CAMOUFLAGE

FIELD TRAINING MANUAL
SECOND MARINE DIVISION
1942

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FOREWORD

This manual was prepared by the Second Marine Division Camouflage School by direction of Major General John Marston.

Acknowledgement is due American and British Army reference sources, and to the Twentieth Century-Fox Film Corporation for its invaluable aid and co-operation.

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SUPPLEMENT
POLYNESIAN NATIVE CRAFTS

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SECTION I

GENERAL

1. PURPOSE.-This manual has been compiled for the purpose of instructing Marine Corps personnel in camouflage problems, and with particular reference to the role played by the Marine in modern warfare.

2. SCOPE.-The manual is not to be considered in any way final or complete. Its flexibility is indicated by the fact that it is issued in loose-leaf form. It is the intention to incorporate new methods and ideas as occasion demands, and to delete or change any material that may become obsolete or is in need of revision.

3. PERFECT CAMOUFLAGE.-In theory, perfection would be reached in deception, if it were possible to manoeuver troops and transports, ships and planes, tanks, guns and equipment over large or small areas of sea and land with complete invisibility. It would be even greater perfection if these forces, still invisible, contacted the enemy and destroyed him. Inasmuch as this is obviously an impossibility, it is none the less logical to direct our efforts towards taking what steps we can in this direction, by any means at our disposal, as long as it does not impair freedom of action or mobility.

4. THE CAMOUFLEUR.-Camouflage lends itself to experiment, and to improvement by trial and error. The problem of camouflage appeals to the imagination and, by an imaginative application to the task on the part of the camoufleur, the science will be developed. A good camoufleur usually has a tough road to travel. He must expect, on numerous occasions, to be treated as some sort of harmless lunatic by his friends. He must expect, more often than not and probably for very good reason, that cold water will be poured on many of his pet schemes and ideas, and that they will be labelled fantastic and impracticable. On the other hand, he must remember that one original brilliantly conceived and executed camouflage scheme will be worth ninety-nine failures, for then he might well enjoy the satisfaction of having been a contributing factor to the saving of many lives, or find himself in the enviable position of having played an important and significant part in the winning of a battle. A reputation for lunacy would be very worthwhile under these circumstances.

5. PSYCHOLOGY AND CAMOUFLAGE.-(a) Camouflage can go far beyond the extent of painting a house to simulate a hill, or the successful making, garnishing, and installation of a flat top.

(b) The Japanese soldier professes to be unafraid of death. To die for his Emperor or for his country is, to him, a sure and infallible method of procuring an irrevocable first-class ticket to heaven. He must therefore, in reverse ratio, have a deadly and horrible fear of going to hell. He is mortally afraid of fire, earthquakes, and the supernatural. Camouflage, and its twin brother, deception, should have much to do in playing upon the enemy's fears and superstitions. It was not entirely an idle jest that caused the Flying Tigers in Burma to paint the noses of their planes to resemble the grotesque images of man-eating tiger sharks and dragons.

(c) It is a fact, and it may sound far-fetched but, when tanks were used by the British for the first time in history at the battle of the Somme in 1916, the Germans were so paralyzed with fear at the sight of them that they threw down their weapons and ran.

6. COMPARISONS.-(a) Camouflage is not a new art, but it has been sadly neglected. History and mythology abound with examples of how battles have been fought, and won, by its use. The difference between the manner of the Ancient Greeks in getting their men within the walls of Troy, concealed in a wooden horse, and the modern counterpart, the demolition squad and paramarine, is mainly one of method and equipment.

(b) Shakespeare, in the Seventeenth Century, wrote of how MacDuff stormed the Castle of Dunsinane, his troops disguised with boughs cut from the trees of Birnan Wood. Small difference between that, and the manner of the Japs on the Malay Peninsula in 1942.

(c) Since the flurry of interest, experiment, and some wholesale practice in a type of camouflage applicable to the trench warfare tactics of World War I, little has been accomplished in advancing the science.

7. DEVELOPMENTS.-While camouflage in all its phases becomes increasingly important as the science of aerial reconnaissance and photography develops, it is evident that two types above all others are going to play a major role in modern combat. These are personal and strategic camouflage.

8. PERSONAL CAMOUFLAGE.-Both the Germans and the Japanese practice the art of personal camouflage with considerable skill. The initial success of the Japanese campaign in the Western Pacific was due in part to its employment on a large scale. They also used to their advantage the very jungles that were considered impassable barriers to troops and equipment. The Japs became a part of those jungles, exhibiting surprising and totally unexpected skill in cutting through them. For more than one reason they had been dubbed "monkey-men" by the Chinese. Their ability to blend with their natural surroundings, by employing various disguises, permitted them to pass undetected through the defender's lines and to successfully outflank, or take them by surprise from the rear. In these operations they practiced the art of personal camouflage with overwhelming success.

9. STRATEGIC CAMOUFLAGE.-(a) The following example of strategic camouflage is given to illustrate the extent to which this type of operation can be carried.

(b) Whether by accident or design, the Germans, in building the Siegfried Line, were responsible for the greatest and most successful deceptive camouflage operation in history.

(c) When, during the winter of 1939-1940, it was reported by the French that sections of the Line were inundated, that concrete installations were crumbling due to exposure and inferior material; when it was observed that pillboxes were easily blown up, and over, when coming under artillery fire; then it is not difficult to imagine the concern that the German High Command might have suffered in supposing that the true purpose of the Line had been discovered by the enemy.

(d) The deception, if deception it was, of building opposing fortifications to the Maginot Line, with the intention of deceiving the French into believing that the challenge had been accepted to wage the War in the style and manner of the trench warfare of 1914-1918, was a stroke of genius and an example of masterly strategy. Subsequent events proved that the Germans had no such intentions, and the fact was not fully appreciated even after the full scale dress rehearsal of a new order in warfare exhibited in the invasion of Poland.

(e) It is possible that the Siegfried Line was intended to serve no other purpose than to deceive the enemy as to strategic intentions, and to perhaps protect the left flank of the German Army in their thrust through the Low Countries.

10. CONCLUSION.-Give then a little thought to camouflage. Consider the camoufleur a lunatic if you will, but remember it is courage, daring, imagination, initiative and, last but not least, deception, that wins wars. Camouflage embraces all. A war may be won by all, or one of these.

SECTION II

THE AERIAL PHOTOGRAPH

11. INTERPRETER VS. CAMOUFLEUR.-(a) We know that much can be done by the use of camouflage to escape detection by direct observation. In other words, it is rather easy to fool the eye of the observer, particularly under combat conditions. The problem of fooling the aerial photograph interpreter, however, is almost impossible unless the camouflage job is an exceptional one and the discipline is perfect.

(b) When compared with the problems confronting the camoufleur, the air photo interpreter has every advantage. In addition to his own skill, he can obtain the help of specialists in artillery, tank tactics, machine guns, etc. to advise him where to look for these installations and verify his findings. The chance of error in photo interpretation is further reduced by comparing the reports of several interpreters working independently on the same problem.

(c) Prior to, during, and after combat operations, the movement of men and equipment is difficult to conceal. The photograph interpreter, studying reconnaissance photographs made under combat conditions, looks for and usually finds evidence of relaxing of camouflage discipline, in most cases in the form of unnecessary foot trails, vehicles' tracks, or as carelessness in leaving equipment exposed. If reconnaissance photographs are taken under such conditions, the interpreter can, by logical deductions, locate camouflaged positions which might otherwise go unnoticed.

(d) In direct observation from the air, the ability of the human eyes to perceive third dimension is limited because of the small distance between the eyes when compared with the altitude of the plane. The photograph interpreter, however, has the opportunity of viewing with a stereoscope, photographs taken at greater intervals with the result that all terrain features will be exaggerated in height. A flat top garnished net unnoticed by direct vision, would stand out in full relief when seen through a stereoscope.

(e) Recent developments in reconnaissance technique such as fast, low flying pursuit ships equipped with automatic cameras which can be used to obtain additional photographs of suspected areas, add to the advantage of the interpreter and make the job of the camoufleur even more difficult.

(f) In general, the problem of actually concealing anything from the photograph interpreter is becoming increasingly more difficult. Under these conditions, the best plan seems to be the intelligent use of dummy installations as decoys to divert the attention of the interpreter from the camouflage position.

SECTION III

TERMS AND DEFINITIONS

12. CAMOUFLAGE DISCIPLINE.-The practice of keeping emplacements in condition by paint or renewal of foliage. The avoidance of making tracks. The application of common sense with regard to the construction of any emplacement or position, and the proper dispersal of material.

13. MATERIAL.-Anything used to form the covering or concealment of position or vehicle (paint, nets, garnishings, garlands, lumber, etc.).

14. PHOTOGRAPHIC SHADE.-The relative amount of light reflected from surfaces of varying colors or textures.

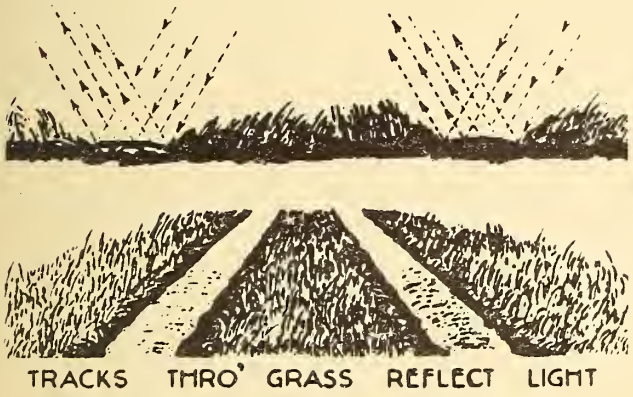


Fig. 1

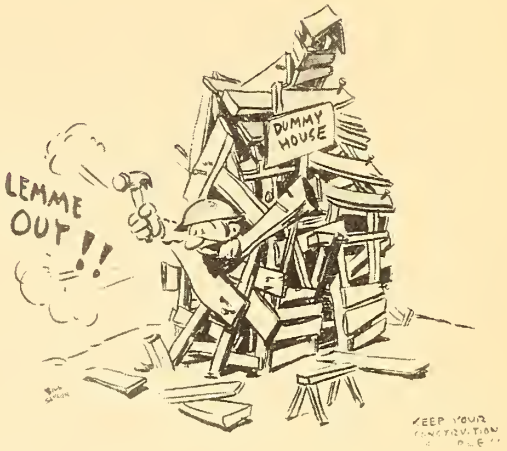
15. TEXTURE.-(a) The element which causes the illusion of shadows in aerial photographs. A flat surface lacks texture. Therefore, regardless of color, it will photograph very light gray or white. A field of long grass or wheat photographs a light gray and the parts which have been trampled by troops or run down by trucks show up clearly as white. A forest or brushy terrain photographs dark gray and black because of the denser shadows. Therefore if trees or brush are removed from the area, it will photograph light gray or white whereas it should show up totally dark.

(b) To clarify this point a bit more, consider texture as a lawn; all grass blades stand straight up when undisturbed. Now, drive a truck over it, or walk over it. Then, look back. You will readily observe the resultant tracks left by you and/or the truck. The color has not changed, but the texture has. (Fig.1)

16. FORM AND SHADOW.-(a) Everything made by man has a definite regular form. Where in nature will you find anything formed like a tank, a recon-car, or a truck? Except in very rare instances, nature does not create regularity in forms.

(b) Regular forms cast regular shadows. A photograph is a reproduction on film of billions of small shadows. A regular shadow surrounded by irregular shadows and standing out from them will be conspicuous. The thing to do is to break up the shadow and when doing so, blend the building into the surrounding terrain. If this is skillfully done, the camera will be fooled.

17. TERRAIN FEATURES AND TERRAIN PATTERNS.-Outstanding landmarks, or characteristics, in any given area. Mountains are terrain features; so are the eucalyptus groves nearby; and as well, canyons and roads. Taken all together they form terrain patterns. Example: Coastal Southern California has an eroded, sub-mountainous, bushy terrain pattern.



18. DUMMY.-(a) A dummy is an artificially constructed form simulating a military work or object, but serving no other purpose than to deceive the enemy as to the position or existence of a real military object.

(b) Dummies should be of simple construction without too much attention to detail. The outline is all that is necessary. (Figs.2,3)

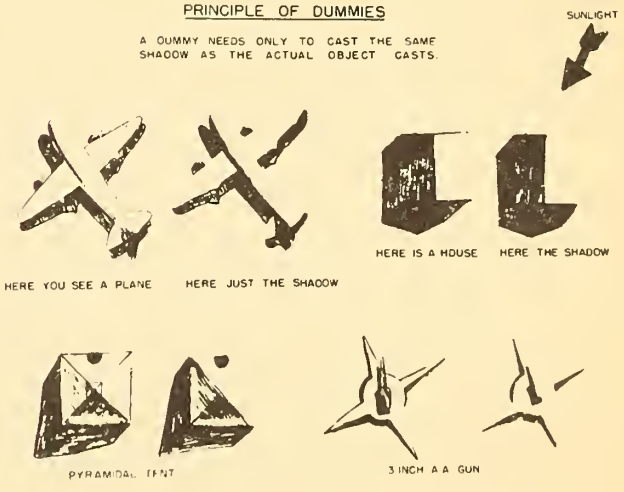


Fig. 2

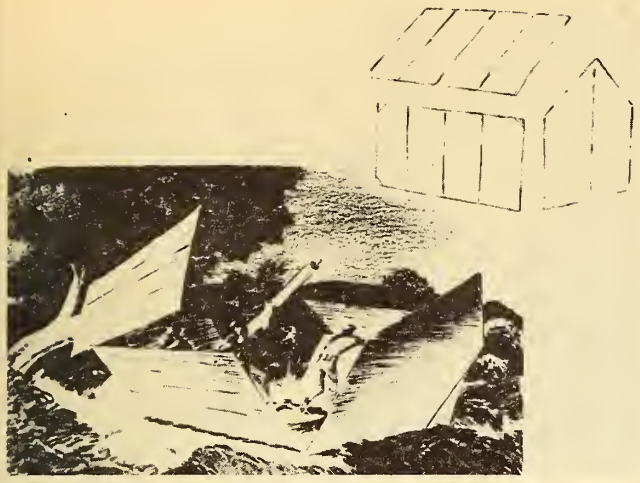


Fig. 3

SECTION IV

CAMOUFLAGE DISCIPLINE

19. DISCIPLINE.-(a) Camouflage discipline has two very important objectives:

(1) To prevent any change in the appearance of the terrain. For example: Making paths or tracks, cutting trees or sod, or leaving any foreign objects exposed in the vicinity of the position.

(2) The maintenance of camouflage material. For example: Repairing it when damaged, and keeping it up to date by changing its appearance or color as that of the terrain changes with the seasons.

(b) Camouflage material should be so placed that:

(1) It does not have a regular form or cast either a regular or well-defined shadow.

(2) It conceals the form and shadow of the object camouflaged.

(c) When using natural material to cover a position, obtain the natural covering in a manner that will not disturb the existing terrain pattern.

20. MATERIAL.-(a) Materials chosen should:

(1) Match the surrounding terrain in color and texture.

(2) Be easy to maintain, considering the length of time the position will be occupied.

(b) Use natural material. For example: Brush, limbs, reeds, palm fronds, cover of trees, etc.

(c) Natural material and cover are always superior to artificial material or effort.

(d) Some types of foliage retain their shape and color for a longer period after being cut if dipped in ocean water. This treatment will not cause the foliage to wilt faster.

