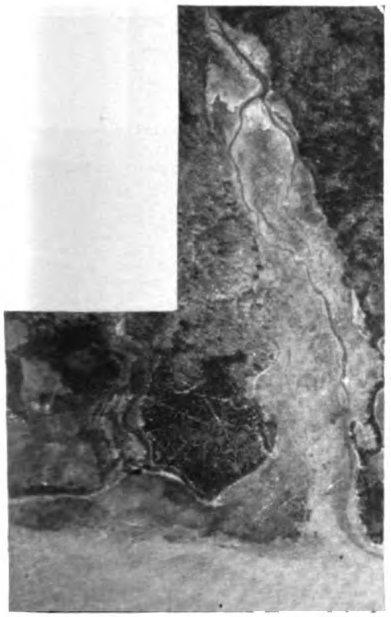


FIGURE 104.—Tidal flat in winter.

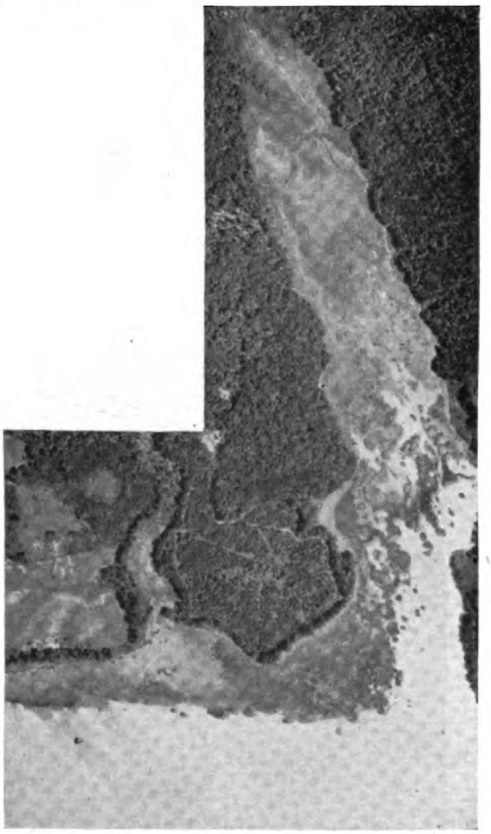


FIGURE 105.—Tidal flat in summer.

30. Coast lines.

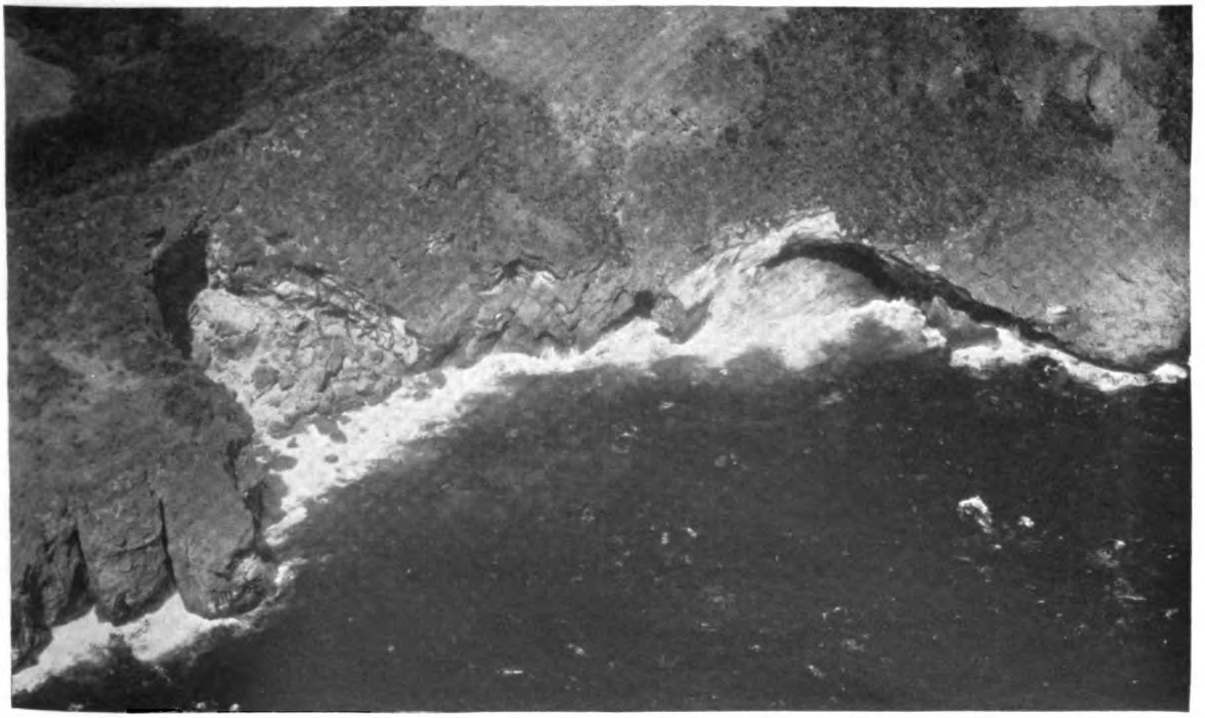


FIGURE 106.—Rocky shores showing the effect of erosion caused by wave action.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

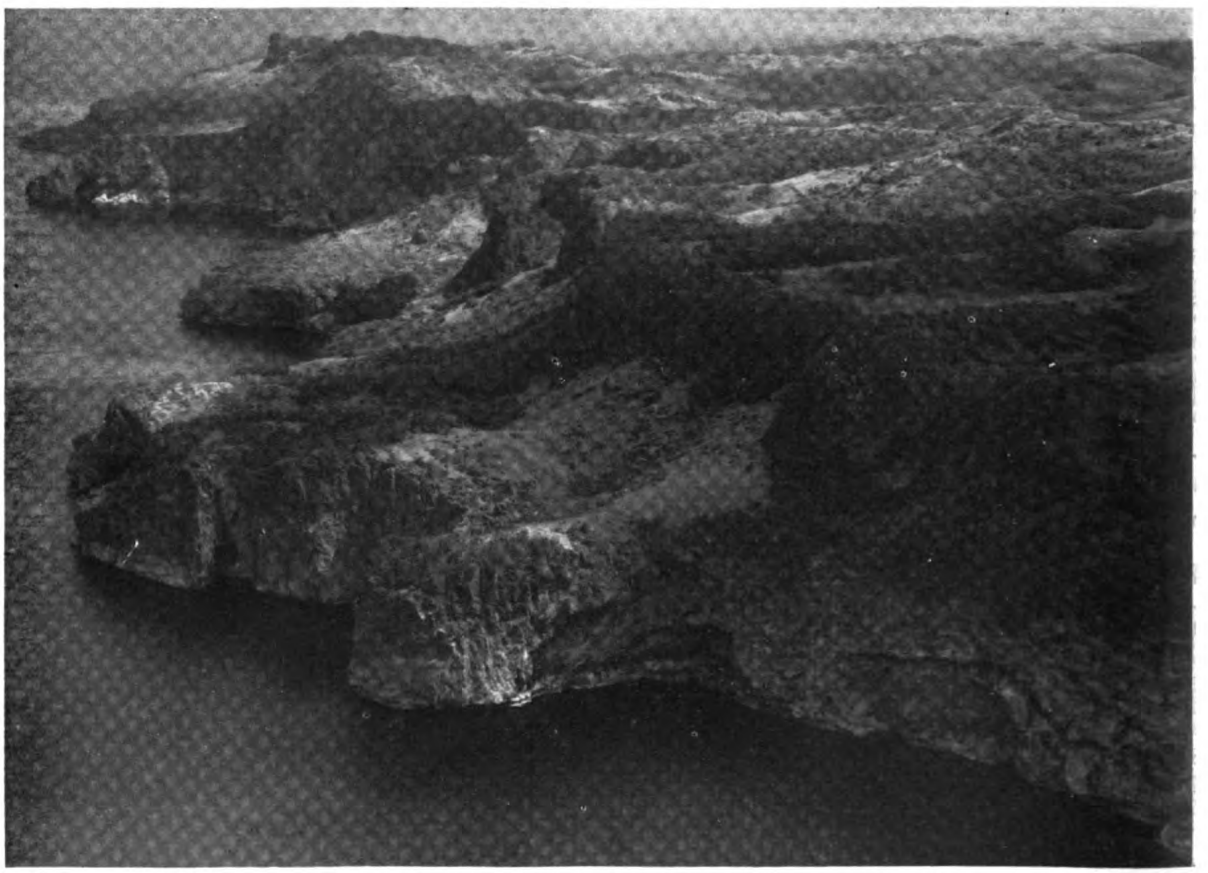


FIGURE 107.—Sunken coast line showing a bold and irregular shore line.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

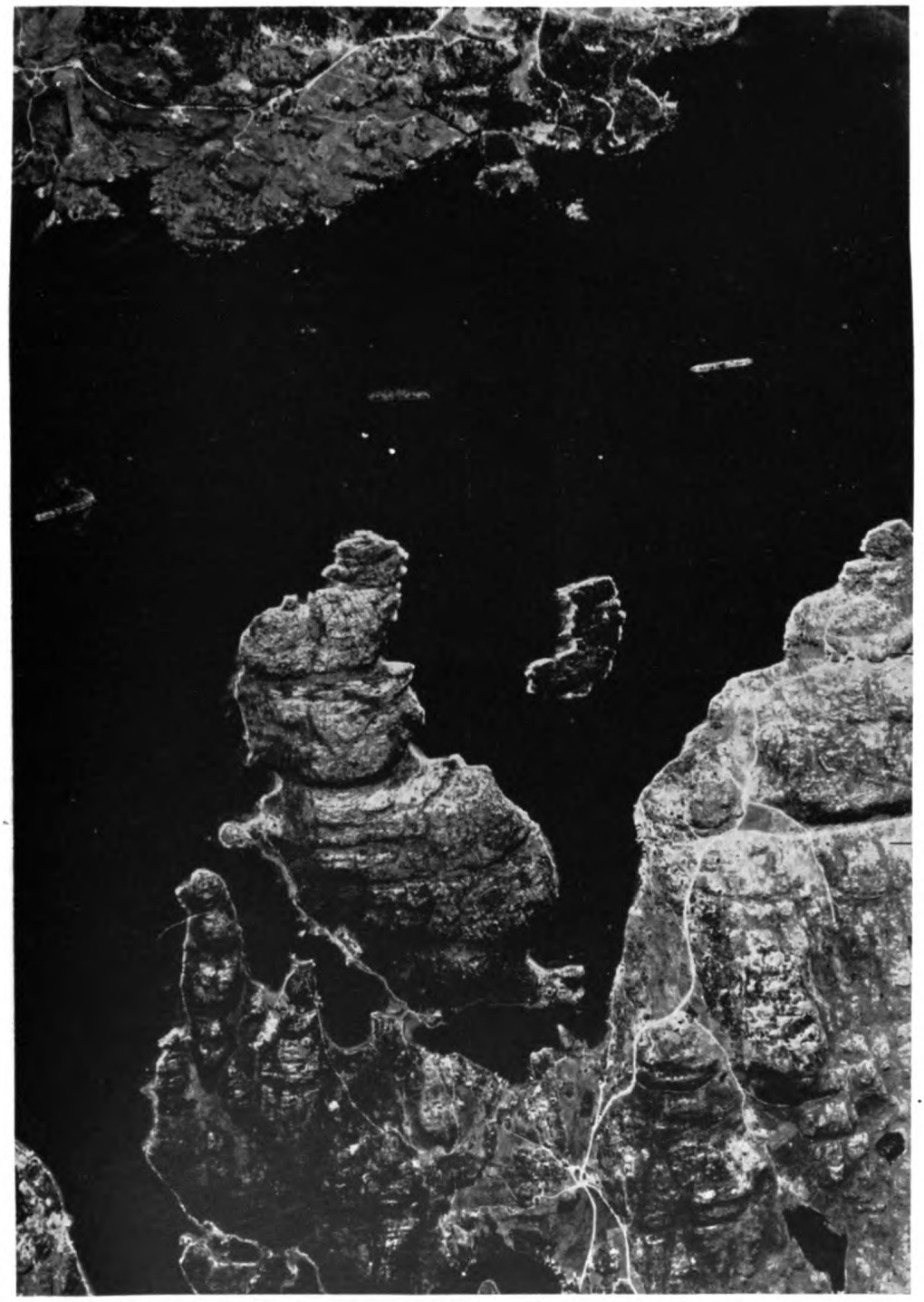


FIGURE 108.—Coast line of Norway showing results of glacial action. The deep water surrounding its irregular shore line and rocky islands offers excellent harbors.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

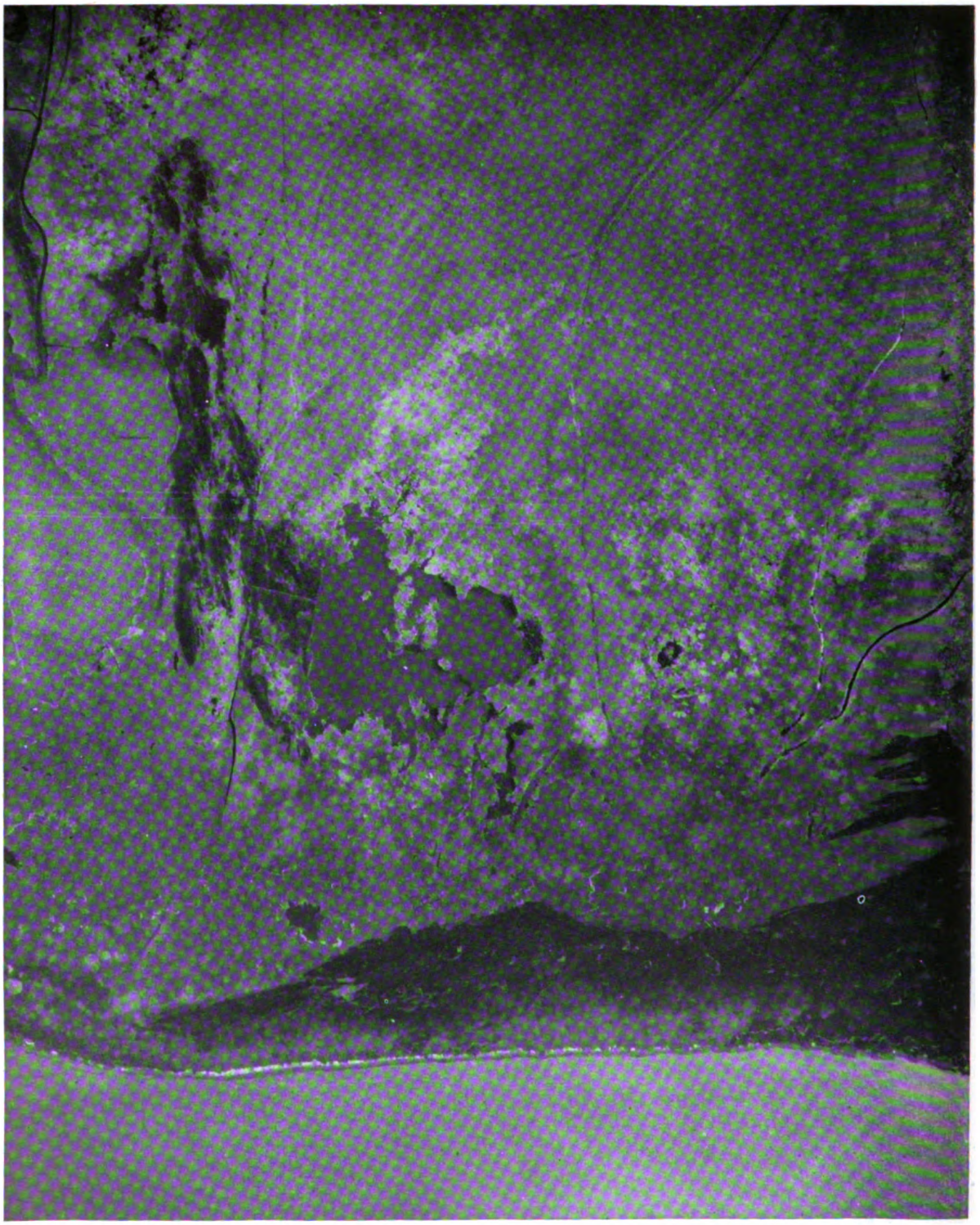


FIGURE 109.—Rising coast line along the Gulf of Mexico. Scale 1:20,000. A small fringe of sand or gravel has been built up at the water's edge, but inward are large, marshy lowlands.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 110.—Delta along coast line of Gulf of Mexico. Scale 1:20,000. All material carried in suspension by the stream has been deposited at its mouth. For large streams, these deltas will often extend many miles out into the ocean.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

31. Sea walls and breakwaters.

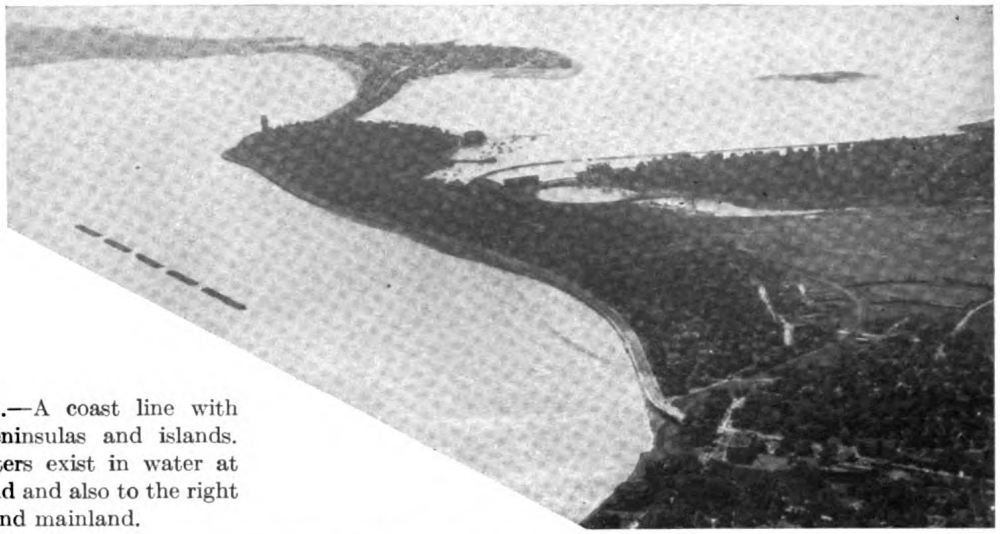


FIGURE 111.—A coast line with many peninsulas and islands. Breakwaters exist in water at foreground and also to the right just beyond mainland.

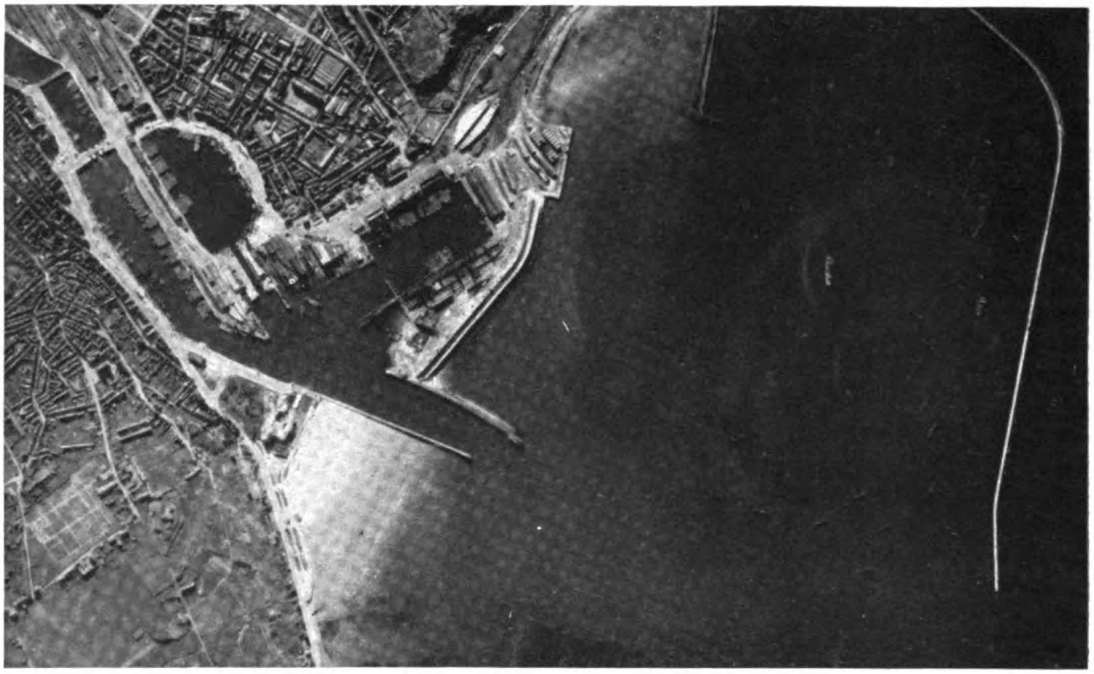


FIGURE 112.—Scale :121,500: Breakwater protecting a harbor along an open coast line.

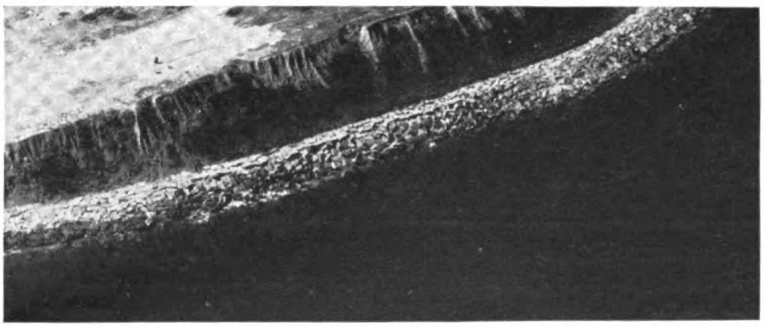


FIGURE 113.—Revetment on a seashore is protection against wave and tidal action.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 114.—Scale 1:20,000: Breakwater at mouth of large, navigable river. These breakwaters extend out into the ocean and protect navigation channels.

496131°—43——5
Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA

32. Practical identification exercise.

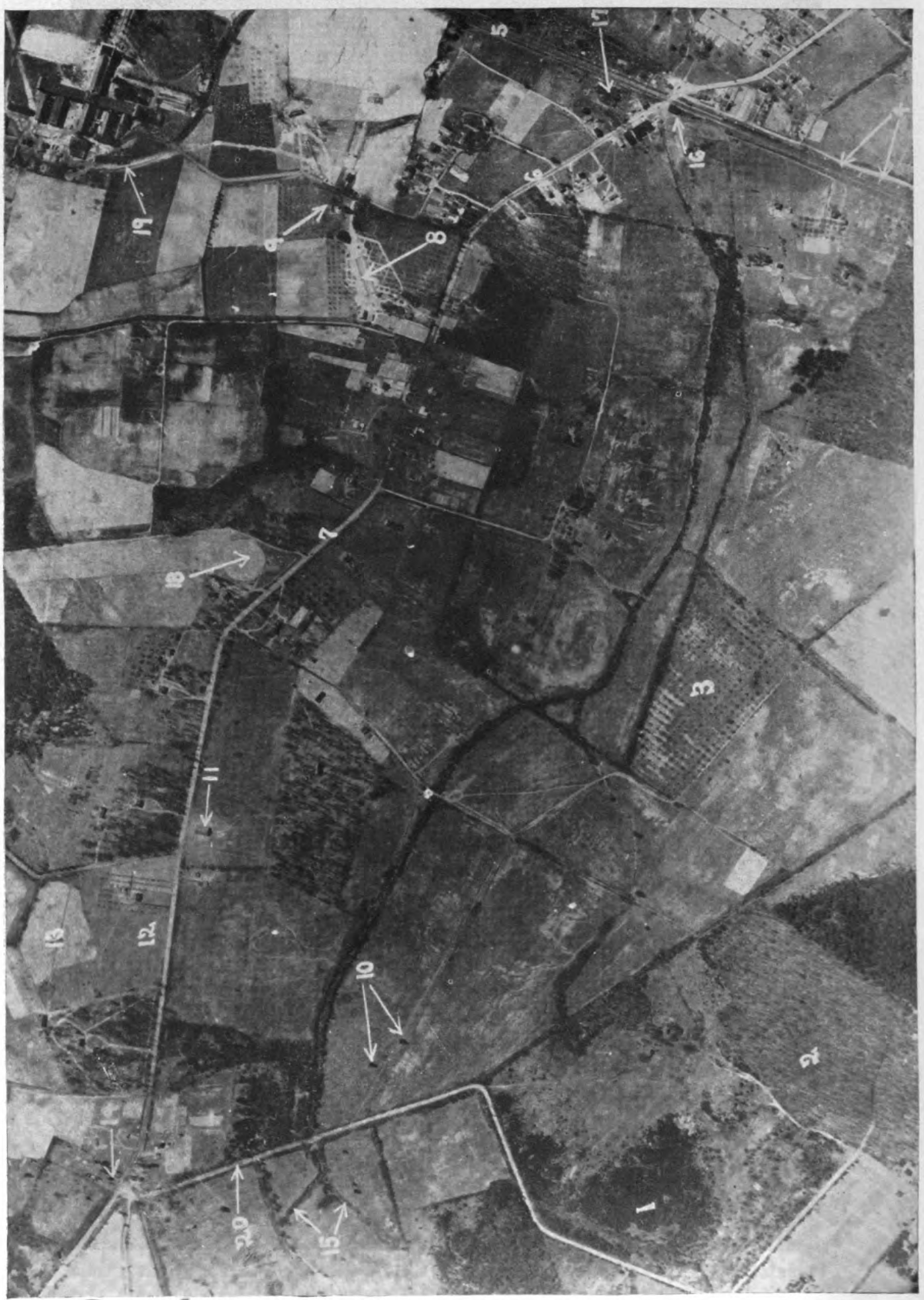


FIGURE 115.—Scale 1:10,000 (approximate).

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Key to figure 116

1. Dense woods of the evergreen type.
2. Thin scrub growth.
3. Orchard.
4. Telegraph poles, disclosed by freshly turned dirt at their bases, recently installed or repaired.
5. Railroad tracks, double track.
6. Tarvia or oil bound road; narrow with wide gravel shoulders.
7. Concrete road.
8. Hothouse or greenhouse. (Identification difficult.)
9. Elevated water tank. (Shadows of supports are visible.)
10. Lone trees.
11. Country school. (Note worn playground and ball diamond.)
12. Stubble or grass field.
13. Cultivated field.
14. Church. (Identification difficult.)
15. Stream lines, probably intermittent.
16. Small railroad station. (Note landing platforms.)
17. Commercial building oriented to the railroad. (Identification difficult.)
18. Old reservoir, now filled in and cultivated. (Identification difficult.)
19. Two railroad cars, probably gondolas.
20. Dirt or gravel road.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 116.—Scale 1:20,000.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

Key to figure 116

1. Three-span stone highway bridge.
2. Mud flats.
3. Overgrown hedge.
4. Elevated storage tank.
5. Manufacturing plant.
6. Apartment house group.
7. Loading platforms and freight cars.
8. Roundhouse and turntable
9. Pier with small boats.
10. Row of high trees.
11. Highway underpass; railroad overhead.
12. Stadium.
13. Sign board.
14. Traffic circle.
15. Fenced-in athletic field.
16. Earth mound.
17. 24-span steel girder railroad bridge.
18. Four freight cars on railroad fill.
19. Radio beam towers.
20. Tug pulling four barges.
21. Sand bar.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

CHAPTER 2

MILITARY INTERPRETATION

		Paragraphs
SECTION I.	General	33–41
II.	Close studies	42–44
III.	Comparative photographs	45–46
IV.	Camps and bivouacs	47–51
V.	Troop movements	52–55
VI.	Supply installations	56–57
VII.	Antiaircraft positions	58–59
VIII.	Antimechanized defense	60–61
IX.	Field artillery positions	62–66
X.	Seacoast defense	67–70
XI.	Engineer activities	71–73
XII.	Advanced landing fields	74–76
XIII.	Camouflage	77–82
XIV.	Reconnaissance from photographs	83–85
XV.	Defensive positions	86–88

SECTION I

GENERAL

	Paragraph
Purpose and scope	33
Photographs in war	34
Photographic missions	35
Recording photographs	36
First phase interpretation	37
Second phase interpretation	38
Obliques	39
Stereo studies	40
Interpretation equipment	41

33. Purpose and scope.—*a.* The purpose of this chapter is to teach interpretation of military activity as shown on aerial photographs. Most of the vehicles, equipment, formations, and installations shown in the figures are those of the United States Army because the student must learn interpretation by studying items of that nature which are familiar to him. When he has become proficient in identifying these, it will be fairly easy for him to extend his knowledge to similar enemy equipment and installations.

b. This chapter covers interpretation of aerial photographs of military activities in the theater of operations. It will serve as a guide to student interpreters who work with the ground and supporting air forces. Large rear air bases and industrial and shipping installations in the zone of the interior are an aerial photographic study so different as to warrant a separate text and therefore will not be included in this manual.

34. Photographs in war.—*a. Types.*—War photographs fall into three main classes: vertical, high oblique, and low oblique. With the use of a long focal length camera, large-scale photographs can be obtained at extremely high altitudes. Sharp obliques at low altitudes may be obtained by mounting a camera so as to take the oblique along the axis of the airplane.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

b. Interpreter and photographer.—Close cooperation between the interpreter and the aerial photographer is of great importance. If the interpreter is to obtain maximum efficiency, he must have a thorough understanding of the limitations of the photographer and his equipment. He must keep abreast of all changes in equipment, enemy interference, and efficiency of photographic personnel. Whenever possible, the photographer should give the interpreter information he remembers from visual observation. He should also specify the priority of printing special negatives in the roll of film which he has exposed.

35. Photographic missions.—*a. General.*—A photographic mission should be ordered for specific information in a specified area. Specifications, such as the exact scale of the photographs, should be advisory only. The photographic agency should be told what specific information is desired but should be allowed to determine the best method for accomplishing its mission with the available facilities. Examples of missions are to obtain photographs of all bridges, fords, or ferries crossing a particular river between two specified points; to photograph an entire area in which activity has been discovered in order to determine the specific nature of the activity.

b. Missions for specific studies.—In cases where missions over enemy territory are ordered for specific studies, such as routes of advance of an armored unit or location of hostile artillery, the requirements should be completely outlined. For routes of advance of the armored force, photographs are desired which afford studies of size and probable capacities of bridges, the steepness of river banks, and the depth of water in streams which are probably fordable. For the study of artillery positions, photographs of probable locations such as woods bordered by fields or roads, defiladed positions, and hedges are desired. These studies require good stereo pairs and often require low obliques.

36. Recording photographs.—When photographs are first received they are usually identified by mission number and date. As soon as the location of the photograph is determined it should be marked with the proper geographical identification, and eventually filed by this identification. The information sought by the mission on which the photograph was taken may become useless in a short time, but the photographed area may be rephotographed at a later date and the earlier photograph become priceless for comparative purposes. A file system should be developed to fit best the maps used in the area. The general sector of operation should be divided into smaller sections; squares of about 20,000 yards should prove appropriate. All photographs within this area should be filed together in chronological order. In case a photograph includes two areas, a copy should be placed in each file. The area mentioned should conform to coordinates and a small-scale master map should give the immediate location of a given area. Where the position is stabilized, smaller areas may be used for filing. All photographs should be given a geographical file number as soon as the first phase interpretation has been made.

37. First phase interpretation.—This phase of interpretation covers that activity which will require immediate countermeasures and which affects the day-by-day conduct of the war. Since landing fields are usually some distance from the headquarters of a ground unit, it is desirable that a good first phase interpretation be accomplished at the photographic laboratory near the landing field. This first phase interpretation is conducted with the assistance of the photographers. It results in processing photographs which are more likely to contain desirable information before those of less value. Information derived from the first phase interpretation may occasionally be transmitted rapidly to the ground force before all photographs obtained on the mission are completely processed.

38. Second phase interpretation.—*a. General.*—When the outstanding information has been obtained from photographs and a geographical file number has been designated, second phase interpretation is started. This phase includes a thorough search of every photograph to determine the existence of any military information. It should be done at the headquarters of the ground force because—

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

(1) The ground force can make full use of its knowledge concerning the rapidly changing military situation.

(2) Other sources of information are available for rapid verification.

(3) The appearance of new enemy installations or equipment is appreciated more because of ground contact with them.

b. Transparencies.—A type of second phase interpretation which may be simultaneously accomplished at the photograph laboratory is the careful study of selected photographs by viewing positive transparencies. The organic equipment within the laboratory allows these studies, and in some cases more detail can be seen from the transparency. Under certain conditions a color photograph gives more detail and contrast than a black and white photograph. Color transparencies can be obtained when the weather is suitable, and the interpretation made at the photographic laboratory.

39. Obliques.—In some cases the ground forces may request that obliques be taken over enemy lines at low altitudes, where verticals would be impracticable due to slow film and shutter speeds being unable to "stop" the ground. (See par. 34*a*.) The lower units of the ground forces will find much use for obliques of enemy territory which are taken from behind our lines. These obliques may be reproduced by lithography in great quantity for wide distribution and can be used by company officers for studying terrain to their front. The interpreters may be called on to give instruction in their use.

40. Stereo studies.—Stereo studies are necessary for tactical interpretation. The principles of stereo vision are explained in FM 21-26 and in other manuals. Single photographs appear throughout this manual, but it is due primarily to the difficulty of presenting in book form photographs for stereo study. Stereo pairs or triplets are the rule rather than the exception for interpretation studies. The use of single photographs for training is discouraged.

41. Interpretation equipment.—*a. Necessary equipment.*—In the study of photographs for intelligence purposes a small portion of the photograph is viewed at one time. While the map maker is interested in terrain features and their physical relation to each other, and for this reason needs a stereoscope with wide coverage, the tactical interpreter concentrates upon objects of extremely small size; hence, in most cases, a pocket stereoscope meets his requirements. Other equipment commonly used in intelligence interpretation is an illuminating magnifying glass, 1:100 inch or 1:1,000 foot scales (may be special scales to fit magnifying glass), grease pencils, books on close studies of equipment, and maps.

b. Other equipment.—In large interpretation units other equipment such as magnifying mirror stereoscopes, parallax measuring devices (height finders), and shadow charts is found.

(1) The magnifying mirror stereoscope accomplishes little in interpretation work that cannot be accomplished with the small pocket stereoscope.

(2) Parallax measuring devices such as Abram contour finder, Talley-Fairchild stereo-comparagraph and binocular stereoscope with parallax bar may be used to find the elevation of one point or object above another. This equipment has its limitations, for serious errors will result in the determination of elevations by parallax measurements on photographs tilted as little as 1° or 2°. TM 5-230 and 5-240 explain the operation of this equipment.

(3) Shadow charts are used to determine the height of an object when the length of its shadow can be measured. Charts can be made up for an area by determining the length of shadows of objects of known heights for each hour of the day. As shadow lengths vary with the time of day, geographical location, and time of year, these variables must be considered. Shadows must fall on fairly even ground to have their lengths accurately measured for height determinations.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

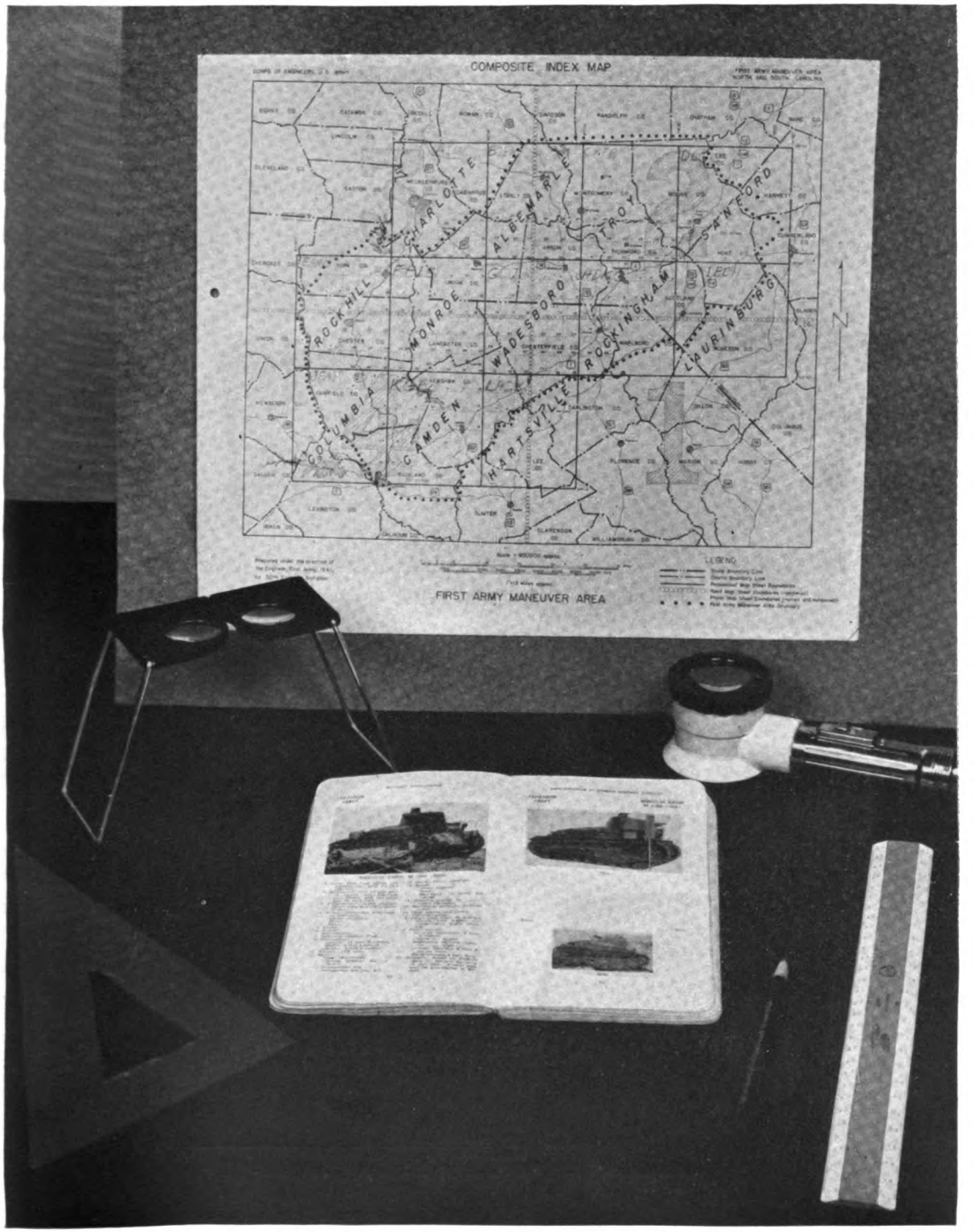


FIGURE 117.—Equipment commonly used in interpretation work.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

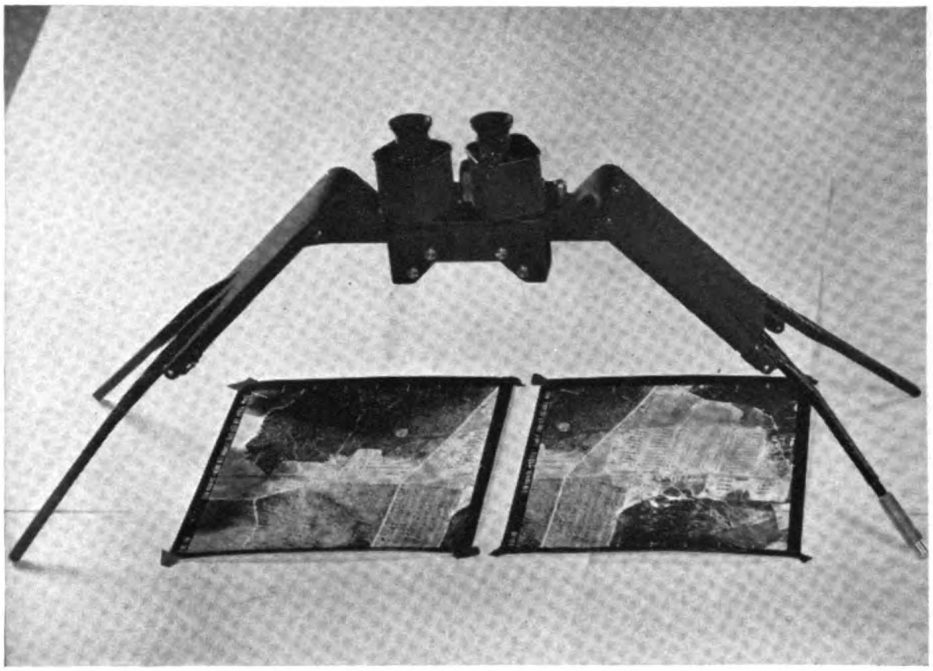


FIGURE 118.—Magnifying mirror stereoscope.

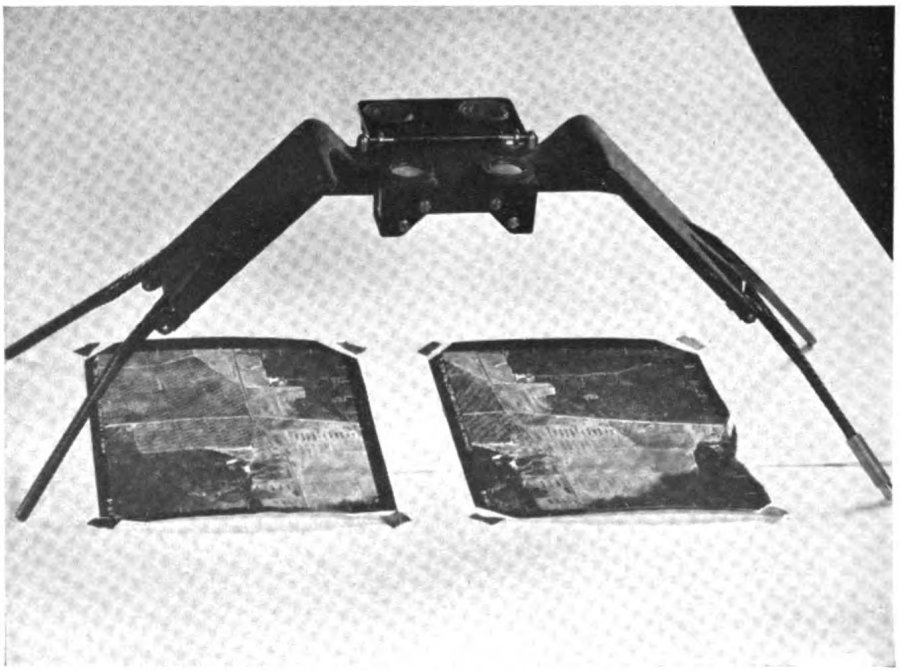


FIGURE 119.—Mirror stereoscope (binocular removed).

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

SECTION II

CLOSE STUDIES

	Paragraph
Importance	42
Means of study	43
Scrapbook	44

42. Importance.—The best interpreters of enemy troop activities and installations are those who are familiar or have been in contact with the enemy and who have observed and learned the characteristic appearance of his equipment. Likewise, close studies of enemy installations and camouflage are important.

43. Means of study.—Close studies are generally made from photographs and drawings. If a ground photograph of equipment is the only one available, a close inspection should be made and, if possible, a plan sketch drawn for comparison with vertical aerial photographs. Similarly, all captured equipment should be sketched or photographed in plan.

44. Scrapbook.—In addition to all close studies and silhouette available from higher intelligence sections, the interpreter should collect photographs and sketches in a scrapbook. This scrapbook should supplement other books already cataloged.

SECTION III

COMPARATIVE PHOTOGRAPHS

	Paragraph
Value of previous photographs	45
Means of comparison	46

45. Value of previous photographs.—The interpreter's work is greatly facilitated if photographs are taken of an area prior to its occupation by the enemy and if successive photographs are taken periodically thereafter, as long as the enemy continues to operate in the vicinity. If this can be done, the enemy's camouflage will not be effective and his intentions can be read by a comparison of the photographs.

46. Means of comparison.—*a.* Study the photographs on this and the following pages. Figures 121, 122, and 123 were taken about 6 weeks apart. Which photograph was taken first? Which, second? Which, last? When was the oblique (fig. 120) taken with relation to the other three?

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

b. In studying comparative photographs, look for signs of activity such as construction work, new paths, or roads widened by increased traffic. Fields change color due to cultivation but white splotches are caused by activity which has beaten down the earth and changed its texture. Observe

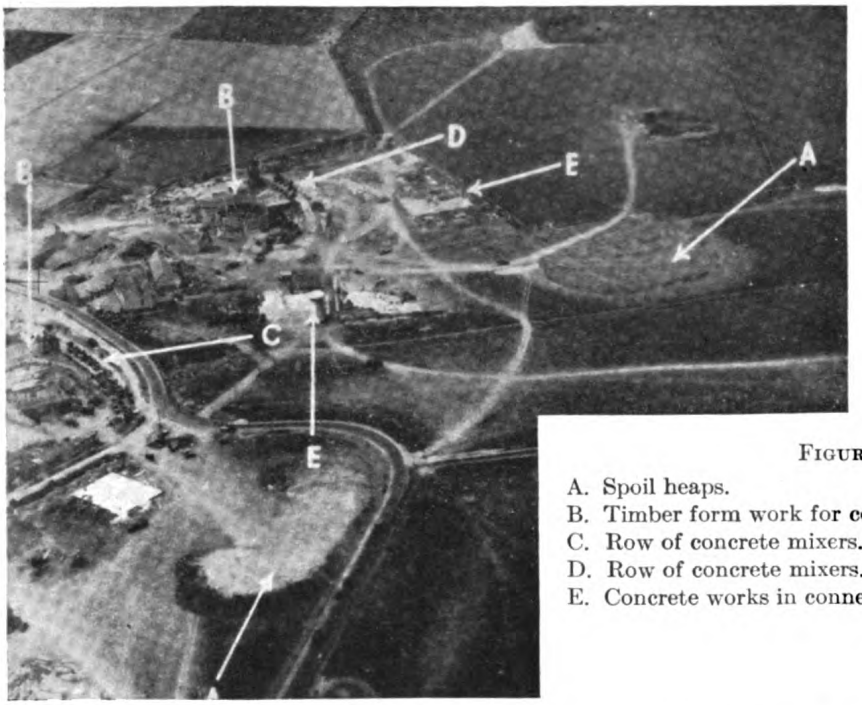


FIGURE 120.

A. Spoil heaps.
B. Timber form work for concrete gun positions.
C. Row of concrete mixers.
D. Row of concrete mixers.
E. Concrete works in connection with but not for guns.

the crossroads in the lower left of figures 121, 122, and 123. Even without the construction work as a clue, it is evident that traffic has greatly increased.



FIGURE 121.—Scale 1:35,000.

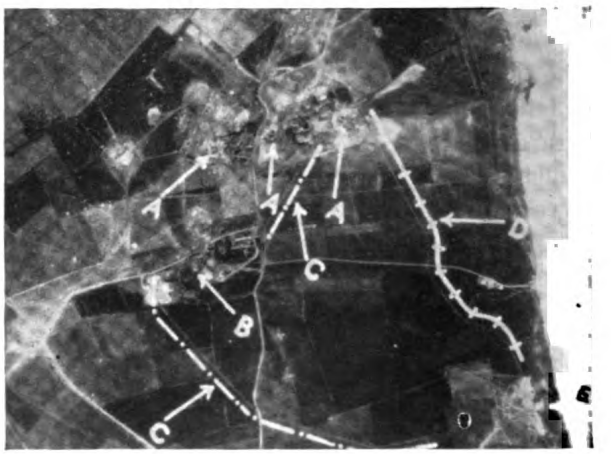


FIGURE 122.—Scale 1:25,000.

A. Three gun emplacements.
B. A fourth emplacement but not so clear.
C. New buried cable.
D. Light railway for construction at E.
E. Observation or fire control station.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 123.—Scale 1:17,500.

c. Figures 121, 122, and 123 were taken 6 weeks apart: 121, first; 123, second; and 122, last. The oblique was taken between figures 121 and 122. All photographs show the construction of heavy gun positions along a coast.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 124.—Scale 1:2,500: Large-scale photograph of part of area shown in figure 126.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 125.—Scale 1:6,000: Photograph of an area taken before occupation by military units.



FIGURE 126.—Scale 1:6,000: Photograph of same area as figure 125 but taken 10 days later when occupied by an infantry battalion and two batteries of field artillery. Fox holes, machine-gun and mortar emplacements, and other military activities stand out when compared to the previous photograph. See figure 124 for a larger scale photograph.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

SECTION IV

CAMPS AND BIVOUACS

	Paragraph
Location and identification	47
Command posts	48
Size of units	49
Type of unit	50
Length of occupation	51

47. Location and identification.—*a. Camps.*—Semipermanent camps may be found in enemy rear areas. They will probably be near towns or villages where utilities are accessible and may be located near air bases and seacoast installations. The presence of one will usually disclose the others.

b. Bivouacs.—Near the battle line, highly dispersed bivouacs are of little value in interpretation since they present no particular target. In rear areas where reserves and fast moving units are located, however, the identification of bivouacs is extremely important. They often give the key to the enemy intentions by disclosing the locations of his concentrations. Photographs of such mobile units as an armored force are of little value except when they are in bivouac. In general, bivouacs may be expected in areas that provide the best—

(1) Concealment for men and equipment from aerial and terrestrial observation.
(2) Means of dispersion. Large forces will not be grouped in small, isolated woods.
(3) Communication. An area will be sought which contains an existing road net.
(4) Protection against attack—in the vicinity of natural obstacles, where possible.
(5) Water supply, especially in an arid country.

c. Means of identification.—Bivouacs are detected by the following, listed in order of importance:

(1) Tracks of vehicles.
(2) Vehicles.
(3) "Trashy" appearance, caused by small and personal equipment.
(4) "Worn" spots—change in texture due to human and vehicular traffic.
(5) Tentage and personnel.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

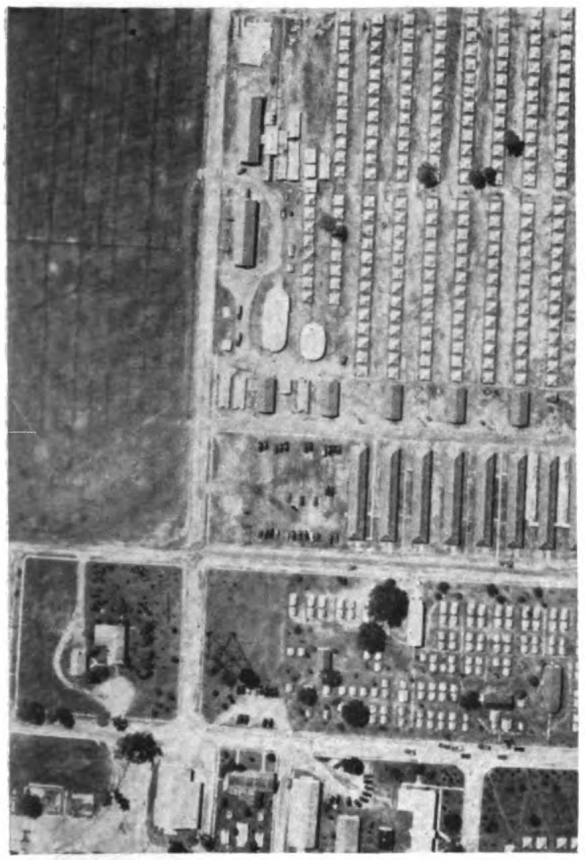


FIGURE 127.—Scale 1:3,500: A day photograph, taken about noon, is shown for comparison with the adjoining night photograph of the same area.

