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AIR SUPPORT OF LANDING ASSAULT OPERATIONS

I was glad to learn from Col Thompson during his opening remarks last Monday that he does not like the term "expert", for I can assure you that we do not have any experts in the Support Command, who can qualify as such as a result of battle experience. In connection with the term "expert" it might be interesting to remind you of the definition of Lt Gen Bill Knudsen gives to that term. General Knudsen says an expert is "just a plain ordinary bench mechanic away from home".

In his opening remarks Col Thompson also made reference to "letting our hair down". That too will be a bit difficult for some of us, but I can assure you that I hope to deal with the subject during this talk and the discussions to follow with as much frankness of expression as the presence of our recorders permits.

I know of no magic solution to the problem of the correct employment of the air components in a large scale assault on a hostile shore, nor do I know of any concrete example which would serve as a model for the operations that lie ahead. The plans and methods of our employment - that is to say the tactics and technique - must be flexible, they cannot be rigid, but at the same time we cannot delay in taking some concrete decisions with regard to our plans and methods.

What air forces are required? How shall we employ them? What technique and procedure will we use to control them and to coordinate their employment with the ground and naval forces? These are questions to which I am sure you would like the answers.

Assault on a hostile shore is our task and this attempt may well come sooner than we expect.

At the outset I wish to caution you against confusion due to differences of nomenclature. This has always been a bugbear in combined air and ground operations, and in this Theater is aggravated by the differing terminology of the British and American Services. I shall refer to certain types of air units or headquarters which are involved in the cooperation between air and ground forces in the assault. Whether we use the term "Tactical Air Force", "Air Support Command", or "Composite Group" makes little difference so long as we understand the unit under discussion. The same is true of the various names for such agencies as "Air Support Controls", "Fighter Control", "MORUs", and so forth. I hope to make these various terms clear as they arise during this talk.

At this point I should like to refer to the strategic air operations against the enemy by our heavy bombers which will be carried on before, during and after the period of the landing assault. Although the objectives of these strategic operations do not lie within the immediate vicinity or area of tactical operations of the landing, they are nonetheless of great importance to the latter. The destruction and threat of destruction of vital enemy objectives compels him to divert formidable fighter forces from the area of the assault.

The destruction by our heavy bombers of key points in the enemy's lines of communication, such as marshalling yards, bridges and large supply centers, prevents the prompt movement of large

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enemy reinforcements or supplies to the beachhead area, and although our heavy bombers and their supporting fighters may not be seen in the skies above the landing beaches, it must not be thought that they are not contributing their utmost to the success of the landing operation. Their objectives will be selected in accordance with plans made on a high level where every consideration will be given to their effectiveness and to their value to the operation as a whole.

Now to return to the composition of the tactical air force which does provice support whose effect is most immediately apparently to the ground forces in the spearhead of the invasion. The units involved must be used offensively in the fullest sense of that term, both against the enemy air forces which are seeking to interfere with the landing and against the enemy ground forces attempting to prevent it, or which may be brought up for the purpose of expelling or destroying our forces which have succeeded in getting ashore.

First we must have a fighter force of at least 2 to 1 in numerical superiority over the enemy's fighters in the air above the beachhead area and within the radius of action of enemy fighters capable of intervening in that area. Our fighter forces must be able to dominate the air in this area to the extent of preventing the enemy fighters from interfering with our aircraft attacking ground objectives and to the extent of preventing enemy bombers and fighter-bombers from inflicting serious losses on our ground troops.

Next we require an air striking force of light and medium bombers and fighter bombers sufficient to neutralize the enemy air forces on its nearby airdromes and also sufficient to strike effective blows at the enemy ground forces opposing our landing.

We also need visual and photographic reconnaissance units to keep commanders of all ranks informed of the disposition and progress of our own and the enemy's forces. The scheme for assault may also include the use of smoke-laying aircraft.

It is more than likely that airborne troops will be used in connection with the landing and in this case forces of troop carrier aircraft, including gliders, will be required sufficient to lift the airborne units involved and to supply them for a period of at least 5 days.

Last but certainly not least we need a well-trained and efficient air staff organization and air - army - navy teamwork which will permit the whole operation to be controlled by the supreme tactical commander.

Let us now see how some of these forces are to be employed. First the fighters as such when they are out to destroy aircraft in the air and are not being used as fighter-bombers. Air fighting is currently grouped under three general heads: Fighter cover, fighter escort and fighter interception.

Fighter cover is the offensive occupation of the air in the vicinity of the ground operations for the purpose of preventing or reducing the operations of enemy aircraft of all types. It is provided by the dispatch of fighter aircraft on offensive missions during the time of important friendly air or ground attacks, or when it is believed that the enemy will attempt to invade the area with his aircraft on offensive missions. Fighter cover is difficult to provide because of the impossibility of maintaining continuous patrol in force over the area and because of the difficulty of determining in advance when the enemy air forces will be present. The strength of this

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fighter cover is dependent on the reasonable expectation of enemy fighter strength which can be made available in the area. It is <u>not</u> dependent on the strength of hostile bombardment units which may operate against our forces, unless that bombardment strength is so great as to saturate our fighter effort. At Dieppe the RAF used nearly fifty squadrons to maintain this fighter cover. On that day the amount of cover at any one time varied from two to eight squadrons - most of the time it was six. Fighter cover operates at heights dependent both on the enemy air action and on weather and cloud conditions. The bulk of the cover will be at medium altitudes (from 10,000 to 18,000 feet), with a proportion for high cover (20,000 to 30,000 feet), and low cover (below the clouds or below 6,000 feet). It is interesting to note that to maintain seventy-two (72) aircraft on cover missions continuously for 12 hours on D-day would require approximately fifteen fighter groups of four squadrons each, or approximately one thousand five hundred aircraft. Such a large fighter force will be necessary to cover the assault landing unless there is a marked decrease in German fighter strength available in N.W. Europe.

The distance of the landing operation from the fighter bases is, of course, a determining factor with regard to the strength of the fighter forces required. Fighter airplanes are necessarily short-range weapons as range must be sacrificed for speed, altitude and rate of climb. Considering that P-47s (Thunderbolts) and P-51s (Mustangs) will be available for fighter cover, it is believed that this cover could be furnished to a distance of approximately 150 miles from the center of the fighter airdrome area in the United Kingdom. Operations at diminished efficiency might be carried out as far as 180 to 200 miles.

From the foregoing it is apparent what a tremendous effort in fighter cover is required. This effort is only half effective if it is not accompanied by an equally heavy effort on the part of the air striking force, which takes advantage of the cover to deal a succession of blows against hostile targets on the ground.

Fighter escort is the next type of fighter operation to be considered. Fighter escort is necessary when fighter cover cannot insure the safety of our air striking units or when the escort method of providing protection is more economical than with a fighter cover. Fighter escort is particularly necessary in the attack on ground objectives behind the range of our fighter cover and deeper within hostile territory. Fighter cover and fighter escort missions complement each other by forcing the enemy to choose between the attack of one or the others, or to divide his strength between the two. For this reason it is not unusual to find cover and escort missions carried on simultaneously. It is vital to saturate the enemy fighter opposition whenever possible. Let me repeat that the amount of escort provided in dependent on the hostile fighter strength that our striking force may be expected to meet, and not upon the strength of our own striking force formations.

The most difficult fighter escort problem is the protection of troop carriers in connection with an airborne attack. Unless our fighters have driven the enemy fighters completely from the skies, strong escort must be provided for each wave of troop carriers and gliders. This escort may operate more as cover than as escort because of the relatively slower speed of the troop carriers. The fighters cannot accompany the transports without turning and also the escorting fighters must protect the land areas until the airborne troops have completed their

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landing and have had time to organize. Troop carrier planes are usually flown to the dropping area at tree-top level. This simplifies in some respects the escort tactics, but it may demand a temporary neutralizing of light flak in hostile territory along the route of the carriers. Thus, a troop carrier operation will require the simultaneous use of a strong force of the fighters in their dual role as fighters, bombers and tank busters if the latter are available.

All fighters capable of carrying bombs would be so armed so that the following functions could be performed:

1. Escort of troop carriers and engaging in air fighting, jettisoning bombs when necessary in order to engage in air combat.

2. Providing cover and close support at destination during landing and organization of airborne troops.

3. Providing escort to returning troop carriers.

The strength of the fighter forces used in connection with airborne operations depends on the strength of expected enemy fighters and on the strength of enemy opposition to airborne forces on the ground. In order to economize on fighters required, the airborne movement must be concentrated in as short a space of time as possible. It is estimated that six fighter-bomber groups would be required in the escort and support of an airborne division and three paratroop battalions in one simultaneous lift against such enemy forces as are now believed available in Northern France.

Fighter interception in connection with an assault over such an expanse of water, as is likely to be the case, will largely be confined to the interception of enemy aircraft attacking our ports of embarkation and our surface craft short of the hostile beaches. Interception tactics depend for their success on the discovery of enemy planes and formations by RDF interception and the dispatch and control of our interceptor fighters to the enemy aircraft. The effectiveness of the interception decreases markedly with the relative distance of our own and the enemy aircraft from the point of interception. The shorter distance the enemy aircraft must fly to strike our surface forces and the longer distance our interceptors must fly to ward off the blow, the less will be the efficiency of the interceptor role. Therefore, until we obtain airdromes and RDF installations on the Continent (which will be after the landing assault), the effectiveness of fighter interception will be felt chiefly at the point of concentration and embarkation of our assault forces.