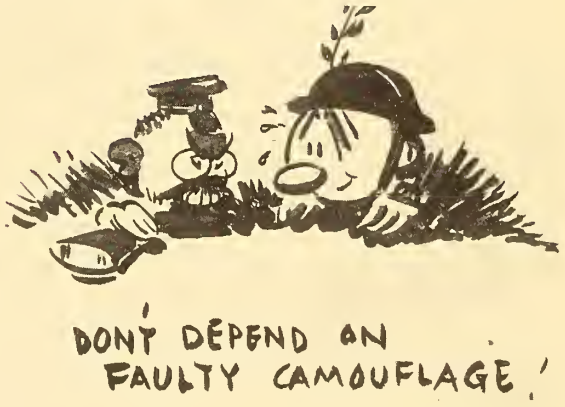
SECTION V

PERSONAL CONCEALMENT

21. HANDS AND FACE.-(a) Light surfaces are a give-away in any surroundings. They reflect light, thus foiling concealment.

(b) Remedy: Smear with mud, dirt, or face-paint, and use head net and hand wrappings.

(c) The natural shine and pattern outline of the face should be broken up. The color should correspond to the background. For this purpose greasepaint and makeup can be used if available. For instance, in the jungle use green makeup for hands and face, streaked with a darker color to cause a contrast and mock shadow pattern.



22. HELMET AND PACK.-(a) The basic color of the helmet is fine, but the outline is non-concealing. It has been found that the new type bucket-helmet is not only better for head protection, but molds into a less bulky form when dealing with head concealment.

(b) Remedy: Break up the regular pattern and gleam of the helmet, and blend the head and shoulders into a less human form with a net or brush.

(c) The head net is made of light fish-net twine of approximately 1" mesh. This net should be approximately 4' x 5', or long enough to drape over the helmet, down the back over the pack, and over the chest in front. The two rear corners can be fastened in front of the body by placing a mesh section over a button. The two front corners are then tucked inside the fastened rear section. When garnished with brush or garlands, the human form is broken up.

Head Net and Sniper's Suit.

Use of Cover

(d) Before donning the net and helmet, the net should be laid out flat. Then the foliage should be placed at the spot where the helmet meets the net. When this foliage is put in thick enough to break up the helmet and body outline, the net should be placed on the helmet and the foliage placed in an irregular pattern. It is advisable to use some of the foliage around the head and shoulders, blending it into the head-piece. The remainder of the net should be strung with small garlands or brush, thinned out towards the edges.

(e) In doing this be sure that the net is over the helmet so that the cord will be tight enough to hold the foliage.

23. SNIPER SUITS.-(a) The two-piece dungaree suit now in use has been augmented by patterns of paints. The basic color of the suit is light green spotted with a darker green, plus light and dark brown spots. This tends towards a heavy shadow effect; and results in breaking up the outline of the body and at the same time blending in very well with the surrounding terrain --grass, brush, woods, etc.

(b) One side of the suit is of a sandy texture--two shades darker brown--which corresponds to the light-reflecting shades so prevalent on deserts and along beaches.

(c) The darker shades of brown (on the light, sandy side of the suit) corresponds to the lumpy loam and small tufts of grass usually found on sandy stretches of country. This side of the suit is quite effective in light, grassy terrains--straw or dead grass fields.

(d) The trousers of the sniper suit are long and baggy in order to cover the leggings and shoes, and to break the regularity of leg outline. Do not tie or secure the bottom around the ankle.

One method for making sniper suits: Take an old dungaree suit and paint-spray it with desired design and colors.

(e) If the requirement is for temporary use, water paints are suitable. They can be washed or brushed off easily when it is desired to change the pattern, but will stand several days of rain before becoming conspicuous.

(f) Use colors that match the surroundings when applying paint. Colors should be so blended as to eliminate telltale lines between shades. A spray-gun is best for this purpose.

(g) Three men, with spray guns containing different colors, should be able to camouflage sixty suits in about two hours.

Fig. 4

SECTION VI

THE SPIDER TRAP

24. THE SPIDER TRAP.-(a) Every Marine is familiar with the "fox hole". Its use, primarily, is for protection during a rapid advance, rather than concealment. The spider trap on the other hand is used specifically for concealment. It is a means of concealing a man or group of men from the enemy's view. A hole is dug in the ground deep enough for a man to stand nearly upright. (Fig.4) It is covered by a trapdoor made of a framework over which grass or brush resembling the immediate terrain is placed. If possible it should not arouse suspicion by unusual firmness or springiness to the feet. (Figs. 5,6)

Fig. 5

Fig. 6

(b) The best place for spider traps is along both sides of a road. One man or several platoons of men can be concealed by this method. When the enemy tanks or infantry are approaching, they are allowed to pass, and immediately after, the men in the spider traps go into action.

25. CONSTRUCTION.-(a) The spider hole is concealed by a cover made of crisscrossed twigs. (Fig.7) It is this cover, or top, that is the first step of construction. It should be large enough to cover the man's head and shoulders.

Fig. 7

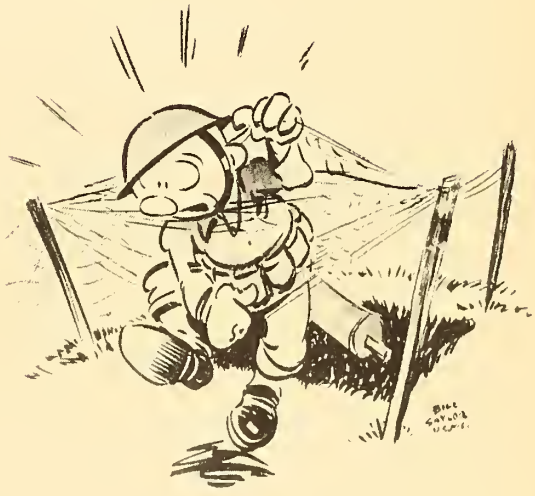
(b) The position is selected and the hole dug. The hole is just large enough to accommodate the body. It may be widened as it gets deeper. Not more than one man is required to dig the spider-hole. However, two men working together will more expeditiously dig two spider holes than if each digs individually on separate ones. This, for the reason that after a depth of two or three feet, digging becomes quite difficult due to the limited width of the hole.

(c) The top layer of soil removed should be carefully placed on the frame in the same position it previously held on the surrounding terrain. (Fig.8) Care must be exercised in removing this top layer of soil--it should be thick enough to insure permanent preservation of the grass.

Fig. 8

(d) The soil should be placed on a poncho, raincoat, or burlap. (Fig.9) When enough dirt to be carried away has been dug out, a disposal spot should be carefully selected. Whenever possible the spider hole should be dug alongside a path or road; thus tracks will not be discernible.

Fig. 9



SECTION VII

NETS

26. PURPOSE OF NETS.-The purpose of garnished nets is to break up and diffuse the pattern of a position or an object so that it will blend in with its surroundings. (Fig.11) A net as such is the element that supports the material used for concealment. A net by itself is useless. The effect of a garnished net is much the same as a curtain on a window. Those behind it or in the house can see out, but the outsiders cannot see in. A garnished net, if it matches the color and the light-reflecting surfaces beneath it, will blend so that it will not show conspicuously in an aerial photograph. (For article on head nets see Section V)

Fig. 10

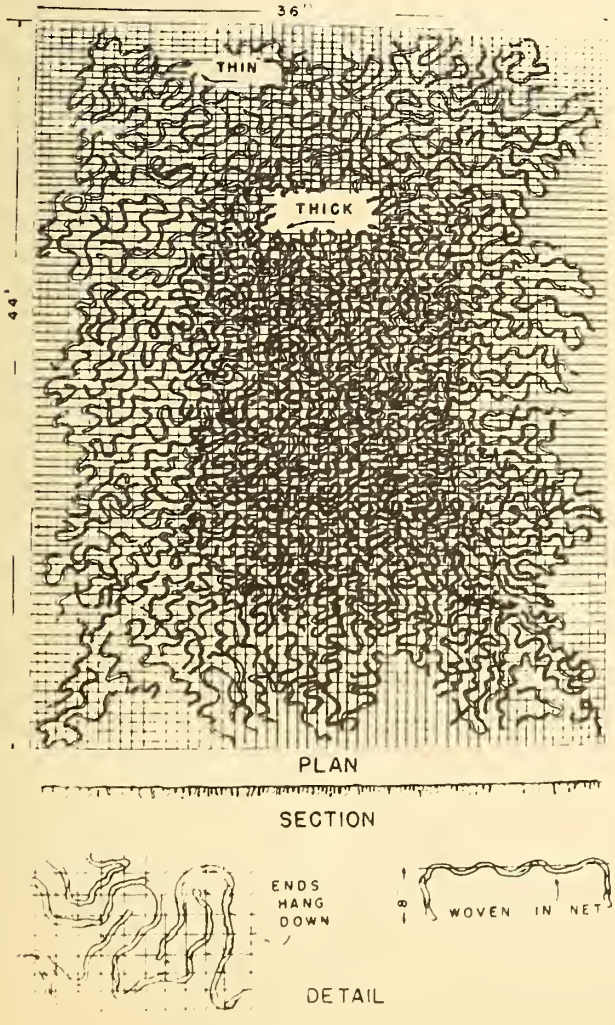


Fig. 11

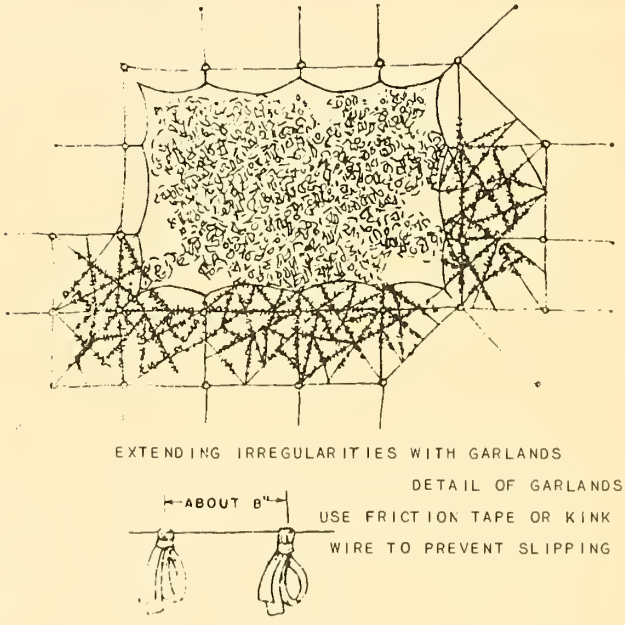


Fig. 12

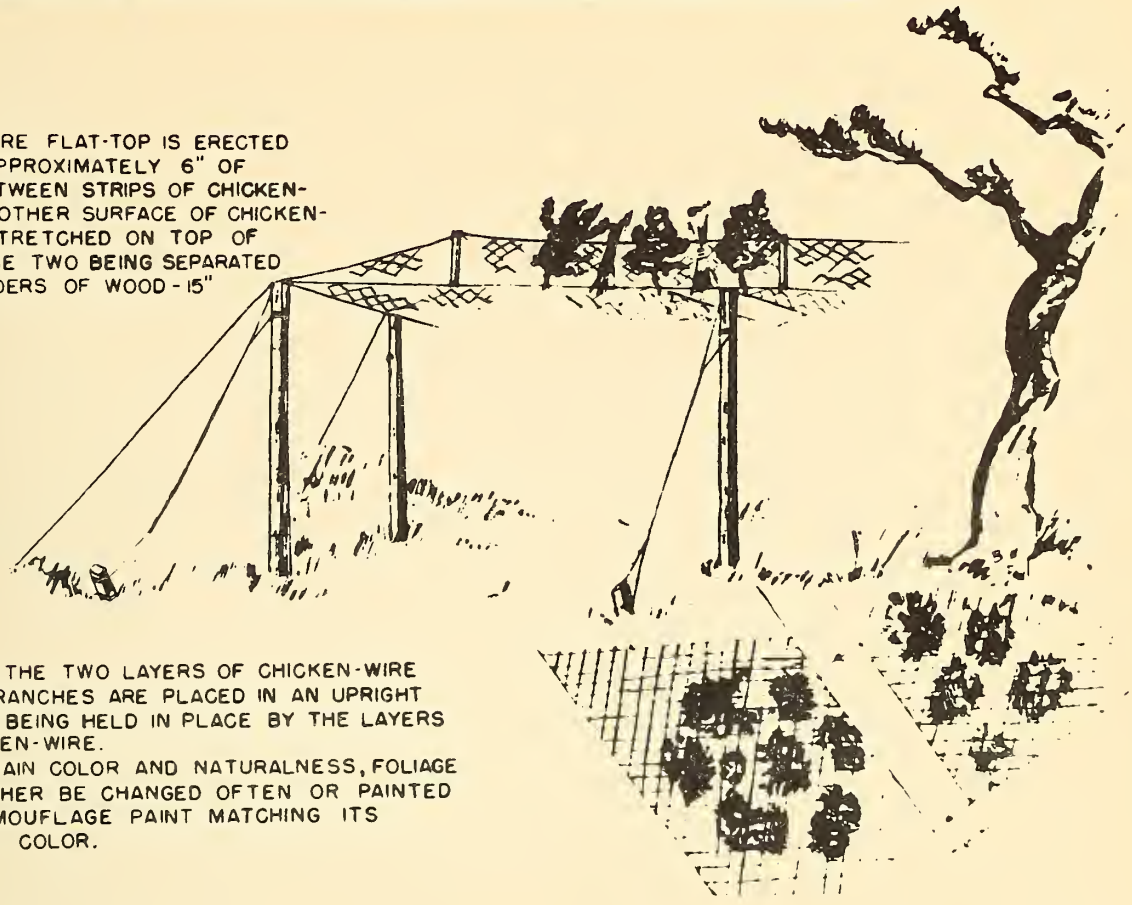
27. FLAT TOP NETS.-(a) These, if used properly, will blend into the terrain pattern to the point where a position so concealed will not be noticeable to the eye or to the camera. (Figs.12,13)

(b) Care must be taken to keep the flat tops flat, otherwise they will betray the presence of activity. The frame for the net should be of the simplest type of construction. (Figs.14,15)

(c) Any means of stretching the net to make it tight is acceptable. It must not, however, "bunch" around the edges like dough around pies. If brush or trees are available, they may be advantageously substituted for part or all of the stakes and poles.

CHICKEN-WIRE FLAT-TOP GARNISHED WITH NATURAL FOLIAGE

CHICKEN-WIRE FLAT-TOP IS ERECTED LEAVING APPROXIMATELY 6" OF SPACE BETWEEN STRIPS OF CHICKEN-WIRE. ANOTHER SURFACE OF CHICKEN-WIRE IS STRETCHED ON TOP OF FIRST - THE TWO BEING SEPARATED BY SPREADERS OF WOOD - 15" LONG.



BETWEEN THE TWO LAYERS OF CHICKEN-WIRE SMALL BRANCHES ARE PLACED IN AN UPRIGHT POSITION, BEING HELD IN PLACE BY THE LAYERS OF CHICKEN-WIRE.
TO MAINTAIN COLOR AND NATURALNESS, FOLIAGE MUST EITHER BE CHANGED OFTEN OR PAINTED WITH CAMOUFLAGE PAINT MATCHING ITS ORIGINAL COLOR.

Fig. 13

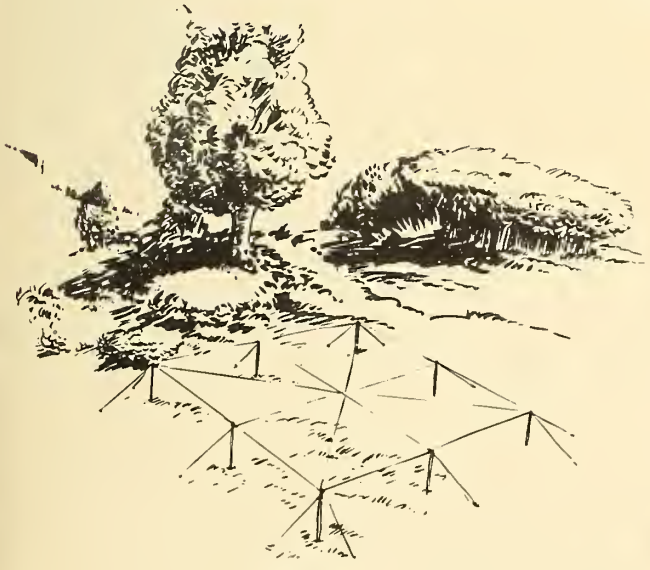


Fig. 14

Garnishing should be irregular in outline. The thickly woven central portion serves to conceal what may be under it, and the thinned edges cast a faint, indeterminate shadow which, merging into the inequalities of the terrain, renders it unnoticeable in aerial photographs. Since the thinned edges allow objects under them to show, the cover must be larger than the object over which it is placed.