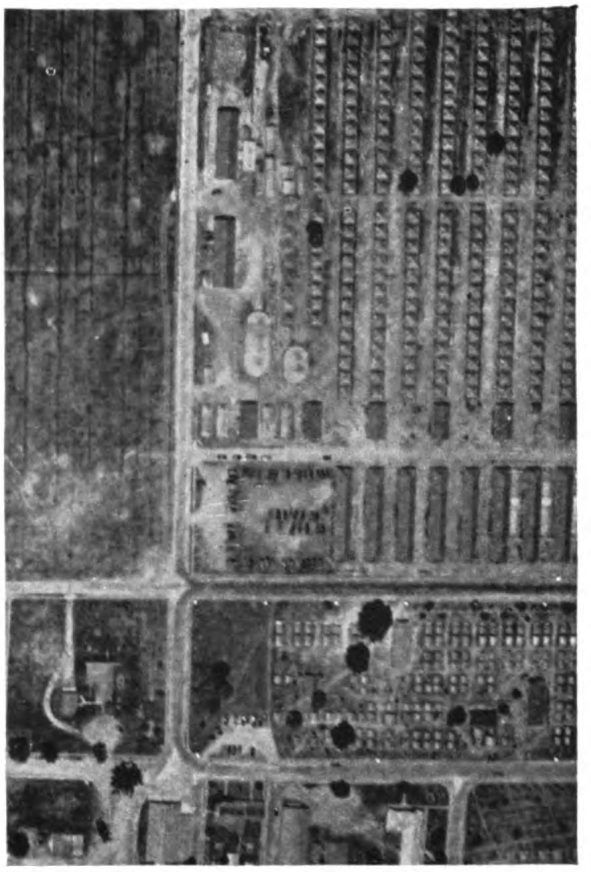


FIGURE 128.—Scale 1:3,500: Night photograph of a camp. Though detail is blurred, note that any general feature can be identified. Drainage features are easily recognized.

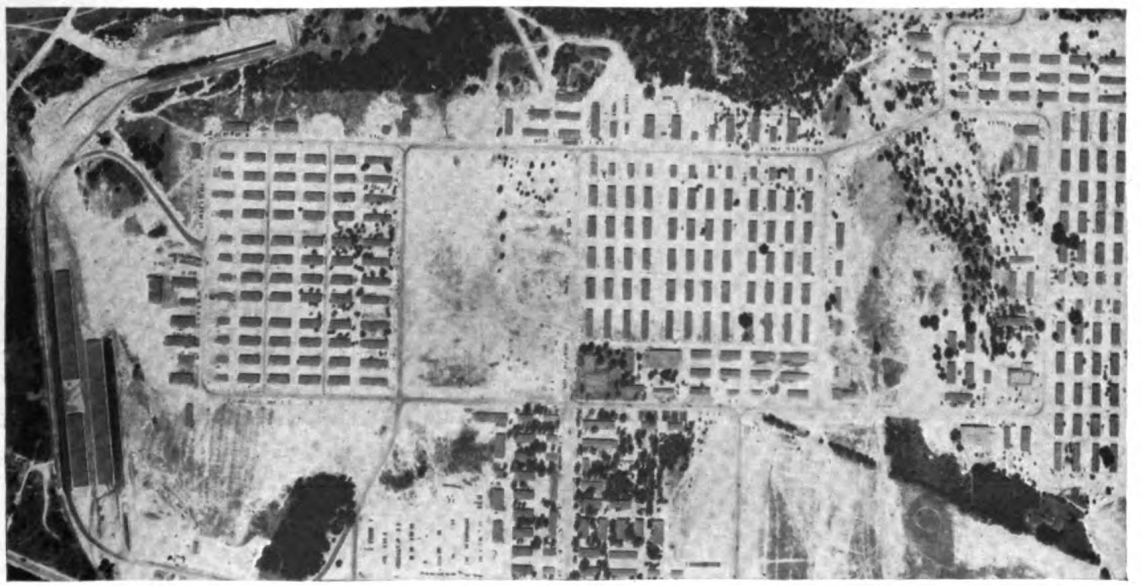


FIGURE 129.—Scale 1:10,000: Large permanent camp of cantonment type. This cantonment area is sufficient to quarter, except for hospitalization, approximately 10,000 men.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

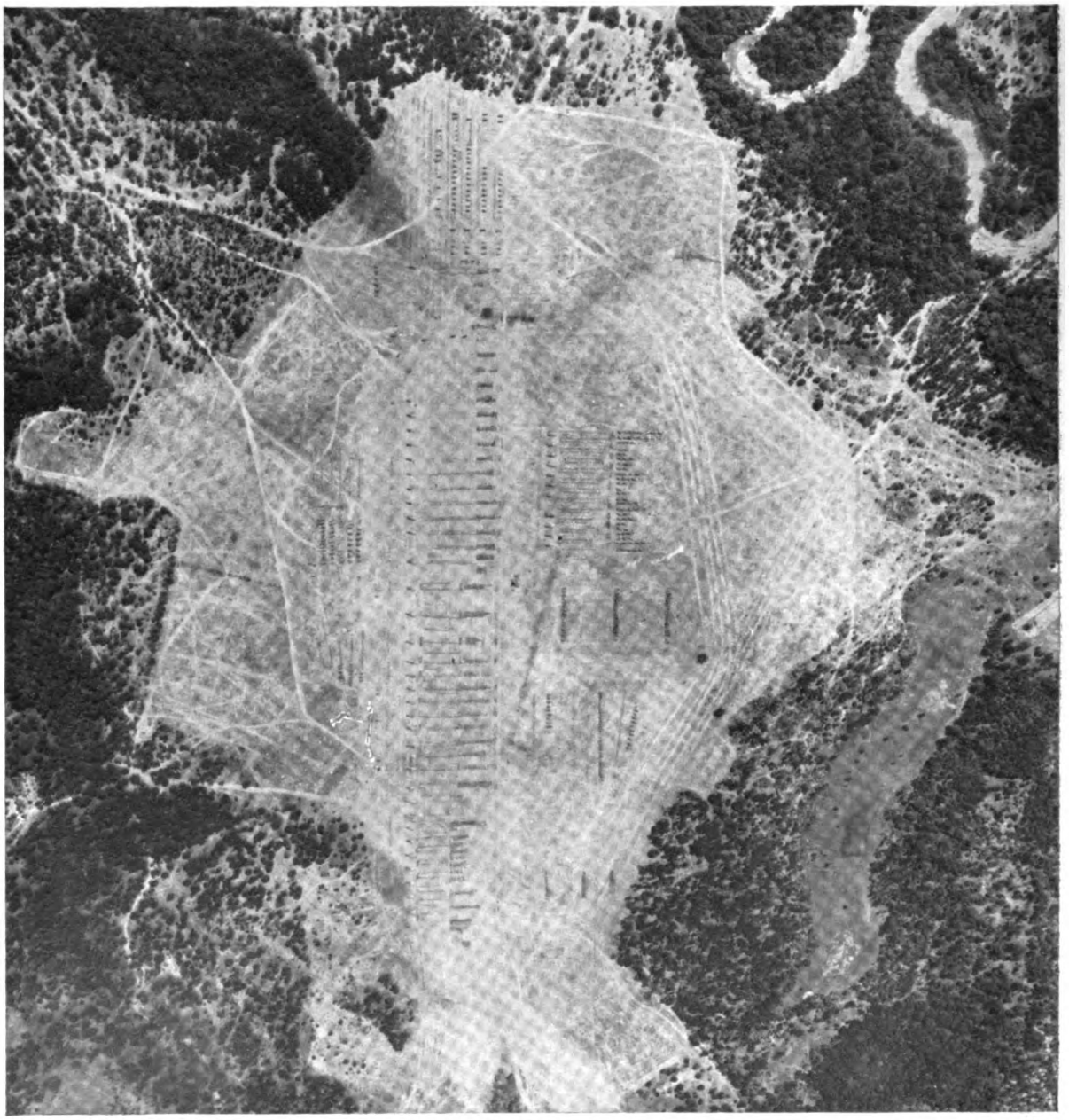


FIGURE 130.—Scale 1:9,000: An armored force division camp. Although the lay-out is nontactical, it gives an estimate of the large amount of equipment a division must conceal in a tactical bivouac.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

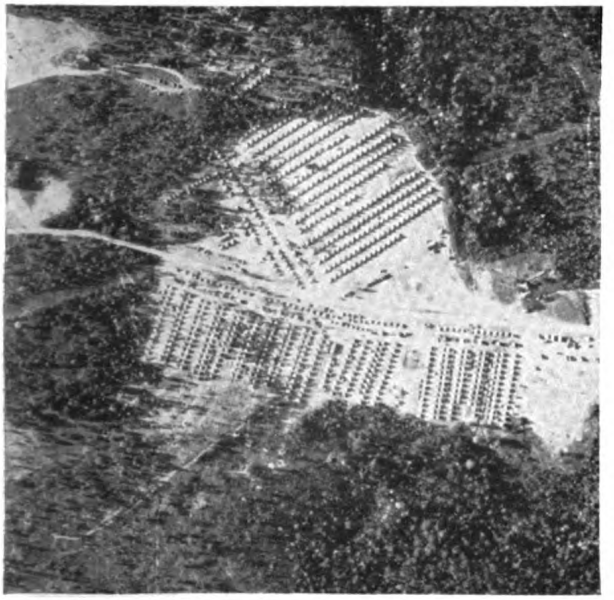


FIGURE 131.—Scale 1:10,000: Base camp of an infantry brigade. It is identified by the size, number of companies, and lack of motor vehicles and equipment. A brigade consists of two infantry regiments of 15 companies each. A close study of each regiment will show its separate companies as a single or double row of tents, separated from each other by wide company streets.

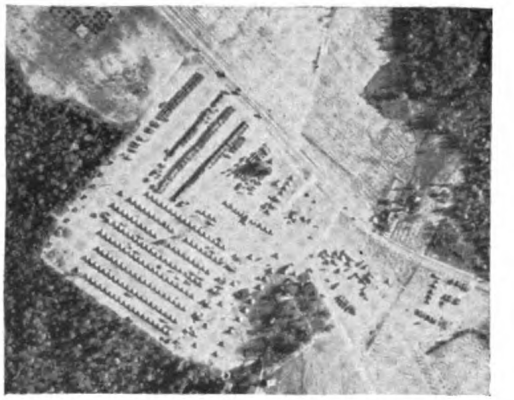


FIGURE 132.—Scale 1:10,000: Base camp of a quartermaster regiment. Its identification is determined from the large number of trucks in comparison to the number and size of the individual companies. A check on the number of companies reveals there are eight, which corresponds to a quartermaster regiment of the square division.



FIGURE 133.—Scale 1:5,000: Photograph of an open-air theater. These theaters are prevalent in base camps, and all have the characteristic appearance of the one shown in the photograph. A ground view is shown in figure 134.

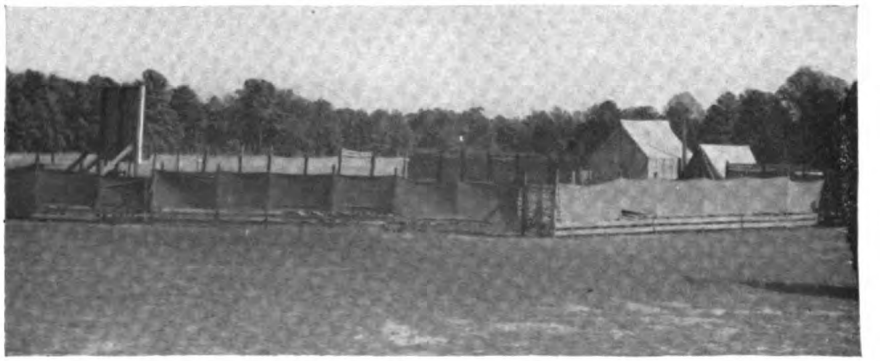


FIGURE 134.—Ground view of open-air theater.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

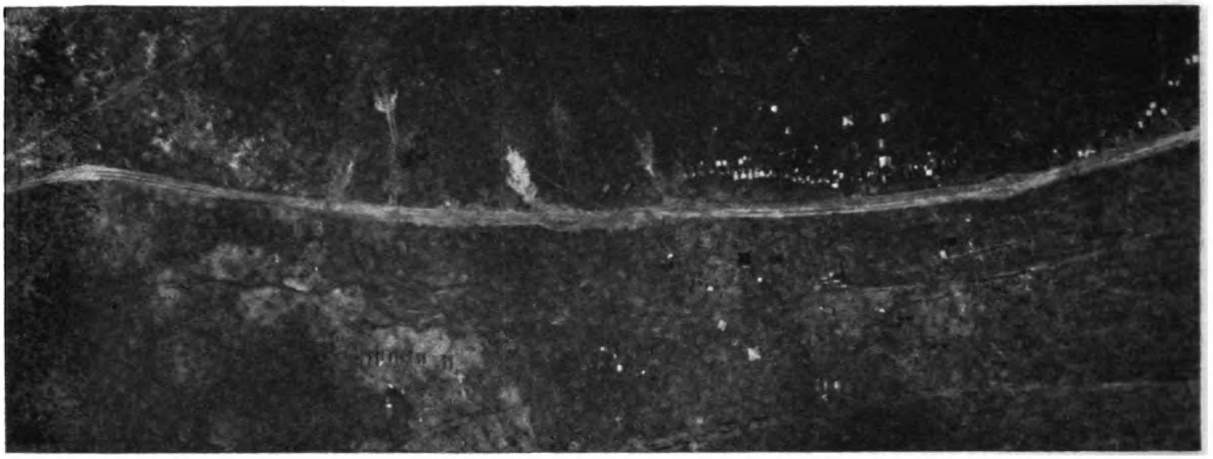


FIGURE 135.—Scale 1:3,500: Night photograph showing bivouac with no dispersion. Night photographs of a clever enemy are difficult to obtain and are possible only when he is known to be in the vicinity just prior to darkness and when he is careless with lights.

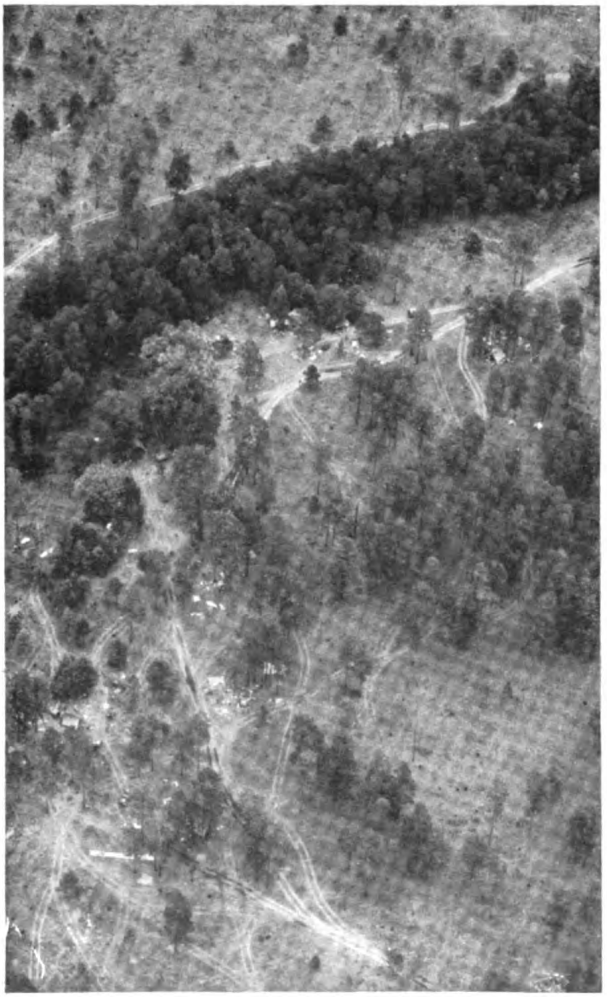


FIGURE 136.—Low oblique of same general area as in figure 137. Note general trashy appearance of whole area. This is a poor bivouac.

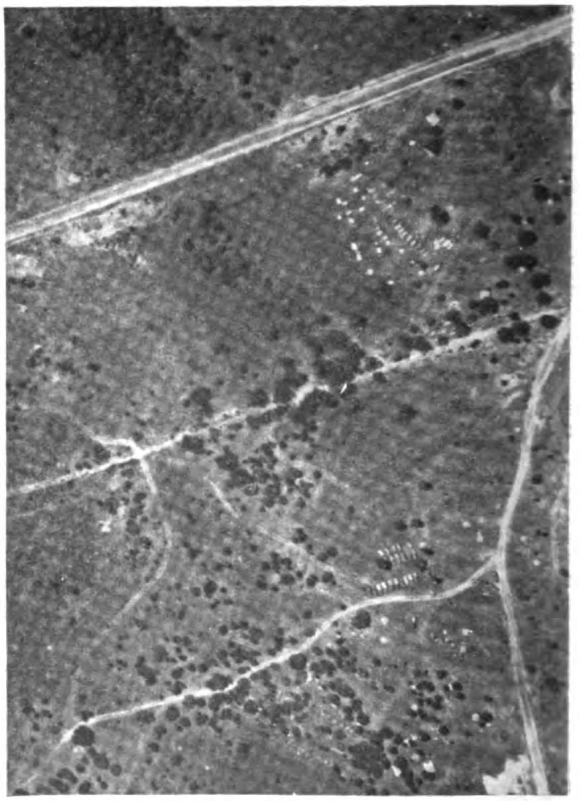


FIGURE 137.—Scale 1:3,500. This night photograph of a bivouac shows no effort to take advantage of small trees for cover. There is a tendency to group close in night bivouacs and not take full advantage of cover, thus often making night photography profitable.

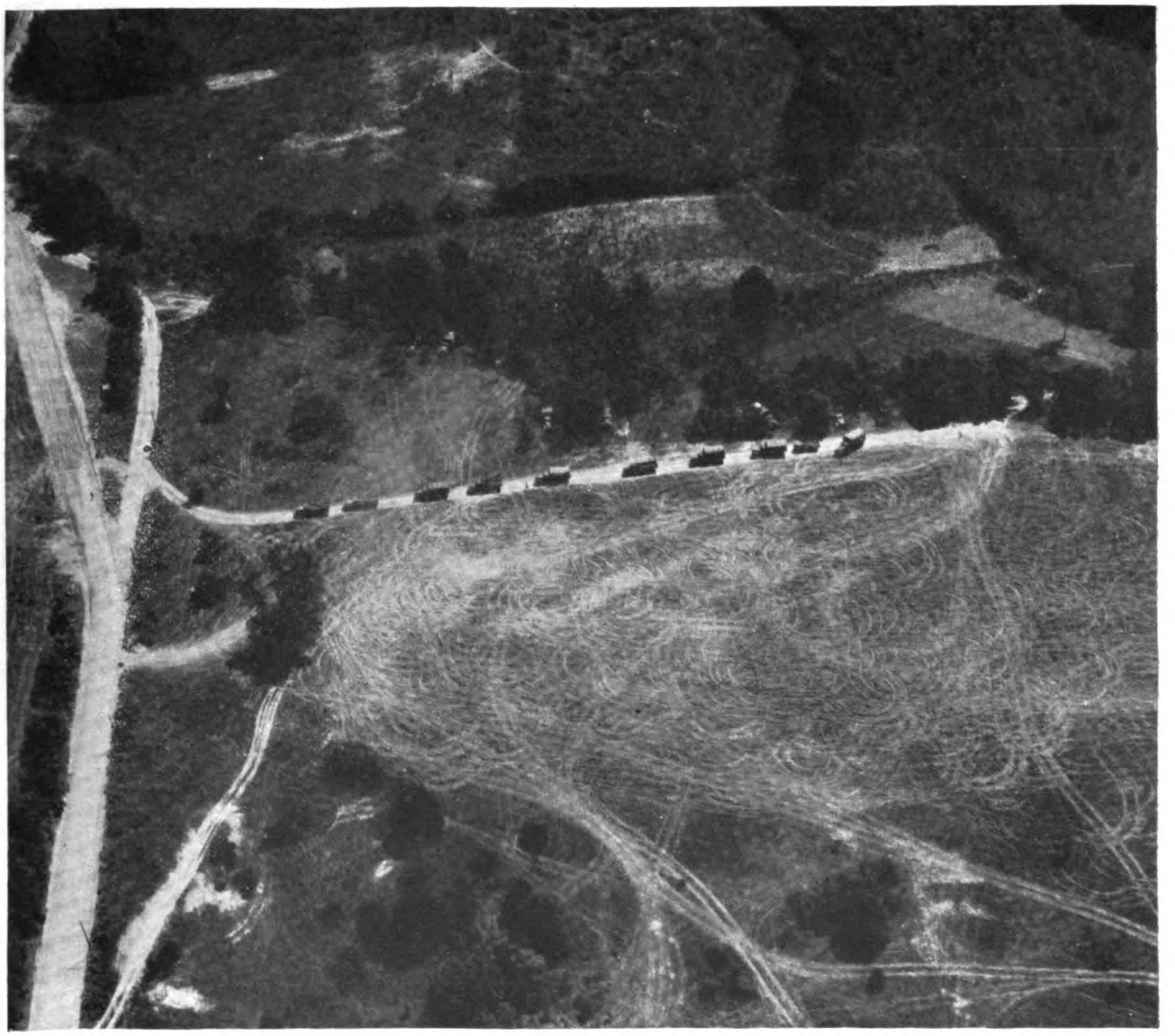
Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 138.—Scale 1:5,000: Bivouac area concealed except for tracks. Reference is not made to the array of tank tracks in the lower part of the photograph, which would immediately mark the area as one of much activity, but to the truck tracks leading into the woods near center of photograph. Very few trucks can be located.

FIGURE 139.—Low oblique (elevation 700 feet) of same area as figure 138 but taken 15 minutes later. All trucks on road have just left the bivouac area. Notice the large number waiting to leave and also those parked under trees. A careful study of figure 138 should reveal more trucks than the first time.



Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

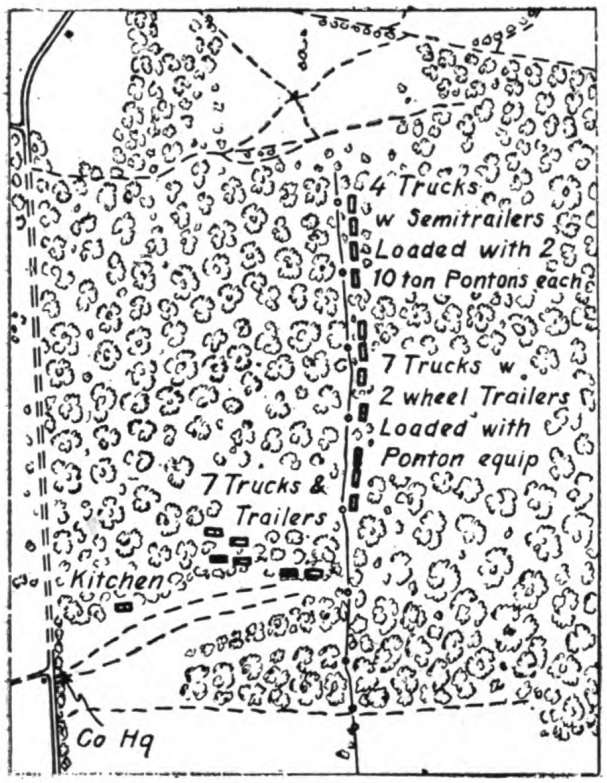


FIGURE 140.

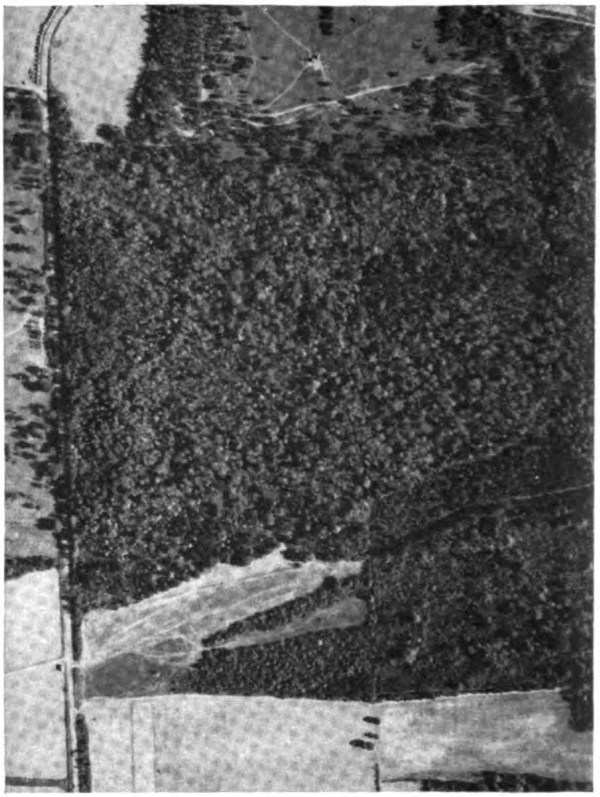


FIGURE 141.

Scale 1:10,000: Engineer light ponton company in bivouac. A close study reveals no signs of activity except tracks in fields adjoining woods. Concealment has been effected entirely by use of natural cover. The sketch shows the amount and approximate location of vehicles and equipment concealed. If the enemy knew this was a ponton company, a river crossing would be suspected at once as the river is less than ½ mile away. Entrance to the bivouac area could have been made from the main road at points where the road and woods join, thus leaving no tracks at all.

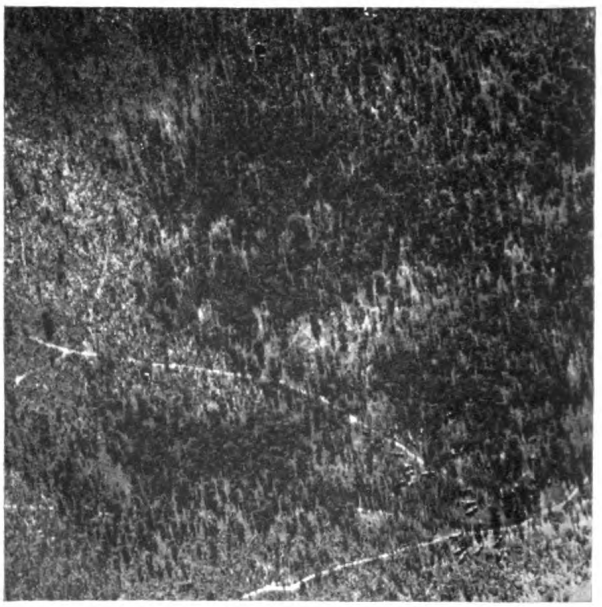


FIGURE 142.—Scale 1:6,000: Bivouac in which full use has not been made of natural cover and concealment.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 143.—Ground view of 10-ton ponton semitrailers concealed in the woods shown in aerial photograph figure 141. The ground and aerial photographs were taken at the same time.



FIGURE 144.—Side view of ponton trailer shown in figure 143.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

48. Command posts.—Command posts of large units will be found generally in existing buildings in towns or villages. When vehicles are kept under cover, these command posts are difficult to locate. Where there are few villages, command posts are located in farm buildings or in woods. In interpreting photographs, farm buildings adjoining a heavy woods should be viewed with suspicion since there is usually room for a command post, an entering road and turn-around, and cover for the attached troops and installations.

Figure 145: Ground view of part of the division command post shown in figure 146. Although in figure 145 the woods appear dense, in figure 146, taken at the height of 1 mile, a concentration of vehicles can be seen. Vehicles parked directly under trees, a little brush laid on top to break up reflection, makes the interpreter's job very difficult.

Figure 146 and figure 150, scale 1:6,000: Stereo pair of a division command post. Notice the two new roads cut from the main highway through the field. New roads leading to woods should be viewed with suspicion as they indicate activity.

Figure 147, scale 1:6,000: Division command post of an armored division. Armored vehicles and radio trailer-trucks are important in the determination of the type of unit. Vehicles are parked in the woods on both sides of the road

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 145.—Ground view of figure 146.

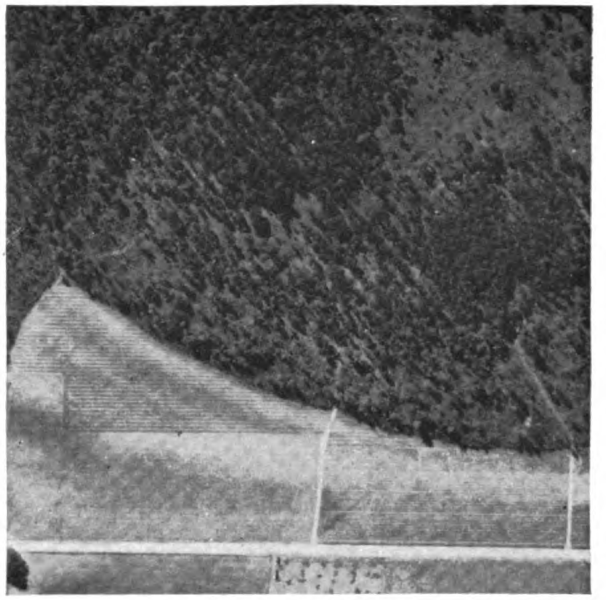


FIGURE 146.—Division command post. Stereo pair with figure 150.

1. Radio truck and trailer.
2. Light tank.
3. Scout car.
4. 2½-ton truck.
5. Command car.

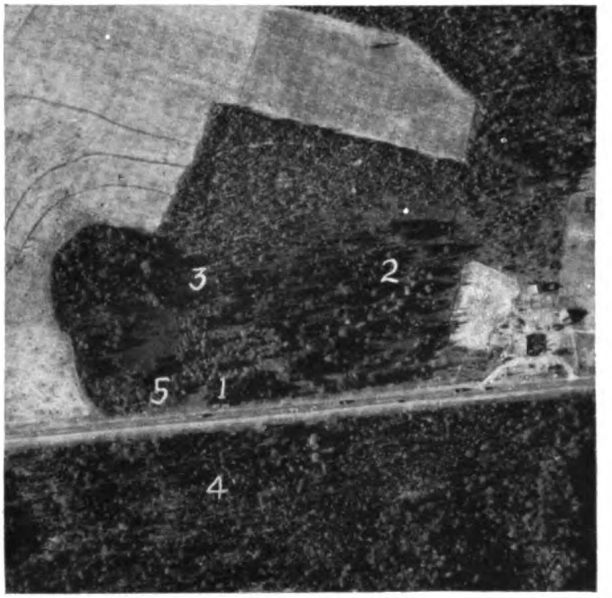


FIGURE 147.—Armored division command post.

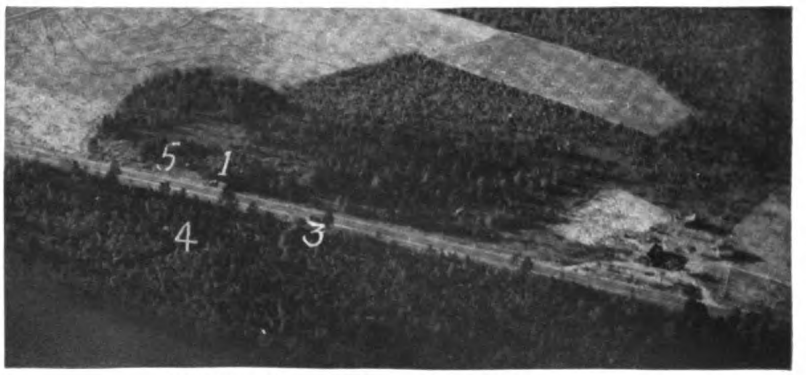


FIGURE 148.—Oblique view of figure 147.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 149.—Low oblique of a division command post. The turn-in for the farm shows excessive use, far more than normal use by the farmer.

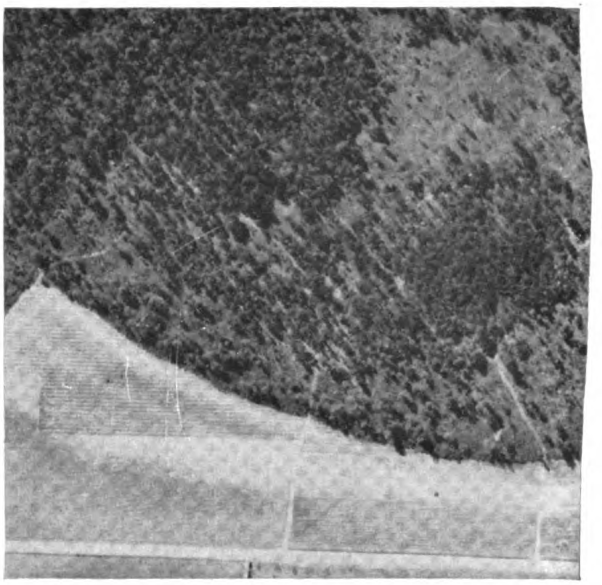


FIGURE 150.—Division command post. Stereo pair with figure 146.



FIGURE 151.—Scale 1:5,000: Field headquarters for a German army. Note the landing field. The airplanes are concealed in the vegetation when not in use.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

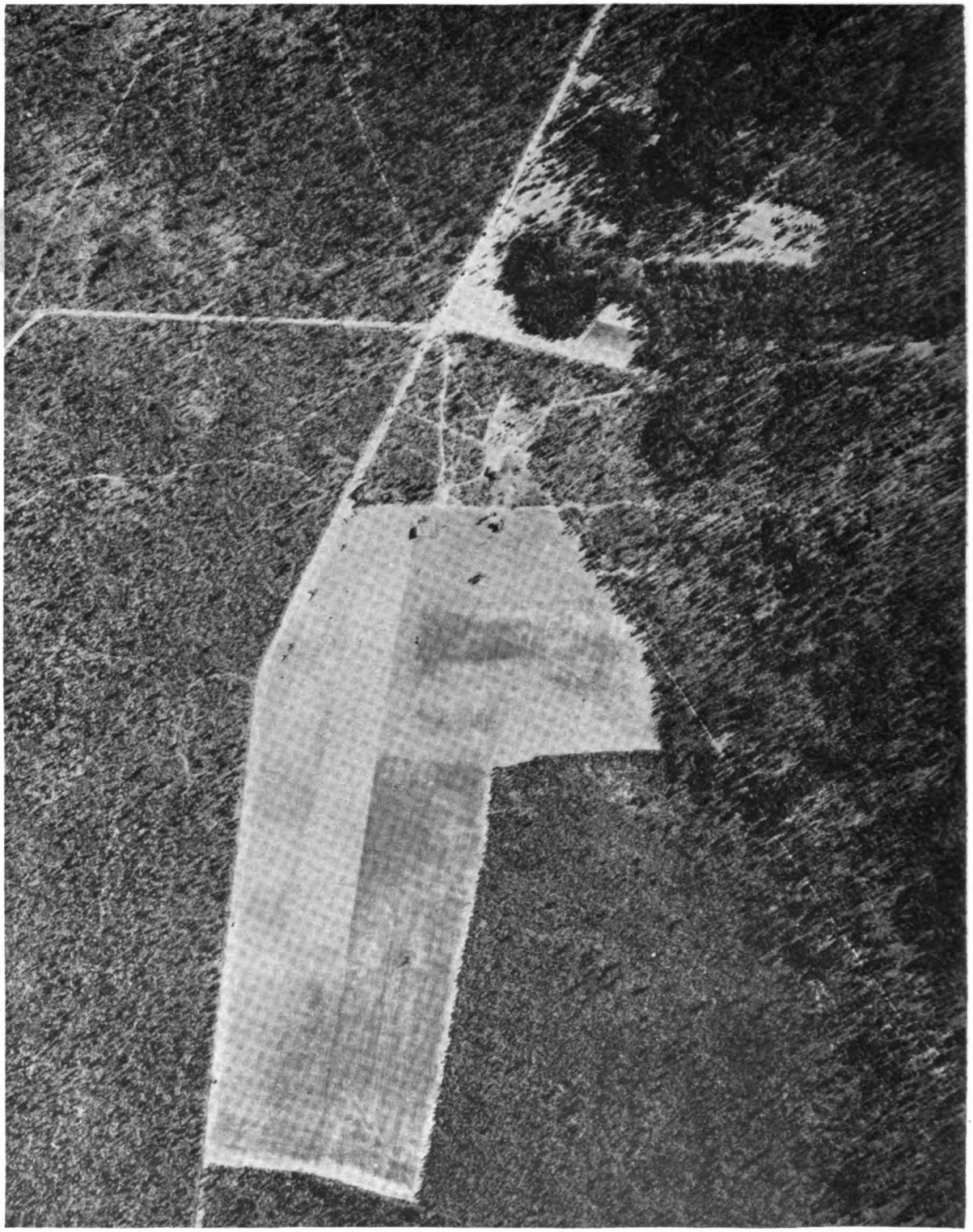


FIGURE 152.—Scale 1:8,000: Corps command post. Command posts of large units are frequently found in locations where small liaison airplanes may land. Farms are often used for this purpose with the farm buildings being used for headquarters, as shown in this photograph. Note the network of paths and roads leading to the farmhouse. Headquarters units are bivouacked in woods to the rear. Under war conditions, the airplanes in the open field would normally be concealed in the edges of woods.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

49. Size of units.

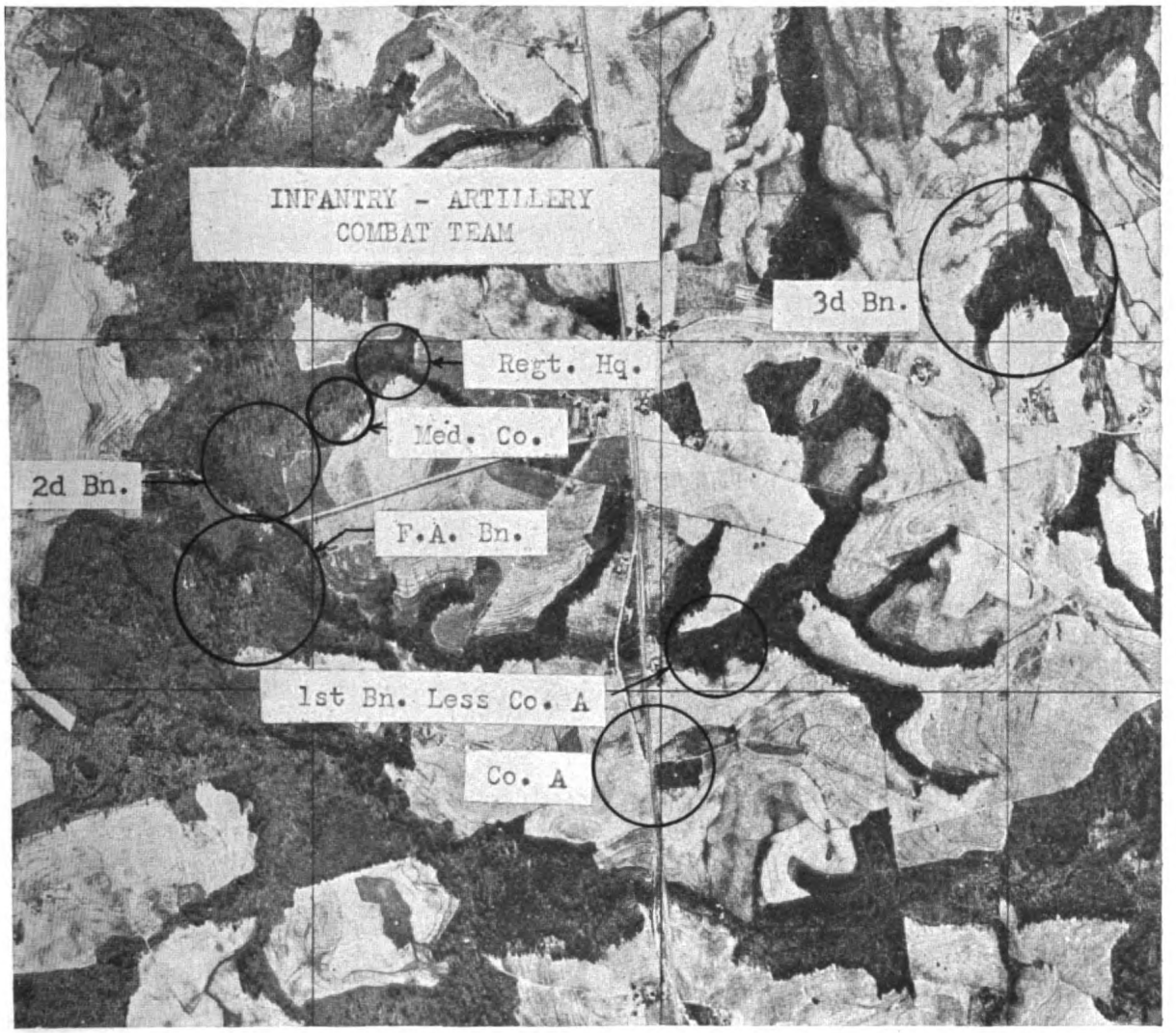


FIGURE 153.—Scale 1:20,000: Photomap of an area occupied by a combat team, composed primarily of an infantry regiment and an artillery battalion.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 154.—Bivouac 2d Battalion. (See fig. 153.)

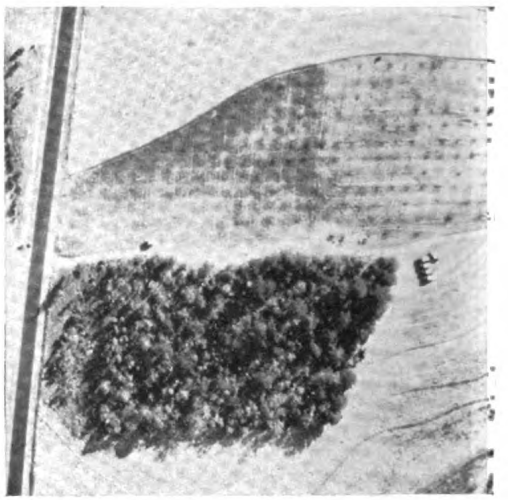


FIGURE 155.—Bivouac Company A, 1st Battalion. (See fig. 153.)

Figure 154, scale 1:3,500: Bivouac area occupied by an infantry battalion, approximately 960 men. It has about 40 motor vehicles consisting of command cars, weapon carriers, and 1½-ton trucks.

Figure 155, scale 1:3,500: Bivouac area of an infantry company, approximately 225 men.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 156.—Bivouac 3d Battalion. (See fig. 153.)

Figure 156, scale 1:3,000: Bivouac area of an infantry battalion.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

50. Type of unit.



FIGURE 157.—Power shovel.



FIGURE 158.—Light tank.

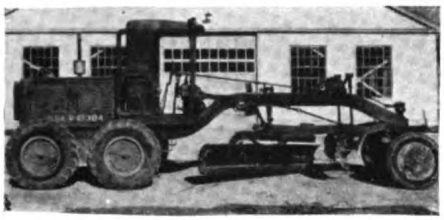


FIGURE 159.—Road grader.



FIGURE 160.—Truck, ¼-ton.



FIGURE 161.—Bulldozer on trailer.

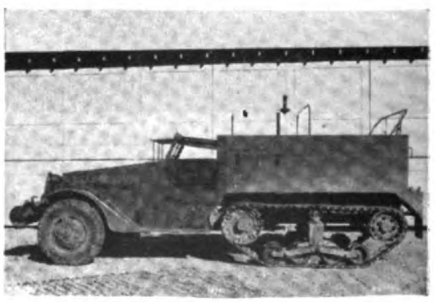
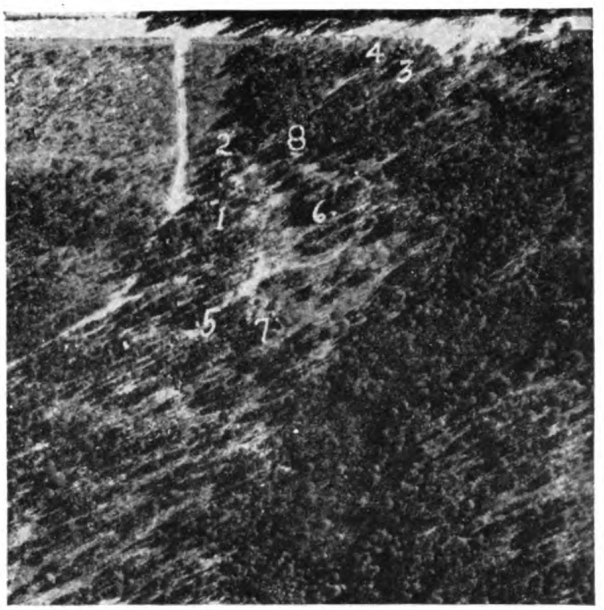


FIGURE 162.—Half-track car.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



1. Two trucks with trailers loaded with lumber.
2. Two 2½-ton trucks with ½-ton trailers.
3. Earth auger.
4. Motorized road grader.
5. 2½-ton truck.
6. Command car.
7. 2½-ton truck with ½-ton trailer.
8. ½-ton pick-up.

FIGURE 163.—Engineer bivouac. Stereo pair with figure 166.



1. Tank tracks.
2. Light tank in woods.
3. 2½-ton truck.
4. Scout car or half-track.
5. Bantam car.
6. Command car.
7. Civilian car.



FIGURE 164.—Ground view. (See fig. 165 for direction of photograph.)

FIGURE 165.—Armored force bivouac. Stereo pair with figure 167.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

Figures 163 and 166, scale 1:4,000: Stereo pair of an engineer bivouac. The kind of equipment is the key to the identification of the unit and the amount gives a fair estimate of the size. In this case a battalion of a corps combat engineer regiment is bivouacked in the area.

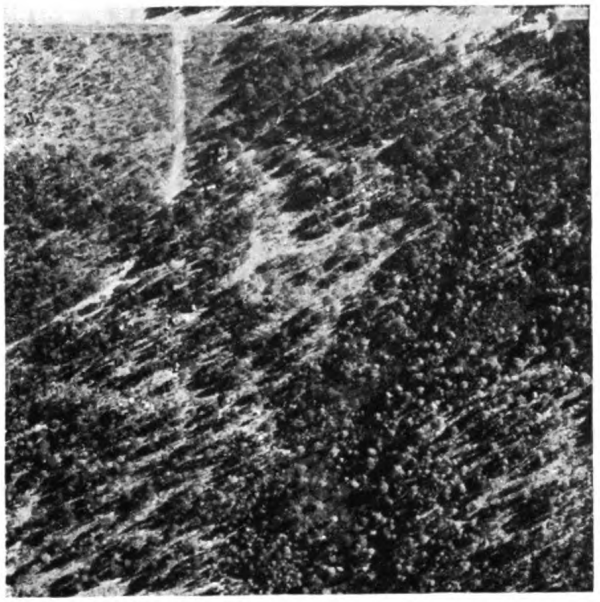


FIGURE 166.—Engineer bivouac. Stereo pair with figure 163.

Figures 165 and 167, scale 1:6,000: Stereo pair of an armored force bivouac. Identification is made from the many tracks in the area covered by the stereo pair. The tracks showing short turning radii and deeply gouged turns are peculiar to track-laying vehicles such as tanks and half-tracks. A close study of the stereo pair and the low-altitude photograph, figure 168, will show tanks, scout cars, half-tracks, and trucks bivouacked in the woods. In many cases tracks can be followed into the woods which lead directly to vehicles. Three companies of a reconnaissance battalion armored division are bivouacked in the area covered by the stereo pair. A ground view of the edge of the bivouac is shown in figure 164.

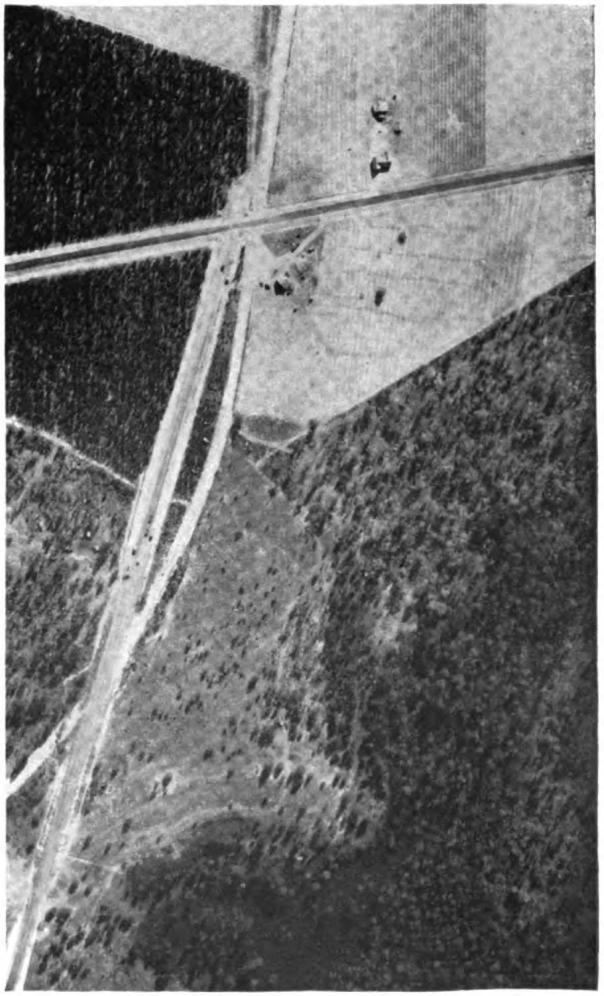


FIGURE 167.—Armored force bivouac. Stereo pair with figure 165.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

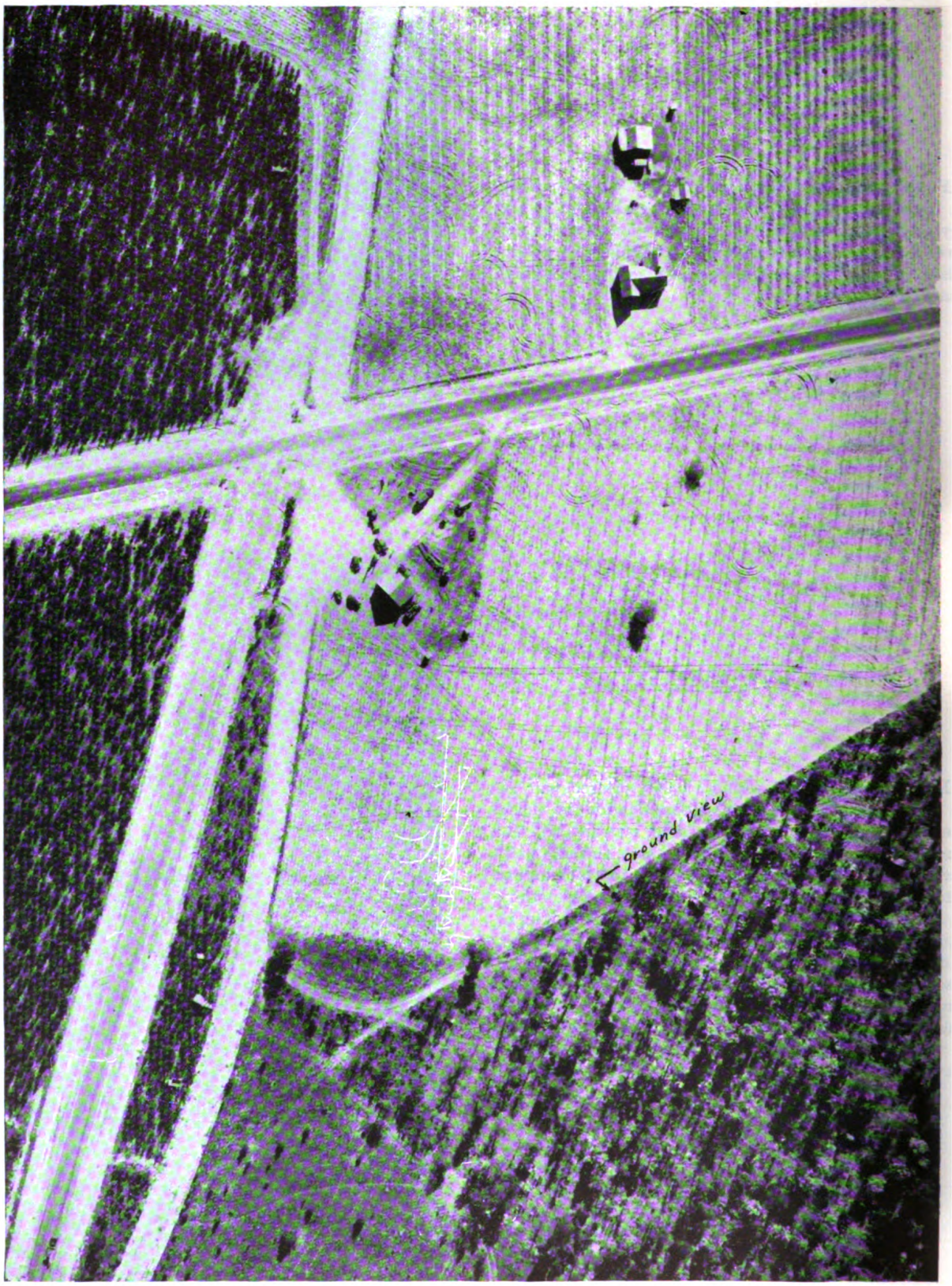
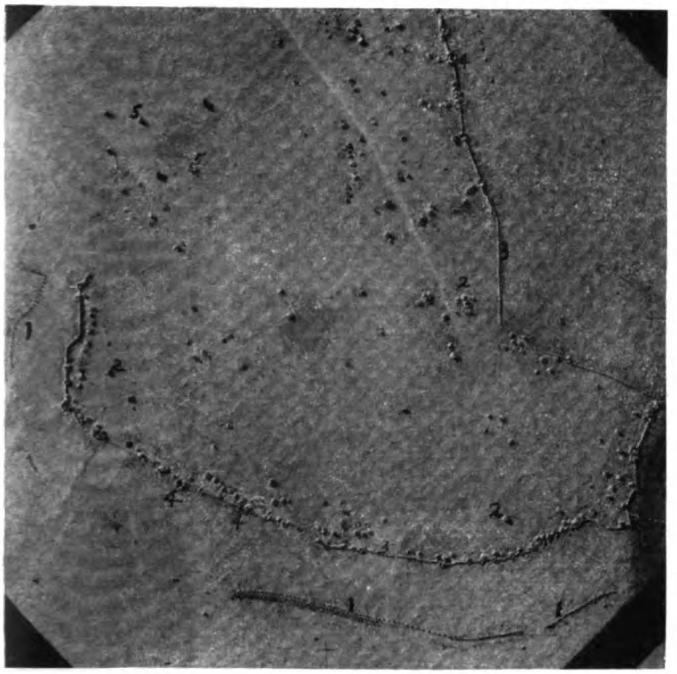


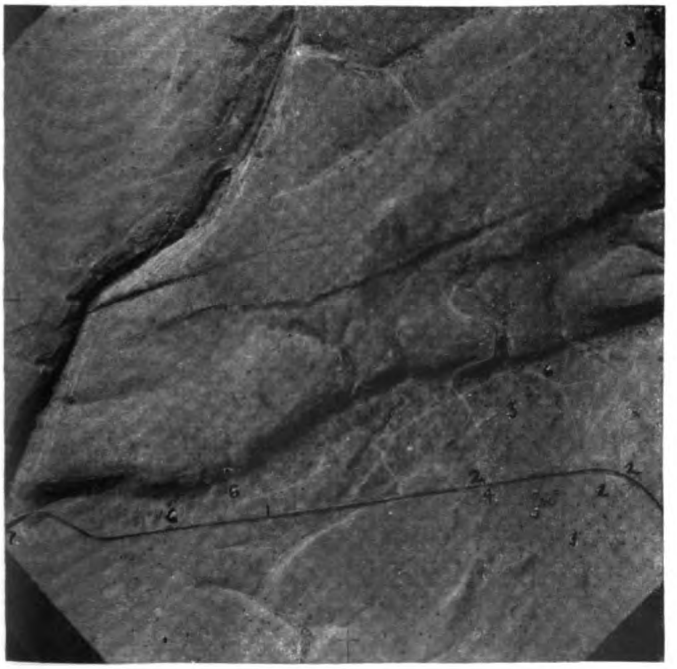
FIGURE 168.—Scale 1:2,000: Bivouac area of an armored force reconnaissance unit. Tracks identify and locate the unit. Same area covered in stereo pair figures 165 and 167.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



1. Antitank obstacles.
2. Stone shelters.
3. 4-foot stone fence.
4. Antitank guns.
5. Parked trucks.

FIGURE 169.—Scale 1:6,000: Camp in desert country. Protection from aerial attack is obtained by building stone shelters. The camp is protected against mechanized attack by antitank obstacles and by guns mounted along the wall surrounding the camp.



