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COMBINED OPERATIONS PAMPHLET

N° 24

CLIFF ASSAULTS

148/44
August 1944

Prepared under the directions of the Chief of Combined Operations

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This pamphlet, when issued to Naval Holders, will be known as BR, 640(24)

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COMBINED OPERATIONS PAMPHLET N°. 24

CLIFF ASSAULTS

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COMBINED OPERATIONS PAMPHLET N° 24

CLIFF ASSAULTS

SECTION 1 GENERAL

1 A number of Combined Operations have included cliff assaults as part of the assault plan.
These assaults have had such objects as the seizure of coast defence batteries, turning the enemy's flank and cutting into his communications. The element of surprise which has been achieved in these assaults has ensured their success at a small cost in lives.

The necessity for cliff assault

2 A study of an average coast, especially one exposed to the prevailing wind, reveals that in only a small part of coastline, often as little as ten per cent, is suitable for beach exits. Along the remaining part, the beaches are either backed by cliffs which vary from the low and sloping to the high and vertical, or are absent altogether, the cliffs rising straight out of the water.

3 A coastline of this type generally allows the enemy to economise his forces on the assumption that an attack is unlikely to be made along those sectors of the coast which are devoid of beach exits. Batteries and other vital installations are placed on the cliffs and the enemy is able to concentrate his field forces for the defence of those beaches where an easy landing can be made. The knowledge that a cliff assault can and may be made at any place along the coastline will, however, force the defender to disperse his force and to protect the entire length of his coastline. The greater the threat of a cliff assault, the greater will be the dispersion of the enemy forces.

4 The threat of cliff assaults, therefore, either alone, or in conjunction with a major landing, is of strategic advantage to the attacker. If the enemy attempts to guard the cliffs, he must weaken the defence on the main beaches. If he leaves the cliffs undefended a bridgehead can be established over the cliffs on his flank by special troops. The installation of cliff climbing apparatus will then enable non-specialist infantry to pass through the cliff bridgehead in sufficient numbers to capture the main beach from the flank.

5 Each cliff assault presents a different problem to the attacker and it must be studied as such ~~before~~. Regarded as obstacles to be surmounted and irrespective of geological classification, cliffs can be divided into two types:-

(a) Cliffs of soft rock, which are vertical or overhanging.
(b) Cliffs of hard rock, which slope at an angle of less than seventy-five degrees to the horizontal.

The techniques for the assault of these two types of cliffs are different, and throughout this pamphlet a distinction is made between scaling and climbing. Scaling involves the use of mechanical aids necessary to overcome vertical cliffs; climbing requires few and simple forms of apparatus and is the method for ascending hard sloping cliffs.

This division is arbitrary and is made to simplify the subject. Although the technique applicable to each type of cliff has been discussed separately in separate sections, much in either part applies equally to the whole subject. A further section, Section 9, deals with rough weather and rocky landings which is an integral part of a cliff assault.

Cliff conformation

6 The following paragraphs give a brief outline of the various types of cliff. Cliff conformation depends on three factors :-

(a) The nature of the rock, i.e. whether it is hard or soft, sedimentary or volcanic.
(b) The nature of the sea action to which it is exposed, i.e. on an open surf coast or the lee of an island or protected inlet.
(c) Whether the sea level has risen or fallen appreciably in the last thousand years.

7 The same type of cliff may be produced by different combinations of these factors. On soft rock coasts an imposing cliff may be formed relatively quickly under mild sea conditions, while on hard rocks coasts the most violent exposures are necessary to produce a cliff.

8 The term "cliff" is usually applied to a cliff formation when it has reached what is called "the mature stage", that is a more or less vertical wall or rock rising from a wave-cut beach which is exposed at low tide and only just covered at high tide. This kind of cliff is produced when the sea has been cutting into the fairly flat country for a long time.

9 Where the rock is soft, or where the cliff is shielded from the under-cutting of the sea by sandbanks or by a slight elevation in the ground, more of the cliff falls down than the sea is able to wash away. The whole bottom of the cliff is then protected in the case of hard rock by an immense pile of fallen rocks or talus, or in the case of soft rock, of mud. Under these conditions the vertical part of the cliff is subject only to ordinary weathering and will usually be overgrown and much softer than a mature cliff. These cliffs are sometimes called "dead" cliffs. (Diagram 1)

10 A third general type of cliff formation occurs when the rise in the level of the sea has been greater than the distance it has been able to cut into the land. In this case the cliff may drop straight into deep water without a beach. This occurs particularly where the rocks are hard. A type of cliff similar to this is produced in earthquake country.

Geological classification of cliffs

11 In para 5 above cliffs were divided arbitrarily into two categories according to the technique required for surmounting them. In the following paragraphs they are classified according to their geological nature. They fall into two main groups, stratified and Unstratified cliffs.

Stratified cliffs

12 Stratified cliffs may be formed of limestone, sandstone, slate or, in some cases, volcanic ash, but all formations are alike in consisting of a series of parallel layers, and they all have a tendency when they break up, to form blocks like blocks of laid masonry. Stratified cliffs can be further sub-divided according to the slope of the strata :-

(a) Layers horizontal, or nearly horizontal,
(b) Layers steeply inclined towards the sea,
(c) Layers steeply inclined away from the sea,

(a) Cliffs with horizontal, or nearly horizontal layers, are usually vertical or nearly vertical, and apart from landslide or talus, are either easy or difficult to climb in relation to their uniformity. Extreme uniform materials, such as chalk, give a very smooth cliff which is practically un-climbable. (Diagram 2). Banded limestone, with alternating patches of hard and soft rock give a staircase effect which is climbable unless the rock is so soft that it falls away.
The lower part of a cliff, which is beaten by waves, is always smoother than the rest, and often overhanging.

.../Stretches

Stretches of cliff, uninterrupted by landslides which provide a way over this overhanging part, are rare. (Diagram 3).

If a cliff is formed of two beds of very different hardness the cliff profile will be uneven. If soft beds overlie hard beds, the lower part of the cliff will be vertical, the upper sloping. (Diagram 4). If the hard bed is on top, the lower bed will be undercut and the beach will be littered with enormous blocks due to landslides. (Diagram 5).

(b) Cliffs whose strata dip steeple towards the sea are not usually vertical, but consist of long smooth slabs. These can usually be climbed by making use of the cracks and the joins. In the more vertical sections, however, the outward dip of the strata make climbing extremely difficult. (Diagram 6).

(c) Cliffs whose strata dip towards inland consist of jagged rocks. These will usually be the easiest to climb as every seam gives a good foothold. (Diagram 7).

Unstratified cliffs

13 Unstratified cliffs are normally of volcanic origin or produced under volcaniv influence. The commonest is granite, but they also include basalt, gneiss and quartzite. All these rocks are very hard and, in exposed positions, form high cliffs. These cliffs, however, are never as even as the vertical stratified cliffs, but are usually diversified by pinnacles and clefts.

(a) Granite - Granite gives characteristic cliffs of rounded convex outline. These tend to break up into enormous boulders separated by flared cracks. (Diagram 8).

(b) Basalt cliffs - Basalt, which is an ancient volcanic lava, cracks vertically and is usually in the form of piles of columns. Recent volcanic lava is also often cut into cliffs. These are excessively jagged but otherwise easy to climb. (Diagram 9).

(c) Gneiss and Quartzite cliffs - The other hard Unstratified rocks such as gneiss and quartzite, form rocks which are originally sedimentary, forming cliffs of intermittent character.

14 The different types of rocks, and the difference in degree of exposure, produce a different alignment of cliff along the coast. Stratified rocks usually present a straight line cliff, only broken up by boulders and stacks, and undercut by natural arches and caves. (Diagram 10).

Unstratified rocks give very much more irregular coastlines of which the characteristic features are the narrow coves at the flanks of the cliffs leading to small valley, and numerous points and skerries.

SECTION 2 - SELECTION OF ASSAULT AREAS

All cliffs are surmountable

15 Given the necessary equipment, no cliffs are insurmountable. But all cliffs are obstacles, their height, composition and slope dictating the methods necessary to overcome them. The time taken to surmount them will depend more on the method employed and the standard of training of the troops than upon the nature of the cliffs.
The selection of the point of assault should, therefore, be dictated by tactical considerations and not by the conformation of the cliffs. Care must be taken that planning is not unduly influenced by the obvious and easy routes.

Factors in the choice of the place of ascent

16 The suitability of the cliff should not be taken into account until the attack on the objective has been considered from the tactical point of view, and the plan of attack prepared.
On completion of this plan, it will be apparent where the units are required to land to enable the plan to be put into effect.

17 The actual place where the cliff should be assaulted can then be selected by the application of certain tactical considerations. The first, and probably the most important, is the degree of cover from fire from the cliff top and concealment from the enemy either at the cliff top or on the flanks. The second is the suitability of the ground in the immediate vicinity of the cliff top for forming and holding the initial bridgehead against counter-attacks. If those requirements are lacking, and serious opposition is encountered, the cliff assault may fail.

Cover from fire and view

18 All cliffs provide considerable degree of protection to troops at their base or on the cliff face from fire either from the flanks or from inland.
Their shadows provide cover from observation, and if clothing is of similar colour to the cliff it will greatly increase the protection afforded. The least cover is given by the cliffs that run in a straight line and have a smooth surface inclined at a large angle to the vertical.
Cliffs that are irregular in outline and are either vertical or overhanging give the best cover.
In such cases cover is provided not only during the ascent but also on the beach or sea immediately below the cliff, and thus will greatly facilitate the operation.

Advantages of difficult cliffs

19 Within the area chosen for the assault it is desirable to select for the cliff ascent parts that are rugged, well indented and either vertical or even overhanging and, above all, it must lead to an area suitable for forming the initial bridgehead.

20 The cliff so selected is likely to be very different to that selected at a first glance as being the most suitable, and unless the planners are familiar with the necessary technique, such cliffs may appear impossible.