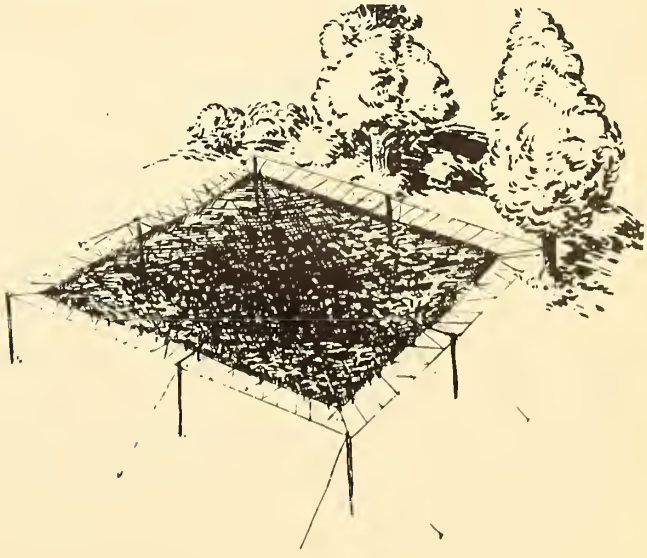


Fig. 15

(d) The frame for a 36' x 44' net should be at least 40' x 48' in order that the net may be laid on top of the wire web and lashed to the outer wires.

(e) In garnishing nets or chicken wire the strips of fabric (or brushy material, if used) should be woven or placed closest together over the object to be concealed, gradually thinning out towards the edges.

Fig. 16

28. DRAPE NETS (GARNISHED).-Their purpose is to break up the outline, shape, shadow and color of any object or position. (Figs. 16,17)

Fig. 17

29. VIZINETS.-Are close weave ungarnished nets, generally dyed or painted to correspond to the existing terrain. Their purpose is the same as drapes.

30. CHICKEN WIRE.-If available, is more permanent than fabric netting and can be used in the same manner.

31. COLORS OF NETS.-(a) Garnishing for nets must be colored to fit the locality where the net is used. In a stable situation, nets may be furnished to the using units already garnished and colored to fit the particular sites. In mobile situations, garnishing or garnished nets may be furnished in a neutral color but must be finally colored on the site. In any case, coloring must be checked by air observation to prove its effectiveness. Nets colored in one solid color throughout generally give as good results as nets with mottled patterns of several colors and are easier to prepare.

(b) Garnishing may be colored either by paint or dye.

32. PAINTING OR DYEING.-(a) Paint or dye can be applied by:

(1) Paint brush, which requires excessive labor.

(2) Spray gun, which is especially useful for correcting colors in the field.

(3) Dipping in a vat of paint, which is the quickest method, but requires much more paint and thereby increases the weight of the finished product materially.

(b) Garnishing can be painted:

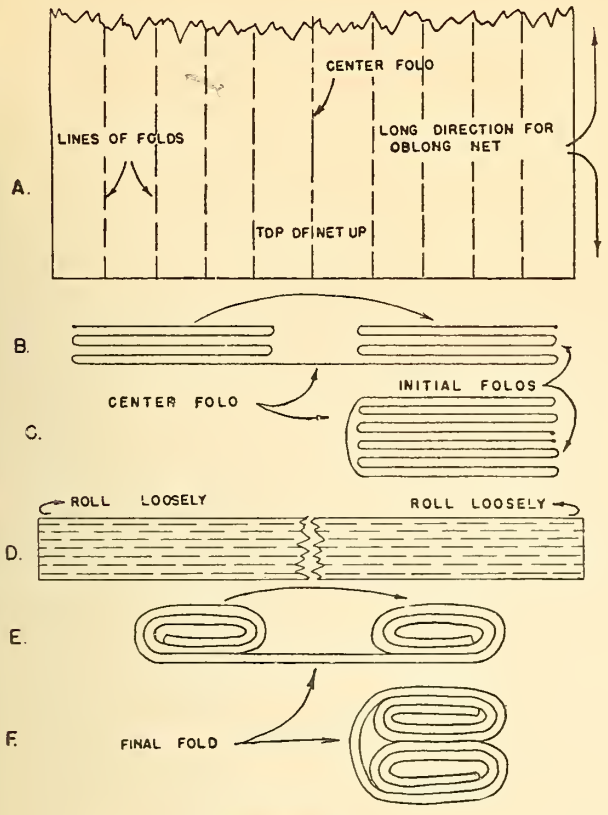
(1) Before weaving, while in the form of large pieces (bolts or rolls) or of strips ready for use. Painting before weaving is economical of paint but makes the material stiff and hence slightly harder to weave. Large pieces are easier to paint than strips, but when strips are cut therefrom their edges are unpainted which changes the color of a garnished net appreciably. This is unimportant where final matching of colors is done in the field.

(2) After being woven into the net. This method is particularly useful when the garnished nets are painted by dipping. Both upper and under sides of the net must be painted.

USE OF NETS TO HIDE PATHS AND ROADS

Fig. 18

33. FOLDING OF FISH NETS.-When not in use, fish nets should be folded carefully in such a way that they can be unfolded for use without confusion. (Fig.19)



PROCEDURE

1. SPREAD FLAT, (A.) AND FOLD TOWARDS CENTER, (B. AND C.) TO FORM LONG FOLDED STRIP (D.)
2. ROLL LOOSELY FROM BOTH ENDS, (E.) AND FOLD ROLLS TOGETHER. (F.)

Fig. 19

SECTION VIII

MAKING AND REPAIR OF FISH NETS*

34. MATERIALS.-(a) Twine. The twine used in camouflage fish nets is commercially known as Number 18 (meaning 18 thread) medium laid seine twine. The commercial unit is the pound containing approximately 1000 feet.

(b) Due to the difficulty of tying knots in tarred twine or of tarring completed repairs in the field, twine should be treated with copper oleate preservative when the maximum durability is required. Normally, untreated twine is satisfactory for repairing damaged nets because the patch will probably be as durable as the older net.

(c) Netting Needles. Netting needles are essential for making nets because the large amount of twine needed for the task can be handled efficiently only by using a needle. Needles are desirable but not essential for making repairs because only a relatively short length of twine is used in any one repair.

(d) If commercial needles are not available effective substitutes may be made of any thin hard wood. A convenient size is 6½" to 8" long, 5/8" to 7/8" wide and approximately 1/8" thick. In making needles, the central spine about which the twine is looped should be so long that it must be pushed to one side or the other to permit the loop of twine to pass over its end. This prevents the needle from unwinding when dropped but permits the user to unwind one loop at a time, as needed, by a slight pull towards the point of the needle.

(e) A drawing of a typical commercial needle is shown in figure 20.

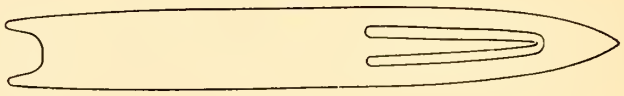


Fig. 20

35. MAKING NETS.-(a) Introduction. It is not anticipated that troops will make any large amount of nets for their own use since ready-made nets of more uniform weave are available through the usual Engineer Supply channels.

(b) However, practice in making portions of nets is essential if one is to develop the manual skill required to make a satisfactory repair.

(c) Special nets or extensions to standard nets may also be required to meet unusual field conditions.

(d) Filling the Needle. The needle is filled by clove-hitching the end of the twine around the central spine, and leading it up the other side. Then bend the spine until its point projects just enough to permit the twine to be looped over the spine. The twine is then led back through the groove at the base of the needle to the starting side where the process is repeated. (Fig. 21)

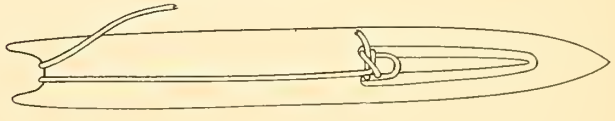


Fig. 21

(e) The needle should be filled until the twine is approximately 1/4" from the end of the spine. Leave about twenty-four inches of twine not wound on the needle.

(f) The Loop. Make a bowline in the free end of the twine attached to the needle. The length of the loop when stretched so that the sides come together should be the same as the distance desired between diagonally opposite knots of a mesh of the net when stretched so that the sides come together. This dimension is technically called the "mesh" and a standard camouflage net has a four inch mesh (in other words the small squares are two inches on a side). To gain facility in judging this size by eye, all training should be conducted with a 4" mesh.

(g) The Chain. The next step is to weave a "chain" of meshes equal in length to one edge of the net. (The body of the net is then made by weaving onto the side of the chain.) To make the chain, hook the loop just formed over a convenient nail or tie it up with a loop of twine. Turn the loop so that the knot is in the middle of the left-hand side. Pass the filled needle up through the loop with the right hand, regrasp the needle with the right hand and pull it down towards the right hip. Hook the left little finger in the new loop from behind. (So the loops might be grasped by the left hand.) See figure 22. Adjust the new loop to the same size as the first one by pulling with the needle or with the finger. The loops and twine should be stretched firmly toward the weaver at this stage.

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* *Reprint of pamphlet prepared by 84th Engineer Battalion (Camouflage)(Army)*

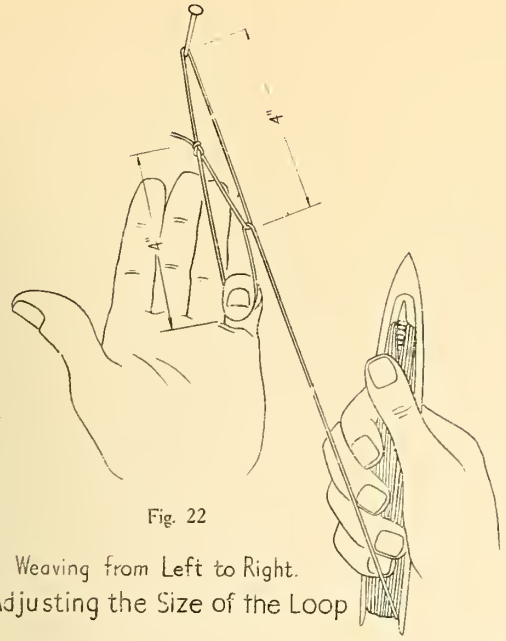


Fig. 22

Weaving from Left to Right.
Adjusting the Size of the Loop

(h) When the size of the loop has been adjusted, grasp the twine where it passes through the first loop with the left thumb and forefinger as shown in figure 23. Note that the thumb is BEHIND the twine leading to the needle and that the thumb-nail grips the bottom of the old loop. Now throw a loop of twine up to the left front as shown in figure 23, with the running end leading from the top of the loop. Pass the point of the needle BEHIND the two sides of the first loop, IN FRONT of the twine leading down from the original bowline to the left little finger, and THROUGH the loop just thrown up to the left front. The appearance should now be as shown in figure 23.

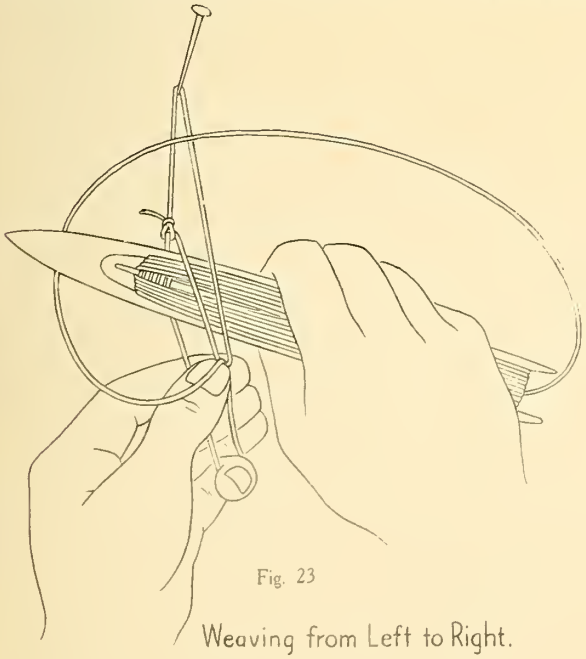


Fig. 23

Weaving from Left to Right.
Making the Knot.

(i) Regrasp the point end of the needle with the right hand and pull the knot tight by pulling the needle smartly down towards the right hip, at the same time keeping a firm hold with the left thumb and forefinger and with the left little finger. The mesh is now completed and should appear as in figure 24.

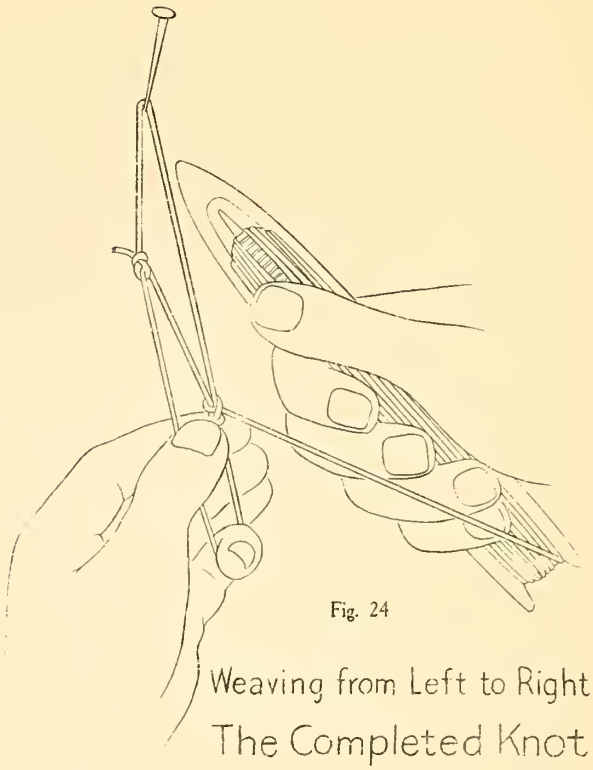


Fig. 24

Weaving from Left to Right.
The Completed Knot

(j) Remove the first loop from the nail, turn it over and replace it so that the twine again leads from the middle of the left-hand side of the loop as shown in figure 25.

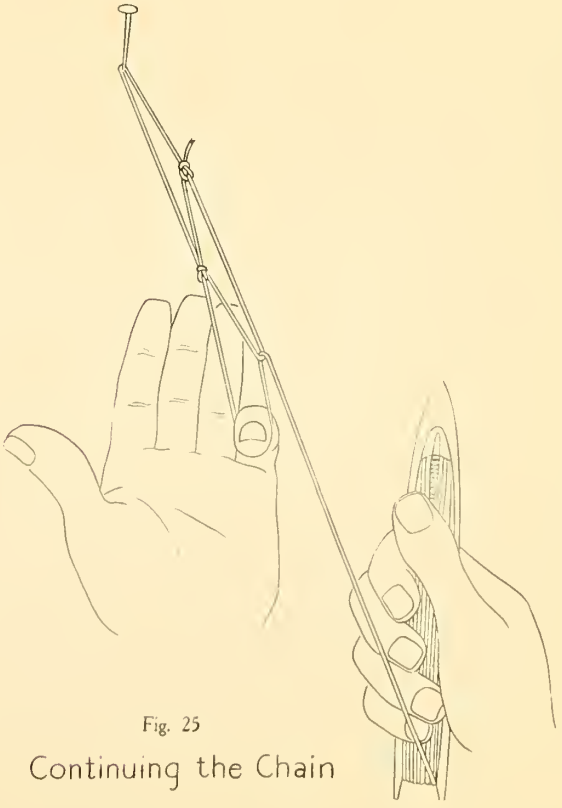


Fig. 25

Continuing the Chain

(k) Weave another mesh in the same manner as the first one, turn the chain over and continue until the number of meshes desired for one side of the net have been made.