Let us now turn from the consideration of purely fighter operations to the employment of air striking forces whether they be fighter type aircraft employed as fighter bombers or bombers themselves.

First a word about the broader bombing picture. As I have previously stated, your landing assault will be preceded by a protracted period of offensive action against the German War Machine by our strategic bombing forces. This will culminate in the selection just before D-day of strategic military objectives for heavy bombardment which give greatest aid to the tactical operation. A study of likely invasion points in northwest Europe will show that each point or area is "fed" by 3 to 4 important rail or highway centers from 10 to 50 miles away. The air preparation for your assault must mercilessly crush each one of these centers and in effect create a ring of

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destruction of least a 50 mile radius. On the night before your attack, the air forces will strike the port town, except the port and dock facilities, and while troops are moving from transports in landing craft other waves of bombers will attack the beachhead area, and other localities along the invasion coast to provide diversion and to help neutralize beach defenses. In the attacks just before the assault and also during the assault, I would recommend the use of a considerable quantity of incendiaries in order to fire the towns and to create the maximum confusion. As you know timing is the essence of this operation.

From the air viewpoint, timing of bombardment attacks of both the Strategic and Tactical Air Forces is based upon putting the maximum strain on the hostile fighter force, and in simultaneously maintaining a more or less constant delivery of firepower. The troop carrier movement should be timed in coordination as well in order that the "air convoy" can come into the area shortly after the enemy has been forced to make his maximum fighter defense and before those aircraft have had opportunity to reservice.

Now as to close air support during the landing assault. What I propose here are methods that I would adopt if forced to mount this operation immediately. I have no doubt that if time permits, the experiments and tests that we will carry out in the Assault Training Center may well modify and of course improve those methods.

Let us consider this close support from the following angles: planning, types of objectives to be attacked and their suitability, frequency and weight of attack, liaison between air units and the assaulting forces.

At best, the communication difficulties in a landing assault will require that the majority of our air support missions must be planned in advance and as I have said coordinated by timing. The tactical scheme must be <u>simple</u> and must permit flexibility and change when required. The plan will consist briefly of following allotments:

1. A portion of the air striking force will be given prearranged missions to be carried out at specified times and against specified objectives. In each case an alternate mission or objective will be given. I estimate that this will involve at least 50% of the air striking strength.

2. Another portion of the air striking force will be held on ground alert prepared to attack objectives as ordered by Air Support Control, afloat on the headquarters ship or ashore in U.K. This force should not be over 25% of the total striking force.

3. I would retain another 25% of this force for the direct use of the Task Force and Air Force commanders, to be employed at the time and place they may desire or to be retained as a reserve as circumstances may dictate.

The plan must include a predesignation of bomb lines at specified time intervals, it must incorporate simple standing operation procedures for use in referring to objectives and bomb lines or other positions and locations in the beach defense area. Whenever possible, I would assign missions on the front of your principal assault units to the same air unit or units. This will permit joint study of the plan by the ground commander and his air support party officer and perhaps a careful briefing of the pilots in advance by the latter. This will simplify and shorten communication.

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My next consideration is the suitability of the various types of enemy installations as objectives for air attack. I mention a few of the most common here and will try to rate each briefly as to general suitability and the factors involved:

1. Airdromes within striking distance of beachhead - an important objective even though previous attacks have been made thereon - asmuch neutralization as possible can and must be maintained.

2. Enemy batteries - (coast defense, AA, or dual purpose) - which are emplaced. These are important objectives but frankly very difficult ones to neutralize by air attack. They require hits within the emplacement for good effect. Smoke is only partially effective as control is given from outside the emplacement. Destruction is most unlikely. These batteries are reasonably easy to locate from the air inasmuch as in most cases we will have their locations accurately on our photos or maps and of course while firing they give themselves away. They are, however, bound to be heavily defended by heavy and light flak. Hits might be obtained by the use of dive bombers or by cannon fighters. The heavy loss of aircraft involved in using either dive bombers or cannon fighters on this type of objective must be carefully weighed. There is no doubt that we must do all we can, within reasonable bounds of losses, to neutralize these batteries. I feel that we should attack these batteries from medium altitude with at least 500 pound if not 1,000 pound bombs to get shock effect on personnel from any near hits and with the chance of having complete effect from one hit. This attack to be preceded or followed immediately by a low level attack using cannon fighters and light bombs with the view of obtaining some hits from the dispersal of more bombs per aircraft. Smoke may also be used if circumstances dictate, and if so I recommend the white phosphorous bomb for its incidental incendiary effect against personnel and equipment. The air attack must be followed as closely as possible by attack by ground troops, as the difficulty of maintaining the neutralization is obvious. I mention all this because I think it would be highly dangerous for me to promise in any way, or for me to allow you to believe that the air can guarantee to neutralize effectively all these batteries. Those that we do attack should be the ones most apt to prevent your landing forces getting across the beaches rather than those sited to fire well out to sea. For protection to the transports and their escorting naval vessels from shore batteries we can and should screen the transport sea area by smoke laid from spray tanks or by naval vessels themselves.

3. Enemy batteries and guns not permanently emplaced, such as field guns, railroad artillery, concentrations of antitanks guns and mortars - these installations will not be as easy to locate in advance but once located can be neutralized with less difficulty than emplaced weapons. On this type of objective I would recommend the 500 pound bomb or larger for shock effect combined with at least 50% fragmentation bombs (in clusters) for antipersonnel effect. In the case of weapons of smaller caliber such as the mortars, the areas in which these are located should constitute the objective for which the pilot is briefed and the firepower should be delivered against the terrain feature rather than the actual weapons.

4. Fortified positions, with overhead cover, will vary in size from "hedgehogs" to individual pillboxes. These installations are of course made particularly for defense against air attack. Their attack will require much combined study by both air and ground. As a rule, individual pillboxes offer almost

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an impossible target. Hedgehogs can at least be partially neutralized by the shock effect of heavy bombs (1000 pound and over) and by smoke.

Pillboxes, except perhaps a few that are located in very prominent positions such as the end of a pier or on a prominent landmark, will be almost impossible to single out accurately enough from the air to warrant an individual attack by aircraft. They will have to be included in the ground attack "bands" or "zones" that are attacked according to the prearranged plan - which I will mention shortly

A type of objective which must be considered suitable for air attack regardless of the difficulties which may have to be encountered are enemy RDF installations. These installations will generally be located on high prominent points and their exact location must be the subject of intensive advance study by our photo reconnaissance and intelligence agencies. Due to the fact that these installations must have aerials and a considerable amount of very sensitive equipment they will be susceptible to both the shock action of heavy bombs and to the fragmentation effect of antipersonnel bombs. They are of course unaffected by smoke. In part, the same applies to signal centers; and to fire control centers and directors although the location of these will not be as easy to determine. The RDF and similar installations must be attacked at the earliest practicable time in order to obtain the maximum neutralization before the air battle of D-day.

Another type of objective which will be attacked from the air for purpose of obtaining some neutralization are the positions of the defending ground forces which are without overhead cover but which cannot be adequately dealt with until field artillery has been landed. These will be so disposed as to have a field of fire over the beaches and the exits from the beaches, or will be in reserve positions defiladed from naval gunfire. These objectives are highly susceptible to attack by fragmentation bombs, cannon fire, and ground-strafing. They cannot however be often "picked out" by the pilot which these objectives are located but he cannot be briefed to attack specific small targets. The pilots must be directed against a terrain feature, and the aircraft generally must be furnished with the maximum number of antipersonnel bombs to create the best "pattern" effect. The attack on these objectives is accomplished by pattern bombing either in formation or "in trail" and by ground-strafing. Some heavier bombs (100-300 pounds) may also be included to obtain "shock" or "blast" effect. A study of the terrain covering the beaches together with careful photo interpretation will disclose the position areas in which these objectives will be found.

Movement of large numbers of reserves especially in vehicles is a very suitable and profitable objective for air attack. Proper deception plans for the operation insure that enemy must and will make movements of his reserves soon after H-hour which will continue until he has devined our complete intentions. These attacks on reserves cannot usually be planned in advance beyond indicating principal routes which are available to him. For this reason and due to the extreme importance of blocking these movements I would direct as much as 50% of my air formations which have been briefed for attack of ground attack "zones" to attack large troop movements whenever seen regardless of mission for which they were briefed, provided these movements are beyond the bomb line. You will note that I have not ordered any so-called search-bombardment missions in these early phases of the assault. What is more, I feel that I cannot order this type of mission until the results of the air

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battle insure that I have obtained local air supremacy for the time being. The reason is that both enemy air and antiaircraft opposition are initially certain to be so intense as to make such a mission highly wasteful. However, by allowing certain formations to attack targets of opportunity, I feel that I can accomplish much the same purpose.