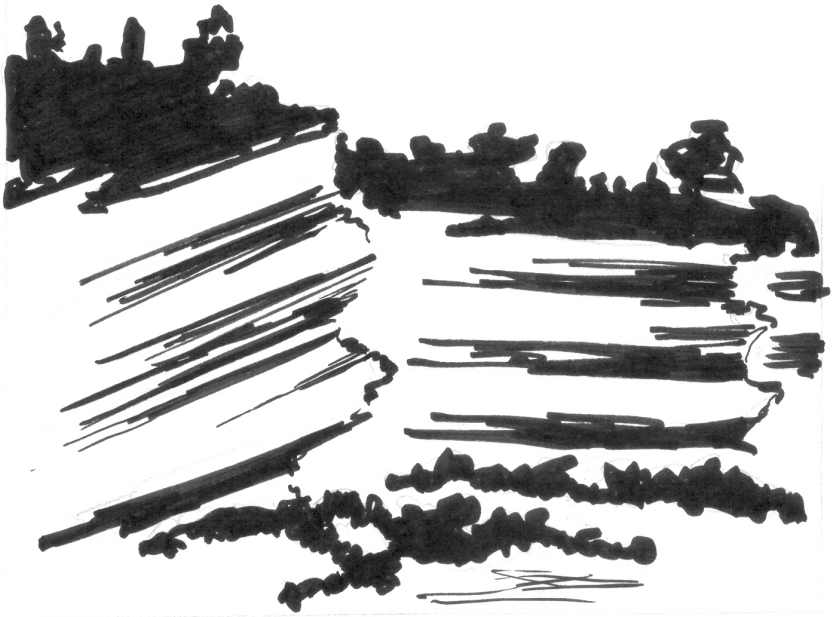
DIAGRAM 1

Soft Rock, where the action of the sea has been interrupted by shielding

DIAGRAM 2

Chalk, uniform material, layers horizontal

DIAGRAM 3



Banded Limestone, the lower part often overhanging

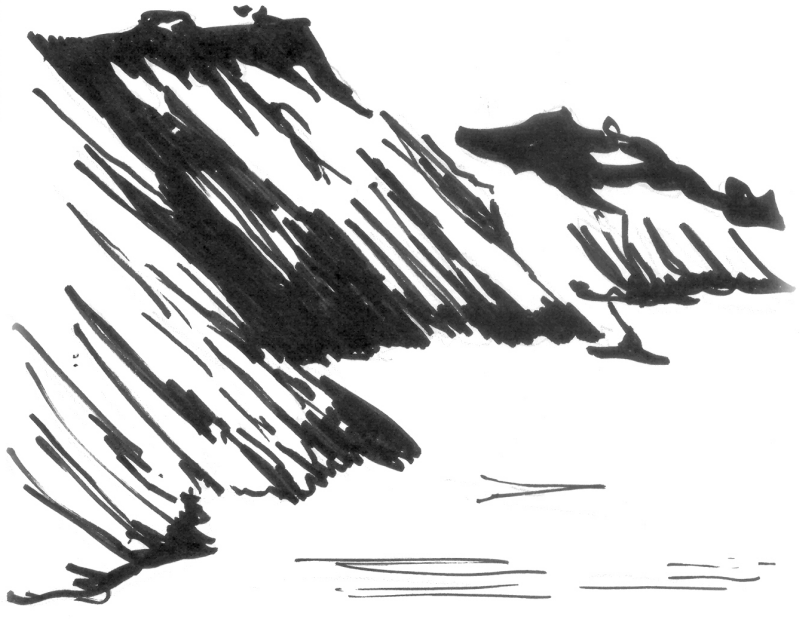
DIAGRAM 4

Cliff of two beds of rock of different hardness; the soft bed overlaying the hard bed.

DIAGRAM 5

Cliff of two beds of rock of different hardness;
the hard bed overlaying the soft bed.

DIAGRAM 6



Strata dipping towards the sea

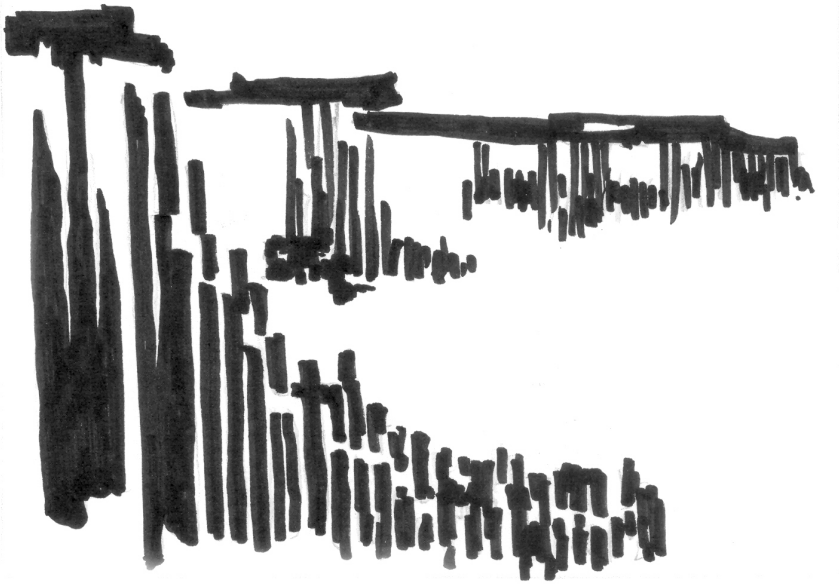
DIAGRAM 7

Strata dipping towards the land.

DIAGRAM 8

Granite Cliff

DIAGRAM 9



Basalt Cliff

DIAGRAM 10

Stratified rocks, undercut with arches and caves.

SECTION 3 - TIMING THE ASSAULT

Timing depends on major landing

21 The choice of H hour for the assault must be considered from the wider tactical aspect.
The method employed must suit the timing, and not the timing the method. The method employed will be dictated by the characteristics of the cliff and the time of the assault.

22 When the cliff assault is part of a major amphibious operation, H hour will be fixed to suit the main landings. The danger of the loss of tactical surprise and the additional naval dispositions required will usually prohibit the cliff assault being made before H hour.

23 Such is the complexity of major amphibious operations against a heavily defended coast that it is probable that such an assault can only be made during daylight hours. In a cliff assault, the actual ascent will be easier by day than by night, but against a heavily defended coast it will be harder to get tactical surprise and the initial resistance will be greater.

Further considerations

24 When a degree of latitude in the timing exists the ideal plan would probably allow the landing and the withdrawal of the craft to be made before first light, thereby confusing the enemy as to the exact spot selected for the cliff assault. Further it will enable the apparatus to be set up and the first man to go up at first light. The main party can then ascend in the growing light.

25 In a land battle the infantry must keep close behind the barrage.
In a cliff assault this is even more important and the landing craft or amphibians carrying the assault troops, should wait as close inshore as possible, until the bombardment lifts, to ensure that the troops are landed at the earliest possible moment. This pause in the final approach of the landing craft may appear undesirable, but it has been found that without it the timing of the run in cannot be adhered to accurately enough to ensure a touch down immediately the bombardment lifts.

26 The period between the lifting of the bombardment and the time when enough men are up to establish an initial bridgehead an the cliff top, is the most vital period in the whole operation.

The period between the moment when the first man of the force lands and the moment when he is at the top of the cliff must not exceed five minutes per hundred foot of cliff and every effort should be made to reduce this time. Under favourable conditions it can be reduced to three minutes.

27 The whole of the cliff assault party must follow fast after the leading men, and the last men should be up within fifteen minutes of the landing.

28 The second wave should not be brought in until the necessary apparatus for their easy ascent is in position and, since it has to be placed to a flank, this cannot be done before H+30 and may be later.
Both the apparatus and the troops should therefore remain waterborne until called in by the cliff assault party commander. He will call in each craft or amphibian separately as required.

SECTION 4 - FIRE SUPPORT

29 The presence of the cliffs imposes no special consideration on the fire plan, which can only be made as for a normal assault. It is of course desirable that enemy posts capable of covering the beach, cliff and cliff top should be neutralised during the assault, but owing to the cover provided by the cliffs, it is not so important as for an assault across open ground or beaches.

Neutralising and covering fire

30 The fire plan will normally consist of two distinct phases

(a) The initial bombardment required to neutralise the enemy batteries, provided by naval warships and/or aircraft.

(b) The support required to cover the final approach of the assault party, provided mainly by support craft.

31 In a cliff assault, it is desirable to combine these two phases and so concentrate the whole available fire power on the objective during the final approach. If the objective is an installation, such as a battery, it is generally advisable to land and scale the cliffs as near the objective as possible, since a single fire plan can thereby be used to neutralise the battery and cover the final approach.

Unit mortars

32 High trajectory weapons fired from the beach can also effectively support the assault on the cliffs, the establishment of the bridgehead and the assault on the objective. This form of fire support will be limited only by the maximum high trajectory range of the weapon. This is an important consideration, since the whole operation will become much easier if these heavy weapons with their ammunition do not have to be hoisted up the cliff during the initial phase of the assault. To enable the support fire to be effective, it is essential that an observation post should be established on the cliff top at the earliest moment. Consequently, the first man up the cliff should, if possible, form an observation post and control this fire.

Effect of heavy bombardment

33 Heavy bombing or an intense naval bombardment with large caliber shells produce craters of a remarkable size. This has several results which must be allowed for during planning.

34 A large percentage of both bombs and shells will land on the beach. While the craters will provide excellent cover for infantry, they will make the beach unusable for vehicles such as DUKWS, which will then have to come in to a flank. The lips of underwater craters, especially on flat beaches, may also prevent landing craft from beaching in their normal depth of water.

35 Owing to the bombardment, the ground inland of the cliff may be made unrecognizable and, although from an infantry point of view, the cover will be improved, it may be difficult to identify objectives and the routes to them.

36 In spite of the apparent destruction caused by the bombardment it may not have achieved more than the neutralization of the enemy defences. It is also improbable that the cliff will have been ramped, although a few falls will take place which may produce a mound. The height of mound is, however, unlikely to exceed a third of the height of the cliff. These mounds, which are of a loose composition and appear unpredictable places, are more of a hindrance than a help in the assault on the cliff.

SECTION 5 ESTABLISHING THE BRIDGEHEAD

Speed

37 Success or failure in cliff assault depends on the speed with which enough men can be establishes on the cliff to form the initial bridgehead. Once this has been done the remainder of the operation consists of ensuring a steady build up of men and material until a force has been assembled strong enough for the task in hand.

38 All cliff assault apparatus has been developed primarily to assist the rapid establishment of the initial bridgehead. After the supporting fire has lifted, there will be a period in the assault when the assault troops have not yet reached the cliff top, and the enemy still control the edge of the cliff and can still dominate the beach. If the enemy are allowed to establish themselves firmly and in strength on the cliff edge it may become impossible to scale the cliff. It is essential, therefore, that all other considerations should be sub-ordinated to the need for speed in getting the first men on the cliff top.

39 As described in para 32, mortars on the beaches and light naval support craft can bring fire to bear on the cliff top to drive the defenders back from the edge and to assist the final stages of the assault. The most certain way, however, of ensuring success is to retain surprise by speed of execution and to get the assault party on to the cliff edge before the defenders can re-organise after the bombardment.

Surprise diversions

40 The attainment of surprise is facilitated by the use of diversions. If the cliff assault is mounted in conjunction with a main assault, the enemy's full attention is likely to be engaged by the main landing and the defenders on the cliffs may fail to appreciate the significance of the craft carrying the cliff assault party.

41 Other diversions may be staged against more obvious lines of approach to the objective, at places where a study of the enemy's defences show that he has anticipated an attack. These diversions can be expanded into secondary assaults though their success will depend on the success of the cliff assault and, therefore, they should not be pushed home at too great a cost during the initial stages. They should await the successful outflanking of the position by the cliff assault party before exerting their main effort. If the cliff assault is successfully executed, this will not be long delayed.

Weather

42 The weather may assist in retaining surprise. In a daylight attack, mist or driving rain will restrict the defenders observation. Rough seas may put the enemy off their guard, as they will consider a landing impossible under such conditions. High wind and rain may delay the ascent but with suitable equipment it will not render it impossible. The controlling factor is the height of the waves on the beach in which landing craft can operate. LCP(L) with good crews can land troops successfully in very heavy weather, even on rocky coasts. Other types of landing craft are not so suitable, and if rough weather is expected care must be taken to obtain the use of suitable craft.

Value of parachute troops

43 The use of parachute troops to establish the initial bridgehead has a double advantage. It speeds up the operation, and prevents the possibility of a small force of the defenders successfully disputing the establishment of the bridgehead and thereby preventing deployment of the main cliff assault party.

44 The terrain inland of cliffs is often of an open nature particularly suitable for dropping. Cliffs are usually visible even on a dark night and form an excellent aid to the identification of the dropping zone. The paucity of defence in cliff areas will often allow the parachute troops to be dropped and to re-organise unmolested and even unobserved. It will also allow the dropping zone to be located near their objective thereby saving much time.