(l) After the first few meshes have been woven it is no longer necessary to remove the end loop from the nail and turn the whole chain over. The chain can be twisted until the twine leads off from the left side, a mesh woven, and a chain twisted back to weave the next mesh.

(m) Note: If the net is to be used to patch another net the exact number of meshes must be counted as explained in paragraph 36 under "Patching". Otherwise it is sufficiently close to allow 17" to 17½" of stretched chain per foot of length of the side. This is the standard used in making the issue camouflage nets and should give a net which will be stretched tightly when pulled out. Figure 26 shows a chain with four meshes on its outer edge. A fifth mesh is shown in dotted lines.

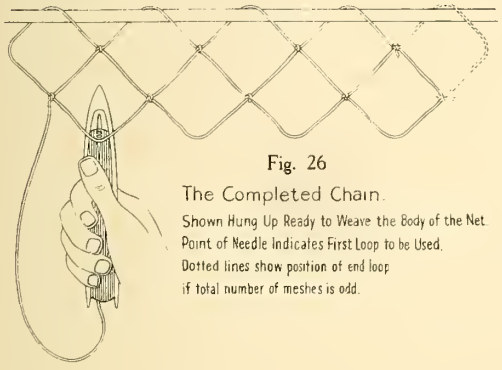


Fig. 26

The Completed Chain.

Shown Hung Up Ready to Weave the Body of the Net.
Point of Needle Indicates First Loop to be Used.
Dotted lines show position of end loop
if total number of meshes is odd.

(n) The chain is now unhooked and spread out as shown in figure 26. The needle indicates the first mesh that will be used in weaving back and forth across the net. The opposite row of meshes (strung on a rod) form the edge of the net. These edge meshes may be strung on a rod or rope or, if the net is small, gathered together on a nail. It is better to have the net hang so that the loops are free to slide together when one pulls at right angles to the bar because it is much easier to judge the correct size of loop than when the net is spread out. Furthermore, the meshes will begin to close up anyway after five or six rows have been woven.

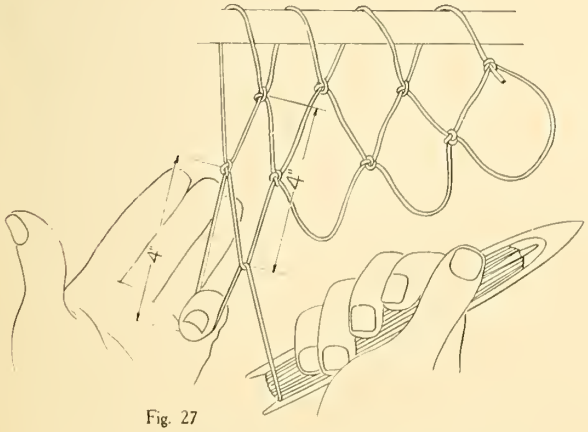


Fig. 27

First Step in Weaving the Body of the Net.

(o) The hanging bar should be thrust through as shown in figure 27, so that all twine crosses the front of the bar in the same direction. This makes the net hang more evenly.

(p) The Body of the Net. With the chain hung up as described above, the twine should lead off from the lower left hand knot. Pass the needle up through the mesh to the right of the knot. Hook the left little finger in the loop as shown in figure 27. Adjust the length of the loop so that the distance from the knot directly above the little finger to the bottom of the loop equals the total length of the mesh. (See dimension lines.) Complete the tie just as was done in making the chain. See figures 23, 24.

(q) Pick up the next loop to the right, tie into it and proceed across to the right hand edge of the net.

(r) Note that if the chain contained an odd total number of meshes the last mesh on the right will be strung on the rod (see dotted lines in figure 26) and must be skipped in weaving the body of the net.

(s) Now change the needle to the LEFT hand, pass the point up and to the front through the last mesh woven, hook the little finger of the right hand in the loop and adjust to length as shown in figure 28.

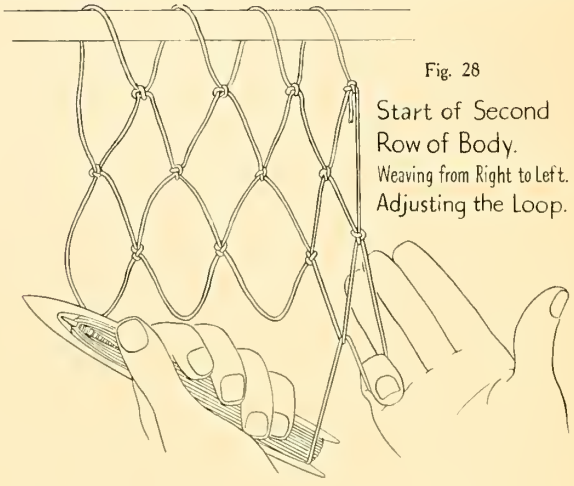


Fig. 28

Start of Second Row of Body.
Weaving from Right to Left.
Adjusting the Loop.

(t) Throw a loop of twine up to the RIGHT front, pass the needle from LEFT to RIGHT behind the mesh being tied into, in front of the loop hooked on the finger, and through the loop thrown up to the right as shown in figure 29.

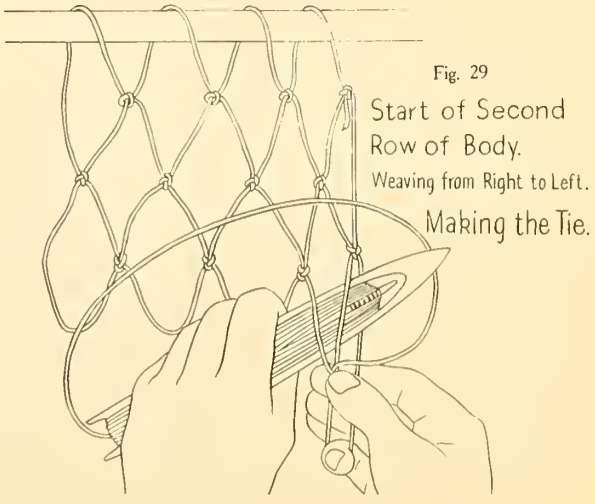


Fig. 29

Start of Second Row of Body.
Weaving from Right to Left.
Making the Tie.

(u) Pull the knot tight as shown in figure 30 and continue weaving from right to left in the same manner until the left hand edge of the net is reached. (Note that the last mesh at the left top is on the rod and must be skipped.)

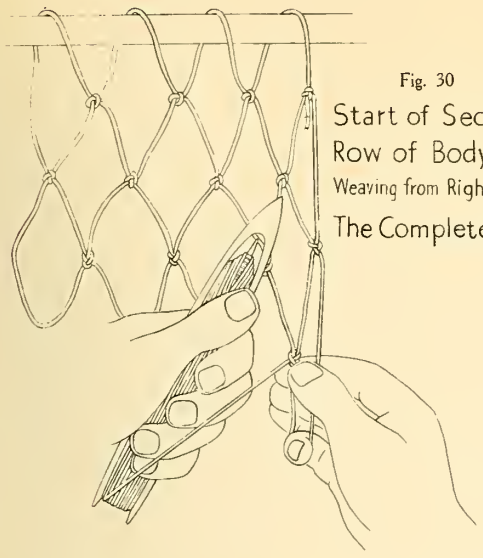


Fig. 30
Start of Second Row of Body.
Weaving from Right to Left.
The Completed Tie.

(v) Change the needle back to the right hand and work back from left to right as in the first row of the body.

(w) Continue weaving back and forth until the desired length is reached. This length is determined in exactly the same manner as the length of the chain, by counting mesh if for a patch, or by measurement if for a complete new net.

(x) General. Note that the ties must be made as described so that the twine will lead directly from one knot to the next without crossing the twine coming into the knot. If trouble is experienced with the twine crossing itself when the ties are made as described, it indicates that the knots are not being pulled tightly INTO THE PROPER SHAPE. Probably the little finger is not holding the loop tightly enough as the knot is pulled tight.

(y) Attaching Bolt Ropes. To finish a complete new net ropes must be attached around its edges. Pull one edge taut, allowing the rest of the net to lie loosely on the ground and measure the pulled edge to get the length of stretched netting. Allow 12" of rope for each 17½" of stretched netting. Repeat the process for each of the other three edges since a hand-made net will seldom be of uniform size.

(z) It is best to use four lengths of rope knotted at the corners. To provide a ready means of adjustment as the net stretches with use, allow 10% more rope outside the knots.

(zz) The ropes may be threaded through the edge meshes in the same manner as the rod used for holding the net while weaving. They may also be clove-hitched to the net at each edge mesh by counting the meshes in the net and marking the rope with a sufficient number of equal spaces to accomodate all the meshes. Use three hitches of seine twine at each mesh for a secure tie.

36. MENDING NETS.-(a) Trimming the Tear. The first step in mending a torn or cut net is to trim away the edges of the tear so that the work can progress continuously from start to finish without the necessity of frequently cutting and resuming the weaving.

(b) The first requirement is that the end of the twine must start at a knot joining THREE strands or from a tag end leading from such a knot. The weaving must also end at a similar point. This is necessary because only one end of the mending twine is attached at the knots and there must be three unbroken strands of the original net to give the required four strands radiating from each knot.

(c) The second requirement is that the knots around the edges of the tear must have TWO and only two unbroken strands of the original net.

(d) In trimming the tear, unnecessary tag ends are first cut off, then enough more strands are cut out to satisfy the above

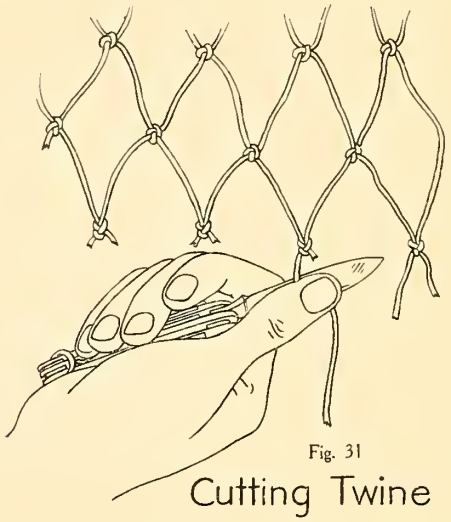


Fig. 31
Cutting Twine

requirements. Figure 31 shows the most convenient method of cutting twine, especially when only one end of the twine is fastened.

(e) Figures 32, 33 and 34 show different typical tears before trimming, the same tears after trimming, and the sequence in which the tears are woven.

(f) Weaving the Tear. If the mending starts at a knot where three strands join, the end of the twine should be tied on as shown in figures 35, 36 and 37.

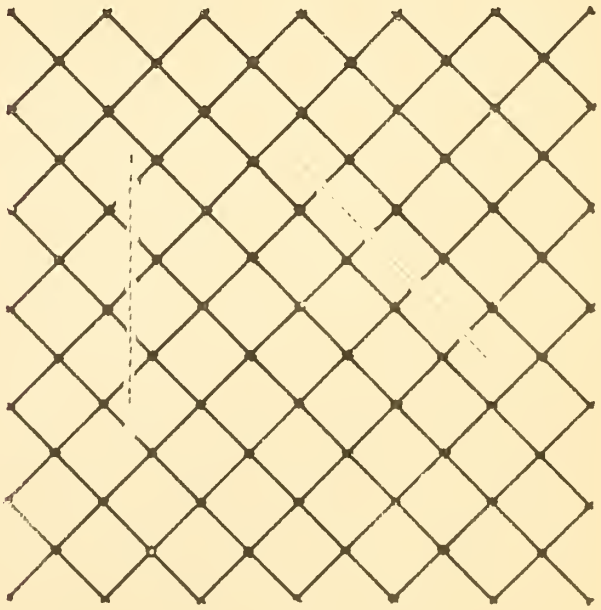


Fig. 32

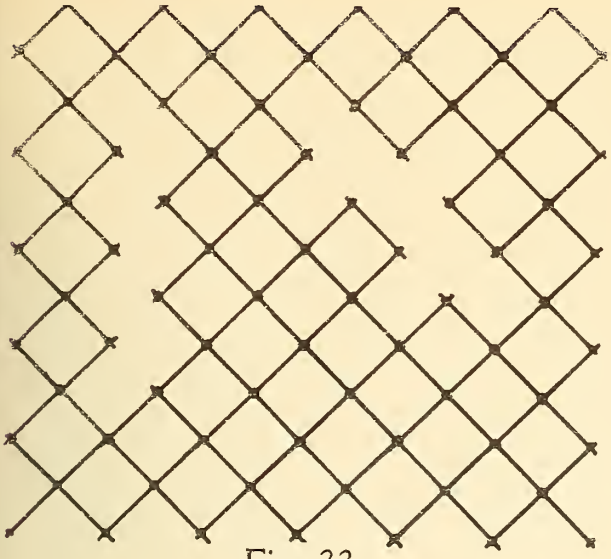


Fig. 33
Tears After Trimming

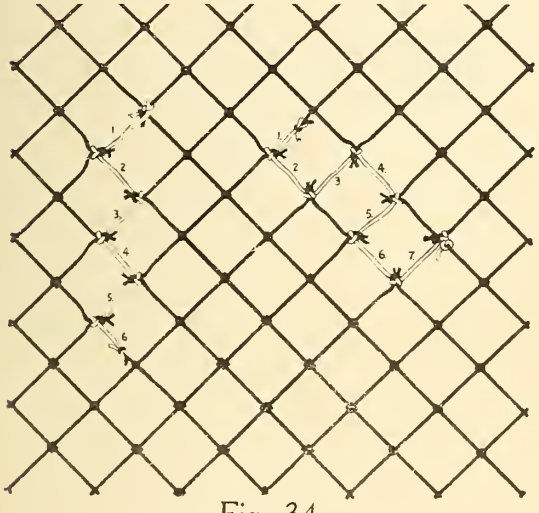


Fig. 34
Sequence of Mending Tears

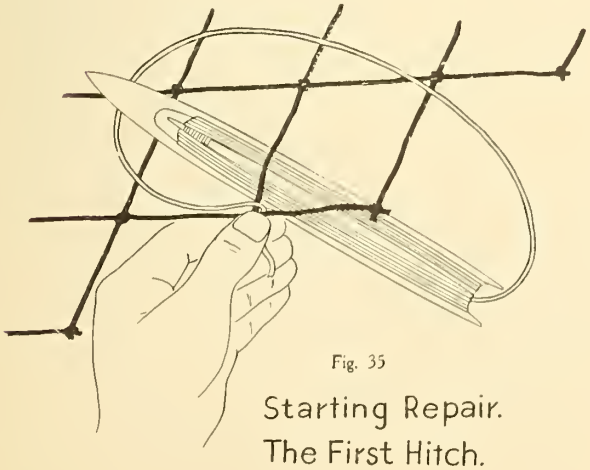


Fig. 35
Starting Repair.
The First Hitch.

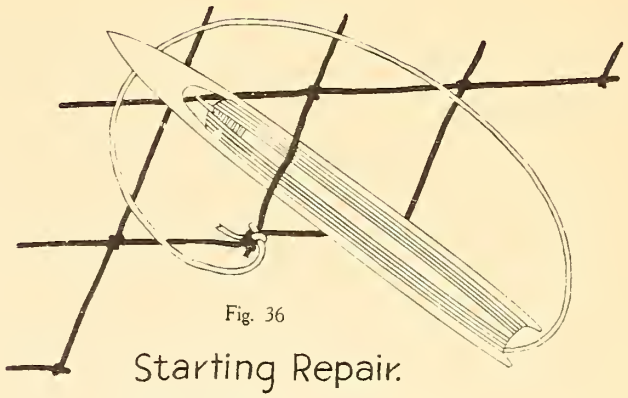


Fig. 36
Starting Repair.
The Second Hitch.