Other enemy installations which your assault will encounter are wire and mine belts; and tank walls or obstacles. Here I feel the air can be of little help. The attack of the hostile position areas or ground attack zones will cause some incidental damage to surrounding wire or mine belts but I doubt its real effectiveness for that additional purpose. The breaching of tank walls or obstacles by air attack is regarded as wholly impracticable and these walls and obstacles cannot be considered as suitable targets. We <u>can</u> attack personnel and equipment behind these walls or obstacles used for cover.

To sum up my remarks on the suitability of objectives for air attack during the assault, I feel that they may be usually arranged in approximately the following order of priority: (Note that this is during the assault or immediately before).

1. Attacks on airdromes and communication centers for continued neutralization.

2. Attacks on enemy reinforcements and reserves, wherever known or found, moving or stationary.

3. Enemy RDF and signal centers.

4. Enemy batteries, troops, installations not permanently emplaced and without overhead cover.

5. Enemy coast defense or AA batteries permanently emplaced but without overhead cover.

6. Batteries, weapons or installations such as pillboxes and hedgehogs, <u>with overhead</u> cover.

7. Others.

The continuity and weight of air attack which can be maintained are of course factors of prime importance in the air part of landing assault operations. They vary directly with the strength of your Tactical Air Force and the distance of the bases from the landing area, and they vary inversely with the hostile air opposition. Remember that if your initial assault waves make their landing in the dark, you can expect little or no close air support until well after first light. At the time when visibility first permits air attack of ground objectives, I think that the air striking force should give you a good half hour of air attack of the maximum weight and continuity possible. If the time of your initial landing is deferred until visibility permits air formations to recognize their objectives, a preparatory bombardment can be expected which is of course subject to the same limitations for various types of objectives that I have just discussed.

What is this weight of attack? I will give you an example. Assume that our Tactical Air Force has an air striking force consisting of 6 Medium Bomb Gps, and approximately 15 light, dive or fighter-bomber groups. This is a very large force and probably the maximum that we could ever expect to have available in this Theater. Out of this force, at once deduct twenty five per cent which the Expeditionary Force and Air

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Commander wish to retain to meet unforeseen contingencies. We then have available approximately 15 groups or 60 squadrons for the assault phase. I feel that there would be at least three airdromes within effective enemy fighter range of the beaches and at least three key communication centers which must be attacked with at least 2 squadrons each. This leaves us 48 squadrons maximum for close air support. At 100 miles distance from its base, no aircraft can repeat a sortie under four hours. Therefore, for the first four hours you can maintain an average total weight of attack of 12 squadrons per hour. If your sea-borne force lands at 5 beach areas and your airborne force lands at 3 landing areas, each could expect a maximum support of one and one half ($1\frac{1}{2}$) squadrons per hour. Would we employ our Air Units in this manner? Of course not. And these figures show why it would be inadvisable. In other words, it means that not every landing effort of our ground forces can receive air support. It means that you must pick out certain key objectives which must be hit and that you must plan to give this air support to only certain main efforts. It appears to me that the rate of air attack might be doubled during the first critical hour of obtaining a foothold on shore and that the use of 24 squadrons the first hour, and perhaps 8 for each of the three succeeding hours is not an illogical distribution.

Close liaison throughout the chain of command between the Tactical Air Force and the assaulting force is essential. During the landing assault phase of this operation there will be a joint Air-and-Ground Headquarters on shore in England and a joint Headquarters afloat, with the air and ground commanders, or their representatives, at each place. With each division effecting a landing there will be an air officer, known as an Air Support Party Officer, with his own means of communication to the Air representative on the headquarters ship. With certain combat teams making the main effort or on an independent mission there will also be an air support party officer, who will accompany the supported unit across the beaches. These ASP officers will be provided with mobile radio sets for communication to both the headquarter ship and to aircraft in flight. The VIII Air Support Command now has such equipment all of which is completely mounted in a "jeep".

The Air Support Party officer advises the supported commander concerning proper requests for Air Support, the probable time it will take to deliver air attacks and other perintent air matters. He forwards requests direct to the Air Representative on the headquarters ship. He continually keeps Air Headquarters informed of the location of the bomb line or any changes therein. He does not brief pilots in the air nor is he usually empowered to divert them to another objective. He does have authority to cancel missions which endanger the supported troops. He may receive information reported by reconnaissance aircraft either direct or by listening in on the tactical reconnaissance frequency.

The Air Commander or his representative on the headquarters ship has a controller working directly under him who in conjunction with a representative of the Ground Commander passes on approved Air Requests and forwards them to Rear Control in England for relay to proper airdromes. We must remain fully aware of the difficulties of perfect radio communication under all circumstances and realize that the transmission of all these requests cannot be assured. (Here again is another reason for the predetermining of the great majority of our air support during the assault phase). The Air Controller does however have authority to brief pilots in the air to the extent that he may divert them from a planned mission to an alternate objective for which they have been partially briefed or which can be unmistakably picked out from the air without reference to a map

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and with little change in course. Time does not permit further elaboration of this subject during this conference. Other details are either a matter of technique and procedure or do not differ from the usual liaision arrangements for ordinary air support operations.

So much for the combat aviation. I will now speak briefly of the use of our reconnaissance units. At this time we have available very complete photo coverage of the invasion coast. Immediately upon selection of definite landing areas, and until the assault is launched, frequent detailed and intensive photo reconnaissances will be made of those areas. This photo reconnaissance will be handled thru a photographic Group Headquarters to which will be assigned a Photo Interpretation Unit.

This Photo Gp before the assault will print and interpret sufficient photographs of the beachhead area to allow each ground commander down to and including companies to have a detailed and up-to-date picture of his zone of action. These will be delivered as far in advance as security will permit. Photo reconnaissance will also be maintained right up to D-day to ascertain the location of reserves and the location of various type hostile air units.

On D-day, photo reconnaissance will be continued and will be supplemented by intensive visual reconnaissance. This tactical reconnaissance is highly important and must occur very frequently on D-day and until the build-up is effected. The use of observation units during the assault phase must be highly centralized and carefully planned. Tactical reconnaissance missions will be ordered to locate definite information and will report to headquarters ship by VHF radio short messages in answer to certain concise requests. The principal mission of tactical reconnaissance will be information of movements and location of enemy reinforcements. Upon return to home bases, pilots will be interrogated to complete the previous reports by radio. It will probably be necessary to run Tac/R sorties at the rate of one each 15 minutes during D-day, in addition to long range Army or Air Force reconnaissance. I feel that we will require at least two and probably three Observation Groups, for an assault on the scale contemplated by present plans.

I have briefly mentioned the use of smoke in an earlier part of this conference. I cannot now go into all the technical details of smoke screens laid by aircraft. Suffice it to say that smoke may be laid by dropping smoke bombs or smoke floats and from spray tanks mounted in the light bomber type aircraft.

Smoke bombs have the following advantages:

1. Can be laid from any light bomber (Boston type) aircraft.

2. Can be dropped by any air crew with little previous training.

3. White phosphorous in smoke bombs has a high casualty effect.

4. Can be used at higher wind velocities than spray (15 - 20 MPH).

5. Supply problems are simple.

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Smoke bombs have the following disadvantages:

1. Not effective over water.

2. Cannot be used in close proximity to our own troops.

3. Break up on very hard ground.

4. Cannot cover on equivalent front to spray tanks.

Spray tanks have the following advantages:

1. Effective over water.

2. Cover 3 to 4 times as much front with same number of planes.

3. Can be used with zero wind velocity.

4. Most effective when used cross wind, while bombs are least effective at cross wind.

Spray tanks have the following disadvantages:

1. Aircraft cannot take evasive action.

2. Requires special training for air crews and special ground personnel for servicing.

3. Supply problem is increased.

The use of smoke is highly dependent on wind and weather. It requires that certain aircraft be definitely allocated for that purpose and that the crews receive prior training in this type aircraft.

As a measure of requirements in aircraft for smoke operations, one aircraft of light bomber type equipped with M-10 spray tanks can lay a single curtain 1800 yards long which will be effective under average wind conditions for approximately 10 minutes. One light bomber, using smoke bombs (WP 160# type) can produce a smoke screen 500 yards long which will be effective approximately 6 minutes. To maintain an effective curtain 1000 yards long for 30 minutes would require 10 Bostons using smoke bombs and 3 Bostons using spray tanks.

A visualization of the tactical employment of Troop Carrier Aviation can best be arrived at by a consideration of the mission for which the Troop Carrier was designed. In general, the primary mission is the delivery of airborne troops into combat, their supply and evacuation. The secondary mission is the movement forward of air force and other units and general supply and evacuation as may be necessary in the situation.

The tactical movement of a large airborne force has many of the same aspects as a seaborne force movement. Large numbers of aircraft are necessary, and extensive, detailed planning must be undertaken in order to coordinate the preparation, movement and protection of the operation. A troop carrier mission of this type differs from a bomber mission in that while a bomber mission requires the delivery of bomb loads in a target area in a given period of time, troop carrier loads must arrive in a given sequence, a given pattern, and each unit of troops must arrive at specific points on a definite time schedule in order that they may properly organize on the ground to carry out their task. This requires the setting up and execution of an

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aerial troop movement table as exacting as a table of movement on the ground in order to prevent congestion and disorder. In addition, aerial traffic control must be established in the objective area as well as maintaining large formation sequence and continuity en route and in the take-off areas.