45 The parachute force used in conjunction with a cliff assault should be strong enough to establish the initial bridgehead one or two "sticks" will often be enough. Since unfavourable weather and the difficulty in establishing contact may prevent the parachute parties reaching their objective, the plan should not depend for success on the parachute landings.

Alternative methods of establishing the bridgehead

46 Where no assistance is available from parachute troops, the assault force must establish its own initial bridgehead. This must be regarded as the normal method. The apparatus used for cliff assault is described in Section 6.

47 The assault must be made on as wide a front as possible with a large number of alternative aids to climbing. The proportion of aids should be one to each six men in the assault force. Bunching around the easy places of ascent must be avoided, as this will enable the enemy to concentrate against the few routes in use.

48 Past operations have shown that resolute men, with the necessary equipment, assaulting on a broad front and supported by naval and air bombardment, can establish themselves, even against strong opposition, with practically no casualties.

SECTION 6 CLIFF SCALING METHODS

Methods of scaling vertical cliffs

49 The methods of scaling vertical cliffs can be divided into two categories :
(a) Ladders
(b) Ropes

Ladders

50 The use of ladders is limited by the height of the cliff. The highest ladders, equipped with the best power operation, working at the optimum angle of seventy-five degrees have a vertical height of one hundred feet. This height is seldom attainable since debris at the foot of the cliff and the angle of the cliff itself alters the working angle and consequently the height. Operating against apparently ideal cliffs this method cannot be relied upon to surmount cliffs of more than seventy-five to eighty feet in height. Subject to this limitation, however, ladders are the best method.

51 Sixty foot hand operated ladders are subject to similar limitations, but are a good method for ascending vertical cliffs not exceeding forty feet.

Ropes

52 Ropes including rope carrying rocket apparatus, rope ladders, tackle and rock climbing ropes are more transportable and flexible than ladders. Whereas ladders require vertical cliffs and no debris at the foot, ropes are more suitable on inclined cliffs with debris. Ropes do not suffer from the same height limitations as ladders.

The steel four feet sectional ladder should be included in the rope category since it is virtually a rigid rope ladder.

Choice of method

53 All the available methods of ascent can be divided into two phases :-

(a) The initial assault, that is getting the first men onto the cliff top.
(b) The follow-up of the remainder of the force.

54 The methods used for the initial assault are given at Appendix "A" and the methods used for the follow-up at Appendix "B". All the ladder methods of initial assault provide also the method of ascent for their own follow-up and, except for these, any combination of methods can be used. Appendix "C" gives in tabulated form details of the weights and performance of the various apparatus.

55 A study of the factors governing the employment of the various methods shows that while each has its own merits, each has limitations peculiar to itself. The angle of the cliff to the horizontal will largely determine the method to be employed. Unfortunately no sector of cliff has a uniform gradient, but the minimum and maximum angles can be established by photography.

56 No method should be used alone; a series of complementary methods must be employed so that where the gradient is unsuitable for one means, an alternative method will be available which is suited to the circumstances.

57 Where the average angle is less than seventy-five degrees, and the composition of the cliff is hard, straight climbing without elaborate apparatus is the best method. Most cliffs are in this category a fact which gives this technique great importance. It has, therefore, been treated as a separate subject and is dealt with in detail in Section 9.

SECTION 7 CLIFF CLIMBING METHODS AND DRILLS

General considerations

58 If the time of landing is at night, and there is a possibility of achieving surprise, pure climbing methods are both quiet and can be performed extremely quickly with trained troops by the drill outlined in the following paragraphs.

59 On a variable cliff, parts of which appear to be scaleable by climbing methods and other parts of which necessitate mechanical aids the rocket throwers may have placed ladders in awkward positions. Where, however, the cliff has been climbed without aids, the handlines running down will be at easy angles, and trained troops using them will clear from the beach rapidly.

60 The cliff should be assaulted on as broad a front as possible. Besides the tactical advantages detailed in para 47 above the fact that there will be handlines available over a wide front will help the speed and efficiency with which follow-up troops can clear the beaches. On a rocky landing, handlines will be led up from a series of distinct points and craft containing follow-up troops must be directed to such points only.

61 Climbing requires a higher degree of individual and sub-unit training than does scaling with mechanical aids. The latter does mechanically much of what in climbing has to be done by the individual. The following climbing methods and drills, modified as required, will therefore also be found suitable for scaling.

Assault wave organisation

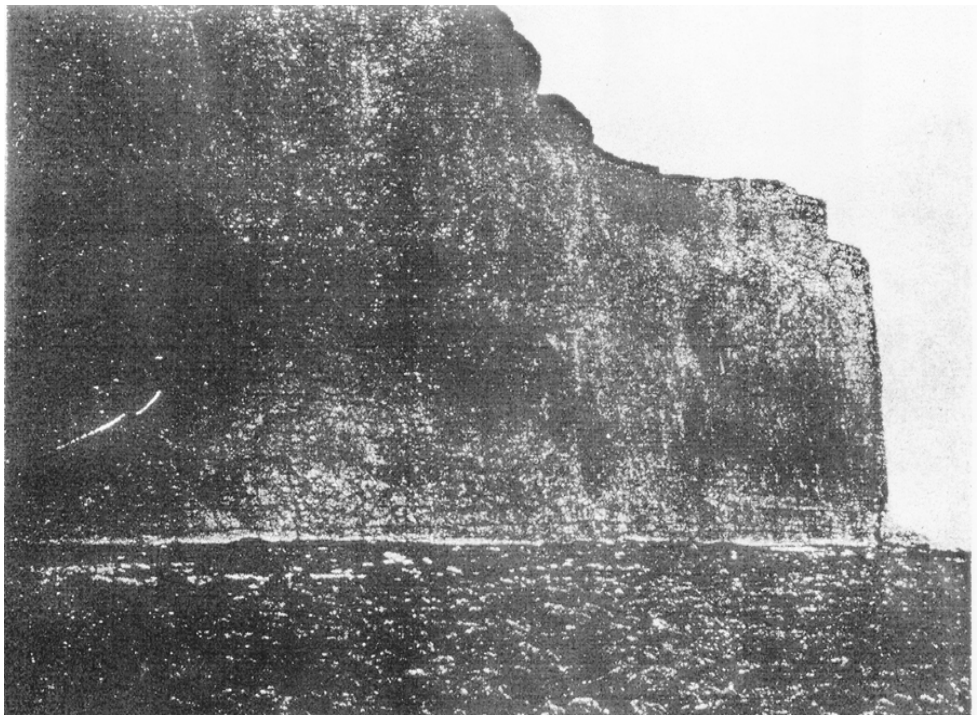
62 The troops should be organized as follows :-

(a) Climbing leaders who will be sufficient in number to ensure that the selected cliff is covered on a wide enough front.
(b) Climbing 'seconds', who also take up ropes once the leaders are up.
(c) A party to provide early covering fire to protect the actual rope heads.
(d) The main body of assault troops to form the main bridgehead.
(e) Signal personnel to establish communication on the beach between the beachmaster and the follow-up troops.
(f) Signal personnel to establish communications from the main bridgehead.
(g) Liaison men from follow-up troops. These will be equipped with rollers etc. if the follow-up troops have heavily laden personnel who will require assistance in getting up the cliff.

Assault wave climbing equipment

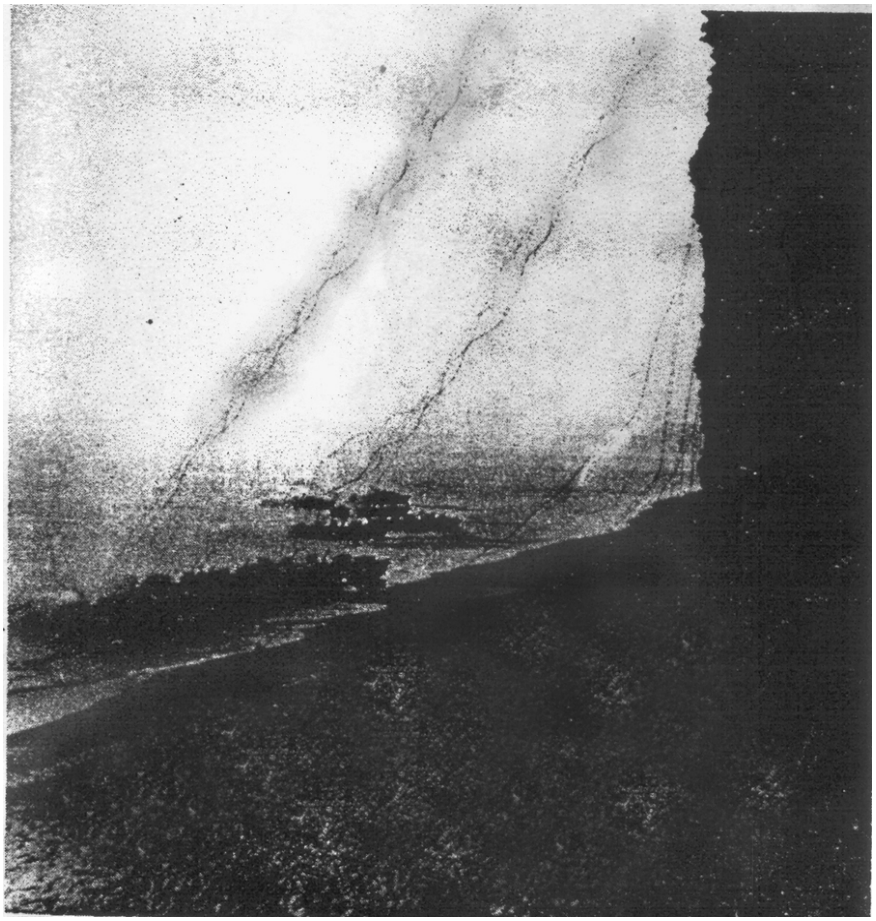
63 Climbing leaders Climbing leaders will land with a gripfast strapped around their waists. A 1½ inch alpine rope will already have been secured to the gripfast, the rest of the rope being handcoiled in baskets on their backs. They will wear climbing boots. If the cliff is not hard rock, they will carry cut-down ice axes. If there is a lip, or a short patch of earth or gravel at the cliff top, they will also carry hand grapnel and hand grapnel carriers which will help them over this. They will be armed with pistols.