Fig. 37
Starting Repair.
The Completed Hitch.

(g) Note that the end of the twine is placed between two of the strands, the first hitch is made around these two strands and the second hitch is made around the middle strand only. The second hitch is made this way to bind the end of the twine more securely without excessively distorting the shape of the mesh.

(h) If the mending starts at a tag end, the end of the twine is tied to the tag end with a square knot.

(i) Similar ties are used in finishing the repair. The sequence of weaving depends upon the shape and position of the tear with respect to the weave of the net and must be determined for each job. Figure 34 shows the sequences for the tears illustrated. The most convenient method for finding the proper sequence and weaving the tear is to spread the net out flat so that the meshes are square and thread the twine through the meshes (without tying it at the knots) until the proper sequence is found by trial. The twine may then be cut and left in the net to guide the weaving. The guiding twine is removed after the repair is finished. With practice, one will become sufficiently expert to dispense with the use of the guiding twine.

(j) In adjusting a loop care must be taken to note whether the loop forms one or two sides of a mesh and to adjust the size accordingly.

(k) Use either the right-hand or the left-hand method of tying the knots, depending upon whether the twine goes from left to right or right to left when the repair meshes are nearest the weaver.

(l) General. Note that on some complicated tears it will not be possible to trim the

tear so that it may be woven in a continuous sequence without cutting out an excessive amount of net. In such cases, it is better to trim less extensively and weave several sequences, beginning and ending at "three-strand-knots" as described above.

(m) Patching. When a net contains a large hole it is quickest and easiest to insert a patch cut from a scrap net or to weave a patch separately and then insert it in the hole.

(n) The first step is to lay the net out and pull the meshes square. Then cut the hole out to a roughly rectangular shape surrounded by knots joining two strands.

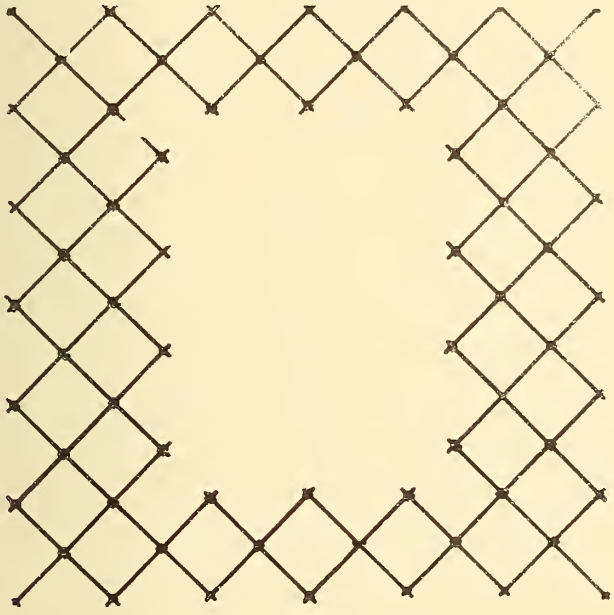


Fig. 38
Hole Trimmed Out for Patch

See figure 38. Notice that a "three-strand-knot" is not used for starting or finishing the insertion of the patch. This is because the weaving starts and finishes at the same knot when inserting a patch rather than at different knots as in mending a tear.

(o) A rectangular patch is now cut or woven with one less "two-strand-knot" on each side than on the corresponding side of the hole. See figure 39.

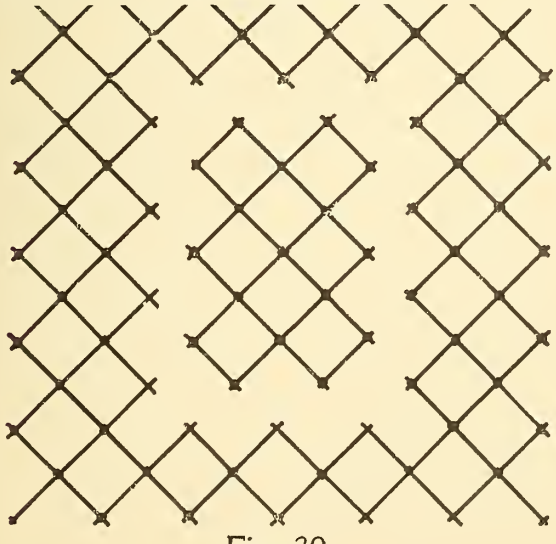


Fig. 39
Patch Placed in Hole

(p) The patch is inserted in the net by weaving continuously around as shown in figure 40.

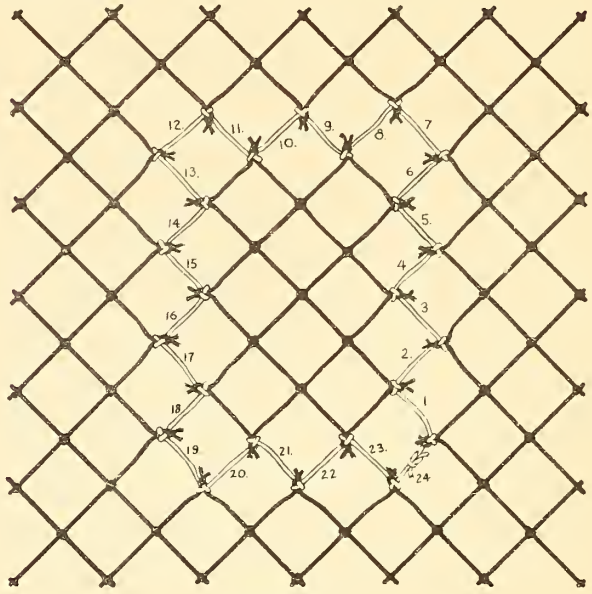


Fig. 40
Completed Repair.

SECTION IX

CAMOUFLAGING MOTOR VEHICLES

37. THE PROBLEM.-Concealing military vehicles presents an unusual problem. It is unique in two ways: First, trucks change their locations frequently from one kind of surrounding to another. Second, vehicles present large and difficult type silhouettes. The first, as a general rule, makes it impracticable to attempt to adapt the coloring of the vehicle to particular surroundings. The second, which is the more important, presents the following difficulty: For every foot that an object is above the ground, shadows of a length of three to six feet, depending on the time of day, result. (If the sun is shining) Therefore, to avoid shadows completely, the camouflage material must slope upwards from the ground, and conversely, slope back to the ground in such a manner that the initial or final angle between the ground and the covering of the vehicle shall not exceed ten degrees.

38. MARINE CORPS TRUCK.-The usual Marine Corps truck of 1½ tons, equipped with a cargo body and top, has a height of approximately 9'3". Shadows ranging from 30' to 60' on at least two sides will therefore result. To overcome this difficulty, experiments were conducted with vehicle nets.

39. MARINE CORPS NET.-(a) The standard Marine Corps camouflage net is 36' by 44'. The net may be best used in two ways:

(1) As a "flat top", in which the net is stretched flat over a supporting structure of wire and wood.

(2) As a drape.

(b) Due consideration was given to the two methods. These are our findings. The "flat top" as camouflage material for individual trucks is impractical because of its weight and bulk. However, using poles of a length from 12' to 15', it may be used successfully to camouflage several

trucks together. For camouflaging trucks individually, the fish net used as a drape has been found to be the best method.

40. TECHNIQUE OF CAMOUFLAGING TRUCKS.-(a) It has been proven in actual practice that it is almost impossible to conceal an object from an expert aerial photograph interpreter. By the use of technical films, plus highly magnifying stereoscopic pairs, he is generally able to distinguish between the natural and the artificial. Consequently, the color of the camouflage material used is relatively unimportant insofar as aerial photography is concerned, provided however, that it is lusterless.

(b) The difficulty of concealing trucks is compensated for by the fact that even after the aerial photographer has taken his picture of a truck, and the photographic interpreter has discovered its existence and location, the bombardier must still see his target in order to destroy it. Consequently, every effort expended toward making a vehicle as inconspicuous as possible by blending it with the surrounding terrain will prove invaluable because the possibility of the bombardier hitting his target is greatly minimized.

(c) Using this fact as our major premise, the following instructions should be observed:

(1) The driver should choose his position carefully, avoiding all skylines.

(2) To get to his position, he must not drive across an open field in order to reach nearby woods.

(3) If necessary to cross open land, he should go around the edge of the field.

(4) Truck tracks are very conspicuous; they are as arrows leading to the target. If tracks exist, stay in them. They should never be broadened unless, of course, there is no alternative.

(5) Upon reaching his position, the driver should make full use of natural cover. A spreading tree is worth truckloads of artificial material.

(6) All conspicuous landmarks must be avoided, and ditches, ravines, creek beds, hedges, etc., fully utilized.

(7) If a tree is available, the driver should carefully consider the direction of the shade.

(8) Always get under a tree on the shady side and move around with the shade. Granting this may mean considerable trouble, yet it is less difficult than dodging bullets.

(9) If only a bush is available, the vehicle should be parked on the sunny side of the bush, so that the shadow cast by the net and the vehicle will be absorbed by the irregular shadow of that bush.

(10) Vehicles may be concealed in woods without leaves, because of the confused pattern of light and shade. But, they will be much more readily observed under these conditions on an overcast day than on a sunny day. This, for the reason that there will be no shadows to break up shapes and forms.

(d) When the location has been decided upon, the vehicle should be camouflaged in the following manner:

(1) Park the truck as close to a tree trunk as possible.

(2) Obtain twigs and branches and place them against all wheels in order to eliminate their familiar silhouette.

(3) Roll down all windows.

(4) Cover all exposed and non-removable glass (headlights and windshield) with dark material. If none is available, drain-oil smeared on the glass, with dirt or sand thrown on top of it, will suffice to eliminate reflecting surfaces.

(5) The rear-view mirrors on both sides of the truck must be turned down. Why spend time camouflaging a vehicle if this is neglected? A rear-view mirror is visible for a distance of ten miles on a sunny day. The tail-light too must not be forgotten.

(6) Additionally, brush thrown against the truck will aid in casting shadows and destroying silhouettes.

(7) If sufficient natural materials are not available to effectively camouflage the vehicle, then the fish net should be used.

(8) If the area chosen is to be occupied for any length of time as a truck park, every effort must be made to deceive the enemy. His attention should be distracted, and he should be led to believe that the area occupied is harmless. This may be effected by drawing his attention to another area.

(9) To increase the security of the position chosen, care should be taken to make sure that it is near no readily discernible landmark.

(10) Tracks or roads leading to a truck park must never come to an abrupt terminus in the vicinity of that area. Road tracks and trails should be artificially continued past the position and toward other and more distant points.

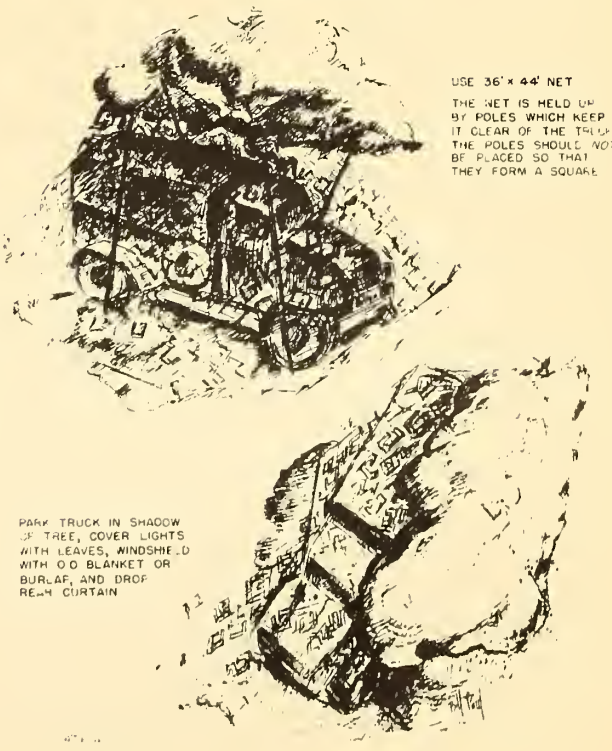
(11) Dummy tracks may be made with the use of wheelbarrows, wagons, brush harrows, etc.

(12) Sham roads and paths across a field may be made by means of light colored sand, dirt, or chalk. Similar effects may be "manufactured" by mowing high grass and permitting it to dry in swaths.

(13) If it is found impossible to make a dummy road or tracks, the effect of a road may be created by using a "flat top" painted to simulate a roadway.

(14) If a wooded crossroad is to be used as a park, all signs of activity may also be concealed in this manner.

CAMOUFLAGE OF TRUCKS



41. USE OF THE FISH NET.-(a) The garlands used with the fish net should be woven in irregular patterns; thickly in the center and gradually thinning toward the edges. The garnish is laid flat and kept running across the squares of the net (never diagonally). This gives best covering power in relation to the amount of material used, and the net keeps its shape when folding up, and in transporting. The net cannot distort across the squares, but it can and does distort badly across the diagonals, thereby pulling diagonally laid garnish into a string.

(b) The method of running garnish out at right angles to and not parallel with the edges is correct in practice as well as theory, giving more diffused edges and merging best with the surroundings.

(c) Vehicle nets, as contrasted to "flat tops", should have a greater area of the net garnished, keeping some parts of the edges comparatively full.

(d) As mentioned in the beginning of this chapter, it is impossible to foresee exactly in what type surroundings the vehicles and nets will be used. Consequently the color of the garnish is something of a problem. It has been found, however, that a net garnished in the center with garlands of light and dark green, and around the edges with brown and light earth, is very effective. Any emergency correction may be made by rubbing in dust, dead leaves, etc. The garlands should be colored prior to their application to the net. This procedure saves both time and materials.

(e) When using the standard 36' x 44' fish net, it is important to bear in mind that, to be effective, the net must never touch any part of the vehicle. It should be at least 6" distant from all points. The net may be raised, lowered, or extended by the use of rods or poles which are usually a part of the standard equipment of each vehicle. Care should be taken to create shapes as irregular as possible.

(f) If cloth garlands are not available, natural materials at hand should be used, such as grass, leaves, twigs, etc. If green vegetation is used, caution must be exercised in two respects: First, the foliage should be placed top-side up. This, because the under side of foliage is not so dense and therefore reflects light differently than the tops. Secondly, the foliage must be changed from time to time, as it dries up.

(g) If fish net is not available, ordinary light weight chicken wire (1" or 2" mesh) may be effectively used with natural or artificial materials.

42. EMERGENCY PAINTING IN FIELD.-Should it become necessary to paint a vehicle in the field under adverse conditions, the following suggestions will be of value:

(1) Use as small a quantity of blue and yellow paints as possible; they register light on a photograph. Red, brown, green, carbon or lampblack should be used.

(2) In mixing paint, dark colors should be poured into and mixed with the light. Never the reverse.

(3) If paints are not available, use may be made of pigments from surrounding earth. Such paints naturally have no lasting qualities, but they can be readily mixed and applied.

(4) An emergency binder or "vehicle" can be made from either glue, flour, syrup or wild honey.

(5) Water colors when used, fade four or five shades when drying. Oil paints, just the reverse.

(6) Gasoline may be effectively used for thinning. Too, it insures quick drying. Gasoline flattens color and reduces light reflection. If texture is to be added, sand, sawdust or asbestos may be used.

(7) After applying paint, the sand, gravel, etc., should be thrown on it while the paint is still wet. A second coat of paint may be added where and if needed.

SECTION X

PAINTS

43. PAINT.-(a) Paint consists of a pigment and binder. The pigment is derived from earth or chemicals. The binder holds it together.

(b) There are two kinds of binder material: Oil and glue.

44. USE OF PAINT.-(a) Paint is used to cover any surface. This may be done by spraying or brushing. Texture is added by throwing wood-shavings, sand or gravel onto the freshly painted surface.