1. Tar road.
2. Telephone line.
3. Parked trucks.
4. Road junction.
5. Bomb shelters.
6. Slit trenches.
7. Bridge.

FIGURE 170.—Scale 1:15,000: Bivouac in desert country. Not much concealment is possible. Protection is obtained by dispersion.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

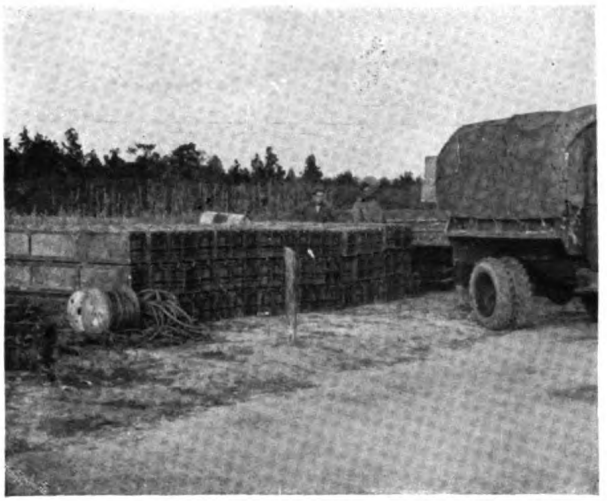


FIGURE 171.—Footbridge equipment.

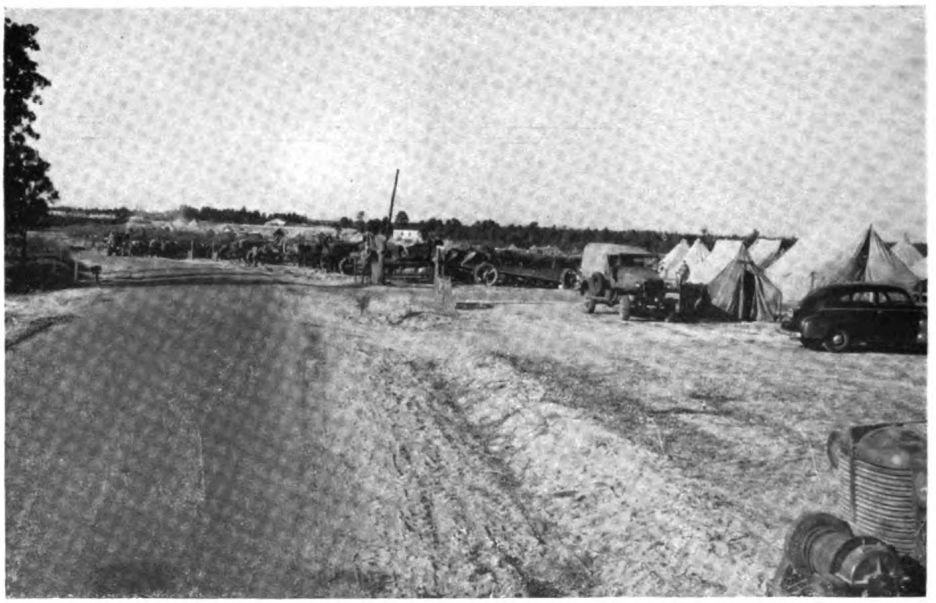


FIGURE 172.—Ground view of figure 175.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

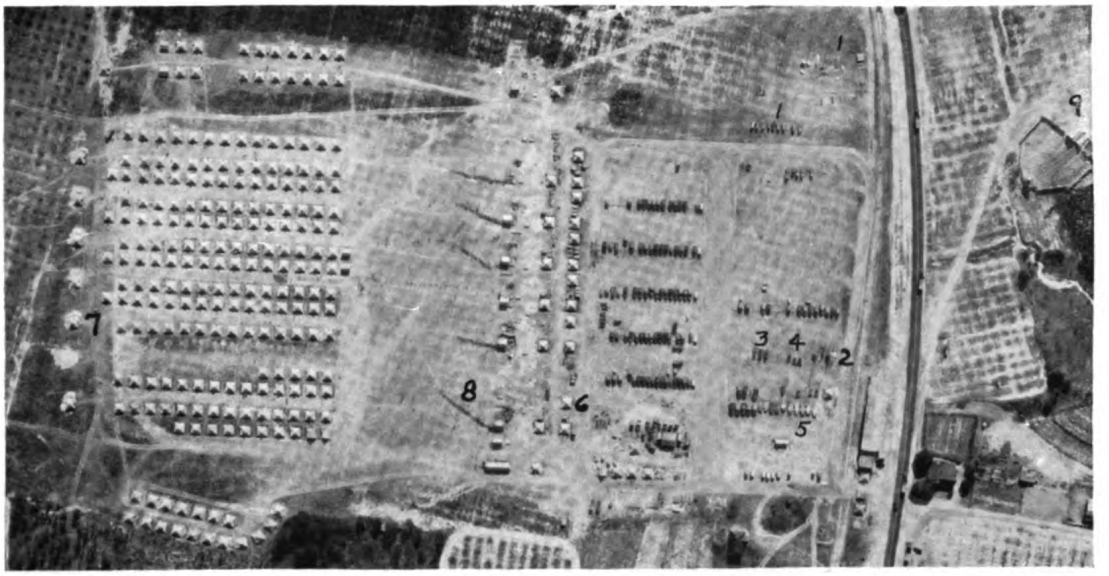


FIGURE 173.—Engineer combat regiment.

Figure 173, scale 1:5,000: Photograph of a base camp. Type of unit is indicated by its equipment. The bulldozers, power shovels, footbridge equipment, air compressors, etc., identify it as an engineer unit. The six mess kitchens and six latrines indicate that it is probably a regiment. A study of the Tables of Organization for engineer units further shows that the unit is an engineer combat regiment less one company. The engineer general service regiment is somewhat similar to the combat regiment in organization, equipment, and operations.

Key to figures 173 and 174

1. Footbridge equipment.
2. Power shovel.
3. Air compressor.
4. Bulldozer.
5. Trailer.
6. Mess tent.
7. Latrine.
8. Men in mess line.
9. Outdoor theater.



FIGURE 174.—Ground view of figure 173.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

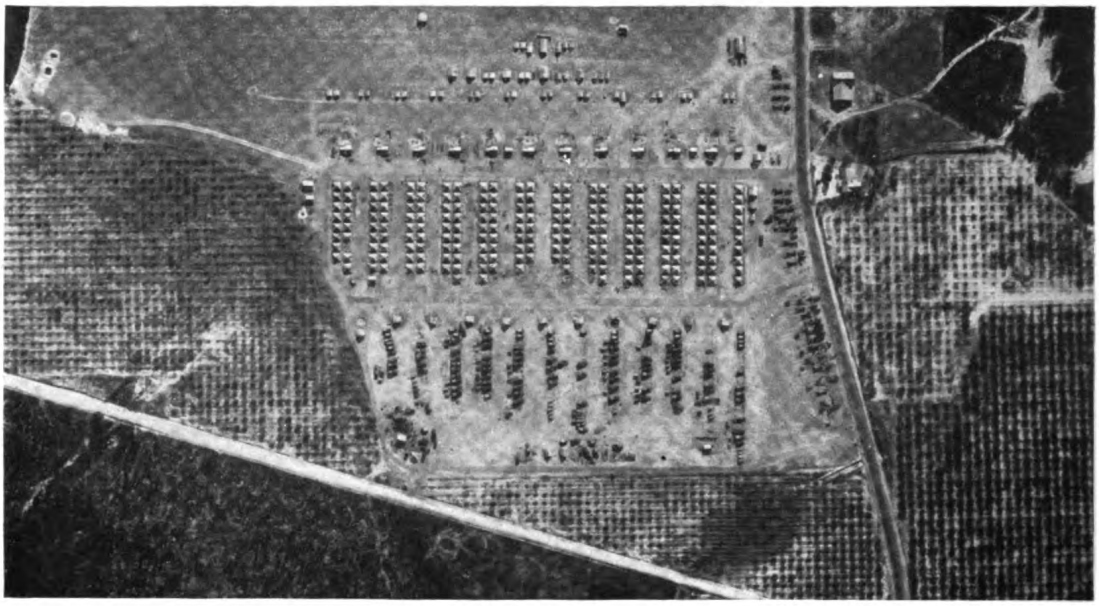


FIGURE 175.—Field artillery regiment.

Figure 175, scale 1:5,500: Base camp of a field artillery regiment. The identification is determined from the guns (155-mm G. P. F.) and tractors. The arrangement of tents indicates 12 batteries.

51. Length of occupation.—The interpreter can, in some cases, make an estimation of the length of time a bivouac has been occupied. Constant study of bivouacs of our own forces is the best means of becoming proficient in this estimation. The significant features in the study of length of occupation are:

(1) Tracks, paths, and roads compared with terrain in the vicinity unoccupied by military forces.
(2) Excavation or fortifications existing within the occupied area.
(3) Differences in general texture of earth in vicinity.

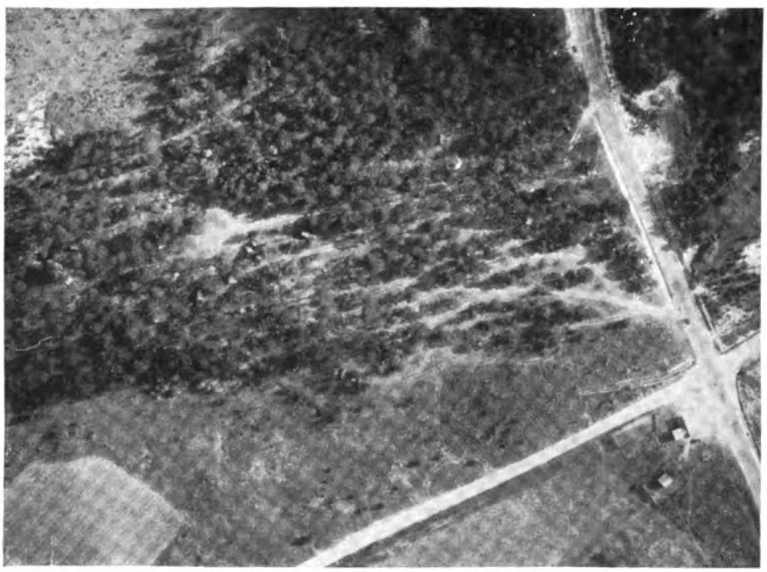


FIGURE 176.—Scale 1:4,000: Bivouac area of a rear echelon which has been occupied for a month.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

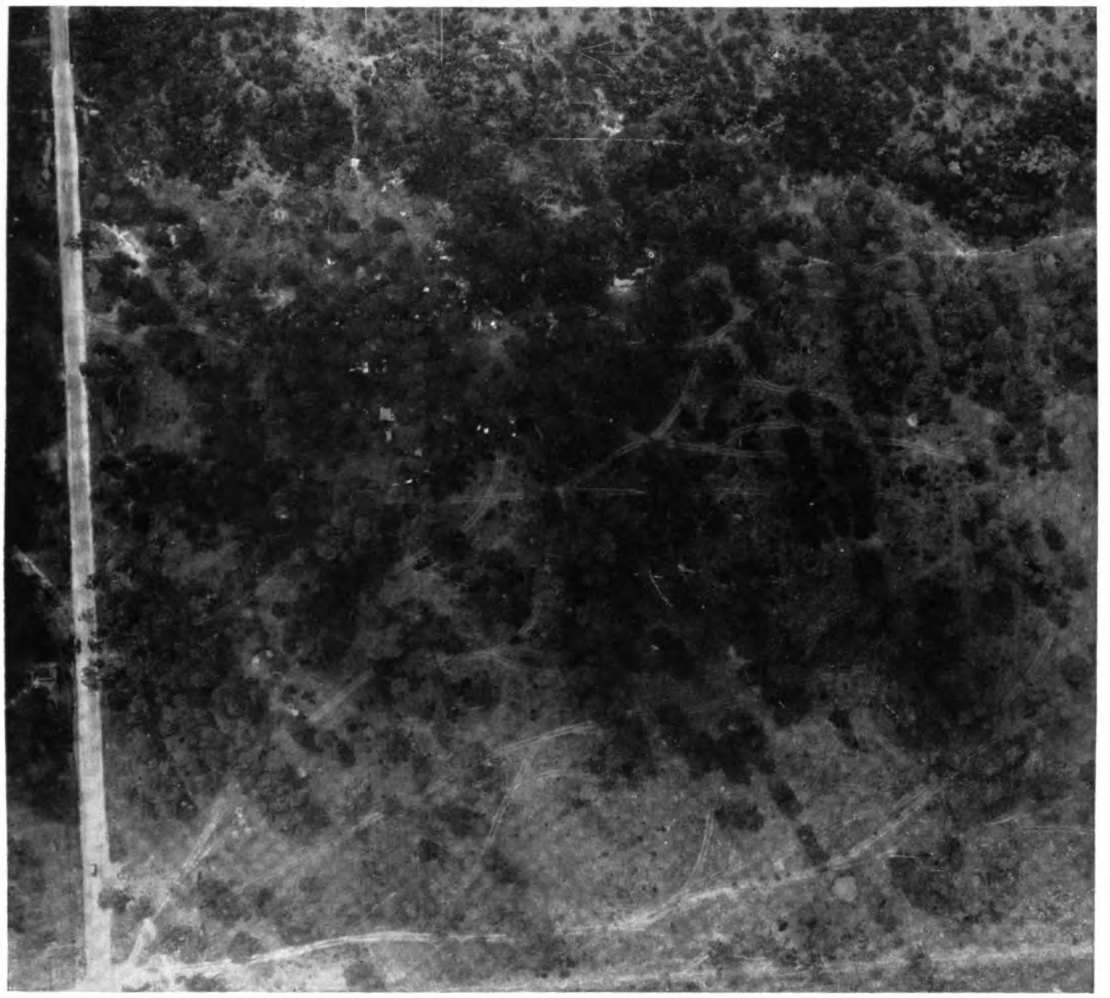


FIGURE 177.—Scale 1:3,200: Bivouac area showing signs of long occupation.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

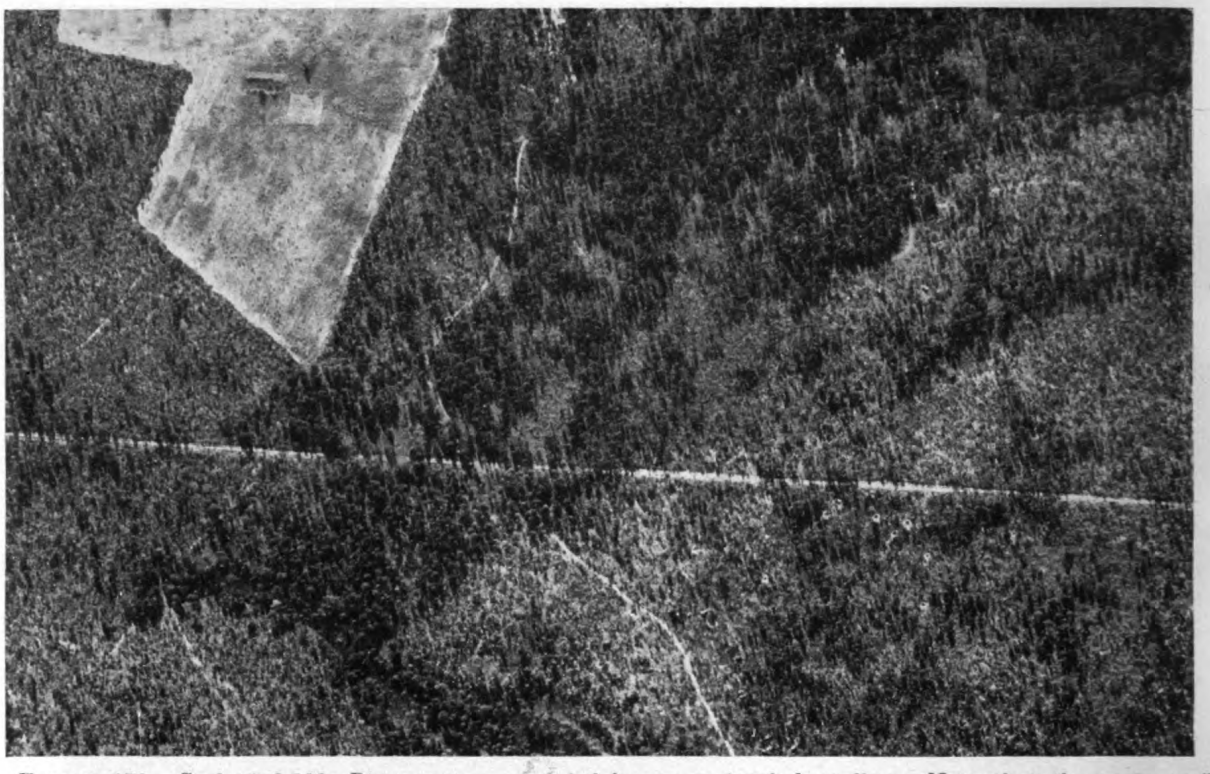


FIGURE 178.—Scale 1:6,000: Bivouac area occupied by an antitank battalion. Note that the main trails are visible and signs of activity such as trucks, latrines, and garbage pits are evident.

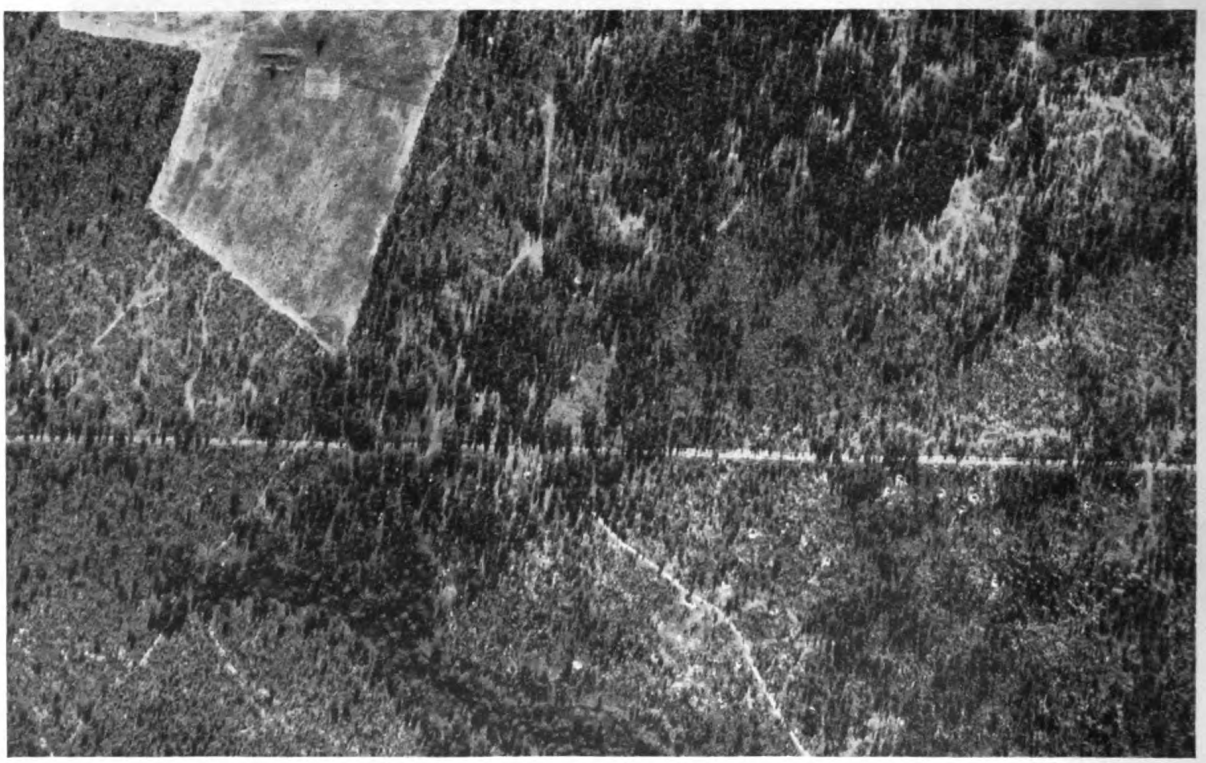


FIGURE 179.—Scale 1:6,000: Same area as in figure 178 but taken 11 days later. Notice how new trails and tracks crisscross through the woods. The scarring of the ground caused by vehicles and the general "trashy" appearance of an area give the interpreter an idea of the length of occupation.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

SECTION V

TROOP MOVEMENTS

Paragraph
Value of photographs of troop movements 52
Identification of units 53
Motorized units 54
Horse and foot movements 55

52. Value of photographs of troop movements.—*a. Identification of unit.*—Though a unit may be miles from where it is photographed by the time the information gets to higher headquarters the knowledge that a certain type of force is moving at a certain speed in a certain direction still remains valuable information. All interpretation of movements on the road must be first phase interpretation at the photographic laboratory, and may be made entirely from negatives.

b. Time element.—An interval of 2 to 4 hours or longer may elapse between the photographing of a moving unit and the time the interpreted data reach higher headquarters. In 2 to 4 hours units may cover distances as shown in the following table:

Troop unit	Miles per hour slowest vehicle in column travels	Miles column has probably traveled		
		2 hours	3 hours	4 hours
Men marching	2½	5	7. 5	10
Field artillery, animal	3½	7	10. 5	14
Cavalry (horse)	6	12	18	24
Motors	10	20	30	40
Motors	35	70	105	140

c. Aid to future identification.—Photographs of troop movements are also of value to interpreters at the ground force headquarters for use in identifying equipment. Equipment on an open road is in the best location for study from an aerial photograph. By comparison, the same equipment may be identified in a later photograph in which the equipment is half hidden in woods.

53. Identification of units.—*a. Importance.*—Units, like vehicles, are much easier to identify on the road than in bivouac. If a unit can be photographed on the road and later photographed or observed going into bivouac, the interpreter's problem is greatly reduced. The aerial observer may report the photographing of a column at a certain time and location, and this information may be radioed direct from airplane to headquarters, but information as to the size and type of force may not be available until the interpreter has had time to view the negatives or perhaps the prints.

b. Means.—Weapons on towed or self-propelled mounts and distinctive vehicles or mobile equipment are the only means of identifying a unit on the road. When the identifying features cannot be distinguished, as is common to extremely small-scale photographs, the speed of travel may be some indication as to the type of unit. Speed is determined from the time interval and the distance a vehicle has traveled between successive photographs.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 180.—Low oblique of horse cavalry detraining. A high vertical would show the characteristic chutes. An established civilian stock loading pen is in the center of the picture. At the extreme left are portés used for rapid transportation of cavalry on highways.

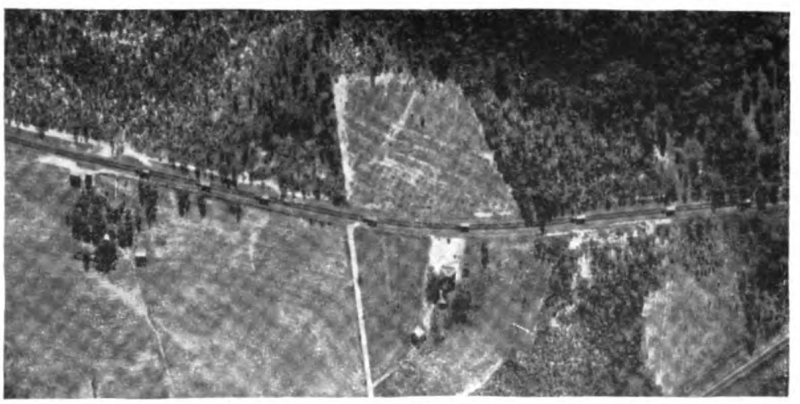
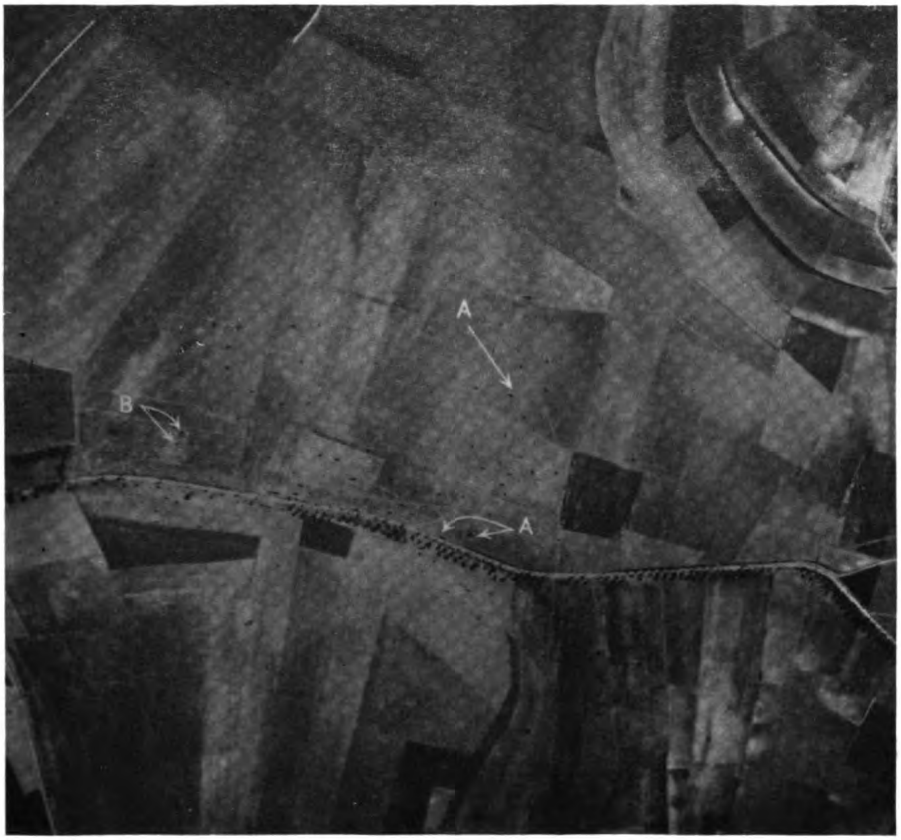


FIGURE 181.—Scale 1:6,000: Cavalry portés on the road. Horses are transported by truck to the close vicinity of their proposed area of operation.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA.

54. Motorized units.



A. Antitank guns. B. Bomb craters.

FIGURE 182.—Scale 1:13,000: Motorized column at the halt. Protection is obtained from aerial attack by dispersion. Note the amount of concealment obtained by taking advantage of the dark patches in the fields.



FIGURE 183.—Medium tank.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

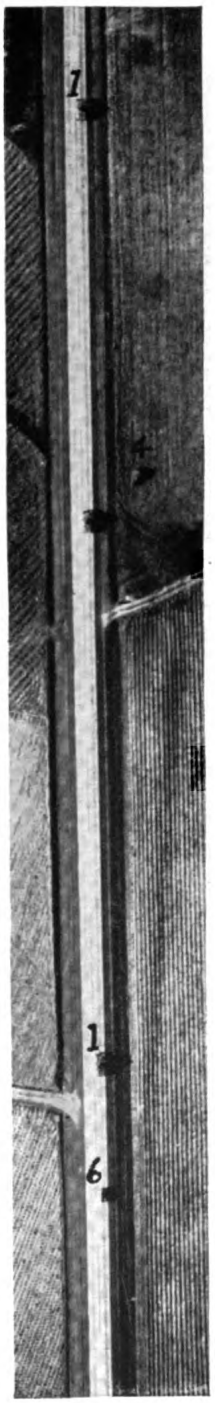


FIGURE 184.



FIGURE 185.



FIGURE 186.

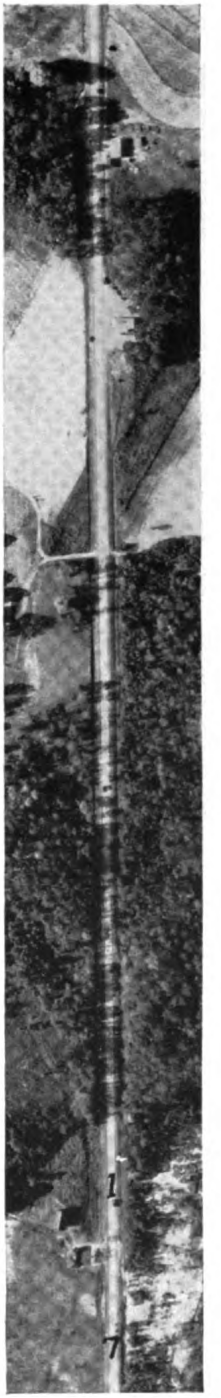


FIGURE 187.

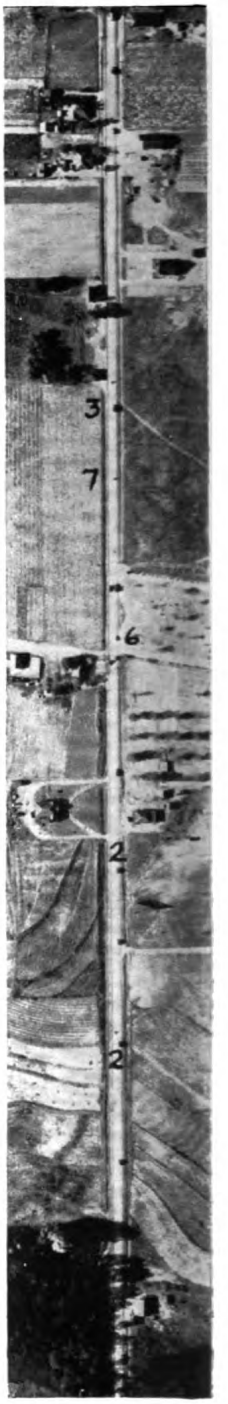


FIGURE 188.

1. Medium tank.
2. Light tank.
3. Car, half-track.
4. Command car.
5. 2½-ton truck.
6. Car, bantam.
7. Motorcycle.
8. Civilian car.

Figure 184, scale 1:2,000; figures 185, 186, 187, and 188, scale 1:6,000: A column of armored force vehicles on the road. The many types of vehicles indicate that it is a large unit reorganizing.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

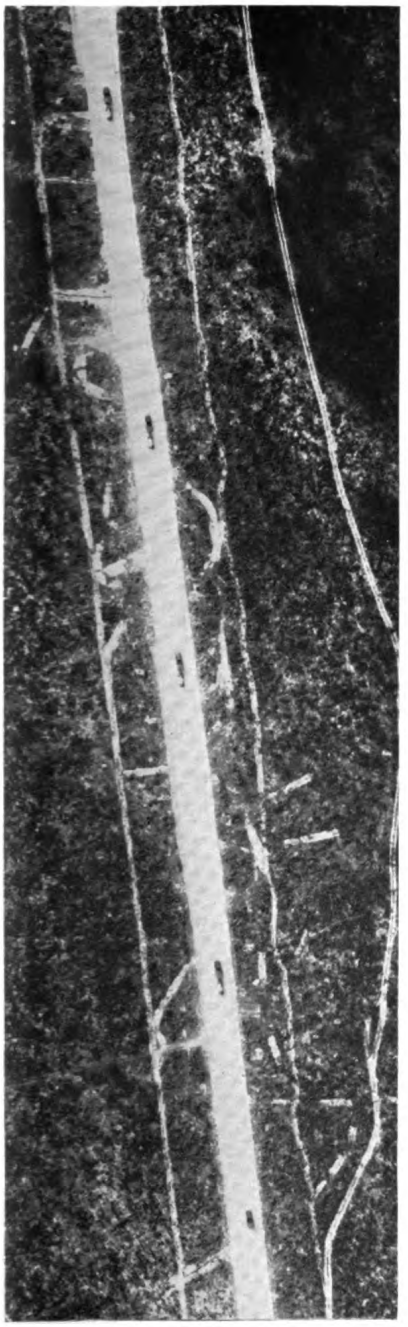


FIGURE 189.—Scale 1:3,000: Battery of 3-inch antiaircraft artillery on the road. The identification and size of the unit are determined from its equipment. The four antiaircraft guns constitute one battery. Note in figure 191 close-up view of truck and gun.



FIGURE 190.—75-mm guns.



FIGURE 191.—3-inch antiaircraft gun.

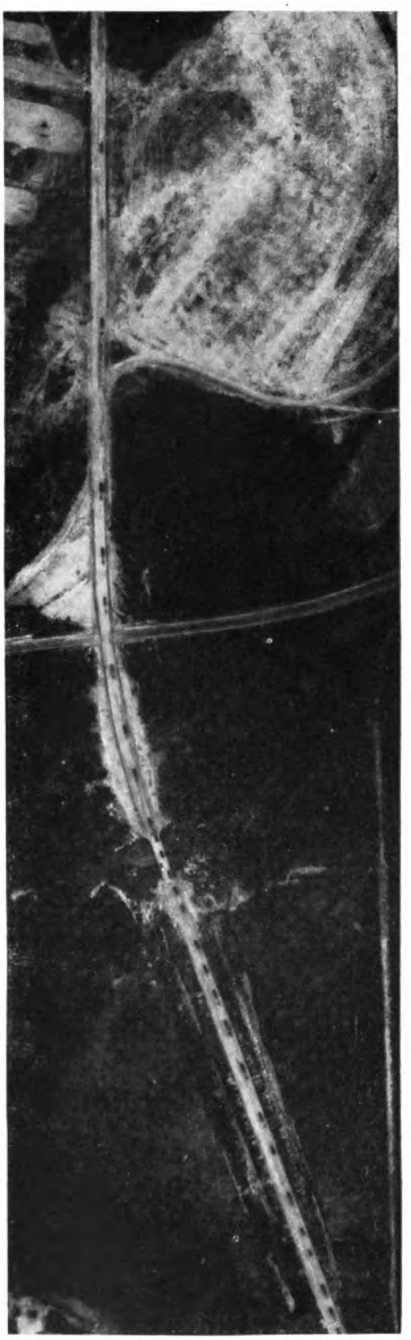


FIGURE 192.—Scale 1:5,000: Column of field artillery on the road. Two batteries of 75-mm guns and their accompanying trucks are shown. Figure 190, scale 1:2,500 is a closer view of a 75-mm gun battery on the road.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 193.—75-mm gun.

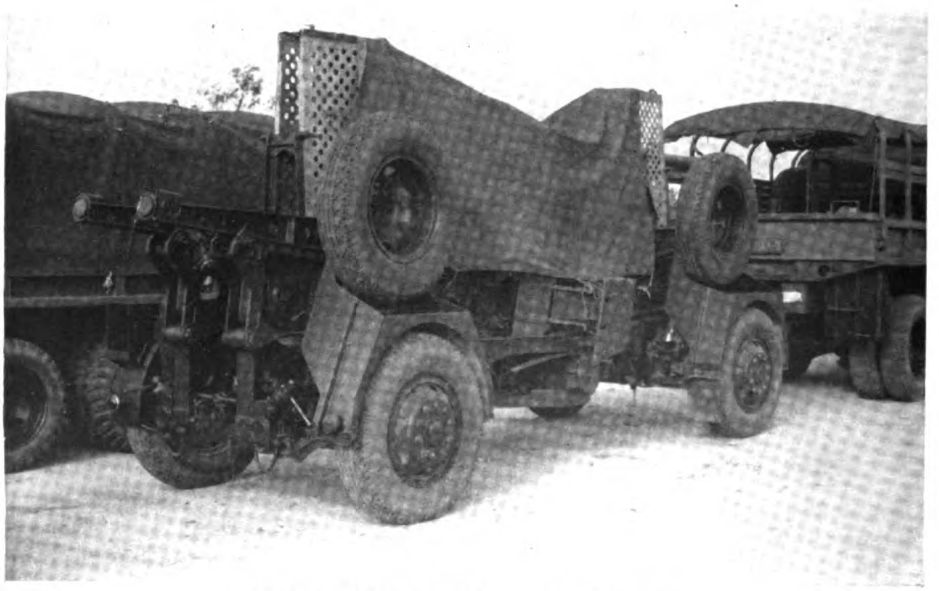


FIGURE 194.—3-inch antiaircraft gun.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

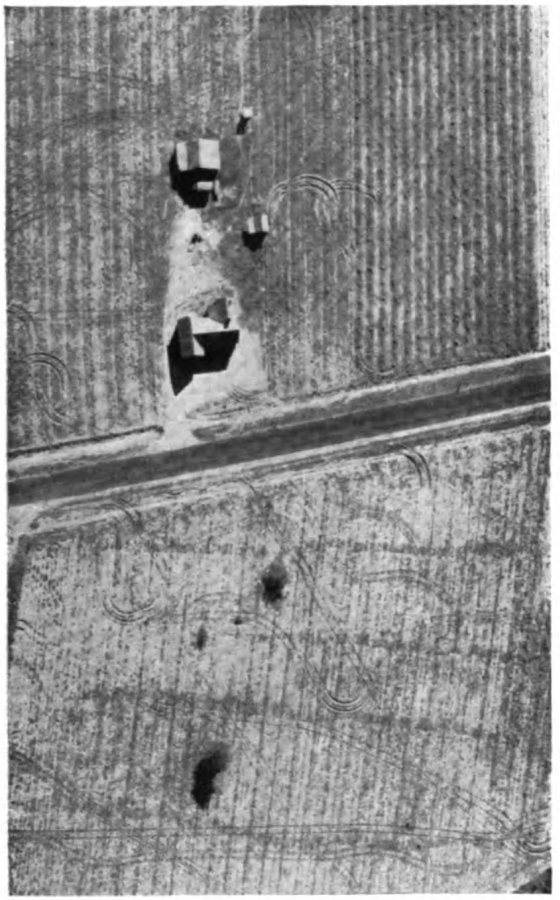


FIGURE 195.—Scale 1:2,000: Photograph showing tank tracks. Note the sharp turning radii and the deeply gouged turns caused by braking one track. Tank tracks are usually more wavy than those of trucks.



FIGURE 196.—Scale 1:2,000: This photograph shows truck tracks. Note that the turning radii are larger and more even than those of tanks, and also the tracks are not as deeply cut. These differences can usually be seen on photographs of any scale.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

55. Horse and foot movements.



FIGURE 197.—Scale 1:5,000: Infantry marching along a road in woods. In the lower part where troops are marching in columns, their numbers can be estimated easily. In the top of the picture the troops are scattered along the road, making them hard to detect and impossible to estimate.

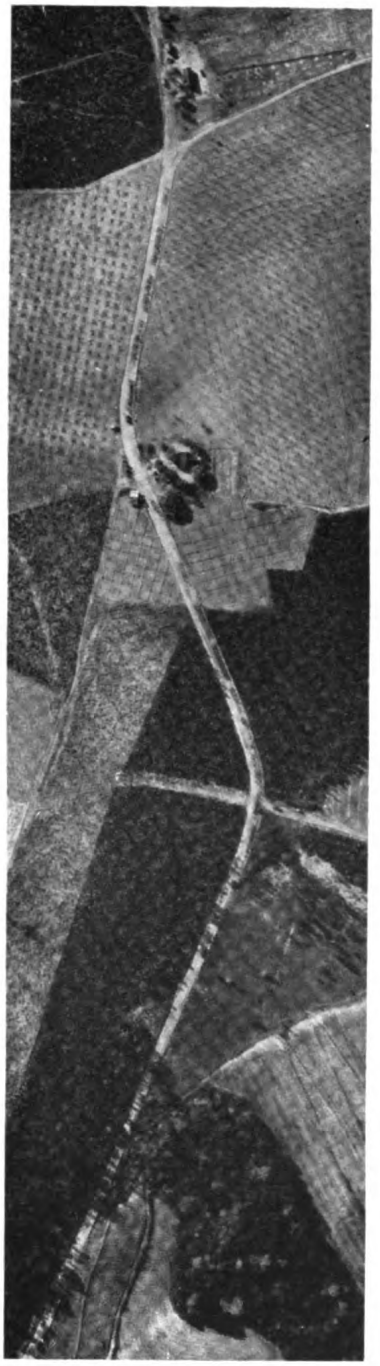


FIGURE 198.—Scale 1:5,000: Infantry marching along a road. When marching in this manner along a smooth road or field the number and size of the unit can be estimated quickly.

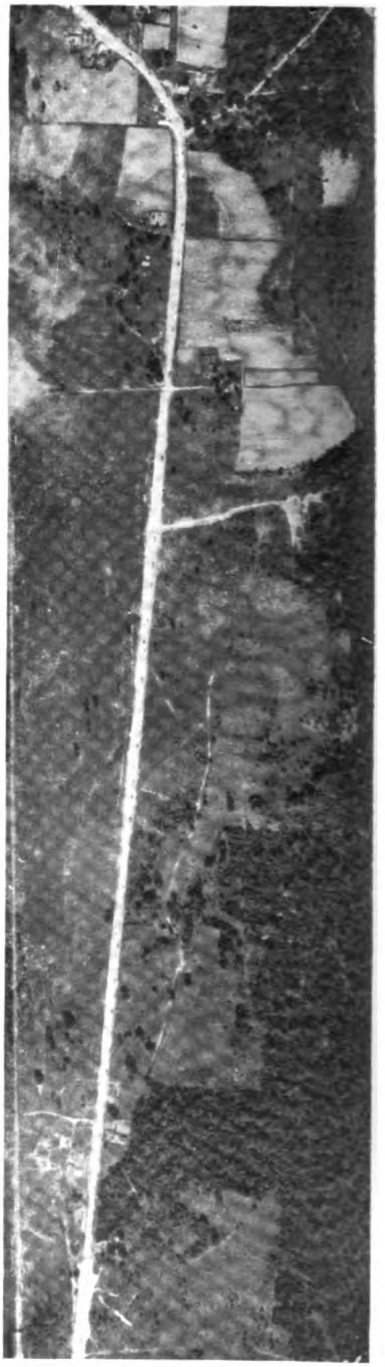


FIGURE 199.—Scale 1:11,000: Motorized troop convoy.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 200.—Scale 1:3,700: Battery of horse-drawn field artillery consisting of four 75-mm howitzers (note the short barrels) and five caissons. This is the organic artillery of a cavalry division.



FIGURE 201.—Scale 1:3,700: Cavalry troop marching along road. Photograph taken at noon when the effect of shadow was at the minimum.

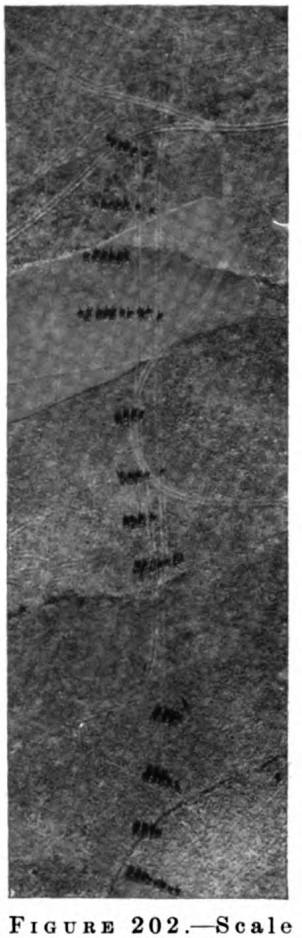


FIGURE 202.—Scale 1:2,500: Machine-gun troop advancing across open ground. Notice how the shadow shows the general outline of horse and man.



FIGURE 203.—Machine-gun troops.



FIGURE 204.—Machine-gun troops.



FIGURE 205.—75-mm guns and howitzers.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

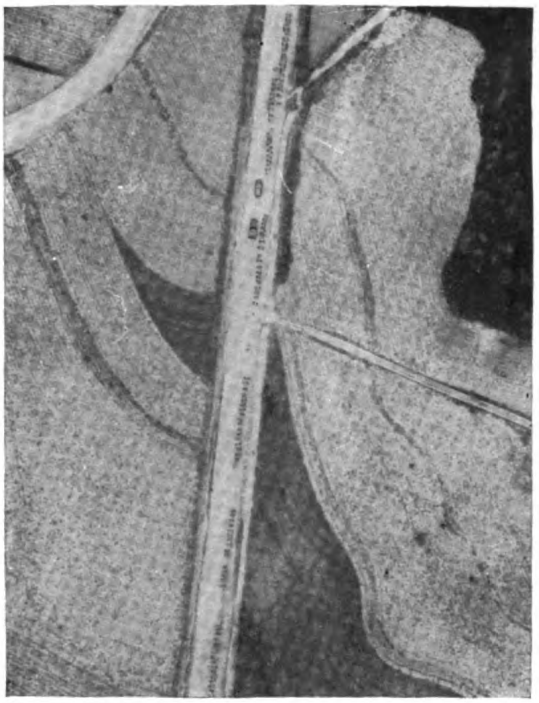


FIGURE 206.

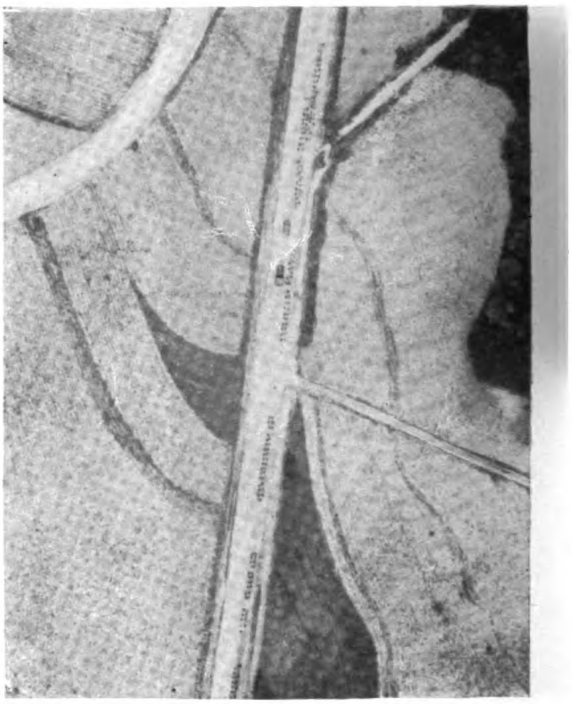


FIGURE 207.

Figures 206 and 207, scale 1:2,000: Men marching on road. The direction in which they are marching can be determined easily from an aerial photograph if a strip or stereo pair is taken and the distance and direction any man or group of men have progressed is noted from the photographs.

SECTION VI

SUPPLY INSTALLATIONS

Paragraph
Railheads and dumps 56
Water points 57

56. Railheads and dumps.—*a. Railheads.*—Points where supplies are transferred from rail to another type of transportation are called railheads. A railhead may be established for any or all classes of supplies. The essential facilities of a railhead are sidings for unloading of supplies, a road net adjacent thereto suitable for operation of motorized trains, and storage space for such reserves as may be maintained. When supplies are stored, the railhead may also be called a dump. Railheads are generally found in small towns and cities where sidings and storage space already exist. Where possible, an attempt is made to select a site for a railhead that affords the best existing protection and concealment; this may be supplemented by camouflage, antiaircraft, or other defensive means.

b. Dumps.—Dumps are temporary stocks of military supplies. Generally, a dump will contain only one class of supplies and will vary from large facilities in rear areas to small piles of supplies in forward areas. Different classes of supplies will often have characteristic arrangements for storage; for example, an ammunition dump will be dispersed and away from other activities. When supplies are issued from dumps, they become distributing points.

c. Identification.—(1) Railheads in towns are identified by existing traffic and signs of abnormal activity. In the theater of operations civilian activity decreases appreciably.

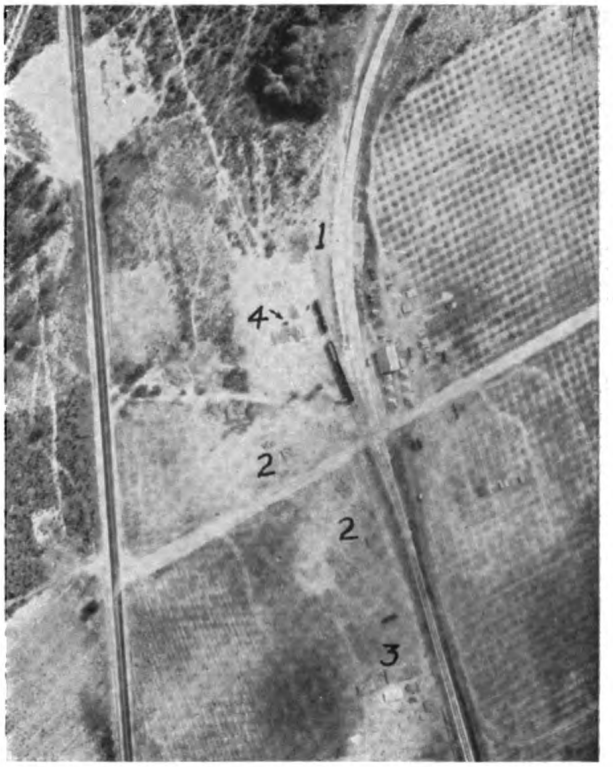
(2) Dumps, though well concealed, are usually identified by tracks and new roads. It is difficult to conceal the evidence of heavy traffic.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 208.—Portable pump and 5-gallon cans.



1. Flat top over tank car.
2. 5-gallon gasoline cans.
3. 50-gallon oil and gasoline drums.
4. Portable gasoline pump.

FIGURE 209.—Railhead. Stereo pair with figure 215.

Figure 209, scale 1:5,500: Stereo pair with figure 215, showing an army railhead for gasoline and oil. A flat top over a siding is under construction. With sufficient flat tops to cover the siding it would still be impossible to conceal the identity of this railhead as the terrain is too open. In active operations railheads should be looked for in woods where camouflaging is more effective.