PLATE 1



No cliff is unscalable

PLATE 2

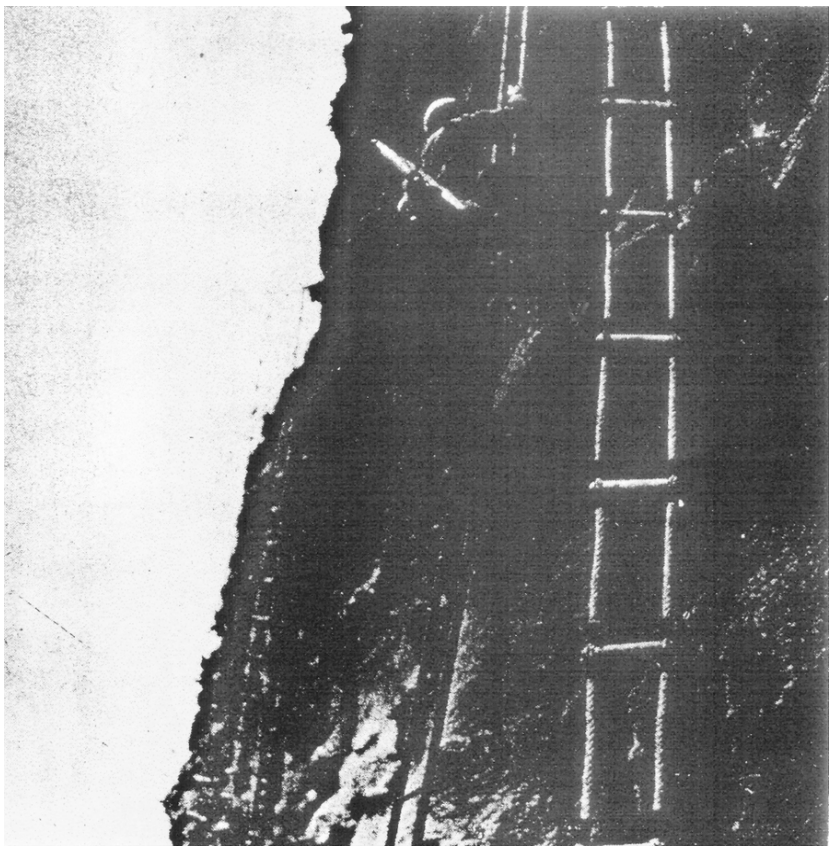


Landing craft firing ropes and ladders

PLATE 3

Combination of tackle and ladder

PLATE 4

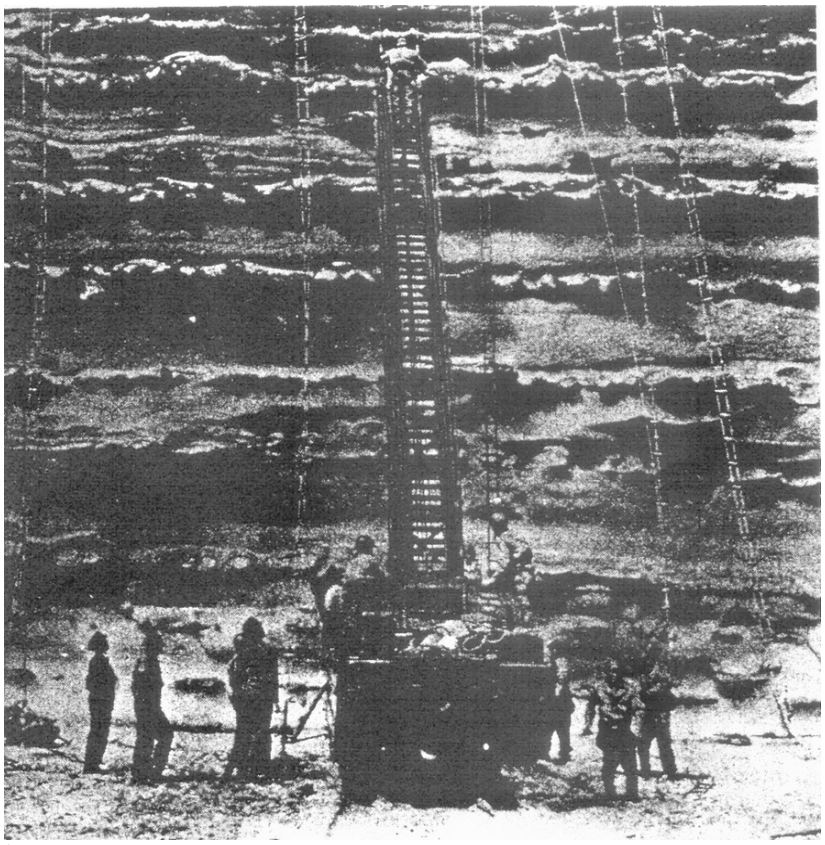


Rope and steel ladders

PLATE 5

Ladder comes ashore

PLATE 6

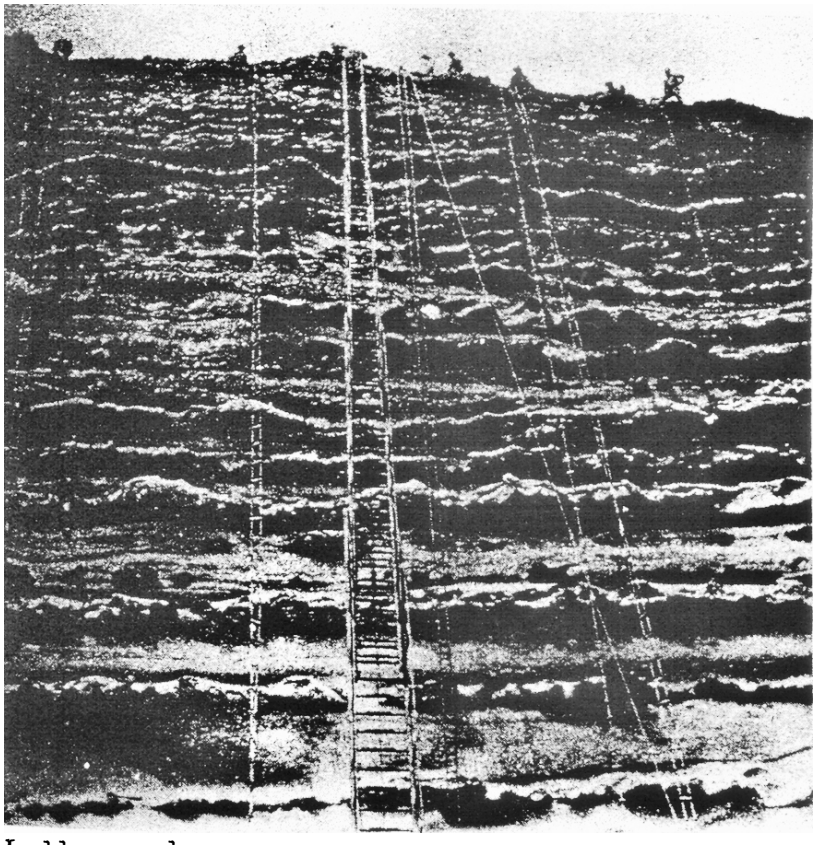


Ladder put into position

PLATE 7

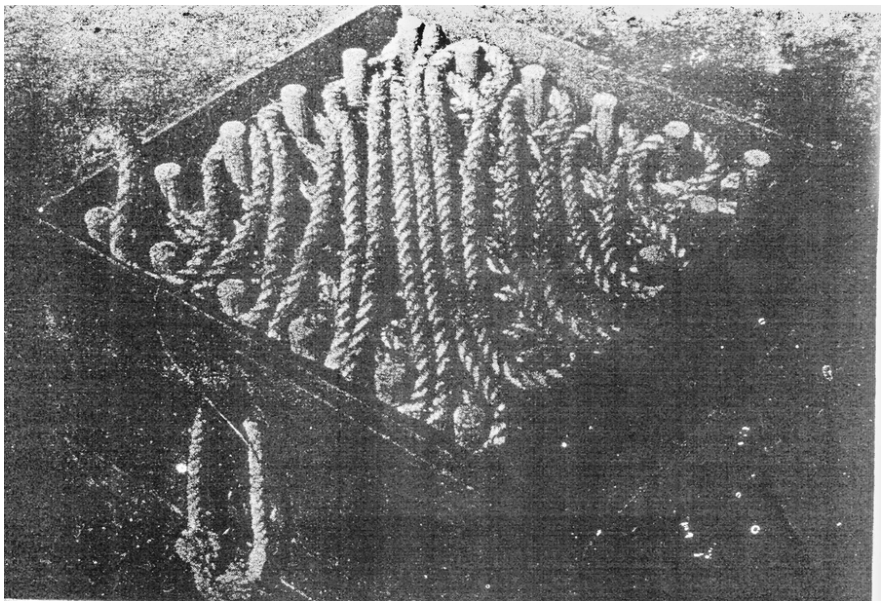
Ladders and ropes

PLATE 8



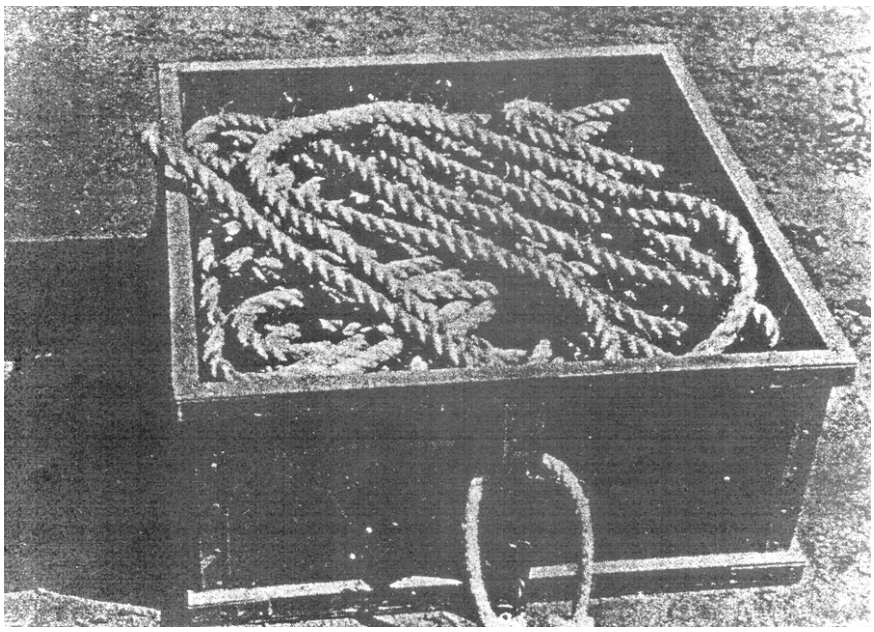
Ladders and ropes

PLATE 9



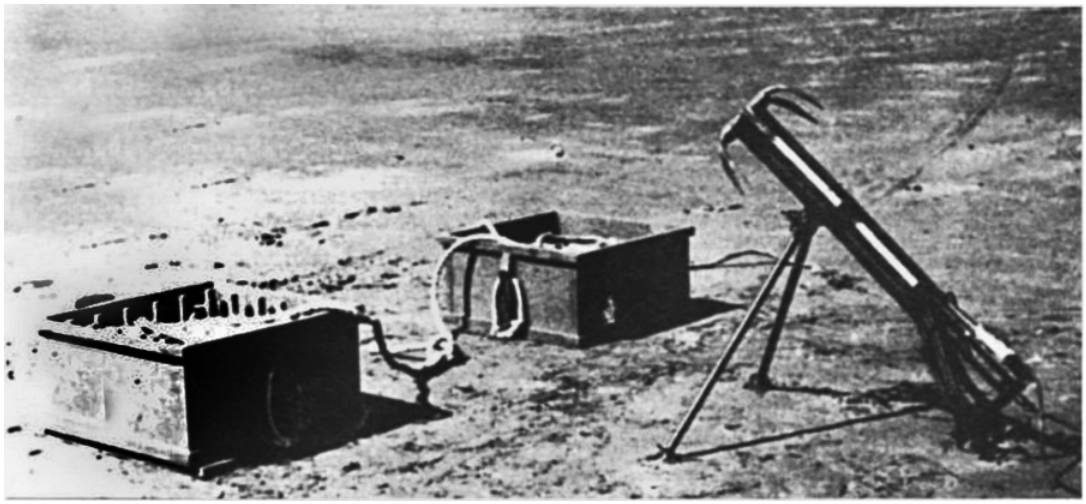
Rope in box in pin board

PLATE 10



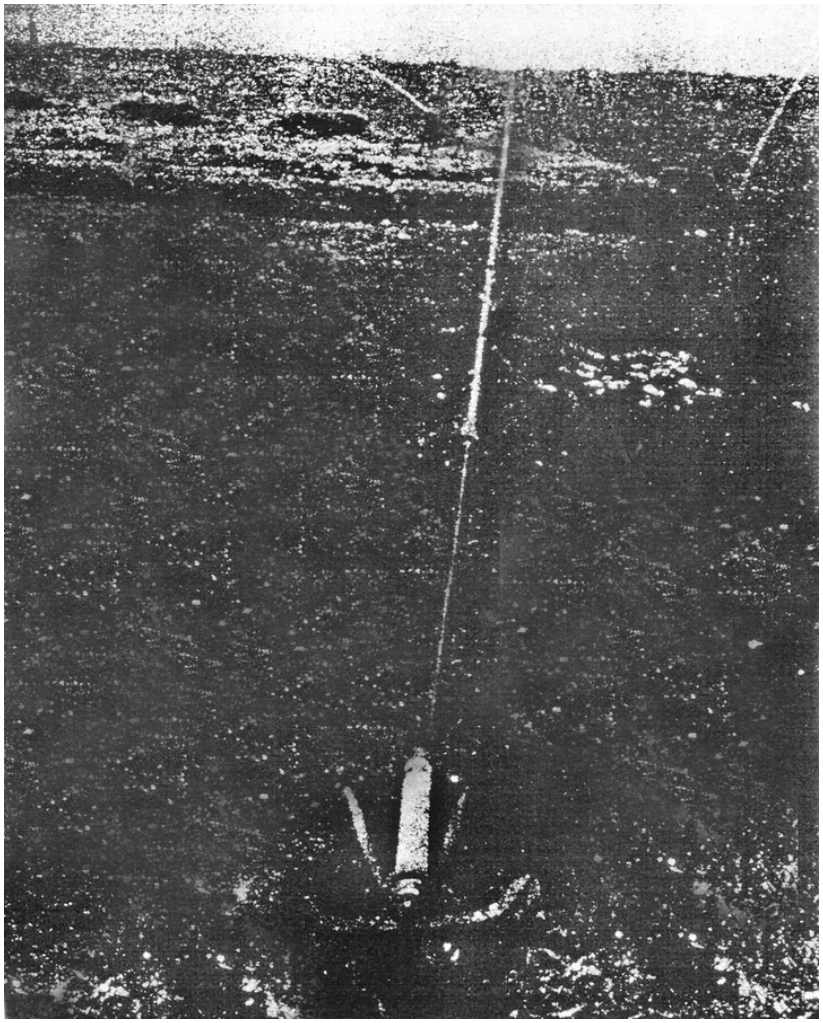
Rope in box with pin board removed

PLATE 11



Rocket projector and grapnel ready to fire. One box still has the pin board to be removed

PLATE 12



Grapnel after surmounting the cliff shown in Plate 1.

Climbing 'seconds' - Climbing 'seconds' will land with a gripfast strapped around their waist and a 2½ inch rope coiled in baskets and secured to the gripfast ring. They will wear climbing boots and carry sidearms and machine carbine.

Party providing covering fire - The party providing covering fire will wear climbing boots for speed and carry machine carbines and hand grenades.

Main body - The main body will carry normal troop weapons and equipment unless particular obstacles are expected inland. Climbing boots should usually be worn.

Signals on the bridgehead - Signal equipment required on the bridgehead will be -

(a) Wireless sets SCR 536.
(b) Light telephone Mark M or sound power telephone.
Twisted cable on light rollers and W130. This will provide a telephone link between the bridgehead and the beach.

Signals on the beach - Signal equipment required on the beach will be -

(a) Wireless sets No. 38 or No. 68.
(b) Beach marking, with lights for use at night.
(c) Morse torches.

Liaison men - Liaison men will carry rollers, gripfasts and coiled ropes to assist follow-up troops in climbing the cliff.

70 Day or night assault drill

Landing drill

(a) On touching down the leaders will land first followed by the 'seconds' and the party providing covering fire. These parties will be split up among the first wave of landing craft.
(b) The main body will fan out at the cliff foot following the leader's general direction from each landing craft.
A party from the main body will guard the beach flanks and will also take up a position from which they can keep the cliff head under observation in order to protect the leaders while climbing.

Climbing drill

(a) The leaders will discard their baskets containing the coiled 1½ rope at the cliff foot, and with the end of the rope fastened round their wastes will climb the cliff by the quickest routes they can find.
(b) The 'seconds' will pay out this rope from the basket. 1½ inch rope is used as heavier rope would impede climbing.
(c) The leaders on reaching the top will crawl over, unhitch their gripfast and will push the prongs in the ground. They then give two heaves on the rope as a signal.
(d) The 'seconds', on receiving the signal, will climb the cliff using the leader's rope as a handline. Their rope will also be run up as they climb, being paid out from the basket by a man at the bottom. On reaching the cliff top, or any point where the angle becomes easy, they will give two heaves on the rope as a signal for the leading members of the covering fire party to ascend.
(e) The 'second' will then crawl to the leader, unhitch his gripfast which will then be fastened in the ground by the leader, and will move forward to give the leader cover with his machine carbine.
(f) The leader, when the 'second' gripfast is in, will give two heaves on the second rope which will then be ready for use. This rope being thicker will be easier to climb. The leader will look after both ropes.

(g) After the initial men of the covering party are on the cliff top, they will be followed by the bridgehead commander, the signal party with the telephone and the main assault party to form a bridgehead in accordance with the plan.
(h) The personnel carrying rollers etc. will place them in suitable positions, reporting their positions to the beachmaster.
(j) If the cliff is steep, only one man will be able to use a handline at a time. When he has finished using it, he will give two heaves on it as a signal to the next man, who will be holding the lower end, to ascend the cliff, his place at the bottom of the handline being taken by another man.
(k) The order of climbing for the various parts of the main body with each set of ropes should be worked out beforehand.
(l) Certain rope positions always prove much easier for ascent than others. It is the beachmaster's responsibility to ensure that bodies of men are shifted to the easier places as soon as they disembark from the landing craft.

72 Formation of assault bridgehead at night

(a) A drill for the formation of a bridgehead at night is necessary to ensure a steady flow of men up the cliff.
(b) The bridgehead commander will select a control point in the centre of the bridgehead and, if possible, under cover. White tape will be run to the control point from the outermost gripfasts on either flank. The main body proceeding up any rope will follow the tapes and pass through the control point.
(c) White tape will be run out from the control point to the bridgehead headquarters The left and right flank of the main bridgehead positions will be marked by the bridgehead commander's runner and the flank commander's runner respectively.
(d) The main body will pass through the control point, follow its appropriate tapes, and form up in its correct position on the outer perimeter, not too close to the cliff head.