(b) Texture should always be applied to smooth surfaces in order to eliminate reflection.

45. MIXING.-(a) Theoretically, all colors can be obtained from the three primary colors--red, yellow and blue.

(b) From these primary colors, secondary colors are derived--green, purple and orange.

(c) Mixing any two primary paints in equal proportion results in creating a secondary color.

(d) From secondary colors, tertiary (third group) colors are derived.

(e) When a particular color is determined upon but found to be too bright to blend with the natural surroundings, it may be dulled by adding its complement.

(f) Black is not an especially good complement, but it can be used when others are not available.

(g) To dull any color use its complement. To lighten paints, use white. Adding binder will effectively lighten transparent paints.

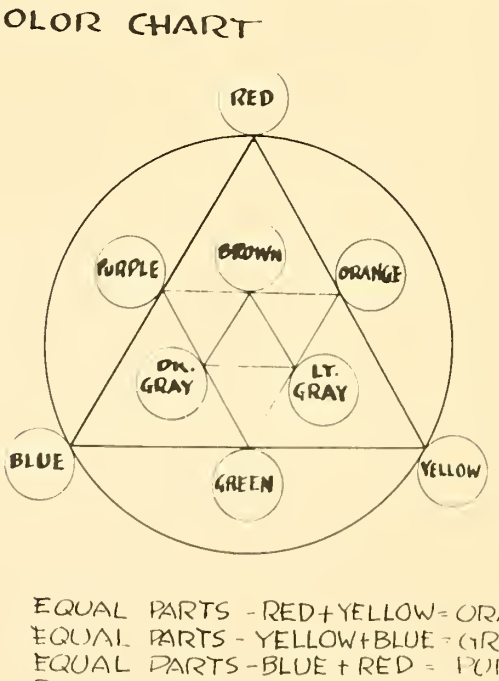


Fig. 41

46. COLOR CHART.-(Fig.41) By mixing the primary colors shown at the points or extremities of the large triangle, the secondary colors, indicated in the center of the sides of the triangle, are obtained. By mixing these secondary colors, indicated at the points of the smaller inverted triangle, the tertiary colors are obtained.

SECTION XI

DYES

47. ANILINE DYES.-(a) Aniline dyes and pigments provide a highly versatile color stock without bulk. Because of the intensity of aniline dyes, a much smaller quantity of this material would efficiently supplant a large quantity of the colors now provided for coloring or tinting purposes.

(b) Aniline dyes, to a certain degree, are soluble in all waters. In hard or salt water a small amount of acetic acid, vinegar or urine, added to the solution will aid in mixing and prevent precipitation of the dye. However, if an acetic acid is not at hand, a mix of some kind can be made without them.

(c) Dyes come in the same basic colors as paints and are mixed in like proportions to get desired shades as pigments.

(d) Dyes are transparent, so a straight dye solution cannot be used as a paint. However, for dipping or spraying fiber of any kind the colors are sharper and truer.

(e) To color or tone, paint with dyes. First, mix a solution approximately the shade desired. Then mix it into a binder such as flour and water paste or casein paste.

(f) Weather-proof casein paint can be made in the following manner in the field: Use sifted wood ashes mixed with canned milk in the amount necessary to make an even, gummy paste. Add a strong dye solution of the desired color. The result will be a satisfactory casein paint paste.

(g) Berry juice, charcoal, lamp black or any coloring available added to this paste will result in a colored casein paint. Add water until the paste reaches the desired consistency for brushing or spraying.

(h) Dyes, mixed with a base, can be used to supplant colored paints for semi-permanent work. If a colored (water) paint is used, but a still greater color strength is desired, add a dye solution. This will darken or more deeply color the paint.

(i) As a spray or dip for any fabric or fiber, dyes will be found quite satisfactory. By using only a dye solution, grass and some types of foliage can be tinted (colored).

(j) If an uncolored or lightly colored base paint is mixed with a solution of dye of the shade desired, a satisfactory paint will result. Such paints adhere to wood, metal, painted surfaces and glass.

48. DYES vs. PAINT IN CAMOUFLAGE.-The use of dyes or pigments in the art of camouflage will be appreciably facilitated by considering the following factors:

(1) Ease of application and accomplishment of purpose.
(2) Permanency of colors.
(3) Covering value.
(4) Bulk (transportation problem).
(5) Comparative cost.

49. COMPARISONS.-(a) By selecting the three primary colors (red, yellow and blue) and perhaps one or two additional colors such as brown and green (which may be required in instances where the disguise of foliage and shrubbery is necessary), it is possible to duplicate any desired shade by using either paints or dyes.

(b) When using paints to make pastel or light shades, white paint is all that is necessary to reduce the standard colors selected. For example: If the standard green is dark green and a pastel shade of green is necessary, just mix white pigment with the dark green.

(c) By the use of dyes, the depths of shades can be easily changed through diluting the dye solution. Or, if deep shades are desired, through adding more dry dye.

(d) The successful application of paint to any surface is dependent upon the adhesive quality of the paint and the physical condition of the surface to which it is to be applied.

(e) A paint will not adhere to a (water) wet surface, nor to a greasy, dirty or waxy surface. (These conditions will frequently be encountered in the field--natural protective coatings on certain types of growing plants, bark-stripped trees, etc.)

(f) A wet surface will be no barrier in the application of dye, but oily or waxy surfaces may.

(g) In some instances it may be necessary to add an adhesive to the dye solution (such as gum arabic, dextrose flour, etc.) in order to impart color to the surface.

(h) Dyes have no affinity for metallic surfaces. Therefore it will always be necessary to add an adhesive.

(i) Paints, in most instances, have good tenacity for metallic surfaces.

50. PERMANENCY.-Paints are more permanent than dyes insofar as fading or water (rain) is concerned.

51. COVERING VALUES.-(a) The covering value of a paint varies with its consistency. One gallon of paint might cover 250 sq.ft., depending upon its viscosity. A gallon of dye will probably cover 500 sq.ft.

(b) A pound of dry dye, depending on type, will produce 12½ to 25 gallons of working solution.

(c) Considering the weight of dry dye and its covering possibilities as against paint, it would be necessary to transport, roughly, 250 to 500 lbs. of paint for 1 lb. of dry dye.

52. TYPES.-The types of dyes selected for experimental purposes are those that are the easiest to use--considering solubility in cold water and coloring strength. Also, they have an affinity for a greater variety of substances than any other types of dyes. These dyes are also soluble in alcohol.

53. TOXICITY.-These dyes are not guaranteed non-toxic to humans. The toxicity will vary with the individual. Some persons will suffer no ill effects whatsoever, whereas others might experience skin irritations.

54. CONCLUSION.-Experimentation will determine if these dyes are satisfactory for any given purpose. It is suggested that these dyes be applied to all types of substances--stones, soil, sticks, burlap, cloth of various kinds, etc.--in order to determine their practicability to conditions characterizing a specific field.

SECTION XII

BREAKAWAY HOUSES

55. PURPOSE.-Breakaway houses are used for concealing weapons, supplies or positions. When it becomes necessary to erect such a "house" on an actual battlefield, materials from the immediate vicinity must be used.

Vines or grass thongs may be used in place of nails. Measurements may be arrived at by eye-estimate.

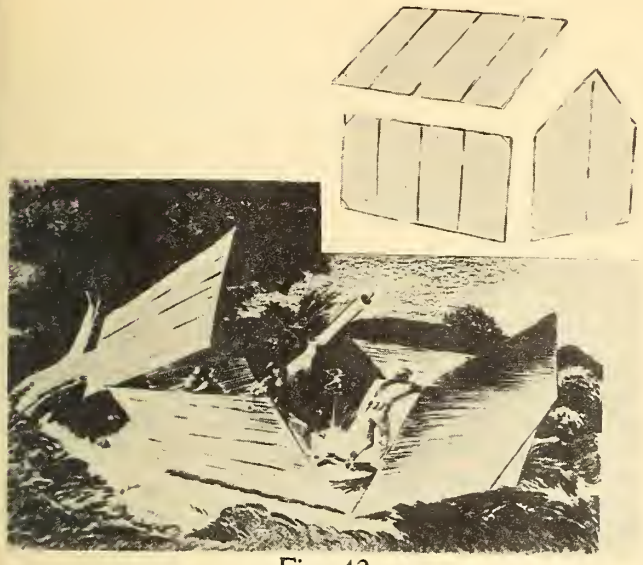


Fig. 42

56. CONSTRUCTION.-(a) Breakaway houses can be made wherever boards or poles are found. Poles 2" x 2" or 1" x 2", or any other available lumber of a size approximating these measurements, should be used for the framework. When the framework is completed it can be covered with either target-cloth, burlap or branches.

(b) The "house" most often used is rectangular in shape and usually about 12' to 14' high and 14' wide. A general rule is to build the house somewhat larger than the weapon it is intended to conceal. It is constructed in two sections. These sections, when completed and covered, are joined together by simply leaning one against the other. When the time comes for the gunners to go into action, the "house" is collapsed by merely pushing one section away from the other. (Figs.43,44)

Fig. 43

57. SIX-SIDED HOUSE.-(a) This type of "house" should be constructed (preferably) from 1" x 2" or 2" x 2" lumber and should include two side sections, two roof sections, and one section each for the front and rear. The top runners will be 14' long and are constructed exactly like the sides, the same number of poles being used. The only difference being that the center poles

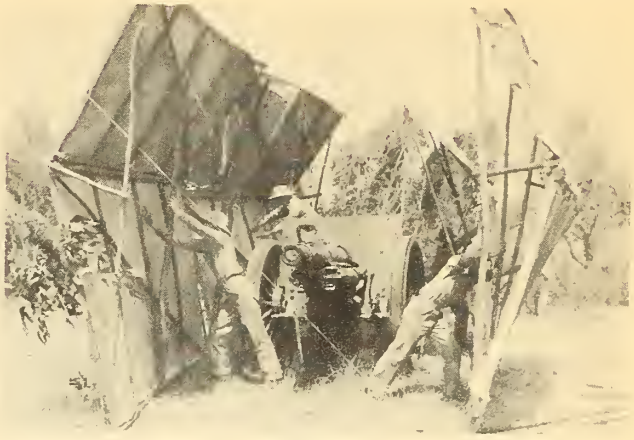


Fig. 44

should be 8½' in length instead of 7'. This additional 1½' length provides the eaves.

(b) The side sections will be 7' high x 14' long. The 7' poles should be nailed between the 14' runners so as to form a rectangle 14' x 7'. Five 7' poles should be secured--interspersed--between the 14' runners, three in the middle and one at each end. The two top or roof sections should be made with four 7' poles, one 12' pole, and two 10' poles. The 12' pole will form the apex of the roof. The two 10' poles should be secured perpendicularly--one as the base and the other seven feet above but parallel to the first. To complete this roof, two additional 7' poles will be needed. These should be joined in such a way as to form a triangle.

(c) All sections, when set up, should be tied together with cord, rope or wire. Or, if such are not available, hemp, vines or other natural materials. Rope is preferable because it cuts easily, facilitating complete collapse of the "house" immediately preceding the command, "Targets", at which time the ropes are cut and roof and sides fall away.

(d) When the complete framework of the "house" is set up, it should be covered with target cloth or burlap and painted to blend with the surrounding terrain or to simulate a dwelling. (Fig.43)

58. MEASUREMENTS.-(a) The measurements suggested in this section are to serve as a guide only. Houses should be constructed to a size or type that will meet the requirements of the individual problem.

(b) Two variations are shown in figures 45 and 46.

Fig. 45

Fig. 51

(e) Another method for constructing plaster rocks is shown in figures 50 and 51. Build a rough frame to the required size. Throw brush or soil over and around this frame to give the "rock" irregular shape. Strips of target cloth or burlap should then be dipped in the plaster or mud and placed on and around the frame. Dirt and gravel should be thrown on the plaster-covered cloth before it dries. The "rock" can then be painted.

DON'T PUT STUMPS
IN A GRASSY TERRAIN

60. ENTRANCE.-(a) The entrance and firing apertures can be cut out with hatchet or bayonet.

(b) The entrance is not always a cut-out. Passage to the "rock" may be by way of a tunnel connecting the "rock" with a spider trap some distance away.

61. EXAMPLES.-"Rocks" made of target cloth dipped in mud and molded over a frame are shown in figures 52 and 53.

62. STUMPS AND TREES.-(a) "Stumps" may be made by securing poles in an upright position and in the form of a circle. An assortment of short and long poles should be used to create the effect of a stump top. (Figs. 54,55) The wide spacings should be filled in with brush, excelsior fibre or grass dipped in plaster or mud.

(b) After covering the framework, plaster or mud should be thoroughly rubbed in and

Fig. 52

Fig. 53

over the outside. Before drying sets in, make creases up and down the stump with a finger or stick. Then wet bunches of grass, fibre or cloth should be dipped in dirt and rubbed over the plaster stump for the purpose of inserting ridges and giving the stump a tree-bark effect. (Fig.56)

63. USES.-"Tree stumps" are used for observation and snipers' posts. (Fig.57) One or more small look-out holes should be cut through and concealed by a screening painted or colored to match the "stump". A "tree stump" made with a core of chicken wire and burlap is illustrated in figure 58.

64. MUD SUBSTITUTE.-Plaster in most cases will not be available, but mud can be substituted in almost every case. The foregoing illustrates ways to build rocks, banks, stumps, logs and other deceptive measures in an easy and practical way in the field. A rough frame of brush, twigs and leaves made to simulate the contours of a rock and covered with mud can be made to appear a first-rate rock, the amount of effort and care expended governing the final effect.