FIGURE 210.—Scale 1:6,000: Class I railhead. In railhead distribution, the ration components are segregated into regimental lots, and regimental trucks are loaded as they arrive in accordance with a time schedule published by the division. In this photograph the existing rail facilities of a small town are being utilized. Note the truck turn-around at the top of the photograph.

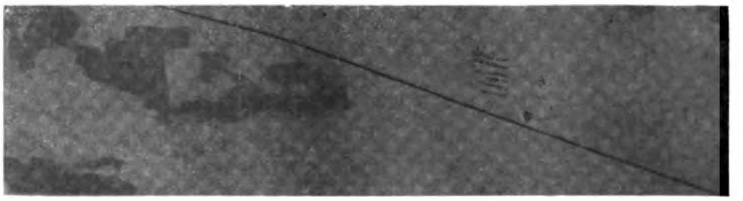
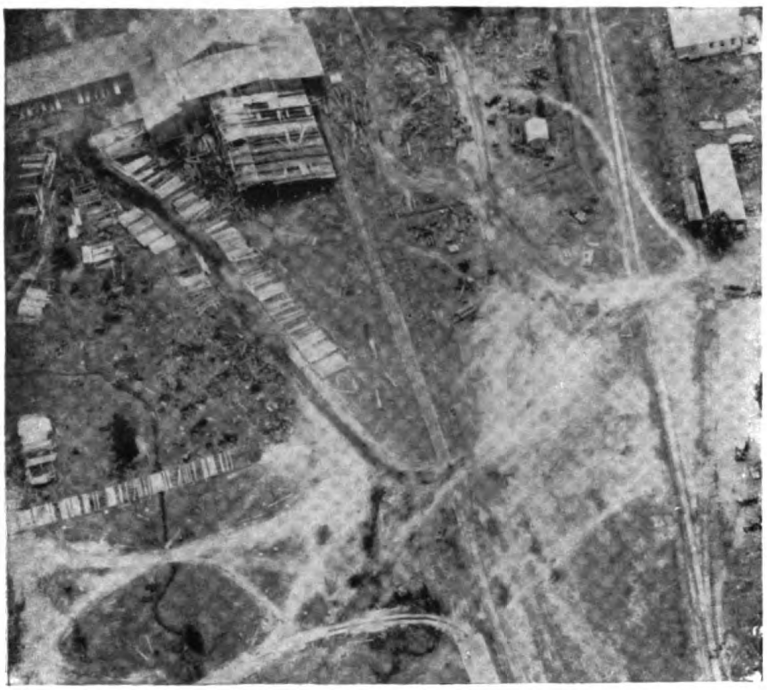


FIGURE 211.—Small dump along a desert road. A dump of this nature could be camouflaged effectively by harmonizing the camouflage with the ground pattern.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



Low oblique of lumber mill with railroad siding. If used as a railhead, its littered surroundings conceal a large amount of equipment and supplies. A close study of the photograph will reveal six large lumber trailers and eleven cars or trucks scattered throughout the mill. From a higher vertical it would be impossible to identify any of this equipment.

FIGURE 212.—Lumber mill.

Low oblique of railhead used for unloading engineer equipment and supplies. Operations are in the open with no attempt to conceal their size or nature.

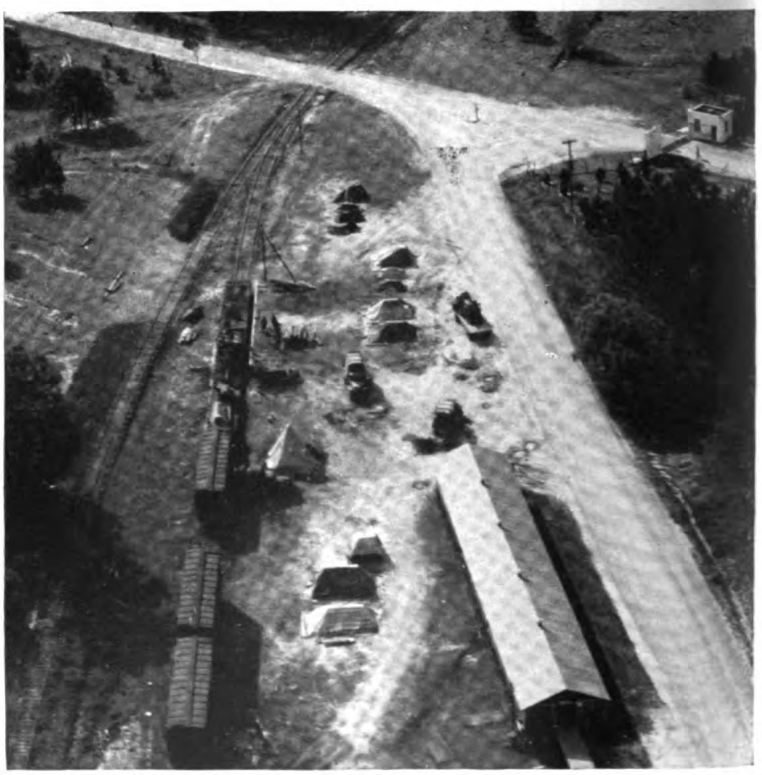


FIGURE 213.—Engineer railhead.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

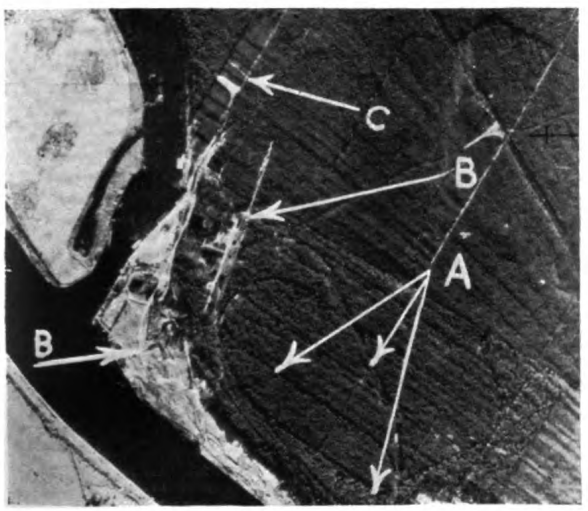


FIGURE 214.

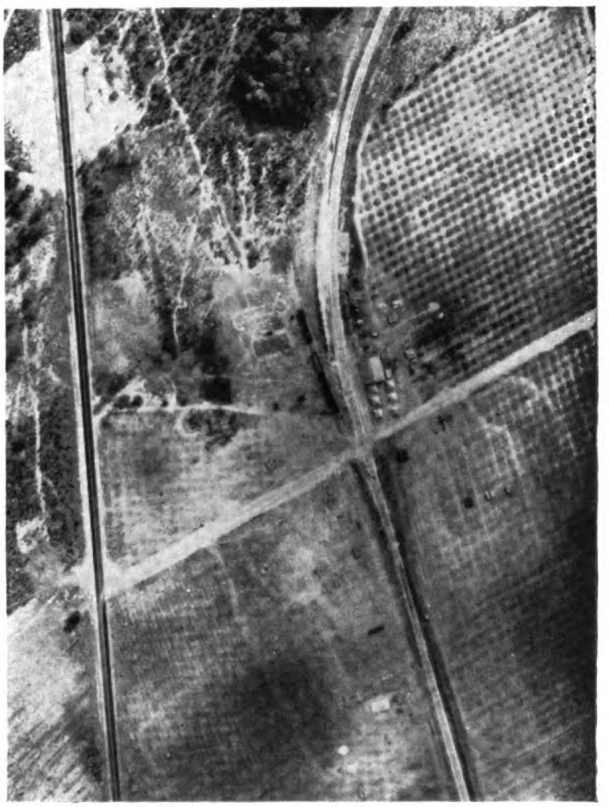


FIGURE 215.—Railhead. Stereo pair with figure 209.

Figure 214, scale 1:23,000: Large ammunition dump in rear area. Supplies moved from docks by light railways, A, are stored in the woods. Note long, sweeping turns in woods which indicate railways rather than roads. B shows new sidings being constructed. C shows clearing in woods with suspicious smooth texture which indicates a camouflaged area.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 216.

Figure 216, scale 1:10,000: Engineer dump located below a coal hump. The material consists principally of lumber of assorted lengths.

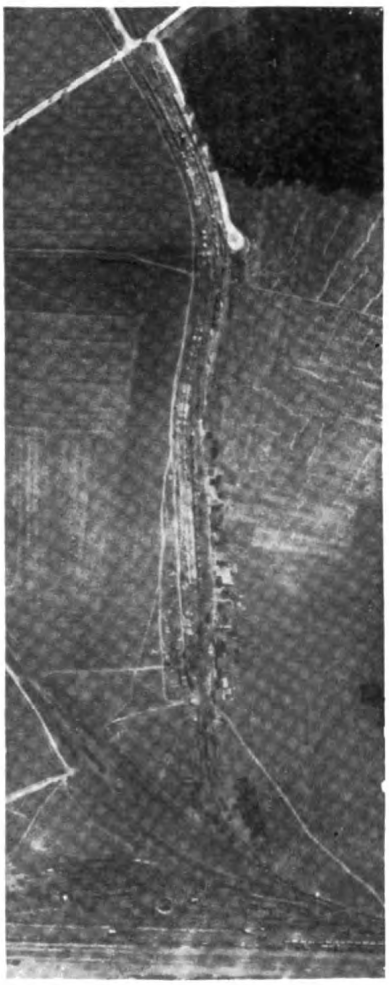


FIGURE 217.

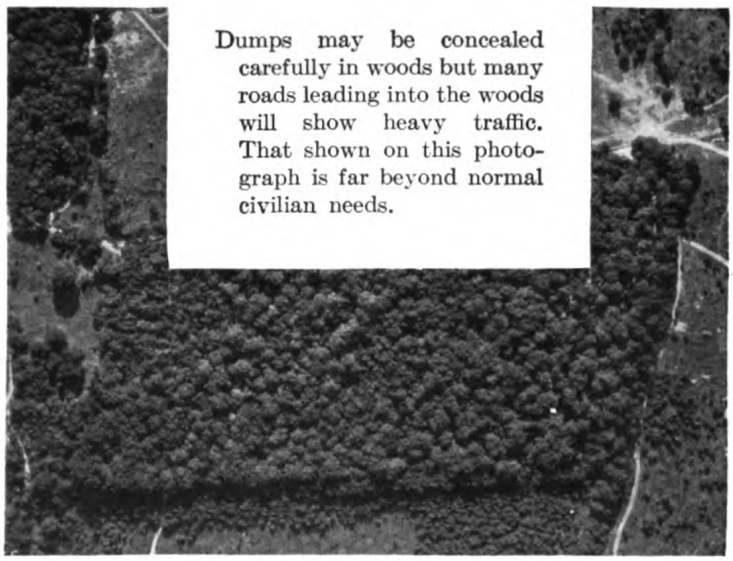
Figure 217: Large railhead and dump in rear area. This is a photograph taken during the first World War, when camouflage and dispersion were not as essential as they are today. Note the truck turn-around, road network, and railroad turntable. The grain harvest continues in the vicinity.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 218.—Engineer supplies along standard-gage railroad. Camouflage of entire spur at extreme bottom would have been easy.



Dumps may be concealed carefully in woods but many roads leading into the woods will show heavy traffic. That shown on this photograph is far beyond normal civilian needs.

FIGURE 219.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

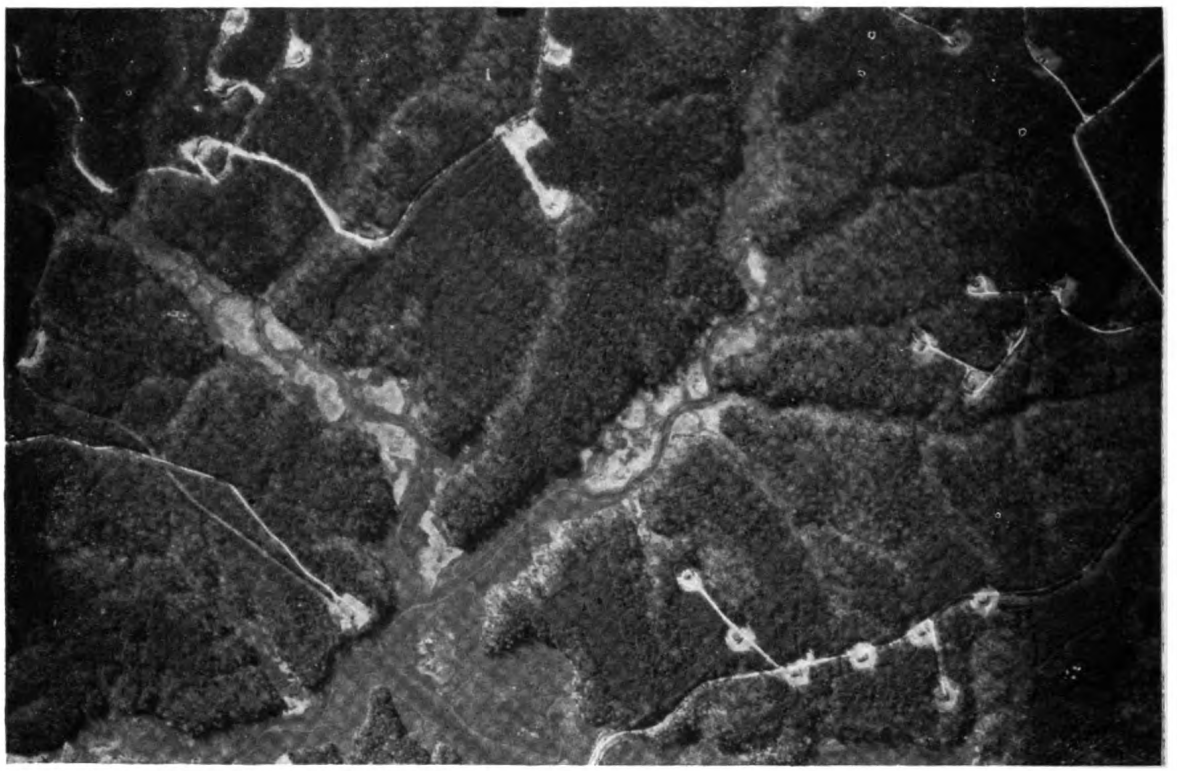


FIGURE 220.—Ammunition storage in the zone of interior is generally widely dispersed though not camouflaged. From the photograph it will be noticed that there is no pattern or means of identification except the roads, loops, and storage compartments. In the theater of operations, ammunition dumps are both dispersed and camouflaged.

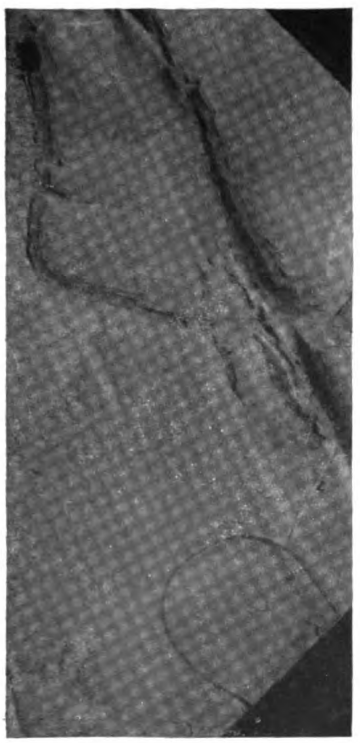
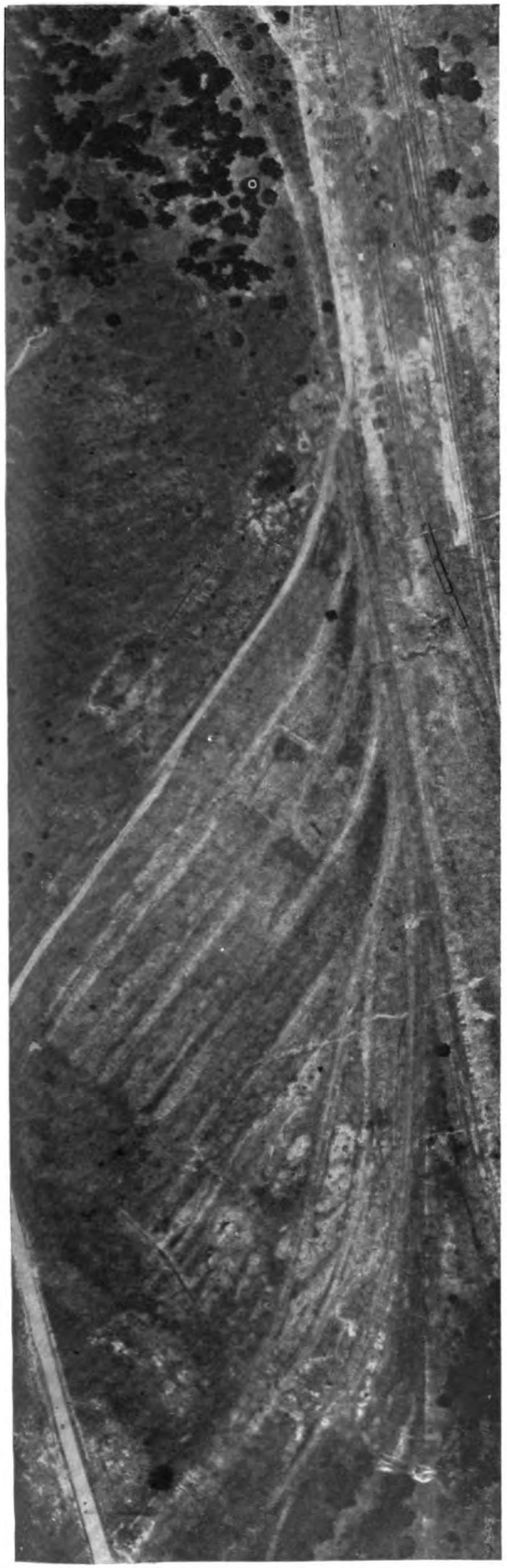


FIGURE 221.—Scale 1:15,000: A desert ammunition dump, well dispersed. Dumps are 150 to 200 feet apart, 1½ to 3 feet high, and about 20 feet in diameter. Dumps dispersed in this manner are not profitable targets for air bombardment, but they should be located and recorded for other troops.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



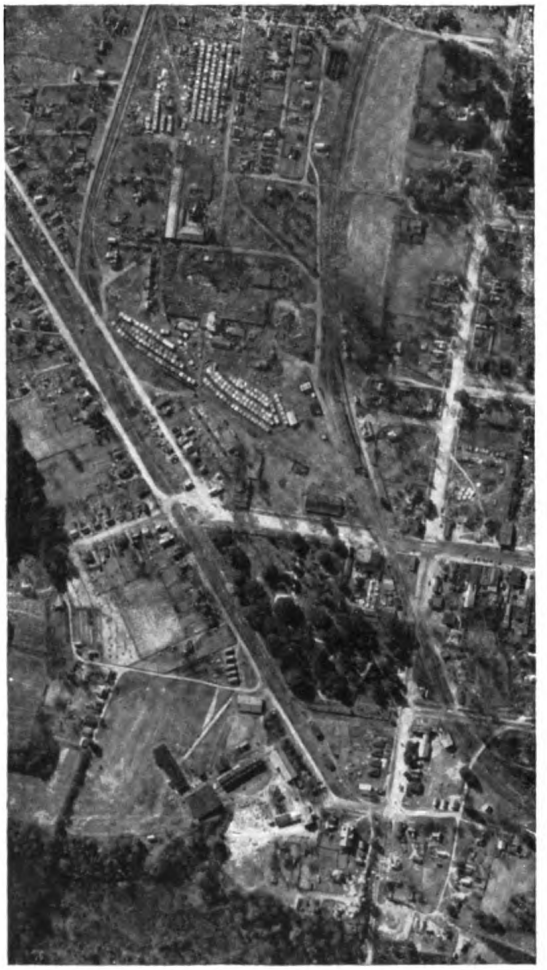


FIGURE 223.—Scale 1:10,000: Civilian lumber mill. Any civilian activity using outside storage near a railroad is easily confused with a railhead. The arrangement here is too neat and close together to be a military supply activity.

FIGURE 222.—Left, scale 1:3,000. This night photograph shows an abandoned railroad yard formerly used by a lumber mill. Vegetation is growing over the old road beds. New construction would appear white where excavation had started.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

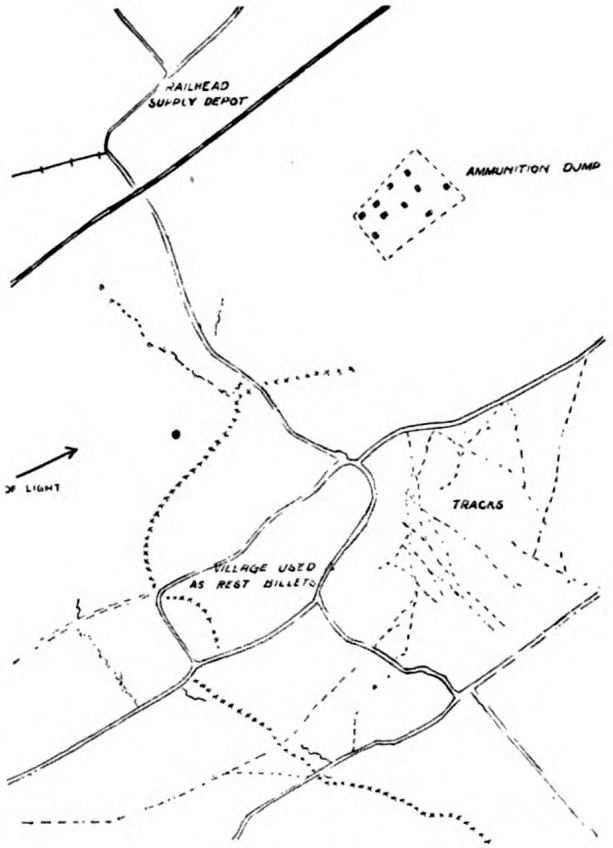


FIGURE 224.



FIGURE 225.

Supply installations require careful study. It is often advisable to make a simple sketch as shown in figure 224 to accompany the photograph. These sketches can be used both for practice and training. (See sec. XV, ch. 2.)

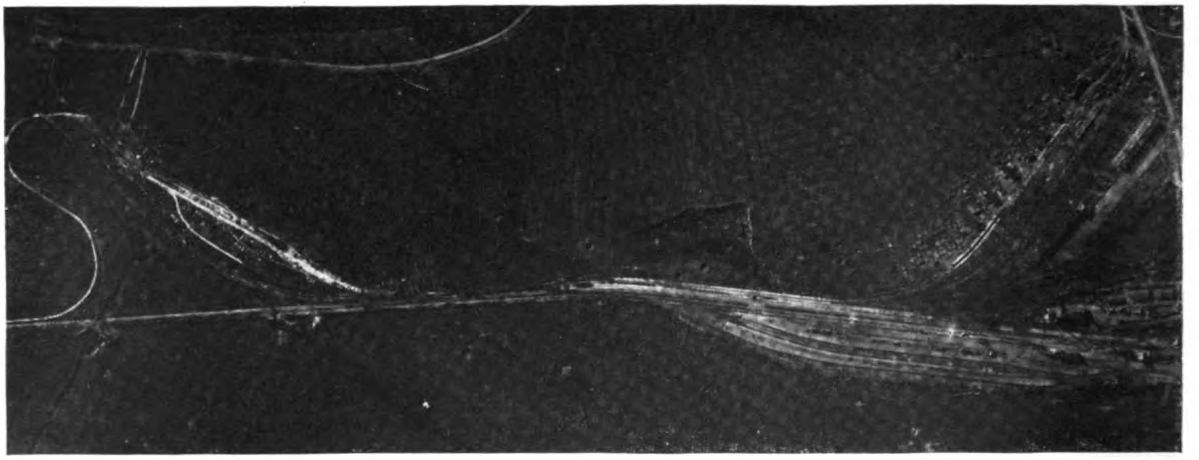


FIGURE 226.—Railhead and distributing point of first World War. At the left is class I supply. At the right are storage tracks and engineer supplies in both open and sheltered storage. Engineer supplies comprise a large portion of the total tonnage transported for armies but, if widely dispersed, make an unprofitable target.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

57. Water points.—*a. Requirements.*—Water points must have a source of water and be accessible from a main supply road. They should be protected and concealed. There should be a concealed place for waiting vehicles. There must be adequate space for pumping, purification, loading, and storage facilities, and for traffic past the area.

b. Identification.—Since trucks generally line up waiting to be loaded with water, the best time to issue water is at night. Little traffic around a water point near the battle line may be expected in daylight. In night driving, less care is given to camouflage discipline, and for this reason the turn-off from the main supply road may be in evidence on a daylight photograph. Thus, to locate an enemy water point, roads are carefully examined for turn-offs where they cross streams or pass near lakes. In towns, the local water supply systems will be used. In the case of a destroyed town, the vicinity of the original source of water supply for the town should be examined on a photograph to determine whether or not the source has been improved for military use.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

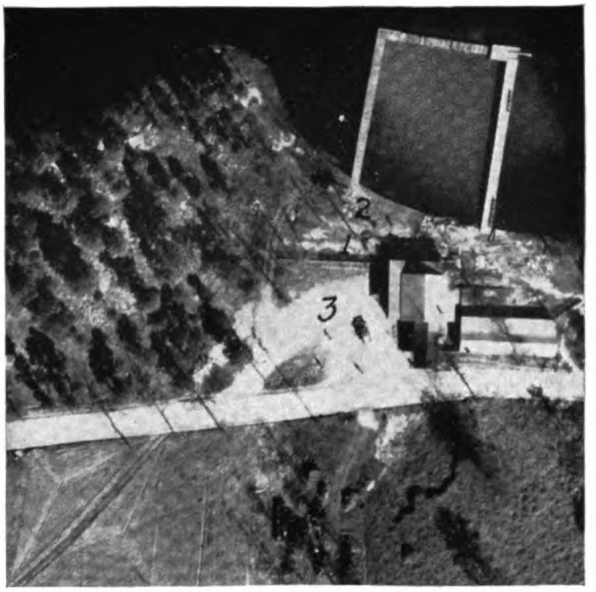


FIGURE 227.—Water point. Stereo pair with figure 231.

Figures 227 and 231, scale 1:2,000: Stereo pair of a water point. The source of supply is a lake. A small portable unit is used for purification and pumping, and a 3,000-gallon canvas tank is used for storage. Note the truck turn-around adjacent to the water point. No attempt has been made to conceal the identity of the operation. Figure 228 is a ground photograph of this stereo pair.



1. 3,000-gallon canvas tank.
2. Portable purification unit.
3. Truck turn-around.

FIGURE 228.—Ground view of water point.

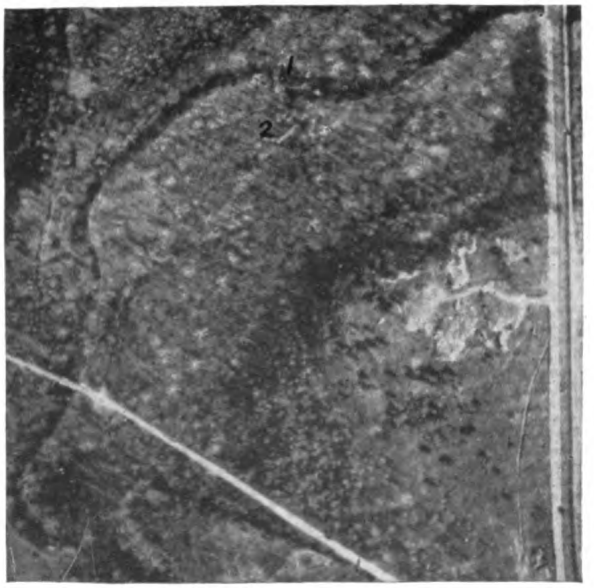


FIGURE 229.—Water point. Stereo pair with figure 234.

Figures 229 and 234, scale 1:5,000: Stereo pair of a water point. A log dam (1) has been constructed across the stream to provide storage. Purification, pumping, and storage facilities have been concealed by a flat top (2). Activity is revealed by the wide space in main road where trail leading from water point joins main road. In the summer, with foliage on trees and brush, this would probably be the only visible indication of the water point.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

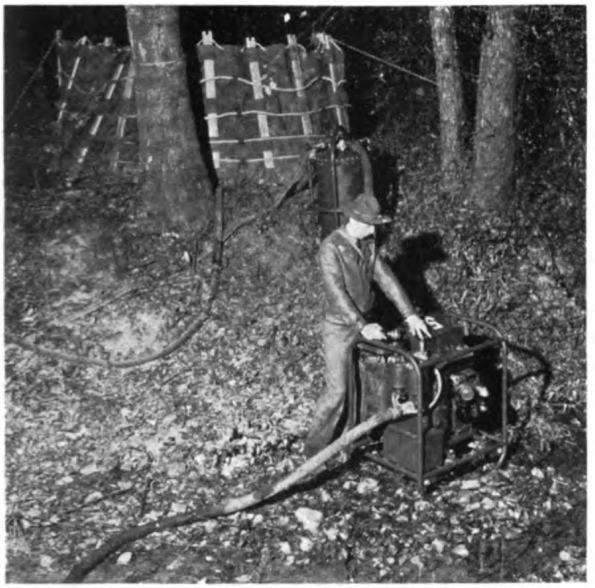


FIGURE 230.—Portable purification unit and 3,000-gallon canvas tank.

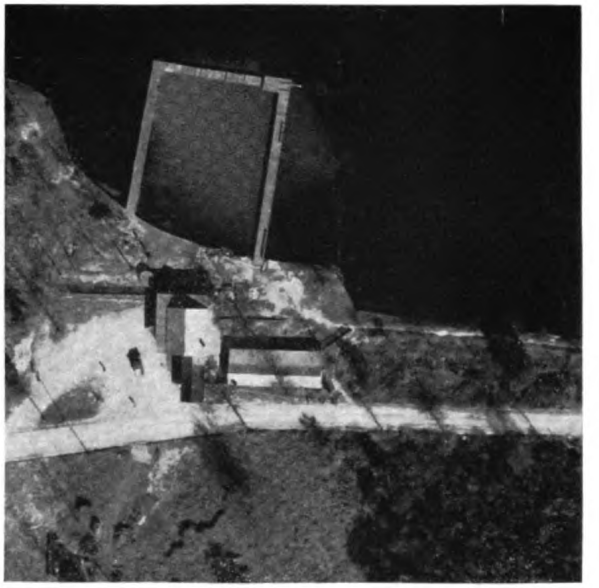


FIGURE 231.—Water point. Stereo pair with figure 227.

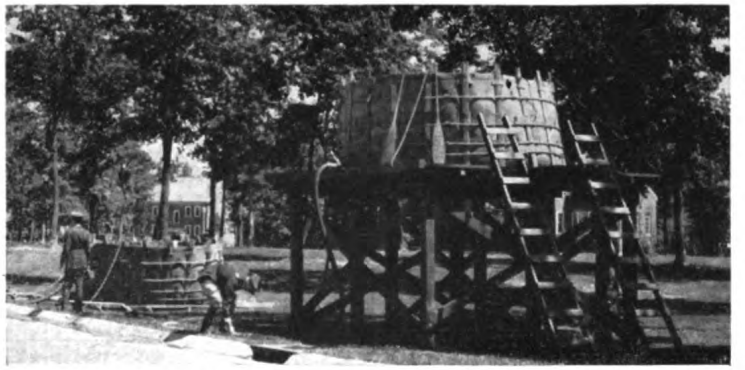


FIGURE 232.—Standard 3,000-gallon canvas tanks.



FIGURE 233.—Mobile purification unit.



FIGURE 234.—Water point. Stereo pair with figure 229.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

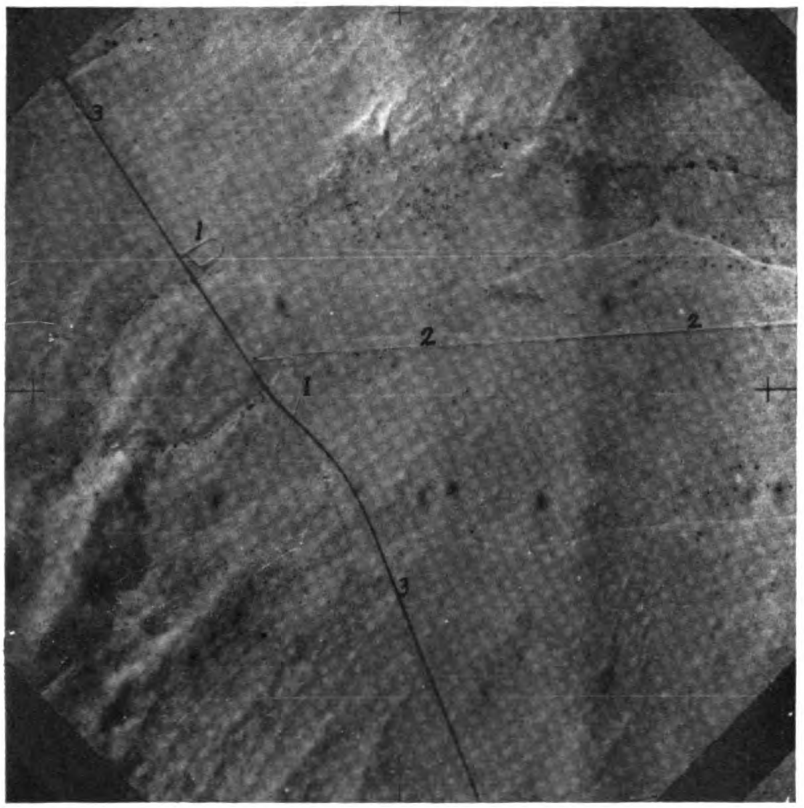


FIGURE 235.—Water points in desert.

1. Water points for motor trucks. Consisting of loops off main road, with four or five stands where water may be obtained.
2. Water pipe line. The rough appearance is due to inspection pits left at pipe joints.
3. Tar road.

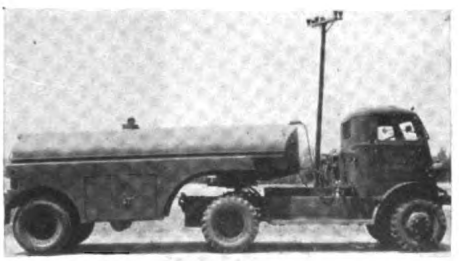


FIGURE 236.—1,500-gallon tank truck.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

SECTION VII

ANTIAIRCRAFT POSITIONS

Paragraph
Location 58
Identification 59

58. Location.—*a. Tactically.*—In the combat zone, antiaircraft artillery will be found protecting bivouacs; troops on the march, military operations such as river crossings, supply and administrative establishments, and routes of communication. In the rear areas, antiaircraft weapons will be found protecting such installations as mobilization centers, regulating stations, airdromes, naval bases, shipping points, and manufacturing centers.

b. Technically.—The principal requirement for locating antiaircraft weapons to perform their primary mission of defense against air attack is an unobstructed field of fire through 360° in azimuth. The larger caliber antiaircraft artillery (3-inch and 90-mm) will be found usually 1,000 to 3,000 yards from the object or area it is defending, and in a location where it can fire to a minimum elevation of 10° to 15°. This means that the guns will be located in positions near crests of hills, at the foot of gentle slopes, and in small orchards, underbrush, cornfields, and grain fields. Another requirement is that they must be in the vicinity of good roads, with routes leading in all directions. The automatic weapons (37-mm and cal. .50 machine guns) will be found in similar locations, 200 to 500 yards from the object or area they are defending.

59. Identification.—The 3-inch and 90-mm antiaircraft batteries consist of a firing unit of four guns laid out in a regular or irregular pattern with a predictor or director, a height finder, and power plant centrally located with respect to the guns. The tracks of gun carriages, trailers, and trucks are nearly always visible in an area where a battery has been installed. When the guns are not carefully camouflaged, the outriggers will reveal their positions. The 37-mm gun may be identified by its carriage, which is difficult to conceal. Machine guns are often placed in pits 7 to 10 feet in diameter which furnish a means of identification on an aerial photograph.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

German antiaircraft positions

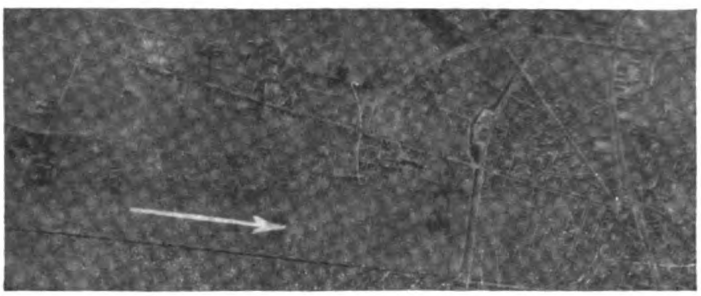


FIGURE 237.—Scale 1:40,000: Typical four-gun antiaircraft lay-out. At this height only the square outline and tracks are visible.



FIGURE 238.—Scale 1:23,000: Four-gun antiaircraft lay-out along seacoast. At this height the sandbag blast shelter surrounding the gun gives it the appearance of a circle with dot in center.

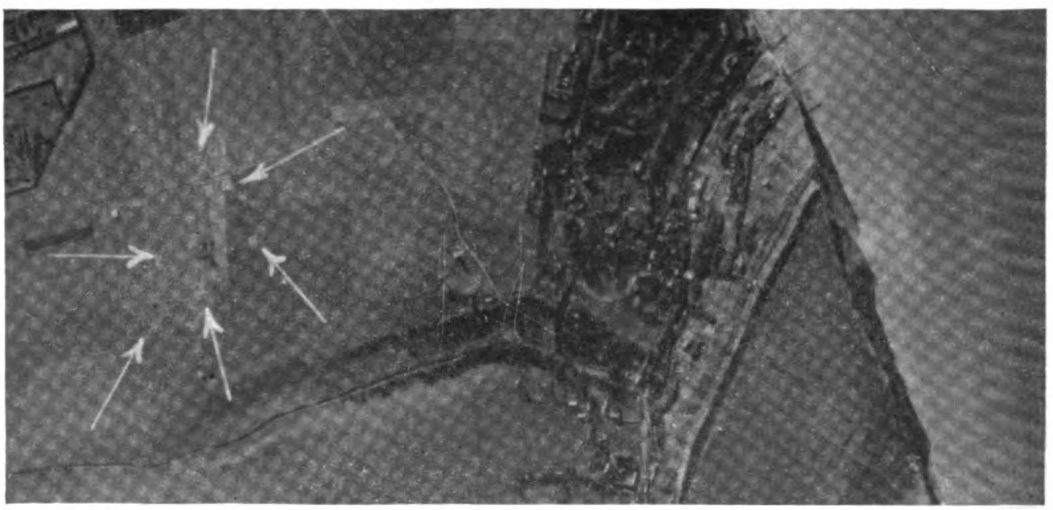


FIGURE 239.—Scale 1:14,500. The construction of huts with earth or sandbag walls draws attention to this antiaircraft battery.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

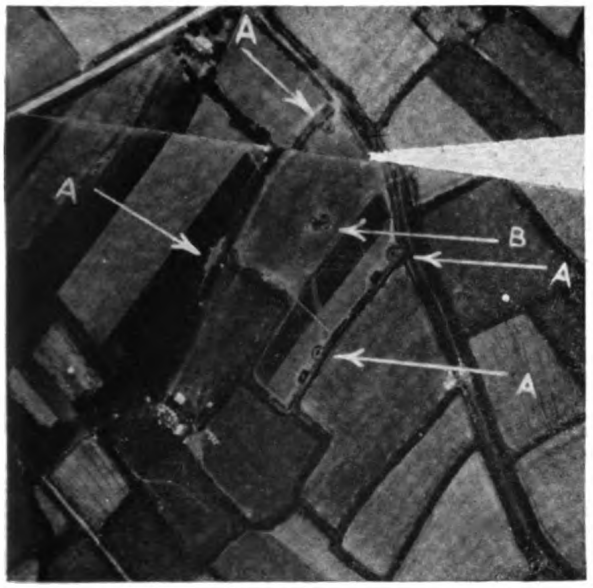


FIGURE 240.—Scale 1:4,500: German antiaircraft battery. The four-gun lay-out is placed along hedges of fields. On photographs taken high up, provided track discipline is strict, this type of position will be difficult to locate. A—gun positions. Note splinter protection walls and shelter for crews and ammunition distributed around hedges. B—director and height finder. When protecting an industrial area or installation which itself cannot be concealed, often no attempt will be made to conceal the antiaircraft positions, the theory being that the enemy will be cautious in bombing an objective that is heavily defended.



FIGURE 241.—Low oblique of 3-inch antiaircraft battery, showing typical four-gun lay-out with director station in center.

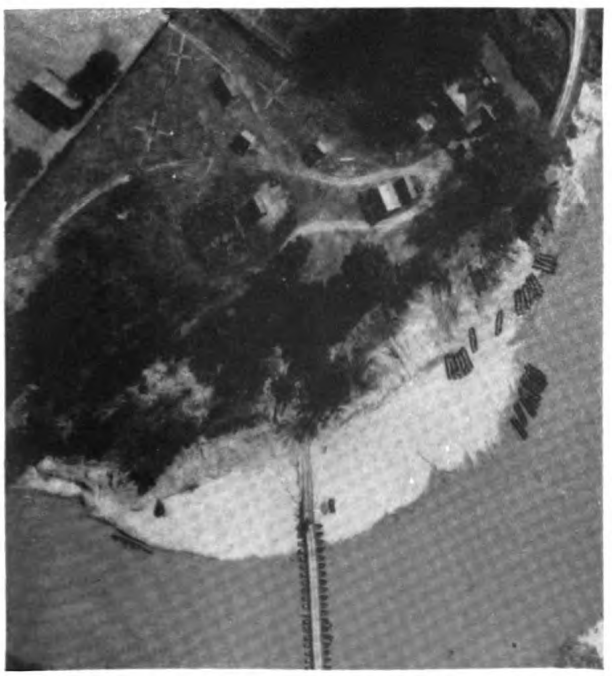


FIGURE 242.—Scale 1:3,000: Dummy antiaircraft position. A well-made dummy position gives a certain amount of protection to an active installation because generally it causes the enemy to fly at a higher altitude and thus makes his bombing less accurate. Dummy installations are also effective in leading the enemy to false objectives. In the photograph to the left the dummy position is exaggerated to too great an extent.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

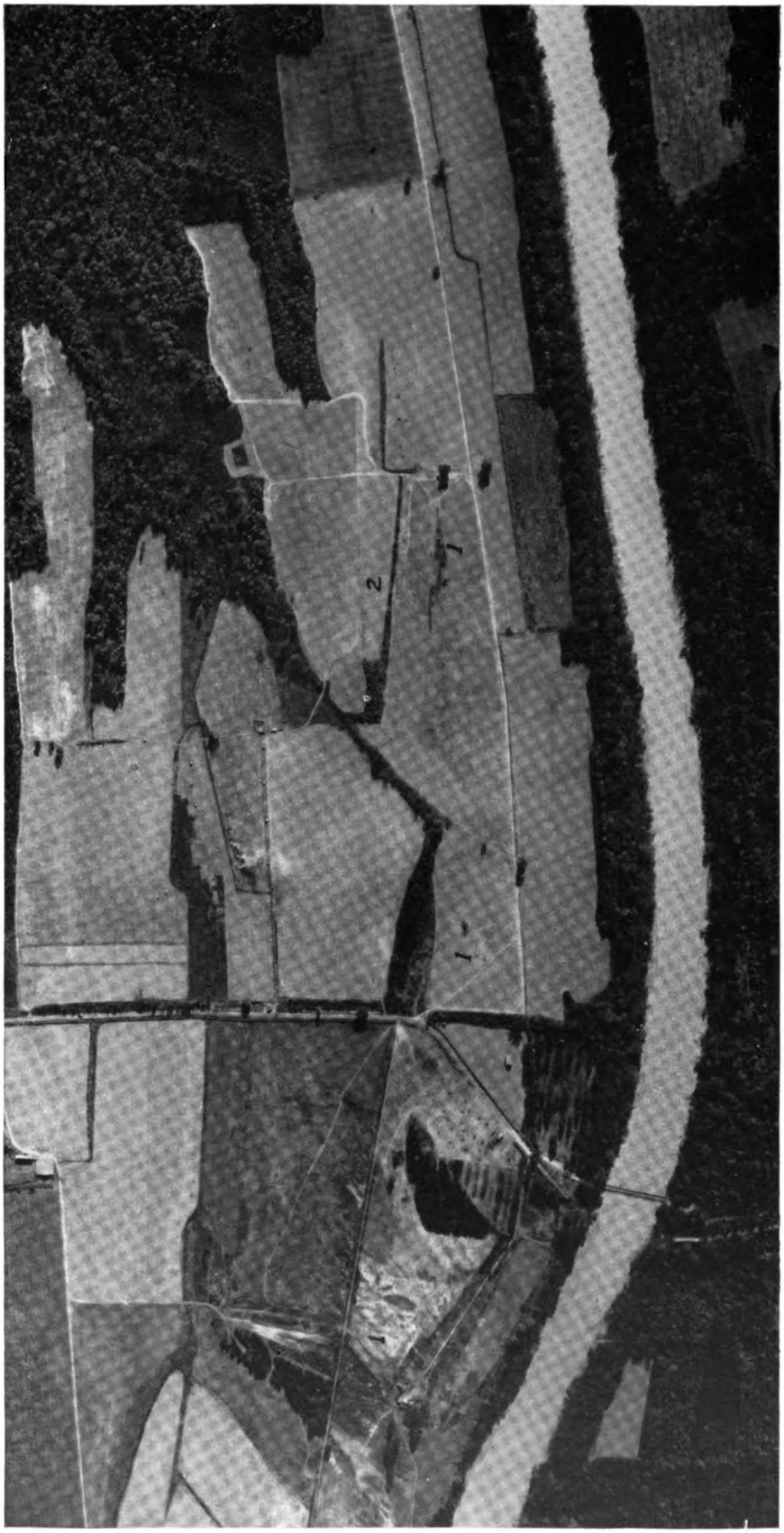


FIGURE 243.—Scale 1:10,000: Antiaircraft defense for a ponton bridge. The caliber .50 machine guns (1) are approximately 300 to 400 yards from the object they are protecting, while the 3-inch guns (2) are 1,000 yards away. Note how the caliber .50 machine guns are located to protect the 3-inch guns. Normally there would be four 3-inch guns to a battery instead of two.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Figures 244 and 248, scale 1:4,000: Stereo pair of camouflaged antiaircraft battery. This antiaircraft battery consists of four guns, a director, a height finder, and a power plant which is connected to the guns and director by cables. It is an example of poor camouflage. The choice of the position is bad because it is impossible to tie in the camouflage nets with existing natural features. The nets are not properly erected. See the ground photograph, figure 247. Camouflage discipline has been poor as tracks exist everywhere.



FIGURE 245.—The same battery shown in figure 244 but taken at a scale of 1:10,000. Note that the camouflaged guns show up just as plainly.

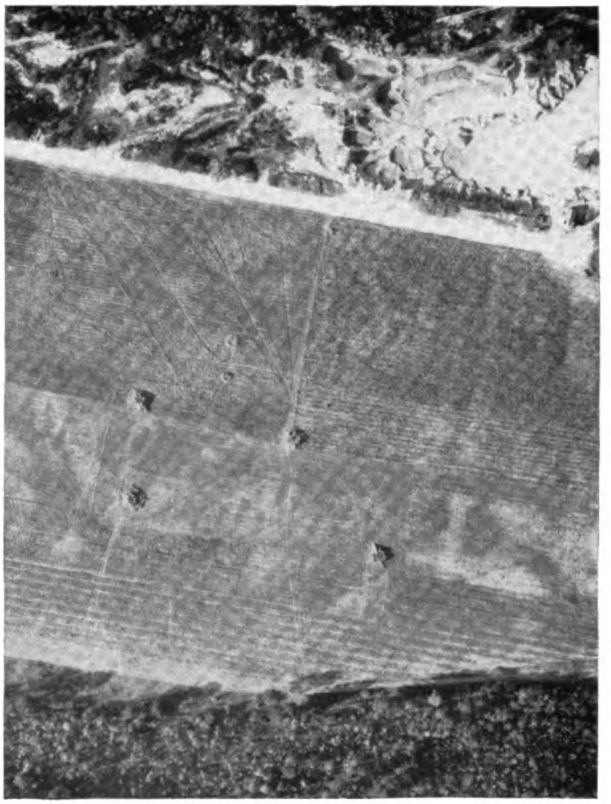


FIGURE 244.—3-inch antiaircraft battery. Stereo pair with figure 248.

Figures 246 and 251, scale 1:1,000: Stereo pair of uncamouflaged antiaircraft battery. The four-gun pattern is plainly visible. Antiaircraft batteries are found frequently near important bridges and often will indicate the location of a contemplated ponton bridge.

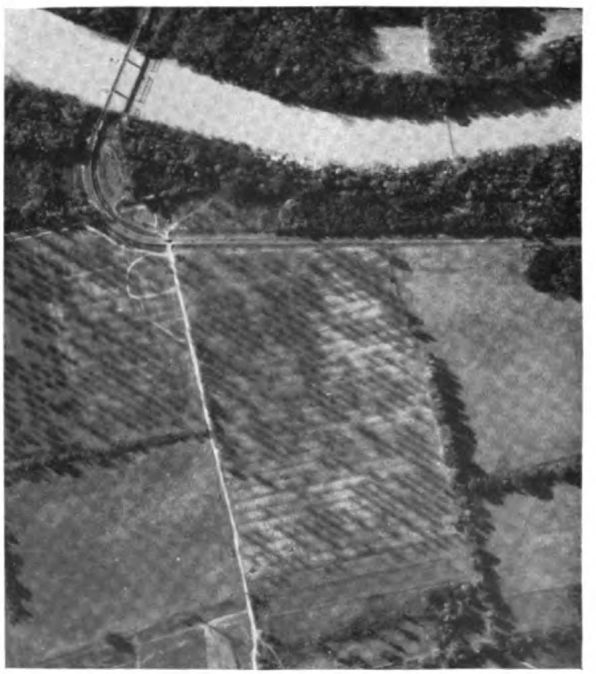


FIGURE 246.—3-inch antiaircraft battery. Stereo pair with figure 251.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 247.—Camouflaged 3-inch antiaircraft gun.

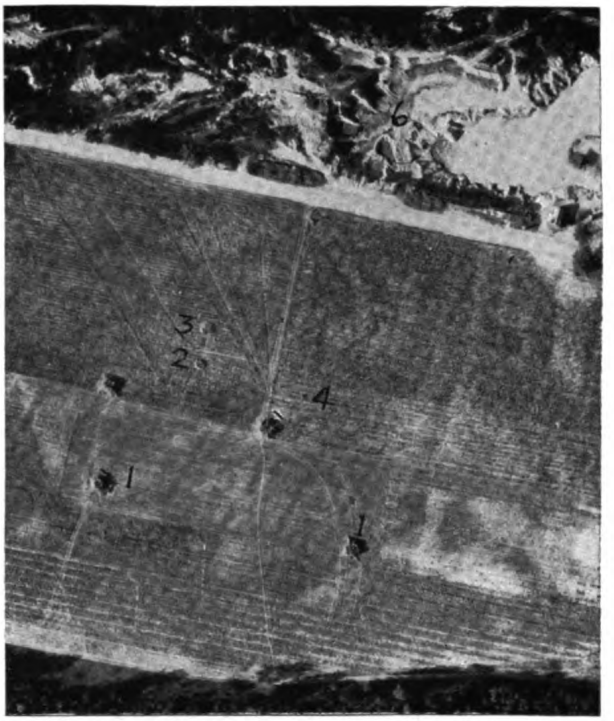


FIGURE 248.—3-inch antiaircraft battery. Stereo pair with figure 244.

1. 3-inch antiaircraft gun camouflaged.
2. Director station.
3. Height finder.
4. Power plant.
5. Foot bridge.
6. Gravel pit.



FIGURE 249.—Director.



FIGURE 250.—Height finder.

