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FM 5-20

WAR DEPARTMENT FIELD MANUAL

CAMOUFLAGE, BASIC PRINCIPLES
FM 5-20

LT. COL. HUGH F. FOSTER JR. O-23837
C. O. 63RD SIGNAL BATTALION (OPN)
APO. 541 c/o POSTMASTER NEW YORK, N. Y.

CAMOUFLAGE,

BASIC PRINCIPLES

U.S. Army Military History Institute
Carlisle Barracks, Pa. 17013

WAR DEPARTMENT · FEBRUARY 1944

NOTE ON FM CAMOUFLAGE SERIES

FM 5-20, Camouflage, dealing with basic principles, and FM 5-20A, Camouflage of Individuals and Infantry Weapons, have been assigned a broad distribution designed to reach all arms and services. Other Field Manuals (see list below) are to have selective distributions to arms and services primarily interested and to higher headquarters of all arms and services. See FM 21-6 for the specific distribution of each.

FM 5-20	Camouflage, Basic Principles
FM 5-20A	Camouflage of Individuals and Infantry Weapons
FM 5-20B	Camouflage of Vehicles
FM 5-20C	Camouflage of Bivouacs, Command Posts, Supply Points, and Medical Installations
FM 5-20D	Camouflage of Field Artillery
FM 5-20E	Camouflage of Aircraft on the Ground and Airdromes
FM 5-20F	Camouflage of Antiaircraft Artillery
FM 5-20G	Camouflage of Rear Areas and Fixed Fortifications
FM 5-20H	Camouflage Materials and Manufacturing Techniques

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This manual and FM 5-20A through H supersede FM 5-20, 1 June 1940

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WAR DEPARTMENT • FEBRUARY 1944

☆ U. S. GOVERNMENT PRINTING OFFICE : 1944

WAR DEPARTMENT.

WASHINGTON 25, D. C., 9 February 1944.

FM 5-20, Corps of Engineers Field Manual, Camouflage, Basic Principles, is published for the information and guidance of all concerned.

[A.G. 300.7 (14 Aug 43).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

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

DISTRIBUTION:

B and H (5); R (4); Bn (4); C 1-4, 8-11, 19, 35, 44, 55 (2); 5-7, 17, 18 (4).

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1-21, 36-40, FM 5-20, 1 June 1940

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CAMOUFLAGE, Basic Principles

CHAPTER 1

GENERAL

1. SCOPE.—This manual covers general camouflage principles. Camouflage of individuals, infantry weapons, vehicles, bivouacs, command posts, supply points, medical installations, field artillery, aircraft on the ground, airdromes, antiaircraft artillery, rear areas, and permanent fortifications are treated in separate manuals of this series, as listed on the inside of the front cover. Other camouflage techniques are covered in TM 5-267 and its supplements.

2. USE OF CAMOUFLAGE.—Camouflage uses concealment and deception to promote our offensive action, to surprise, to mislead the enemy, and to prevent him from inflicting damage upon us. Concealment includes hiding from view, making hard to see clearly, arranging obstructions to vision, deceiving and disguising, and deception involving sound.

3. DUTIES AND RESPONSIBILITIES.—*a. Individual.*—The practice of concealment, camouflage construction, and camouflage discipline is as much the normal business of a soldier as firing a rifle, driving a truck, planning an attack, or observing sanitary discipline.

b. Unit commander.—The unit commander is responsible for all camouflage measures within his command. This responsibility includes detailed instruction by means of standing operating procedures and training in (1) choice of position, (2) camouflage discipline, and (3) the efficient employment of materials and construction

methods for concealment. This is accomplished by close supervision, inspection, and correction during phases of field exercises. It is not enough to give orders; the commander must see that each man understands what to do and does it, that each understands what not to do and avoids it.

c. Staff.—(1) The intelligence section of a staff is charged with counterintelligence, including non-tactical measures, to preserve secrecy. This generally includes camouflage. Close co-ordination between intelligence and camouflage officers is essential. The counterintelligence plan must provide for taking and distributing aerial photographs of friendly positions and installations to insure that the camouflage effort is being properly planned and executed.

(2) The operations, training, and planning section of a staff is responsible for preparation of plans for and supervision of activities concerning tactical measures to preserve secrecy and effect surprise. One such responsibility is *operational camouflage;* it involves concealment and deception through camouflage activities and construction, and is used tactically in ruses and feints to deceive and surprise the enemy. The operations, training, and planning section

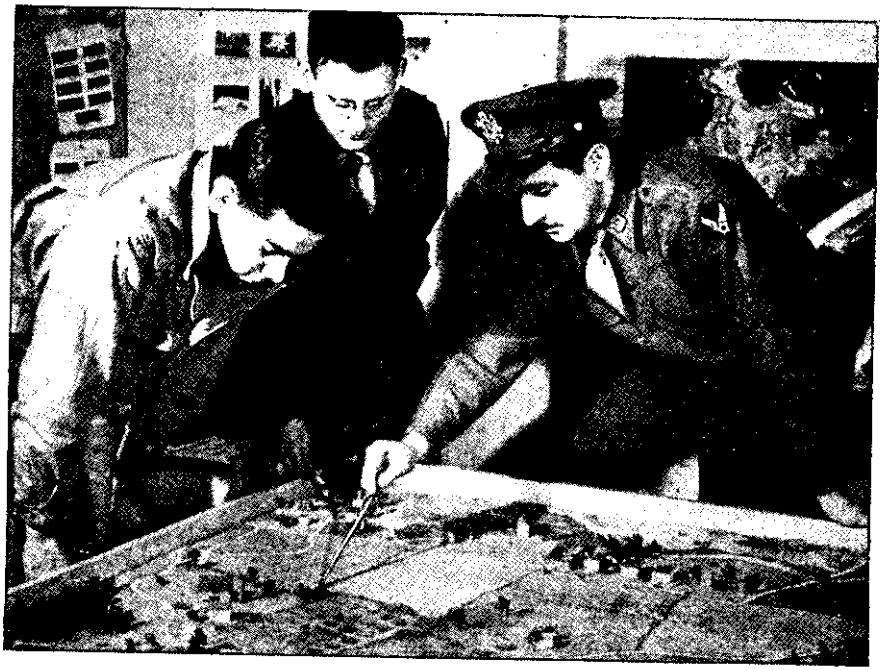


FIGURE 1.—Engineer camouflage troops assisting in planning large-scale operational camouflage plan with aid of terrain model.

shares this responsibility with the intelligence section. A typical procedure may be as follows:

(*a*) The commander decides on a plan of operations.

(*b*) After air and ground reconnaissance, G-3, G-2, and G-4, working together, prepare operations plans, camouflage "cover" plans, and supply plans, respectively. (The cover plan is an operational camouflage plan designed to confuse the enemy.)

(*c*) The commander decides priorities, allocates resources, and issues orders.

(*d*) G-3 makes the necessary operational arrangements.

(*e*) G-4 furnishes the necessary materiel.

(*f*) Troops assisted by technical staff advisors carry out the plan as directed.

d. Corps of engineers.—The corps of engineers is responsible for the development of methods and materials for camouflage, supply of camouflage materials, and instruction in camouflage and in camouflage discipline.

4. SPECIAL CAMOUFLAGE TROOPS.—Specially trained camouflage units—engineer troops—include camouflage battalions and separate camouflage companies of ground forces; aviation camouflage battalions; and camouflage sections of engineer headquarters companies of the air force.

a. Duties.—The duties of camouflage troops in theaters of operations are: camouflage inspection; technical aid in training, planning, and construction of camouflage; supervision of special large-scale camouflage measures; assistance in supply of camouflage materials; and, in some measure, manufacture of certain camouflage supplies. Camouflage troops should supervise the execution of operational camouflage plans. Normally the erection and maintenance of camouflage is performed by the troops who occupy the installation. However, in the case of airdromes with appurtenances and similar large-scale camouflage installations, troops skilled in camouflage practice will normally carry out the camouflage measures, assisted by other available troops.

b. Units.—(1) *Camouflage battalion (army).*—A camouflage battalion is assigned to a field army. This battalion is organized so that it can function either massed with an army or in separate detachments with smaller units. A company (four platoons) is a normal attachment to a corps, a platoon being attached to each division and one to corps troops. The battalion commander continually studies, plans, and recommends to the army commander, through the army engineer, proper attachments and detachments of the ele-

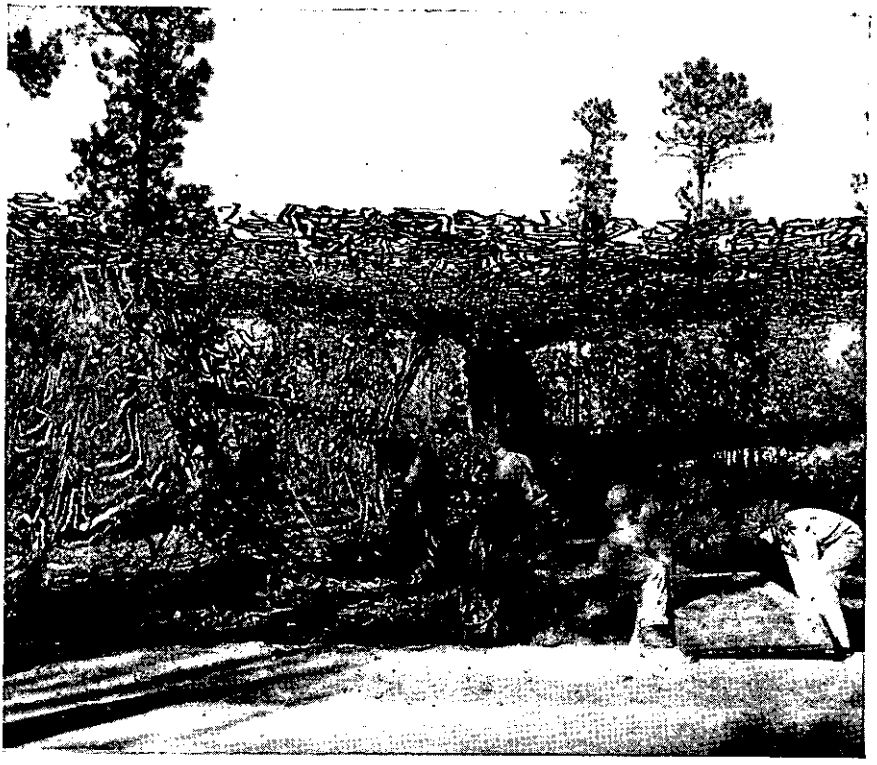


FIGURE 2.—Troops of an aviation camouflage battalion cover a plane in a dispersal point.

ments of his battalion to meet the changing camouflage requirements. As with topographic units, close relations exist with G-2. The battalion's primary mission is to inspect camouflage and advise, supervise, and instruct other troops in the army area in camouflage work and discipline. It also conducts experiments for new camouflage methods, prepares detailed plans for general or special camouflage installations, and facilitates camouflage supply by giving advice on the use of camouflage materials and their availability. The factory section of the service platoon of the headquarters and service company may furnish technical supervision for the manufacture of camouflage materials by local inhabitants or assigned troops. See FM 5-5, FM 5-6, and T/O and T/E 5-95, 5-96, and 5-97 for details.

(2) *Separate camouflage companies.*—Separate camouflage companies are assigned to independent corps and also may be assigned to task forces of a corps or smaller. Their organization, duties, and functions are generally similar to those of a lettered company of the army camouflage battalion.

(3) *Engineer aviation camouflage battalion.*—An aviation camouflage battalion is assigned to a theater air force. It is organized to work in separate detachments or massed. The battalion commander continually studies, plans, and recommends to the air force commander, through the air force engineer, proper attachments and detachments of the elements of his battalion to meet changing camouflage requirements. The battalion commander co-ordinates with air staff intelligence on the use of decoy and deceptive measures to mislead the enemy and effect surprise. The mission of the battalion is to furnish technical assistance, supervision, and control for the camouflage activities of a theater air force in connection with the design, planning, and execution of camouflage works. It constructs special camouflage projects associated with airdromes and air force installations. In other respects its mission is similar to the engineer camouflage battalion of the Army, as indicated in paragraph (2) (*a*) above. For further details see FM 5-5, FM 5-6, FM 5-20E, TM 5-255. and T/O and T/E 5-465, 5-466, and 5-467.

CHAPTER 2

THE PROBLEM OF CONCEALMENT

5. KINDS OF ENEMY OBSERVATION.—Of the perceptive senses available to the enemy, sight is by far the most useful; hearing is second, while smell is of only occasional importance. The comparative usefulness of the perceptive senses is primarily a matter of range. For this reason basic camouflage stresses visual concealment, while sound camouflage is covered only briefly. Camouflage must be effective against both ground and air observation. All our lives we have looked from one position on the ground to another position on the ground. Before we can conceal ourselves from aerial observation, therefore, we must become familiar with what our activities look like from the air—both in an aerial photograph and in direct observation (fig. 3).

a. Ground observation.—Ground observation can be maintained for long periods. Ground observers increase their range of vision with binoculars, telescopes, and radar, and their range of hearing by sound ranging.

b. Aerial observation.—Aerial observation may be visual or photographic; it is frequently intermittent and cannot be maintained for long periods. Haze, fog, storms, smoke, antiaircraft fire, and attack by hostile aircraft impose limitations on aerial observation.

(1) *Visual.*—Aircraft are used for visual aerial observation to discover quickly signs of suspicious activity within an area, to direct fire of fighter and bomber aircraft and artillery, and to locate targets for artillery. The observer's eye may be aided by binoculars.

(2) *Photographic.*—Aerial photographic observation is usually more revealing than visual observation because it permits longer and more detailed study of the terrain. Panchromatic, infrared, and color film (fig. 18) are used to detect camouflaged installations. For the role of aerial photography in military intelligence, see FM 30-21; for technical data, see TM 1-220. For interpretation of aerial photographs, see FM 21-26 and TM 5-246. Photographs are frequently taken only of suspicious areas. Therefore, concealment from visual aerial observation often eliminates much of the danger of detection by the aerial camera.

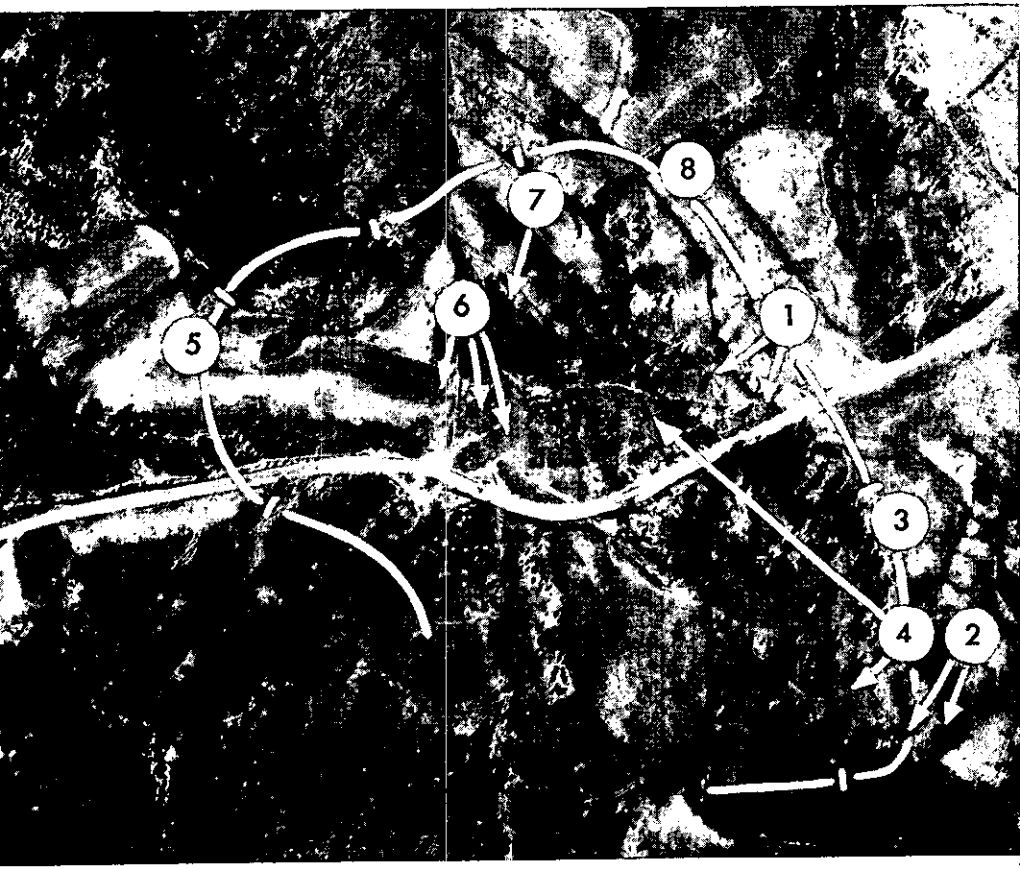


FIGURE 3.—Aerial view, at scale 1:3,500, of a hilltop occupied by an infantry company. The company has organized a typical defensive position. Numbered points are identified below.

1. Light machine-gun positions.
2. Heavy machine-gun positions.
3. Right platoon front.
4. Antitank gun positions.
5. Support platoon front.
6. 60-mm mortar positions.
7. Observation posts.
8. Left platoon front.



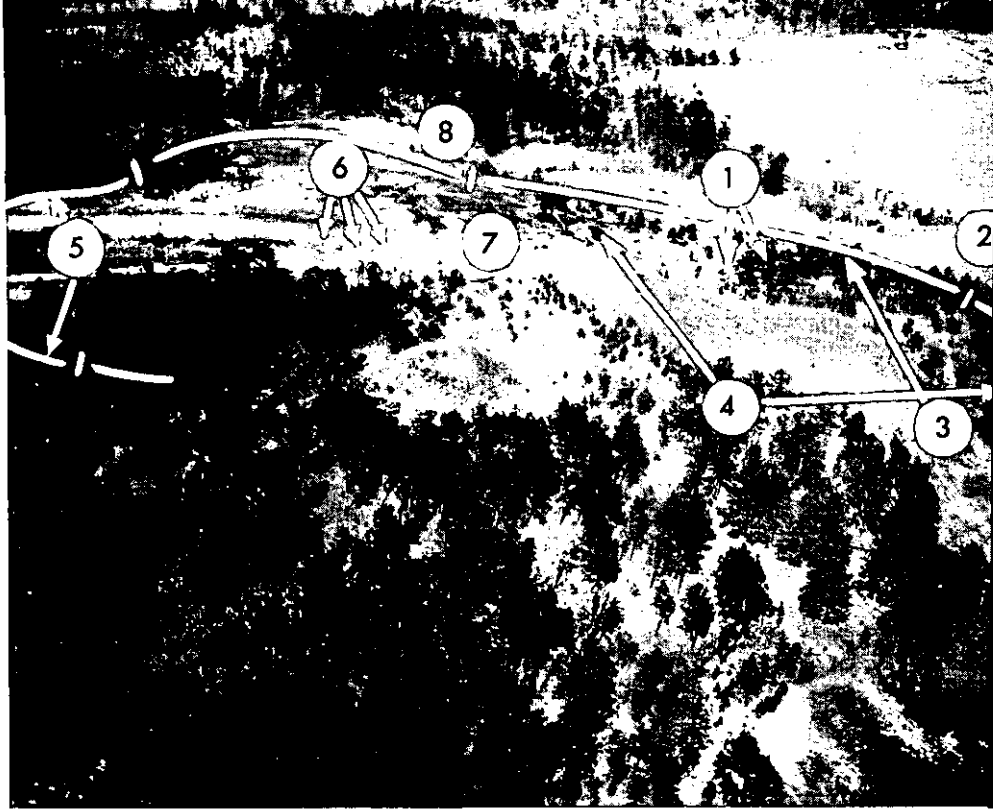


FIGURE 4.—What the enemy airman sees as he approaches the hilltop. Scale at center of photograph is approximately 1:1,500.

FIGURE 5.—A 360° panoramic view, which the company commander sees from the highest point on the hill.



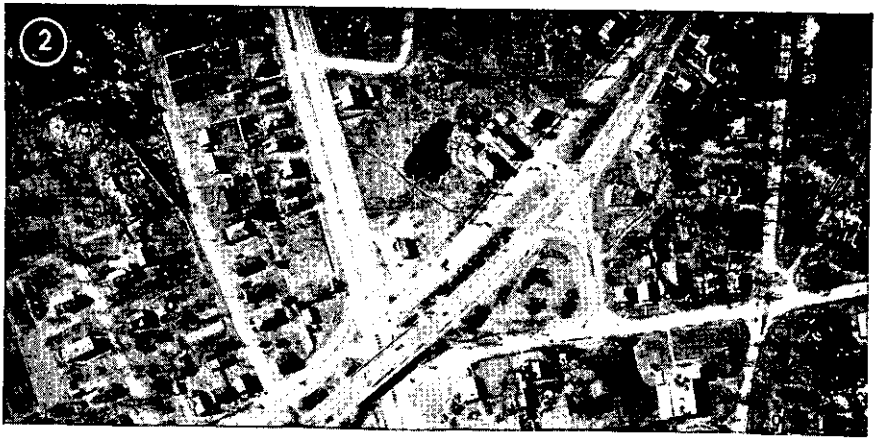


FIGURE 6.

6. THE CLUES TO IDENTIFICATION FROM THE AIR.—Figure 7 shows aerial photographs of different landscapes. Many objects hidden from the ground observer are easily recognizable from the air. The main factors which enable the observer to determine the nature of objects seen from the air are *form, shadow, texture,* and *color.* Other contributing factors are *movement, shine,* and *tone.*

FIGURE 7 ①.—Agricultural area bordering on sparsely wooded areas.
②.—Urban area, showing regularly shaped pattern of streets and buildings.
③.—Desert area, showing terrain lines and scraggly vegetation.
④.—Jungle area, showing dense growth and deep texture.




2


3


4



FIGURE 8.—Size and shape identify ½-ton truck and pup tent. Other objects are half-tracks.