Fig. 54

Fig. 55

Fig. 56

Fig. 57

Fig. 58

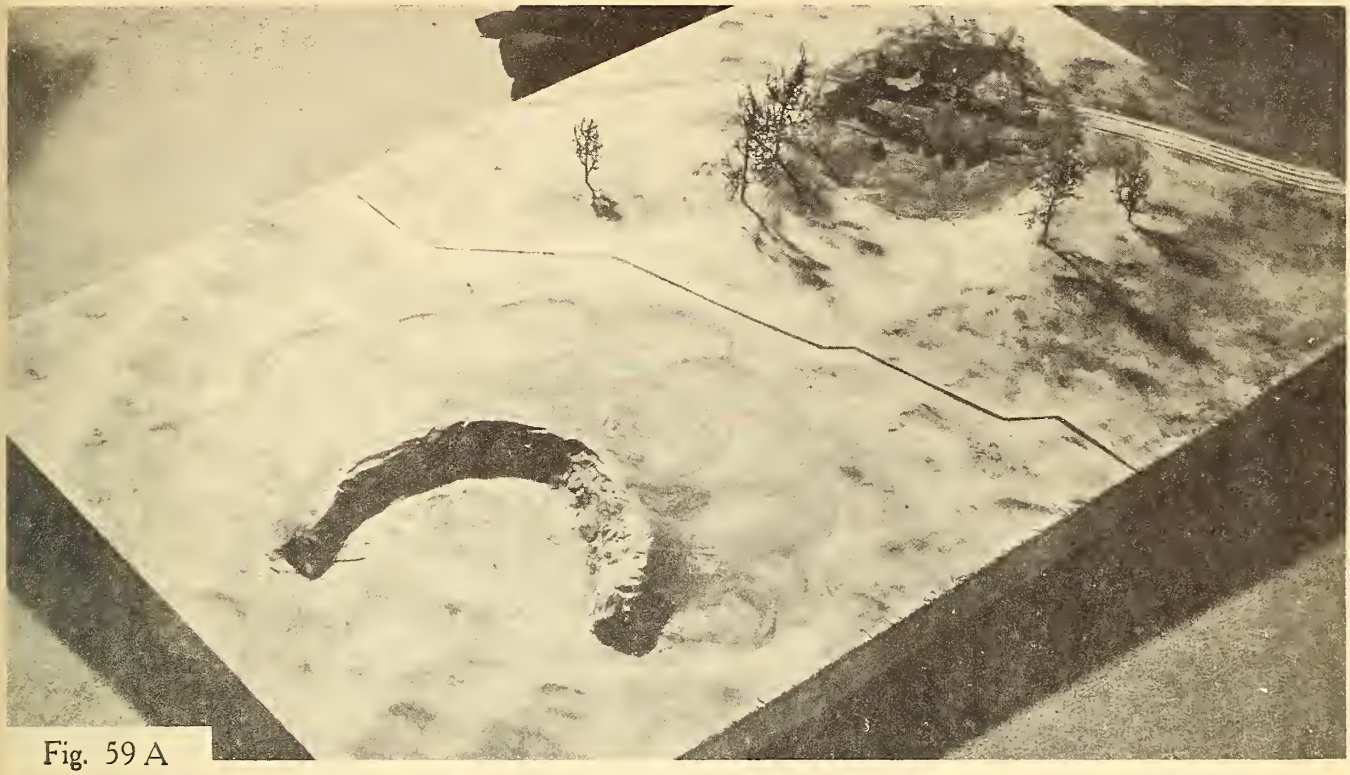


Fig. 59 A

Fig. 59 B

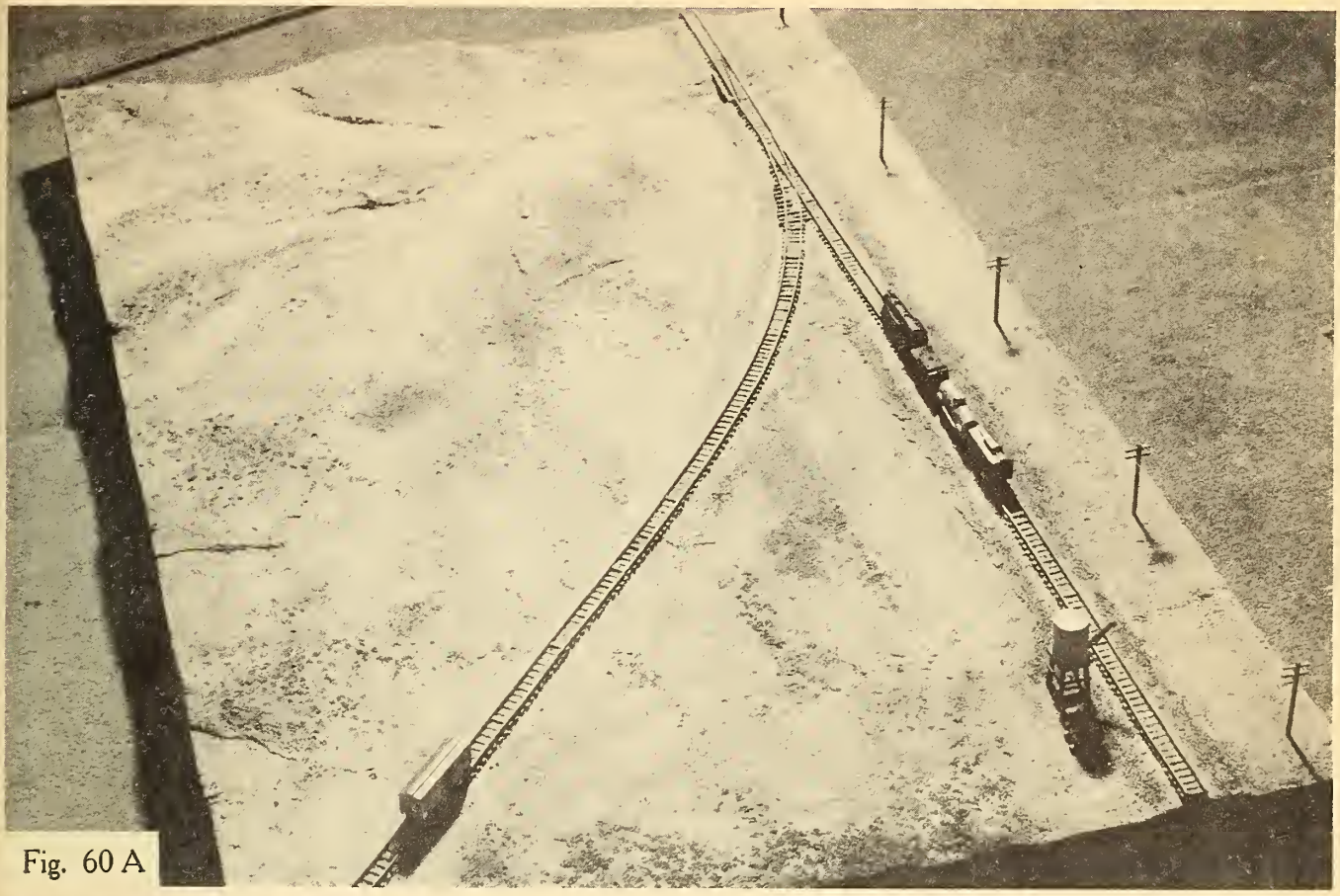


Fig. 60 A

Fig. 60 B

SECTION XIV

MODELS

65. DEFINITION.-A model is a three dimensional reproduction in miniature, built to a determined scale, of any existing or contemplated man-made object. A model can either be constructed from working drawings or by rule of thumb.

66. PURPOSE.-(a) A model is employed for the purpose of permitting an examination and inspection of a proposed project before any actual construction begins. It is quicker, easier and certainly more economical to rectify possible mistakes, or effect changes and corrections, on a model than on a full-sized work.

(b) A relief map of a specific area can be used to advantage for the purpose of modelling upon its surface any proposed military installation or camouflage scheme. (See Second Marine Division manual, "Relief Map Making".)

(c) A model of a military installation or camouflage scheme can be employed to illustrate lectures or to give demonstrations on tactical problems or camouflage discipline.

67. SCOPE.-(a) If time and circumstance permit, the camoufleur can profit enormously by employing models to study and examine any of his contemplated projects, particularly if they are of an experimental nature.

(b) The following are some of the situations wherein the time spent on constructing a model will be well worth the effort and prove to be of inestimable value:

(1)The further development of standard camouflage practices. It must not be taken for granted that, just because a system has been adopted for concealing the position or the outline of an anti-aircraft gun, the accepted pattern cannot be improved.

(2)The camouflaging of an installation or an area situated in terrain features of a strange and unfamiliar pattern.

(3) The camouflaging of a new weapon, vehicle, or other form of military invention presenting an unusual type or pattern.

68. EXAMPLES.-Figures 59 to 62 inclusive are photographs of models illustrating camouflage schemes prepared by the Walt Disney Studio unit for the 604th Engineer Battalion (Camouflage)(Army).

Fig. 61

Fig. 62

SECTION XV

"CAMOUFLAGE DO'S AND DON'TS"

69. CAMOUFLAGE DO'S.-(a) DO choose your position carefully. A proper "estimate of the situation" will make your work easier and avoid impossible camouflage problems.

(b) DO use common sense. "To outwit the enemy, common sense seems to be very unoommon."

(c) DO avoid the skyline when concealing against terrestrial observation.

(d) DO make full use of natural cover. The cover of a spreading tree is worth truck loads of artificial material.

(e) DO utilize ditches, hedges, edges of woods, folds in the ground, etc. These "accidents" of the ground will prevent accidents to you.

(f) DO avoid conspicuous landmarks. You don't want to be at a focal point of enemy attention.

(g) DO keep in the shadow. The enemy can't see or take pictures of something in the shade.

(h) DO remember that shadows move. Although shadows as a rule fall toward the north of an object, the length and direction of such shadows change throughout the day.

(i) DO avoid all regularities of line or spacing. Nature has no straight lines and the enemy is looking for unnatural signs.

(j) DO remember that anything unusual catches the eye of the enemy observer. Try to blend into the background; you want to be inconspicuous.

(k) DO garnish carefully. Natural garnishing must look NATURAL--so use material similar to that in the vicinity and support it as it would grow.

(l) DO thin out garnishing at the edges. A regularly garnished net casts a regular shadow which is obviously out of place in the surroundings. It will look like a stamp and we don't want to pay postage on our own death bombs.

(m) DO change dead vegetation. Forget it and something (or somebody) else will be dead.

(n) DO keep turf or topsoil when digging in. It can be used to cover your spoil on the parapet.

(o) DO make bold patterns in garnishing or painting. You can't see a two foot "break" in the outline from a distance of a mile or two.

(p) DO "look before you leap". Plan and lay out your position in detail before moving in and trampling down promiscuously. Signs of activity lead to enemy activity which reduces the possibility of further activity period.

(q) DO observe camouflage discipline in making a reconnaissance. Signs of activity before occupation are just as disastrous as signs afterward.

(r) DO restrict movement when the enemy is observing. A motionless object may escape detection; a moving one will attract attention.

(s) DO take extra care when tired. Fatigue leads to carelessness.

(t) DO work in the shade or at night. The enemy is looking for you at all times but his eyes are not as good as a cat's. He can't hit what he can't see.

(u) DO keep your flat tops "flat". Sagging nets are worse than baggy knees.

(v) DO use existing roads and paths. Traffic there will not leave noticeable signs.

(w) DO conceal the entire layout. If one tent or truck is seen, then all of the remaining installation is betrayed.

HIDE YOUR SPOIL !!

70. CAMOUFLAGE DON'TS.-(a) DON'T be careless and give away your buddies. They're depending on you just as you are depending on them.

(b) DON'T look up at airplanes. The enemy is looking for you too and you're easier to hit than he is.

(c) DON'T move unless you have to; then think first how you can move to cover most unobstrusively.

(d) DON'T use artificial materials unless the natural cover is insufficient. Natural cover blends best with Nature.

(e) DON'T be regular in your layout. Regularity is a military attribute and the enemy recognizes it as such.

(f) DON'T take shortcuts over the open or step outside cover. Every time you put your foot down you attract enemy attention.

(g) DON'T walk around the outside of a net to fix the camouflage. Where you walk will be light in a photograph; the camouflage will be dark. Do you think the enemy will miss such a bullseye?

(h) DON'T hide your installation and leave your spoil and belongings in the open. Remember the ostrich.

(i) DON'T let your flat tops sag. They will photograph like wet blankets laid out on brushes and they are not a bit safer.

(j) DON'T lower the sides of your camouflage. Your commanding officer cannot see what you are doing, but when the enemy sees the shadow thrown by these sides he will be even more severe.

(k) DON'T hide under matted camouflage. It is as conspicuous as a bad haircut.

(l) DON'T end a road at an installation or make a lot of trails to a position. Did you ever lose your way to a canteen?

(m) DON'T leave things near the edge of your camouflage. The edge of your camouflage isn't and shouldn't be--opaque.

(n) DON'T put up bad camouflage and think it's a magic veil. There aren't any in war.

(o) DON'T crowd around an installation. Dispersion reduces the likelihood of conspicuous trampling.

(p) DON'T clean up an old position. It won't look natural to the enemy. If you're moving out, it will remain as a dummy. If you're moving in, you don't want to change the appearance.

(q) DON'T expose lights or make a great deal of smoke. The enemy is looking for such beacons.

* * * * * * * *

SUPPLEMENT

POLYNESIAN NATIVE CRAFTS

FIELD TRAINING MANUAL
SECOND MARINE DIVISION
1942

Pango Pango Harbor, American Samoa.

POLYNESIAN NATIVE CRAFTS

SECTION I

GENERAL

1. PURPOSE AND SCOPE.-The inhabitants of the South Pacific islands are particularly skillful in crafts applicable to camouflage, such as weaving mats and nets, thatching, dyeing, and the making of fibre ropes and cords. Whenever practical, our forces operating in the Southwestern Pacific area will undoubtedly employ native labor for these, and other, activities. For the most part, however, the practice will of necessity be restricted to areas removed from actual combat. Familiarity, therefore, with certain methods and materials employed in this work may prove to be of the utmost value in a battle zone, for camouflage or other purposes, at a time when local help is unobtainable. A rough general knowledge and some practice, in a few native crafts, is all that is necessary and can be acquired with little effort, as the methods employed are simple and easy to learn. The data collected in the following sections is to be used as a guide and for general reference purposes, to be studied and applied as occasion demands in suitable localities in the field.

2. REFERENCE.-The bulk of the data contained herein has been compiled from publications of the Bernice P. Bishop Museum, Honolulu. It is suggested that, should the opportunity occur, advantage be taken of the services of the museum for further reference. Some of the illustrations have been taken from the following publications: "Our Familiar Island Trees", by Mary Dillingham Frear; "The Indigenous Trees of the Hawaiian Islands", by Joseph F. Rock; "The Tree Lover's Hawaii", by Ralph D. Cornell.

3. RECOGNITION OF MATERIALS.-Recognition of plant life used in native industry is essential, and its importance to the successful and speedy conclusion of any work undertaken cannot be over emphasized. The vegetation generally employed is usually of a common variety and grows abundantly on a large majority of the islands, but it must be remembered that a single plant, or tree, may be known by one of half a dozen native names, depending on the locality in which you find it; consequently, the importance of self-recognition is obvious. This is a study that can best be made on the ground, and every advantage should be taken of an opportunity to do so. Local knowledge is important and should be sought whenever possible as many natives are experienced in crafts made from plant life peculiar to their locality only.

SECTION II

DYES

4. GENERAL REMARKS.-(a) Native dyes are in common use at the present time in the South Pacific islands. The majority of them are easily made, in most cases requiring little more than the basic material which, when squeezed or mixed with water, gives the dye. Others require more care in preparation, but it will be found well worth the trouble if other materials are unobtainable. Some of the plant elements used for dyes are seasonable and are, therefore, only available at certain times of the year.

(b) Soil and clay are used on many islands for dyeing purposes. Local observation and inquiry will be necessary in this instance and, in fact, any likely material, vegetable or mineral, should be the object of experimentation in localities where proper information cannot be obtained or where a specimen is in doubt.

(c) For setting colors, seawater or burned coral lime are extensively used.

5. COLORS AND METHODS.-(1) BROWN.

(a) Sappan wood, or sibucao, is a large, straggling, prickly, semi-climbing shrub that yields a brown dye. If mixed with coral lime it gives a dark red color.

(b) A brown dye is obtained by mixing the inner bark of the pani tree with seawater.

(c) A reddish-brown dye is made from the bark of the o'a tree. The bark is scraped from the growing tree. The chips are gathered in a cloth or matting and the juice is squeezed, by wringing, into a pan. The bark has to be dealt with the same day that it is procured. It is surprising the amount of liquid that is obtained from the bark, and it can be covered and stored and will last some time. The fluid forms the full dye, nothing being added to it.

(d) Cloth can be stained brown by spreading the material in the mud of a taro patch, (fig.1).

(2) RED AND ORANGE.

(a) A bright red dye is obtained from the seeds of the loa tree. The seeds are simply squeezed with the fingers and the juice collected in a bowl. It is only

Lagoon and Coconut Trees.

Fig. 1
Taro Patch

Fig. 2
Malay Apple

available during seeding time, as there is no way of keeping or preserving it.

(b)A bright crimson color is obtained by mixing the bark of the nonu fi'afi'a, or Malay apple, (fig.2), with seawater and lime.

(c) The fruit of the fig or banyan tree, (figs.3,4), yields a milky juice. The leaves of the kou tree are immersed in the fluid and squeezed. Pink color soon appears and, after continued treatment, deepens into a brilliant crimson dye.

(d) Red dyes can be obtained from the bark of the kolea tree, the fruit of the ohia ai or mountain apple tree, (fig.5), and the leaves of two ferns, the palaa and the ama u mau.

Fig. 3
Wild Fig Tree

Fig. 4
Banyan Tree

Fig. 5
Mountain Apple

(e) The tuber, or underground stem, of the turmeric plant, (fig.6), gives a deep orange-colored juice.

(3) YELLOW.