(e) The parties on the left and right flanks will report when they are in position, and the bridgehead commander will call in the initial covering fire party by signal. This party will move up to the bridgehead headquarters to form a small reserve with high fire power. They will usually take up a position just forward of this headquarters, as the final link-up of the two flanks may take a long time in the dark.
(f) A password and countersign are essential.

Follow-up wave. Link-up with the initial assault

73 The bridgehead commander, when he considers the situation suitable will call in the follow-up troops by R/T, using codewords. At night, the beach should be lit with three lights, port, starboard and centre, to enable the follow-up wave to land on the correct part of the beach.
These lights will be placed, facing seawards, by the beachmaster on the instructions of the bridgehead commander. In the case of failure wireless communications two further links should be available and also a powerful directional light. If wireless silence is imposed, light signals from the beach can be used in conjunction with the line communication linking the beach to the cliff top.

74 At night, it is often difficult to direct men quickly to the rope positions, particularly if there is a wide beach to be crossed. A transverse white tape should, therefore, be laid by the beachmaster between the port and starboard lights, and white tapes run out from each pair of ropes in use to the transverse tape. The men will then be guided to the end of the ropes and will avoid going into gullies etc. up which no ropes have been led. This procedure is necessary particularly for deeply indented cliffs.

Climbing personnel within the follow-up troops

75 There should be some climbers with rope baskets and gripfasts amongst the follow-up troops in case -

(a) The initial assault has heavy casualties and there are not enough ropes in position.
(b) The initial assault lands on the wrong beach and the military force commander, coming in later with the follow-up troops decideds to assault the correct beach.

76 If the initial assault is successful and the ropes are in position, climbers of the follow-up troops will ascend the cliff carrying their ropes and gripfasts and dump them with the leaders at the top. The latter can put then put in the gripfasts and throw the ropes down. These extra ropes will enable the beach to be cleared quicker and will provide more means for withdrawal in cases where the cliff assault is a raiding operation only, terminated by re-embarkation.

Reorganisation of the follow-up troops at the cliff top

77 Parties going up the handlines will be split up and must reform into their sub-units before the force can move out of the bridgehead. In daylight sub-unit commanders will lead their sub-units to particular ropes and the sub-unit will reform at the top. At night, particularly if the landing is opposed on the beaches, such organisation may be impossible. Personnel of one sub-unit may go up different rope groups, and sometimes individuals or sub-units will be shifted by the beachmaster to easier places. The follow-up procedure will be adopted to reform mixed bodies as quickly as possible with sub-units. White tape will already have been laid by the initial assault party from the outer flank gripfasts to the control point , as described in para. 74. More white tapes will be laid from the control point to areas within the bridgehead which have been allotted to each of the main units taking part. In the case of a commando with A and B troops used as the initial wave, tapes would be run out for C, D and E troops, the heavy weapons troop and the headquarters troop. A liaison officer or NCO will be posted at the control point to ensure that personnel follow along the correct tape. Phosphorescent signs will make tapes more easily visible. In this way, whatever ropes are used, all personnel will pass through the control point and thence to their correct forming up area.
Medical personnel will remain near the control point and will carry out cliff evacuation from there.

Heavily laden personnel

78 Men who are part of the medium machine gun or 3 inch mortar sections may have difficulty in getting up steep handlines. Such men can be helped up by a hauling team at the cliff top equipped with rollers and a looped rope. The hauling team with their equipment should be landed with the assault wave. They should choose a suitable area and get their apparatus erected as soon as possible. The beachmaster must be informed where this area is, and in daylight it should be indicated by a beach sign. At night, all heavily laden personnel should report to the beach centre light where a guide will direct them to the place where the rollers have been erected.

Heavy stores

79 In addition to the equipment referred to in the above paragraph, it will probably be necessary to haul heavy stores up the cliff. Trained haulageteams will be required for this task. They will be equipped with a bipod, from which a stay (usually the end of a hauling rope) is attached to a gripfast. A second rope attached to gripfasts at the cliff top will be stretched taut and passed through a spring link clipped to the bipod, and made fast to a boulder or sand hook at the bottom of the cliff. Stores are tied on the haulage rope with simpls non-jamming hitches and suspended from the stretched rope with light snatch pulleys or spring links. A simple system of heaves on the hauling line is used for signalling. Stores can be raised at greater speed by use of a haulage bag, consisting of a large canvas bag on a metal rod with fittings for suspending it to the stretched rope. When the load reaches the top of the cliff, the bipod is swung back. The load lands on the cliff top, where it is undone (or taken out of the bag), and removed to a dump near the central point.