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Obviously the sequence in which airborne troops will be delivered to an objective area will depend on the type of objective and the battle plan of the airborne commander. However, in most cases, the sequence will be a variation of a standard formula which provides for the delivery of parachute troops first, followed by glider-borne units of both ground and air force. These troops may then be reinforced by troops landed from powered aircraft if the situation allows. The mission of resupply follows immediately and is actually part of the original mission though it is generally done more slowly inasmuch as more time is required for loading and unloading of supplies than is the case with troops, and their arrival on a carefully timed schedule is not so important. Supply by air may be accomplished by parachute, glider and powered aircraft. The glider is probably the best method since parachute supply is slow due to the smallness of loads and time required for packing. Powered aircraft delivery requires the use of landing areas which probably will be used to better advantage by advanced fighter and bombing operations.

While no set rule exists as to the time of day for such operations, it is logical to consider the dropping of parachutists at night and the arrival of glider units at or shortly after daybreak. The operation would then continue until completed. Weather conditions of relatively low ceilings with reasonable visibility and light winds seem to have advantages from the standpoint of protection from enemy fighters if complete control of the air by friendly forces does not exist. The experience level and equipment at present do not permit instrument operations, although there are projects under way that may change this restriction.

I have already pointed out the need for close fighter escort and for cover and air support of airborne elements in the air and on the ground.

To effect the lift of airborne troops I would organize within the Tactical Air Force a troop carrier command headquarters which will be charged with effecting close coordination with airborne units. In addition to the movement of purely airborne elements, it must be borne in mind that it will be necessary to introduce in the movement certain air force units. These comprise: advanced troop carrier command and operations headquarters, with the necessary ground and air traffic control agencies, air support parties with the airborne elements, aviation engineers to keep landing areas cleared and in repair, and to construct or repair captured airdromes, advance servicing echelons for maintenance of aircraft on the advance landing fields or captured airdromes, and specially trained air evacuation troops. Advance elements of the Air Warning Service with highly mobile air warning equipment may also be included.

Methods and equipment exist and are continually being developed to provide for formation control in flight, traffic control in the objective area, recognition and identification, and the locating of the objective area under conditions of poor visibility or darkness.

The third question propounded for which you required an answer was "what technique and procedure will be used to control and coordinate the employment of our air forces with seaborne,

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airborne and naval elements"? I have frequently referred in this discussion to elements of the procedure in the control of air units in this type of operation. Time does not permit an explanation of the entire technique but I believe I can show you the general outline in chart form. I find that much unwarranted mystery has been allowed to surround these methods and that we have in both the American and British services invented a wide variety of "professional" nomenclature which only serves to confuse the issue. What our procedure and control really amounts to is the following:

1. Careful planning and timing of operations.

2. Simple standing operating procedures.

3. Close liaison from air force to supported ground elements and the establishment of a separate channel of communication for this liaison.

4. Establishment of controls or advanced air headquarters where air support requests (i.e. offensive missions) can be coordinated, acted on rapidly and made to accord with the joint plans of air and ground commanders.

5. Establishment of an Air Warning system which reports the approach of aircraft, filters or evaluates these reports, and makes them available to a fighter control.

6. Establishment of a fighter control which controls and directs our fighter aircraft on the ground and in the air as a result of filtered reports from the War Warning System, or in accordance with directives from air headquarters.

7. Establishment of a simple but very complete system of communications which provides alternate channels and good flexibility.

(At this stage "Air Units in support of a landing-assault" chart was shown).

I will conclude this conference with a brief discussion of air logistics during the initial assault phase. While it appears that the capture of an operational airdrome along the invasion coast during the first day or so of the assault may not be possible, it must still be considered as a primary objective of the ground forces. In addition, we must immediately capture or construct some type of advance landing strip. To do this, at least one engineer battalion aviation must be taken in over the beaches closely following the assault waves. We must establish on this landing strip certain airdrome communications and an advance servicing echelon. We have tentatively called this servicing personnel "Servicing Rangers" - similar to the RAF "Servicing Commandos". At least one unit of these Servicing Rangers comprising about 150 men must closely follow the initial assault waves. Again, provision must be made for supply of aviation gasoline to the advance landing field, or fields. Other air units to follow closely over the beaches are an advanced air headquarters, and an advanced fighter control with necessary air warning and RDF equipment. For air warning on an initial front up to 40 miles, we must need at least six highly mobile RDF units known as "light warning sets" plus two Ground Control Interception Units (called GCIs) plus approximately 15 air warning observers with radio transmitting sets.

In addition, we will need immediate AA support for advanced landing strips or captured airfields. It is estimated that two AA gun batteries and at least one AA light battery (automatic weapons) will be required for each advance landing ground or

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airdrome. The air force also expects to provide a few air base security battalions for the protection of advanced airfields against local ground attack.

The priority in the order of movement of our air echelons to advance bases will be: fighters, night fighters, reconnaissance or observation, followed by the light bombers as fields become available. The principle is that we must move our air battle forward by movement of our fighter bases at the earliest possible time.

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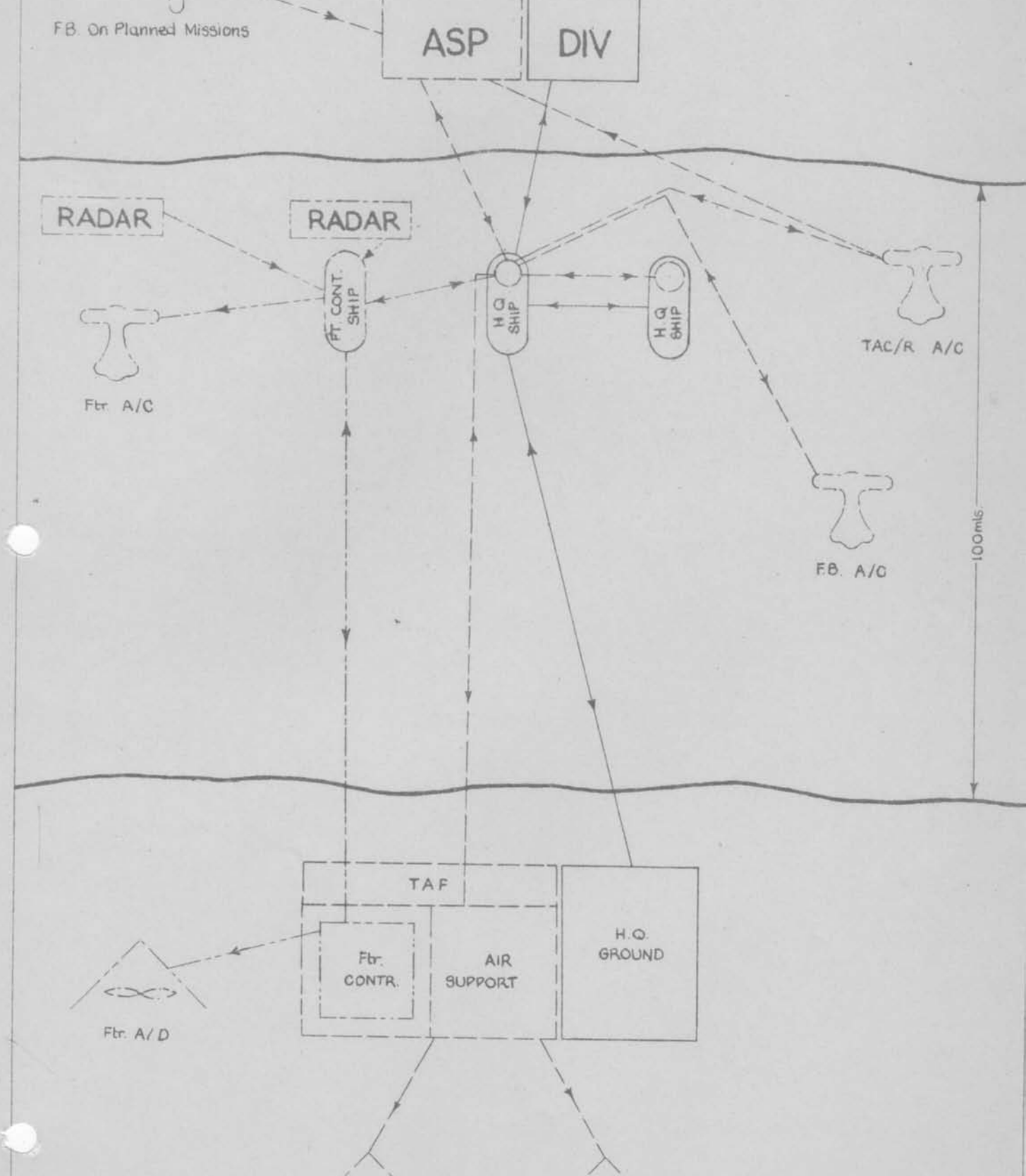
1ST PHASE (SIMPLIFIED)