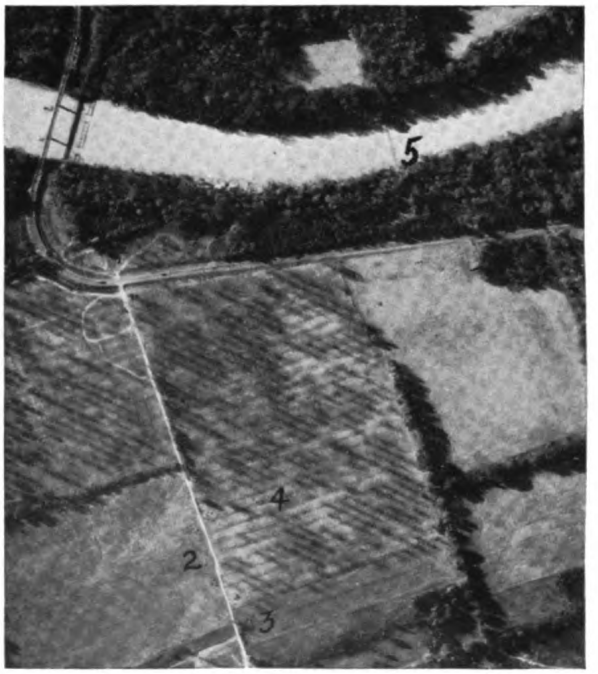


FIGURE 251.—3-inch antiaircraft battery. Stereo pair with figure 246.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 252.—3-inch antiaircraft gun.



FIGURE 253.—Power plant for antiaircraft battery shown in figure 248.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 254.—Ground view of figure 257.



FIGURE 255.—Close-up of 37-mm antiaircraft gun.



FIGURE 256.—Ground view of caliber .50 machine gun (antiaircraft).

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

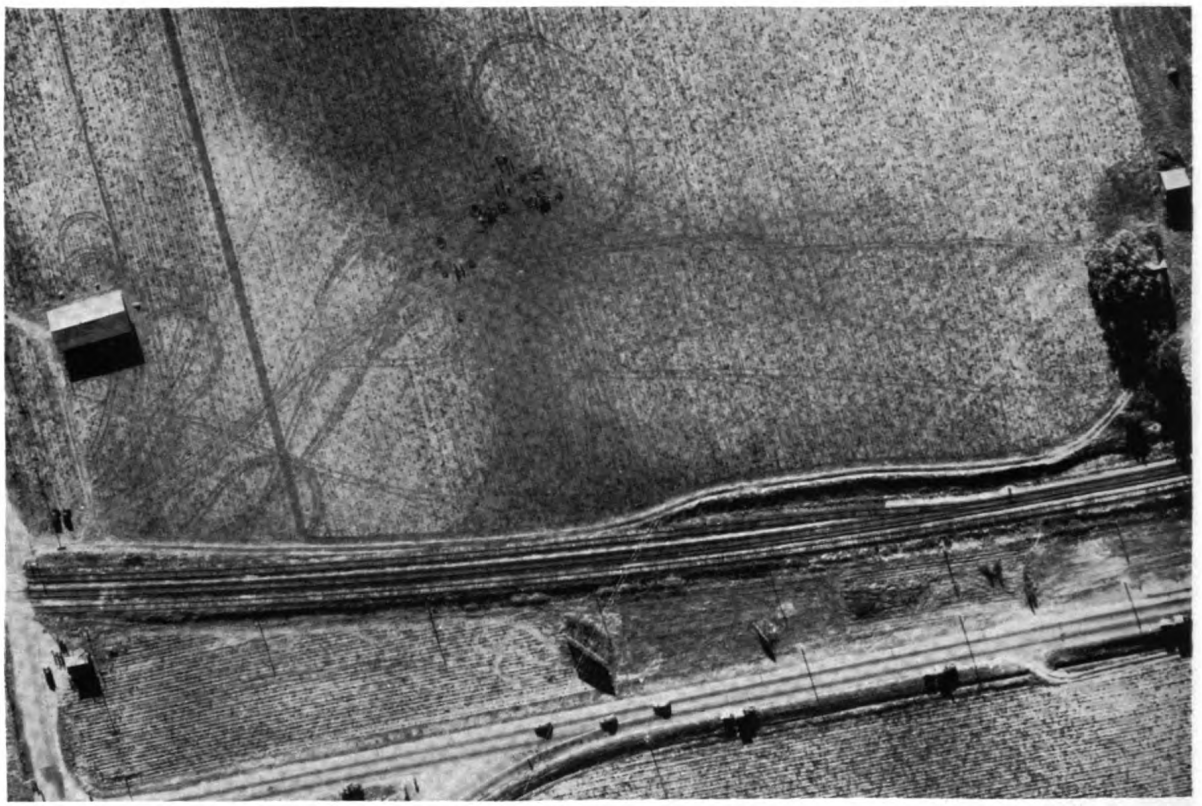


FIGURE 257.—Scale 1:2,000: A 37-mm antiaircraft gun in middle of open field. The interpreter could not expect a low photograph of this nature. The tracks, however, would identify it from high up. If it had been located in high grass or low brush, with good track discipline, the work of locating would be difficult.

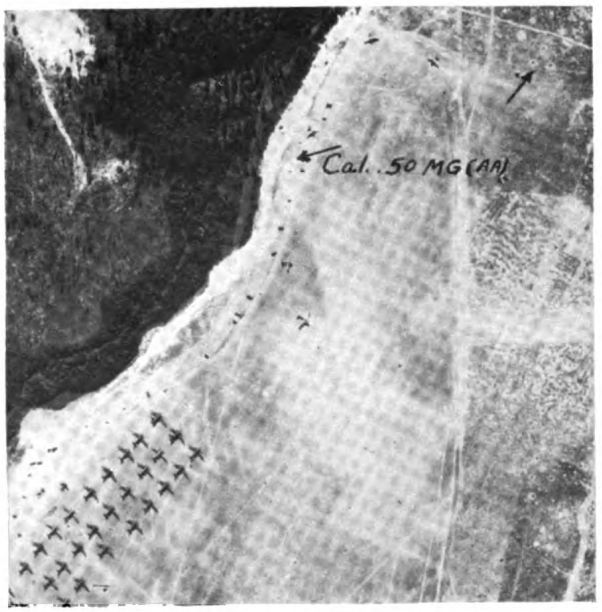


FIGURE 258.—Scale 1:10,000: Antiaircraft machine gun, caliber .50, used in defense of an airfield. Their principal use is against low-flying attack airplanes, parachute troops, and airborne troops. Preparatory to an attack on an enemy's airfield, the interpreter may be called upon to give the exact location of each gun.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

SECTION VIII

ANTIMECHANIZED DEFENSE

Paragraph
Location 60
Identification 61

60. Location.—*a. Active defense.*—The means for protection against mechanized attack are active and passive. The active means include antitank guns, smoke, chemicals, artillery, combat aviation, armored vehicles, grenades, and small arms. Usually active and passive means are used in combination, the freedom of maneuver of the enemy mechanized vehicles being limited by the passive means and their destruction accomplished by the active means. Thus, antimechanized weapons may be expected in the vicinity of natural or artificial obstacles or where artificial obstacles would normally be placed. Antitank guns depend upon direct laying fire and therefore must have a good field of fire at ranges up to 1,000 yards. They are often found covering long, straight stretches of road.

b. Passive defense.—Obstacles such as mines, ditches, barricades, and demolitions will be located at tank defiles such as bridges across unfordable streams and roads through heavy woods where it is difficult or impossible for the vehicles to detour. When located on roads, obstacles will generally be placed around curves to obtain the element of surprise. Artificial obstacles will usually be joined with natural obstacles such as lakes, marshes, heavy woods, and rocky ground.

c. Protection of obstacles.—An obstacle is not of full value unless protected by fire. The interpreter should attempt to locate the protecting force.

61. Identification.—The antitank mine is probably the most effective artificial obstacle. Most mines are round, from 7 to 10 inches in diameter, and usually are laid in rows. Unless the mines are carefully buried and covered, these rows or bands of mines generally can be seen on an aerial photograph. When laid from trucks the tracks will often be seen more readily than the mines. Wire rolls or "concertinas" across roads may be seen on aerial photographs of scale 1: 2,000 or larger. Most artificial obstacles, such as road blocks and antitank ditches, can be recognized easily on aerial photographs because they present an unnatural pattern or design.



FIGURE 259.—37-mm antitank gun.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

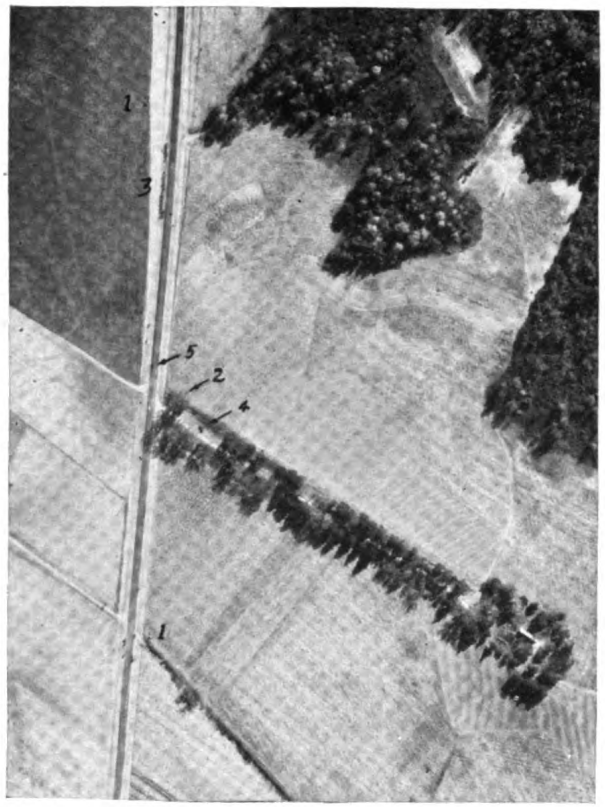


FIGURE 260.—75-mm antitank positions.

1. 75-mm gun position.
2. 75-mm gun under tree.
3. Cavalry on road.
4. Weapons carrier.
5. Bantam car.



FIGURE 261.—37-mm antitank positions.

1. 37-mm gun.
2. ½-ton weapons carrier.

Figure 260, scale 1:6,000: Two 75-mm antitank gun positions. The positions are revealed by the tracks in their vicinity. Antitank guns on self-propelled mounts are often found in tank destroyer battalions. The most useful information concerning a tank destroyer unit is its location, size, and composition.

Figure 261, scale 1:2,500: Two 37-mm antitank guns along a road. The long, straight stretch of road, shown in the ground view, figure 263, gives the guns a good field of fire. The heavy woods on both sides of the road force mechanized units to use the open road, thus depriving them of a covered route of approach.



FIGURE 262.—75-mm gun.



FIGURE 263.—Ground view of figure 261.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 264.—Ground view of wire roll.



FIGURE 265.—Ground view of antitank mines. When possible and time permits, mines are buried and covered with grass or thin layer of earth.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

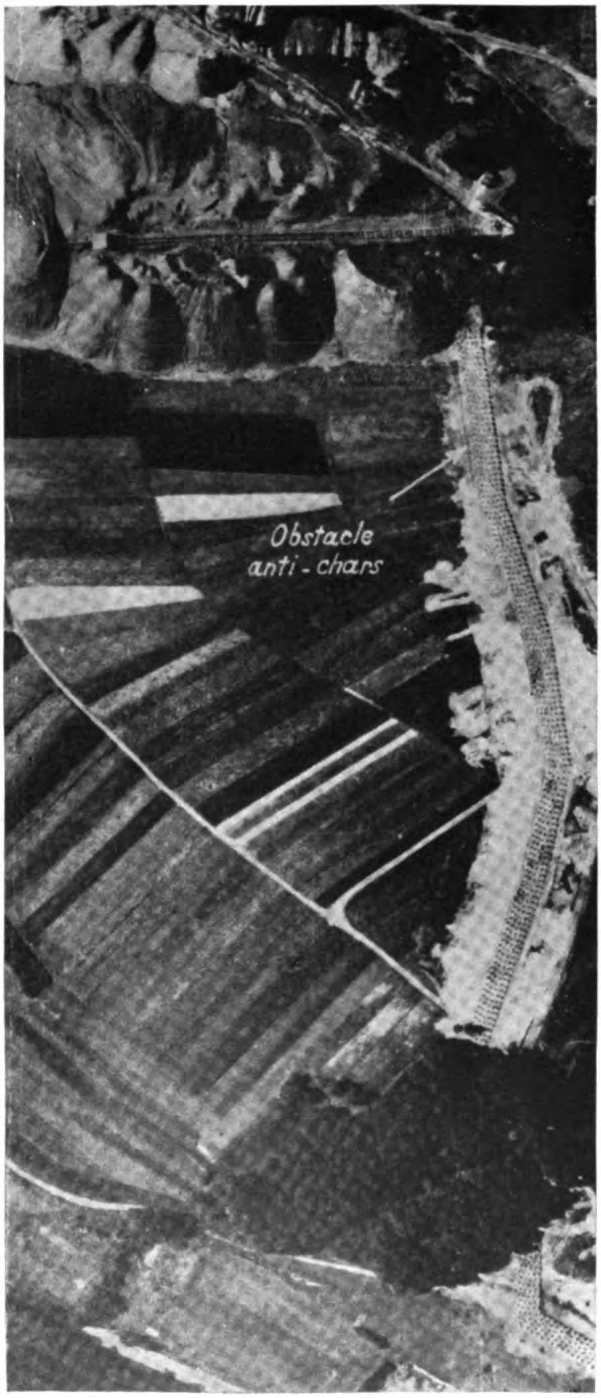


FIGURE 266.—Antitank obstacles.

Figure 266, scale 1:4,000: Antitank barrier of permanent type. This illustrates the practice of joining natural obstacles with artificial ones. It would also be a good location for a mine field. The word "chars" on photograph means "tanks."

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Figures 267 and 270, scale 1:12,000: Stereo pair of a defensive position in desert or arid country organized defense against mechanized attack. Note how the rows of "dragon's teeth" antitank obstacles are tied in with natural obstacles, the two steep ridges.

Key to stereo pair figures 267 and 270

1. Rows of "dragon's teeth" antitank obstacles.
2. Pits.
3. Line of pits.
4. Pits being dug. Note lighter colored earth.
5. Road passing through gap in dragon's teeth. Road can be closed with movable obstacle.
6. Road passing over saddle.
7. Antitank gun.
8. Machine-gun pits.



FIGURE 267.—Antitank obstacles. Stereo pair with figure 270.

Figures 268 and 272, scale 1:25,000: Stereo pair of a camp in desert country. Defense against air attack is obtained by antiaircraft artillery and dispersion. Defense against mechanized attack is provided by a combination of antitank guns, ditches, and mines. The mines are hardly detectable at this scale but upon close study can be seen as a light line 50 to 75 feet outside the antitank ditch.

Key to stereo pair figures 268 and 272

1. Antitank guns.
2. Machine guns.
3. Empty gun positions.
4. Antiaircraft guns.
5. Slit trench.
6. Pits.
7. Tents.
8. Antitank mines.
9. Trench.
10. Antitank ditch.
11. Entrance to camp.

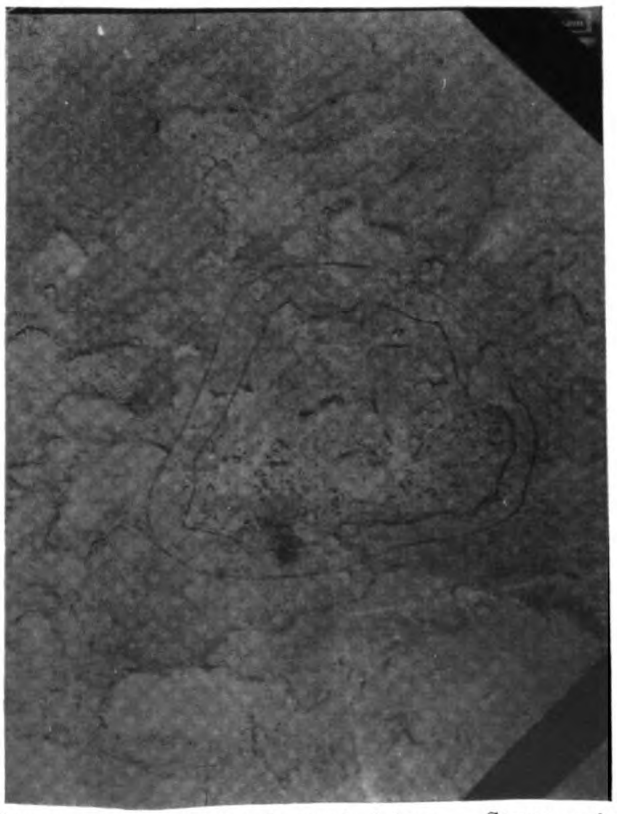


FIGURE 268.—Antimechanized defense. Stereo pair with figure 272.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

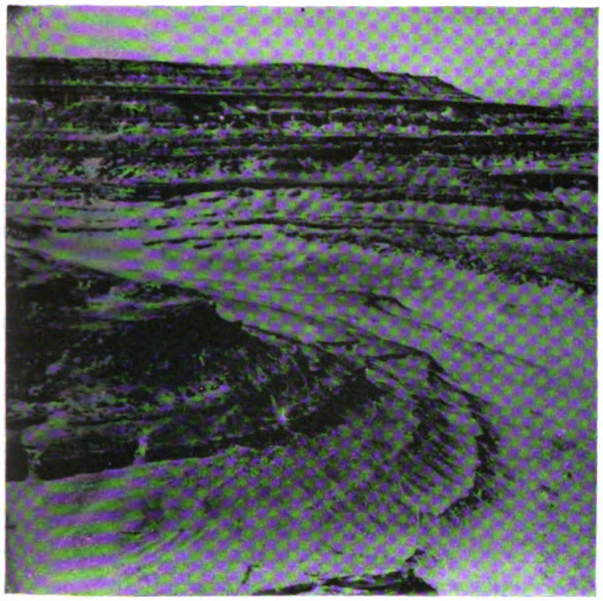


FIGURE 269.—Desert terrain.

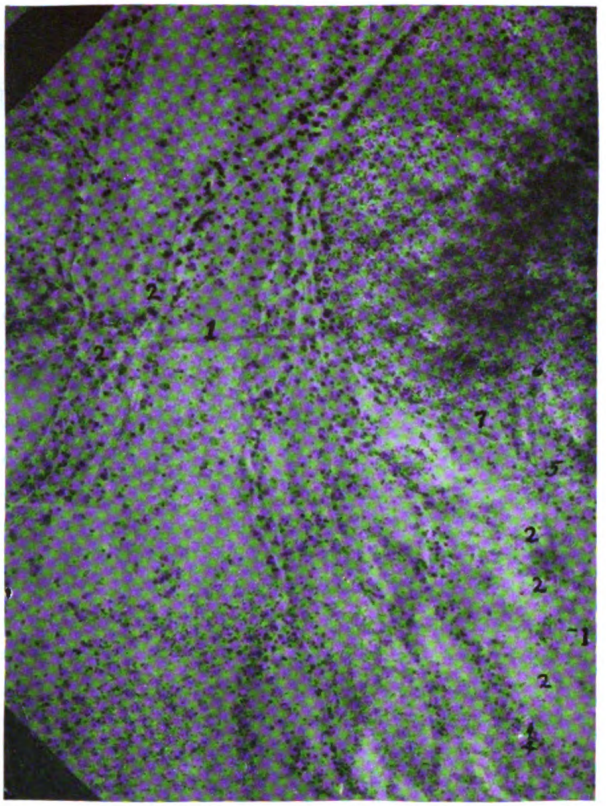


FIGURE 270.—Antitank obstacles. Stereo pair with figure 267.

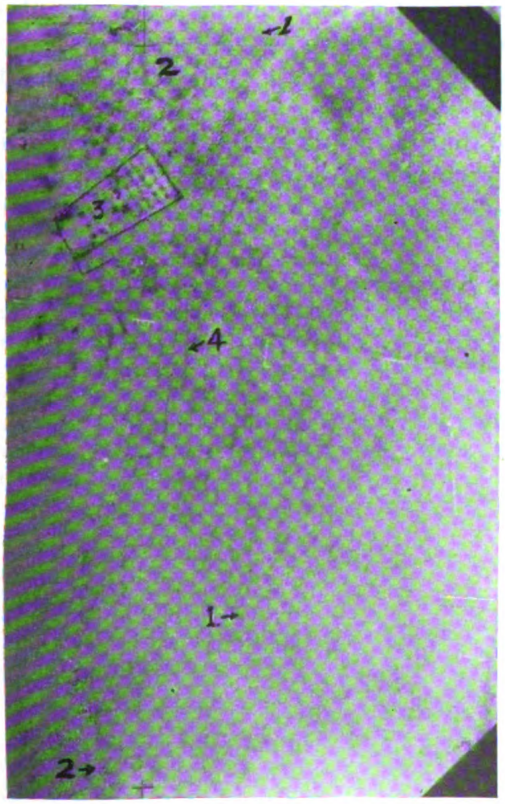


FIGURE 271.—Antitank mines and guns.

1. Antitank mines.
2. Antitank guns with splinter protection wall.
3. Abandoned fort.
4. Trench between antitank guns.



FIGURE 272.—Antimechanized defense. Stereo pair with figure 268.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

SECTION IX

FIELD ARTILLERY POSITIONS

	Paragraph
Characteristic positions	62
Tracks	63
Light artillery	64
Medium and heavy artillery	65
Wire communication	66

62. Characteristic positions.—*a. Location.*—A battery of artillery usually consists of four guns spaced in an irregular line at intervals of 25 to 30 yards. Batteries are generally located under some type of cover, either natural or artificial. Positions difficult to locate on aerial photographs are those well concealed in villages, quarries, along roads, thickets, hedges, woods, ditches, or ravines. A good camouflage net, properly garnished and erected, offers artificial cover which is often effective.

b. Identification.—Batteries are usually spotted on aerial photographs from tracks leading to them, by camouflage being too regular in its outline, by piles of ammunition near the position, by blast marks, and by unusual activity in the immediate vicinity of the guns. The guns themselves are only a small part of the evidence of the existence of the battery and are rarely seen on a photograph. Batteries in woods are discovered by slashings in front of the guns, white marks in the woods resulting from disturbances of the surface of the ground and scattering of debris, loops and doubling trails entering woods, and by trucks and prime movers parked near the gun position.

63. Tracks.—*a. Single vehicles.*—Troops are often unaware of the danger invited by leaving tracks, even of single vehicles, in open fields. An interpreter when first viewing a photograph or a stereo pair hastily scans the area for tracks. Many times tracks serve as guiding arrows pointing toward the battery position. Tractors and similar vehicles are the worst offenders of camouflage discipline since their turns are usually deeply cut into the earth.

b. Traffic.—Blotched spots on a photograph often aid the interpreter in locating active positions. These spots are a result of a difference in texture of the ground caused by multiple tracks made by men and vehicles. The locality in which such blotched spots are present will warrant close scrutiny by the interpreter.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

Figures 273 and 279, scale 1:6,000: Stereo pair of 75-mm gun battery. At 6,000 feet the battery is well concealed from aerial observation except for tracks leading to the gun positions. On these photographs tracks can be followed into the woods, thus giving the exact locations of the four guns and their prime movers, half-track armored cars in this case. The half-tracks and guns were moved along the edge of the woods to the place where the guns were to be located, then the half-track swung out into the field backing the gun into position. This can be verified on the large-scale photograph, figure 278. Types of artillery are determined from the relative size of the guns and their general location.

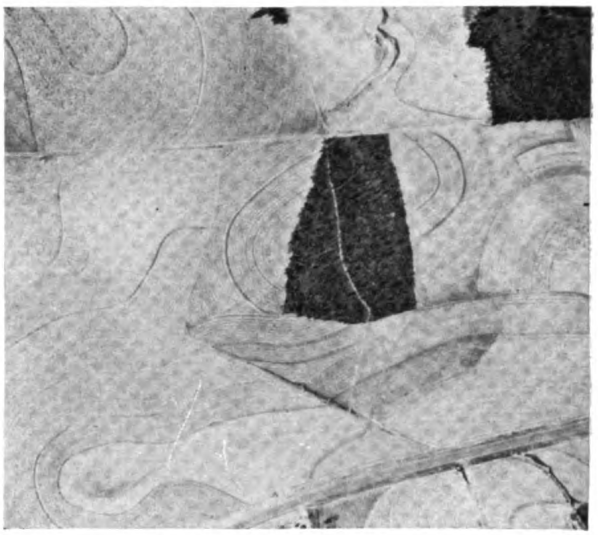


FIGURE 273.—75-mm artillery battery. Stereo pair with figure 279.

Figures 274 and 281, scale 1:6,000: Stereo pair of 75-mm battery. This battery is so well concealed that a close study of the photograph will disclose only one vehicle. The many tracks in the adjoining field, however, give away the position. Had a covered approach been used instead of the open field, the positions probably could not be discovered from aerial photographs.

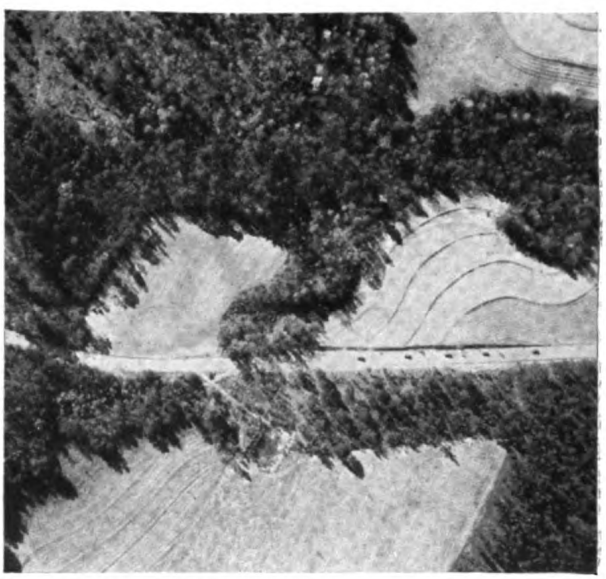


FIGURE 274.—75-mm artillery battery. Stereo pair with figure 281.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

64. Light artillery.

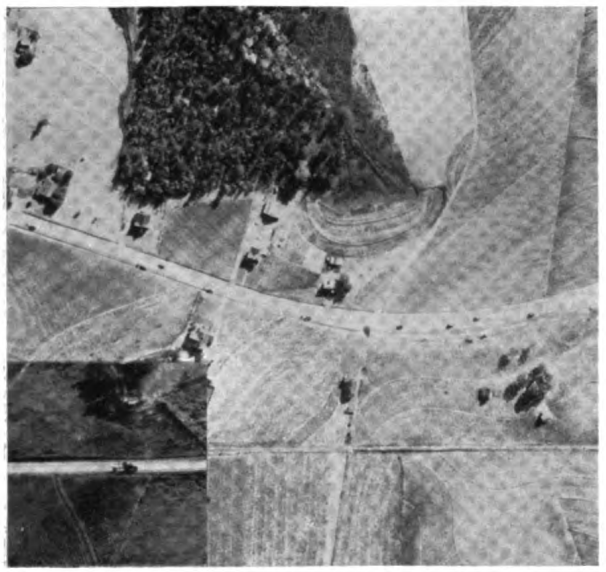


FIGURE 275.—Half-track with 75-mm gun.

Figure 275, scale 1:6,000: Battery of 75-mm guns being towed along road by half-track cars. Insert shows a low oblique of gun and half-track.

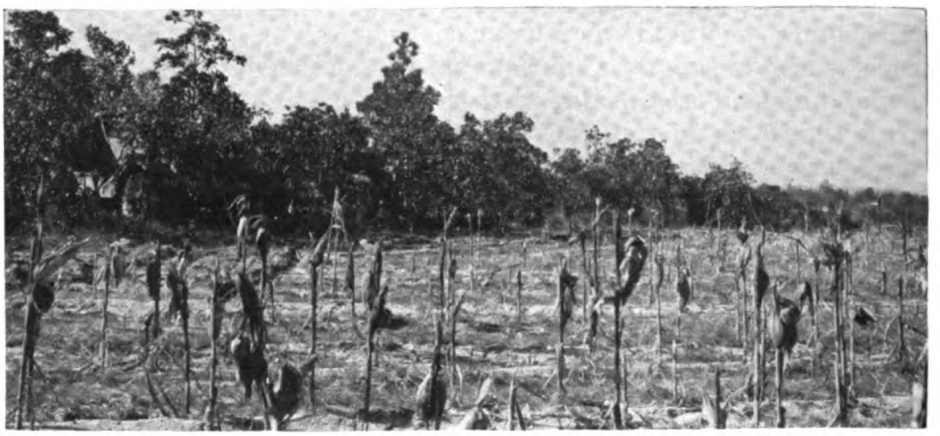


FIGURE 276.—Artillery battery—ground view of figure 273.

Figure 276: Ground view of battery shown in figure 273, showing how well the position is concealed from terrestrial observation. Note how the vegetation and tracks differ from the aerial view.

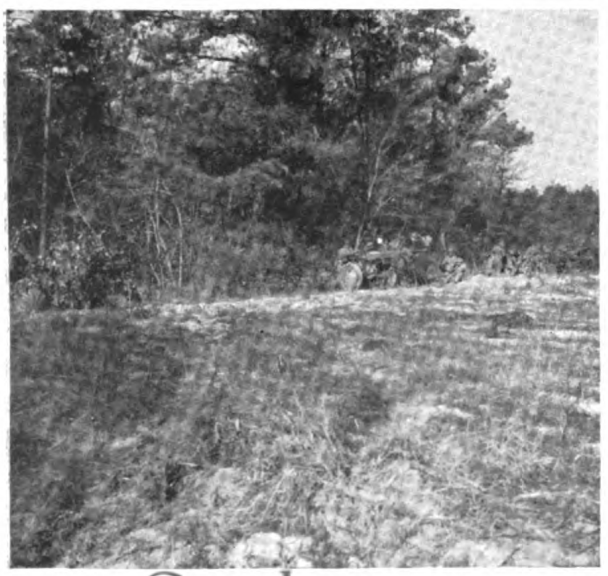


FIGURE 277.—Artillery battery—ground view of figure 274.

Figure 277: Ground view of battery shown in figure 274. Shadows of woods in the background completely hide guns from aerial view.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

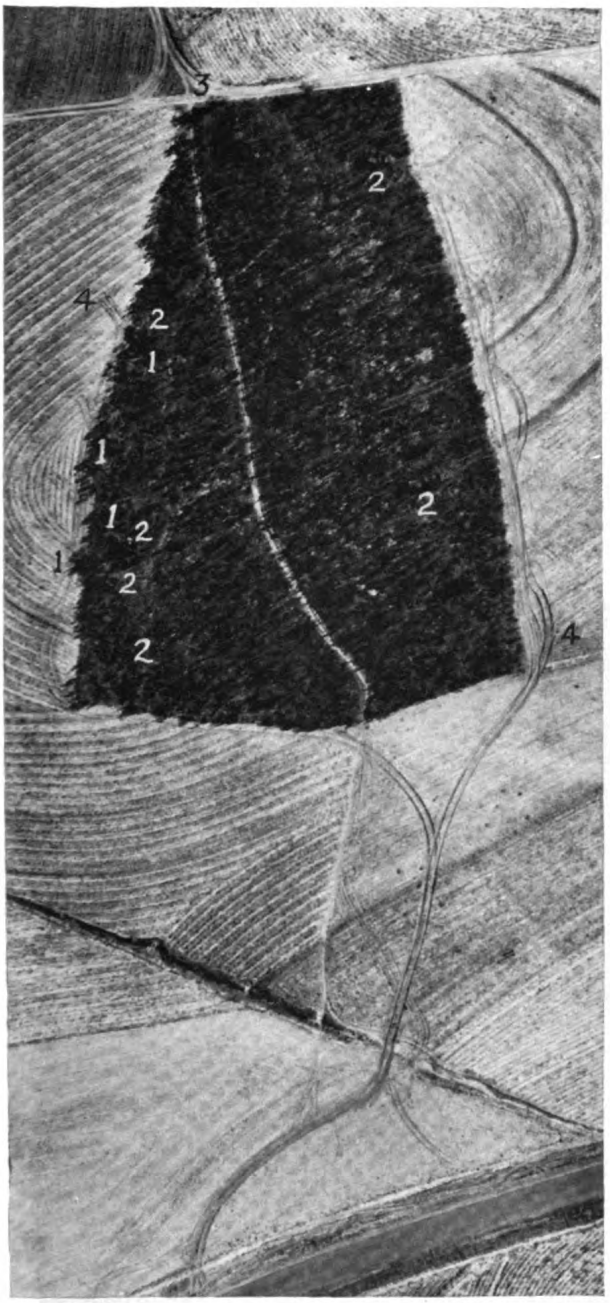


FIGURE 278.—Artillery battery, scale 1:2,000. (Close view shown in figure 275.)



FIGURE 280.—Half-track car with 75-mm gun.

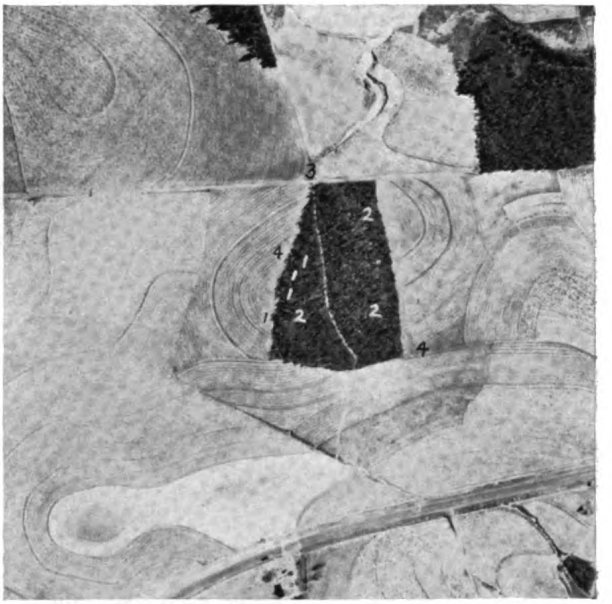


FIGURE 279.—75-mm artillery battery. Stereo pair with figure 273.

Key to figures 278, 279, and 281

1. 75-mm gun.
2. Half-track car.
3. Covered approach
4. Vehicle tracks.

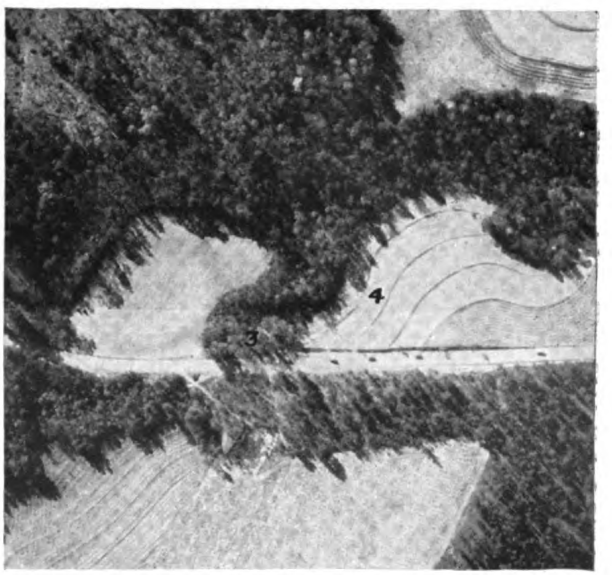


FIGURE 281.—75-mm artillery battery. Stereo pair with figure 274.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

65. Medium and heavy artillery.



FIGURE 282.—Low oblique taken at 600 feet of 155-mm howitzer battery positions. This illustrates what battery positions would look like were they not concealed or camouflaged.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 283.—Low oblique of the 155-mm gun position shown in stereo pair, figures 288 and 293. Note how the tracks point to the gun position.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Figure 284, ground view of two of the 155-mm guns shown in figure 287.



FIGURE 284.—155-mm gun (G. P. F.).

Figure 285, ground photograph of a 155-mm gun M1. No garnishing whatsoever was used on the camouflage net.



FIGURE 285.—155-mm gun (M1).

Figure 286, scale 1:8,000: The same battery as in figure 288, but at a much higher altitude. The same identifying features are present on the small-scale photograph.



FIGURE 286.—155-mm artillery battery.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Figures 287 and 290, scale 1:5,000: Stereo pair of battery of five 155-mm guns. Tracks give the position away. Had these tracks followed the furrows on the ground, the position would not have been as noticeable from the air.

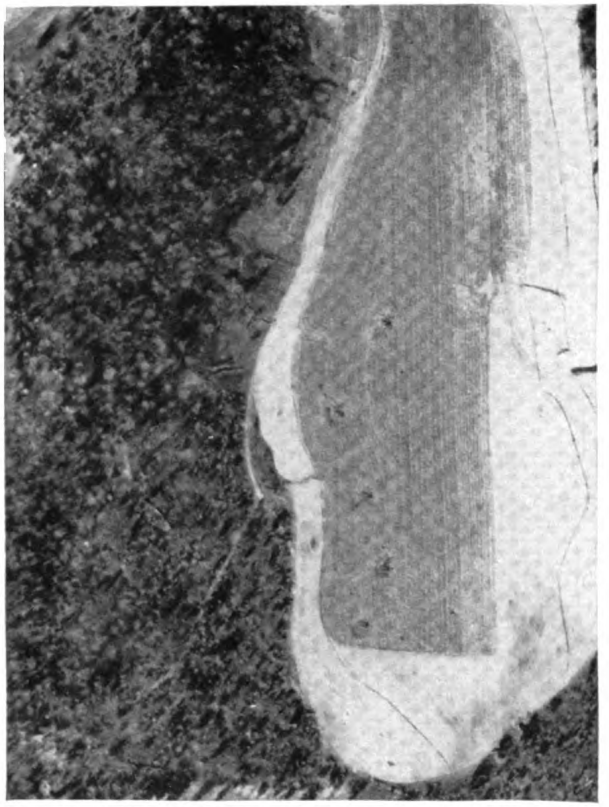


FIGURE 287.—155-mm artillery battery. Stereo pair with figure 290.

Figures 288 and 293, scale 1:3,000: Stereo pair of battery of three 155-mm guns M1. The white marks resulting from the disturbance of the surface of the ground around the guns clearly disclose their location. The tracks of guns and prime movers all lead to gun positions.

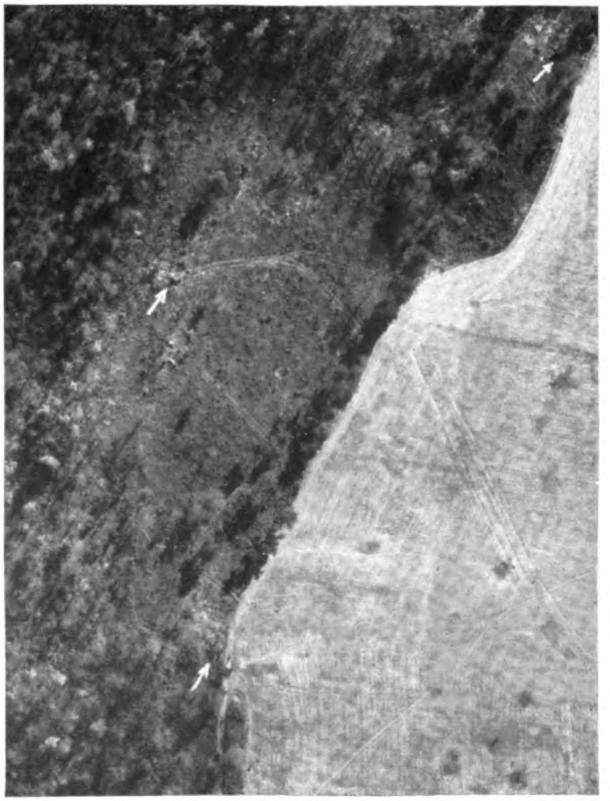


FIGURE 288.—155-mm artillery battery. Stereo pair with figure 293.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

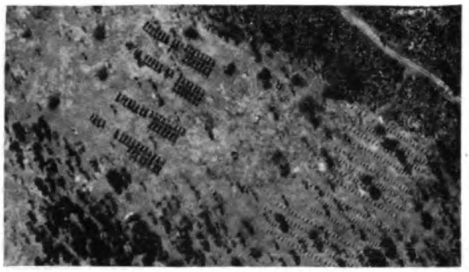


FIGURE 289.—155-mm guns (G. P. F.). Scale 1:5,000.



FIGURE 291.—155-mm gun (G. P. F.). and prime mover.



FIGURE 292.—155-mm guns (M1) and prime mover.



FIGURE 294.—155-mm howitzers.

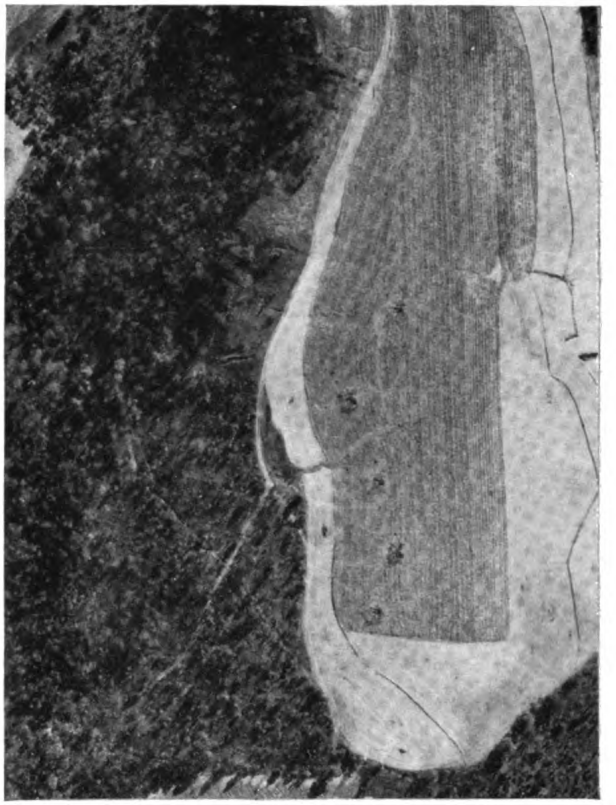


FIGURE 290.—155-mm artillery battery. Stereo pair with figure 287.



FIGURE 293.—155-mm artillery battery. Stereo pair with figure 288.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

Figure 295, scale 1:800: 155-mm howitzer on road. Photograph is turned so shadow falls away from student. Note similarity of shadow to actual shape of gun in photograph.

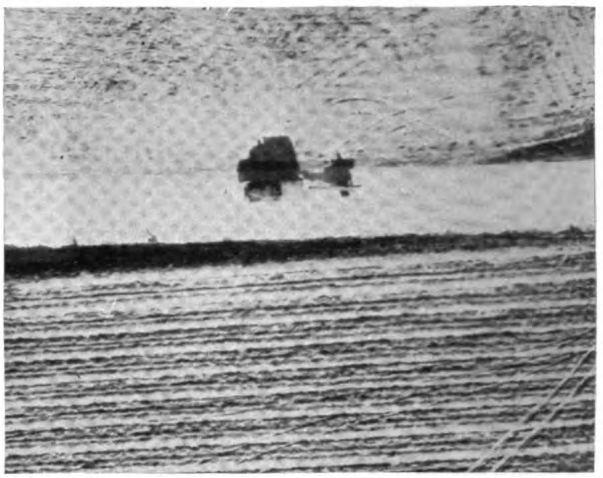


FIGURE 295.—155-mm howitzer on road. Scale 1:800.

Figure 296, scale 1:6,000: Smaller scale photograph of same howitzer and truck as is shown in figure 295.



FIGURE 296.—155-mm howitzer on road.



FIGURE 297.—Ground view of 240-mm howitzer.

Figure 297: Ground view of figure 299. Note large amount of construction necessary to eliminate shadows.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

Figures 298 and 302, scale 1:6,000: Stereo pair of 155-mm howitzer battery. Three guns only are shown. Not a tactical position; photograph shows that the size and type of artillery can be determined at this scale by close study on part of interpreter.

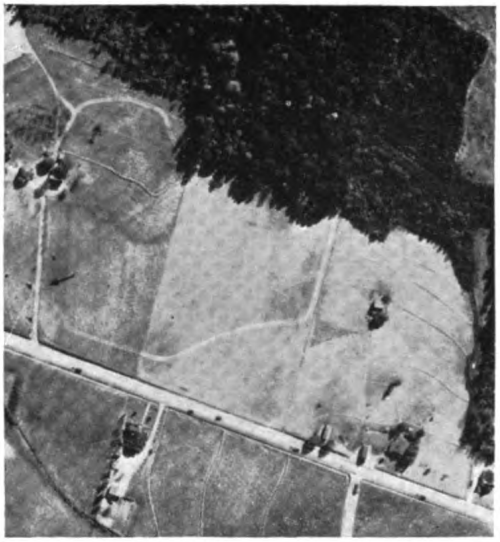


FIGURE 298.—155-mm howitzer battery. Stereo pair with figure 302.

Figures 299 and 304, scale 1:6,000: Stereo pair of 240-mm howitzer position camouflaged with a flat top. Although position is nontactical, it shows what can be accomplished with sufficient care.



FIGURE 299.—240-mm howitzer position. Stereo pair with figure 304.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

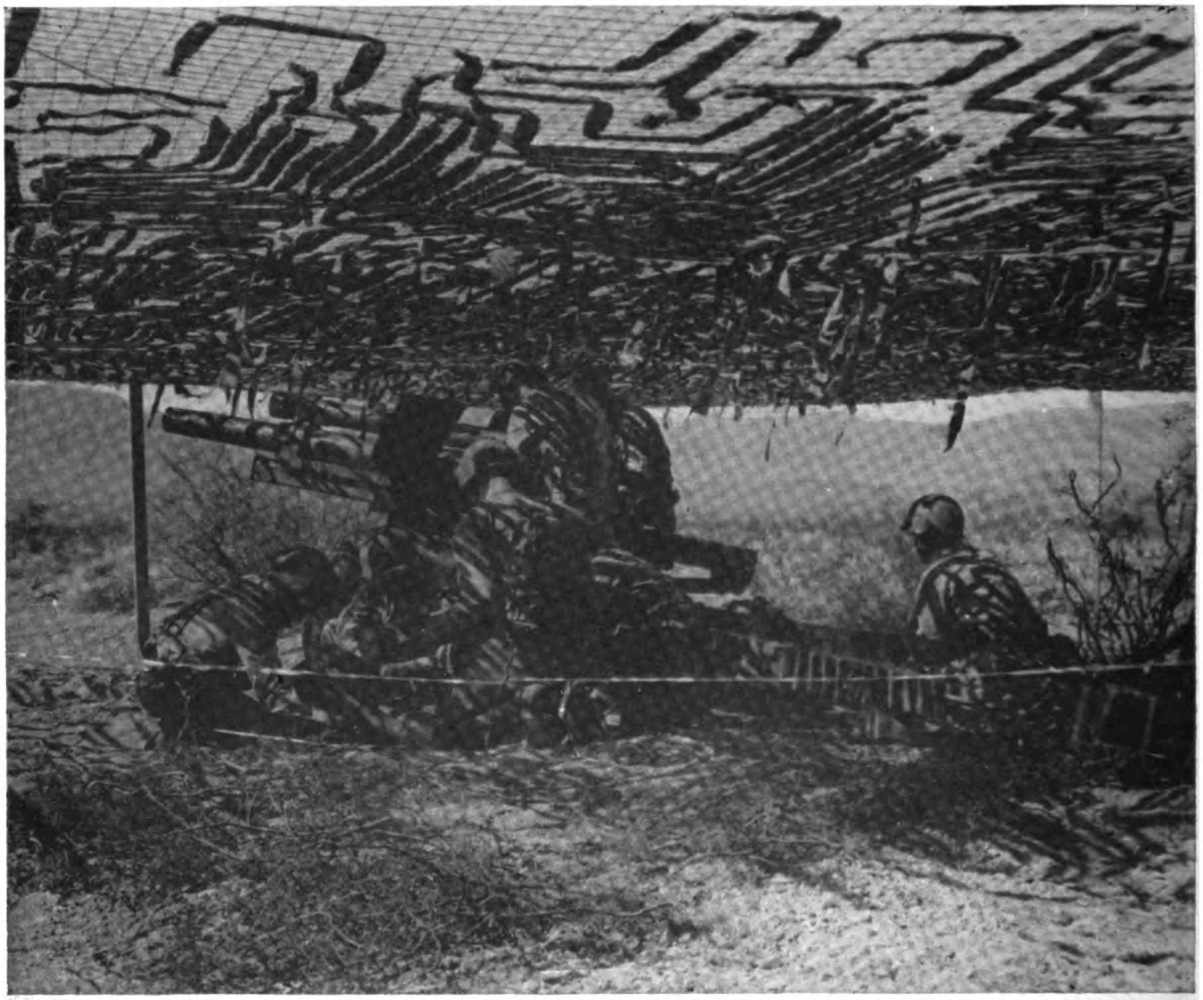


FIGURE 300.—Ground view of 105-mm howitzer in position under flat top.

66. Wire communication.—Cable lines connect observation posts, artillery batteries, command posts, and headquarters. Their installation may precede that of important establishments, thus giving advance notice of future operations in an area. Cable lines from permanent installations such as coast defense and other large caliber guns are usually buried but may be distinguished by their straight course, angular changes in direction, and fuzzy appearance on aerial photographs. In a mobile situation, lines are laid on top of the ground and are usually inconspicuous, except where they cross roads where, if buried, they may be detected by a dark streak. When in use in active operations, the dark streaks across the roads will disappear, but tracks or paths along the route of the line will appear as the result of men repairing breaks.

Figure 301, scale 1:17,000: Two cable lines leading from batteries or command posts to a headquarters near edge of town. The broken lines outline the path of the cables. Around the headquarters are light-toned scars which indicate activity, possibly concrete strengthening work.

Figure 303, scale 1:20,000: Showing how, after 2 months, the signs of the cable are disappearing. This emphasizes the importance of locating enemy cable lines early and recording their routes. On the photograph the many new paths and roads indicate increased activity in the area.

Figure 305: Three batteries revealed by blast marks. In snow covered terrain, blast marks appear black while on snow-free ground they have a light gray to dark gray appearance.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 301.—Buried cable lines.

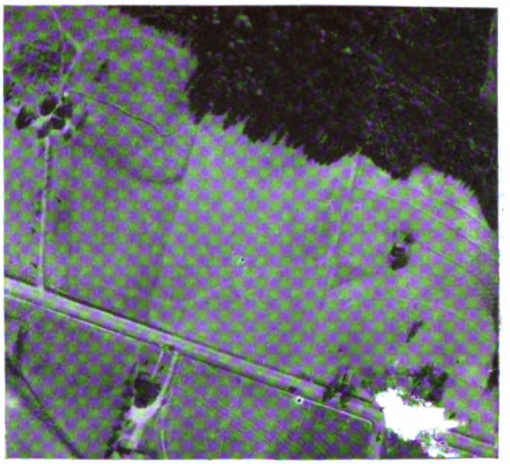


FIGURE 302.—155-mm howitzer battery. Stereo pair with figure 298.



FIGURE 303.—Cable lines, 2 months later.

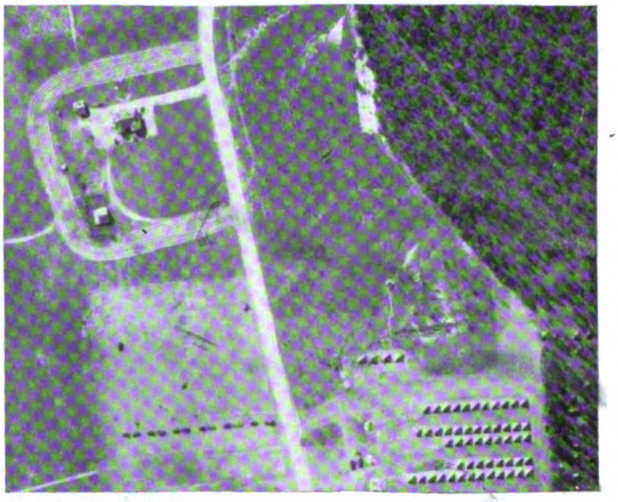


FIGURE 304.—240-mm howitzer. Stereo pair with figure 299.