Casualty evacuation

80 There are two main problems in casualy evacuation -

(a) Getting casualties down a cliff to be evacuated by sea.
(b) Getting casualties up a cliff to a regimental first aid post forward.

81 The casualty to be lowered down a cliff is strapped in a navan "Neil Robertson" stretcher, which is suspended from the stretched rope of a haul apparatus by spring links at either end of the stretcher. The stretcher is then lowered away from above. Besides the loops at either end of the stretcher a central suspension is needed. This is obtained by threading a line through the four carrying handles, bringing together the four loops so formed, and clipping them in a spring link. This spring link is clipped to the stretched rope with another spring link. Nine inch diameter rope loops should be attached to either end of the stretcher to facilitate clipping on.

82 An alternative method is by rivetting shoulder straps and a waist belt on to the "Neil Robertson" stretcher. The stretcher can then be worn like a rucksak. A stretcher bearer, with the stretcher attached, lies on his stomach. The casualty is then strapped in the stretcher. A rope is tied to the upper loop of the stretcher leaving about 12 feet of slack end. This end is tied around the waist of the bearer so that he also is attached to the rope. The bearer is lowered over the cliff edge. He then stands, leaning outwards, with his feet on the cliff, and is lowered away. To help his balance, he holds on to the loose bight of rope connecting his waist rope to the loop where the stretcher is made fast. At the bottom the stretcher is undone, the casualty removed and the bearer is pulled up the cliff again, using a roller.

83 When a casualty is being raised up a cliff, the stretcher is suspended on the stretched rope as above, and the hauling rope is taken over a roller between bipod legs. The roller eases the friction as the casualty is hauled up and landed at the top in the usual way.

.../ Using

Using a roller at the cliff edge, the bearer and stretcher (worn like a rucksack) are hauled up, the bearer leaning outwards from the cliff. If the extreme top portion of the cliff is vertical this method demands considerable strength on the part of the bearer.

Cliff withdrawals

84 Cliff withdrawals are difficult to do smoothly.
A carefully prepared timetable will have to be made and considerable individual training will have to be done in the technique of roping down a cliff, particularly in the dark.

85 The withdrawal should take place in three main stages -

(a) Returning troops will form up inside the bridgehead and sub-unit commanders will report to the bridgehead commander when they are ready. The bridgehead commander will give the order for the withdrawal by sub-units, and will give the orders for the appropriate craft to be called in. If it is dark, beach lights must be turned on.

(b) All external troops having been withdrawn, a close support party on a inner perimeter will be put on covering the rope heads. The main body of the bridgehead will then withdraw on orders fron the bridgehead commander. The bridgehead commander will withdraw his headquarters to the control point, and each sub-unit will report to the control point as it passes through. The bridgehead commander will give the necessary orders for craft to be called in.

(c) Finally, a "crash" withdrawal will be carried out by the close support party and the leaders. These men should be selected for their speed in roping down.
In the dark, such withdrawals will be greatly facilitated if the subsidary white tapes are run to the heads of the ropes from the two main tapes leading to the check point. Also confusion will be avoided if such ropes are previously grouped in groups of four.
If there is a sandy beach, such withdrawals can be speeded up by erecting several bipods at the top with a stretched rope leading down from them to a sand hook well buried at the bottom.
All men will carry a toggle rope, or a rope loop with a spring clip, and either pass it over the stretched rope, or clip on and go down a "death slide".
Men trained in this method of roping down will be able to carry out a withdrawal very fast.

SECTION 8 - PRELIMINARY TRAINING

The object of training

86 The object of training for cliff assaults is to be able to reduce a cliff to the status of an incidental obstacle, the act of scaling being constantly subordinated to the tactical requirements necessary to capture the objective.

Time required

87 The time required for training troops and boats crews in cliff and rock climbing and landing will normally be eight weeks. By the end of the sixth week of training the object that is to reduce the cliffs to the status of an incidental obstacle must have been attained, to allow adequate time to prepare in detail the actual assault on the objective.

Location

88 The place chosen for training must resemble the scene of the operation and should, if possible, be more severe. The exact geological composition of the cliffs to be assaulted in the operation should be matched if possible

Outline plan

89 The commander's plan should be made before the training starts, since the equipment required depends on the method chosen for the assault. The danger of a breach in security may have to be accepted unless the whole operation is to be jeopardised by faulty training.

Safety precautions

90 In the early stages of training men must not be unduly rushed or accidents may occur. Accidents before the men are accustomed to climbing can retard progress indefinately. Cliff and rock climbing is difficult, and planty of time must be given to the instruction of the individual soldier. Safety ropes must always be used during training.

Attached units

91 Joint training of the boat crews, and of the army unit detailed for the cliff assault, should be begun as soon as the individual phase of training has been finished.

92 In addition, the parachute troops should carry out their training in close conjunction with the seaborne force so that co-operation may be complete, for on this may depend the success of the operation. All other attached troops must also be nominated early, and must undergo the full training if they are required to land with the assault force.

Training of officers

93 During training all officers should carry out a careful study of the problem of cliff assaults. The film "Way Back" will be useful as an indication of up-to-date progress in this technique. Sketch maps of the main topographical features and layout, and of the present relative position of enemy defences will be required. These need not disclose the location of the objective. Oblique aerial photographs of the actual cliffs can be used if the hinterland is first removed since one area of sea and cliff face looks remarkably like another.

94 Vertical and oblique photographs of the practice cliffs should also be taken. These are valuable if taken with the same sized lens and at the same height as the photographs of the actual cliffs. A study of these training photographs, stereoscopically and in comparison with the practice cliffs, will enable the following deductions to be made from the photographs of the assault cliffs :-

(a) Are the steep sections of the cliff rocky or composed of steep earth and grass?

(b) Has it a lip at the top which can be sormounted with hand grapnels and ice axe?
(c) Having regard to the geological formation, does it require mechanical aids or can it be easily climbed?
(d) How long ropes and/or ladders will be required?
(e) Will the climbers be defiladed from any obvious strongpoints?
(f) If a rocky landing is necessary, where are there least underwater obstructions?

If available, the best stereoscope for use with untrained officers is the adjustable pocket American Pattern, Type B3.

95 When studying aerial photographs of cliffs the following points should be remembered :-

(a) In comparing vertical photographs with the ground the cliffs should be obscured from both their seaward and landward sides, if a true impression of their relative steepness is to be obtained.
(b) Oblique photographs, if taken parallel to the coast, make headlands and the rocks of headlands appear disproportionately large and steep. Conversely the coves and indentations appear deceptively easy. This false perspective does not affect portions of the cliff which lie at a considerable angle to the line of flight, and the gradient of these portions can be most accurately measured from such obliques.
(c) An estimate of the height of cliffs can be arrived at with fair accuracy, provided there is in the photographs one known height.
Even the worst maps can be relied upon to provide at least one spot height. Failing this, there will usually be in the picture objects of a known height, such as houses, telegraph poles or at worst trees. By relation to known objects in general, and in particular by the comparison of shados, the height of the cliff can be estimated.

96 While the technique of cliff assaults has been the subject of considerable experiment, it is still in the development stage. It is far enough advanced to be used but the teaching and practice are still fluid and capable of improvement. It therefore offers scope for ingenuity and initiative.

Training of climbing leaders

97 Climbing leaders require considerable training, both day and night.
They should be picked NCOs and men, selected mainly from those sub-units which have been chosen to be assault wave sub-units. They should be trained by qualified instructors, first on easy boulders to gain confidence in using nailed boots, later on harder boulders to acquire technique, then on easy exposed climbs to overcome dislike of heights, and finally on difficult exposed cliffs. The standard aimed at should be "very difficult" according to peace-time rock climbing standard. Climbing problems and rock should be as varied as possible.

98 At first these climbers should be allowed to gain confidence by being put only on hard firm rock such as granite, but later varying rocks particlarly loose poor rock should be introduced. Weapons and equipment should not be carried until the later stages, when the drills for sub-units are introduced. Leaders must be taught sound rope management and knots, as they will have to instruct the rest of their sub-units. They must be capable of climbing steep earth and grass, with the use of cut down ice-axes, and patches of vertical and overhanging gravel at the tops of cliffs, with the use of hand grapnels.

99 Not less than a fortnight should be spent on this, on a scale of two or three students per instructor, and practicing on varied rock. Climbing leaders will gain further confidence in themselves by instructing their own sub-unit afterwards.

100 In the assault, the 'seconds' should also be men who have done these preliminary leaders courses. The climbing leaders for the assault should be the fastest climbers in the unit.

Training of assault troops

101 Assault troops, once their leaders are trained, should undergo similar, though not quite such difficult training for at least one week without equipment, so that all members become fairly quick on steep ground.
All personnel should be capable of climbing "moderately difficult" rock unaided and with weapons and equipment.
They should be specially trained in moving up handlines quickly, and in roping down quickly.

102 These troops, after this first stage has been reached, should be practised over and over again at cliff sub-unit assaults, withdrawals, and bridgehead formation both by day and night, until all are clear about their respective roles whatever the character of the terrain. All personnel likely to be with this assault, such as signallers, medical orderlies, etc. must be included in this training. Besides handline training such troops must be well practised in climbing rope ladders fired up by rockets.

Training of follow-up troops

103 Follow-up troops must be trained to move up handlines and rope ladders quickly, and to rope down. They should be taught the general formation of the bridgehead, and be given several schemes in which they form up within that bridgehead. If opposition in strength is expected, withdrawal practice will also be needed.

104 Heavily laden troops must be used to operate with rollers.
Stretcher bearers need careful training in their roles.

Summary

105 The technical aspect of the cliff ascent must be kept in proper proportion relative to the tactical requirements of the plan.
No cliff is unsurmountable, but poor planning may result in failure.

106 A cliff assault can be carried out only by troops who have undergone suitable training and who have been well rehearsed. With suitable equipment the ascent of the largest cliffs is only routine.
Without suitable equipment a twenty foot cliff can be a great obstacle.

SECTION 9 ROCKY LANDINGS

General

107 Rocky landings may be made on two types of coast, one where a considerable cliff leads straight down into the water, and the other where the cliff has fallen away and may even be practically non-existant.
Landings in considerable swells are possible on the former type of coast but calmer water is needed for the latter.

108 If other tactical considerations allow, the best place to land is on the leeward side of a headland. Usually there are many awkward underwater rocks continuing the line of the headland itself, and there may also be a tidal stream which causes a lop.
By choosing a headland first it is often easy to find a suitable landing area to its flank.

Suitable craft for rocky landings

109 Normal flat bottomed landing craft are unsuitable for rocky landings.
The most suitable craft are LCP(L) with a ribbed reinforced bow. These craft draw very little water, and the waterline at the bow is well aft of the place where they usually touch the rock at deck level. They will require a strong belaying post aft for holding the kedge warp. Each LCP(L) will carry 20 fully equippedsoldiers with the necessary equipment. Theflat deck level which extends right forward, is the most suitable platform from which men can run off and jump on to the rocks.

Any boat with a strong curved stem post may be used, such as a dory, but dories are more difficult to land from as they have no deck.

Selecting the landing point

110 Vertical aerial photographs taken at low water should be studied, and any areas of cliff edge without outlying swirling patches of foam should be considered as possible landing places. At high tides such places will be clear of underwater obstruction.
Oblique photographs, giving silhouettes from which bearings can be taken, should be stdied.
The ideal conditions of moonlight are when the moon, which should never be less than quarter full, shines from the sea on to the cliff, though not of course along the selected line of approach. Without favourable moonlight, distance judging and picking out of sudden obstacles will be very difficult.