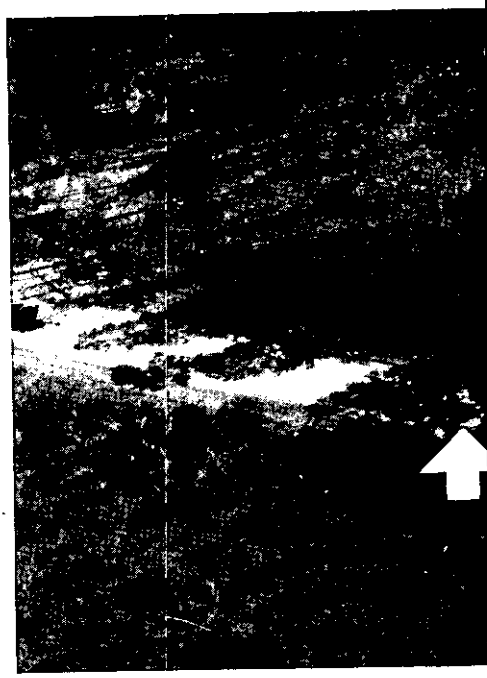


FIGURE 9.—Truck in shadow of trees is more likely to be overlooked than truck in open.

a. Form.—Man-made objects or groups of objects tend to have straight or uniformly curved lines and are laid out in regular patterns, while nature tends to form irregular patterns. In an area of irregularity, a regular object attracts attention. If the object is of a military nature, it will be conspicuous to the enemy (fig. 8). Its shape and its relative size are clues to its identity.

b. Shadow.—From the air, shadows are very noticeable, particularly on aerial photographs. Often a shadow reveals the form of an object better than its top outline (fig. 11). Objects such as factory chimneys, telegraph poles, vehicles, and tents, for example, have distinctive shadows (fig. 10). Objects in the shadow of another object are more likely to be overlooked (fig. 9).

c. Texture.—(1) Texture is the degree of roughness of a surface. A rough surface has the ability to cast shadows within itself. Perfectly smooth surfaces cast no shadow, absorb no light, and therefore have smooth texture (fig. 12). From such surfaces a large proportion of the reflected light rays enters the eye or the camera, and the surface appears light. Barren or rocky surfaces having no vegetation

reflect most of the light they receive; they have little texture (fig. 13) and appear light gray when photographed.

(2) Surfaces which contain large numbers of shadows, such as grass and brush or heavy woods, absorb light; they have much texture. They reflect very little light and appear dark on photographs (fig. 14). The degree of darkness is largely dependent upon the amount of texture. For instance, a field of tall grass will appear darker in a photograph than a field of short grass, since the former has a greater shadow content than the latter.

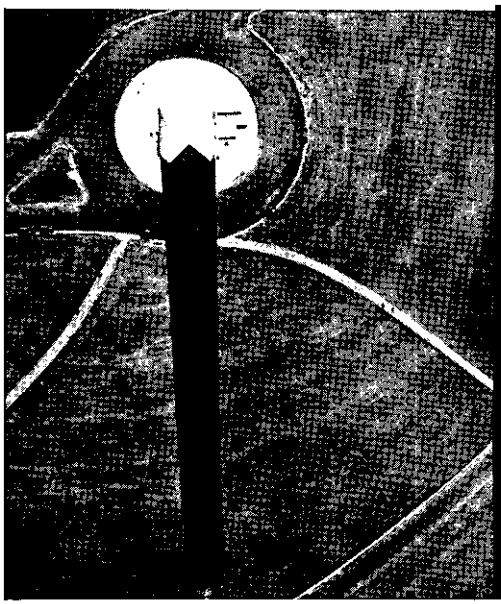
d. Color.—Color differences at close range distinguish one object from another.

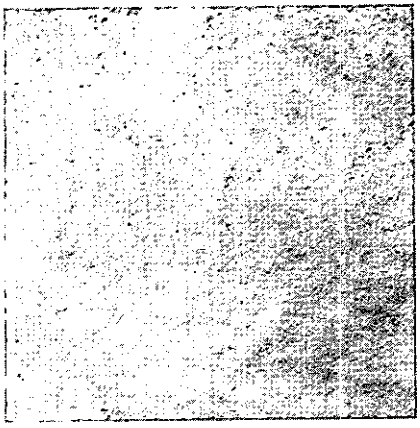
e. Movement.—The area in view below an aerial observer is so large that small objects fade into the landscape and do not attract his eye. If the object moves, however, the eye is immediately attracted, and what was unnoticed before is suddenly conspicuous. The aerial camera records the fact that something has moved when two photographs of the same area are taken with a time interval between. If an object has moved, the changed position is apparent when the two photographs are compared. The same principles hold true in ground observation.

FIGURE 10.—Without clear shadows such as these, it is extremely difficult for an aerial photo interpreter to identify certain objects.



FIGURE 11.—From the air, shadows often reveal more than the shape of the object itself. Monument is over 500 feet high.





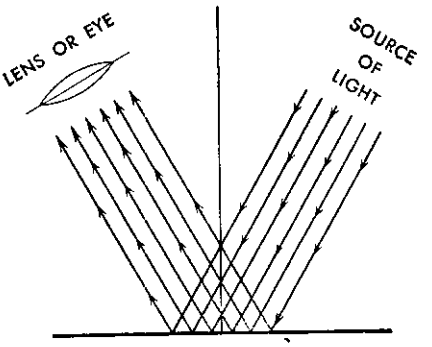


FIGURE 12 ① and ②.—Smooth surface—no texture.



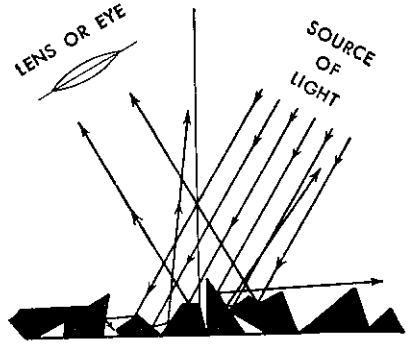
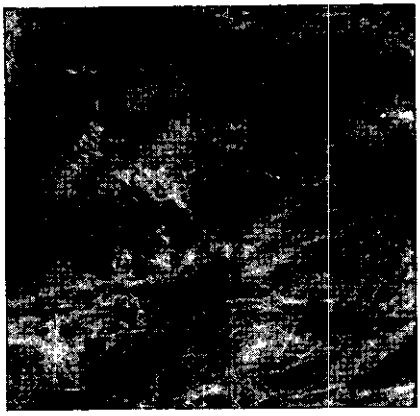


FIGURE 13 ① and ②.—Irregular surface—little texture.



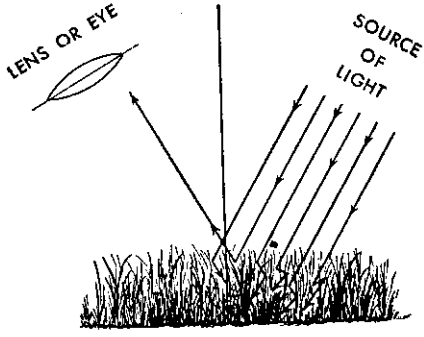


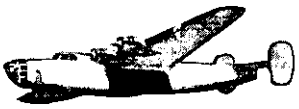
FIGURE 14 ① and ②.—Tufted surface—much texture.



FIGURE 15.—Shine—one of the most revealing signs to observers on the ground and in the air. Shine alone can betray the best camouflage.



FIGURE 16. — Study in tone. Tone is the relative shade of gray in which objects appear on an aerial panchromatic photograph.



f. Shine.—A particularly revealing signal to an observer is shine. Shine is the flashing of light reflected from a smooth surface. Wherever light strikes such smooth surfaces as windows, roofs, the windshields (fig. 15) and tops of vehicles, smooth concrete surfaces, or steel helmets, that light may be reflected directly into the observer's eye or the camera's lens with striking emphasis.

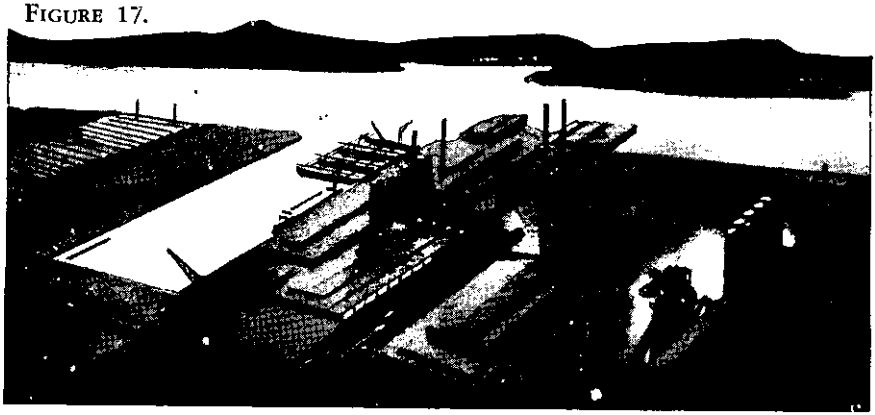
g. Tone.—The shade of gray in which an object appears in a black and white photograph is known as *tone.* All objects are represented on a black and white photograph as patches ranging from black through various shades of gray to white (fig. 16). By the addition of texturing material a smooth or shiny surface may be made to produce a dark tone or value in a photograph.

7. FACTORS AFFECTING OBSERVATION.—The kind and quality of observation obtainable by the enemy govern camouflage.

a. Visual.—(1) The height and distance of an aerial observer from an object determine what he can see and identify. As a general rule, contrasting objects are seen from the air, under ideal conditions, at a scale of 1 foot per thousand feet of elevation. For example, an object 2 feet in size can be seen at 2,000 feet, if the observer knows where to look for it.

(2) Colors change rapidly above 10,000 feet, becoming gray.

FIGURE 17.



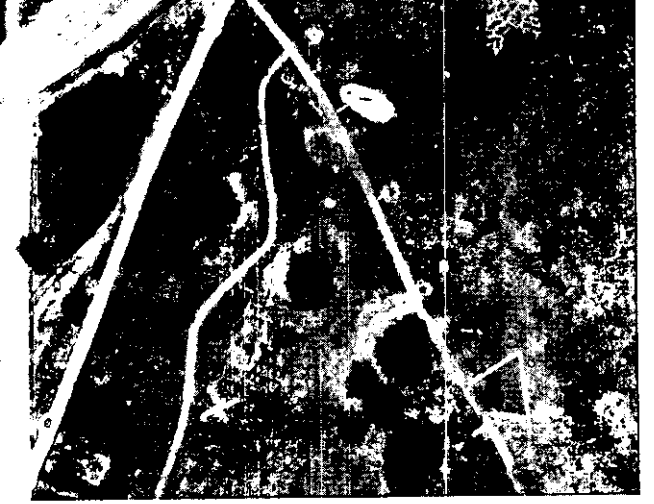
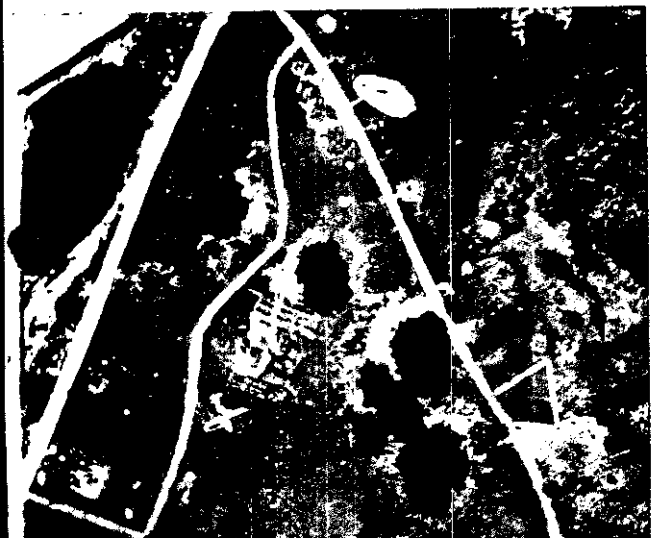


FIGURE 18 ①. — Panchromatic film — the most common kind used in aerial photography. The aerial photo interpreter gathers information from size, shape, shadow, and tone of objects.



②.—An infrared photograph of the same area shows up certain camouflage areas. Artificial vegetation, for example, is revealed by this infrared photograph.



③. — Color photography detects faulty matching of color in camouflage. Many clues which evade the panchromatic film may be picked up by color film. But color film has many operational disadvantages and is not commonly used.

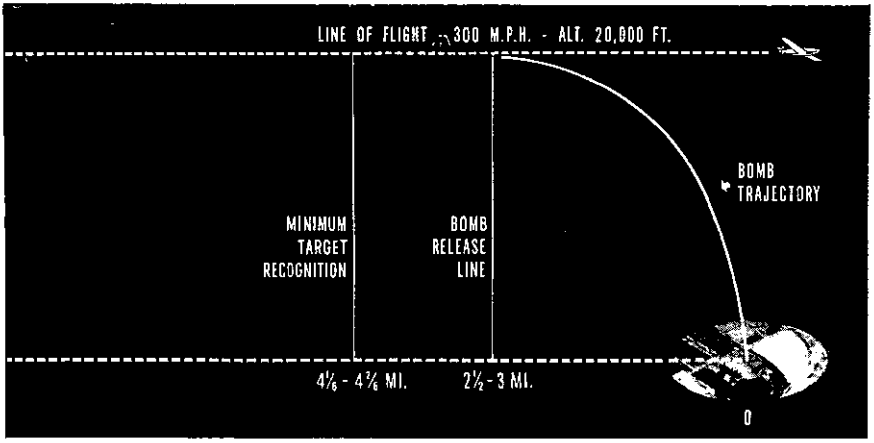


FIGURE 19.—A diagram of bombing practice by high-altitude bombers.

(3) Figure 19 illustrates the problem confronting high-altitude bombers. It is clear from this illustration that a bombardier at 20,000 feet must identify his target correctly while still 4 to 6 miles away from it.

b. Photographic.—(1) Photographs may be taken of a suspected area at frequent intervals. By comparing these photographs, enemy interpreters find changes in the terrain (fig. 20).

FIGURE 20 (a) and (b).—Changes in the terrain are revealed by comparing successive photographs of the same area. Many foxholes appear in the right-hand photograph, taken one day after the left-hand photograph.



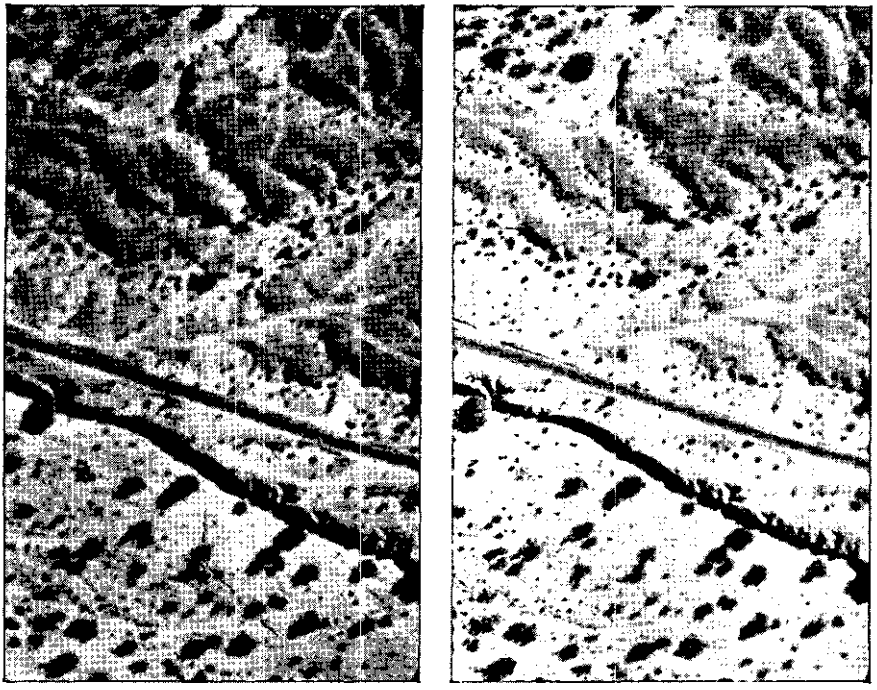


FIGURE 21.—Stereopair of desert scene. The rough ground is clearly defined in stereovision.

(2) Stereopairs or overlapping photographs taken at the same altitude provide enemy observers with photographs with which they may study the terrain in three dimensions (fig. 21). See TM 5-246 for technical information on stereopairs.

(3) Under favorable conditions, vertical night photographs can be taken (fig. 23). Concealment provided by cover of darkness may be of no value where night photography is possible.

(4) An object which measures approximately .0125 inches on a photograph can usually be identified. A foxhole with a parapet made of spoil is 7 to 8 feet in diameter. On a photograph to scale 1:5,000 it measures 0.018 inches and can be identified (fig. 22).

c. Sound.—The intensity of sound at the source and the enemy's means of intercepting it are major effective factors. Sound carries well at night, in mist, fine rain, and on water. Both lack of wind and wind blowing from the camouflaged object favor sound-carrying. Wind blowing from the observer to the camouflaged object detracts from sound-carrying. Wind velocities of more than 13½ miles per hour make sound-carrying impossible. Heavy and thundery weather have the effect of subduing sound. These influences must be considered.

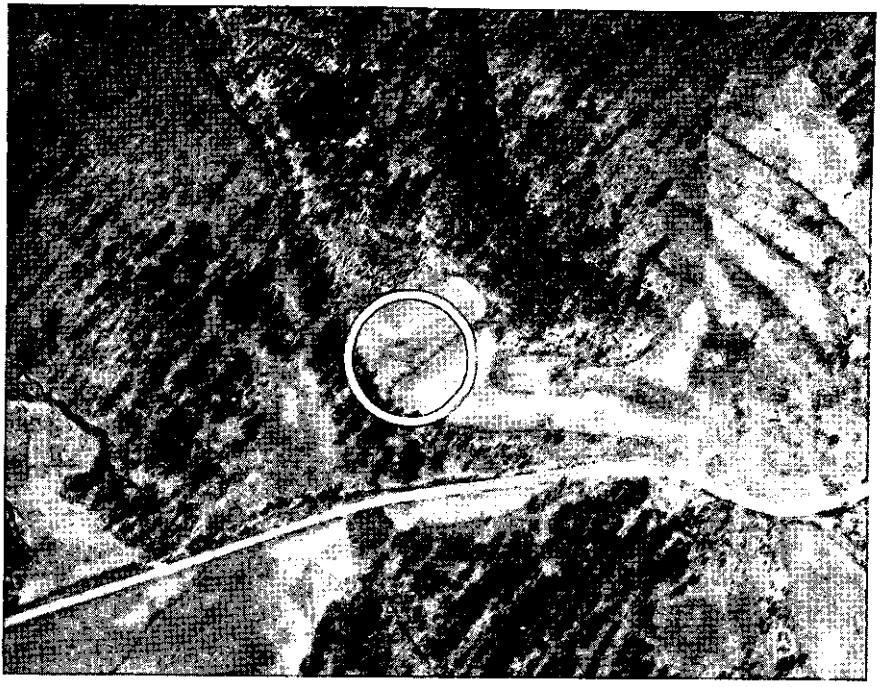


FIGURE 22.—Scale 1:5,000. Diameter of foxhole, including spoil, is 0.018 inch on photograph. The aerial photo interpreter can identify it easily.

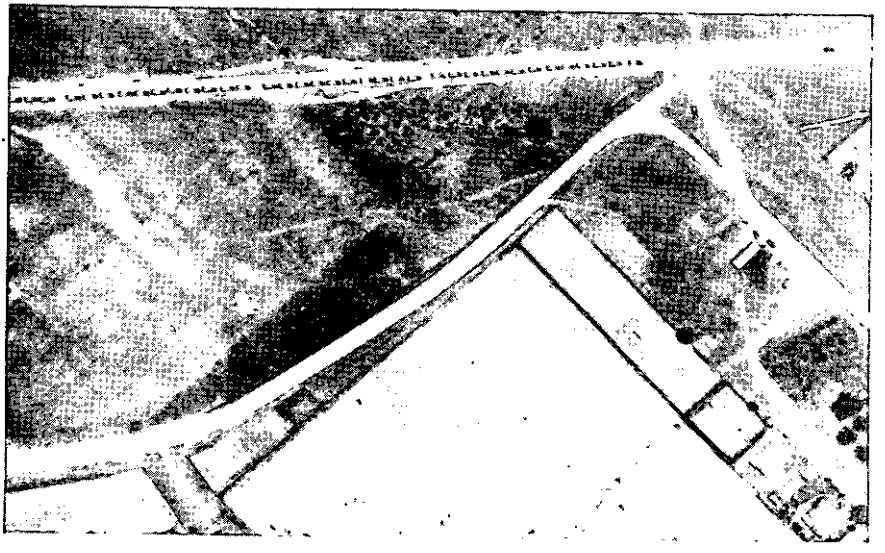


FIGURE 23.—High-altitude aerial photographs taken at night can pick up details as sharply as day photographs. Notice unsuspecting truck convoy.