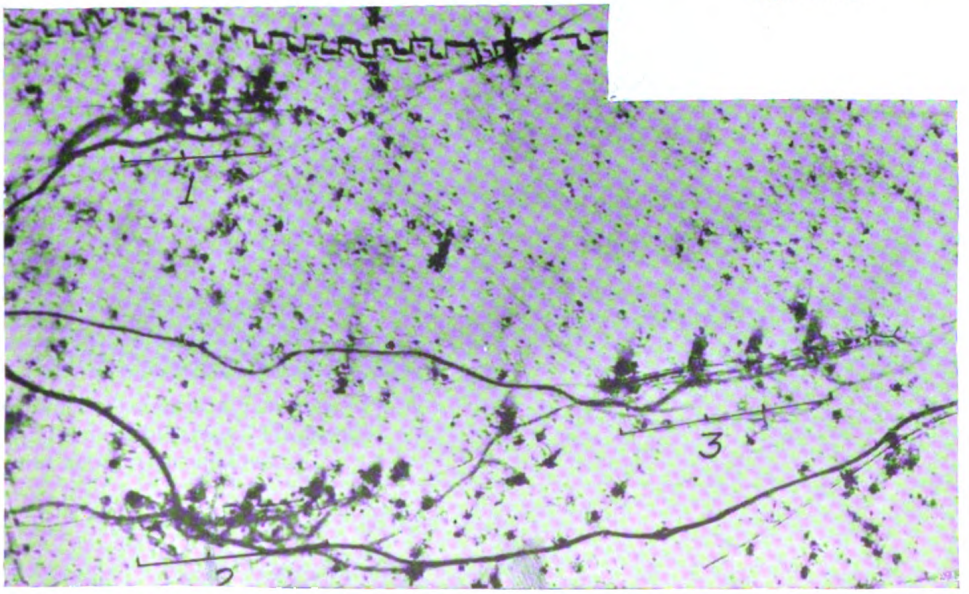


FIGURE 305.—Blast marks in snow.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

SECTION X

SEACOAST DEFENSE

	Paragraph
General	67
Permanent gun installations	68
Railroad guns	69
Obstacles	70

67. General.—A more thorough study of seacoast defenses as they appear on aerial photographs is made in special publications of the Army Air Forces and of the Navy. TM 5–265 gives information on the general type of camouflaged installations that may be expected to appear on photographs of seacoast fortifications. Studies of such fortifications follow the same procedure as interpretation studies in a stabilized situation. (See sec. XV, ch. 2.)

68. Permanent gun installations.—The advantage that the defender has in the case of secretly constructed permanent installations lies in his ability to conceal them by planting natural trees and foliage. However, permanent batteries are often of the casemated or pit type. Permanent antiaircraft guns may be unequally spaced but the battery usually forms a distinctive pattern. Where construction is undertaken while subject to aerial photography, a clear picture is obtained by the interpreter. (See sec. III, ch. 2.)



FIGURE 306.—Example of a permanent seacoast battery. Note its symmetrical appearance.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

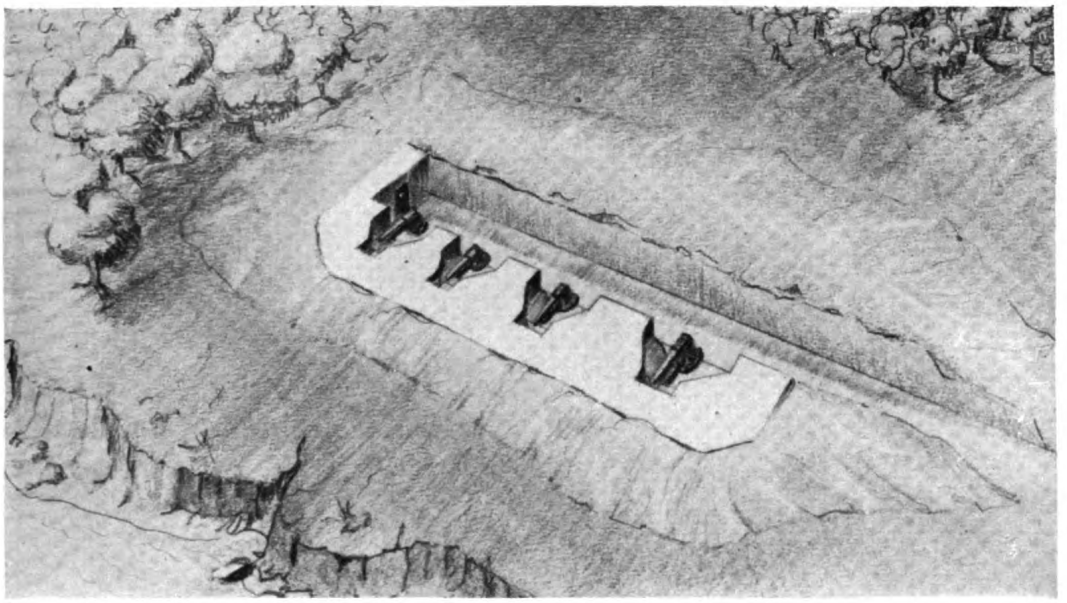


FIGURE 307.—Sketch of a seacoast permanent gun installation.

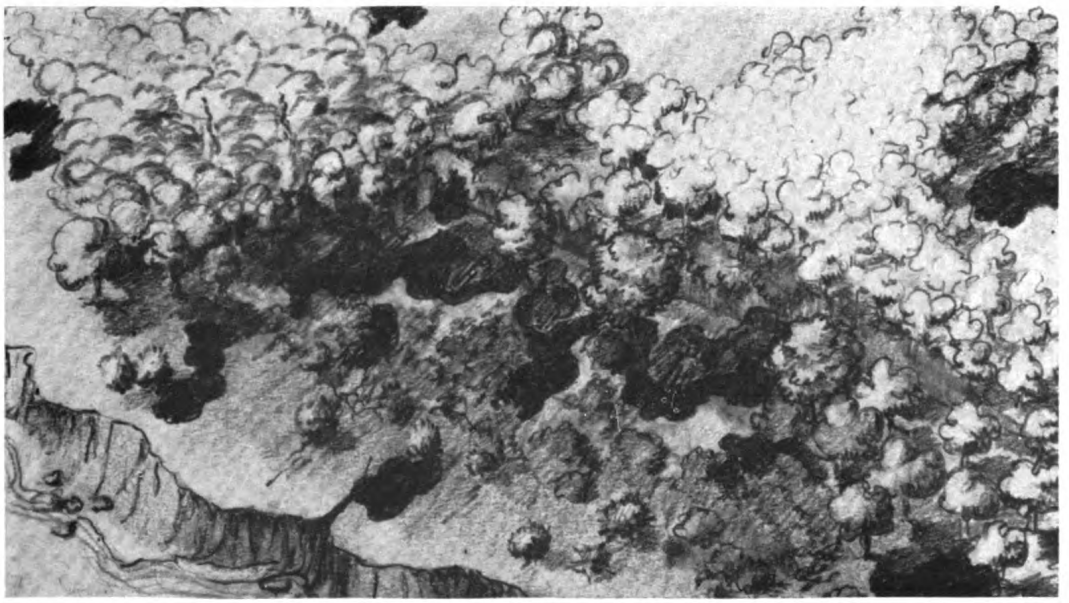


FIGURE 308.—Sketch of appearance of above battery after painting and planting both permanent and removable trees. Pit shadows have been broken up by a combination of painted shadows and actual tree shadows.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

69. Railroad guns.



FIGURE 309.—Scale 1:47,000, taken May 5, 1940: A railroad line with spur, A, under construction.

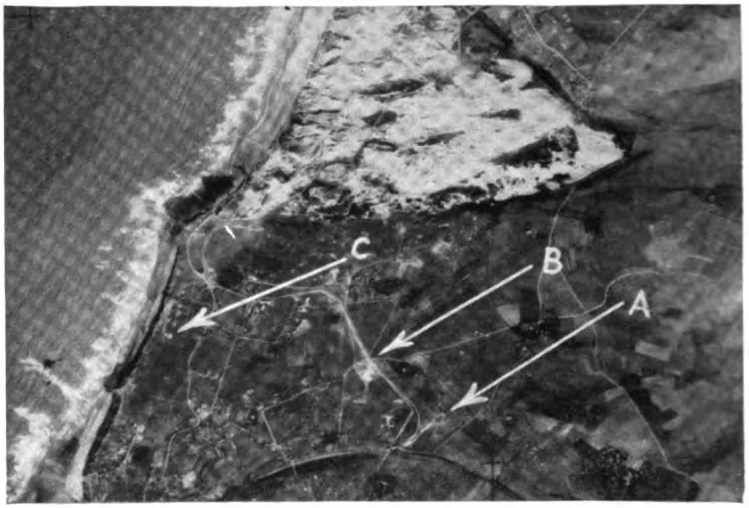


FIGURE 310.—Scale 1:47,000, taken September 9, 1940: Additional spurs and railway gun emplacements under construction. Note how construction work stands out.

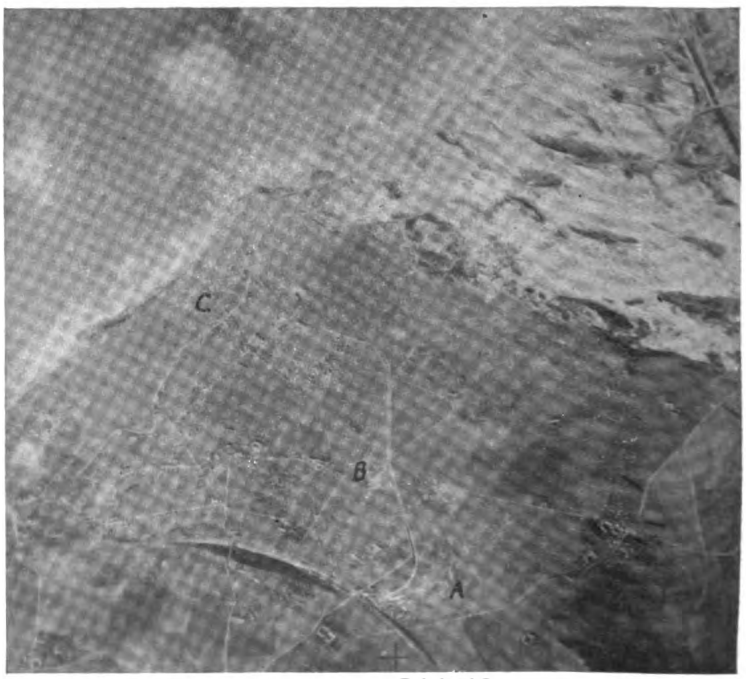


FIGURE 311.—Scale 1:33,000, taken November 2, 1940: The completed gun emplacements. The two railway guns A and B have turntable mountings. The four-gun battery at C is located alongside the railroad spur and is a permanent seacoast gun battery. Note how the scars of the construction work have toned down.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

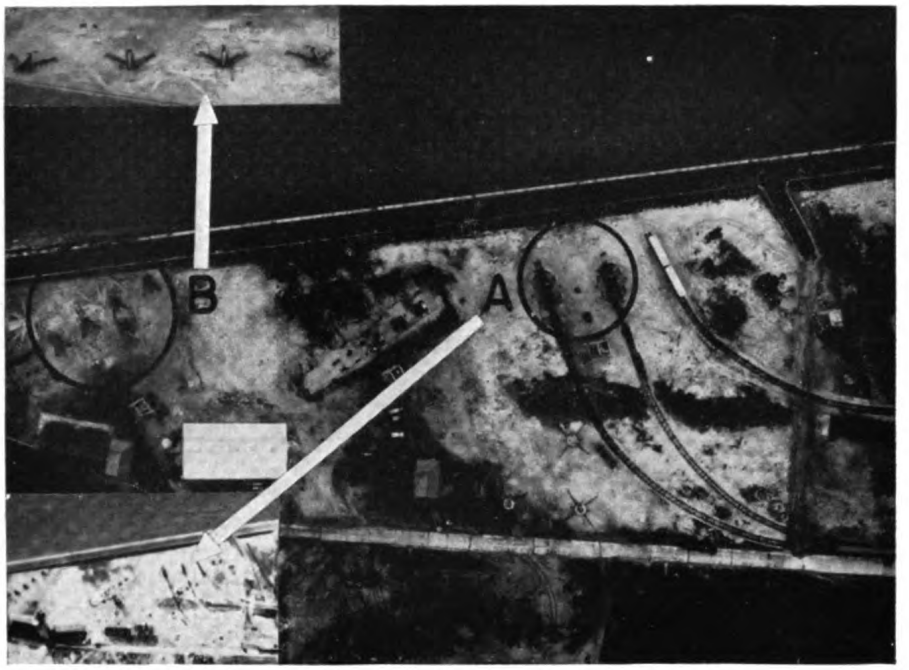


FIGURE 312.—Scale 1:3,000: A—railroad battery with an insert of the same guns at scale 1:10,000; B—battery of 155-mm guns with insert showing low oblique of same guns. Note the permanent antiaircraft guns in the center of the photograph.



FIGURE 313.—Ground view of a large railroad gun in action.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

70. Obstacles.—Photographs of obstacles used for beach defenses are not rare at this time, but their value should not be overlooked. When photographed at low tide, the types of obstacles and their weaknesses *may* be discovered from aerial photographs.

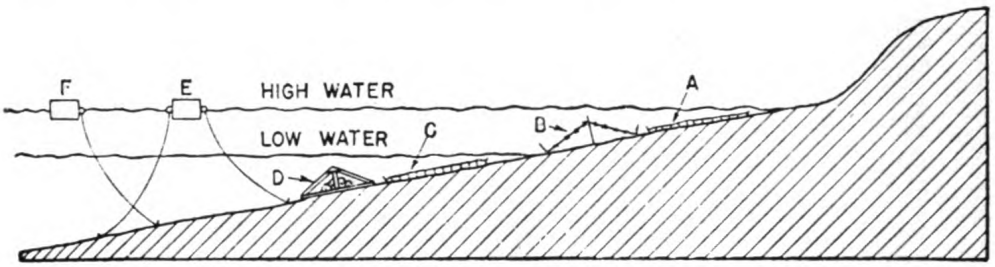


FIGURE 314.— Underwater obstacles.

A and B. Standard types of entanglements and obstacles constructed during periods of low water.
C and D. Standard types of entanglements and obstacles constructed on shore and then sunk in position.
E and F. Heavy booms, cables, or chains used to protect the entire installation.

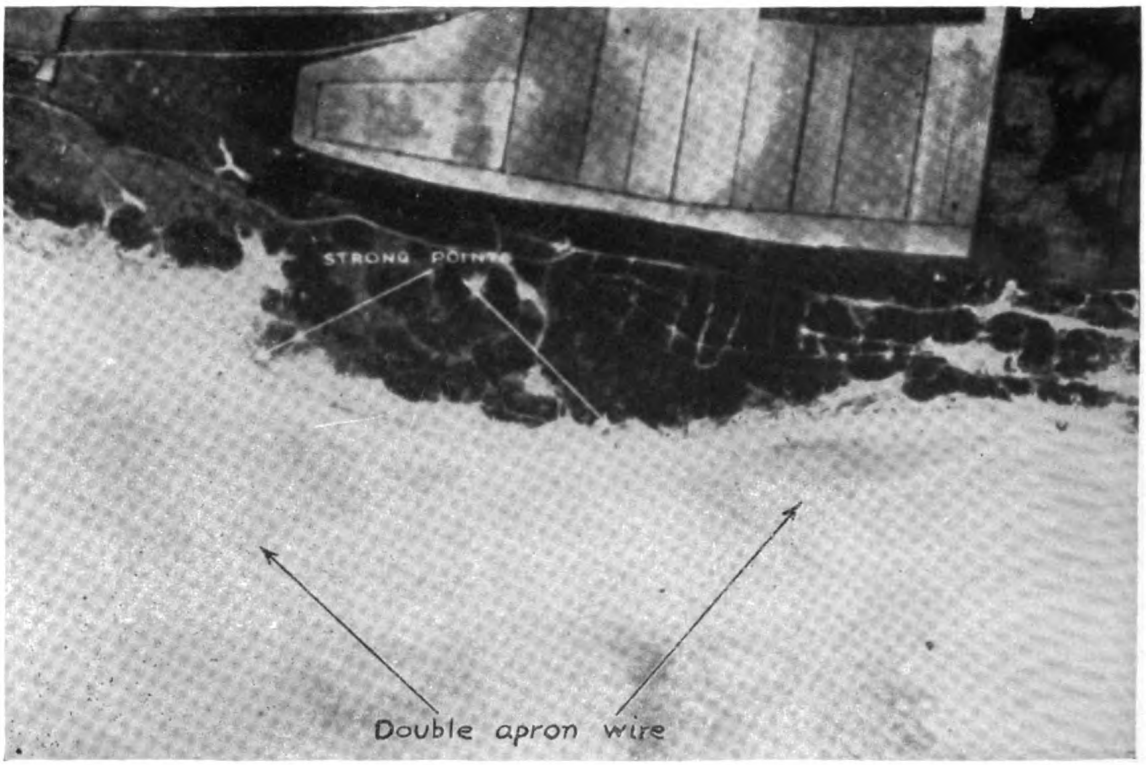


FIGURE 315.— Double apron wire used for beach defense. Strong points, manned with antitank guns and machine guns, protect the wire from removal.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

SECTION XI

ENGINEER ACTIVITIES

Paragraph
Significance 71
Equipment 72
River crossings 73

71. Significance.—A familiarity with the activities of engineers allows predictions as to the possible employment of other enemy troops. In forces the size of corps and larger, engineers employ many types of equipment which, if in the open, is easily identified and the engineer activity is consequently disclosed. Below are listed some of the elements of information peculiar to engineer activities.

Possible enemy line of action	*Engineers activities*
a. Attack.	*a.* (1) Working well forward with road equipment. (2) Reinforcement and construction of bridges. (3) Constructing mine fields and road blocks on one flank only. (4) Construction of advanced landing fields. (5) Dumps well forward.
b. Defend.	*b.* (1) Establishing field fortification material dumps well forward. (2) Active road construction and maintenance. (3) Construction of barriers on both flanks. (4) Construction of entrenchments. (5) Construction and improvement of landing fields. (6) Increased camouflage activity.
c. Withdraw.	*c.* (1) Preparation of barriers and demolitions in zone of withdrawal. (2) Moving heavy engineer equipment to the rear. (3) Slight maintenance of artery roads. (4) Construction of temporary landing fields in rear. (5) Preparation of defensive positions and of barriers and demolitions in rear areas.
d. Delay.	*d.* Engineer activities the same as in a withdrawal, but without preparation of rear defensive positions.

72. Equipment.—Enemy engineer equipment may be expected to parallel our own. The interpreter should therefore be able to recognize various special items of equipment and know their general use. Construction work is usually quite conspicuous when started, but the presence of equipment, as evidence that it is to be started, is often more important to commanders.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

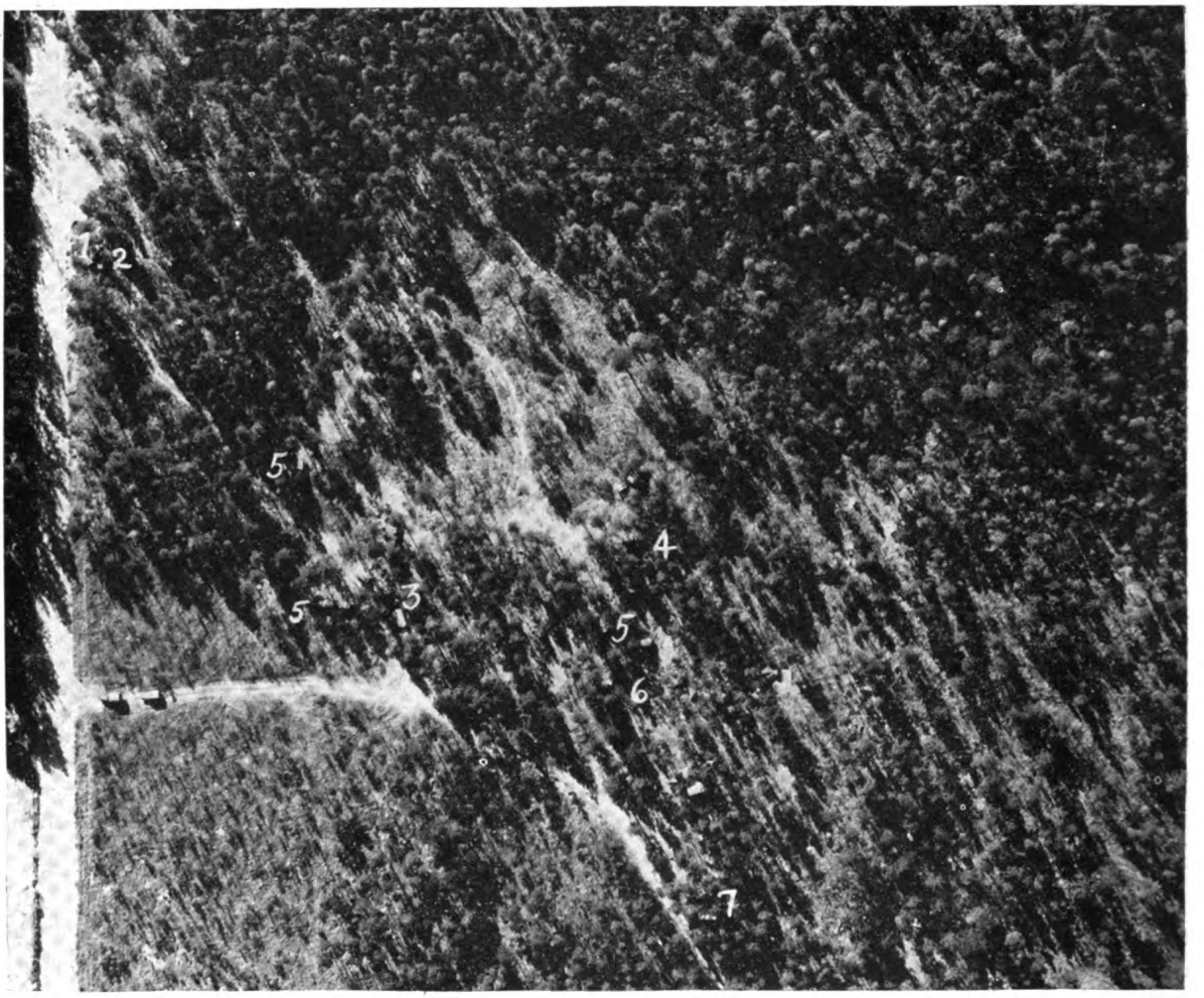


FIGURE 316.—Scale 1:2,000: Engineer bivouac. A close study of this photograph will show much construction equipment. A list of the easily identified items is given below. From the amount of equipment, it is probable that road and bridge construction is to be undertaken in the immediate vicinity.

1. Power shovel.
2. Road grader.
3. Large trailer truck loaded with bridge timber.
4. Truck with trailer and bulldozer.
5. Trucks.
6. Bulldozer.
7. Air compressor.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

73. River crossings.—*a. Importance.*—Intelligence and counterintelligence are keyed to their highest pitch in river crossings. Aerial photographs are employed extensively by both the attack and defense in this type of operation.

b. Attack.—When our forces are to attack a river line, the location of the enemy's reserves, the routes by which he may bring them forward, and the location of good crossing points are of prime importance. The officer in charge of interpretation may be called upon to furnish a detailed report on the condition of stream banks, locations of points of enemy resistance, extent of cover on both sides of river, possible bridge locations, and other information which would require more than normal photography and interpretation.

c. Defense.—(1) Where a river line is to be defended, photographic studies will be carefully made to determine the logical river crossing points from the location of—

(*a*) Approaches to river.

(*b*) Points along the river where there is moderate current, fairly deep water extending close to both shores, sloping banks, and existing road net nearby.

(*c*) Enemy troop concentrations.

(*d*) Engineer river crossing equipment concealed in final assembly areas, such as woods near the river.

(*e*) Old bridge and ferry sites which might be used advantageously as crossing points.

(2) If the location in forward areas of assault boats, footbridge, and ponton bridge equipage can be determined, it will be easier for the commander to estimate the approximate location of the enemy's main effort. Photographs of a ponton bridge already in place are of value as a bombing objective for our air forces and to determine the loads the bridge will carry. A photograph of the beginning of a ponton bridge is of great value to ground forces as proper steps can be taken to oppose its construction and use.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 317.—Loaded dolly trailer.

Figure 317: Ground view of dolly trailer loaded with trestle balk and trestle columns.



FIGURE 318.—Reinforced ponton bridge.

Figure 318: Ground view of the 10-ton reinforced ponton bridge. Note gently sloping banks which confirm information obtained from stereo study of the aerial view.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

Figures 319 and 322, scale 1:6,000: Stereo pair of river crossing point. Photographs taken in peacetime. Note preparations for crossing. From the standpoint of good location, this river crossing point meets all necessary qualifications. There is sufficient cover to conceal equipment in the final forward assembly area. The sloping banks make excellent approaches, and the deep water close to both shores simplifies bridge construction. Familiarity with equipment will reveal to the interpreters that this is 10-ton ponton equipage. Note the difference between the 10-ton and 25-ton semitrailers in the close-up views shown in figures 326 and 328. These differences can be seen from an aerial photograph.

Key to figures 319 and 322

1. Ponton used to transport trestle across river.
2. Five pontons.
3. Ponton on dolly trailer.
4. Ponton on semitrailer.
5. Empty semitrailer.
6. Caliber 50 antiaircraft machine gun.
7. Old bridge ramp.
8. Covered bridge ramp.
9. Final assembly areas.
10. Assault boat.

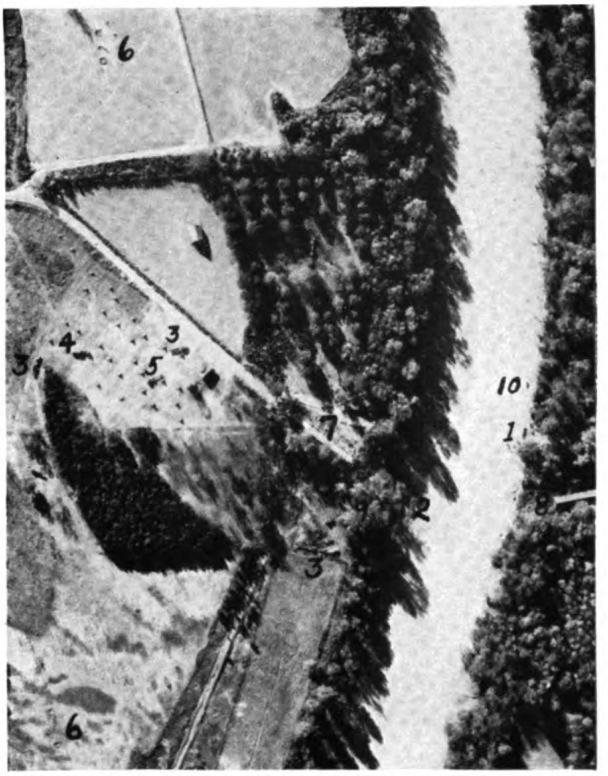


FIGURE 319.—River crossing point. Stereo pair with figure 322.

Figures 320 and 324, scale 1:10,000: Stereo pair of a 10-ton ponton bridge reinforced to 20 tons. Stereo pair figures 317 and 322 were taken at 9:00 AM while figures 320 and 324 were taken at 3:00 PM of the same day and show the completed bridge in operation. Note the antiaircraft machine guns.

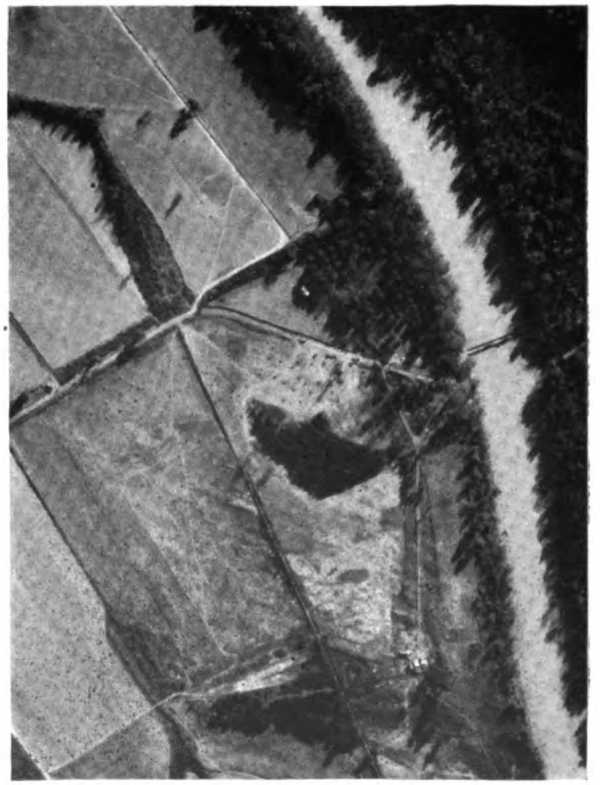


FIGURE 320.—10-ton ponton bridge, reinforced. Stereo pair with figure 324.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 321.—Oblique of armored force pneumatic taken at 5,000 feet. The hook-shaped appearance of pontons on right side of bridge is caused by the angle at which the photograph was taken.

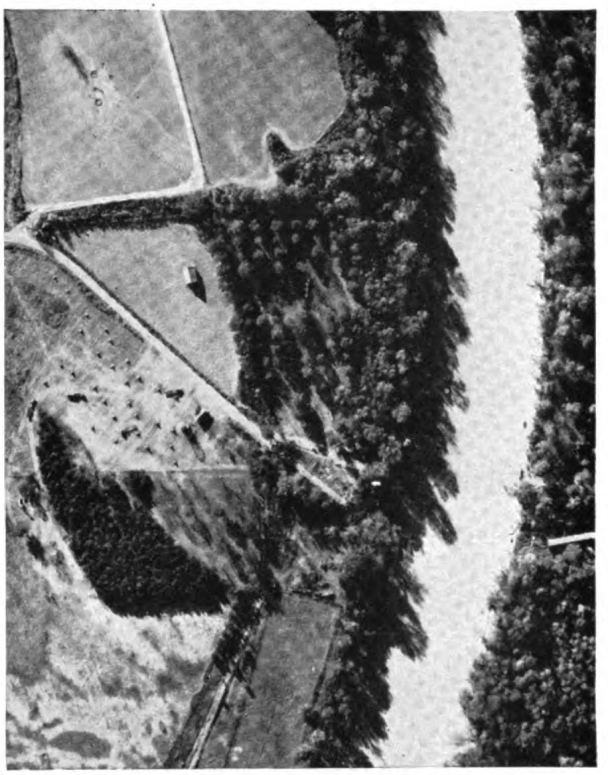


FIGURE 322.—River crossing point. Stereo pair with figure 319.

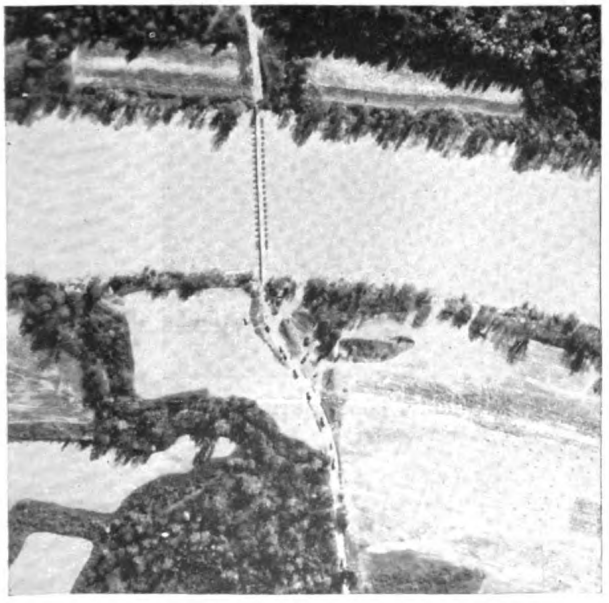


FIGURE 323.—Scale 1:6,000: 10-ton ponton bridge constructed at a ferry site. Note large number of trestle bays necessary on each bank because of shallow water. Old bridge and ferry sites must always be considered as a possible ponton bridge site.

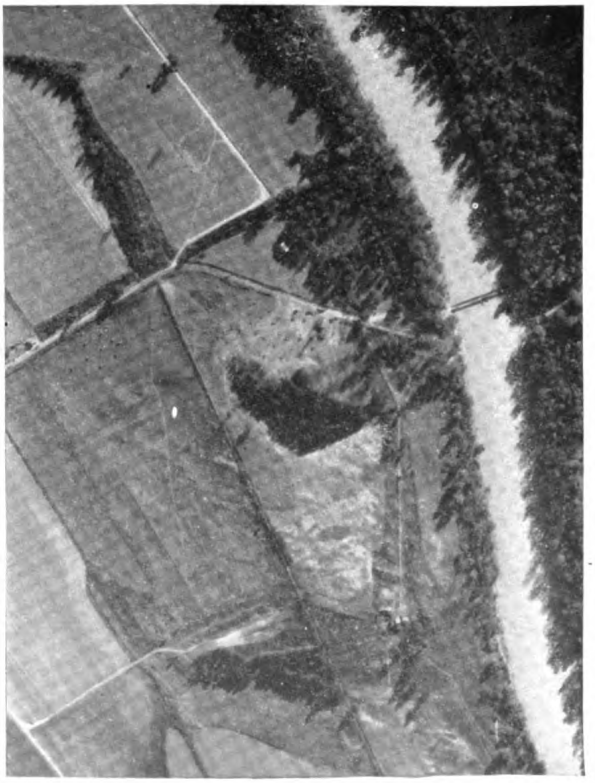


FIGURE 324.—10-ton ponton bridge reinforced. Stereo pair with figure 320.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

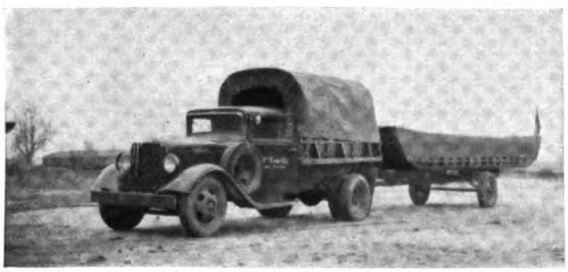


FIGURE 325.—10-ton ponton on dolly trailer.

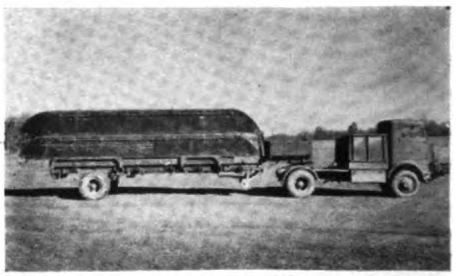


FIGURE 326.—10-ton pontons on semi-trailer.



FIGURE 327.—Ground view of armored force pneumatic ponton bridge.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

Figures 328 and 334, scale 1:6,200: Stereo pair of a 25-ton ponton bridge under construction. One look at the trailers or pontons should tell the interpreter it is 25-ton equipage.

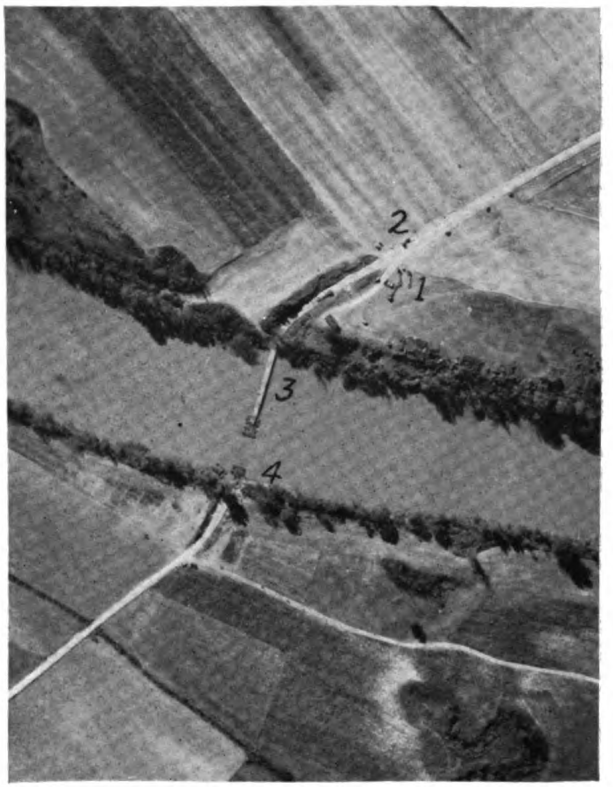


FIGURE 328.—25-ton ponton bridge. Stereo pair with figure 334.

1. 25-ton ponton semitrailer.
2. Truck crane.
3. Trestle bays.
4. Civilian ferry.

Figure 329, scale 1:10,000: Same area as figure 331 but taken several minutes later. Note progress on the two bridges.



FIGURE 329.—Ponton equipment.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

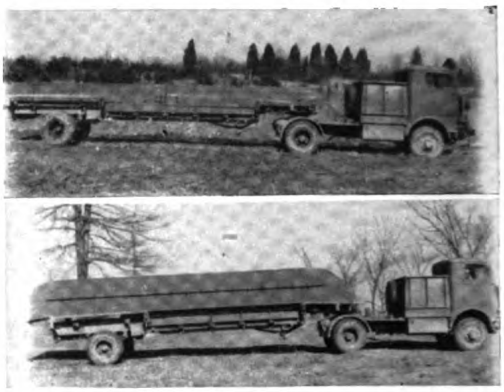


Figure 330: Ground photograph of 25-ton ponton semitrailers. The top one is loaded with balk, and the bottom one with a 25-ton ponton. Note that the box directly in front of the pontons on the 10-ton trailer is not on the 25-ton trailer; this is a distinguishing feature from the air.

FIGURE 330.—25-ton ponton semitrailer.

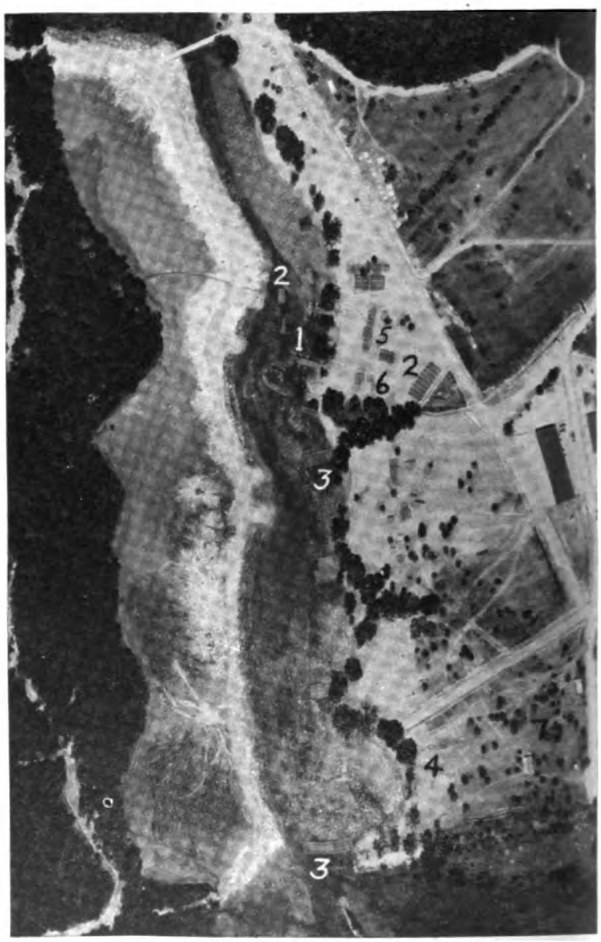


Figure 331, scale 1:5,000: Ponton training area. Although nontactical, it affords a good study of ponton equipage. The stream shown in this photograph was formerly a tidal flat through which a channel was dredged and the bank built up on one side; hence the odd appearance. Note in the center of the photograph the two bridges under construction. A careful measure of the lengths of the pontons will show them to be about 32 feet long, the length of the 25-ton pontons. The pontons in the lower part of the photograph measure 28 feet and are the 10-ton or light pontons.

FIGURE 331.—Ponton equipment.

1. 25-ton ponton bridges under construction.
2. 25-ton pontons.
3. 10-ton pontons.
4. Assault boat being carried to water.
5. Pile of chess, 25-ton equipage.
6. Pile of balk, 25-ton equipage.
7. Men.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 332.—Truck crane.



FIGURE 333.—Scale 1:40,000: German ponton bridge. The pontons are much longer than those used in this country and are probably employed only in rear areas to replace bombed bridges.



FIGURE 334.—25-ton ponton bridge. Stereo pair with figure 328.

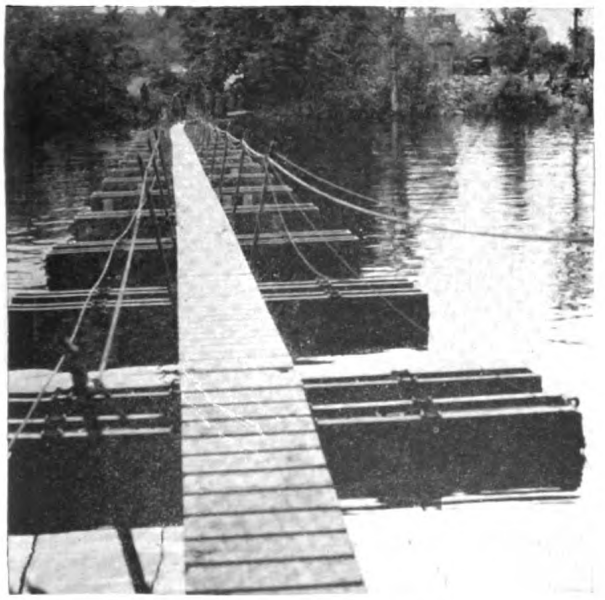


FIGURE 335.—Footbridge.

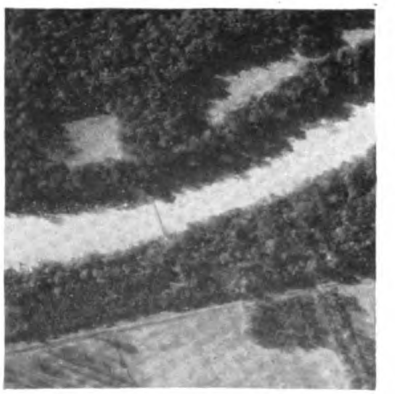


FIGURE 336.—Scale 1:10,000: Footbridge. A single bay consists of two floats and a duckboard, as shown at the left. This bridge can be built from one side of a stream by connecting assembled bays and pushing them out from the bank. One 1½-ton truck can transport 108 feet of this bridge.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 337.—Low oblique of ponton bridge.

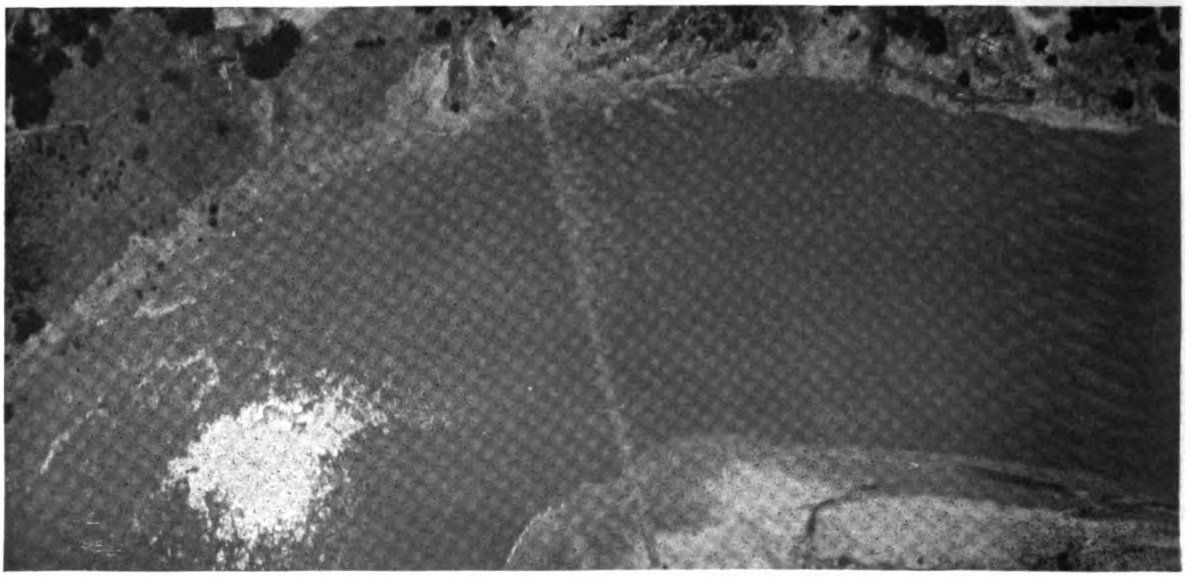


FIGURE 338.—Scale 1:3,500: Night photograph of ponton bridge. The light spot at the left was caused by the reflection of the flash bomb.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

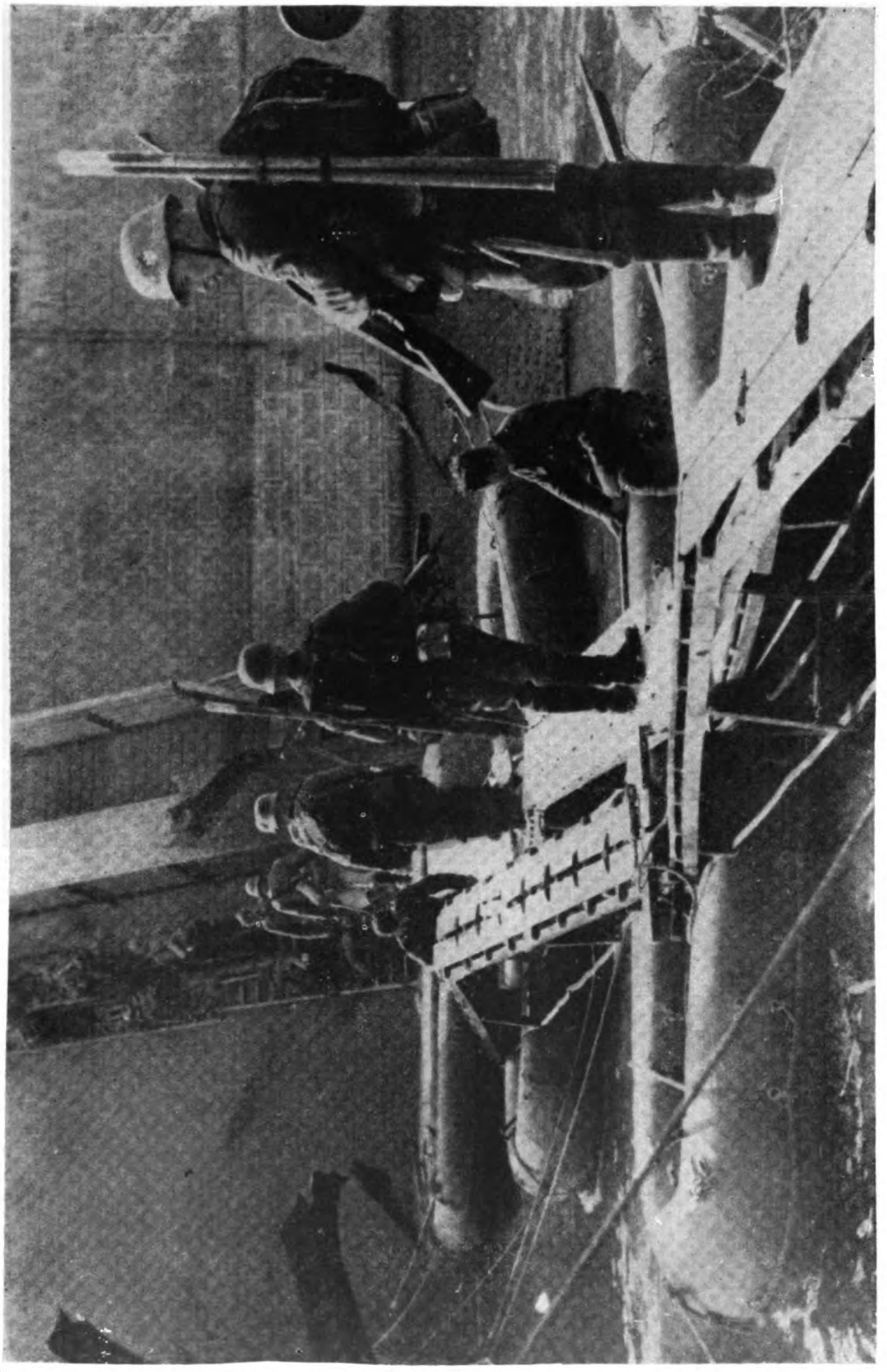


FIGURE 339.—German rubber ponton boats used as a footbridge expedient.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 340.—Composite bridge—wooden trestle and steel trusses.

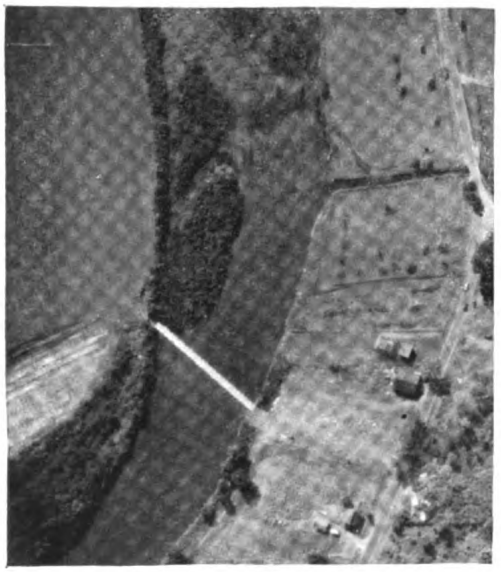


FIGURE 341.—Trestle bridge.

The bridges shown in figures 340 and 341 are found over streams too shallow for floating bridges and with bottoms too soft for fording; over streams or gullies with steep banks, in which case steel trusses would probably be used; and in rear areas where sufficient time and material are available.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 342.—Oblique of cable bridge.

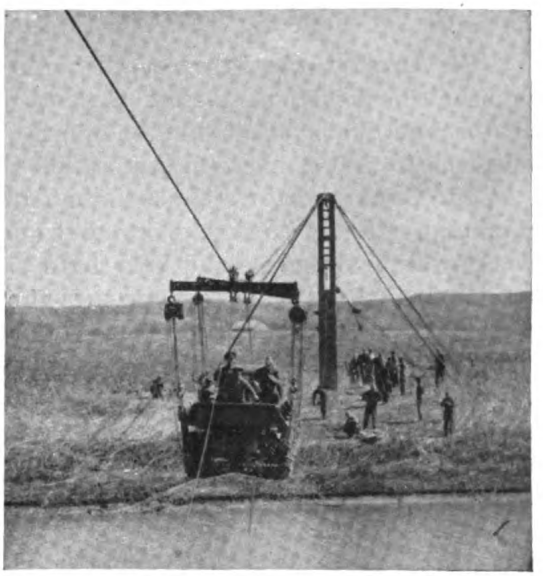


FIGURE 343.—Close-up of cable bridge.



FIGURE 344.—Transportation of cable bridge.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

SECTION XII

ADVANCED LANDING FIELDS

Paragraph
Importance 74
Construction 75
Protection 76

74. Importance.—Advanced landing fields are of all types. They are generally located in or near the theater of operations and are used for grasshopper, observation, photographic, interceptor, and light and medium bombing airplanes. Information concerning the enemy's airfields is obtained from first phase interpretation and turned over immediately to the air force.

75. Construction.—In building advanced landing fields, construction work is kept to a minimum not only because of economy and speed but because it is impossible to conceal construction work while in progress and very hard to camouflage later. Advanced landing fields will have a minimum of facilities. Dispersion is the most important means of protecting personnel and airplanes. Where level land is used to eliminate grading, it is sometimes necessary to install subsurface drainage lines. These can be seen on an aerial photograph taken months, or even years, later. Advanced fields consisting of metal landing strips are successful, particularly when laid on turf requiring very little grading; the camouflage effect is excellent and improves with use. These fields will generally be located where natural overhead cover can be used for concealment of accessories such as buildings, operating facilities, and airplanes.