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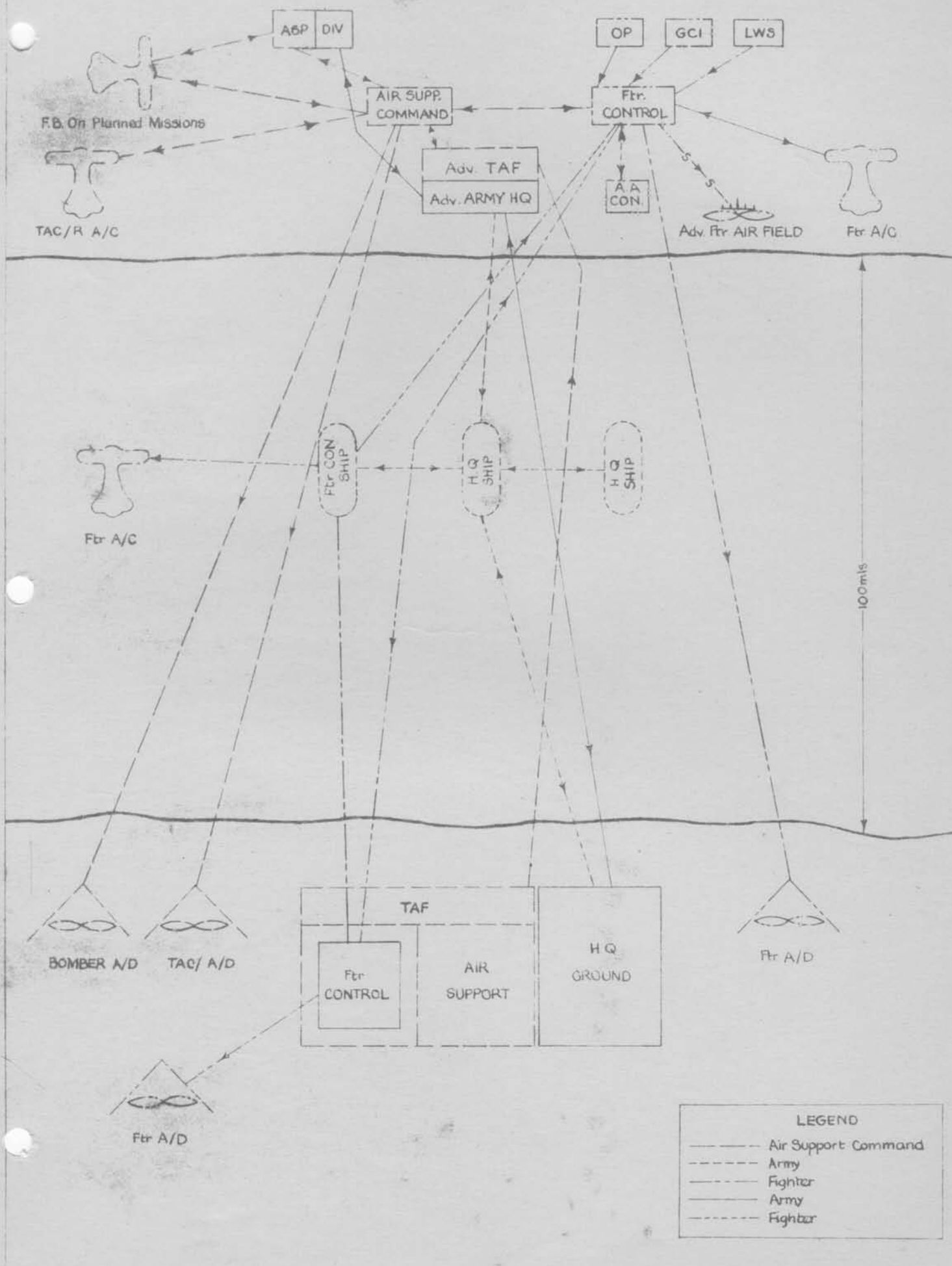

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Discussion following the talk
by Brig. Gen. R. C. Candee

27 May 1943

The question as to when fighter control would be set up on the hostile shore was discussed. General Candee asserted that fighter control must be set up at the earliest possible moment and that ground stations must be established to guide our fighters in the interception of enemy aircraft.

Dive bombers were also discussed. General Candee stated that the dive bomber is an excellent means of getting all round precision bombing. Doubtless there will be occasions when they will again be used and it may be anticipated that there will be dive bombers in our Air Force. General Candee believes, however, that if the location of the target is known and there are trained crews available, as good an effect will be obtained with fewer losses by the tree-top bombing method.

There was also a discussion as to just what constitutes a dive bomber. General Candee stated that it originated, as far as this war is concerned, as a result of the use of the German JU 87, which is practically a rather slow fighter type capable of carrying bombs. Its success was due mainly to the surprise it caused among the demoralized Poles and Frenchmen. As soon as the initial surprise period was over and it ran up against troops prepared to offer resistance, the losses of this type of plane became very heavy.

FM 31-5 was discussed and it was the opinion of the conference that the principles set down in this manual are correct. Colonel Edwards stated that most of the criticism of this document had been due to the fact that no mention was made in it of fighter planes, although the author had added a rider that fighters would be attached where necessary.

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28 May 1943
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Review of discussion following the lecture:
"AIR SUPPORT OF A LANDING-ASSAULT" by Brig Gen R. C. CANDEE

Question 1 - Considering limitations imposed on fighter aircraft by their restricted range and ammunition supply, what degree of air superiority can be assumed in connection with a landing-assault?

Conclusions reached: Air superiority over the assault area is vital throughout the operation. (Air superiority means that hostile aviation has been destroyed or neutralized to the extent that the hostile air threat against the landing attack is insufficient to prevent the successful accomplishment of the mission).

Question 2 - What can be provided in the way of a preparatory bombardment of beaches (including mined areas), beach and coast fortifications, gun positions, and the like?

Conclusions reached: a. A preparatory bombardment can be provided, but in the main it will have to be directed against a position area and a limited number of specific targets but not all enemy installations.

b. The "shock" or "blast" effect of this bombardment will accomplish a certain amount of "softening up" of the defenses and may, if lucky hits are obtained, neutralize some gun positions.

c. This bombardment cannot be depended upon to blast paths through wire and antitank obstacles, or to destroy pillboxes and fixed gun positions. However, many mines will be detonated and paths through minefields are likely.

Question 3 - What are the possibilities in the way of close air ground support for the assault troops?

Conclusions reached: a. Air attacks on the beaches after naval gunfire lifts will be of considerable value, but cannot be expected to neutralize the beach defenses.

b. Our air force can also effectively support the assaulting troops by attacking bridges, railroad marshalling yards, columns of troops and supplies, and similar targets, and thus hinder or prevent the enemy from bringing up his reserves.

Question 4 - From the air force standpoint, what factors influence the use of smoke in a landing-assault?

Conclusions reached: (The subject of smoke was fully covered in Gen Candee's lecture - the following are answers to specific questions):

a. Using equal number of aircraft, three times as much smoke can be put down by spray tanks as by smoke bombs.

b. The main disadvantages in the use of spray tanks are:
1. aircraft cannot take evasive action,
2. special training for aircrews and servicing personnel is required,
3. aircraft cannot be readily transferred to bombing missions.

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Question 5 - What observation, reconnaissance and photographic mission can be flown prior to, and during, the operation?

Conclusions reached: a. Prior to the operation the area can be completely and continuously covered by photographs, and these will be our most dependable source of intelligence.

b. During the operation reconnaissance aircraft will be sent out on specific missions only. It will be impossible to maintain a constant patrol over the operation area, but there will be frequent reconnaissance sorties.

Question 6 - How will air support of a landing-assault be affected by time of assault (day or night), weather and visibility?

Conclusions reached: To provide air support, the aircraft crews must be able to see the target; the better the visibility the more effective the support.

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ADDRESS BY: Col J. T. DALBEY, GSC, C of S, A/B COMD
(from notes)

AIRBORNE TROOPS IN A LANDING ASSAULT

GENERAL

The employment of airborne divisions is one of our latest developments, as yet relatively untried. They have had very little operational experience to date, and are still suffering from very acute growing pains. Their organization and their equipment will possibly change, due to the fact that they have been more or less experimental. The airborne divisions at Fort Bragg and the parachute units, largely at Fort Benning, have not been tried out in maneuvers a great deal. The result is some misapprehension and a somewhat general lack of understanding throughout the army regarding these troops.

I will try to give you, without too much detail, a true picture of their organization, their characteristics, powers, limitations, and what we consider to be a proper tactical doctrine to govern their employment.

There are three types of airborne troops. I might modify that by saying there are two real classes. The word airborne is an inclusive term which includes parachute troops and glider troops. There is a third class used in airborne operations, which is called an "air-transported" division.

The beginning of the airborne project in the U.S. took place in 1940 when they organized a small platoon of parachutists at Fort Benning. It suffered the usual growing pains, and, by degrees, this platoon was expanded into a battalion and, after so long a time, we got an additional battalion and then one or two others. That was followed, finally, by approval of the regimental parachute organization which is the organization obtaining at the present.

When the Germans captured the Fort of Eben Emael, using parachutists, and this fort was considered impregnable to assault by land, that event did a great deal to bring about a more serious consideration of the value of these troops.

The Glider. Before mentioning glider troops, it might be appropriate to give you a brief description of the glider which we now have and the only one which is available for our current use.