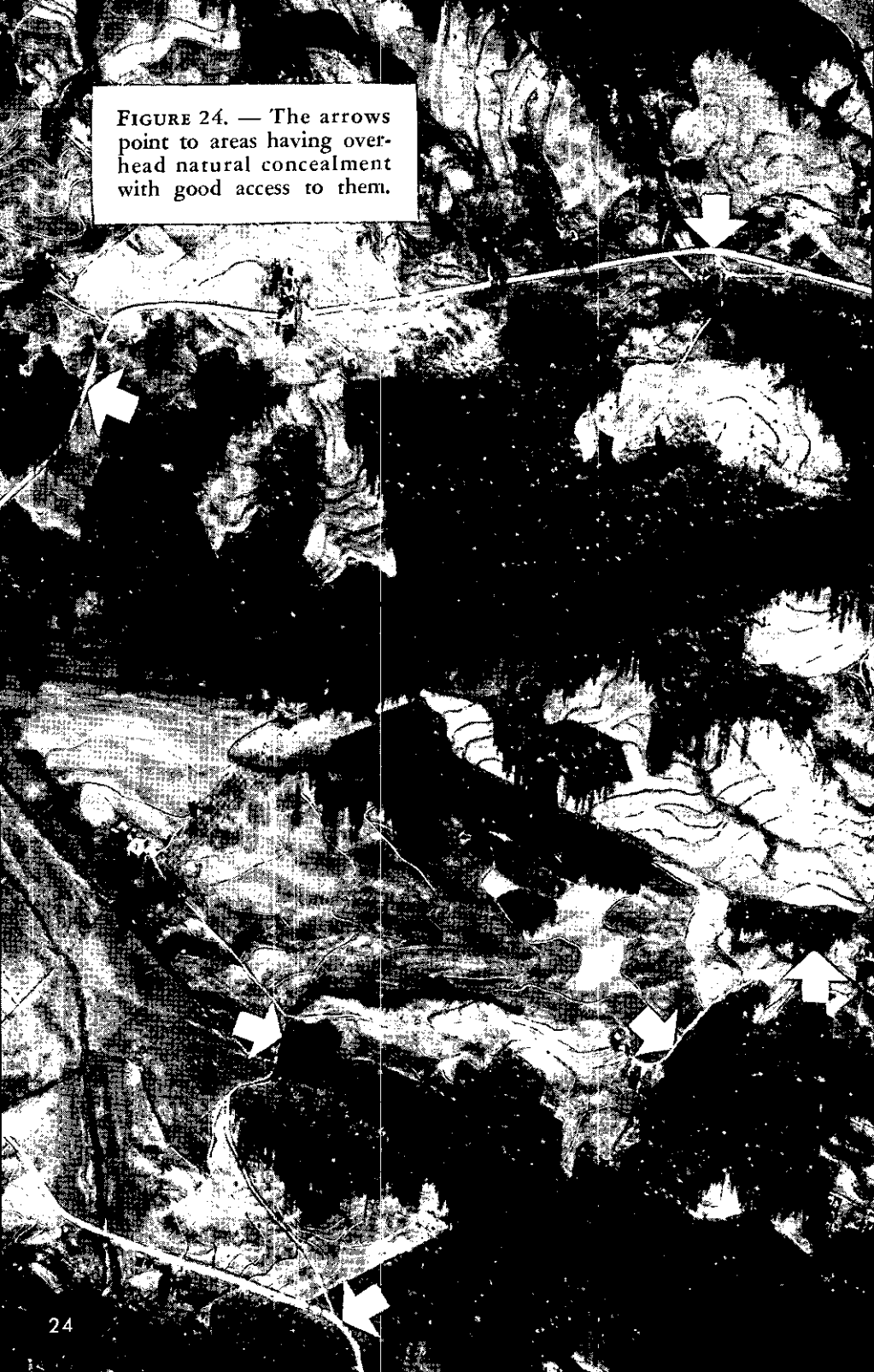


FIGURE 24. — The arrows point to areas having overhead natural concealment with good access to them.

CHAPTER 3

PRINCIPLES OF CAMOUFLAGE

8. GAINING CONCEALMENT.—The two most important considerations in gaining concealment are *choice of position* and *camouflage discipline.* The other basic consideration is *construction,* which includes both the correct choice and the correct erection of materials.

a. Choice of position.—When choosing a position to gain concealment, seek a background which will visually absorb the elements of the position. The appearance of the background must be changed as little as possible by their presence (fig. 26). Natural cover (fig. 27) and defilade are desirable, as is concealed access to the position (fig. 24). Make certain the terrain will accommodate the required layout of the installation. Landmarks are avoided because they attract attention to themselves (fig. 30). Sometimes, by making wise use of background, complete concealment can be gained with no construction work at all. This may be easy to do when there is enough natural cover. It may also be possible when natural cover is sparse by taking advantage of irregularities in the terrain.

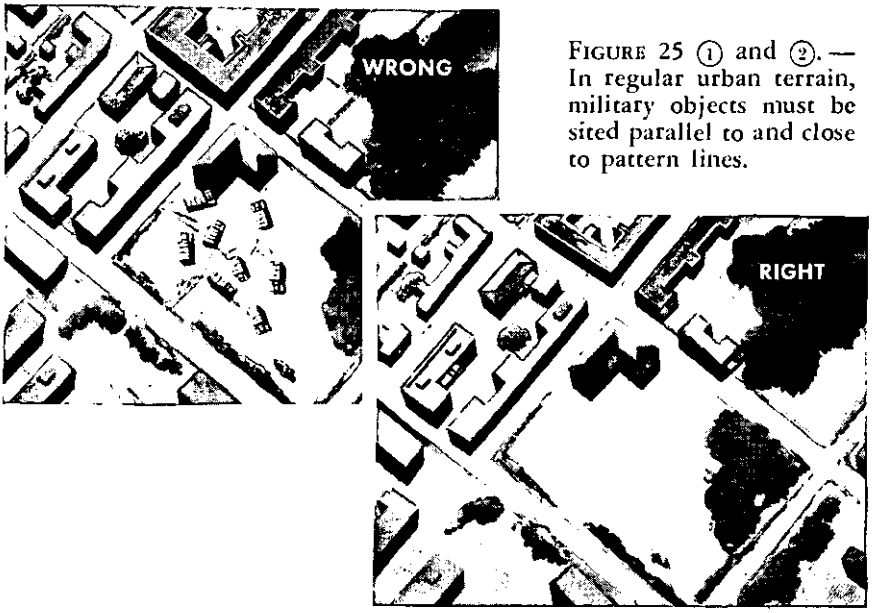


FIGURE 25 ① and ②.— In regular urban terrain, military objects must be sited parallel to and close to pattern lines.

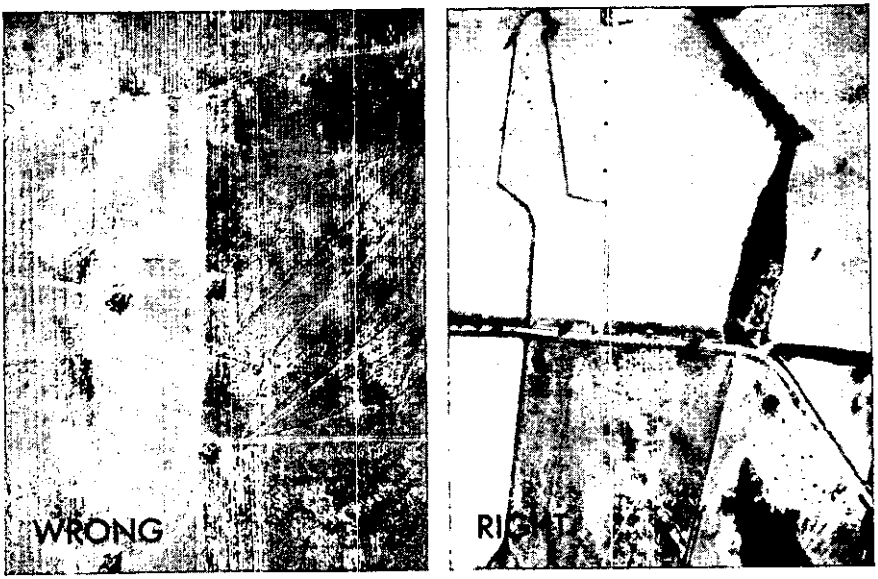


FIGURE 26 ① and ②.—On the left, an example of suicide siting for an antiaircraft battery. There are no access routes, no broken ground pattern, no concealment. The area on the right has the advantageous features lacking in the other picture.



FIGURE 27.—Vehicles taking advantage of natural concealment.

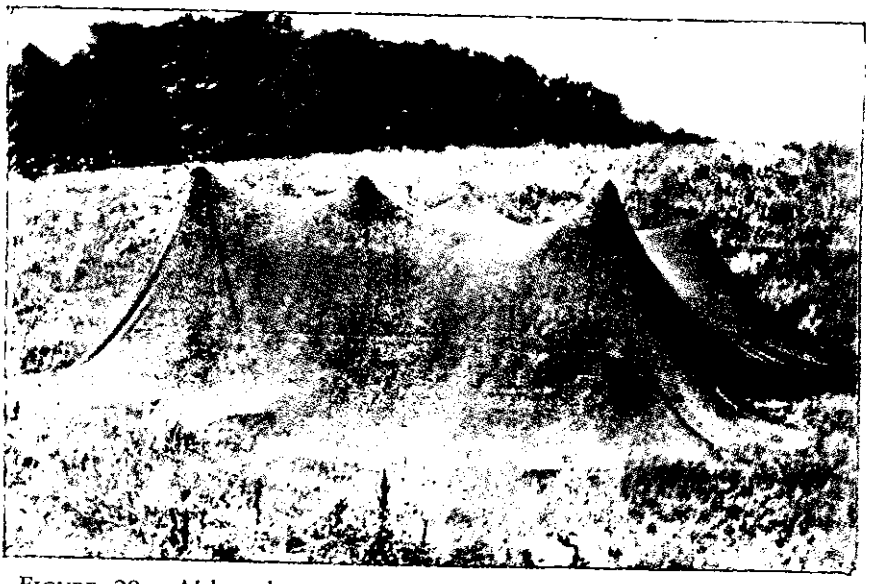


FIGURE 28.—Although natural concealment is plentiful near-hy, this vehicle failed to use it. Identity of the vehicle may be concealed by the drape, but the poorly chosen site fails to hide its presence and tracks would betray it.

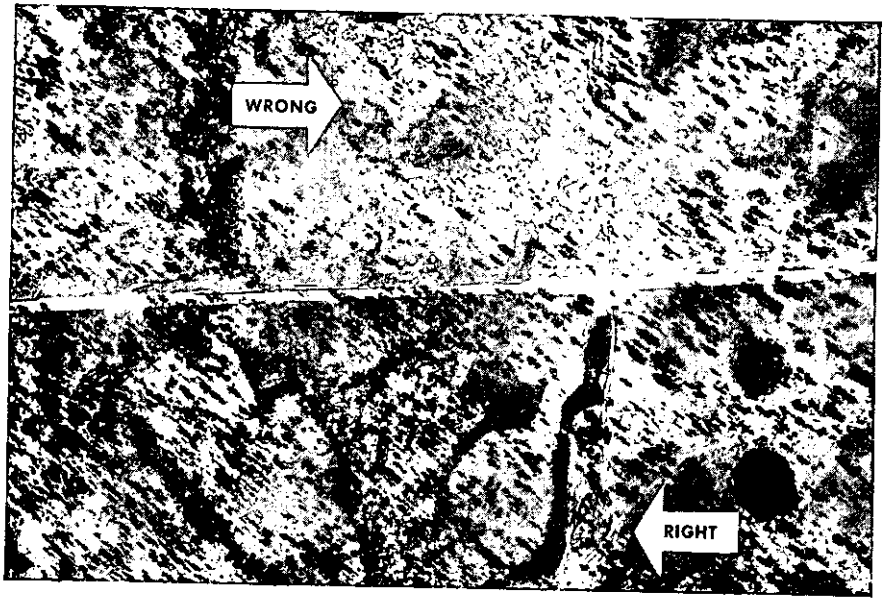


FIGURE 29.—In choosing a position for a large installation take advantage of hidden or existing access routes (right). The site indicated by "wrong" demands new access routes, which would be extremely difficult to conceal.

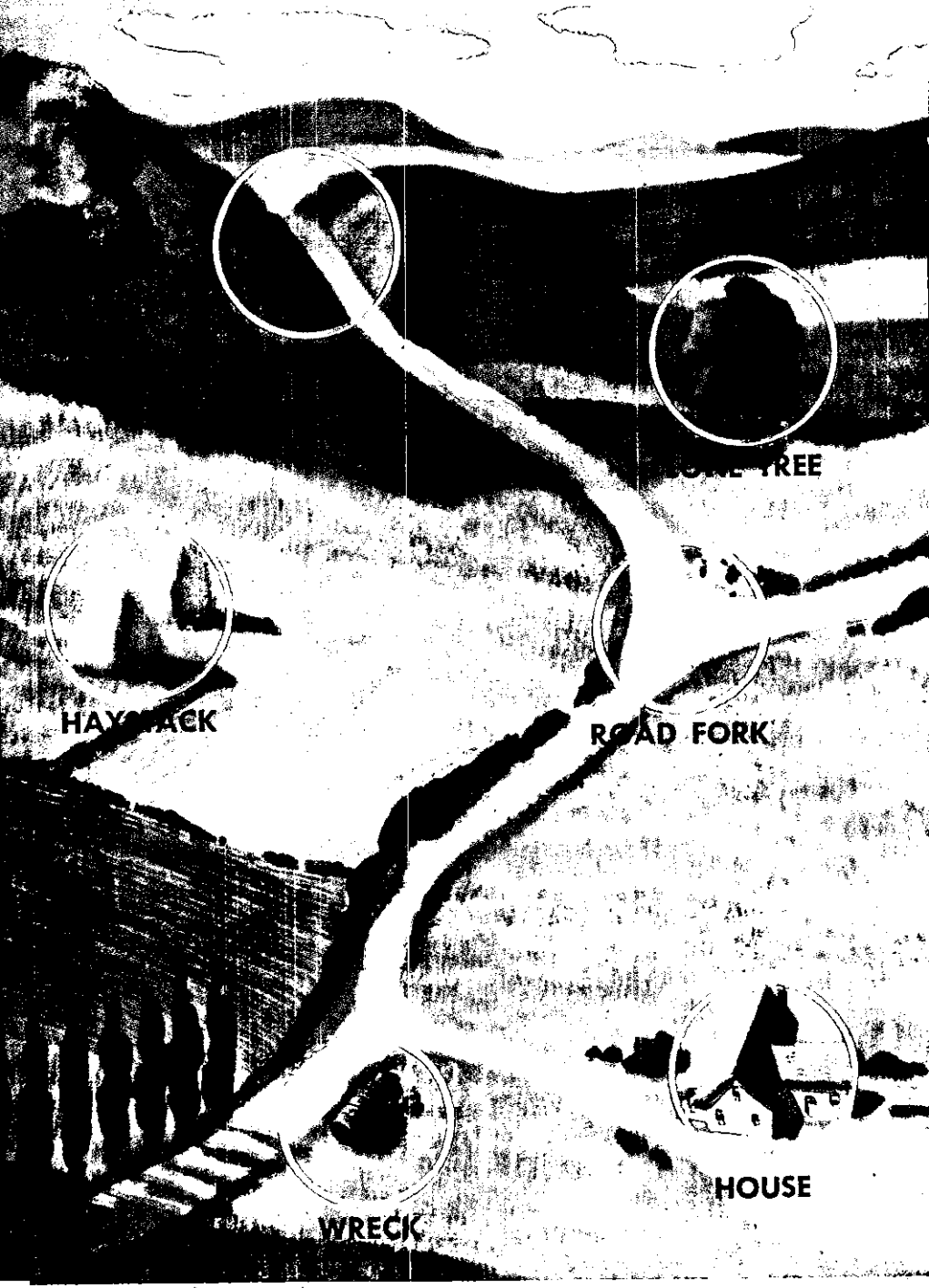
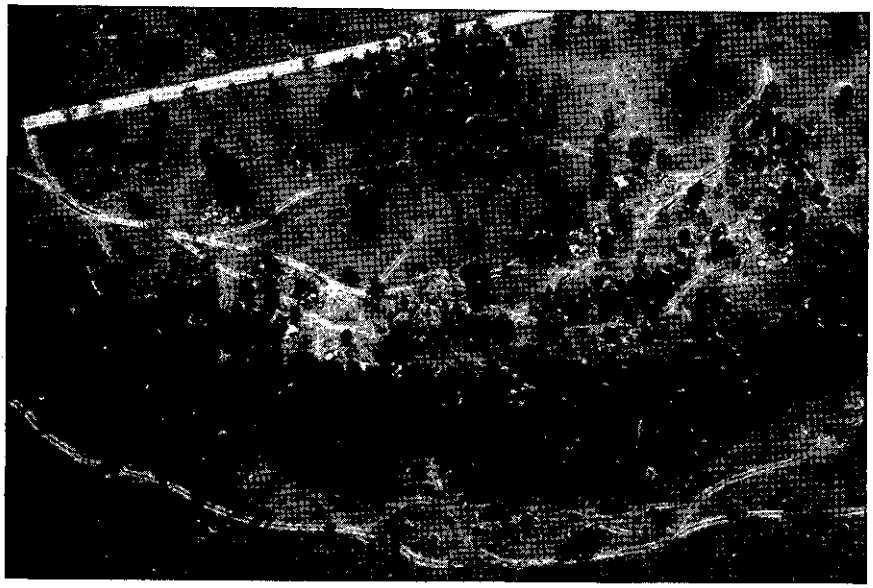


FIGURE 30.—Landmarks attract attention. Installation should avoid terrain features which may be used as reference points by enemy ground and aerial fire.

b. Camouflage discipline. — (1) Camouflage discipline is the avoidance of activity that changes the appearance of an area or reveals military objects to the enemy. Tracks, spoil, and debris (fig. 31) are the commonest signs of military activity which indicate concealed objects. Therefore, new tracks follow existing tracks, paths, roads, or natural lines in the terrain; exposed routes do not end at a position, but are extended to another logical termination. If practicable, exposed tracks are camouflaged by brushing out or covering with materials. Spoil and debris are covered or placed to blend with the surroundings. Camouflage construction must be maintained. Smoke from kitchen fires must be controlled and dispersed. Aerial photographs taken at night by the light of flares can pick up breaches in camouflage discipline, which are more likely to occur at night than in the day (fig. 23). Consequently the same standard of camouflage discipline must be adhered to by night as by day. Light discipline is important at night. Sound discipline is always important.

(2) Sounds can be lessened, when in the neighborhood of the enemy, by suitable measures. Loud orders, talking, calling, coughing, and sneezing must be avoided. Hard ground should be avoided and full use made of soft ground. Signs should be used where possible. Soldiers' equipment should be fastened in such a manner that

FIGURE 31.—Tracks, debris, and equipment exposed in this bivouac area invite artillery and bombing attacks.



banging noises are impossible. Each piece of equipment should be wrapped in hay, straw, wood shavings, rags, or similar materials. Wrapping the wheels of horse-drawn vehicles and the horses' hooves is effective for short distances. Horses that are inclined to neigh must have their mouths tied shut. When horses are stationary, nose-bags have a quieting effect. Vehicles must be loaded in such a way that any banging of equipment is impossible, even on bad roads or when going cross country. Straw, wood shavings, and other muffling agents should be used for packing. Loading and unloading of vehicles must be carried out in silence. Every single piece must be carefully lifted and set down. Vehicle horns must be disconnected. At times it is necessary to switch off engines. The noise of engines and tracked vehicles cannot be diminished, but where conditions allow, it can be drowned by the noise of artillery fire, planes, and other loud noises. In order to prevent the enemy from locating gun positions by sound-ranging, ranging should be carried out wherever possible by roving troops, and ranging guns should be brought up for this purpose. If such a system cannot be employed, fire should, if possible, be restricted to closed bursts of fire or salvos. The use of decoy troops equipped to simulate the sounds of firing also makes sound-ranging more difficult.

FIGURE 32.—A well-made overhead drape in color harmony with the background. Color of artificial materials must be changed with the seasons.



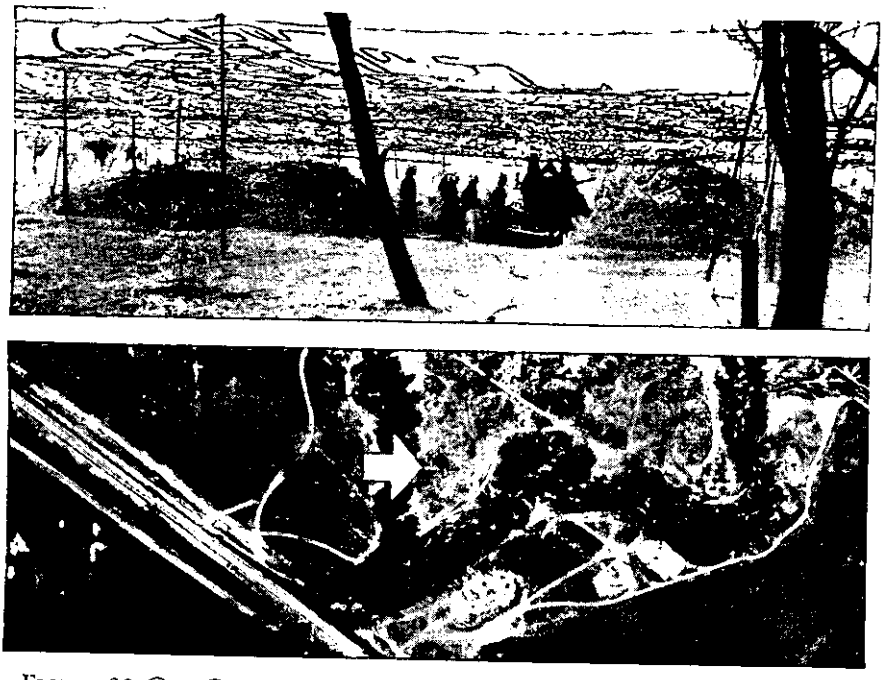


FIGURE 33 ①.—Ground view of 155-mm gun under camouflage blending with surroundings.
②.—Air view of above emplacement.

c. Construction.—Where there is not enough natural cover to hide an entire installation, either natural or artificial materials are used to supplement existing concealment.

(1) Choose natural materials which are similar to those at the site and which resemble them in form and color.

(2) Artificial materials must be capable of withstanding local weather conditions. They must be arranged to blend with their surroundings. Seasonal changes may require gradual alteration in the color and kind of materials used (fig. 32).

(3) Even the best camouflage materials are worthless if used carelessly or improperly. Construction must be hidden. Work parties must not make tracks which will betray the installation.

9. CAMOUFLAGE METHODS.—There are three fundamental ways of concealing installations and activity.

a. Blending.—An object is concealed by camouflage materials arranged so that both the materials and the object seem a part of their background (fig. 33). The aim is to prevent disclosure of the object by a change in the natural appearance of the site.

b. Hiding.—Hiding is concealing the identity of an object with a screen even though the screen itself may sometimes be seen (fig. 34).

c. Deceiving.—(1) Deceiving simulates an object or activity of military significance or disguises them so they appear to be something else. Deceiving accomplishes the following:

(*a*) Divides an enemy attack by offering more targets than actually exist.

(*b*) Draws enemy attention and fire away from essential installations or activity (fig. 35).

(*c*) Deceives the enemy as to identity, strength, intention, or degree of activity in an area.

(2) When deception is used on a large scale by a force commander, it is a part of operational camouflage (see chapter 5).

(3) Decoys—imitations of real objects— are the basis for most deceptive practices. Although it is possible to make a decoy representation of any object, the most useful are decoy roads, paths, rocks, stumps, trees, hedges, guns, vehicles, planes, and buildings.

(4) Disguise changes the appearance of an object or activity to give a false impression of its character (fig. 36). The purpose may be either to create a military target or to conceal the object by making it appear to be of non-military significance.



FIGURE 34.—Hiding. Trees and drape hide light tank.