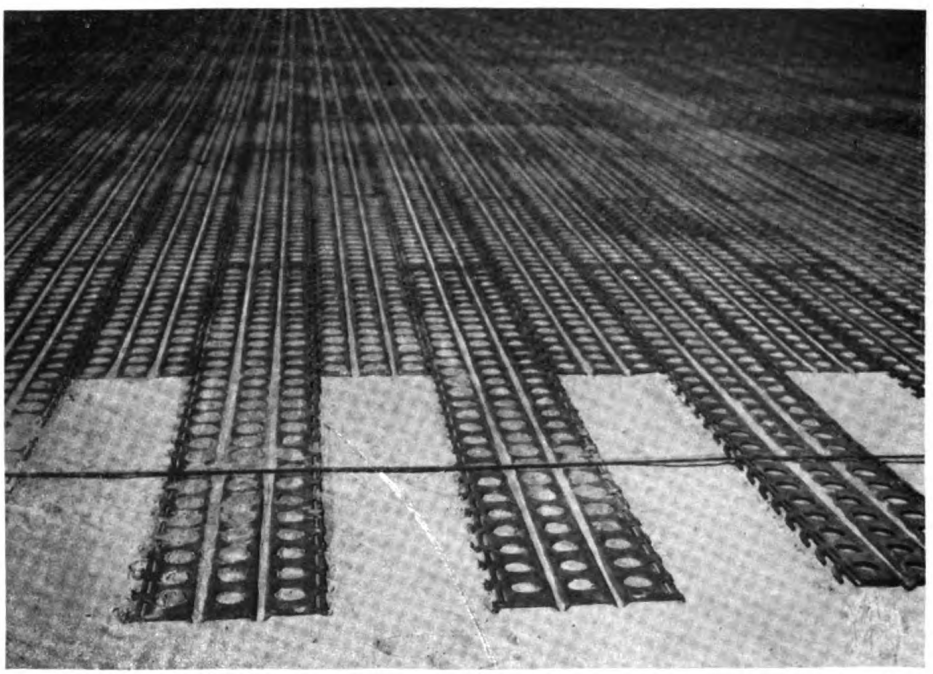


FIGURE 345.—Metal landing mat shown in figure 347, made up of strips.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

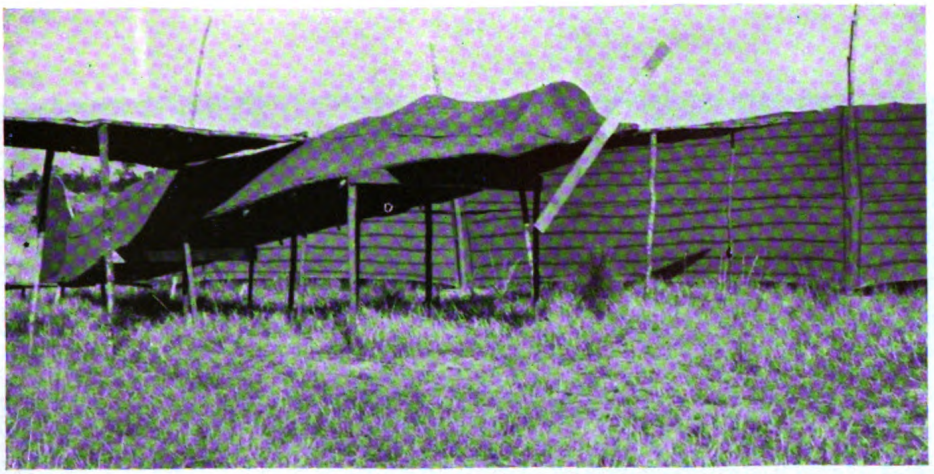


FIGURE 346.—Dummy airplane.

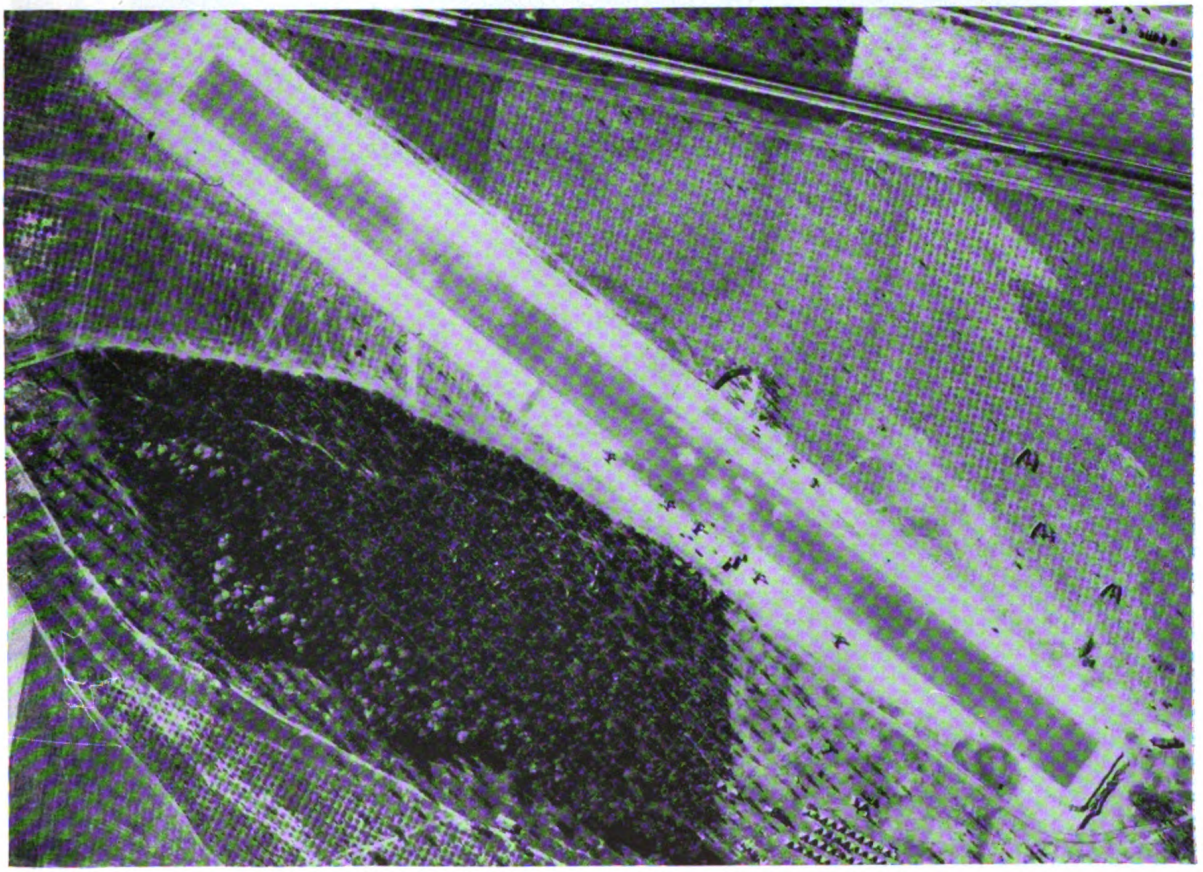


FIGURE 347.—Advanced landing field under construction.

Figure 347, scale 1:6,400: Advanced landing field consisting of a metal landing mat 150 by 3,000 feet. The large amount of grading and construction work necessary on this field would make its concealment from the enemy impossible. Field patterns will often be an aid in determining the location of a camouflaged airdrome, for it is difficult to tie in a landing field with the patterns of the surrounding fields. Note the checkered pattern in figure 347, but from the ground view, figure 349, it cannot be detected. Figure 348, scale 1:10,000, shows the same checkered field pattern. These fields were once peach orchards. See paragraph 80 for dummy installations.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

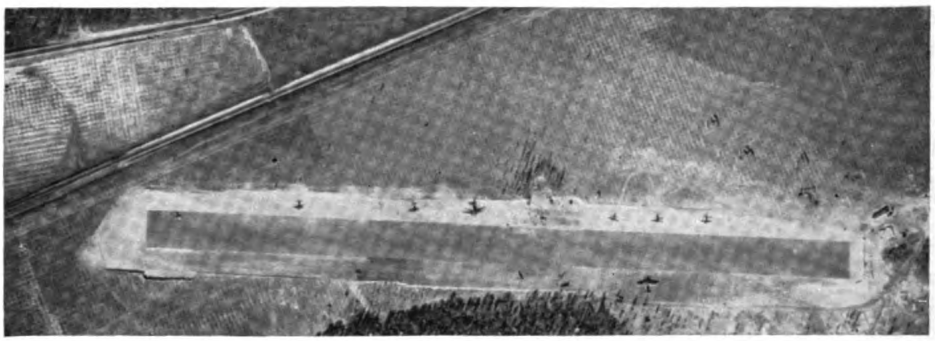


FIGURE 348.—Advanced landing field.

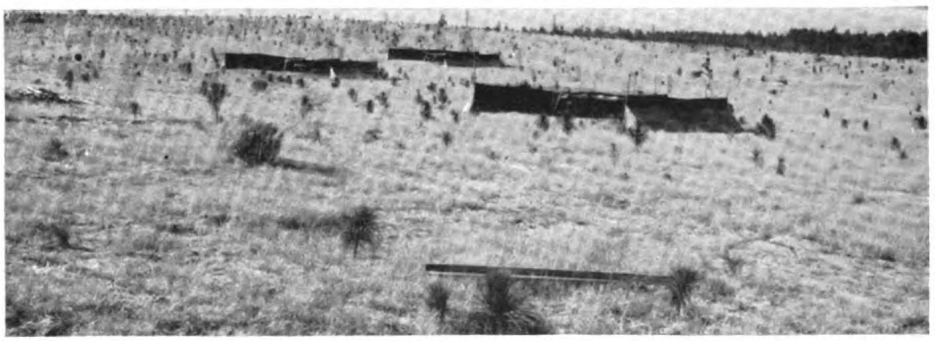


FIGURE 349.—Ground view of dummy airplanes and revetments.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

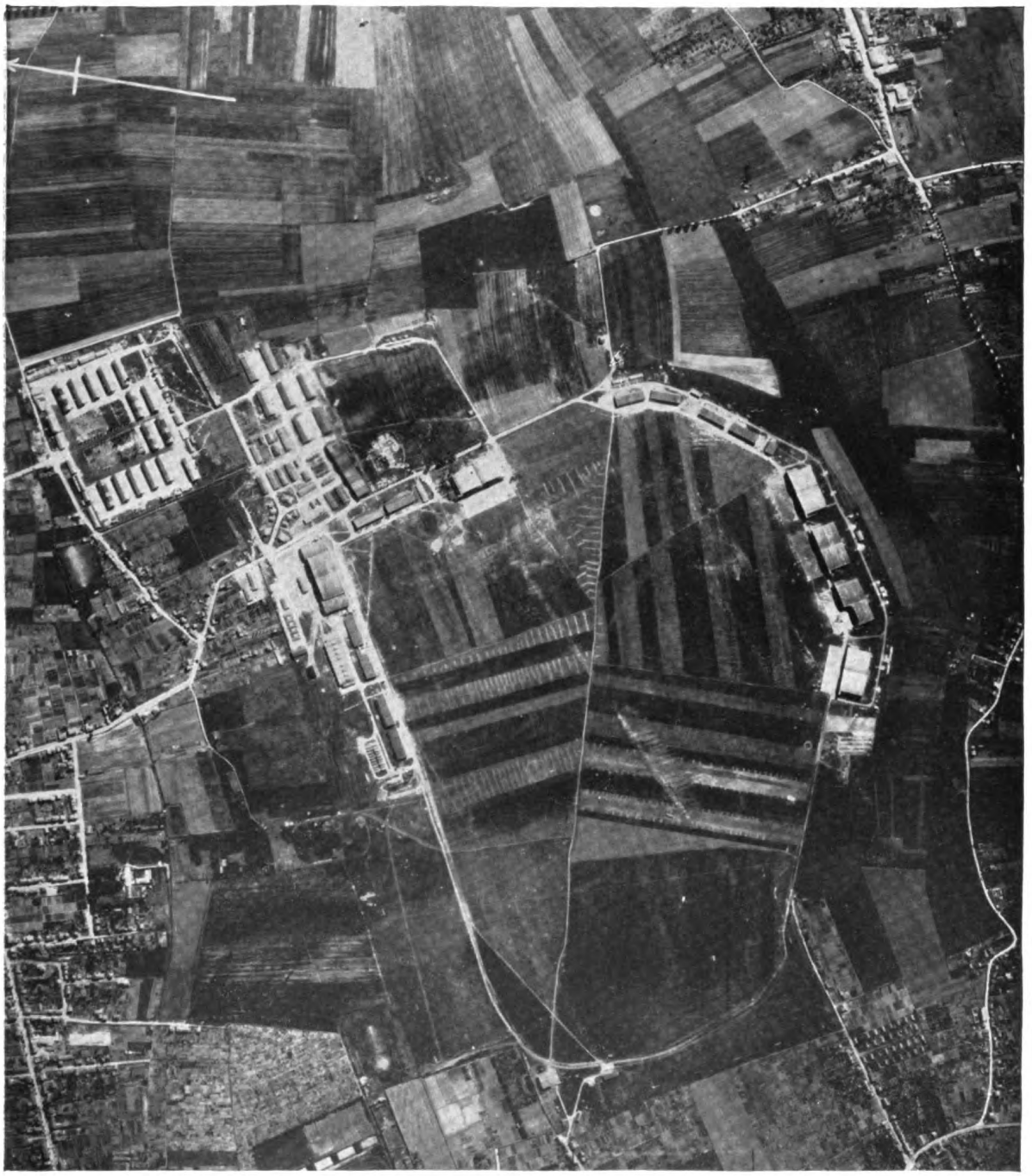


FIGURE 350.—German airfield. Note attempt at camouflage by copying patterns of surrounding fields. This photograph brings out the points to look for when searching for a well-concealed field. Such items are roads used by maintenance crews around outer edge of field; large and small buildings close to the edge of the field; subsurface drainage lines; field patterns not corresponding to surrounding fields; painted roads crossing the field and ending abruptly; and the characteristic ham-shaped outline of entire field.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 351.—Scale 1:10,000: Small advanced landing field, located where the common ground patterns are irrigation control terraces, or field terraces, and numerous wooded patches. The construction of the landing field disrupted the natural pattern, making it easy to locate.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA



FIGURE 352.—Scale 1:10,000: The same advanced landing field as shown in figure 351. Photograph taken 18 days later, when landing field had been camouflaged. No attempt was made to conceal the hangar. The dummy roads, simulated field terraces, orchards, and wood patches are very effective for visual observation, but a close study of the aerial photograph reveals their falseness. Note the orchard, as compared to the real orchard to the right of the airfield. The roads across the field are too even and regular; compare them to existing roads. See figures 353 and 354 for a close view of simulated terraces, orchards, and roads.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

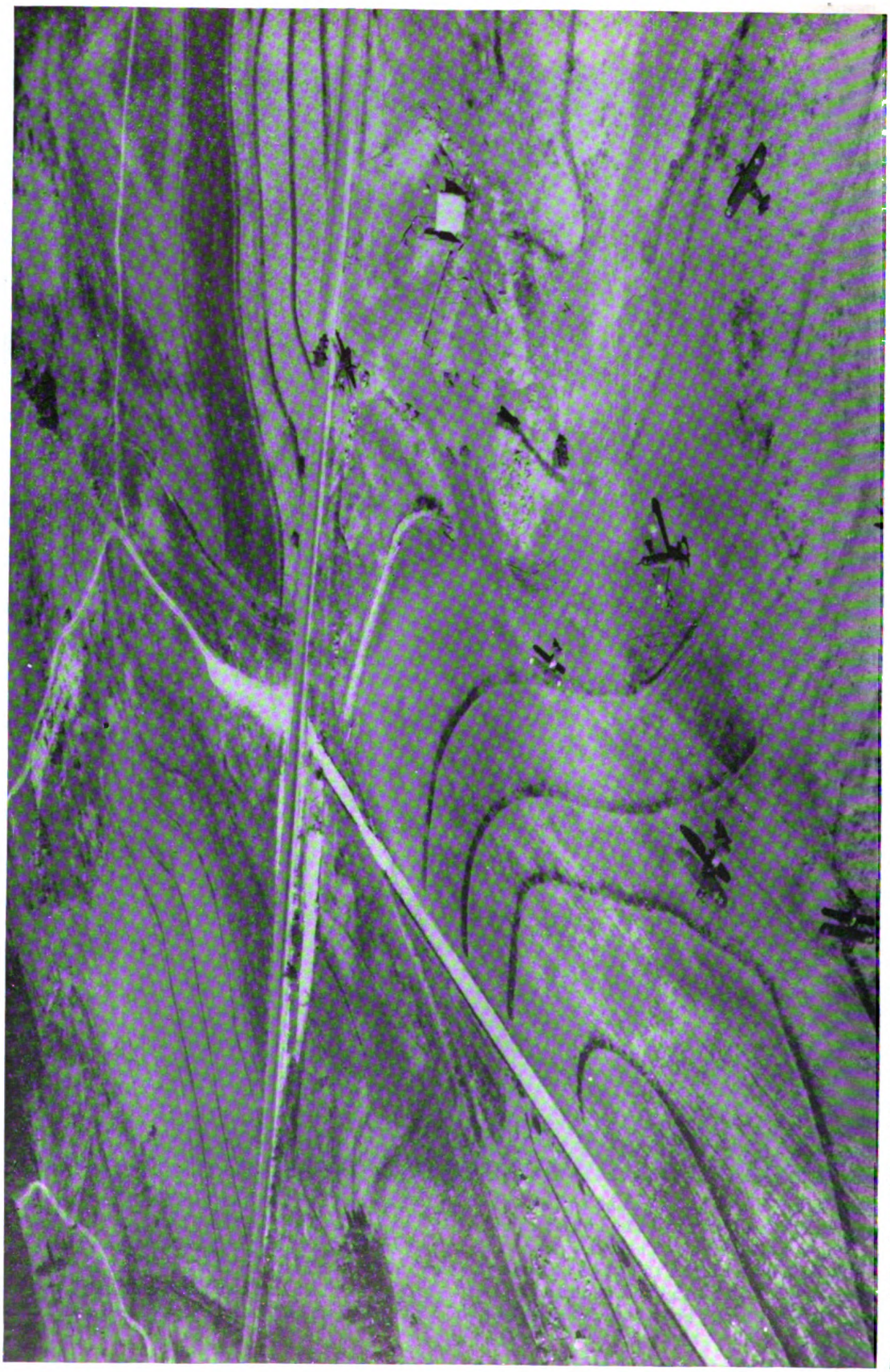


FIGURE 353.—Low oblique taken at 600 feet, showing the false road and simulated terraces. The road was constructed by bulldozing the earth and painting the edges with asphalt paint. Terraces were painted on the ground, and highlighting was accomplished by applying clay along one edge.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 354.—Low oblique, taken at 600 feet, shows end of runway camouflaged as orchard. The tree patterns were painted on the ground with asphalt paint.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

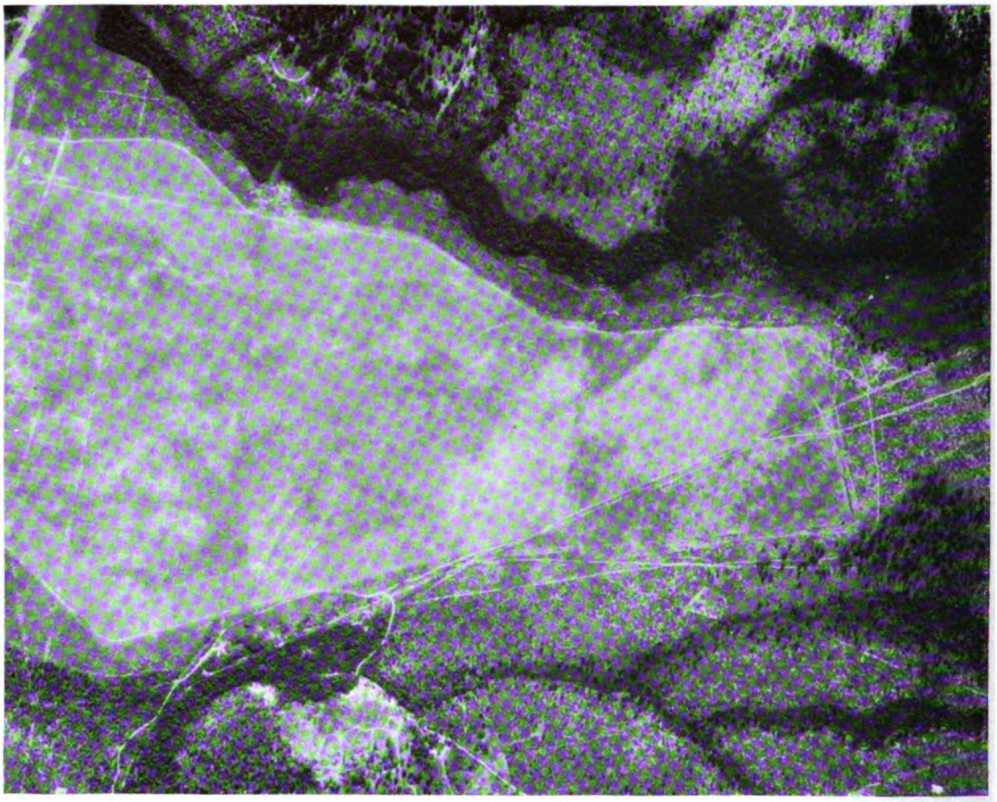


FIGURE 355.—Scale 1:12,000: Advanced landing field. Note the subsurface drainage line leading toward the bottom of the photograph. No camouflage has been attempted on this field.

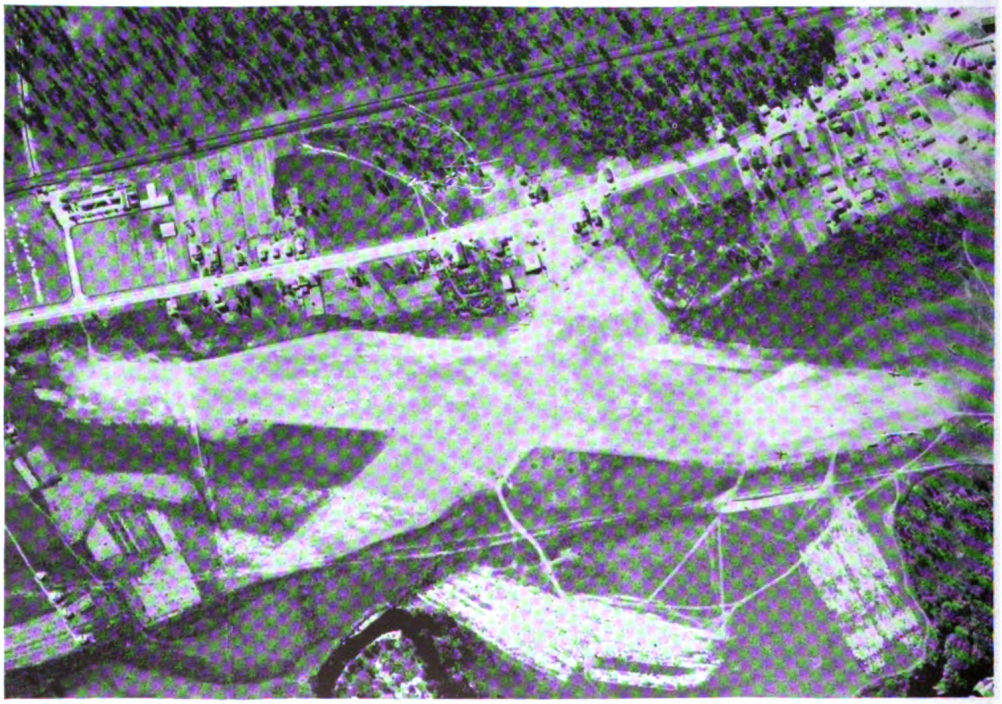


FIGURE 356.—Scale 1:9,000: Advanced landing field under construction. Note how conspicuous it is.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

76. Protection.—The war in Europe has proved that dispersion of airfield facilities is the most effective means of protection against enemy attack. With antiaircraft keeping the attacking airplanes high and with targets dispersed, permanent damage to airfields has been slight.



FIGURE 357.—Example of a forward air base in first World War. No protection was given the field or its facilities. Grouping of airplanes and hangars in this manner today would be fatal.

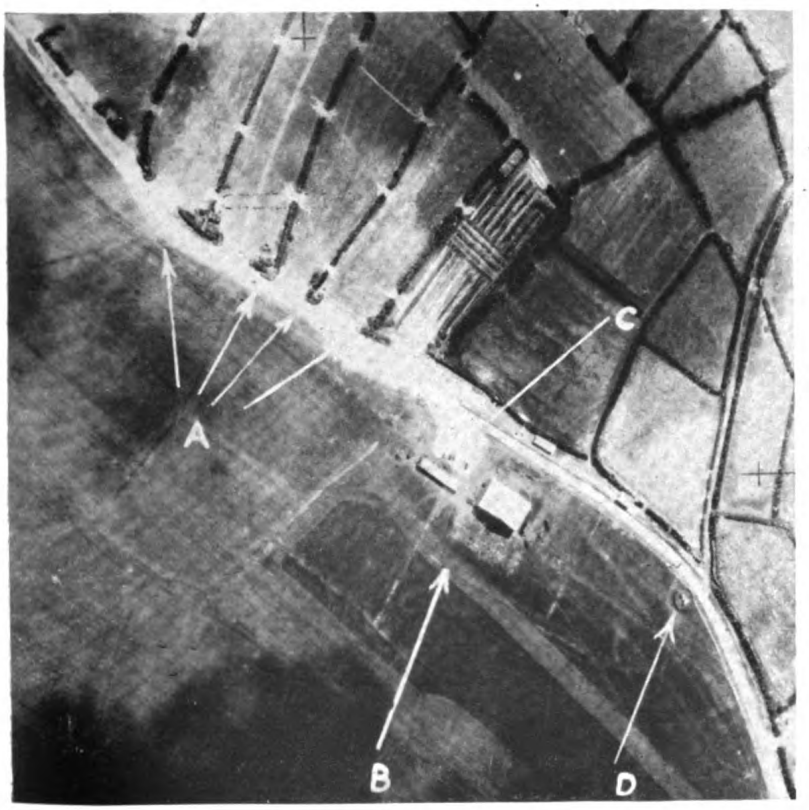
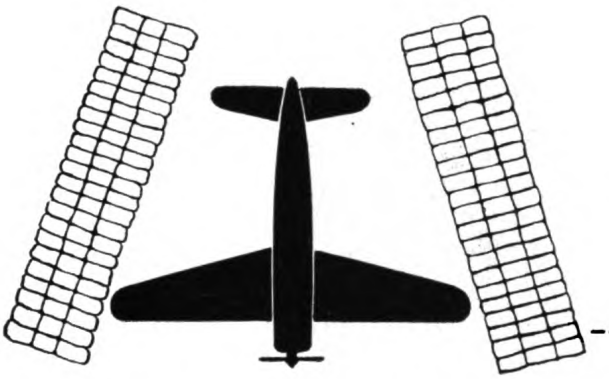
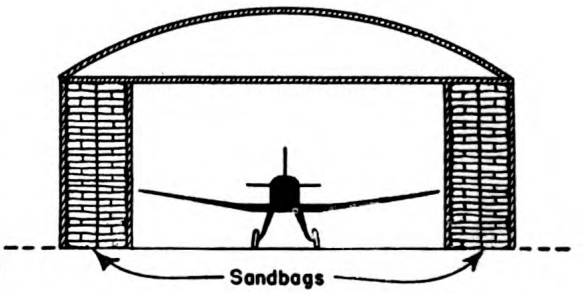


FIGURE 358.—Example of a forward air base in second World War. Protection is obtained by dispersion. This photograph shows part of a dispersal area, A. These areas often extend for a mile or more in all directions from the airfield. Gaps in hedges are wide enough to allow aircraft to pass from field to field. Where hedges and woods do not exist adjacent to the airfield, blast shields or revetments of earth or sandbags are built near the field (see fig. 359). B, hangar 250 by 150 feet; C, parked trucks; D, landing "T."

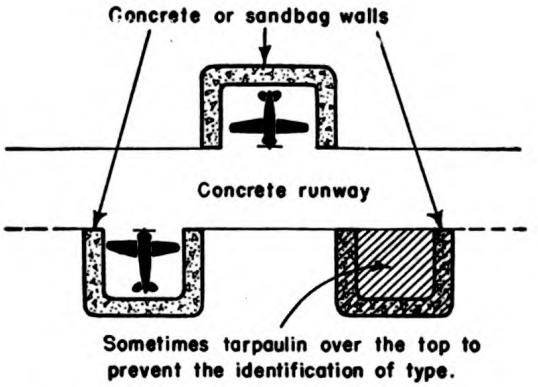
Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



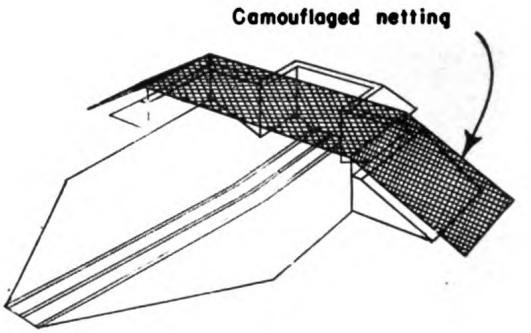
(A) TWO WALLS BUILT OF EARTH OR SANDBAGS — (SOMETIMES PARALLEL)



(B) SINGLE AIRCRAFT HANGAR BUILT OF SAND BAGS



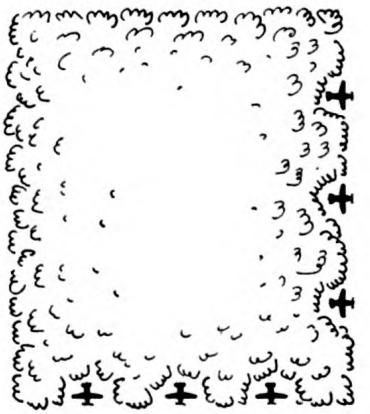
(C) PERMANENT DISPERSAL BAYS



(D) SUNKEN BLAST SHELTERS



(E) GAPS IN HEDGES



(F) BAYS CUT IN EDGES OF WOODS

FIGURE 359.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

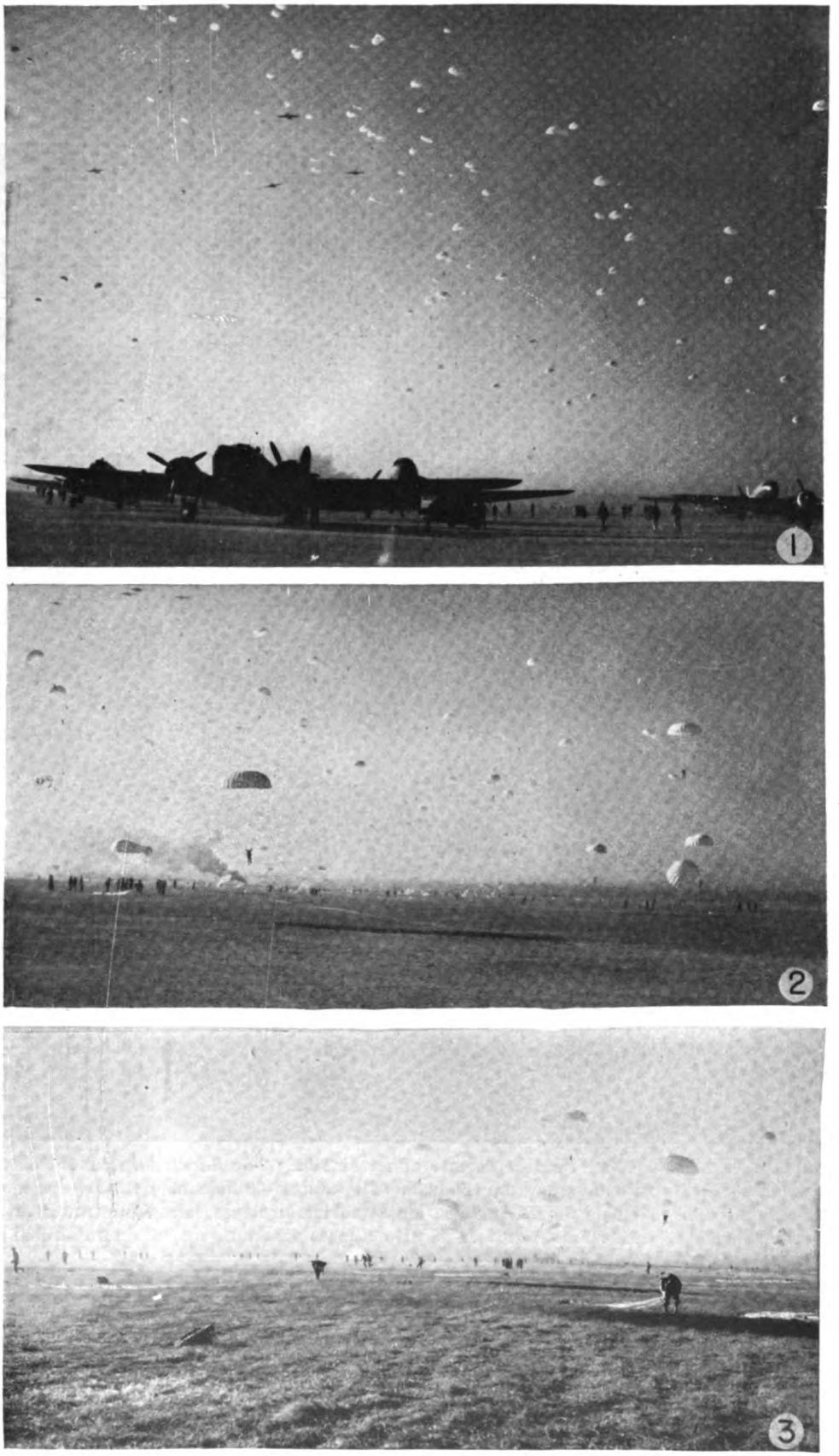


FIGURE 360.—Parachute attack.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 361.—Scale 1:35,000: Plan of defense of an airfield. The 3-inch antiaircraft batteries are placed 2,000 to 3,000 yards from the field. The caliber .50 machine guns are much closer as they are used to defend the field against low attacking airplanes, parachute troops, and airborne troops. Figure 360 gives an idea of what a mass parachute attack on an airfield looks like.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

SECTION XIII

CAMOUFLAGE

	Paragraph
General	77
Study of own position	78
Signs of occupation	79
Dummy installations	80
Break-down by photography	81
Counterintelligence	82

77. General.—The interpreter must be thoroughly versed in camouflage methods and technique and must study those of the enemy. Our own manuals on camouflage and protective concealment are FM 5–20, TM 5–265, 5–266, and 5–269; these should be studied.

78. Study of own position.—The officer in charge of interpretation may expect to be charged with photographic inspection of his own unit's positions. Camouflage discipline is the responsibiityl of every commander, and subordinate commanders must be checked. Close cooperation is essential between the interpretation officer and the camouflage officers to see that camouflage is used where needed and is effectively maintained. The original selection of bivouacs and positions is important as utilization of natural concealment as much as possible is essential.

79. Signs of occupation.—Signs of occupation are obvious when an area can be studied on comparative photographs. However, photographs of territory prior to occupation by the enemy are rare. Signs of activity which do not appear to be the normal civilian activity are the primary means of arriving at enemy locations within an area. An attempt to identify every blemish on a photograph with some civilian activity should be made. Trails should be traced to see if they lead to some field under cultivation or other normal place of civilian activity. New appearing roads or trails should be viewed with the utmost suspicion.

80. Dummy installations.—*a. Purpose.*—Care must be exercised in interpretation work to avoid recording dummies as true installations. Dummies have two purposes:

(1) To deceive or confuse visual observers and bombers.

(2) To deceive interpreters.

The former are hurried jobs and become apparent on photographs. The latter are deliberate, carefully planned and executed.

b. Identification.—Dummy installations frequently may be identified because of the tendency of installers to make the subject too obvious. Exposing characteristics of dummy installations are the following:

(1) White is too white.

(2) Signs of activity inherent to construction of a real installation are lacking.

(3) Size of object or installation smaller than real object.

(4) Installations made by designs on earth (roads and runways) are usually too angular and edges are too well defined.

(5) Objects designed to have depth are more often the opposite of (4) above and have wavy edges.

(6) Lack of shadows, or shadows in the wrong relation to actual objects.

(7) Location not logical for real object.

(8) Absence of communication to object, which would be in evidence on a real object.

(9) Absence of allied or supporting objects. This is a case where a dummy airfield lacks signs of personnel living in the vicinity or where dummy artillery positions have no signs of prime movers and communication.

(10) Lack of maintenance. This is easily determined by comparative photographs.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

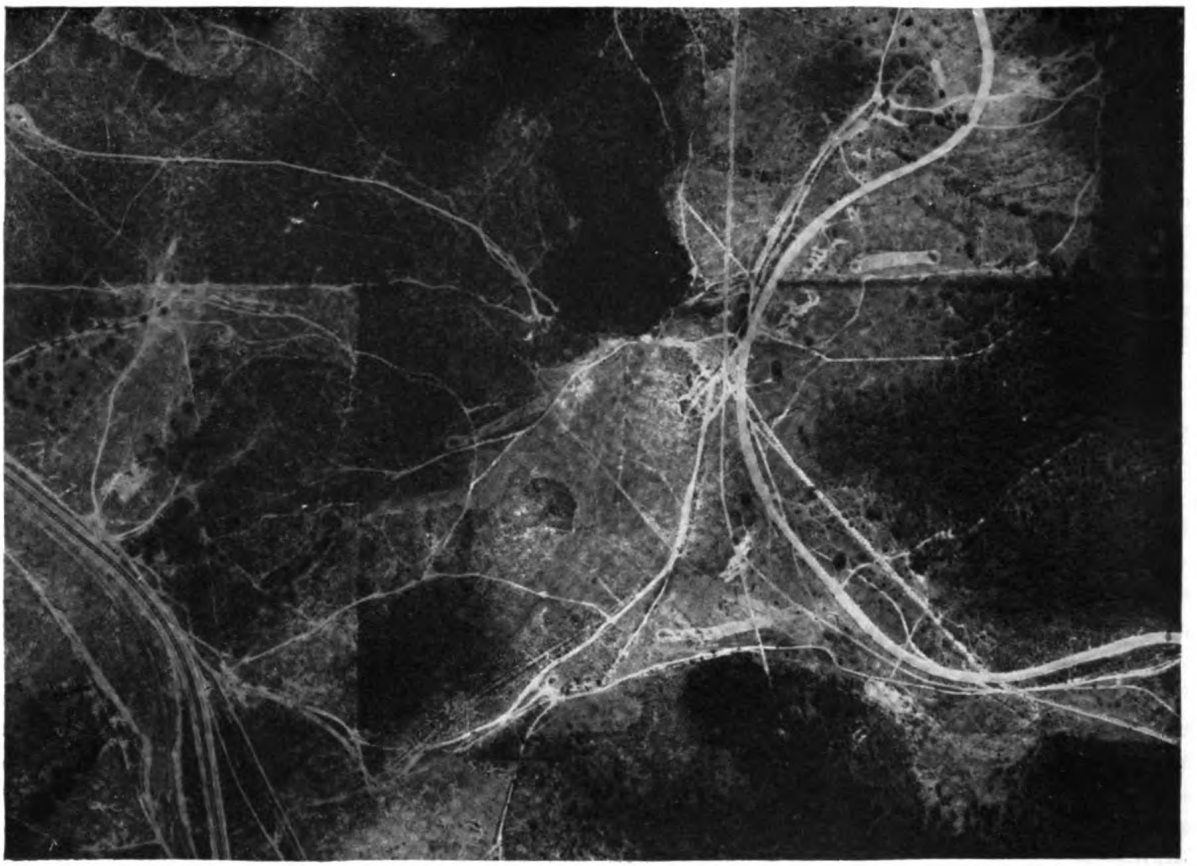


FIGURE 362.—Scale 1:10,000. Great military activity without regard to concealment. On photographs of this type, where an area is extensively disturbed, little new activity can be determined from the ground pattern without comparative photographs.

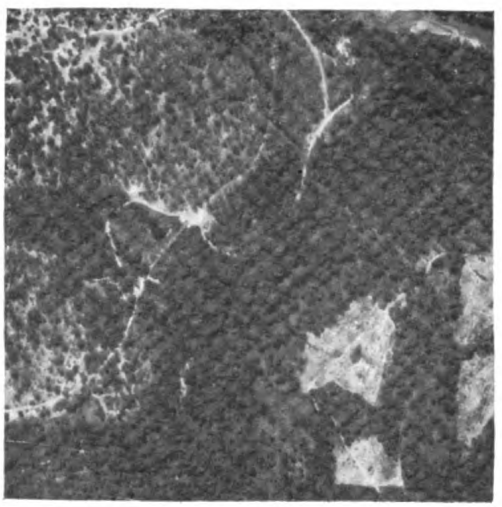


FIGURE 363.—Scale 1:10,000. Trails which lead through woods without junctions or wide places, are generally civilian trails. In this photograph, the trails widen at junctions and extend for short distances without leading to buildings, which indicates military activity.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

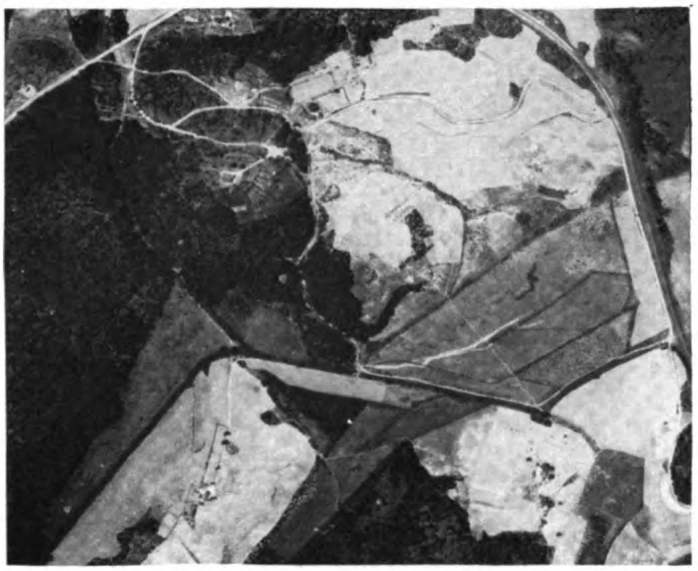


FIGURE 364.—Scale 1:10,000. The road net in the upper left around the buildings warrants suspicion. Compare with road leading to farm group at lower left.

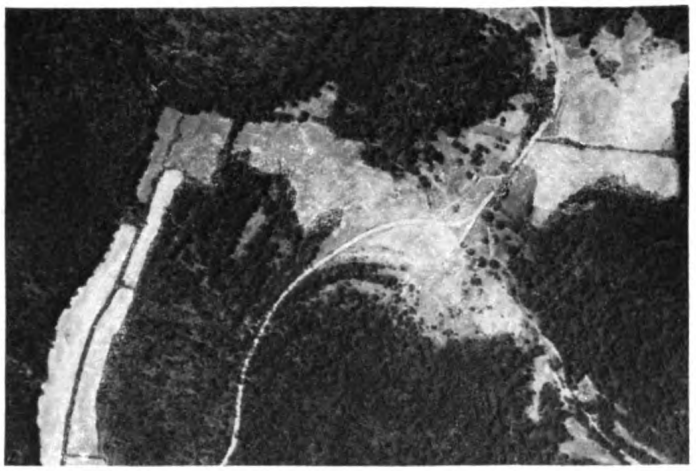


FIGURE 365.—Scale 1:10,000. Many paths around farms are normal when narrow and of a regular width. These are caused by farm animals and by the performance of routine farm chores around the scattered buildings and fields. Compare this photograph with those of military activity.

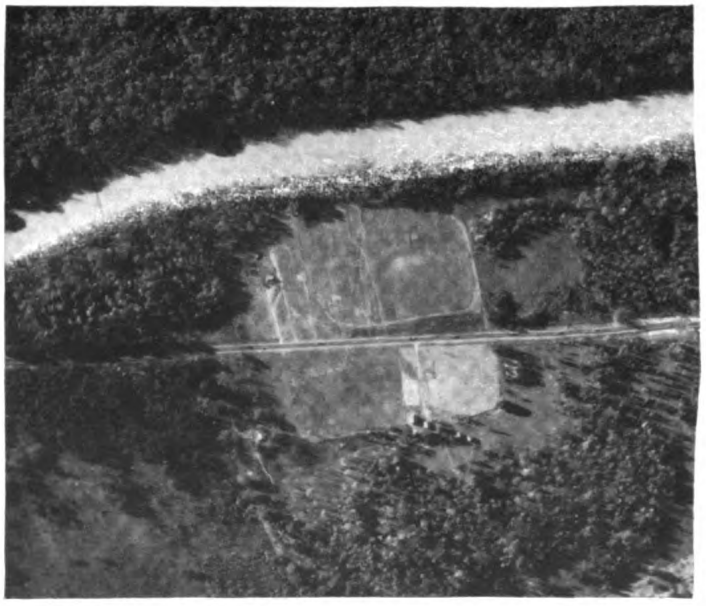


FIGURE 366.—Scale 1:10,000. A study of the field near the river reveals that an antiaircraft battery had occupied the area.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

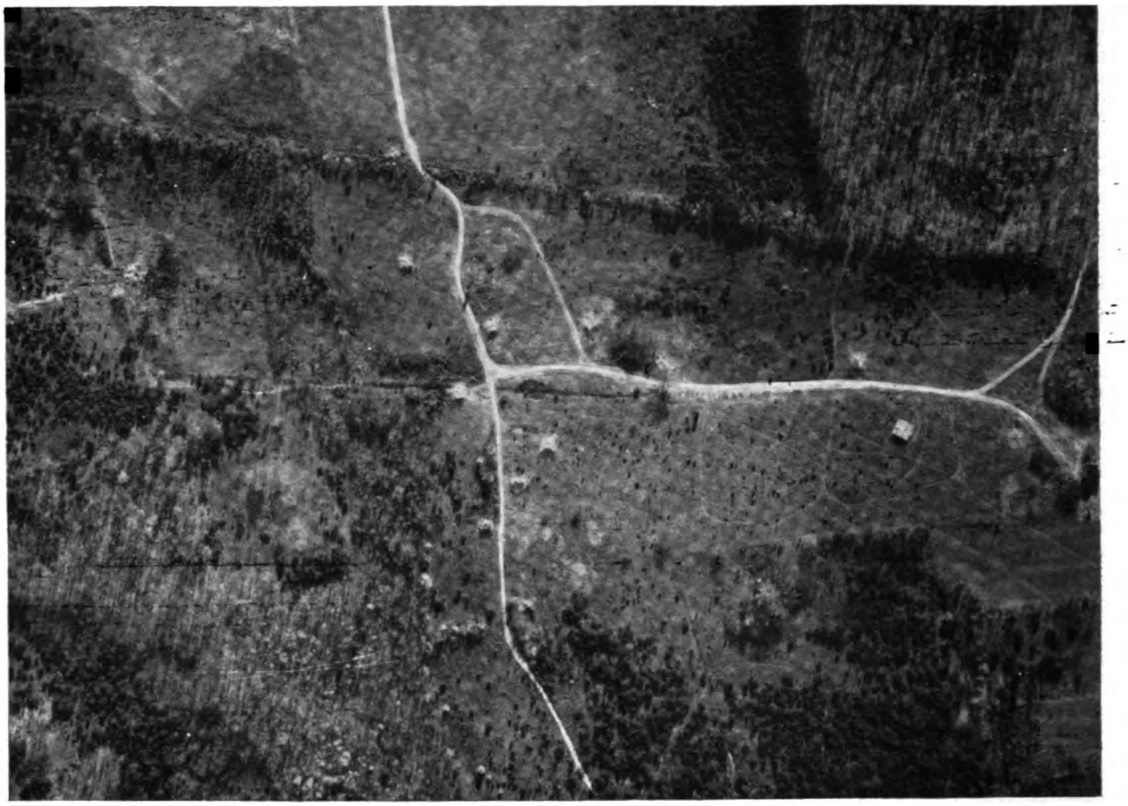


FIGURE 367.—Old flat tops will often be left standing as a dummy position. This can be detected as lack of maintenance causes the flat tops to sag and fade.



FIGURE 368.—Scale 1:3,000: Dummy airplane (see arrow). Note how much "brighter" the dummy is than the real airplanes.

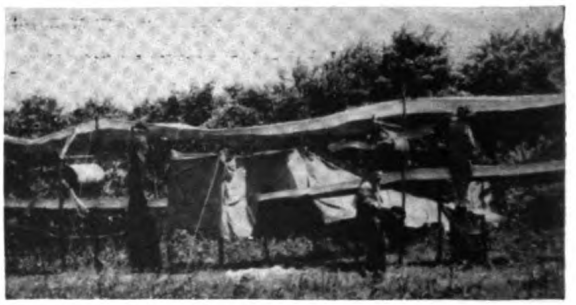


FIGURE 369.—Dummy airplane.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

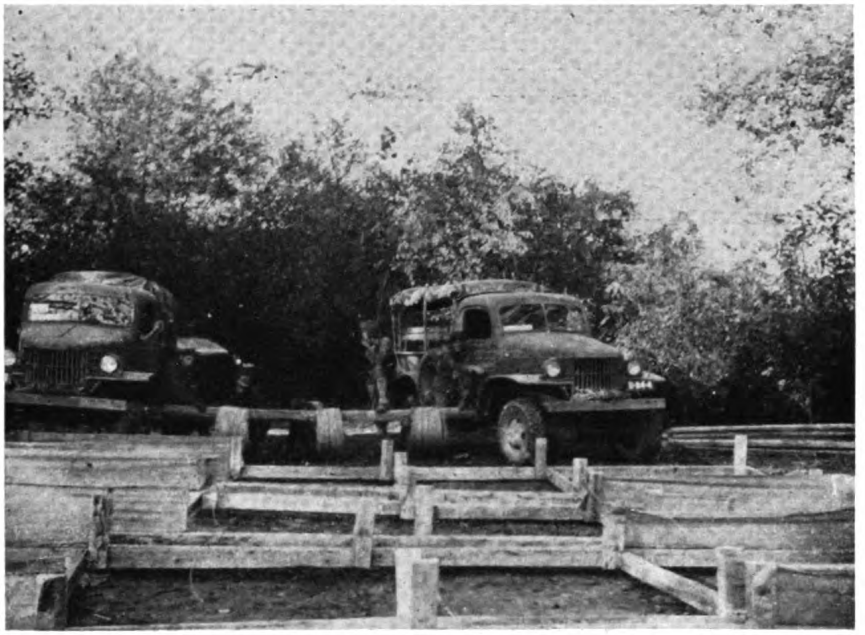


FIGURE 370.—Construction of a dummy ponton bridge.