This glider, known by type as the CG4A, is a cargo or personnel carrier. It is a highwing monoplane, constructed of tubular metal, fabric and plywood. It has no engine, of course, no gas tank, and is non-inflammable. The machine, I would say, is very substantial, carries a pilot, copilot and 13 others, or a total of 15 in the ship. The glider itself weighs 3650 lbs, and it can carry a pay load of 15 people or an equivalent weight of 3750 lbs.

The term "Glider" has misled some people as to the conception of its flight characteristics. The military, or CG4A, glider is in no sense a sport sail-plane. It does not make use of thermals or rising air currents, or anything of the sort. It is towed by transport or other type of aircraft, and when the tow-line is

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is released, or the glider is released from its tugship, it must come down. In coming down after release from a tug, it has an optimum glide ratio of 15-1, that is, at the moment of release it can go forward before it lands a maximum distance of 15 times its altitude. The glider in flight cannot stand the stress and strain of maintaining high speeds; it is not so constructed. It averages a speed of somewhere between 120-140 m.p.h. It builds up to this speed, and I know that the air people will think this is terrifically slow.

The glider is attached to its tugship by a 300' Nylon rope. This rope has somewhere between 10-15% stretch in it, so that when the glider is taken off the ground there is no shock as it lifts in the air. There is radio and telephone communication between the glider and the tow ship. The glider lands at a speed of between 50-75 miles. This is somewhat in excess of what was originally set up as a characteristic. I believe initially they desired to have a landing speed of around 45 miles an hour, and it built up in excess of their anticipation. Nevertheless, the glider can land in a very small area, and take a run on landing somewhere around 300-400' and stop. It may crack up when it stops, but the crack-up will not result in unusual casualties. At Fort Bragg we have cracked up so many gliders it is not even funny. We have not killed a soldier as yet, and we have had no serious injuries.

Colonel Richards informed me the other day (he is just back from the States a couple of weeks ago) that the Chief of the Army Air Forces had allocated to the Airborne Command 150 gliders for the specific purpose of making operational landings as would normally be the case in combat, and where we expect a great many of these gliders will be cracked up. One hundred fifty of these things have been scratched off the books as potential loss, and I would say that is a great forward step in the training of airborne troops.

The glider at the present time cannot carry a heavier antitank weapon than the 37 mm antitank gun; its artillery weapon is a 75 mm pack How. The largest piece of transportation it can carry is the 1/4 ton truck or jeep.

To get the jeep in and out of the glider, the glider was constructed with a two-piece nose which can lift up on hinges and, as the glider comes to a stop, the motor of the truck is started and it goes forward pulling a steel cable which lifts up the nose and out comes the truck. The vehicle comes right out in a matter of seconds. That used to be a very secret proposition in all the publicity pictures we had of gliders. Here about a week ago, however, there was a picture of this contraption on the front page of the "Stars and Stripes".

Glider Troops The Germans used large numbers of combined parachutists and glider troops when they took Crete. These two things directed considerably more attention towards the activation of airborne units other than parachutists. The boys at Fort Leavenworth had been a long time talking about the vertical envelopment. I know it was some years ago, when they did not know how to do anything any other way, they had a vertical envelopment. Some officer, a few days ago, told me that in one of the approved solutions at Leavenworth, when they were taking some Kansas town that had hostile command installations in some big building in the city, they just dumped the parachutists right down on top of the building, with tommy guns, and took it over.

The War Department has become a little less skeptical about the creation of airborne units. I happened to be in the War Department and tried to nurse this new baby along and it was an up-hill fight to put the thing over. We are not yet sure what we have put over but, at any rate, we began to get new airborne

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organizations by slow, up-hill degrees.

The British set up an airborne division before we did, and, at the time they got their division set up, we had, in the meantime, created what is called the Airborne Command; General William C. Lee had taken over this Airborne Command, so he made a trip over here to see what the British were doing. He discovered the main units in their division consisted of two parachute regiments, one glider regiment and, of course, the other divisional troops. He came back to the United States and this thing was proposed to General McNair. The Ground Forces, in the meantime, had taken it over after the War Department was reorganized, and the same organization was proposed; that is, two parachute regiments, one glider regiment. No great amount of thought apparently was given to why that was the case because it was evident that a parachute regiment is a weaker unit than a glider regiment, due to the fact that a glider can carry all sorts of stuff, whereas parachutists cannot. Equipment must be small, it must be light, it must be dropped by parachute. So General McNair said "Why this?" and a quick recast was made and we settled on a division having one parachute regiment and two glider regiments, which we think is a proper proportion.

I do not mean to cast any reflections on the British organization. There was a reason for the organization they adopted. As I understand it, it was the fact that, at the time, they were in a hurry to get organized and had more parachutists than they did gliders or glider troops. They had very few transport airplanes, of which we had plenty. The British have never developed the transport airplane because the distances over here are so short, and they were compelled to use, or did use, bombers for their parachutists.

Air-transported Troops The third class, air-transported troops, is a sort of first cousin to airborne troops. It is not organically an airborne organization. It is the result of taking a standard infantry division and stripping it down, more or less, of its rear echelon personnel, its heavy transportation, heavy equipment, weapons, and, in general, what is left can be carried and fitted into the gliders. You wonder what you have left after it is stripped down. At the moment, I won't say. Naturally, when you take the divisional artillery away from it, you have to substitute something else. There has been developed, standardized, and in production, a short-barrelled, sawed-off 105 mm howitzer. This gun was developed as an airborne weapon. It has been recommended, and I think it will be carried out in plans, that when an infantry division is stripped down for this air-transportation proposition, it will be issued short-barrelled 105's to replace its normal artillery. Artillerymen tell me it is a good gun.

Present Strength As to the present strength of airborne units: The American army has right now four active airborne divisions; two additional airborne divisions are, or were, (what's happened in the two months I have been away I don't know) scheduled for activation within the next three or four months. By contrast with what the U.S. has, the British have one airborne division, and I have been given to understand that they plan the activation of one additional division.

As to parachute regiments (when I speak of parachute regiments I mean separate regiments, independent of and not belonging to an airborne division): We have between 6 and 8 separate parachute regiments at the present time. The parachute school at Benning has an almost unlimited capacity for turning out parachutists. It can provide the personnel for as many additional parachute regiments as we think the war requires, together with all necessary

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loss replacements. I might mention, in passing, it looked as if we were scraping the bottom on parachute volunteers and we were quite perturbed about it for a while. I think possibly a notion of "suicide troops" got around, and the boys didn't think it a good idea, but we killed that. They are not suicide troops, and we will certainly have no shortage in volunteers, particularly in officers. We get a basketful of applications from very fine young officers every day.

As to air-transported divisions, there has been one division given that training; that was the Second Division at Fort Sam Houston. As I recall it, we sent a group of around 25 officers and 225 enlisted men, and they worked on this division for something like two months. It was in good shape when they got through. There is in existence a War Department directive, and it has been in existence for quite some time, which specifies that every infantry division prior to proceeding overseas will be given this air-transport training. That was put out by G-3 but, as usual, lack of time and one thing and another have prevented its being carried out. Only one division has been given such training.

I might remark, in general, that the British have very plainly indicated to us that they expect the U.S. to take the lead in the matter of airborne troops. There are several reasons for that desire, all quite valid. It is my opinion that the United States has taken the lead in this matter and, conceivably, that our equipment, organization, and technique is probably a little more advanced than the British. Certainly, it is a fact that our numbers are far superior. I should also remark, however, that the British have led the way in this airborne development. The cooperation between the Airborne Command of the U.S. and the British airborne division here has been very intimate and we are greatly indebted to them for their assistance to us.

Training As to the matter of training of airborne units, in the United States the training of all airborne units comes under the direction of the Airborne Command. Units are assigned to that Command solely for training purposes. Their supply and administration is handled by the Army Commander in whose area they happen to be located. Now there is a little catch, the Airborne Command is supposed to train airborne units, but the gliders, glider pilots, and transport airplanes are furnished by the Troop Carrier Command, which is a separate installation and part of the Army Air Forces. So there is a division of responsibility, which, no doubt, has slowed down the development of this project somewhat, it couldn't be helped.

There are two large glider-training centers, so called; one at Laurinburg, North Carolina and one at Alliance, Nebraska. At each of these centers, the Troop Carrier Command places at the disposal of the Airborne Command the necessary airplanes and glider craft. There are likewise, or scheduled, two locations to give air-transport training to infantry divisions. One of these is supposed to be set up in a location on the East Coast and the other on the West Coast, to give this training to divisions that are slated for overseas shipment, either East or West.

The Invasion Problem (At this point Col Dalbey presented a blackboard diagram of the German defenses we might expect on a typical stretch of the European coast, and briefly explained the German probable employment against an invasion attempt. This diagram points out chiefly the frontages and depths of the defense units, to include a coast defense division).