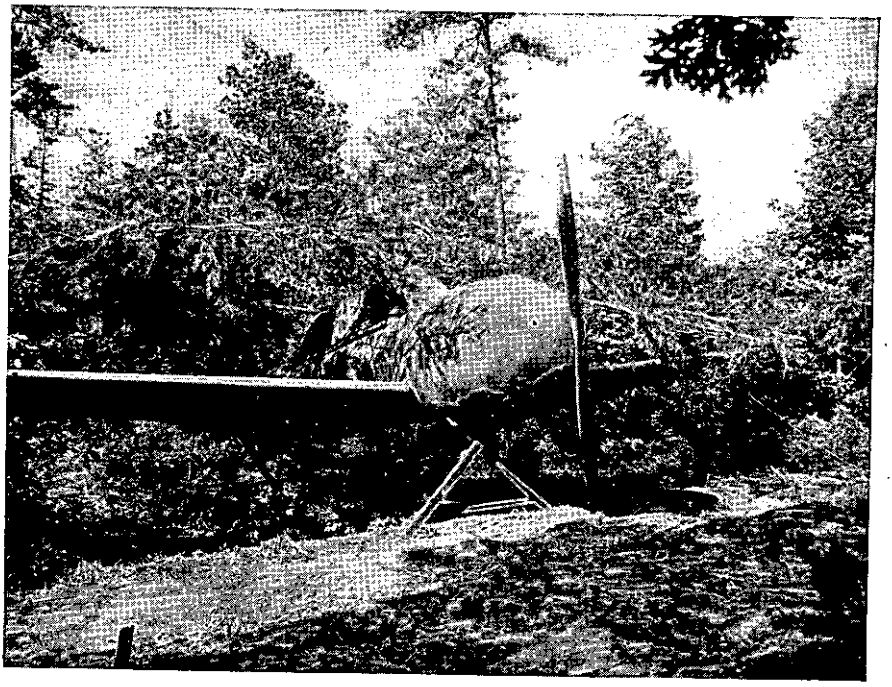


FIGURE 35.—Deceiving. Portable decoy aircraft is designed to draw enemy attention and fire.

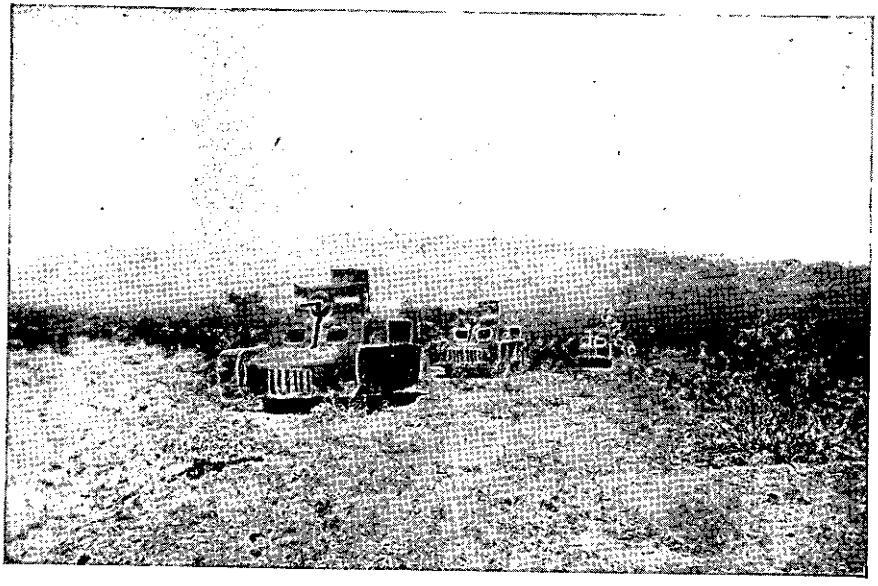


FIGURE 36.—Disguised as tanks, ¼-ton trucks mislead the enemy.

CHAPTER 4

HIDING AND BLENDING

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SECTION I. USE OF NATURAL MATERIALS

10. GENERAL.—Natural camouflage materials match local colors and textures and, when correctly used, are proof against both direct and photographic observation. Their use reduces the quantity of supplies to be carried from rear areas. However, in combat zones they cannot be prepared ahead of time, are not always available in usable types, and foliage wilts after cutting and requires renewal. Foliage of coniferous trees (evergreens) retains its camouflage qualities for considerable periods, but foliage that sheds leaves wilts in a day or less, depending on climate and type of vegetation.

11. LIVE VEGETATION. — Planted rapid-growing weeds, grasses, vines, bushes, and small trees are used extensively to conceal permanent and semipermanent installations. The fastest-growing weeds in the locality are often useful for living camouflage. In some instances relatively large trees are transplanted to furnish concealment, but this method, requiring special equipment and skill, is exceptional. Small trees and bushes can be potted successfully. In barren areas, scrub growth is an excellent supplement to artificial garnishing on nets.

a. Vines.—Vines have approximately the same color and texture from all sides. They grow quickly in a tropical climate and can be trained on wires over permanent installations (fig. 37). They can cover screens, serve as garnishing, and break up an even tone. Grown on skeleton forms, they can simulate trees.



FIGURE 37.—Vines make a concealing cover for this seacoast installation.

b. Grasses.—(1) *Controlled mowing.*—The controlled mowing of grasses is a technique sometimes included in camouflage plans of airdromes and rear-area installations. Controlled mowing means mowing one section or area all at the same height and in the same direction, with adjacent areas at different heights and directions; this results in what appears to be fields with different crops (fig. 38).

FIGURE 38.—Grass landing field where directional mowing simulates agricultural patterns. Edges of fields are outlined by painted boundaries.



(2) *Toning.*—Grass may be toned by spraying with chemicals such as iron sulphate, sodium arsenite, or ammonium thiocyanate. The process must be carefully controlled. The vegetation will be discolored, but the damage will be slight and temporary. After a period of a few days to a few weeks, depending on the rates of application employed, the grass resumes normal growth. In the case of ammonium thiocyanate, the grass turns a rich deep green following the burn, because of the nitrogen supplied by the spray. Asphalt emulsions and tannin dye also are suitable for toning. Waste oil may be used, but it prevents growth of grass for several months after application.



FIGURE 39.—If time permits, place sod or brush over new spoil. Sod must be watered to keep it alive.



FIGURE 40.—Cut foliage must always be placed as it appears in its natural growing state.

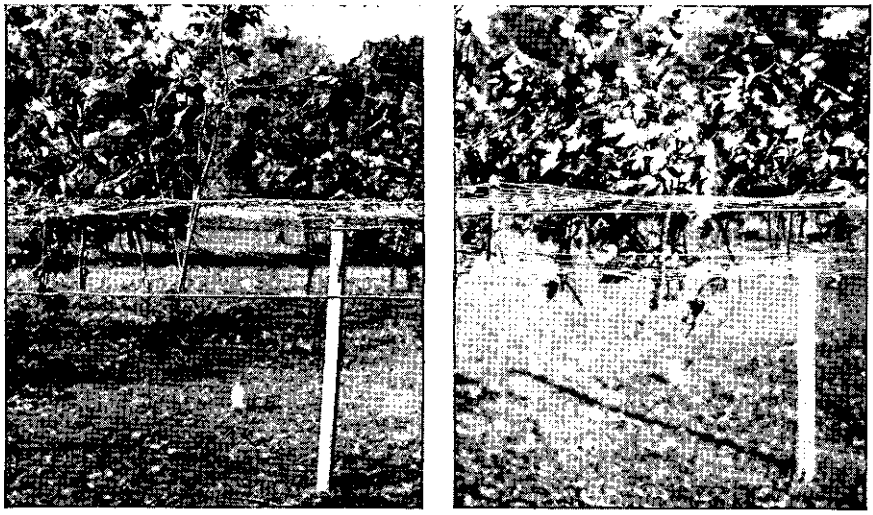


FIGURE 41 ①.—Chicken wire supports this cut vegetation in its natural upright position. Smooth-strand wire anchors butts.

②.—Alternate method employs two separated layers of chicken wire.

12. CUT VEGETATION.—*a.* When freshly cut vegetation is used as garnish or screening, it must be replaced with fresh-cut materials, or painted, as soon as it has wilted sufficiently to change color or texture. If vegetation is not maintained it is ineffective. Thorn bushes, cacti, trees, and other varieties of desert growth retain growing characteristics for long periods after being cut. Evergreens in snow-covered terrain are especially lasting.

b. Arrangement of cut foliage is important. Upper sides of leaves are dark and waxy; under sides are lighter. In camouflage, therefore, cut foliage must be placed as it appears in its natural growing state—top side of leaves up and tips of branches toward the outside of the installation. Cut foliage must be matched to existing foliage. For instance, foliage from trees that shed leaves must not be used in an area where only evergreens are growing. Choose foliage with leaves that feel leathery and tough. Branches grow in irregular bunches and, when used for camouflage, must be placed in the same way. When branches are placed to break up the regular, straight lines of an object, use only enough branches to accomplish this purpose; it is not necessary to cover the object completely.

c. Methods of supporting natural materials are shown in figure 41. Chicken wire and small smooth-strand wire are commonly used for this purpose.



FIGURE 42.

d. Cut green vegetation may be sprayed with bituminous emulsion in a matching color to prolong the time it can be used (fig. 42).

13. DEBRIS.—Debris furnishes valuable means of concealment. Frequently it may be used just as it is found. Positions concealed by debris require little maintenance. Debris also makes excellent decoys. Planes beyond repair, for instance, may be placed in partly concealed positions and, with the addition of simulated activity near-by, may lead the enemy to waste ammunition. Rusty tin cans cut into strips and combined with cloth can be used to garnish wire nets (fig. 43).

FIGURE 43.—Sides of tin cans are slit at 1-in. intervals. Pieces of cloth are crimped into ends of resulting strips.



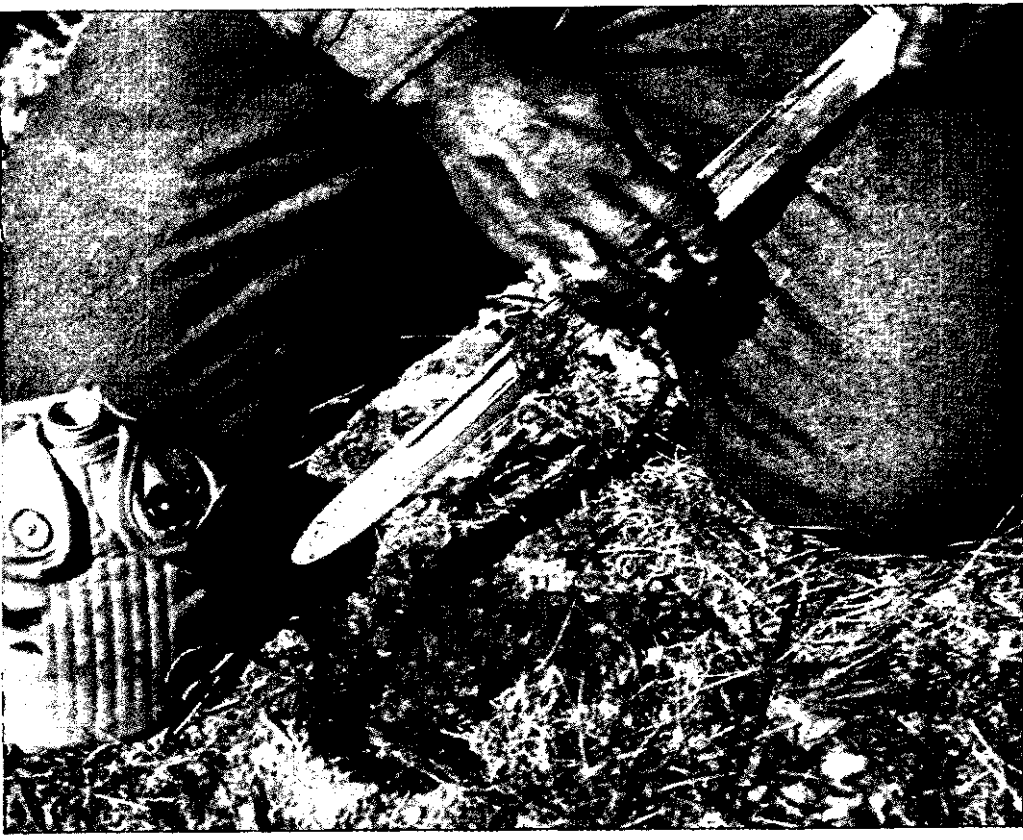


FIGURE 44.—Mud used to tone down bright surfaces on bayonet.

14. EARTHS.—Earth, sand, and gravel are used to change or add color, provide coarse texture, simulate cleared spots or blast marks, and create forms and shadows.

a. Earth, in mud form, provides good material for tonedown of bright surfaces (fig. 44). The combat soldier, using mud, can quickly tone down his shoes, leggings, and vehicle. Artificial rocks may be colored and textured effectively with mud.

b. Sand adhering to paint or oil provides means for toning down vehicles in the desert. In the desert, dispersed supply points under tarpaulins, if made low and irregular in outline, can be hidden effectively by covering them with sand.

c. Gravel is used to provide texture on roads, roofs, and other flat surfaces. It is not altogether satisfactory on runways because, if dislodged from the adhesive, propeller blasts cause particles to fly into and damage airplane parts.

SECTION II. USE OF ARTIFICIAL MATERIALS

15. ISSUED MATERIALS.—Camouflage materials issued include shrimp nets, twine nets, chicken-wire netting, cloth garnishing, steel- and glass-wool garnishing, smooth soft steel or iron wire, rope, wood and steel stakes and posts. For complete details see FM 5-20H and Engineer Supply Catalog.

16. PURPOSE OF CAMOUFLAGE NETS.—A garnished camouflage net, either twine or wire mesh, is supported on a wire frame to make a flat-top. Erected over an object, it conceals the object by breaking up its form and shadow. The garnishing in the net blends with the surroundings so the net itself cannot be seen. Twine camou-

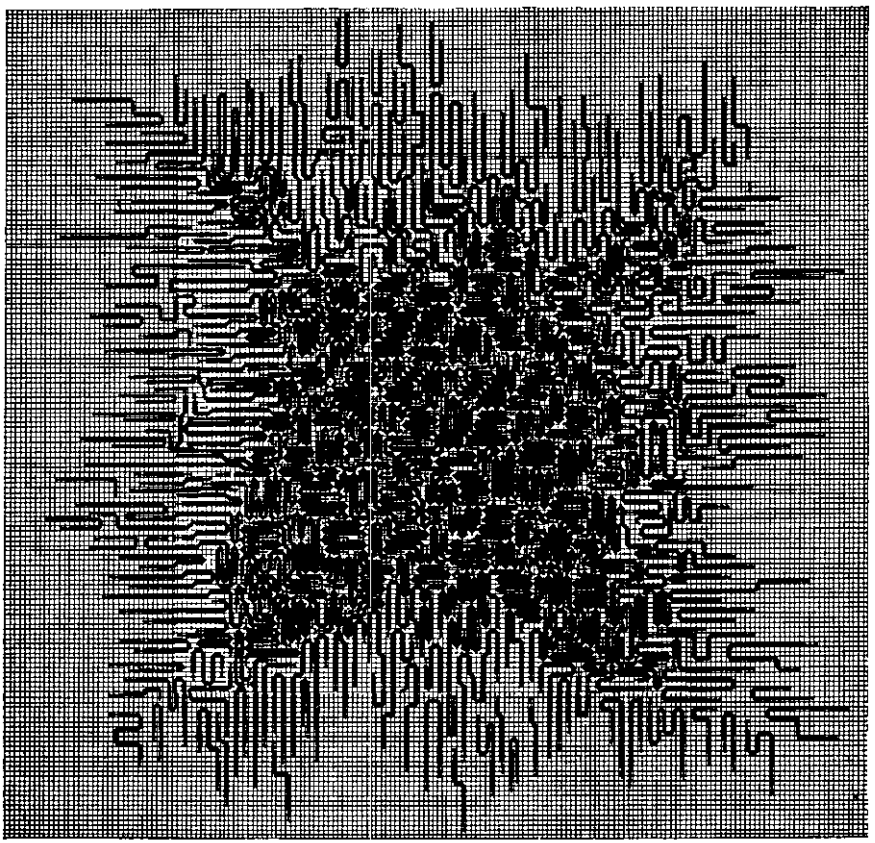


FIGURE 45.—Net with standard arrangement of garnishing patterns.



FIGURE 46.—Hanging net vertically facilitates garnishing.

flage nets are also used as drapes for the same purpose. A drape is supported above an object by poles.

17. GARNISHING FOR FLAT-TOPS.—*a.* Garnishing material is woven or tied to nets and netting. The standard arrangement of patterns can be used effectively wherever there is a naturally rough ground texture. For other types of terrain, special arrangements should be used. For pattern arrangement on drapes, see paragraph 20.

b. The standard arrangement is irregular in outline (fig. 45). Approximately 80% of the center area of the net is covered. Toward the edges, the garnishing is thinned to approximately 10% coverage. For estimating purposes, total area of garnishing is about 55% of the area of the net. Thinning the amount of garnishing at the edges is important, because it serves to blend the screen with its surroundings and prevent conspicuous straight-edged shadows. Particular care must be taken to keep thick garnishing away from the corners.

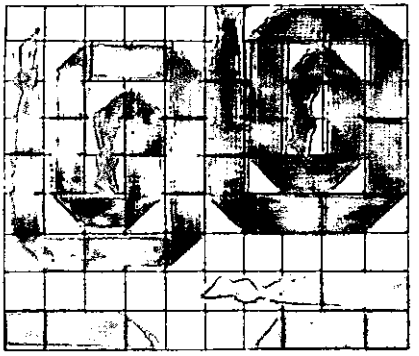
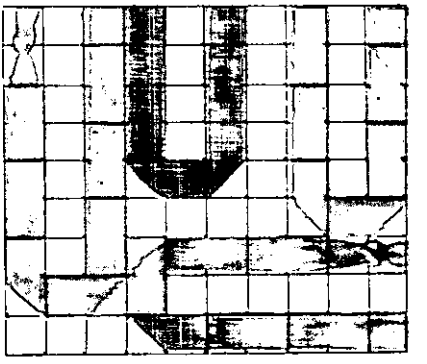


FIGURE 47 ①. — Greek-key pattern for strip garnishing. Pattern is woven parallel to edges of net.



②. — U pattern for strip garnishing. At edges of pattern arrangement, open ends of U-form are made to point towards nearest edge of net.

18. APPLICATION OF GARNISHING.—Nets are easily garnished when hanging vertically (fig. 46). The most difficult position is when they are attached to an overhead frame. Tests have shown that there is little difference in effectiveness between the many garnishing patterns. Two patterns, known as the Greek-key pattern and the U pattern, have certain advantages. They save time, are easily applied, and the basic design is easy to control; together, they achieve the desired irregularity and blending effect.

a. Greek-key pattern (fig. 47 ①). — Strips of garnishing are woven parallel to the sides of the net in a "squared spiral" or fretwork design.

b. U pattern (fig. 47 ②).—Each strip of garnishing is woven in U-shape. The pattern is made irregular. Near the edges of the net, the strips are woven so that both ends, still following the U-form, point toward the nearest edge of the net.

c. Special patterns.—Properly colored straight-line garnishing (fig. 48) is particularly useful in barren terrain and areas of smooth uniform texture. In broken, mottled terrain, patch garnishing may be used to match the terrain pattern. Patch garnishing is illustrated in figure 49. Bow-tie garnishing (fig. 50) is useful in matching thick, leafy texture.

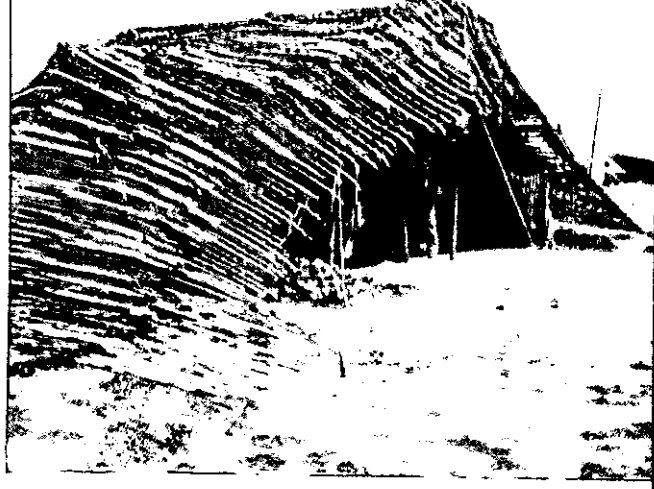


FIGURE 48.—In correct color proportions, straight line garnishing disguises a headquarters tent in open terrain.



FIGURE 49. — Patch garnishing. Bunching material deepens texture.



FIGURE 50. — Bow-tie garnished drape does a complete job of matching thick leafy background.

19. MATERIAL AND LABOR REQUIREMENTS — FLAT-TOPS. — The following table gives the approximate amount of materials and man-hours required to garnish the different-sized twine nets when they are to be used as flat-tops.

TABLE I.—Approximate material and man-hours required to garnish nets.

Size	Garnishing Strips 2″ x 60″	Material Required— No. Rolls 2″ x 300′	Man-hours Required to Garnish
15′ x 15′	125-150	2-3	3
14′ x 29′	220-300	4-5	8
17′ x 35′	325-450	6-8	11
29′ x 29′	425-600	7-10	16
36′ x 44′	775-1,150	13-20	30

20. GARNISHING FOR DRAPES.—When twine nets are garnished to be used as drapes, garnishing is carried completely out to the edge of the net and thinned to approximately 50 percent of the outer area covered, so that the total covered area of the net is about 65 percent, instead of 55 percent. For this use, the table above should be revised by adding one-sixth or 17 percent to the materials and man-hours required.

21. COLOR PERCENTAGES FOR GARNISHING. — When artificial materials are used, color patterns may be sprayed on to match the surroundings. Precolored cloth can be selected to match. The following table gives the color percentages necessary in garnishing for various kinds of terrain.

TABLE II. — Color percentages for garnishing with artificial materials.

Tropical and Summer, Temperate	Winter, Temperate	Desert or Arid Areas
70% -dark green 15% - light green 15%—field drab	60% -earth brown 30% -olive drab 10%—earth red	70% - -sand 15% - -earth yellow 15%—earth red

These percentages must be changed as necessary to conform to local coloration.