(a) This dye is made from the root of the ango plant. After the roots are gathered they are washed in seawater. They are then grated and, when mixed with fresh water, give a dull yellow color. If mixed with a portion of the reddish-brown dye of the o'a tree, the yellow becomes much brighter.

(b) Yellow dyes can be made from the wood and root of the noni tree, the fruit pulp of the nau, or gardenia, and the bark and root of the hoolei tree.

(4) BLUE

(a) Juice obtained from the berries of the uki plant furnishes a rather pale, but lasting, blue color.

(b) The leaves of the indigo, locally known as the tayum or tagum plant, give a rich blue dye. The leaves are mixed with charcoal in a pit and water is poured on. Cloth, placed in this solution, will take on various shades of blue depending on the length of immersion, which can be anywhere from one to ten days.

(5) GREEN. The leaves of the mao shrub, when crushed and mixed with water, give a good green dye. It is not dependable however, due to its rapid fading tendencies.

(6) PURPLE. The plantain or banana plant gives a purple dye. The trunk of the plant is cut through and the sap allowed to drip into a container.

(7) BLACK.

(a) Black or gray dye is made from a concentrated or diluted mixture of charcoal in water or candlenut oil. Charcoal is obtained by roasting the candlenut or sugar cane. A black or gray tint can be applied to cloth by rubbing the surface with a cotton bag containing powdered charcoal.

(b) A perfectly black dye can be made from the seed kernels of the candlenut tree, also known as the lama or kukui tree, (fig.7). The hard-shelled nuts are cooked thoroughly in an oven, after which the nuts are cracked and the kernels removed. The kernels are then set alight in a fireplace that has been roofed with stone and sheltered from the wind. The nuts are very oily and burn readily, emitting a black, oily smoke. The fine black soot adheres to the surface of the stone and, when enough soot has accumulated, the roof is removed and the soot scraped off into a container. The stone is replaced and the operation repeated.

Fig. 6
Turmeric Plant

Fig. 7
Candlenut Kernels

The dry powder, when used, is mixed with reddish-brown o'a dye and not with water. The dye is perfectly black and the o'a gives it a shiny appearance.

(8) WHITE. Pieces of coral, baked over a hot fire until they crumble, form coral lime. A fine whitewash is obtained from the powder when mixed with seawater.

Native Canoe

Fig. 8
Arrowroot

SECTION III

PASTES, GLUES AND BRUSHES

6. PASTES AND GLUES.-(a) Arrowroot (fig.8). The tuber, or underground stem, of the arrowroot is washed and cooked in an oven. It then forms a ball of paste which, upon drying, may be dipped every now and again in water to moisten it.

(b) Breadfruit (fig.9). The over-ripe breadfruit is very sticky and tenacious. The top of the fruit is removed and the rind acts as a natural glue pot containing the softened, fleshy substance. The ulu nea is the best kind of breadfruit for paste. Some varieties are not suitable. Heated breadfruit gum, smeared over the seams of a boat, provides satisfactory caulking.

Fig. 9
Breadfruit

(c) Fau songa. The fau songa is the plant whose bark furnishes the best material for lines and cords. The bark contains a copious, clear gum which drains freely when the bark is cut.

7. BRUSHES.-(a) The keys of the pandanus fruit, (fig.10), that have fallen to the ground and become dry, form neat natural brushes. The thicker, outer part acts as a handle, while the stiff fibres of the inner, smaller end are trimmed to form the brush.

Fig. 10
Pandanus

(b) Larger brushes are made of coconut husk which is trimmed to suitable sizes. Brushes are also made by breaking the ends of a piece of coconut leaf midrib, or cane, to split up the fibrous core into a brush-like appearance.

Native Hut

SECTION IV

ROPES AND CORDS

8. THE MATERIAL.-(a) General. The plants which supply material for cordage are the fau or fau tu, the fau songa or fau olonga, the mati or matiata, the breadfruit and the coconut. These plants grow abundantly and practically everywhere. Except for the coconut, the inner bark, or bast, of the plants is used and it can be readily split off from the outer bark. For finer cords, the bast is scraped on a board with a shell to remove coloring matter or any gummy substance. After being scraped, the strips are usually braided together and can be rendered whiter by soaking in seawater, rubbing in sand, and bleaching in the sun.

Fig. 11
Coconut Tree

(b) The Fau. The fau plant supplies the material for ordinary ropes. The whole bark is used, in wide strips for heavy work such as tying scaffolding and framework, or in narrow strips for minor purposes.

(c) Olonga. Olonga is stronger than fau tu but does not grow in such quantity. For this reason its use is generally restricted to finer cords.

(d) Matiata. The matiata supplies a very strong fibre in the bast of the slender rods which characterize the plant. It is used as cordage for the making of tough and strong fish nets. Shark nets, for instance, are made from matiata cordage.

(e) Breadfruit (fig.9). The bast of the younger shoots of the variety of breadfruit known as ulu manna are used. Seine nets are made of two-ply twisted cords of breadfruit bast.

(f) Coconut (figs.11,12). The coconut supplies strong fibres from the husk surrounding the fruit. The large quantity of interfibrous material is separated by a special process. The three-ply braid is plaited from it and also good strong ropes.

Fig. 12
Coconut Husks

9. PLAITING.-The term "plaiting" is used so much with cordage that, as a general term, it need not be confusing. There are two distinct methods of plaiting, twisting and braiding.

10. TWISTING CORDS AND LINES.-(a) Two-ply cords. Two-ply twisted cords are usually made from fau songa. After the material is collected and prepared, each individual strand is rolled. This is done with the palm of the hand on a smooth surface. The natives use their bare thigh for the purpose. The strands, or plies, are then twisted around each other, over and then under. The plies are lengthened by joining a fresh strand of material to the shortening ply with an overlap, and then rolling them together before rolling the two plies around each other. Besides the simple join of new strands by direct overlapping, two other methods are used, (figs.13,14). In the case of coconut fibre the strands are twisted individually only, and then braided over and under. Three or more plies can be used for braiding.

FIGURE 13.—Two-ply cord, joining ply (*so'o*): *a*, the ply (2) is the shortening ply; *b*, the new strand (3) is directly laid over the short ply (2) from below with its short end (3') projecting upwards past the point of joining; *c*, the other ply (1) is twisted around over the reinforced ply (2); *d*, the projecting upper short end (3') is doubled down over the other ply (1); *e*, the twisting is carried on and both the short end (3') of the new strand, and the short ply (2) is buried so to speak in the twists, while the new strand (3) continues the ply (2).

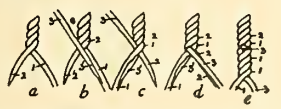


FIGURE 14.—Two-ply cord, alternate join: *a*, the alternative method is exactly the same in result but the opposite in commencement technique. The ply (2) is again the shortening ply. *b*, The new strand (3) is added from above with its short end (3') on the long ply (1); *c*, the ply (1) with the short end (3') is twisted over the short ply (2); *d*, the long end of the new strand (3) is doubled down over the short strand (2); *e*, the twisting is carried on with the same results as in figure 125.

(b) Three-ply cords. Three-ply cords are usually made from fau songa and matiata. Finer cords are made from the former and thicker lines from the latter. The bast is divided into appropriate thicknesses and rolled separately into strands. Three strands are held between forefinger and thumb in such a way that they are slightly spaced apart. Still holding them firmly, they are laid transversely over the right thigh. The right palm towards the base of the fingers is laid over the three strands and rolled firmly downwards or away from the body. The first part of the movement rolls each strand on itself into three separate twisted strands during the outward movement, the right palm having worked over the strands to near the wrist. The left hand is slacked slightly and the last part of the movement twists the three strands over each other into a three-ply cord. At the end of the outward sweep, the palm is turned over on its outer edge and returned towards the body with a firmer pressure that twists the plies more closely together in the twist already commenced. The left hand is shifted down to hold the end of the section that has been firmly twisted. The ends of the three plies are separated and again held in the left hand while an outward and backward sweep completes another short section. By continuing this operation, and by proper joining, any length of cord can be obtained. The join in this thickness of three-ply is made by the doubling over method with the new strand added from below, (fig.15).

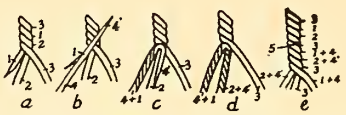


FIGURE 15.—Three-ply twisted cord, join: *a*, ply (1) is the shortening ply; *b*, the new strand (4) is placed over the short ply (1) from below with its short end (4') projecting upwards beyond the point of joining; *c*, the three plies are held apart by the left hand on the thigh, while the right hand rolls the new strand (4) and the short ply (1) together. The short end (4') of the new ply is then turned down on the next ply (2); *d*, the ply (2) and the short end (4') are rolled together on the thigh. To complete the rolling, the ply (3) is also rolled separately; *e*, the three strands are rolled as in the usual *milo* technique. In well-made cord, the join (5) can hardly be seen.

11. BRAIDING CORDS AND LINES.-(a) Sennit braid. Sennit braid is the most important single article in Polynesian usage. The coconut from which the braid is made is known as the niu afa or sennit. The husk is thick, about 13 inches long, and the nut comparatively small. When the sennit nut cannot be obtained, ordinary nuts can be used.

(b) Treatment of husk. The husk is removed in even, longitudinal segments. The object is to separate the interfibrous material from the fibre. Most of them require soaking in water to soften the material. Some green husks require 4 to 5 days soaking, others a month or more. It is important to recognize types that require the least soaking. After the material has softened, the interfibrous material is removed by beating the husk sections with a wooden mallet or club. The outer skin is peeled off, the inner, short part removed, and the end of the segment is held with one hand while the pounding takes place. The interfibrous material flies off under the beating and the fibre can be loosened and flicked off after every few blows. The ends are reversed and the beating continued until only the cleaned fibres remain. The interfibrous material has a vile odor which is painfully evident while the husk beating is going on. The fibre having been collected, it is now washed and left exposed to sun and air to dry.

(c) Rolling the strands. The short fibres are separated from the long and discarded. A sufficient number of good fibres are collected for a strand. They are held by the left thumb and forefinger while some of the fibres are pulled out slightly at each end, not only to lengthen the strand, but to thin the ends for joining purposes. A single fibre is separated, its middle placed against the strand, and one end twisted around it with the right hand. The other end of the single fibre is then doubled back and the strand twirled between the finger and thumb to finish the rolling of the binding fibre. The strand is now rolled on the right thigh with the right palm and is then laid down and the process repeated until a sufficient quantity has been made.

(d) Plaiting. In plaiting the fibre braid, the plies are held between the left thumb and forefinger with the thumb uppermost and plaiting is directed away from the body. The technique thus consists of pulling whatever strand is in the middle position outwards under a side ply, first on one side, and then on the other. Whilst the right hand pulls the middle ply outwards and under, the left thumb rolls the side ply over into the middle position. The left thumb also, by downward pressure with the left forefinger, keeps the plies in their relative positions after each twist is made. The plaited part, therefore, passes backward under the thumb towards the body, (fig.16). It is just the free edge of the braiding that protrudes beyond the thumb, but in this and following figures, the thumb is shown well back so as not to obscure the technique.

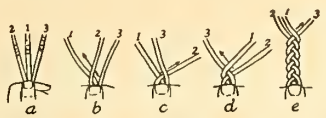


FIGURE 16.—Three-ply sennit braid, plait technique: *a*, each ply is formed by a single *fa'ata'a* strand of which there are three; *b*, the middle ply (1) is pulled outwards by the right hand, under the left ply (2), which brings the ply (2) into the middle position; *c*, the middle ply (2) is pulled outwards under the right ply (3) which brings (3) to the middle position; *d*, the middle ply (3) is pulled outwards to the left under the left ply (1); *e*, the continuation of the above results as shown.

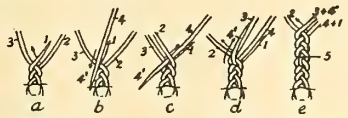


FIGURE 17.—Three-ply sennit braid, join of ply: *a*, the short ply (1) has been worked to the middle position; *b*, the new strand (4) is added to the short ply (1) with its short end (4') projecting back on the completed work; *c*, the middle ply (1 and 4) is pulled out to the right under the side ply (2) which comes to the middle position; *d*, the ply (2) is pulled out to the left under the side ply (3) when (3) comes to the middle position, the short end (4') of the new strand (4) is doubled forward on (3); *e*, the braiding goes on in the usual way and only the doubled over short end (5) is seen in the middle line.

(e) The Join. A fresh strand is added to a shortening ply in much the same manner as in a twisted cord. The rule is to bring the short ply into the middle position and add the new strand to it with its short end projecting back on the complete work where it is held under the left thumb, (fig.17). As the braiding proceeds, the fingers naturally feel the thickness of the plies. If one is felt to be too thin and needs reinforcing, a fresh strand is added in a manner opposite to the join above, (fig.18). The principle of reinforcing a thin ply is to add a new strand from below with its short end on a long ply in the middle portion. A couple of turns are made to bring the thin ply into the middle position, when the long end of the new strand is doubled forward to join it. The braiding goes on until the required length is reached. The end of the braid is stopped by tying the two outer plies together in the first part of a reef knot.

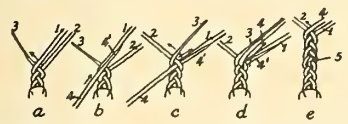


FIGURE 18.—Three-ply sennit braid, reinforcing thin ply: *a*, the ply (3) is too thin and needs reinforcing; *b*, the new strand (4) is added from below to the ply (1) which is in the middle position. The short end (4') of the new strand rests on (1) while the long end (4) is directed back on the braid. *c*, The middle ply (1) with the short end (4') is pulled outwards to the right under the side ply (2). After (2) comes into the middle position, it is pulled outwards to the left under the side ply (3) which comes to the middle position. *d*, The middle ply (3) is the one that needs reinforcing. The reinforcing element (4) is therefore doubled forward on (3) and everything is ready to continue the ordinary braiding. *e*, The braiding is continued, (3 and 4) being treated as one ply. The only part of the join seen is the doubled over new strand at (5) in the middle line.

(f) Uses. The ordinary three-ply braid is used for lashing houses, canoes and for general purposes. Quickness in manufacture and efficiency in use are the guiding principles in braiding of this type.

12. ROPES.-(a) Two-ply Twist. Rough ropes of fau bast are quickly made, (fig.19). New strands are added by doubling down the short end on the other ply as in figure 13. The plies are twisted with the hands and plaited towards the body, the commencing end being fixed to a stake or post. The individual plies are twisted to the right and then crossed over the other ply from above, downwards and to the left.

(b) Shark Rope. A shark rope is a three-ply twisted rope in which each ply is formed of a number of strands of the common three-ply braid. As many as nine strands have been used in each ply. Five fathoms of untwisted sennit braid will make a little over four fathoms of rope. Half the total

Fig. 19

number of strands required, but of twice the length, are doubled at the middle. A space is left at the looped end to form the eye for a loop and a stick is passed through. The stick is suspended and lashed against a beam so that it will not rotate. The strands are lashed together with a piece of cord beneath the stick. The strands are divided into three equal parts to form plies. Each ply thus formed is taken charge of by an assistant, who ties a short cross stick to the lower end of his ply. The chief rope maker uses a mature, dry, unhusked coconut with three longitudinal grooves cut in it to correspond with the plies. This is inserted under the plies close to the upper binding around the strands. The three assistants then twist their sticks in the same direction so as to twist the strands of their respective plies. As the plies become closely twisted, they are allowed to twist around each other to form the rope. The chief rope maker manipulates the coconut gage by moving it downwards as the assistants walk around in the same direction. The process is continued until the rope is completed. The three-ply twist makes a very strong rope that will hold any shark.

13. NETS.-The methods used by the Polynesians in the making of nets is similar to the system employed by the Second Marine Division Camouflage School. No explanation, therefore, of native methods, is considered necessary. Reference should be made to the section of this manual devoted to the making of nets.

Samoan Chieftain

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Camouflage. 11,696