The following figures were given:

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1. Average front of defensive division - approximately 25 miles.
2. Average front of defensive regiment - approximately 12 to 15 miles.
3. The Res Regt of the Div is approximately 12 miles to the rear and center of the Div area.
4. The normal disposition of the battalions of the forward regiments is two battalions forward and one battalion in reserve.
5. The Germans will probably meet an invasion attempt within 8 to 12 hours with a Res Div (probably armored), and can also reinforce by one or two additional divisions per day.
6. The British have set up a type division for the purpose of attacking the coast on a front of approximately 3 miles. Feints and diversions will be executed to conceal the main effort. Four Commando units per division will be alloted for protection on the flanks. Ranger units might be similarly employed.
7. Airborne divisions may be employed against the hostile reserve divisions to block their reinforcement of advance defenses.

8. The chief dangers to a successful landing assault are:
   a. Coastal Defense Batteries
   b. Hostile reserves in the forward area.
   c. Counter-attack of armored divisions.

The controversial question of the most suitable time to land was discussed briefly in connection with the blackboard diagram. The many angles to the subject resulted in no definite conclusion being reached.

Organization: Parachute and Glider Regiments: (Figures were shown on a blackboard, giving personnel and equipment for both units.

Organization: Airborne Division: Now the airborne division. The division has a strength of 500 officers and 8,000 enlisted men. It consists of three infantry regiments of which one is a parachute regiment and the other two glider regiments. This proportion of 1 to 2 maintains generally throughout the large units of the division. The divisional artillery regiment consists of three battalions, of which one is a parachute battalion and the other two glider battalions. There is an engineer battalion which has one parachute company and two glider companies. There is an antiaircraft battalion, all glider, having 6 batteries with 24 37's and 36 cal .50 machine guns. In addition there are the usual divisional units, all glider units; medical, quartermaster, ordnance, signal, Hq, MP's.

The divisional artillery, with its three battalions, has a total strength of 1400 men. In the parachute battalion are three batteries. Each battery has 4 74 mm pack howitzers. Those three batteries in the parachute battalion are designed to work with the three battalions in the parachute infantry regiment. Each glider battalion has two 6 gun batteries and is designed to operate with the two battalions of the glider regiment. There is a total of weapons of 36 75 mm pack howitzers. There are 60 caliber .50 machine guns, intended primarily for antiaircraft. There are 4 37 mm antitank guns and there are 175 rocket projectors, which we call Bazookas, intended to augment the antitank defense.

For transportation, the divisional artillery have 110 ¼ trucks and 30 trailers, plus about 20 hand trucks. It might be appropriate to remark that the dropping of 75 pack howitzers by parachute has been proven entirely possible. I do not remember off hand just how fast we got those guns into action after they were droppped. Obviously they are broken down into several parts, the men have to recover them on the ground, assemble the guns and ammunition from here and there, set up and start shooting. To take a chance on my recollection, they will do that between 15 and

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20 minutes after they hit the ground, and they can hit what they aim at. So that parachute artillery is something well worth while. Previously parachute units have had no backing up whatever by way of fire support. This ability in the future to attach parachute artillery to parachute infantry, plus a detachment of parachute engineers as well, will materially increase the value of parachute troops.

An Engineer Battalion has 400 men, one parachute company and two glider companies. We are not going into the details of weapons. It is well armed for combat; it is intended for combat; it includes at present 27 flame throwers in its equipment. It is particularly well trained, not only for combat, but to execute demolitions and also to assist or to take the lead in the clearance and restoration of landing fields. I know that we have airborne engineer outfits, but I think they are tied in with the Air Corps. Their mission, likewise, is to clear landing fields. I do not believe, however, that they will come in on early situations in the same manner we expect these engineer parachute companies and glider companies in the airborne division.

The other units of the division perform the usual services. I do not think it will serve any purpose to describe them; they are set up on a scale in keeping with the size of the division and, to date, we think they do all right.

Factors on Organization: The basis for the present organization of airborne units was several factors; transports, gliders, weapons that could be carried in these craft. These factors are constantly undergoing change, and I mean constantly. Get away for two or three months and they have turned cartwheels in your absence. The nice thing about it, however, is that everything is getting better all the time. We do business with the British and they likewise with us. If we get anything we think is worth while, we ship it to them, and they have consistently done the same thing.

The size of transport airplane more or less sets up the organization of parachute units. The C-47 was the plane of which we had the greatest number available (and it was and is a very fine transport airplane) and that obviously limited the size of our present weapons. The British, unfortunately, do not have a counterpart to our C-47, certainly not in numbers.

The only glider we have right now is the 15 place glider. We do not like that because it is too small. Obviously if we had a glider with twice the capacity, we could use half the number of tug ships. The British have a glider we commonly refer to as a 25 place glider; possibly it will carry two or three more than that. The U.S. has not been behind unduly in trying to set up a large glider. We had a difficult time in getting the 15 place glider set up, and then promptly on its heels, they set up plans for the bigger glider. Colonel Richards tells me that, at Wright Field for the last two months they have been flying, very satisfactorily, a 30 place glider. It is pretty much the same type of ship as the 15 place glider; it is a larger version and is understood to be equally satisfactory. Then a snag developed by way of the metal shortage and someone said "No, we won't have these big gliders, due to the metal, and so on and so forth; we must have a wooden glider". So, the wooden glider is obstensibly in process of development. The British have an all-wooden glider, and we anticipate certainly no difficulty in the setting up of this new ship. To take a shot in the dark, I would say that they might be available in the course of the next eight months. For our purpose here, we should confine our plans, I think, to the use of the 15 place glider.

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Inasmuch as this is a Secret Conference, I presume there is no particular objection in stating that I have been given information to the effect that the U.S. has contracted with the British for delivery in the U.K. of 1500 of the Horsa gliders, so-called, which is a 25-man wooden glider, and about 200 Hamilcars, which is a freight glider. Approximately half of these gliders are supposed to be delivered about January 1st, 1944, - which is another example of intimate cooperation with the British.

The size of the division, 500 officers, 8,000 men, which is somewhat smaller than the British airborne division, was practically dictated by General McNair, commanding the Army Ground Forces, as a limiting figure. It was his opinion, and generally concurred in, that the aircraft required to move a division larger than 8,000 men, taking into consideration all the fighter craft, escort craft, bombardment craft and so forth needed to support an operation involving an airborne division, would never be available; certainly not for a long time to come, so he clamped down on this 8,000. Obviously, everyone wanted to fatten up their units. We turned out the organization that we have and that is the best we can get. I think there is little question but that General McNair is right; that there will not be sufficient craft to take a unit larger than 8,000 men for quite a while.

To make a single lift of an airborne division requires, in round figures, about 800 gliders and about 1,000 transport airplanes; actually more than that. If you add up 800 gliders and 1,000 transports, fighters and bombardment craft, you get a lot of aircraft. It brings out the difficulty of coordinating all of those ships in the air. Actually, we do not propose, nor do the British figure, on lifting a division at one time. That day may come. We figure on moving a division in either two or three lifts, preferably two. When we get gliders twice their present size, that will cut the number of gliders in half; likewise the tow ships.

One factor should be considered. Thinking of the strength of the division as being 8,000 men, we all have in mind that the infantry division is around 15,000 men, so that the airborne divisions, of half this size, can do half the job that an infantry division might do. That is incorrect. You can have an outfit half the size, it's true, but you have weak parachute elements, little stronger glider elements, short-changed in everything conceivable in the way of heavy weapons strength. You must be resupplied by air, so that the combat value of your airborne division is materially less than one-half the combat value of a standard infantry division. That should be kept in mind.

Powers and Limitations: As to characteristics, powers and limitations of those sundry units, your parachutist is capable of dropping almost anywhere, any time, day or night. It is undesirable that he be dropped under wind conditions in excess of 15 miles an hour. If you do so you get excessive casualties and obviously weaken the combat value of the unit. When a parachutist drops, he is very lightly equipped, necessarily. Most of his equipment, certainly all of his heavy equipment, is carried in equipmeht bundles. These bundles are dropped by parachute simultaneously with the dropping of the parachutists. When he gets on the ground, he has got to scurry over and find his equipment, open it up, get himself organised and then take on his job. Naturally, if he is dropped at night he may have a lot of trouble in finding his bundle. To make provision for that we have, and the British likewise, sundry colored lights which are supposed to go on by contact with the ground, to assist in finding the bundles. If the lights go on, all works well. At best, it is difficult to find these things, and it makes it desirable that he be dropped in cleared spaces, avoiding wooded spaces if possible, the stuff gets hung up in trees; so does the parachutist. During the few seconds the man is dropping, which might average 5- 6 seconds, he is quite vulnerable as he is coming down; he is vulnerable when he gets on the ground for some few seconds; and,

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particularly, when he goes over to his equipment bundle to get out the rest of the stuff he needs. The British got wise to this proposition when in Crete. They would pass up the individual parachutists as that got on the ground. If they had not bumped him off in mid-air, they let this boy alone after he hit the ground. Next thing they knew, there were six, eight or ten men all ganged up around equipment bundles. Then they would open fire and give them the works. But that is one of the problems. It obviously makes it desirable that a parachutist be dropped out of range of small arms fire. Crete, however, was a special case. I hate to mention Crete now, and I hate to hear other people mention it. It was so special in its nature that we are likely to be misled by lots of the things that went on. It is true however, that it did teach us a great deal.