SECTION III. DRAPES, FLAT-TOPS, AND SCREENS

22. DRAPES.—Standard drapes are either shrimp nets, ungarnished, or twine nets, garnished. Drapes are commonly used over vehicles, planes, structures, and equipment which must be camouflaged quickly with little labor. To be effective, drapes must be associated with natural ground patterns.

a. Application of drapes.—The drape is held away from the object by supports (fig. 51) so it does not reveal the outline of the object, but presents an irregular form. It is drawn out and staked to the ground; or the edges may be thrown over low bushes, or held down by weights. Eight to twelve stakes are required for each large net. Four to six are sufficient for 15- by 15-foot and 29- by 29-foot nets. If available, some natural materials from the immediate vicinity are added to give improved blending qualities to the drape.

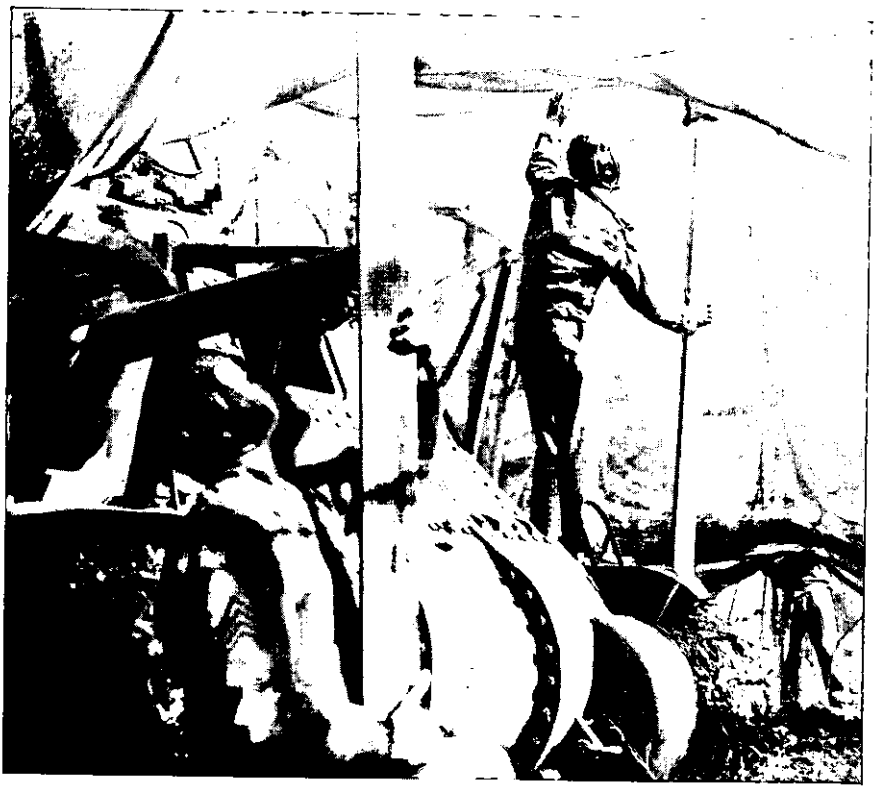


FIGURE 51.—Drapes must be held above and away from the object by props to make the shape of the installation irregular and to conceal identity of object.

TABLE III.—Appropriate uses for issue drapes.		
Size	Type	Use
15′ x 15′	Garnished twine nets	For small weapons such as machine guns and mortars.
22′ x 22′	Shrimp nets	For ¼-ton trucks.
29′ x 29′	Shrimp nets	For small vehicles such as weapon carriers, light tanks, 1-ton trailers, scout cars, and passenger cars.
36′ x 44′	Shrimp nets	For trucks 1½ tons or larger, half-tracks, and large trailers.
45′ x 45′	Shrimp nets	For medium and heavy tanks, and self-propelled 105-mm howitzers.

b. Twine nets used as drapes.—Twine nets should be pregarnished with artificial materials to save time at the site.

c. Drapes instead of flat-tops.—Drapes are used when it is not practicable to erect a flat-top. Drapes are usually successful in concealing an object from direct observation, although it is usually possible to detect their presence on an aerial photograph. In the latter case, however, identity of the object beneath the drape is concealed.

23. FLAT-TOPS.—A flat-top (fig. 53) is used to conceal a position from overhead and oblique observation. It consists of a twine net (or chicken wire for permanent installations) stretched flat and garnished correctly with natural and artificial materials to blend with the background (see par. 17). When erected and garnished correctly, flat-tops conceal against all types of aerial observation.

a. Flat-tops must be parallel to the ground (fig. 52). On a hillside a flat-top follows the slope of the hill. A flat-top covering a large area must have variations in slope to conform to the ground.

b. Normally a flat-top should be at least 2 feet above the surface of the object to be concealed (fig. 54).

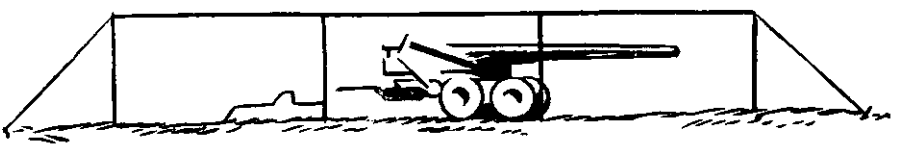


FIGURE 52.—Flat-tops must be parallel to the ground.

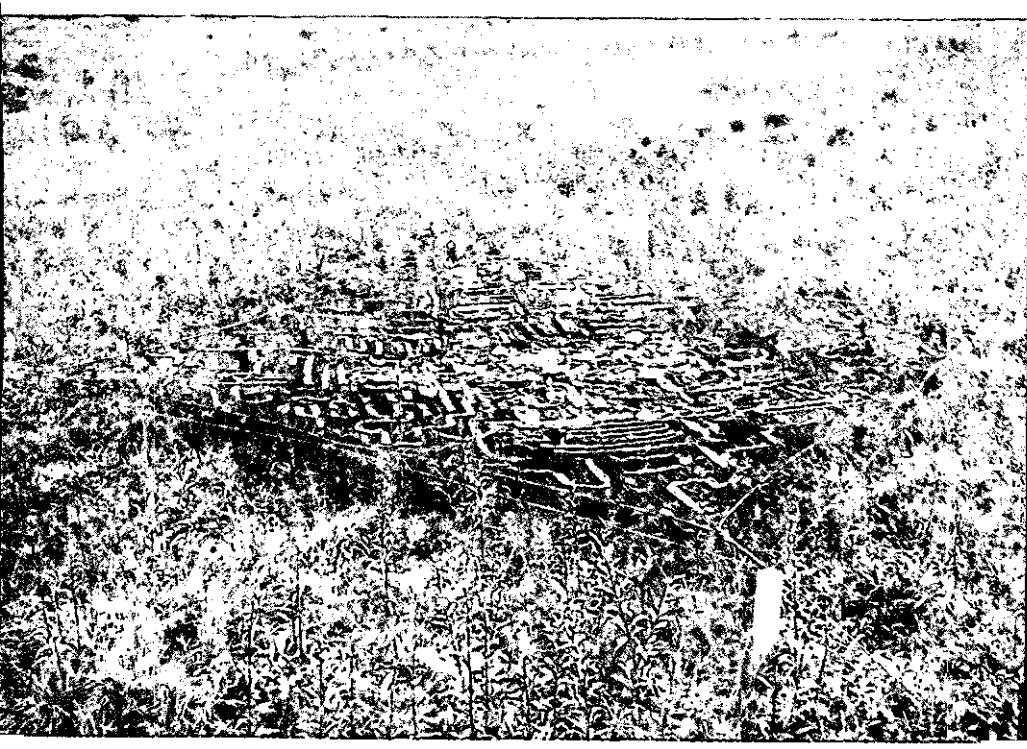


FIGURE 53.—Small flat-top conceals a machine gun from oblique and overhead observation.

c. The area under a flat-top should be matched to its surroundings with sod, leaves, and other natural materials. Concealment is more complete if the object is toned to match its background.

d. Flat-tops must bear wind and snow loads, and large permanent flat-tops should usually be strong enough to support men engaged in repair and maintenance operations. The area to be concealed is wired in, and access paths are run under cover or along natural lines in the terrain to prevent tracks showing.

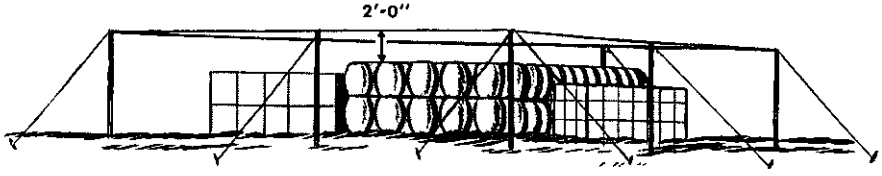


FIGURE 54. — Normally a flat-top should be at least 2 feet above the surface of object concealed.

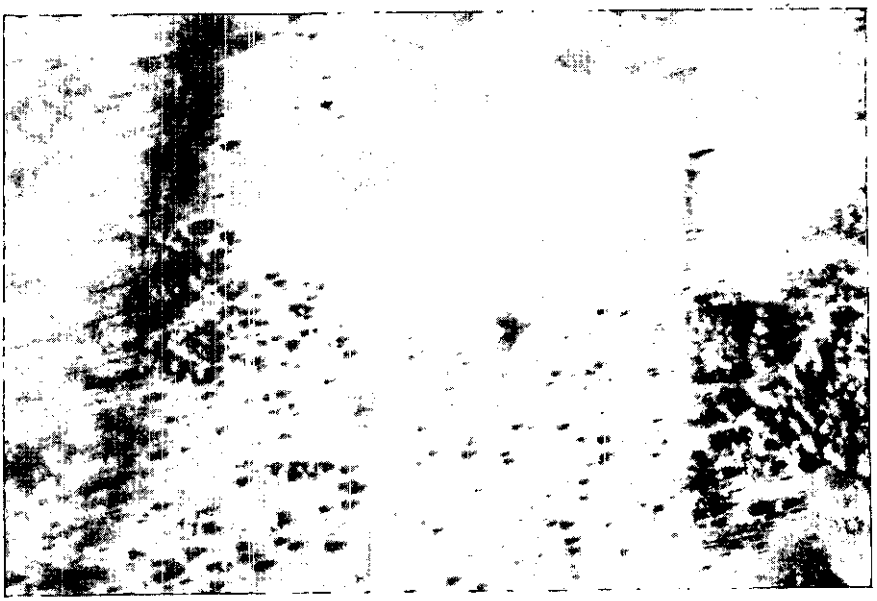


FIGURE 55.—This flat-top is too high and too heavily garnished. It casts a conspicuous shadow.

24. HEIGHT OF FLAT-TOPS.—The closer to the ground a flat-top can be placed, the more chance it has to escape discovery. A high flat-top may not be disclosed in a single aerial photograph, but under stereoscopic examination it will appear to be floating in the air. Shadows cast by the garnishing of a high flat-top can be seen (fig. 55). For complete concealment flat-tops should be no more than 3 feet above the general height of the vegetation at their edges. If the position does not permit this, the installation is dug in or the flat-top is supplemented by sloped screens (par. 35).

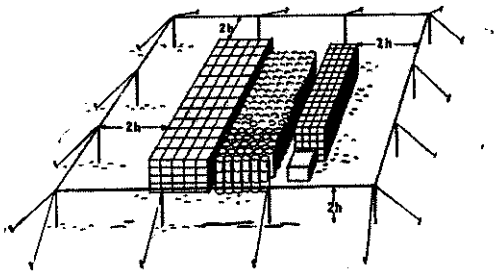
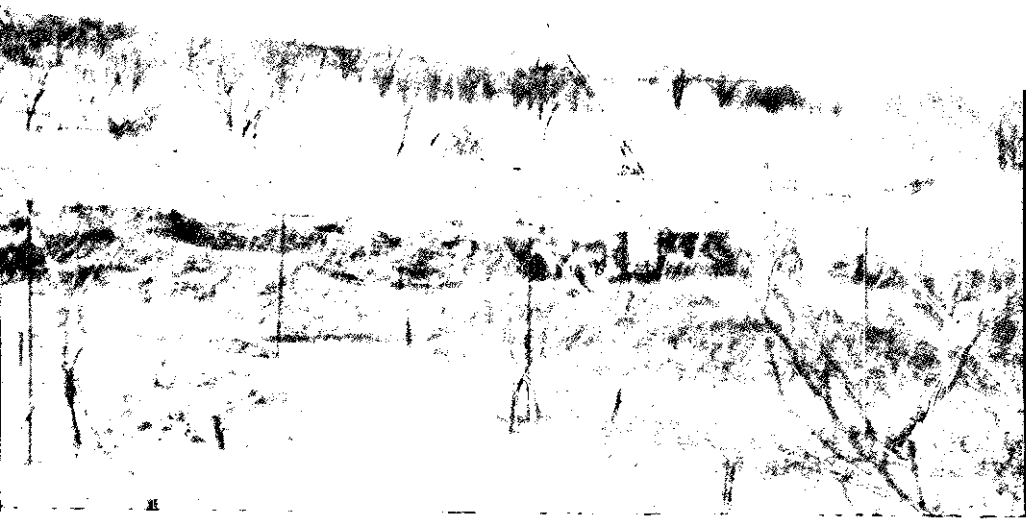


FIGURE 56.—Flat-top should extend beyond the concealed object on each side a distance twice the height of the flat-top.

25. PROTECTIVE AREA OF A FLAT-TOP. — The flat-top should extend past the area to be concealed on each side by a distance equal to twice the height of the flat-top above the ground (fig. 56). This provides an all-around margin to protect from oblique observation and to allow for thinning the garnishing at the edges. Even the most skillfully prepared camouflage flat-top does not conceal the entire area under the net. The higher the flat-top, the smaller the area effectively concealed from oblique observation. The outer area of the net provides little concealment—unless the net is used at ground level. Objects near the edge of the net must be concealed by supplementary cover.

26. TYPES OF FLAT-TOPS.—*a.* Flat-top material may be (1) small, standard, T/E twine nets (fig. 58) without organic supports; (2) T/E net sets composed of standard twine nets with standard supports, wire cables, and anchors (fig. 57); or (3) of material from depots—engineer class-IV supplies (fig. 59). Net sets have fixed erection procedures which are described in the supplements to this manual. The following procedures describe general *deliberate* erection, using T/E equipment supplemented by depot stocks or using depot stocks entirely.

FIGURE 57.—Issue net set erected over artillery emplacement.



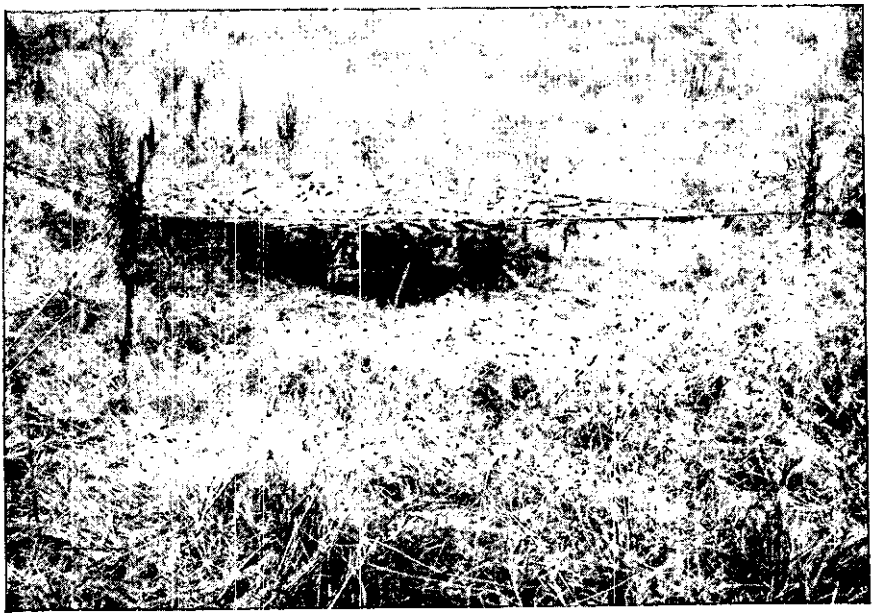
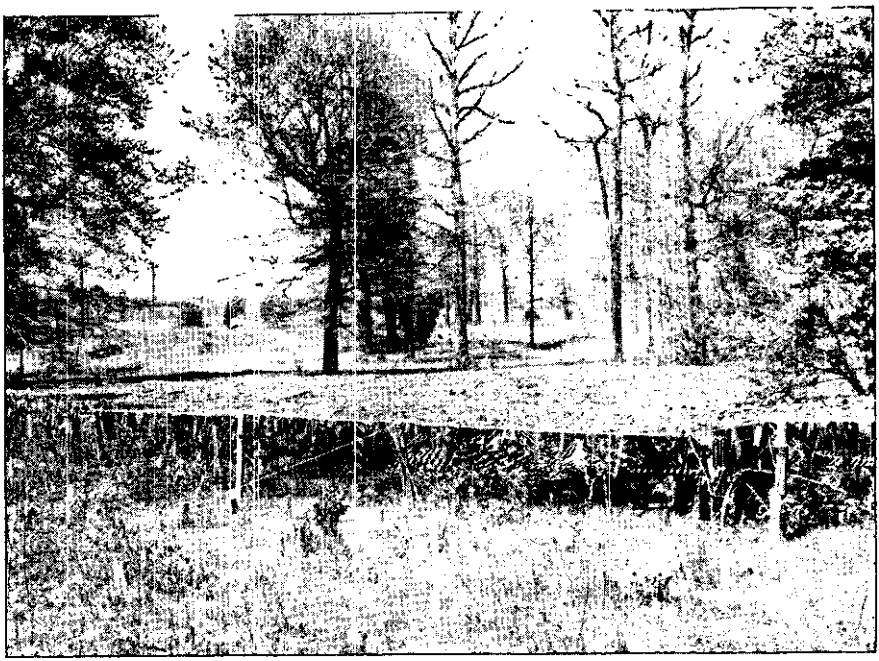


FIGURE 58.—Small flat-top, using issue camouflage twine net.

FIGURE 59.—Irregular low flat-top, using chicken wire.



27. PROCEDURE FOR ERECTING 15- BY 15-FOOT FLAT-TOP (fig. 60).—This flat-top is usually erected close to the ground because it is employed to conceal small weapons such as machine guns and mortars.

a. Supports.—The supporting framework consists of four posts which form a square 18 feet on a side. Each post is approximately 2 feet long, depending on the height of the flat-top, and 2 or 3 inches in diameter. Twelve stakes are driven, 4 to 6 feet out from the posts, in prolongation of the sides and diagonals of the square. Instead of wooden posts and stakes, standard barbed-wire equipment—medium screw pickets and anchor pickets—may be used to advantage in some soils. The framework supporting the flat-top consists of strands of No. 10 wire, which form the sides and diagonals of the square.

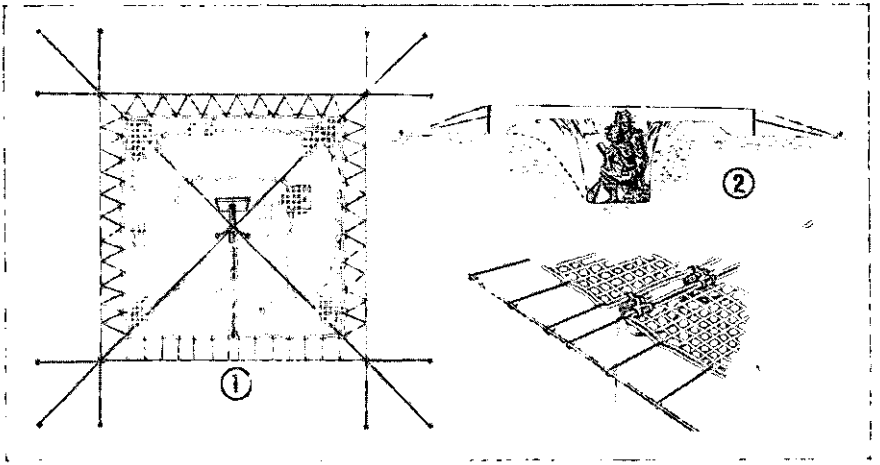


FIGURE 60 ①.—Plan of 15- by 15-ft. flat-top. ②.—Wiring diagram.

b. Wiring.—Two nails are driven into the top of each post. Posts are inclined toward the center while the wire strand is twisted two or three times around a stake, the free end being left long enough to be doubled back and fastened near the top of the post. The wire is brought back *over* the post between the nails, which act as guides to hold it in place, thence to the opposite post, and down to the bottom of the anchor stake. Two or three turns are taken around the stake, and the free end is left long enough to be fastened near the top of the post. When all wires have been placed, the posts are straightened to tighten the wire, the ends of the wire are tied back near the tops of the posts, and the nails are bent down to prevent the wire from slipping off. Maintenance tightening is accomplished

by racking the double guys between posts and stakes.

c. Net.—The net is then placed on the frame and attached by pieces of No. 16 wire. If the flat-top is to be used for high-angle weapons, a slit embrasure about 6 feet long is provided in the center of one side, as shown in figure 60. This embrasure is closed by a quick-release device, as shown in figure 67. When it is desired to open the net, the lacing is released by a pull on the rope.

28. PROCEDURE FOR ERECTING 29- BY 29-FOOT FLAT-TOP.—Nets of this size are used for both flat-tops and net sets. If erected as a flat-top, the method used in figure 60 is employed. This method is that used for a 15- by 15-foot flat-top, except that posts are about 3 inches in diameter, an additional post is placed in the middle of each side, with a stake outside it, and two additional wires are used to connect intermediate posts and stakes. When it is neces-

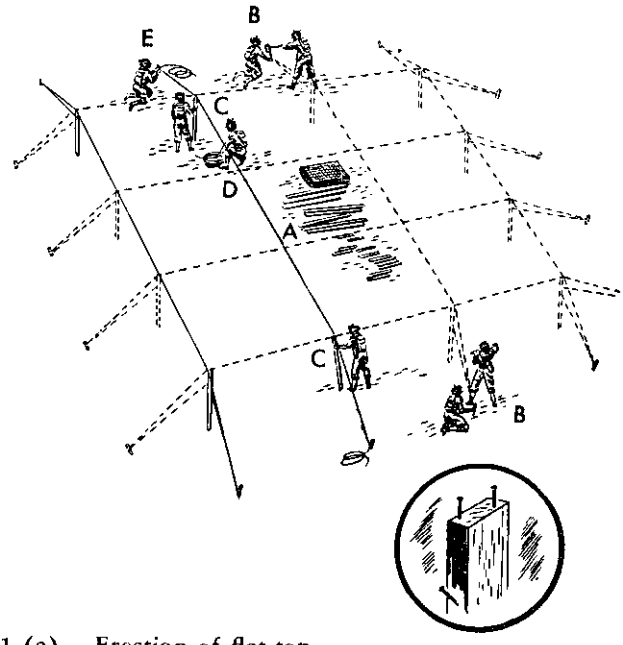


FIGURE 61 (a).—Erection of flat-top.