Making the landing

111 When the boats are opposite the correct landing place, the leading boat or boats will go in at 'dead slow'.
They should be provided with a kedge anchor, and, in the case on LCP, 30 or 40 fathoms of kedge warp. It is advisable for all LCP to have the same length of warp, otherwise when flotilla officers use different craft, they may misjudge the length.
Two soldier bowmen wearing climbing boots should lie on the bow, one holding the end and the other holding the coils of a long bow warp. Not more than three men on either side should be lying on deck. At a suitable distance from the cliff, the kedge is dropped on a hand signal, from the officer in charge (or the leading hand in later boats). The kedge is then allowed to run free for several fathoms before a turn is taken round the wooden belaying post. This ensures that the kedge holds the ground and is not dragged along with the flukes not gripping.

Personnel in craft, and calling in of rest of assault wave

112 Ifthere is a cliff to be climbed after the landing, the leading boat or boats should contain the following parties:- two leaders and 'seconds', the initial covering party, the bridgehead commander, and a beachmaster and party for each landing point. The assault waves must each contain a leader and a 'second' in case of accident to the first craft. They should be signalled in by light as soon as it is clear that the cliff can be climbed at this point. The beachmaster should have two beach transit lights placed about 12 feet off the ground also a morse light for calling in the craft. As the incoming craft nears the cliff, the beachmaster shines his torch on to the rock edge, but not out to sea, to enable the boat commander to judge his distance.

Follow-up troops

113 Follow-up troops are called inshore by wireless, and are called in to the beach by signal. This signal will be the beachmaster's light if it is dark. If the cliff is difficult the craft following the assault wave will land where the ropes are already in position, i.e. direct on to the area of the initial landing point. If the cliff is easy, a suitable area of rocks is chosen, This landing area will be marked by beach marks by day, and by beach lights at night. Craft will come in between these beach marks. The whole process is slower than with a beach landing as there are less men to the boats and the navigational difficulties are greater although opposition is likely to be slight. Follow-up craft should carry climbers in case they fail to link up with the assault wave. In general, the number of men taking part in a rocky landing will be limited by the number of trained boat crews and craft available.

Haulage of heavy stores

114 Bipod (sheer leg) teams can be landed and ropes run out from the craft. When the bipod and upper gripfasts are in position, the craft is warped out on its kedge and the stretched rope passed through a ring bolt on the forward deck. The boat is thus moored to the kedge aft and to the cliff top over a bipod. Stores are run up this rope in the usual way. This method, however, cannot be used in a big swell.

APPENDIX 'A'

METHODS OF MAKING THE INITIAL ASSAULT

	Type	How employed	Factors	
			For	Against
1	Parachute troops	Small parachute force drops before H hour inland of selected spot, re-organise and move to cliff edge and there establish initial bridgehead to prevent hostile interference with cliff scalings. At H hour parachute force lower light well marked lines over the cliff. To these are attached the ropes, ladders etc which have been landed by the seaborne force, and up which the follow-up force climb.	(a) Enables small enemy posts to be dealt with. (b) Speeds up operation. (c) Provides protection in early stages of the cliff climb. (d) Silent.	(a) Dependant on weather (b) Dependant on correct landing (c) Difficult to establish contact with seaborne force even if point of contact well defined. (d) May alarm enemy.
2	Rocket and grapnel	Rocket projector set up on beach or landing craft, consisting of rocket stand, rocket and grapnel especially coiled 2½ inch rope in special box and electrical firing device. For the rope, a small rope ladder or a combination of a tackle and ladder may be substituted. First man climbs up and helps to raise the remainder of the follow-up force and/or the apparatus for their use.	(a) Height ceiling over 200ft (b) Certain method. Grapnel grips well. (c) Equipment is easily transportable. (d) Can be fired from shore or boat. (e) Speediest method of getting line to cliff top.	(a) Rocket makes a flash and roar during flight. (b) Grapnel can be interfered with by enemy before first man is up.
3	Schermuly mortar (A) Multiple shot. (B) Single shot.	This light mortar works in the same manner as a Schermuly pistol. It fires a small rocket with light grapnel head attached to a line. The line is coiled in a waterproof paper box by the manufacturers. It is used to assist the initial men to scale the cliff either alone or in conjunction with other apparatus. It can be carried and fired by one man. Type (A) can be reloaded and is used for training. Type (B) cannot be reloaded and is the operational model.	(a) Very light. (b) Can be rapidly set up and fired. (c) Can be fired to fall on any selected part of the cliff. (d) Requires little storage space. (e) Expendable and cheap.	(a) The grapnel cannot support heavy weights. (b) The line is too thin to be climbed. Thus can only be used as aid or safety line. (c) Difficult to fire with accuracy. (d) Extra thin line necessary for height over 100 feet.

	Type	How employed	Factors	
			For	Against
4	Ladders - extending power operated.	A power operated fire ladder or water tower, mounted on an amphibious vehicle swims ashore, takes up position and extends with leader in position at top of ladder. A MMG can be mounted on top of the ladder. Remainder of force run up ladder which provides broad treads and hand rails.	(a) needs no special training except for operator. (b) Provides covering fire early. (c) Very rapid. (d) Relatively silent. (e) At its best on over-hanging cliffs. (f) Carries up with it the telephone connecting beach to cliff.	(a) A 100 feet ladder with oper-ational limit of 80 feet. (b) Needs suitable beach, free from obstructions and solid enough to take the vehicles. (d) Ceiling drops rapidly as angle of cliff from vertical increases.
5	Ladders - extendable hand operated.	As for power operated, except leader is not raised with the ladder and MMG cannot be mounted on it. Rungs instead of treads and no handrails.	(a) Lighter than ladders extending power operated. (b) Quite silent in operation.	(a) A 60 foot ladder oper-ational limit of 40 feet. (b) Needs suitable beach, free from obstruction and solid enough to take the vehicle. (c) Ceiling drops rapidly as angle of cliff from vertical increases. (d) Has to be manhandled into position.
6	Balloons	Naval kite balloons are flown off shore at a suit-able operational height (500) feet the leader is attached to the cable by a parachute harness at a height slightly greater than the height of the cliff. One to three balloons are used to give the necessary lift, depending on wind force.	(a) Silent. (b) First man quickly up. (c) Virtually no ceiling.	(a0 Balloon is vulnerable to small arms fire. (b) Can be easily picked up by enemy Radar. (c) Difficult to handle.

	Type	How employed	Factors	
			For	Against
6	Balloons (Cont'd	The balloons are flown ashore attached to a power winch in a boat or amphibious vehicle. Leader drops off on to cliff top, balloon is then used to lift remainder.		(d) Can only operate with onshore wind.
7	Cross bow grapnel	Not at present available. Attempts are being made to develop this grapnel in order to get the advantage of a rocket without its flash or roar.		

APPENDIX 'B'

FOLLOW-UP METHODS

	Type	How employed	Factors	
			For	Against
1	Steel tubular 4 foot sectional ladders.	Each section is carried by one man. The first section is attached to the line or rope and hauled up by the leader, sections being added till the necessary height is obtained. The ladder then hangs vertically like a rope ladder. Wharf hooks on the top of the ladder grip the cliff edge and a line with grip fast is used in addition.	(a) Light and handy. (b) Easy to climb. (c) Quickly erected. (d) In good supply. (e) Has not been tried beyond 88 feet, but works well at that height. (f) Very suitable for overhangs.	(a) Liable to come apart in the middle through faulty assembly.
2	Light rope ladders.	Hauled up and attached by leader and secured.	(a) Light. (b) Can overcome overhangs.	(a) Difficult to climb.
3	Knotted or toggle rope.	Taken up by second man and then climbed by the remainder with assistance of foot work against the rock face. Alternatively may be fired attached to 2 inch rocket and grapnel, in which case it may be used to assist up the leader and thus becomes an initial assault method.	(a) Simple and straightforward. (b) Particularly suitable for sloping cliffs.	(a) Tiring and can only be used up to about 100 feet depending on the slope. (b) Impracticable for big overhangs.
4	Block tackle and sheer legs.	Sheer legs placed on the edge of vertical cliff, and used to haul up heavy weapons and stores.	(a) The best way of getting stores up a cliff and for evacuation of casualties.	(a) Hauling party at the top may be exposed to enemy fire.
5	Rollers.	A special roller is placed on the cliff edge and a bight of rope dropped over it to the bottom. Each man then runs up the cliff, assisted by haulers pulling on the bight, which he has placed under his armpits.	(a) very rapid. (b) Simple. (p) Suitable for heavily laden men. (d) Most of the weight taken by the climbers legs.	(a) If the cliff is vertical or over-hanging, all the weight comes on the haulers and the method becomes slow and dangerous. (b) The haulers are exposed to enemy fire.

DETAILS OF THE WEIGHT AND PERFORMANCE OF APPARATUS USED IN CLIFF ASSAULTS

1 ROCKET AND GRAPNEL (Projected Grapnel)

(a) Description of parts and weights

(I)	Projector	Modified PAC Type J Length 4 feet 3 inches	Weight 38 lbs
(ii)	Rocket	Standard 2 inch Type J	Weight 9 lbs
(iii)	Rope box with pin base	Size 2 feet 5½ inches square by 1 foot 3½ inches deep	Weight 49 lbs (no rope)
		Box without pin base	Weight 34 lbs
(iv)	Rope	45 fathoms in each box	Weight 58 lbs
(v)	Grapnel	15 inch overall diameter	Weight 9 lbs
(vi)	Wire strop	8 inch flexible wire (1 ton) with brass thimble each end	
(vii)	Flame protector	Connects strop to tail of rocket	
(viii)	Firing battery and key	4 volt dry battery in water-tight container combining firing key and socket to take firing lead plus	

(b) Performance

		Rope size and type	Approximate vertical height	Elevation
(i)	Standard 2 inch rocket grapnel	1 inch plain	600 feet	80 degrees
(ii)	Standard 2 inch rocket grapnel	2½ inch plain	300 feet	80 degrees

2 SCHERMULY MORTAR (Light weight grapnel equipment)

(a) Description of parts and weights

(i)	Schermuly rocket	27 inches by 3 inches diameter	Weight 5½ lbs
(ii)	Grapnel head		Weight 4 lbs
(iii)	Projector	27 inches by 3 inches diameter	Weight 4½ lbs
			14 lbs
(iv)	Rope box	23 by 23 inches by 6 inches deep	Weight 10 lbs
(v)	100 feet of 1 inch rope		Weight 25 lbs

(b) Performance

		Rope size and type	Approximate vertical height	Elevation
(i)	Light Schermuly equipment	1 inch rope	200 feet	80 degrees
(ii)	Light Schermuly equipment	1½ inch rope	150 feet	80 degrees

3 LADDERS EXTENDING POWER OPERATED (100 foot power operated ladder on DUKW

(a) Description of parts and weights

(i)	Weight of ladder (standard 100 foot Merryweather)	22 cwt
(ii)	Weight of frameand mechanism (frames duralumin)	33 cwt
	Total weight	55 cwt
(iii)	Maximum length of ladder	100 feet
(iv)	Height of bottom of ladder from ground	5 feet
(v)	Distance of ladder fulcrum from bow of DUKW	20 feet 6 inches
(vi)	Overhang of ladder when horizontal	7 feet
(vii)	Maximum elevation	75 degrees

Power to drive ladder is taken off winch drive on DUKW

(b) Performance

(i)	Time to elevate from horizontal to 75 degrees (maximum elevation)	50 seconds
(ii)	Time to extend to 100 feet	90 seconds
(iii)	Time for man to climb	45 seconds

(c) For a vertical cliff

	A Angle of elevation	B Loss of height for full extension	C Height of ladder above ground	D Distance of DUKW bow from cliff base
(i)	75 degrees	3 feet 6 inches	101 feet 6 inches	7 feet
(ii)	70 degrees	6 feet	99 feet	16 feet
(iii)	65 degrees	9 feet 6 inches	95 feet 6 inches	25 feet
(iv)	60 degrees	13 feet 6 inches	91 feet 6 inches	34 feet

Column D has taken into account the sage of the ladder due to the weight at the tope, and those distances are therefore a minimum.