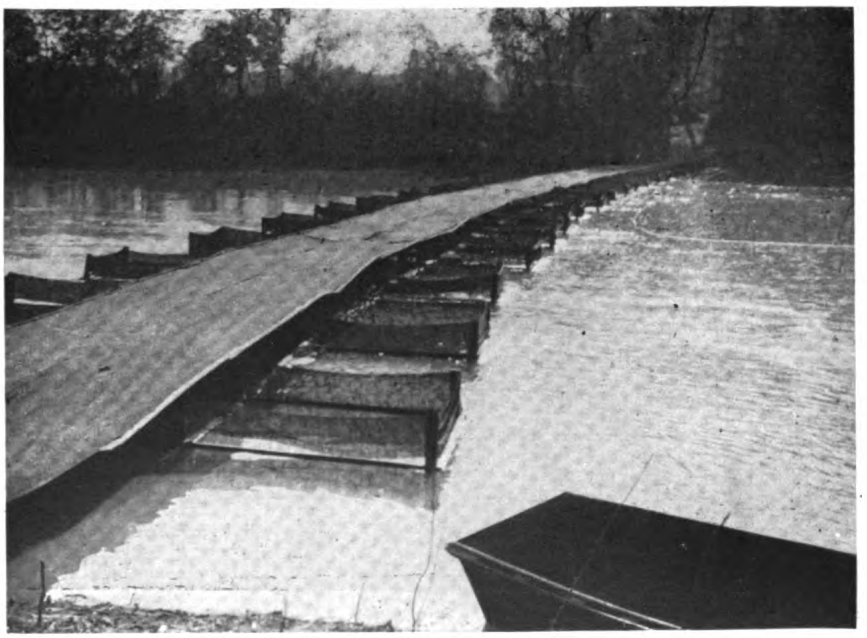


FIGURE 371.—Ground view of a completed dummy ponton bridge.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

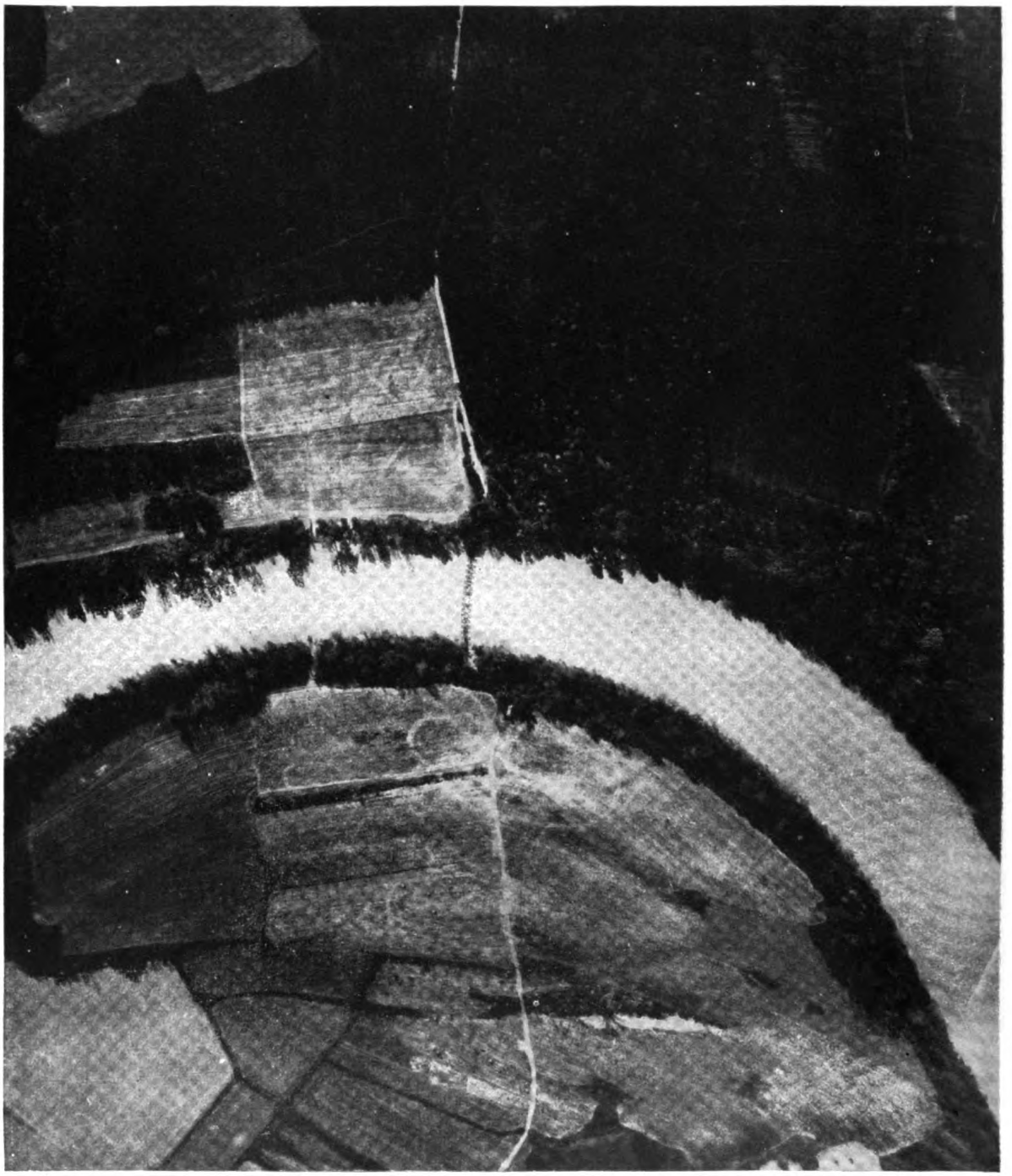


FIGURE 372.—Scale 1:6,000: Dummy ponton bridge constructed by a squad of 12 men in 8 hours. This type of dummy might be effective against visual observation but a study of an aerial photograph shows its falseness. Compare it to bridges shown in figures in paragraph 73.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

81. Break-down by photography.—*a. General.*—There are many types of cameras, lenses, film, and filters which the interpreter has at his disposal to aid him in his work. The type of camera and lens used will depend upon the altitude to be flown, the amount of enemy interference expected, the area to be covered, and the type of information to be obtained. The type of camouflage expected and the atmospheric conditions will govern the kind of film and filters used.

b. Film.—There are four general kinds of films:

(1) The orthochromatic film is not well adapted to intelligence missions because of its slow emulsion speed and its lack of red sensitivity. It provides an excellent rendition of greens and browns but is not generally suitable for detection of camouflage.

(2) The panchromatic film has the fastest emulsion and provides an excellent range of color sensitivity. It is sensitive to the entire visible spectrum and may be used with any filter. It is particularly effective for high altitude photography. Its great speed with artificial light makes it useful for night photography.

(3) Infrared film has two very useful properties that give it great value in military intelligence photography. Infrared light has great haze penetration, and the film can be used at extremely high altitudes or when weather would render photography by other films vitually impossible. It has the unusual ability to detect many paints or other materials which visually match growing foliage. This characteristic arises from the fact that artificial greens seldom possess the same complete reflection spectrum as growing foliage. In an infrared photograph the foliage appears light to medium gray, while artificial greens appear black. (See figs. 373 to 377, incl.) Infrared photography will of course be employed by the enemy.

(4) Recent developments in aerial color film have greatly increased its use in interpretation work. Operational altitudes for this film at which colors can be distinguished is 30,000 feet on a good clear day, 20,000 feet on a medium day, and 15,000 feet under heavy haze conditions. The processing of color film is more complicated than panchromatic film. It can be processed in the field with the use of standard developing equipment, but at present only one transparency can be obtained from a negative. Color photography is frequently used in preparing and checking camouflage programs, because it reveals how the installation appears to an aerial observer. In special cases it may be used, like infrared film, to reveal variations between natural and artificial colors of the same visual appearance.

c. Filters.—The most important filter for military use is one for eliminating haze. The two principal filters for this purpose are the minus blue, which is the yellow filter, and the minus green, which is the red filter. Dark red filters are used with infrared film.

d. Night photography.—Night photographs are made by dropping flash bombs that explode at predetermined altitudes. The flashes actuate the shutter. Night pictures have been taken with success from altitudes as great as 8,000 or 10,000 feet.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

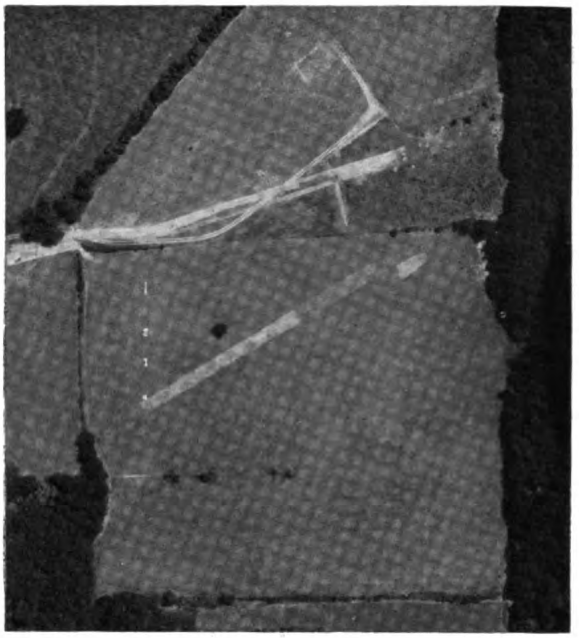


FIGURE 373.—Scale 1:5,000, panchromatic film. The flat tops numbered are hardly distinguishable. Note how the tracks stand out as compared to figure 374.

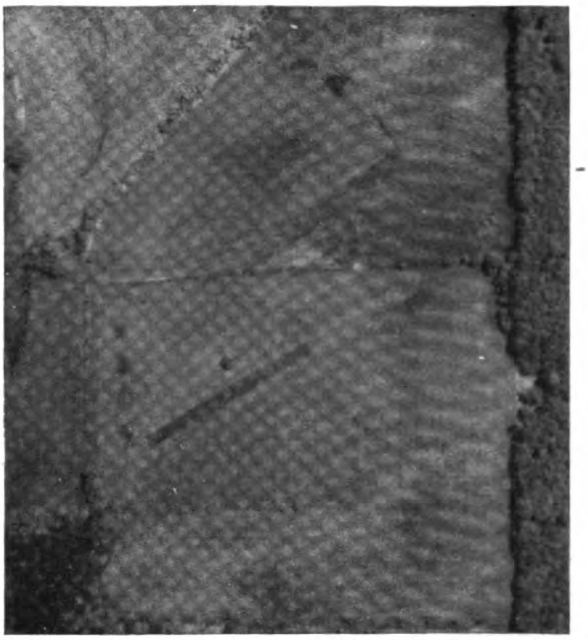


FIGURE 374.—Scale 1:5,000, infrared film. This photograph was taken at the same time as figure 373. Note the four flat tops, also the flat tops in upper center of photograph.

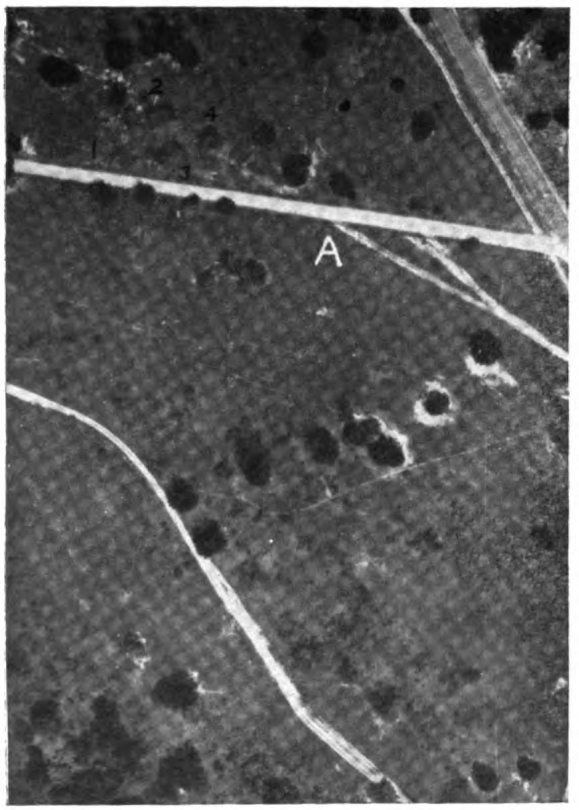


FIGURE 375.—Scale 1:3,000, panchromatic film.



FIGURE 376.—Scale 1:5,000, infrared film.



FIGURE 377.—Scale 1:50,000, infrared film.

FIGURES 375, 376, and 377 were taken at the same time. Note how the four flat tops stand out when taken with infrared film. Point A is common on each of the photographs.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

82. Counterintelligence.—*a. General.*—The object of counterintelligence is to destroy the effectiveness of the enemy intelligence system. Counterintelligence measures are either *negative*, designed to conceal our actual situation and intentions; or *positive*, designed to create in the mind of the enemy a false conception of our situations and intentions or capabilities. The commander is responsible for counterintelligence measures within his command. The intelligence officer in appropriate echelons is responsible to the commander for the preparation of plans for such measures and for their coordination and surveillance throughout the command. It is the responsibility of the officer in charge of interpretation of aerial photographs to bring to the attention of the intelligence officer information which the enemy may obtain from aerial photographs taken of our areas, so that proper steps with regard to it may be taken immediately.

b. Negative.—In order to deceive enemy interpreters, soldiers should learn the value of the disruptive appearance of objects or areas and place their equipment so that it appears on enemy photographs as ordinary objects or parts of objects. Armored forces take advantage of old junk lots or civilian dumping grounds to park their vehicles; antiaircraft guns are blended into old quarries which contain lumber and many-shaped stones, and lumber mills are used as small railheads. The ruins and remains of villages destroyed by bombs or artillery fire give opportunity for countless concealed military installations. Whenever practicable, the counterintelligence plan should provide for such aerial photographs of our own position as are necessary to insure the proper surveillance of our camouflage effort. Interpretation officers should study these photographs with a view to the immediate correction of defective camouflage work and breaches in camouflage discipline. It is valuable to occupying troops to be furnished with a photograph of their area, with remarks or annotations.

c. Positive.—(1) When the enemy is aware that large areas are likely to be occupied by our troops, positive counterintelligence measures should be initiated to deceive or confuse the enemy by creating signs of occupancy in all logical locations which are not actually occupied. This plan may be worked out from a photograph or photomap by taking the steps listed below. These are shown in figure 378.

(*a*) Locate areas actually occupied by our troops.

(*b*) Verify location on ground.

(*c*) Locate areas to be prepared so as to appear occupied. These should be logical ones.

(2) In preparing areas to appear occupied, care should be exercised not to make their appearance too obvious. The following are among the items which can be easily accomplished:

(*a*) Drive heavy vehicles into the area frequently, using half hidden turn-arounds.

(*b*) Scatter debris in the area.

(*c*) Run a bulldozer along the edge of woods, making frequent sweeps into the edge of the woods so as to give the trampled vegetation effect.

(*d*) Clear out a portion of a hedge row for entrance to each dummy area.

(*e*) In case of a simulated artillery position, run a truck along the edge of woods, turn out, and then back into edge of woods in four places, leaving the tracks which would be left by guns going into position in four places.

(*f*) Do some minor clearing of underbrush at the edge of woods, making the ground appear barer than previously.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 378.—Counterintelligence dummy field artillery positions.

1. Area occupied by troops.
2. Entrance into "1" areas.
3. Exit from "1" areas.
4. Dummy FA positions. Do not make road entrances and tracks too conspicuous.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

SECTION XIV

RECONNAISSANCE FROM PHOTOGRAPHS

	Paragraph
General	83
Route of advance	84
Supply	85

83. General.—In the planning phase of operations, reconnaissance made from aerial photographs taken over enemy territory is highly important. However, once troops are committed to action involving fast movement over enemy territory there is seldom time for the study of photographs. Consequently, very close study should be made in advance and reports prepared giving the information desired by the various units and headquarters. Reports, in most cases, will be accomplished by all of the photographs used in making the study, in order that those concerned can continue to study them while making their plans.

84. Route of advance.—Forces contemplating rapid motor movements into enemy territory will require photographs accompanied by interpretations of probable routes of advance. This applies particularly to armored forces, which have heavy loads and must move with extreme rapidity. Items which should be studied closely are road blocks, bridges, and sites for possible road blocks or other obstacles. (See par. 61.) Bridges may be found destroyed and places on the road favorable to barrier tactics may be found in an impassable condition. These contingencies must be planned for in advance. For this reason, a study of the terrain should be made for the location and construction of bypasses. River and stream banks on either side of an existing bridge site should be studied with the view to constructing floating bridges in the place of destroyed bridges.

85. Supply.—In addition to the information on the routes of advance, units making rapid thrusts into enemy territory are vitally interested in the location of supplies and communications. This is both for tactical reasons and to replenish their own supplies. All types of supplies necessary for the continued action of an army can be located on photographs and the type and location should be reported accurately. Gravel pits, quarries, lumber mills and yards, railroad yards, gasoline and oil storage, and public utilities are the most easily located. With knowledge of the exact location of these supplies, armored forces and paratroops are often able to seize them before they are removed or destroyed by the enemy.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



Figure 379, scale 1:10,000: Gravel pit in operation. These pits are of exceptional importance to engineers.

FIGURE 379.—Gravel pit.

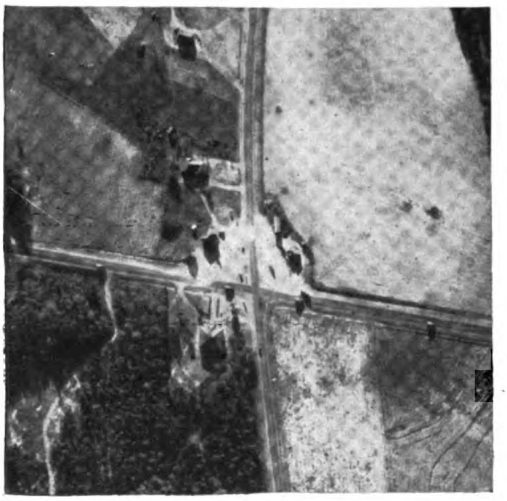


Figure 380, scale 1:6,000: Gasoline service station. Easily identified because of characteristic location, at intersections on main highways, corners of main streets in small towns, and along main highways. Their importance in a rapid advance was well demonstrated in the Battle of France, for the Germans, because they knew their exact locations, were often able to capture them before they were destroyed.

FIGURE 380.—Gasoline station.



Figure 381, scale 1:6,000: Railheads always contain supplies needed for a rapid advance. They should be spotted and used as objectives for the advance units.

FIGURE 381.—Railhead.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

Figures 382 and 385: Stereo pair of a large wholesale gasoline storage. Generally located alongside railroad facilities. The exact location of these is important as often mechanized units are thus enabled to capture them before they are destroyed. Note the 17 tank cars on the siding near the storage tanks.

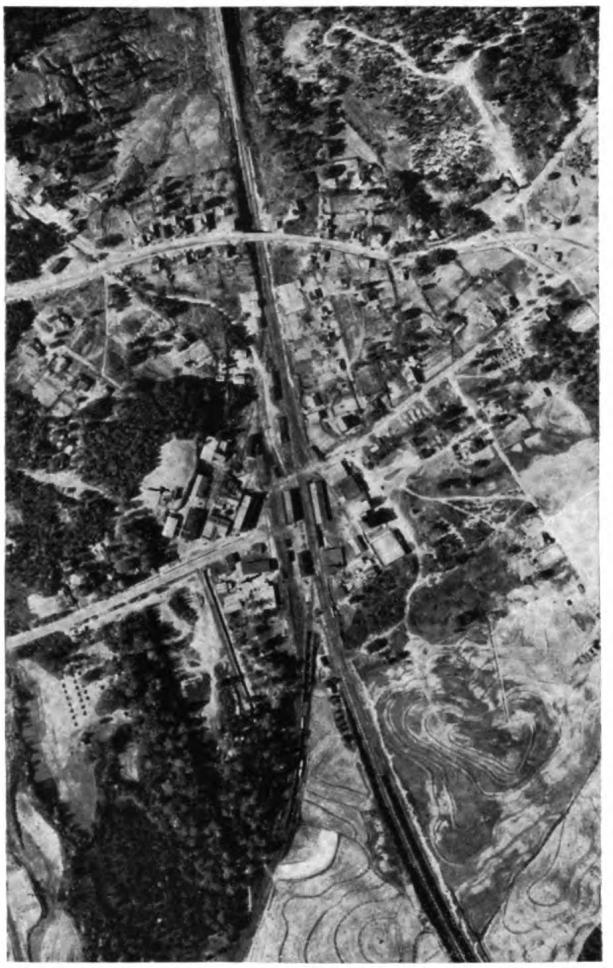


FIGURE 382.—Gasoline supply. Stereo pair with figure 385.

Figures 383 and 386: Stereo pair of a lumber yard. Supplies from local sources are of importance to engineers, for their supplies normally constitute a large proportion of all military supplies.

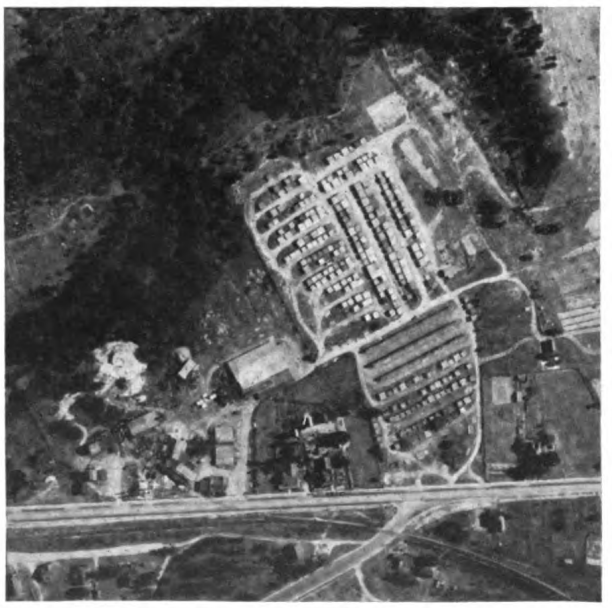


FIGURE 383.—Lumber yard. Stereo pair with figure 386.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

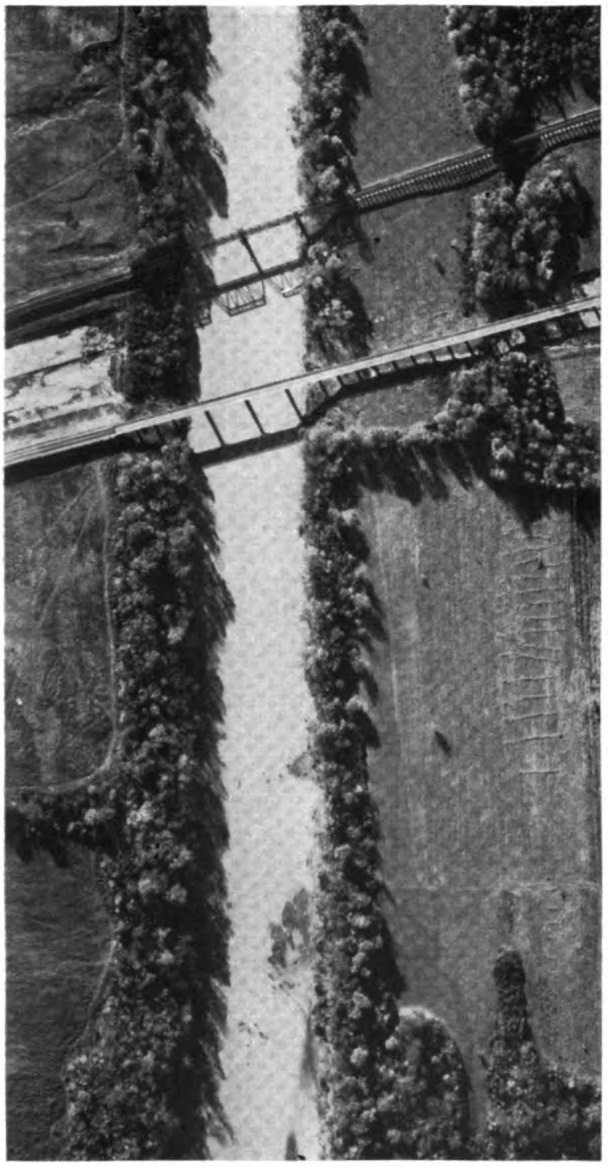


FIGURE 384.—Scale 1:6,000: A photograph of this type could be used by mechanized forces in plotting their route of advance when contemplating a rapid movement into enemy territory. The bridges might be destroyed by the retreating force. Information concerning the adjoining terrain is obtained from the photograph. From the shadow cast by the bridge, it is seen that the banks have a slope of 45°. A ford could probably be developed in section of river shown in lower part of photograph.



FIGURE 385.—Gasoline supply. Stereo pair with figure 382.



FIGURE 386.—Lumber yard. Stereo pair with figure 383.

4961311 12
Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



FIGURE 387.—Scale 1:6,000: Exact location of utilities and facilities such as are shown on this photograph will be of great aid to paratroops and armored force units making rapid thrusts into enemy territory.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

SECTION XV

DEFENSIVE POSITIONS

Paragraph
General 86
Characteristics 87
Employment of photographs 88

86. General.—To make proper plans to break through a defensive position, a thorough photographic study must be made of all its details. To a limited extent, photographic studies of one defensive position aid in the analysis of another. In general, a trained interpreter can easily adjust himself to photographs of one organized position if he is already familiar with the characteristics of other enemy installations (see sec. II, ch. 2). The photographs shown in this section illustrate the methods and means of studying defensive positions.

87. Characteristics.—Organization of ground for defense is designed primarily to increase the natural defensive strength of the terrain and to furnish cover and protection for the defenders. In creating a defensive position there are three main factors considered: terrain, weapons which will be employed in attacking the position, and weapons and obstacles to be employed by the defense. For the interpretation of aerial photographs of an organized defensive position, appreciation of the above factors is essential. The trained interpreter must also have mastered the general terrain in the area, and be thoroughly familiar with the weapons, tactics, and technique of the enemy and his own forces.

88. Employment of photographs.—*a. Methods.*—When aerial photographs were first used extensively for intelligence purposes, the first World War had reached a stabilized condition. Interpreters became masters at identifying positions and installations, and interpreting their use and meaning. The same methods are used today but modified somewhat because of different terrain, more effective use of camouflage, and changed weapons. Modern defenders give much more consideration to concealment from aerial observation and bombardment than in the first World War. Reproduced in this section are a number of photographs of the first World War, showing the methods then used by interpreters and by instructors in interpretation. These methods are used today by an interpreter beginning studies of deliberate defensive positions.

b. Study.—Once an organized position is discovered, the interpreter must begin intensive study. He must prepare folders of ground studies of enemy installations as soon as any small part of the position is captured. He must consult with officers and men who have viewed the enemy position on local raids. He must keep his studies up-to-date as the enemy develops the position.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

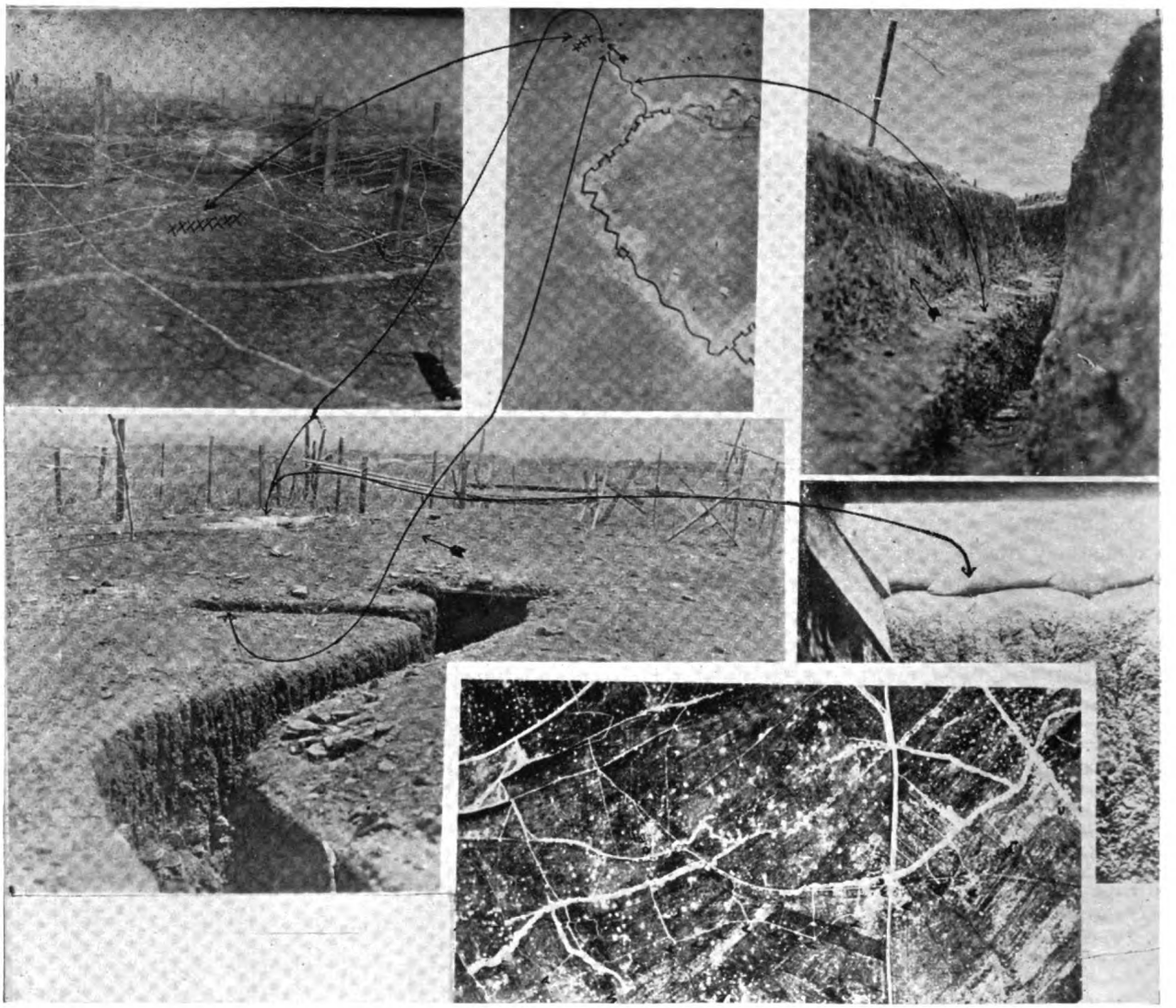


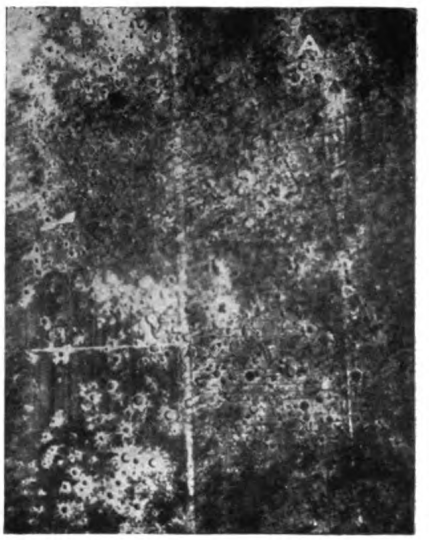
FIGURE 388.—An example of stabilized warfare interpretation training used in the first World War. Note how the ground studies tie in with the aerial photographs.

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA



① Before.



② After.

FIGURE 389.—In ① and ② the destruction of a long range railroad gun is shown. Railroads have become quite plain in ② below the white "A." Longer shadows in ② are confusing but time of day, time of year, and difference in scale may be expected on comparative photographs.

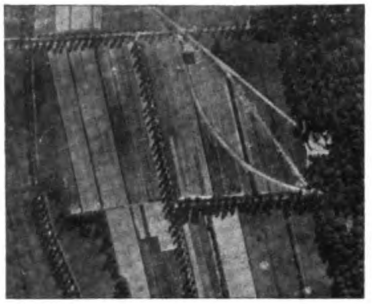


FIGURE 390.



FIGURE 391.

Comparable to the Army Air Forces "bomb damage assessment," the damage done by artillery will be carefully studied during stabilization. Here is shown incomplete destruction of an enemy battery in the edge of a woods.

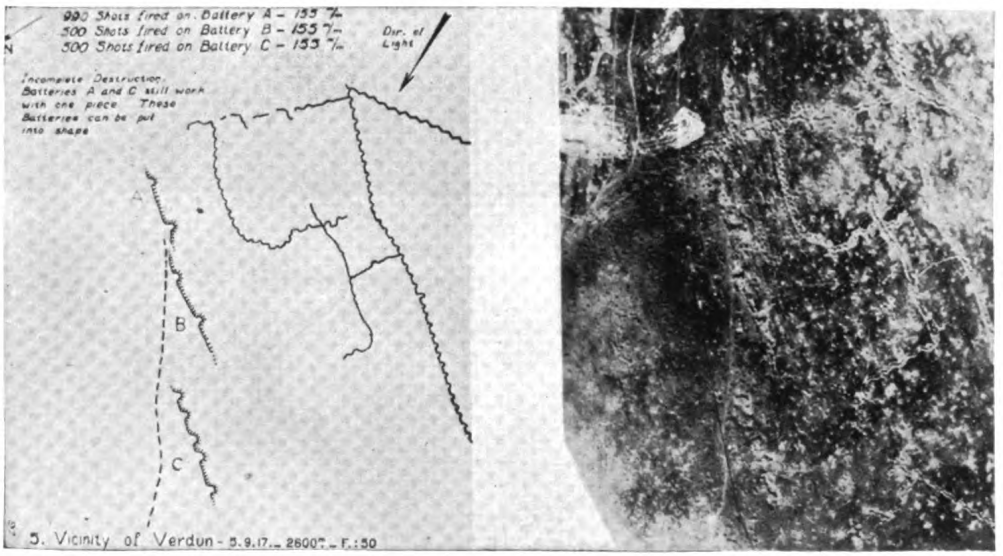


FIGURE 392.—When ground becomes scarred by shelling, the interpreter must make sketches to explain his deductions.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA



FIGURE 393.—Reveted fire trench.

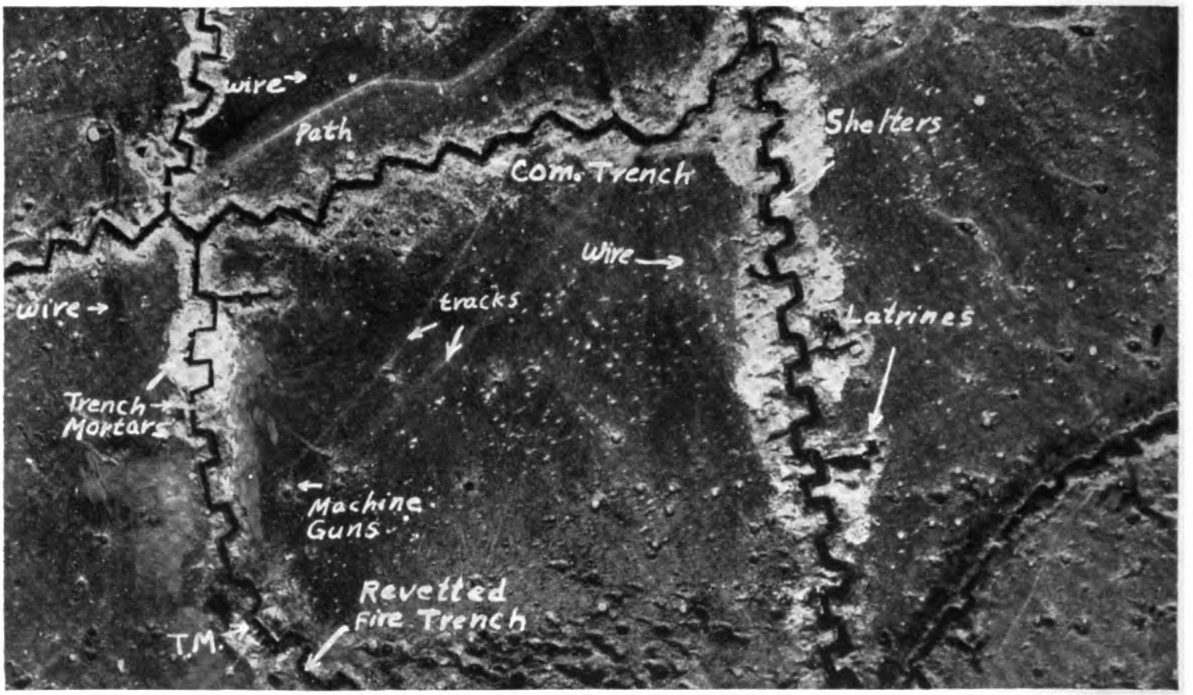


FIGURE 394.—Interpreted photograph of first World War.

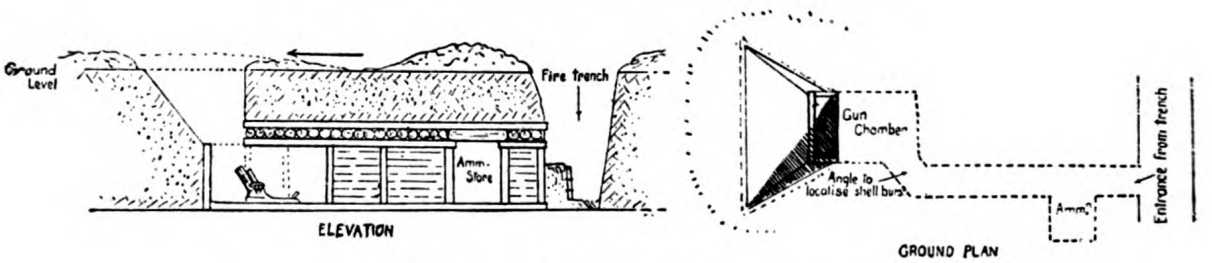


FIGURE 395.—Sketch of trench mortar emplacement.

Where time permits, good typical photographic examples, together with drawings in plan and cross sections, are prepared on sheets for the training of new interpreters and for verification by combat troops.

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

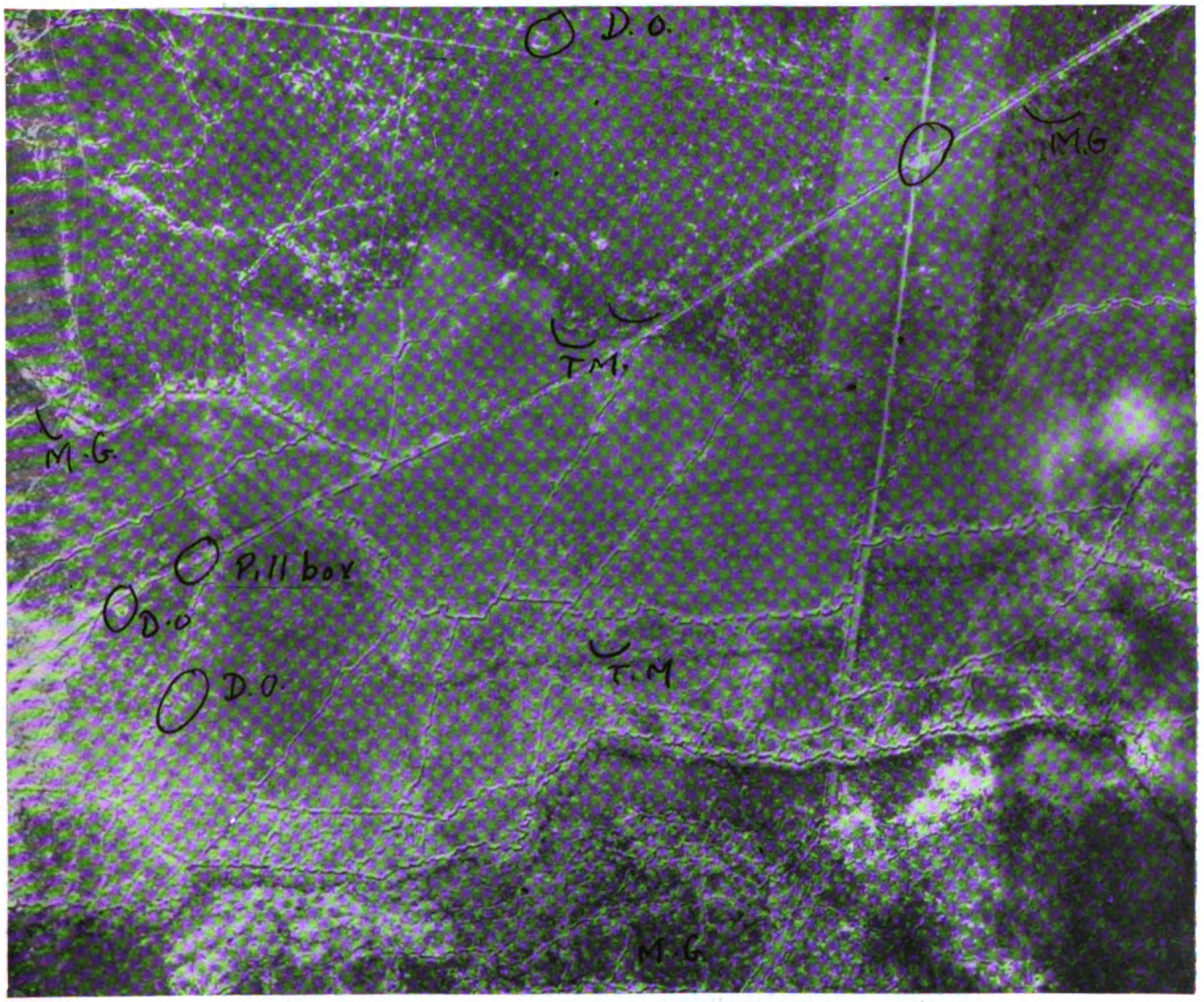


FIGURE 396.—Scale 1:6,000: An interpreted photograph of stabilized positions in the first World War. D. O., dugout; T. M., trench mortar; M. G., machine gun.

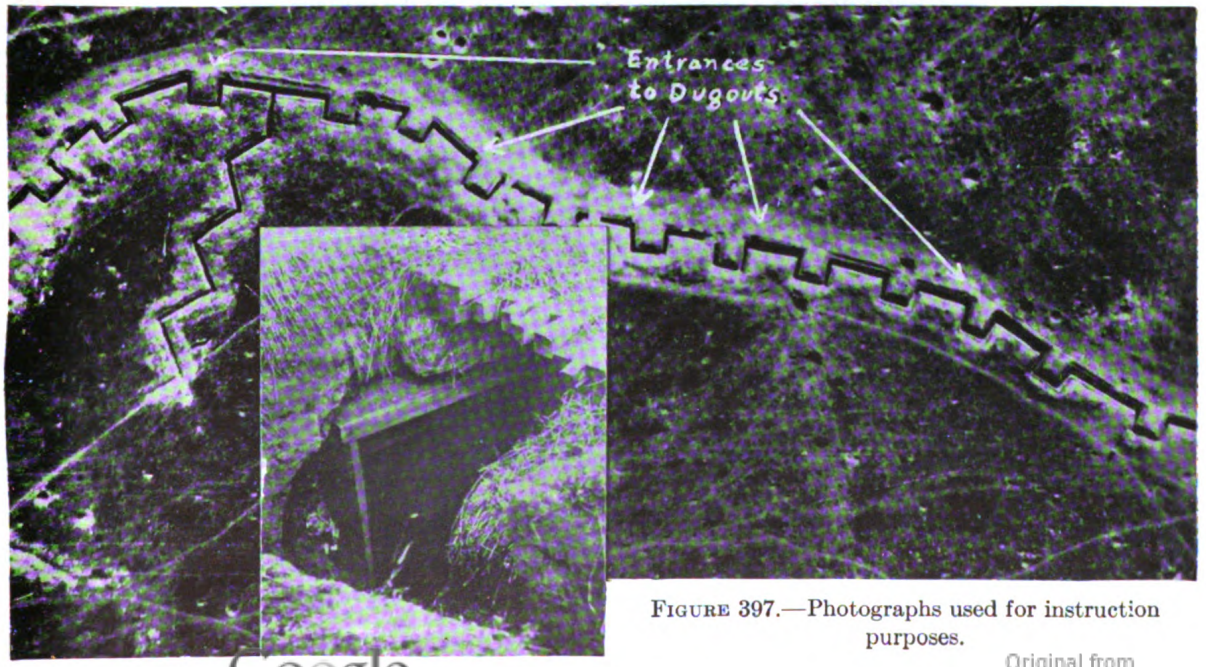


FIGURE 397.—Photographs used for instruction purposes.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

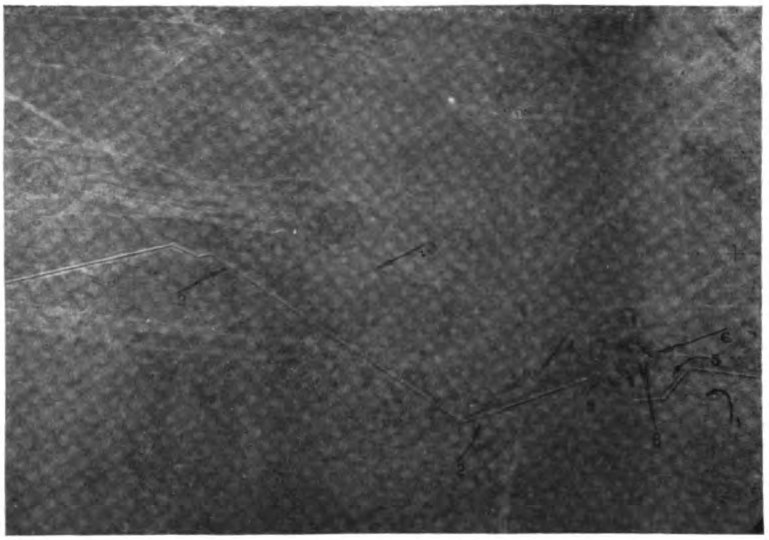


FIGURE 398.—Scale 1:16,000.

1. Antitank mines.
2. Antitank ditch.
3. Wire.
4. Gap in wire.
5. Shallow ditch.
6. Antitank trap (covered ditch).
7. Antitank guns.
8. Machine guns.

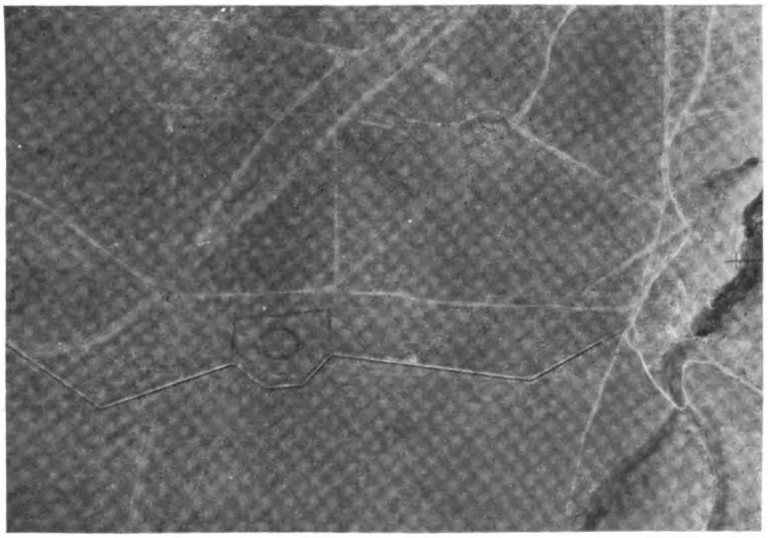


FIGURE 399.—Scale 1:16,000.

Stabilized positions of the present war. Emphasis is placed on defense against mechanized attacks.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

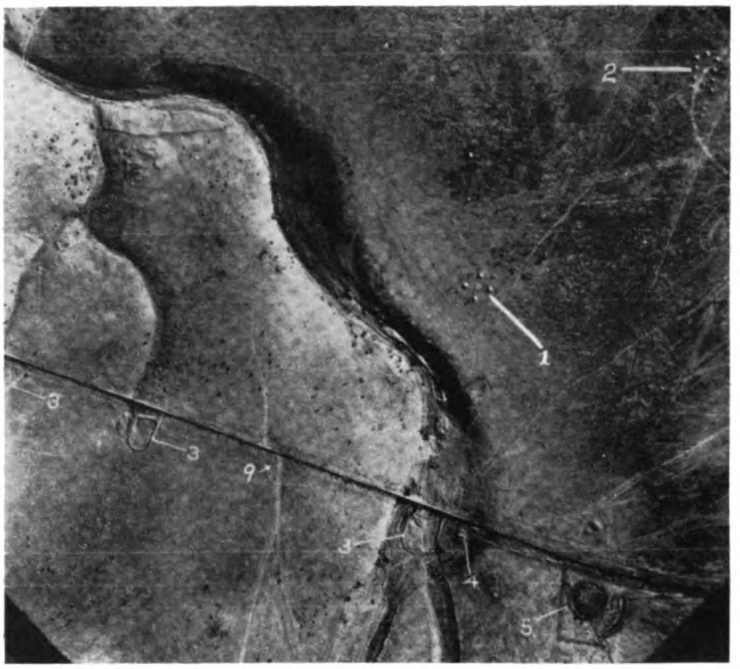


FIGURE 400.—Scale 1:14,500.

1 and 2. Hospitals.
3. Water point.
4. Pumping station.
5. Defensive outpost.
6. Road block—concrete pillars 9 feet square and 6½ feet high, slotted to receive three 8-inch I-beams.
7. Antitank trench 10 feet wide.
8. Wire.
9. Pipe line.

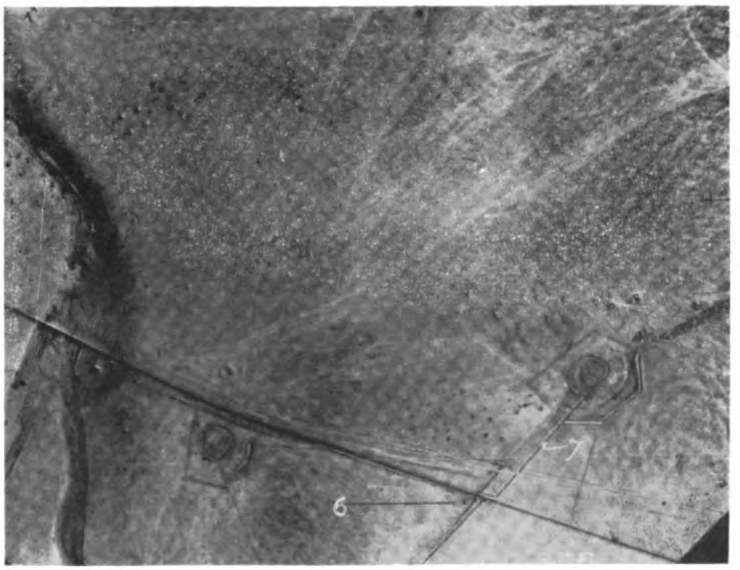


FIGURE 401.—Scale 1:14,500.

The interpreted photographs above are of stabilized positions of present war. Detailed interpretation at this small scale is made possible only by close studies of the enemy's positions. This can be accomplished by visiting captured positions, studying ground photographs, and consulting officers and men who saw these positions on local raids.

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

INDEX

	Paragraph	Page
Advanced landing fields	74–76	182
Aerial view	10–13	12
Antiaircraft positions	58, 59	131
Antimechanized defense	60, 61	141
Area included at various scales	17	29
Artillery positions	64, 65	148
Bivouacs	47–51	80
Break-down of photography	81	201
Camouflage	77–82	195
Camps and bivouacs	47–51	80
Close studies	42–44	75
Coast lines	7	7
Command posts	48	88
Communication, wire	66	160
Comparative photographs	45, 46	75
Construction, landing field	75	182
Counterintelligence	82	203
Crossing, river	73	169
Defense, seacoast	67–70	162
Defensive positions	86–88	211
Dummy installations	80	195
Dumps	56	116
Employment of photographs	88	211
Engineer activities	71–73	167
Equipment:		
Engineer	72	167
Interpretation	41	72
Erosions	4	5
Escarpments	9	7
Farms	11	12
Faults	9	7
Field artillery positions	62–66	148
First phase interpretation	37	71
Gun:		
Permanent installations	68	162
Railroad	69	164
Horse and shoe movements	55	114
Identification:		
Antiaircraft positions	59	131
Antimechanized defense	61	141
Bivouacs	47	80
Camps	47	80
Field artillery positions	62	148
Interpretation:		
Equipment	41	72
First phase	37	71
Second phase	38	71
Land forms	1–9	4
Landing fields:		
Advanced	74–76	182
Construction	75	182
Length of occupation	51	104
Location:		
Antiaircraft positions	58	131
Antimechanized defense	60	141
Bivouacs	47–51	80
Location—Continued.	Paragraph	Page
Camps	47–51	80
Field artillery positions	62	148
Means of comparison	46	75
Means of study	43	75
Mission of photography	35	71
Motorized units	54	109
Mountains	22	36
Objects visible at various scales	16	28
Obliques	39	71
Obstacles	70	166
Occupation:		
Length	51	104
Signs	79	195
Orientation and location	15	26
Photographic missions	35	71
Photographs:		
In war	34	70
Recording	36	71
Plains	6	7
Positions:		
Antiaircraft	58, 59	131
Artillery	64, 65	148
Defensive	86–88	211
Own, study of	78	195
Posts, command	48	88
Previous photographs	45	75
Protection	76	191
Railheads	56	116
Railroad guns	69	164
Reconnaissance from photographs	83–85	205
Recording photographs	36	71
River crossings	73	169
Rivers	5	6
Scale and orientation of photographs	14–17	23
Scrapbook	44	75
Seacoast defense	67–70	162
Second phase interpretation	38	71
Shadow	20	32
Signs of occupation	79	195
Stereo studies	40	72
Streams	5	6
Supplies, location	85	205
Supply installations	56, 57	116
Terraces	8	7
Terrain features	1–32	4
Tone	19	31
Topography, developments	3	4
Towns	12	13
Tracks	63	148
Troop movements:		
Horse and shoe movements	55	114
Identification of units	53	107
Motorized units	54	109
Value of photographs	52	107
War photographs	34	70
Water points	57	125
Wire communications	66	160

Digitized by Google
Original from UNIVERSITY OF CALIFORNIA

[A. G. 062.11 (10-14-42).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

X.

(For explanation of symbol see FM 21–6.)

Digitized by Google

Original from UNIVERSITY OF CALIFORNIA

U. S. GOVERNMENT PRINTING OFFICE: 1943

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

Digitized by Google

Original from
UNIVERSITY OF CALIFORNIA

Digitized by Google
Original from
UNIVERSITY OF CALIFORNIA