A Materials piled in center of site.
B Two 2-man crews drive stakes vertically. One nail is driven in outer side of each stake near ground.
C Two men hold posts at opposite sides, with tops inclined about 1 foot toward each other.
D One man feeds wire from coil to prevent tangling.
E One man strings wire.

Note. If embrasure is used, it is inserted in edge wire nearest enemy. See figure 62.

sary to provide an opening for fire on one side, the middle post on that side and on the opposite side, and the wire between them, are omitted. The frame for this flat-top is approximately 33 feet square.

29. PROCEDURE FOR ERECTING 36- BY 44-FOOT FLAT-TOP.—The recommended way to erect the wire frame for a 36- by 44-foot net requires a detail of one noncommissioned officer and eight men. The 12 posts for the frame are 2- by 4-inch lumber or 3-inch round poles squared at both ends. On soft ground, the lower ends are placed on footings. Two nails are driven into the top of each post and one nail is driven into each side about 8 to 12 inches below the top. Posts are the desired height of the flat-top. Stakes (16 required) are the same size as the posts and about 2 feet, 6 inches long. No. 10 wire is used for the wire frame. For erection procedure, see figure 61.

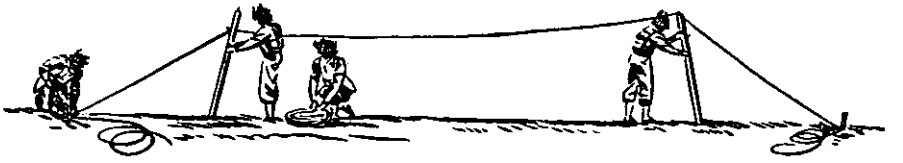


FIGURE 61 (b).—Wire is attached to near stake, leaving extra length for double guy, carried over top of near post, over side nail of far post and pulled tight before fastening to far stake.

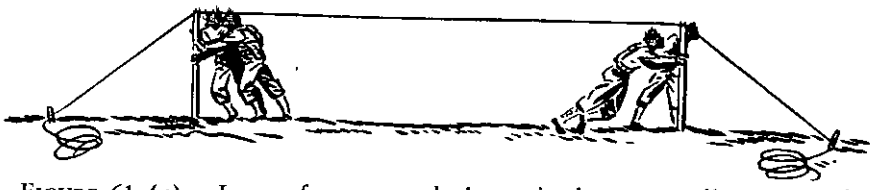


FIGURE 61 (c).—Lower far post and place wire between nails on top of post. Push both posts out to erect position to tighten wire.

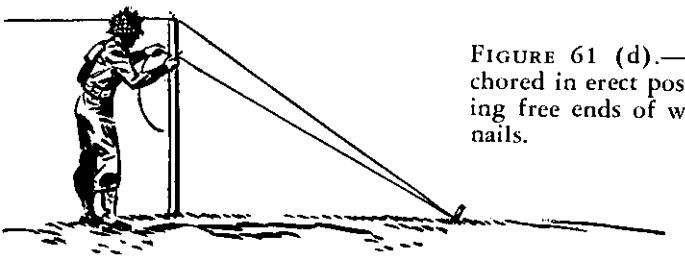


FIGURE 61 (d).—Posts are anchored in erect position by fastening free ends of wires above side nails.

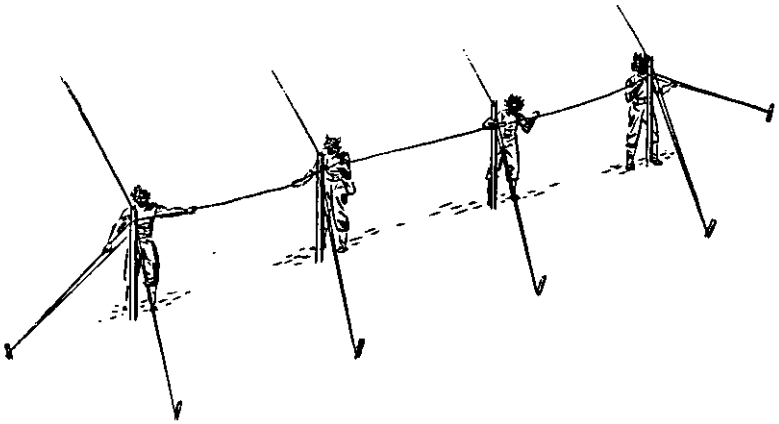


FIGURE 61 (e).—The edge wires are strung hand-tight on the sloping portions of the guy wires and are tightened further by being lifted onto the tops of the posts.

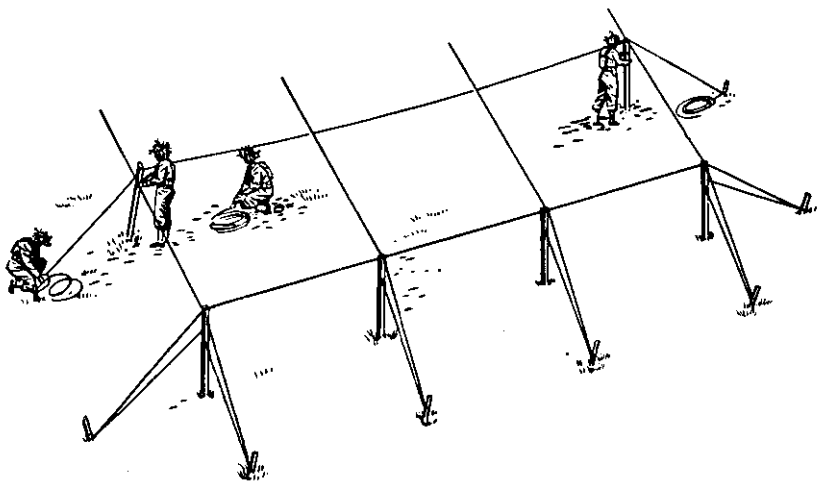


FIGURE 61 (f).—The intermediate wires are erected *under* the first four wires to facilitate tightening.

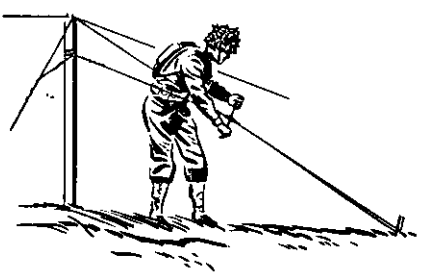


FIGURE 61 (g).—Loose wires are tightened by racking double guys or by driving stakes deeper into ground.

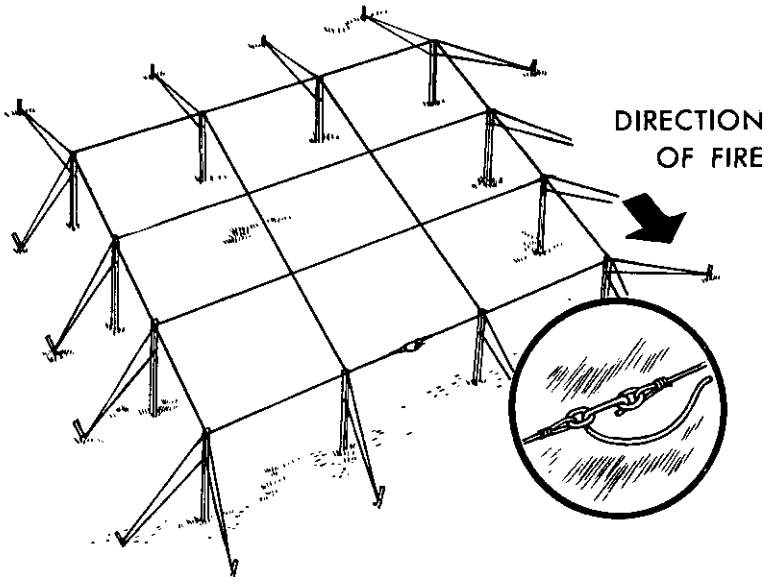


FIGURE 62 (a).—If flat-top is used for artillery, embrasure release is inserted in the edge wire nearest enemy.

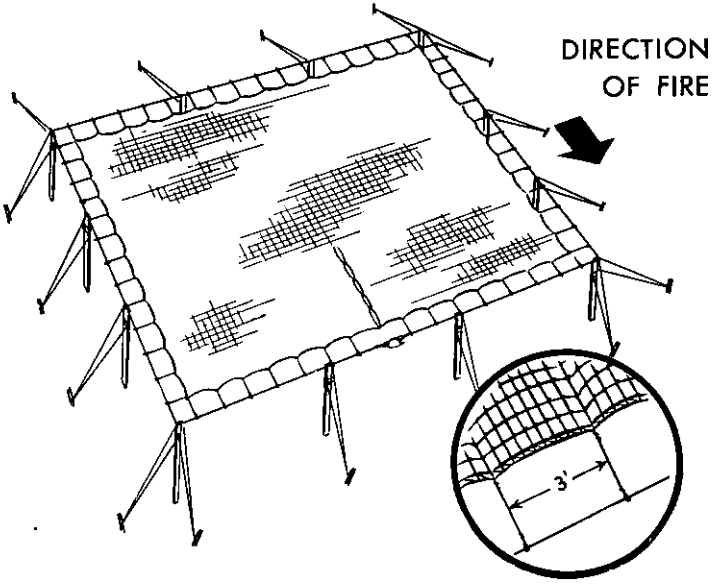


FIGURE 62 (b).—Net is unfolded over frame with embrasure opening—if any—toward enemy. It is stretched tight and fastened to perimeter wire with pieces of No. 16 wire, about 2 ft. 6 in. long, at 3-ft. intervals. The embrasure is held closed with a "quick-release" device (fig. 67) so that a pull on the rope will open the entire embrasure.

30. PROCEDURE FOR ERECTING IRREGULARLY SHAPED FLAT-TOP (fig. 63).—A frame of this type may be used to support either a garnished net or plain wire netting used as a base for natural materials. Although it requires more material to erect than other flat-tops, it is adaptable to any size or shape of cover. Construction procedure follows:

a. Lay out posts about 12 feet apart in each direction of area to be covered.

b. Drive side nails in outside posts only.

c. Run No. 10 diagonal wires across each line of posts, placing wires between nails on top of posts.

d. Tighten diagonal wires by racking at crossings in centers of squares. This will tighten whole frame.

e. Additional bays may be erected around edges to make outline irregular.

f. After erection, interior posts may be shifted in position to accommodate needs of occupying troops, without loosening frame.

g. Maintenance tightening may be accomplished by racking doubled portions of main wires and intersections of diagonal wires. The nails and wire used in these flat-tops can seldom be used again. All posts and about 50 percent of the stakes can usually be salvaged.

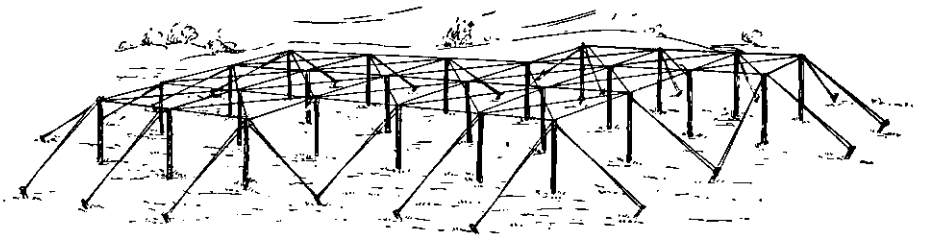


FIGURE 63.—Irregularly shaped flat-top.

31. HOLDFASTS.—In different soil conditions, different types of holdfasts are required. Types used commonly are single stake in firm soils; double and triple stake in loose soils; screw anchor and screw picket in firm soils; log, concrete, and sandbag deadman in sandy and soft soils; and counterbalances can be used, as expedients, in rocky, frozen, or sandy soils (fig. 64).

32. MAINTENANCE OF FLAT-TOPS.—*a.* The maintenance of flat-tops is essential. Twine nets shrink approximately 10 percent

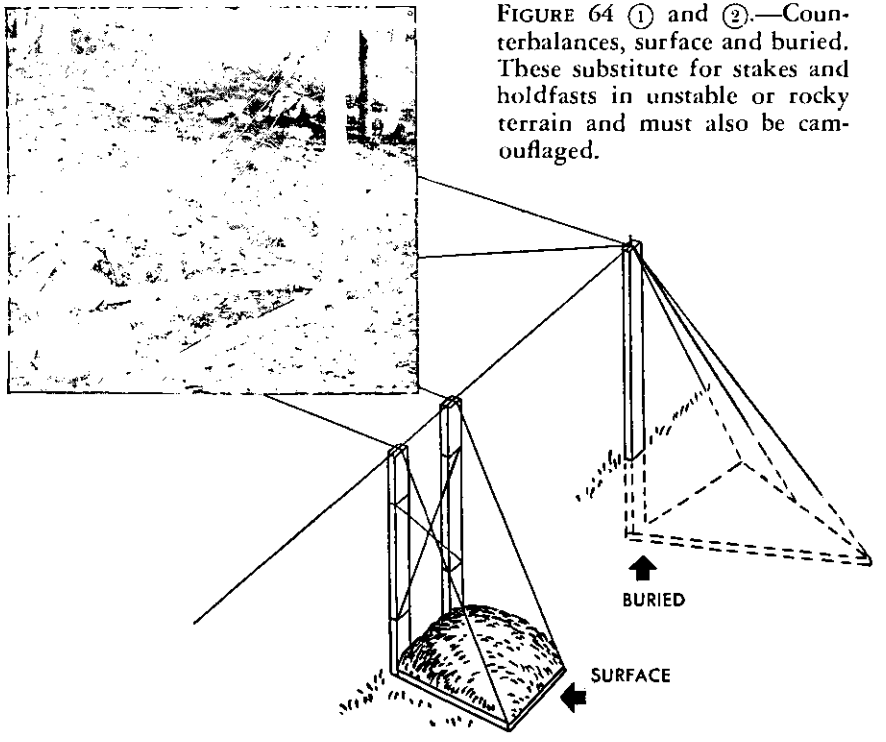


FIGURE 64 ① and ②.—Counterbalances, surface and buried. These substitute for stakes and holdfasts in unstable or rocky terrain and must also be camouflaged.



FIGURE 65.—Camouflage materials require constant maintenance. This gun crew changes cloth garnishing in net as the color of surrounding vegetation changes.

when wet. In shrinking, they develop sufficient tension to break the threads, pull out tightly driven stakes, or break No. 10 wire. Nets must be loosened during a rain and at night when there is a possibility of dew. This loosening is permissible because enemy observation is handicapped at these times. At all other times nets must be kept tight, because a sagging net will allow the supporting wires to show through in a spider-web pattern. This pattern is readily detectable on aerial photographs and immediately identifies the flat-top.

b. Other maintenance consists of preventing tracks around the outside of the flat-top, keeping wires uniformly tight, preventing stakes from working out of the ground, and repairing or changing garnishing as necessary (fig. 65).

33. HANDLING OF NETS.—*a.* When not in use, twine nets should be folded carefully in such a way that they can be unfolded easily. One good method is shown in figure 66 (e) through 66 (a). The net is spread out and stretched by pulling at the corners. The detail folds the long edge toward the center, making accordion folds 18 inches to 2 feet wide. The edge binding is kept on top and toward the center. When these folds have almost reached the center of the

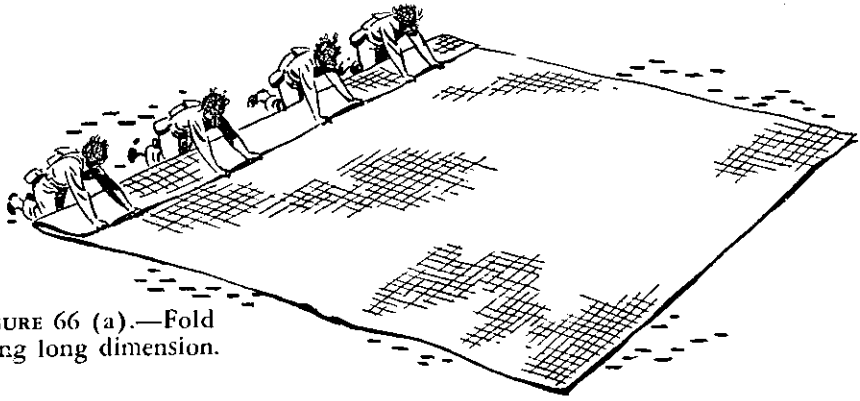


FIGURE 66 (a).—Fold along long dimension.

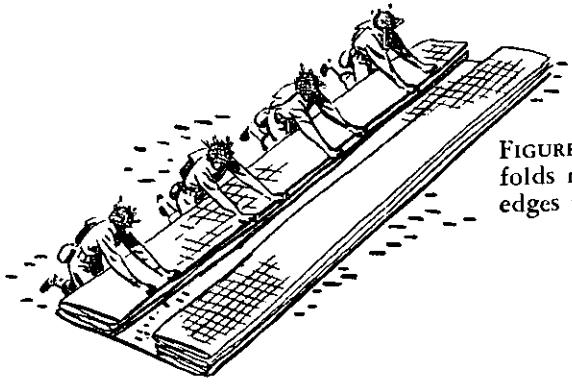
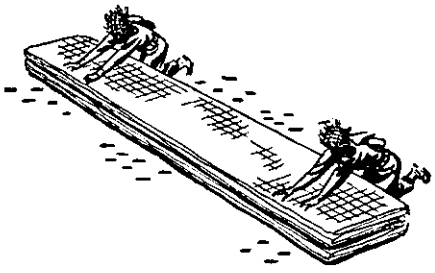
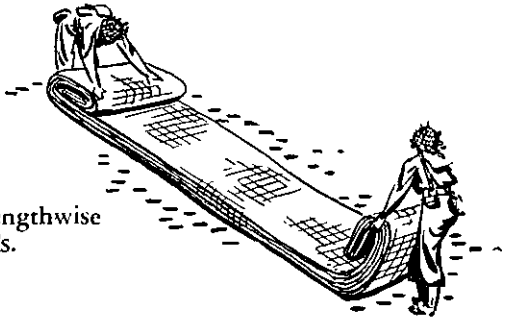


FIGURE 66 (b).—Accordion folds made from both long edges toward center.

(c).—One folded section is lifted and placed on top of the other, with edge rope away from men.





(d). — Folding lengthwise into final 2-ft. folds.



(e). — Final bundle should be securely tied.

net the other side is folded in a similar manner. The second bundle of folded net is lifted and placed on top of the first, with the edge rope on top and away from the men. If the net contains an embrasure, this edge is folded last so that the embrasure can readily be identified by touch in the dark. Embrasures should be laced closed before folding, with one of the quick-release devices shown in figure 67.

b. The folded net is now stretched lengthwise to remove irregularities. Each end of the folded net is turned in about 2 feet, and two flat rolls are formed by folding from the ends toward the center of the net. The final step is to place one of these rolls on top of the other end and to tie the net securely.

c. Nets should be dried before storing to prevent rotting and mildewing.

34. EMBRASURES.—Embrasures for high-angle weapons should be about one-third the dimension of the net from front to rear and should be placed in the middle of one side—the longer side, for rectangular nets. It is difficult to cut a straight embrasure in old-style nets where the twine runs at a diagonal to the sides, but it can be done by following a row of knots which runs perpendicular to the sides. Use one of the quick-release devices illustrated in figure 67.

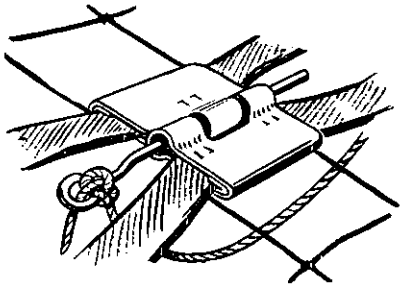
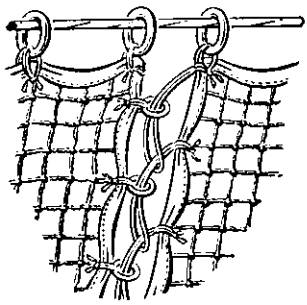


FIGURE 67 ①. — Quick-release device—hinge and pin.



②. — Quick-release device—ring and loop.

35. SLOPE SCREENS.—*a. Types.*—Sides may be added to a flat-top and sloped gradually to the ground. These sides should not make more than a 15° angle with the net; otherwise, a regular, hard "ridge" line will be formed where the sides join the large net, and the sloped portion will differ in appearance from the horizontal part. They must be very gradual extensions of the top to form a sort of inverted shallow bowl with a flat bottom. If the area to be covered is not too large, a dome-shaped slope screen can be constructed (fig. 68). There is little or no definite flat area in this type of net. The sides slope continually in gradual curves to form an angle of 15° or less with the ground, again forming an inverted shallow bowl, but with a round bottom.

b. Construction.—The required number of vertical uprights is erected over the area. Between the tallest uprights of the installation and the outer boundary of the area, additional uprights of intermediate height are erected in line. No. 10 wire run along the top of these uprights rises gradually from stakes in the ground on one side, up and across the middle of the curve, and down again to the opposite side. A long, gradual, uniform slope is formed. To maintain this uniform and even-sloping surface, many cross-sectional or radial wires should be used. In planning slope screens, care should be taken that radial wires do not cross the opening for an overhead embrasure.

if one is required. The finished framework should be a strongly constructed, taut umbrella of wire, fastened to wooden supports.

c. Garnishing and framework.—Large sections of garnished netting are rolled over the framework and laced together. The garnishing, in general, is equivalent to about 60 percent of the complete net area and must be carefully thinned at the edges.

d. Access routes.—For permanent installations of great size, it is possible for access routes to be made by means of tunnels which emerge beneath the slope screens, thus doing away with the necessity for constructing doorways in the outer edge of the net, and also preventing the wearing of telltale tracks or paths. Hedges, actual or simulated, may provide means of covered access to the sloped net.

36. OTHER SCREENS.—Road screens may be used to conceal from ground observation either actual or decoy road blocks, to conceal the character and extent of movement along a road, and to hide turn-offs and loading points on roads at supply points and other installations. Similar screens conceal new construction for coast artillery from marine observation, and conceal supply points and command posts. Overhead screens are, of course, the only ones effective against aerial observation.



FIGURE 68.—Slope screens gently rounded to conceal building.