(d) Alteration of elevation will move ladder top :-

	Vertically up	Horizontally out
(i) From 60 degrees to 65 degrees	4 feet approx	7 feet 6 inches
(ii) From 65 degrees to 70 degrees	3 feet 6 inches approx	8 feet approx
(iii) From 70 degrees to 75 degrees	3 feet approx	8 feet 3 inches

4 ROPE LADDERS

(a) Description of parts and weights

(i)	Two 1 inch manilla ropes with wooden rungs 1 inch diameter by 9 inches long spaced 18 inches apart.	
(ii)	200 foot length of ladder	Weight 48 lbs
(iii)	Box to hold ladder 50 inches by 10½ inches by 19 inches high	Weight 30 lbs
(iv)	30 feet of 2½ rope between rocket and ladder	Weight 5 lbs
		83 lbs

(b) Performance

		Rope size and type	Approximate vertical height	Elevation
(i)	Standard 2" rocket grapnel	Rope ladder (light)	250 feet	80 degrees
(ii)	"	Rope ladder (heavy)	200 feet	80 degrees

5 TOGGLE ROPE

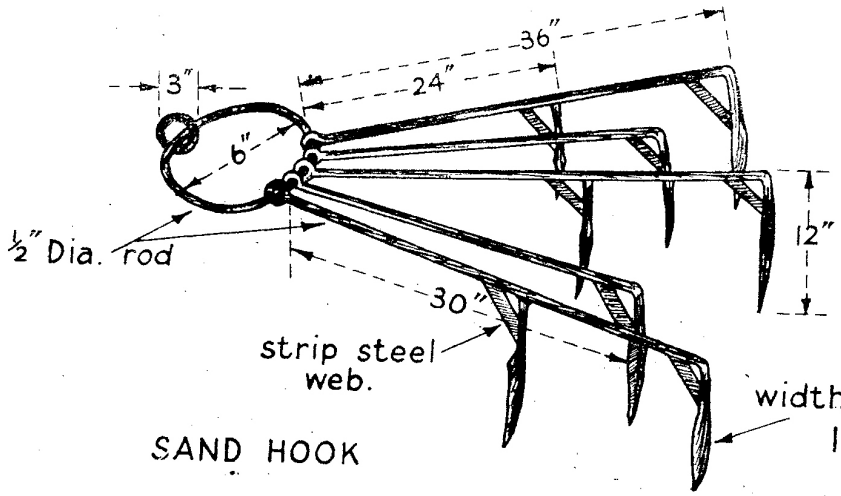
(a) Description of parts and weight

(i)	5 inch wooden toggles spaced every 3 feet 220 foot length	Weight 45 lbs
(ii)	Box as for plain rope	Weight 35 lbs without pin base.

(b) Performance

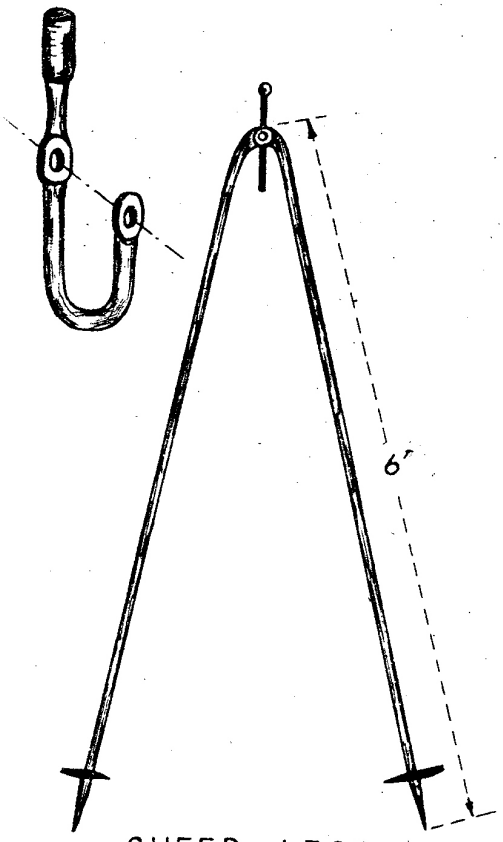
		Rope size and type	Approximate vertical height	Elevation
(x)	Standard 2 inch rocket grapnel	2½ toggle 3 feet spacing	275 feet	80 degrees

DIAGRAM 11



SAND HOOK

DIAGRAM 12



SHEER LEGS (BIPOD)

DIAGRAM 13

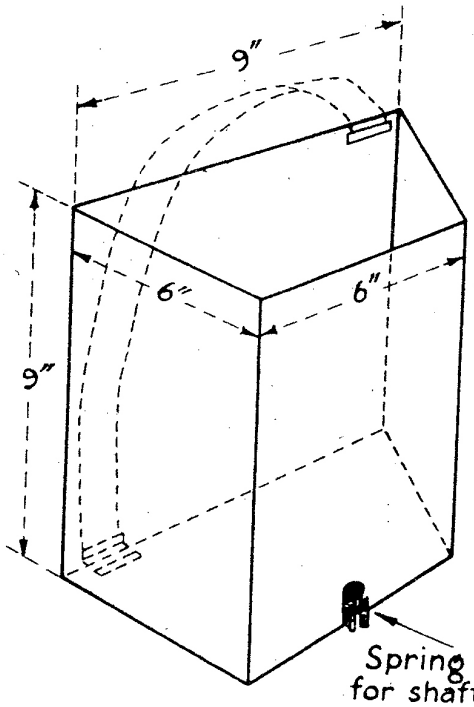
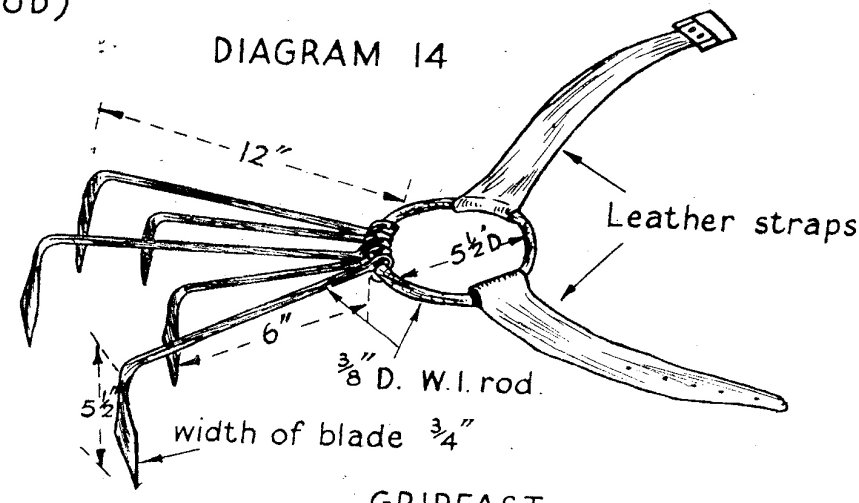
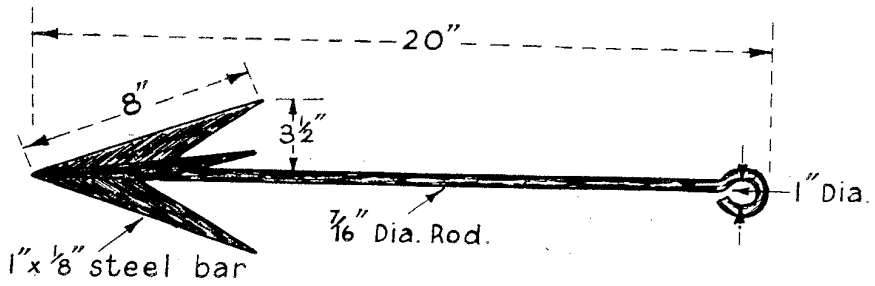


DIAGRAM 14



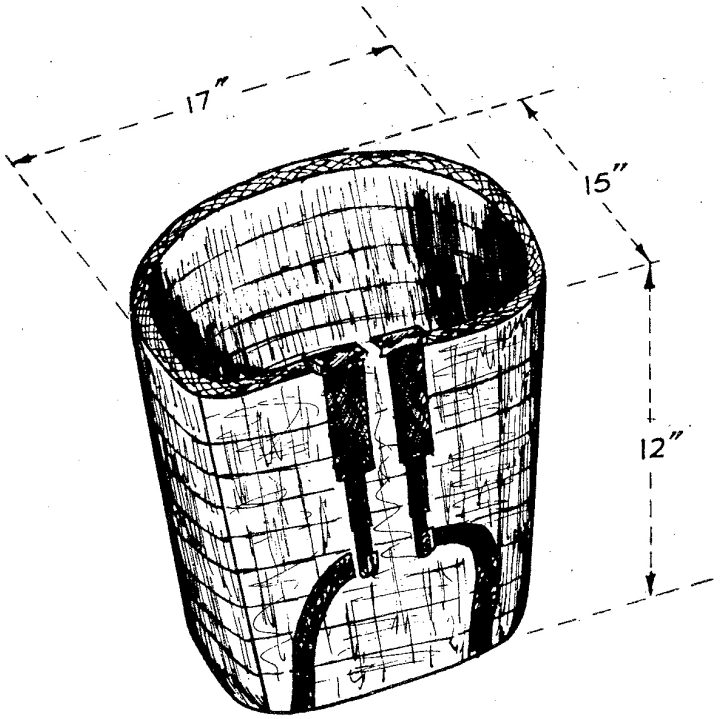
GRIPFAST

DIAGRAM 15



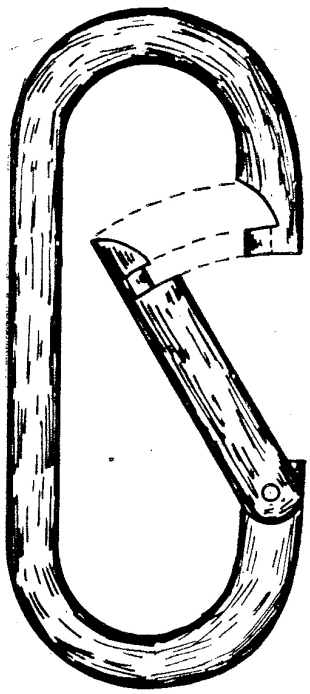
LIGHT THROWING GRAPNEL WITH FIVE PRONGS

DIAGRAM 16



ROPE CARRIER BASKET
FITTED WITH EQUIPMENT
SHOULDER STRAPS.

DIAGRAM 17



SPRING LINK (KARABINER)
Approx. full size.