LT. COL. HUGH F. FOSTER JR. O-23837
C. O. 63RD SIGNAL BATTALION (OPN)
APO. 541 c/o POSTMASTER NEW YORK, N. Y.



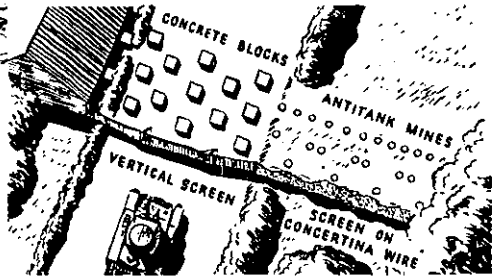


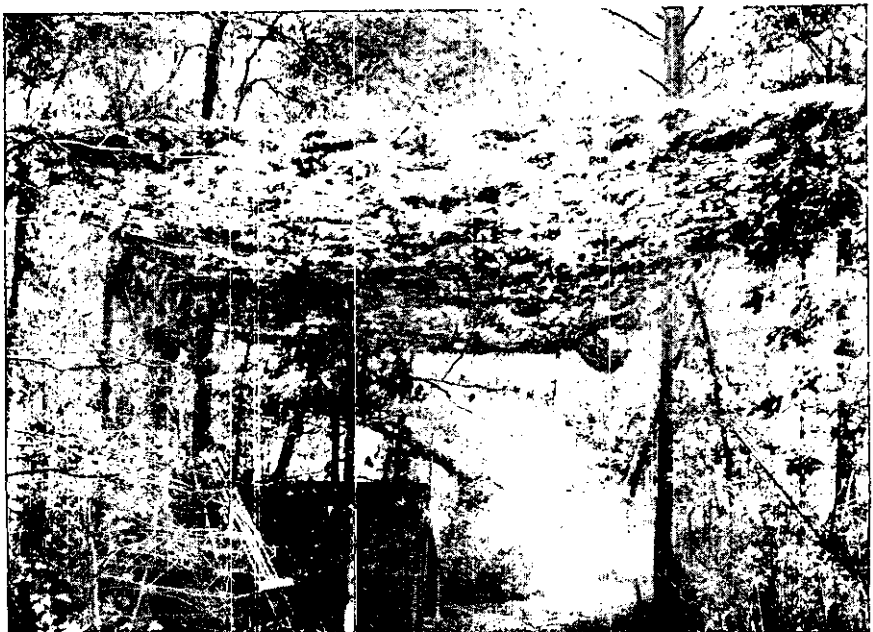
FIGURE 69 ① and ②.—Road screen used tactically prevents enemy ground troops from determining nature of obstacles from a distance.

a. Screens for concealing road blocks may be made of any material—debris, vegetation, or artificial materials variously garnished. One technique is illustrated in figure 69. The idea simply is to hide the block so that the enemy must make a choice either to run over the screen and risk what is behind it, or to stop and investigate it. If he stops, he is vulnerable to fire. If he tries to run over it, he cannot take advantage of possible weak points in the obstacle.

b. Vertical screens to protect bivouacs from enemy patrols are made of natural materials to blend with the background.

c. Screens have a further use as deceptive devices in barren areas, where they can mask gun positions from ground observation.

FIGURE 70.—Overhead screen conceals short stretch of access route.



d. Turn-offs and loading points at command posts, headquarters, bivouacs, dumps, and other installations may be concealed by overhead hammocks such as shown in figure 70. These are made of garnished wire netting supported on No. 10 wire strung between trees. Another method of improving overhead concealment at such points is to pull branches and small trees together at the top and fasten them with wire or rope.

37. SMOKE. — Smoke is sometimes used offensively to screen an operation such as a river crossing, or defensively in hiding or reducing the visibility of large fixed installations such as railroad yards, docks, and water supply dams (fig. 71).

a. Method of smoke screening. — The use of smoke to protect rear-area points involves production and maintenance of large clouds or screens over a broad area. The most satisfactory method of accomplishing this, from the standpoint of economy of materials and operating personnel, is with oil as a medium. Vaporization and condensation of special oils in a mechanical smoke generator produce a dense, persistent smoke with ample obscuring power to hide surface objects from aerial observation.

b. References. — For further information on smoke, see FM 3-5, Tactics of Chemical Warfare; FM 3-50, Antiaircraft Smoke and Smoke Generator Units; TM 3-240, Meteorology; and TM 1-282, Tactics and Techniques of Air Chemical Sprays.

FIGURE 71 (a).—Smoke generators in the first stage of screening a port.



(b).—Heavy smoke hides city from aerial view.



SECTION IV. REDUCTION OF TONE CONTRASTS

38. COLOR.—*a.* Reduction of color contrasts makes an installation inconspicuous. A light plane on a light runway is most easily located by its shadow (fig. 72 ①), while on a darker runway it is picked up through its own contrast with the background (fig. 72 ②). If we reduce all color contrasts—a dark plane on a dark runway—the plane practically disappears from view (fig. 72 ③).

b. Color differences are less perceptible as the distance from object to observer increases. Installations subject only to high aerial observation can be toned down with one simple shade of a color that matches the background. This is more concealing than poorly chosen disruptive patterns.

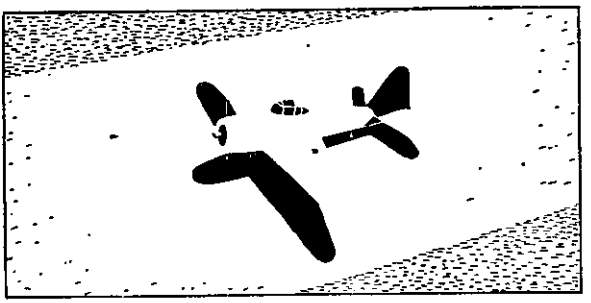
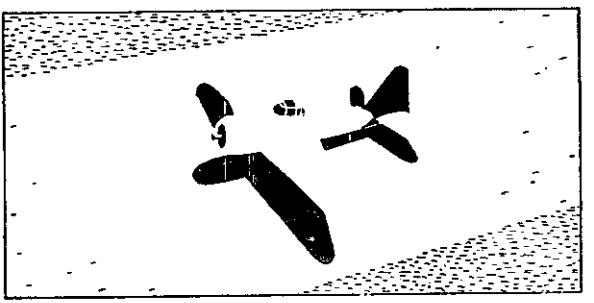
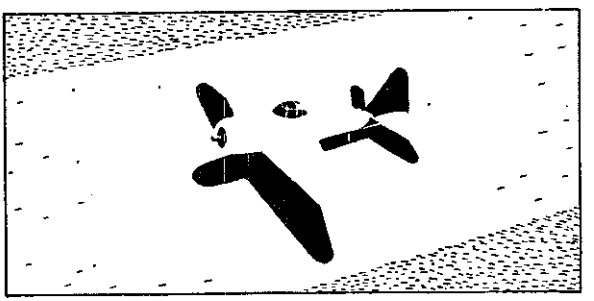


FIGURE 72 ①. — Light-colored plane on light-colored runway is revealed by shadow of plane.



②. — Light-colored plane on dark runway is revealed by contrast.



③. — Dark-colored plane on dark runway blends well. Shadow, though less conspicuous, is still there, revealing plane.



FIGURE 73.—Texturing runway with wood chips to produce darker tone from the air and reduce contrast with surrounding area.

39. TEXTURING.—Texture affects tone because of the way in which it casts shadows and reflects light. As with colors, texture applied to match an object to its background must have the same general characteristics as the background. A concrete runway, painted the color of adjacent grass, does not look the same to the observer because the grass has texture and the concrete has little or none. Given texture by the application of wood chips or other texturing materials, and painted a suitable color, the runway becomes less conspicuous (fig. 73). Other flat surfaces require similar treatment.

SECTION V. DISRUPTION OF FORM

40. GENERAL.—Disruption of form is accomplished by adding irregular outlines to regular-shaped objects and by using disruptive patterns in paint or other materials (fig. 74). Paint is the most commonly used material; but cinders, for example, break the outlines of runways when applied in irregular patterns on the runway surface and carried onto the shoulders. Disruption of form is not a positive preventative against direct observation or aerial photography, but it aids in confusing the aim of the bomber, tank gunner, or rifleman.

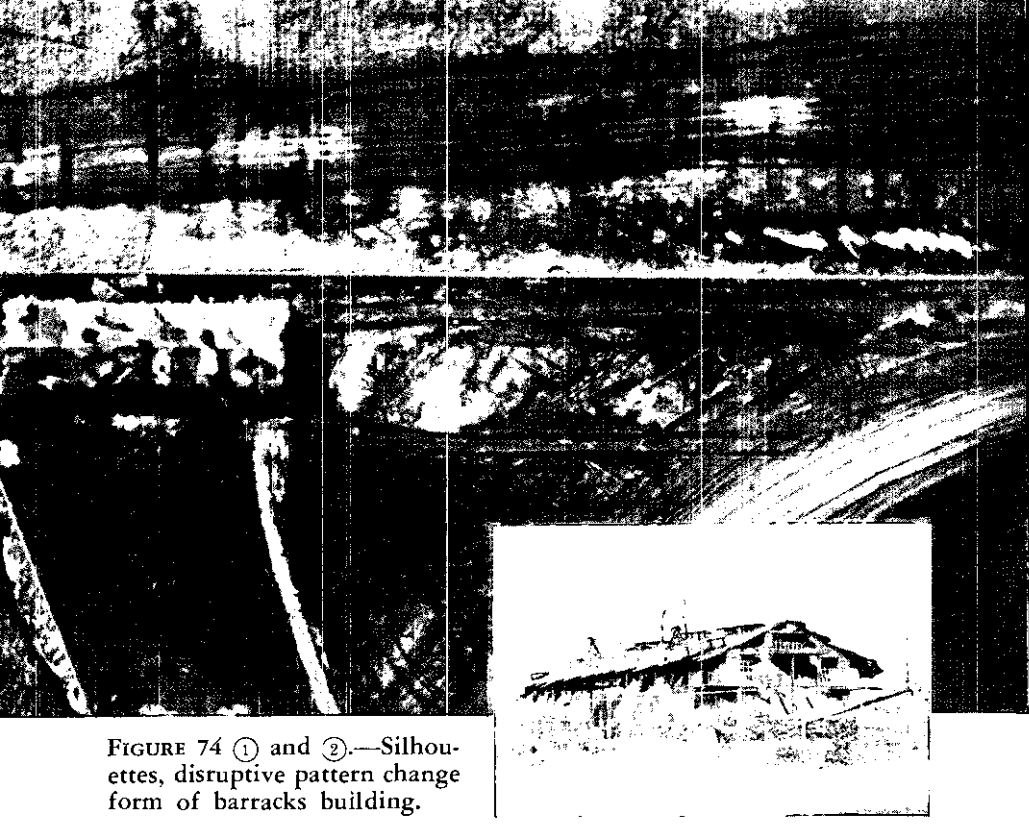


FIGURE 74 ① and ②.—Silhouettes, disruptive pattern change form of barracks building.

41. SILHOUETTES.—Disruption of outline, form, and shadow of buildings is aided by the use of silhouettes, usually attached to the edge of roof surfaces. They must be irregular and bold. Materials such as plywood or stiff chicken-wire-garnished frames have the necessary firmness and durability. Scaffolding, nets, or framed decoy structures are also used (fig. 75).

42. PATTERN PAINTING.—*a.* In pattern painting, the object is painted two or three contrasting colors, applied in irregular shapes. Colors should be similar to the predominant colors in the object's surroundings (fig. 76). Objects are painted darker on top and lighter below, for the reason that upper parts receive and reflect more light. This principle is especially important in vehicle painting (fig. 77). Patterns should extend around corners and over vulnerable points.

b. There is no definite rule governing pattern sizes. They depend on the size of the object, the size and type of its surroundings, and the type and range of enemy observation. Patterns should be as large as practicable. When seen from a distance, small patterns blend into one monotonous color, and do not destroy the shape of the object. Small color differences cannot be distinguished by aerial observers.

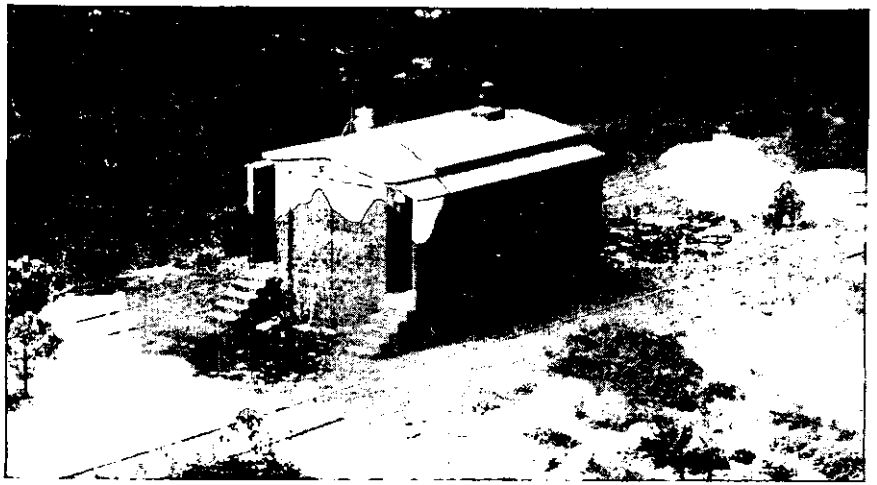


FIGURE 75.—Terraces of garnished nets conceal outline of building.

c. Painted patterns alone do not give reliable concealment. The object must be seen against the background for which the colors have been chosen to be effective.

d. Disruptive painting of vehicles is *tactical* protection. It is protective coloration intended to conceal vehicles in well-selected positions, when they are not on a road and not disclosed by tracks, under circumstances which do not permit the use of drapes, and where early

FIGURE 76. — Bold disruptive pattern painting continued over adjacent ground with patterning of cinders and pine needles breaks up characteristic lines of a building.



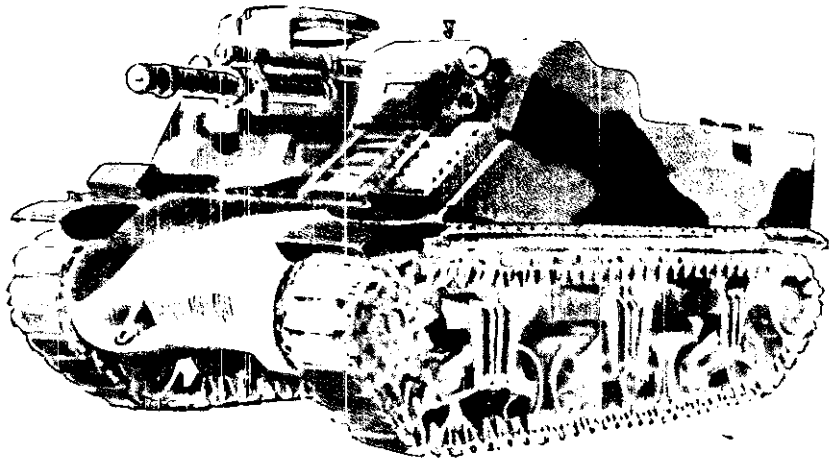


FIGURE 77.—Three contrasting colors are used on this tank destroyer. Colors are olive drab and black to match the dominant colors in temperate zones, and white for undercarriage. Upper parts are darkened, lower parts lightened in color to compensate for differences in amount of light striking these parts. Elements of pattern extend around corners and over vulnerable points.

resumption of movement is expected. It is ineffective while a vehicle is in motion. The type and size of pattern to be adopted is determined by the characteristic pattern of the terrain in which the vehicle will operate, its tactical use, and the type of enemy observation expected to be encountered. A pattern should blend with its background and should be sufficiently disruptive to make the form of a vehicle unrecognizable. Whenever the fire mission permits, a pattern-painted vehicle should be sited so that the dark portions of the pattern blend with adjacent shadows in the position. In some theaters, standardized patterns have been established for various types of vehicles. There are many tactical situations where such standard patterns are superior to a single neutral color, although they lack the wide adaptability of the single color. Equipment is painted darker than its surroundings. Using the standard camouflage colors, the following basic color schemes are recommended for painting patterns on military objects. Other combinations are used as required by local terrain colorings.

(1) *Temperate zone.*—Olive drab, field drab or other light color to match terrain, black.

(2) *Desert.*—Sand or earth yellow, earth red or other light color to match terrain, black.

(3) *Arctic.*—White, olive drab.

CHAPTER 5

DECEIVING

43. DEFINITIONS.—*a.* A decoy is a false military installation designed to simulate a real activity and thus to attract enemy attention (fig. 78). It may consist only of *signs* of activity, such as simulated blast marks or wheel tracks.

b. Decoys are camouflage weapons of deception. Since large-scale deception planning may give an effect of strength or weakness, plans for such work must be approved by higher commanders (see par. 3*c*).

44. EMPLOYMENT.—*a.* The use of decoys in combat zones depends on many factors. Decoys must be located in logical positions far enough away from actual targets to prevent enemy fire on the decoy from hitting the real installations. This distance depends on the size of installations and the type of enemy observation and fire

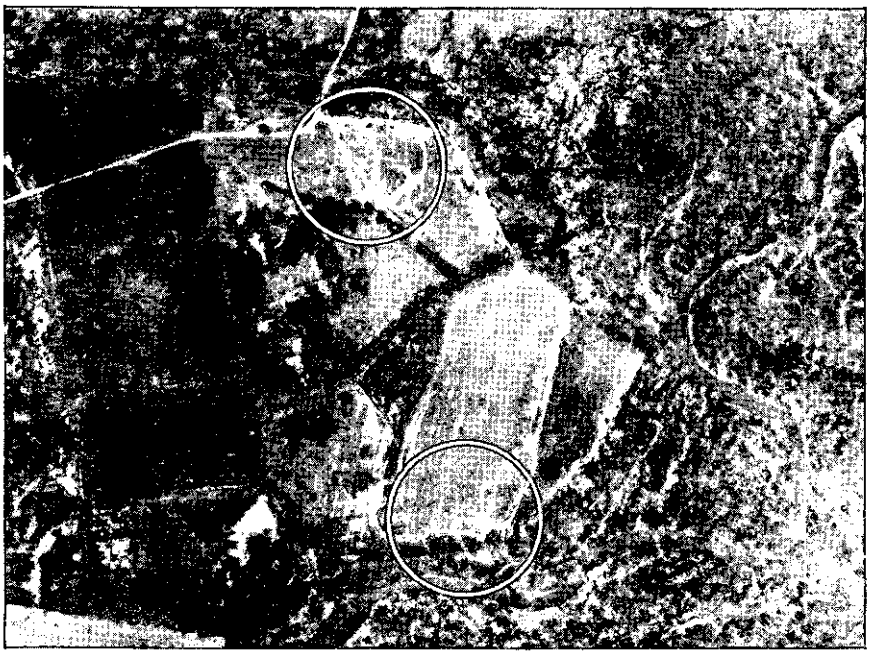


FIGURE 78.—Decoy batteries of field artillery using abandoned positions.

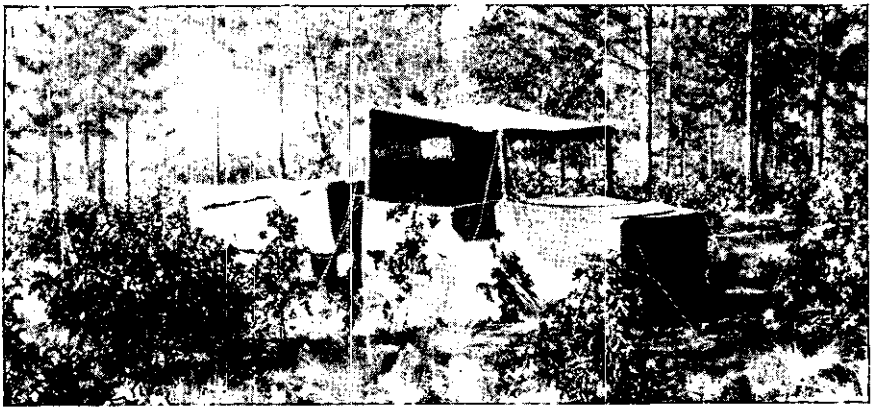


FIGURE 79.—Decoy truck made of frame covered with cloth.

expected. Decoy bridges, dumps, railheads, and airfields may be 2 to 5 miles from the real object, while decoy field artillery or antiaircraft-artillery batteries may be less than 1 mile away. In all cases, the location of real installations must be carefully considered when siting decoys so that the decoys do not draw fire on the real installations.

b. To deceive the enemy, a decoy simulating a large rear-area installation generally should be sited to have approximately the same relationship to near-by landmarks as the target itself. Landmarks are likely to be used as enemy reference points.

45. THEORY OF DECOY DECEPTION.—*a.* A decoy installation must avoid the appearance of being a decoy. It is so constructed that its disclosure to the enemy appears to be the result of defects in its camouflage. There are various methods for accomplishing this deception, such as the disclosure of parts of a decoy, leaving tracks, incomplete concealment of shadows of decoys, or the improper use of surface texture or color. If a decoy draws attention away from a real installation, it serves its purpose. A decoy position which has been discovered to be such by the enemy may later be occupied as an actual position.

b. To be effective, the decoy installation must include features normally associated with the real installation and must be properly maintained. For instance, decoy planes on an airfield must be moved from time to time; in the case of decoy trucks, a few real trucks should be used to make tracks; in every case the effects of normal activity should appear.

c. Decoys intended to divert attention from real objects or instal-

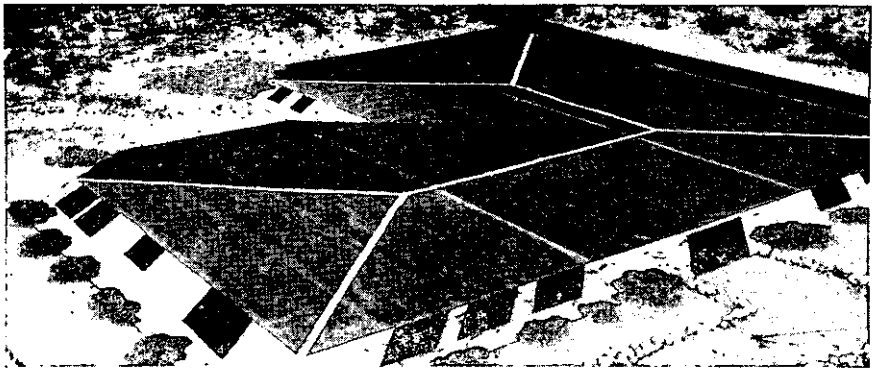


FIGURE 80. — Three-dimensional appearance of building simulated by paint alone.

lations are effective only when the real objects are completely concealed. A decoy must bear a convincing resemblance to the true object or activity it simulates. If it is suspected as false, it will attract enemy attention to the area.

46. MATERIALS AND FORM.—*a.* While imitation of the form of the genuine object is sought in the construction of decoys, they are built along the simplest possible lines. In combat areas, field expedients are important. Construction may consist of earth and brush, rough timber or framing covered with cloth (fig. 79), building paper, screening, or wire netting garnished with chicken feathers or cloth. All the standard camouflage materials may be used for this purpose.

b. It is possible to simulate the minor elements of a large installation by means of paint alone. Thus, the principal decoy buildings of a decoy installation can be built in three dimensions, and other structures painted on the ground (fig. 80). However, lack of shadow, or the unchanging direction of painted shadows, is likely to give away such decoys when aerial photographs are closely studied.

47. USE OF DECOY TRACKS.—On occupying an area, a large unit can often deceive the enemy by constructing numerous turn-outs from roads and railroads into woods not occupied for military purposes (fig. 81). This is likely to draw enemy artillery fire or bombing missions. Later, after enemy action has ceased, if it becomes necessary to occupy the wooded area, the decoy turn-outs can be used for entrance without changing the appearance on aerial photographs.

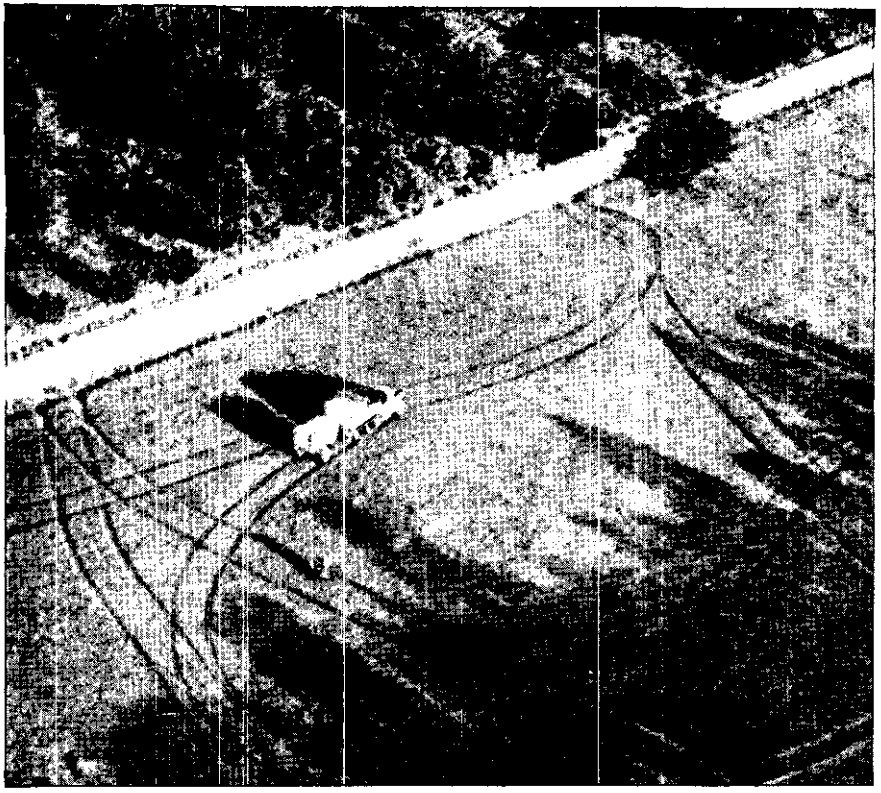


FIGURE 81.—Deliberately made paths and tracks give false indication of military occupation.

48. CHECK LIST.—To insure realism in decoys and to guard against common errors in construction and operations, the following points should be checked:

a. Are a few indications of the presence of allied or supporting objects included? For example, decoy artillery positions may have signs of prime movers and communications.

b. Is location logical for a real installation?

c. Is position continually maintained? For example, a decoy railhead which has been bombed should have bomb damage repaired.

d. Is the scale of the decoy object or installation approximately the same as that of the real object?

e. Do simulated roads and paths appear worn? Turns should not be too angular, and edges should be uneven.

f. Are shadows lacking? If present, are they in the correct place relative to the actual object?

g. Are signs of attempts at camouflage included?

CHAPTER 6

GEOGRAPHIC AND CLIMATIC FACTORS AFFECTING CAMOUFLAGE

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SECTION I. TEMPERATE ZONE

49. GENERAL.—When not otherwise specified, temperate-zone terrain and climatic conditions are assumed in this manual.

50. SEASONAL CHANGES.—Transition from one season to another brings marked changes in terrain coloring, requiring changes in garnished camouflage. More camouflage is needed when leaves are shed. Where rainfall is heavy, supports of flat-tops may require footings to counteract softening of the ground. When ground is frozen, counterbalances may be adopted to save digging holes for flat-top supports. Snow adds to the problem of camouflage maintenance because excessive loads on flat-tops may break them down.

SECTION II. DESERT

51. CONCEALMENT FACTORS.—*a.* Lack of natural concealment in the desert; lack of rainfall, causing dust clouds; high visibility and the bright tone of the desert—all necessitate special emphasis on siting, dispersion, camouflage discipline, deception, and the use of artificial camouflage materials. Desert areas are not always flat single-toned areas. They are frequently characterized by strong shadows and heavily broken terrain lines (fig. 82). Cast shadows in the desert are extremely conspicuous. When possible, installations and equipment are dug in.

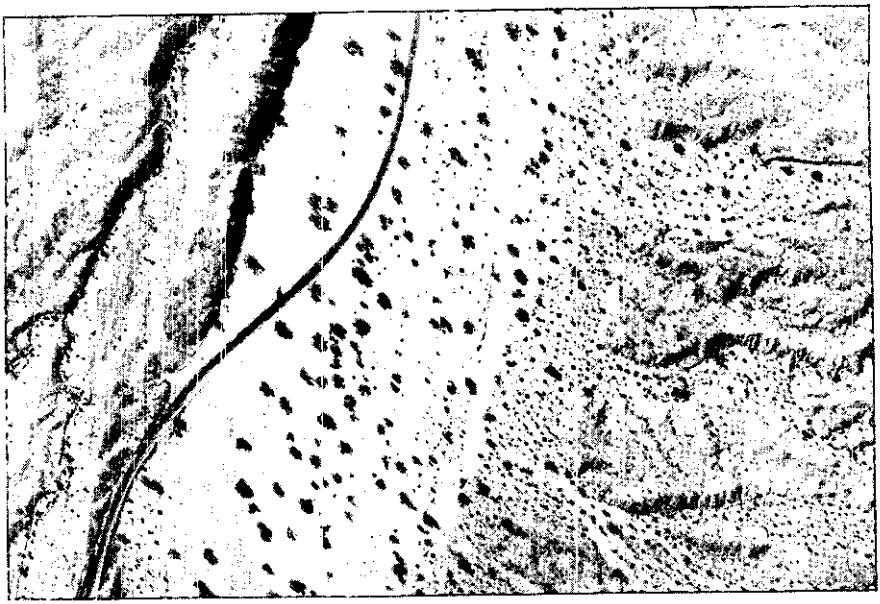
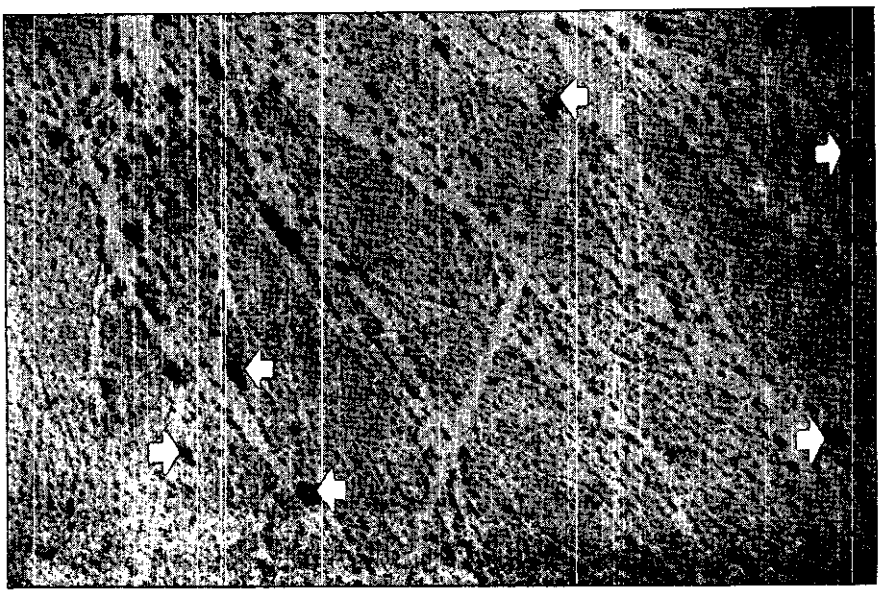


FIGURE 82.—Desert area, showing characteristic variety of tones and shadows.

FIGURE 83.—Six vehicles are concealed in this desert area. Ground views of four of them are shown in figs. 85, 86, 87, and 88.



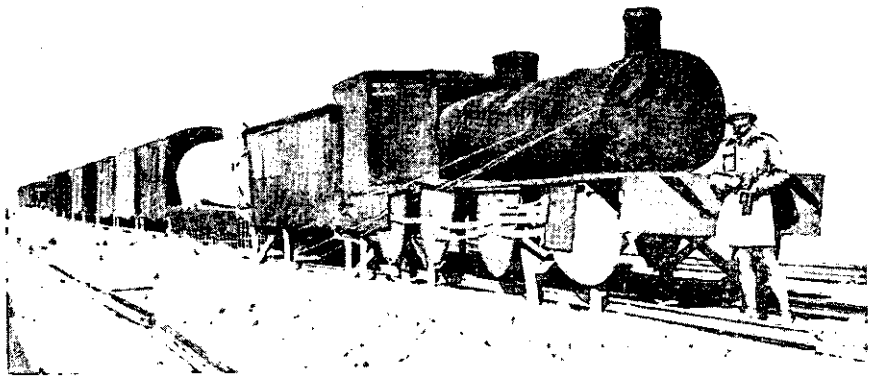


FIGURE 84.—Decoy train used in large-scale operational deception.

b. Many objects which cannot be made invisible from the air can be effectively concealed from ground views. Even though they are observed from the air, because of lack of reference points in typical desert terrain, they are difficult to locate on a map to aid attacking ground forces. For instance, an antitank ditch covered with wire mesh in which bunches of grass are fastened to match surrounding growth is visible from the air because of its deep shadow; but attacking tanks, with their limited visibility, often cannot distinguish the ditch from its surroundings. This is true also of well-camouflaged trenches; covered and irregularly sited they lose much of their aerial visibility.

52. SITING.—Siting is most important in the desert (fig. 83). Valley floors in most deserts have little natural concealment. Slopes into valley floors are often cut with dry washes. These terrain features support small plants, bushes, and trees and offer defilade and natural concealment suitable for vehicles and artillery.

53. DISPERSION.—Vehicles maintain dispersed distances of 100 to 300 yards in bivouac or in movement.

54. ARTIFICIAL MATERIALS.—Of all artificial materials, drapes garnished correctly as to colors and coverage are most commonly used in desert terrain. They must be tied in with natural terrain features, must be heavily garnished, and should be used over dug-in installations, if possible. It is especially important in the desert that sloping screens be used. This, however, does not mean that sloping screens are desirable elsewhere. Paint may be employed to tone down vehicles, tanks, and tentage. Colors in the desert generally must be very light, and simulated shadows very black.



FIGURE 85.—Half-track, using desert scrub growth for concealment.

55. .CONCEALMENT PRACTICE.—In addition to using what natural concealment is present, digging in is important for all units. The following concealment practices are commonly used:

a. Foxholes are sited in the shadows of brush, gullies, and other natural objects, when possible; the openings are covered with artificial or natural material or with shelter halves. Spoil is widely and irregularly distributed under brush and in gullies. The visibility of wire is reduced by siting it irregularly, omitting long pickets, substituting bends for sharp angles, and following existing tracks.

b. Weapons emplacements are dug in; natural concealment is supplemented with drapes, flat-tops, and decoy structures. Artillery obtains defilade and concealment from ground observation, when mission permits, by siting in dry washes and other terrain depressions or among rocks.

c. Vehicles are dug in when possible. Use drapes, and site to take advantage of shadows and natural concealment. Trucks remove tarpaulins, if practicable, to reduce the size of cast shadows. These tarpaulins may be used as sloping sides on parked trucks to break the shadow. Vehicles may be painted with colors and patterns and allowed to stay dusty to blend with the surroundings. Tracks are brushed out, if possible, or continued past a dispersed position.

d. At depots, material is placed under underbrush or natural terrain features, draped, irregularly dispersed, toned down, dug in, covered with tarpaulins and sand, or covered to simulate existing terrain features, such as rocks.

e. Bivouacs are dispersed and sited in shadows of gullies; camouflage discipline is strict. Tents are painted with canvas preservative to match the terrain.



FIGURE 86. — Tank parked in shadow of tree and draped with garnished twine net.



FIGURE 87. — Light tank, draped with shrimp net, tied into nearby vegetation.



FIGURE 88. — Light tank, draped with garnished twine net, hugs shadow of desert scrub growth.

SECTION III. JUNGLE

56. *a.* Due to the abundance of natural cover in jungles, the type of enemy observation most frequently encountered is from the ground at comparatively close ranges. For this reason, and because jungle warfare is conducted largely by infantry in extended formations, camouflage is an especial concern of individuals and small weapons. Wide use is made of natural concealment by hiding, by blending with backgrounds and with shadow patterns, and by screening individuals and emplacements with materials found in the vicinity (fig. 89). There are many opportunities for small-scale deceptive practices. Overhead cover must be preserved, particularly near bivouacs and camps. Slashings in jungle cover draw immediate attention of enemy aircraft.

b. Certain *individual* items should be especially stressed. The proximity of the enemy and the concealment available to him make sound, light, and camouflage discipline especially important. Booby traps must be set carefully to warn of enemy approach. Special care is necessary in movement forward not to spring his traps or otherwise give him warning by disturbing local wildlife. In no operation is systematic scanning of the terrain ahead for selection of position and route of approach better rewarded. Silhouette against the skyline is a major problem. Cooking with its inevitable accompaniment of shine, smoke, and movement is a constant danger to mass movement. Insect pests and fatigue diminish alertness, and bare skin, in addition to being a health hazard, also shines. Likewise belt buckles, luminous watches, and other shiny objects are special hazards. Dark clothing is essential. Footprint tracking is common.

c. Concealment of mules is practically impossible where overhead cover is not available. In such circumstances, dispersion and great effort are necessary as the animals trample terrain and eat foliage.

d. In semi-open or open terrain, track planning is essential prior to vehicle movement. Use of natural cover, supplemented when necessary by drapes, is essential. Use knot and bow-tie garnishing, which matches foliage. Props *must* be used to break vehicle form. Selection of site is as essential in parking trucks as in other combat action. Dust clouds from vehicles draw enemy dive bombers.

e. Workshop sites, even when well sited, are revealed by concentrations of deadlined vehicles. This can be solved by (1) reducing the deadline by better maintenance and (2) restricting the number of vehicles permitted in the workshop area. A dispersal area within 5 miles can accommodate surplus vehicles.

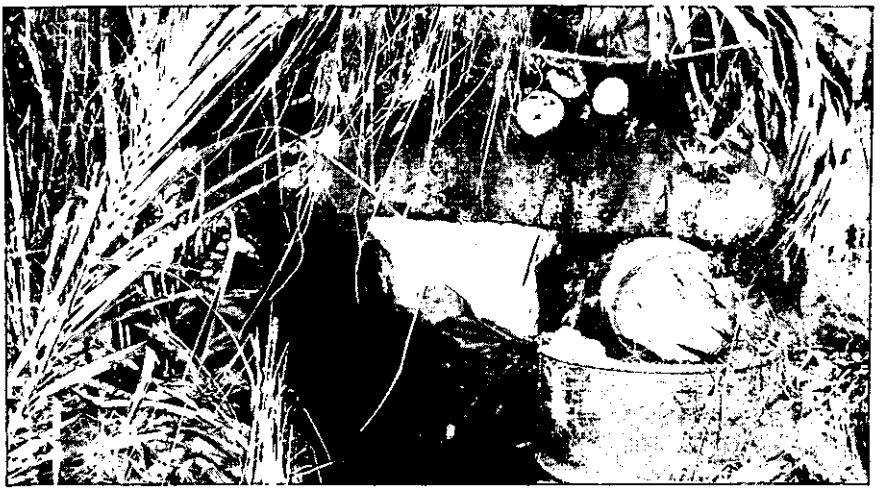


FIGURE 89.—Entrance to firing position concealed in jungle. Natural materials arranged over entrance and loop-holes would make position difficult to see at close range.

f. Headquarters, supply points, staging camps, and other concentrations should not be in the vicinity of:

(1) The main track or line of communications.
(2) Dropping ground.
(3) Track junction.
(4) River.
(5) Clearing.
(6) Gun position.
(7) Top of important feature.
(8) Captured enemy hutments or headquarters.
(9) Accommodation or vacated headquarters which has been bombed already.
(10) Any obvious target.

Other things being equal, the best site is on the side of a hill, up a narrow re-entrant. In forward areas, if time permits, sleeping, office, and store accommodation should be dug in on a hillside if possible. On flat ground, accommodation is dug down. It is advantageous to have protective overhead cover, but if this is not possible, the roof and surfaces such as tent flies, waterproof paper, and similar materials should be covered with natural blending camouflage and maintained.

g. Sniping, mortar fire, and bombs are particular hazards. In defensive positions, trenches should have overhead protective cover at ground level and should be covered completely with natural camouflage. Communication or crawl trenches — also camouflaged — should be dug to alternate positions. Slit trenches should be covered with camouflage and have overhead cover if possible. Decoy trenches should be left open.

SECTION IV. SNOW

57. GENERAL.—From the air, snow-covered ground is an irregular pattern of white, spotted with dark tones (fig. 90). The dark tones are produced by objects protruding above the snow and by shadows cast by irregularities in the snow surface, such as valleys, hummocks, ruts, and tracks. Shadows are comparatively gray in snow-covered terrain. Making sure dark military objects have dark terrain objects for background, avoiding movements that leave conspicuous and meaningful tracks, and maintaining military installations which are covered with snow so that the snow does not melt off and leave them conspicuous, are important. Camouflage discipline is highly important in snow terrain.

58. BLENDING WITH BACKGROUND.—Imitating snow is difficult because it has great reflectivity. Care must be exercised in matching it, as its color varies from white to gray tones. White issue clothes used as outer garments for individuals, and white paint or whitewash for guns, tanks, and trucks are effective against direct observation (fig. 91). However, due to texture difference these techniques are not effective against aerial photography. At present no practical material has been developed to reproduce the texture of snow. In the field, paints should be used which are not affected by freezing temperatures, such as oleoresinous mixed with gasoline.

59. CONCEALMENT PRACTICES.—Nets covered with large irregular areas of white cloth must be strong enough and well supported to withstand heavy snow and high winds. Trucks, tanks, and supplies can often be concealed by throwing snow over them. Tracks show up even more clearly than they do on grass or ordinary ground because they cast shadows which show as dark streaks. Obliteration is almost impossible; hence, tracks should not stop at a place where they betray the presence of an installation.

60. DECEPTION.—Deception has an important place in snow camouflage. Since paths in the snow are almost impossible to obliterate, one practice is to make many tracks that do not lead to an installation; the result serves to confuse the enemy. Shallow trenches in the snow, filled with grass, leaves, or brush look like deep defensive works from the air. Regular patterns of dark brush may easily be mistaken for batteries. Brush piles with paths radiating from them resemble command posts or supply or ammunition dumps. One of the best ways of making a decoy installation is to examine an aerial

photograph of a camouflaged real installation and then to duplicate the track plan and some of the concealed objects by decoys. The decoy should be more conspicuous than the real installation, as though it had been badly camouflaged.

61. BARREN ARCTIC REGIONS.—In barren arctic regions such as the Aleutian Islands, camouflage methods used in the desert can often be applied effectively. Strong winds usually prevailing in barren arctic regions make it necessary to use heavy strong construction.

62. NOTES ON SNOW CAMOUFLAGE.—*a.* As the temperature falls, sound carries better in snow country, and great care must be taken to muffle the sounds of moving men and equipment.

b. In arctic regions the length of the night assists concealed movement. Camouflage discipline, well regulated, plus night movements can conceal the operations of a military unit successfully.

c. In arctic regions the attendant cloudiness of the sky often prevents or hampers enemy ground and aerial observation. Concealed movements can be made under such conditions.

FIGURE 90.—Snow-covered terrain, viewed from the air, reveals a surprising proportion of dark area.





FIGURE 91.—Gun is whitewashed and crew wears white clothing to blend installation into snow terrain.

d. The use of decoys as well as decoy tracks is particularly effective in snow terrain.

e. In soft snow care should be taken to brush out distinctive tracks, such as those made by tanks. When tanks turn quickly, small mounds of snow are piled up and reveal the nature of the vehicle. Such mounds of snow should be brushed out. If tanks turn slowly in a gradual arc, these snow mounds are not formed.

f. When it is desired to obliterate tank tracks on a hard crust of a road, use a road grader.

g. Especial care must be taken to avoid shine from vehicles and equipment. Shine is often the only betraying sign of an otherwise well-concealed object in snow.

h. When bushes, buildings, and marked terrain lines are in evidence, parking procedure for vehicles is essentially the same as in temperate zones.

i. Leafy woods, orchards, and brushwood lose much of their concealment value in winter and should be supplemented by covers of white disrupted with branches.

j. When no white covers are available, dark ones can be used and covered with a layer of snow.

k. Thawing conditions are advantageous to camouflage since they reveal dark patches of ground which form a disruptive pattern. Vehicles and equipment can be made to blend easily against such a background.

l. In bivouac or in ambush, in deep snow, ditches may be made to conceal equipment or vehicles, but additional covers must be used to hide entrances. Track discipline must be rigidly maintained to prevent disclosure of the hiding place.

m. The degree of whiteness of artificial material employed must be carefully chosen. A hint of yellow or other alien color betrays the camouflage.