We have pulled a few grand-stand drops in the U.S., generally, I would say, dictated by safety reasons and a desire not to crack up a lot of men in training. We have actually landed on airfields, but we think that is foolishness. The idea of anybody landing on an airfield, when he can land off it, then go to it, assault it and take it, is perfectly absurd. Yet, in one of the parachute drops in Africa, they dropped a parachute unit right smack dab in the middle of an airfield, which was held by the French. The airplane photographs on which that plan was made indicated there was very little by way of defensive installations. It was also hoped that there would be very little French offensive action. When the boys dropped in the middle of the airfield, however, they discovered that the whole perimeter of the field was simply studded with machine guns. They could have been mowed down like wheat, but it so happened that the political situation and wishful thinking materialized. Frenchmen came out, helped them off with their parachutes and kissed them on both cheeks; then they all went off and had a drink. But I don't call that a well planned operation. It worked and possibly that is what counts, but it is a pretty risky operation to count on.

The training of our parachutists is pretty much the same as the training the British give to their Commandos, although these men are not Commandos and we do not want them regarded as such. They are highly selected volunteers to begin with; they are good physical specimens, toughened up, given all sorts of intensive instruction as military specialists, and particularly in the tactics of small units. There is an added factor in that they get extra pay, which enables them to take away some of their soldier friends' girls and induces a constant and high state of morale.

Any parachute unit is capable of sustained exertion, due to the physical stamina of the men. They land and take off on the double; they can go miles at a tremendous speed; they are imbued with the offensive spirit. When they get to their objective, they will take it; and given proper superiority and strength, which is one of our doctrines, they will take any objective against which they are thrown. Then the catch comes- how long can they hold it? They will generally be in the middle of a hornet's nest, utterly surrounded. You can see that they have absolutely nothing with which to protect themselves against armored attack. Sad but ture. They will take anything, but how long they will keep it is problematical.

With the advent of the glider unit, which was the follow-up of parachute units, we generally came to regard the parachute outfit as sort of an advance guard to clear the way, and to be followed in by the gliders. You cannot land gliders under fire and expect to carry on from there. The glider is pretty vulnerable when it lands. It makes a big target if anybody is in the immediate vicinity. Due to its slow speed, its lack of armor and armament

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it is likewise extremely vulnerable while it is enroute to its objective. Some joker has very accurately called the glider "a slow flying clay pigeon" enroute to its objective, and that might be true under certain conditions. If the glider is flown at night that is not so true; on the other hand, that is an Air Force problem. Our air people tell us that while they can fly gliders at night, they cannot bank on finding the attack or landing area in the dark. They are working on that; the British are working on it. They are already installing night landing lights on gliders and anticipate that the problem will be solved. Other than that, the glider may be flown to its objective during the night and contemplate a landing at daybreak; I mean, when it is just light enough to see; that is entirely feasible. If gliders have to go from here to there in daylight, they are subjected to all sorts of antiaircraft fire. The American procedure, at the present moment, is to hump these babies about 200' off the ground, right straight across the country at tree-top level, hedge-hopping. They are very difficult to see; they are not particularly vulnerable from aircraft in the air. So far as the man on the ground is concerned, they are here and gone before he knows it. That is the American technique of approach in daylight, right along at ground level.

The air-transported division, about which there is some doubt as to their value, was devised as a means of making a ground force available at a location which we could not get to any other way. What that is worth, I do not quite know. Obviously, it presupposes secured landing fields being accessible. You drop down with a reasonable amount of equipment and these people will go in and reinforce your airborne division, conceivably taking over, if necessary. So long as we can maintain air superiority, an air-transported division on the ground can be supplied by air and can sustain itself for a considerable period of time. General Cota questioned me some few days ago. He is very skeptical, and properly so, about lots of things. He said "Why can't you take any infantry, and in about 15 minutes give them air transport training?" It seems so easy to put men in a ship or glider and move them here and dump them off, but it is not quite that easy. It requires a great deal of training and technical knowledge. It requires excellent instructors and if you don't have them, even in training, you will suffer casualties. The only experience that we have had, as I mentioned, was the training of the Second Division at Fort Sam Houston. I have a few figures here which may be of casual interest to show you the size of the problem that was undertaken for the first time and what it amounted to.

We moved the 9th, 23rd and 38th Infantry Combat Teams from several air ports in the vicinity of San Antonio to other air ports on the Mexican border. In these three combat teams, there were something over 9,000 men, moved by transport-airplane and glider. In round figures, there were about 1,100 planes, not separate planes, but a duplication of planes so that there were 1,100 plane-loads making the trips. About 200,000 lbs of baggage was transported; 140,000 lbs of rations, gas, oil and water. A million and a half pounds of ammunition was transported. Four hundred jeeps were moved to the Texas border, and about 170 trailers. There was a grand total of something over 5,000,000 pounds moved without difficulty, without casualties. Although we did have two or three crash landings, there were no casualties due to the fact that the loads were properly secured, lashed, and properly placed. That is something the air people will tell you cannot be laughed off. It takes expert training. It takes knowledge. I think that those figures are fairly impressive as a first try on such a job. It promises much for the future. Most of these ships and gliders were loaded at night, and practically all the take offs were at night. It requires very good non-commissioned officers, they must be highly trained.

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Tactical Doctrine: We now touch on the subject of tactical doctrine and, as I say, I am a bench mechanic away from home. I would like my remarks on doctrine to be understood as unofficial. I should explain that the present lack of doctrine to govern the employment of airborne troops has not been occasioned through oversight; it is due, rather, to the fact that the existing manuals antedated the creation of the glider unit and airborne division. There are some remarks in our manuals about airborne divisions but at the time they were written it was like the boys at Leavenworth speaking of something they hoped would materialize some day. The thing has materialized and the manual really doesn't cover it in any great amount of detail. What I may say however, expresses I believe the current thought of the Airborne Command and the thought of the Troop Carrier Command in the U.S. From my association here with the British, I believe that they generally concur with us.

We like to regard the airborne division as a small combat team; that is, the division itself is a team. We have a different set-up from the infantry division, where we break it down into three teams. We think that the airborne division is so little to begin with that the way it is set up is not susceptible to being broken down. To get the most out of it, it should be used as one team against one rather definite objective.

Something I have not mentioned is the matter of airborne brigades. I believe that this has been approved; General McNair understood the War Department was to approve it some two months ago. We desired to create what we would call an airborne brigade, not based on any standard table of organization, and not consisting of any set type or number of units. We wanted the thing flexible and elastic so we could build up a small airborne task force, smaller than a division. This could be used on some mission where the small force was in keeping with the size of the mission. It might be a parachute regiment, glider regiment carrying artillery, two or three batteries, some engineers, or what have you. There was this desire (and I think good reason for it) to create a small airborne task force so that, when we had a small job to do, we wouldn't break up the division and ruin the divisional team. And that probably has materialized by now.

There are several characteristics of airborne divisions which should be appreciated, especially by higher commanders. Many times the boys in the lower echelons understand things but we get some arbitrary commander who has not been grounded in basic essentials, or he may not be receptive to suggestion from his staff.

The mere fact that a commander of a large force has available for his use, in reserve, an airborne division, or any large force of airborne troops, has a tremendous effect on the plans of the enemy, there is no question about that. The mere fact that we are holding out this airborne force which can take off, go anywhere and drop within reason, will tend to make the enemy conservative in his plans. It will definitely make him immobilize reserves which are out of all proportion to the airborne force. We had a very specific case of that a year or so ago on Army maneuvers in the U.S. Some of you may be familiar with this. It was reported to me and I believe it is true. One army commander held out a force of between 7-10,000 men, rather suspiciously close to his command post, because he knew the other side had all of one battalion of parachutists, 500 men. This outfit was held out and was motorized ready to take off; they were really going to do away with parachutists. In that maneuver they did not use those 7,000 men, which is pretty good pay for the 500 men on the other side.

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The division has great strategic mobility but very little tactical mobility. It is tied down to the rate of speed of foot movement on the ground. To compensate for these shortcomings, the division must be employed in a plan which is based on surprise, superior strength and on speed. For a commander to decide to use his airborne force, it should be required to be directed against some objective which is of vital importance to his force as a whole. If that is not done, it is not economy. There might be an exception, if it is desired to sacrifice a division and a valid reason exists, obviously he will do so. So much for the general points.

There are a certain number of specific points of doctrine and I believe that these may apply, in part, to our case here. Generally I am speaking of a division, although it will hold true for an airborne brigade and smaller units.

When a division is operating alone, a very unusual case, and is not tied in with another force, it will operate pretty much in the same manner as any infantry division, with the restriction that it must be resupplied by air.

The employment of the division in conjunction with other large forces, ground forces, air forces, sea borne forces, will always anticipate that the division will be properly tied into and joined by those other forces on the ground. The division cannot sustain itself and this linking up must occur.

We hear people who draw big plans talk about shooting a division 500 miles inland and dropping it down, taking this and that. We have a rule of thumb, which applies as much as any rule of thumb does; that the maximum distance inland from a hostile forward area at which you should land airborne troops should be about equivalent to that distance which can be covered by ground forces in three days. If you are out in the desert and you figure an armored force could go 100 miles in a day, you might drop airborne troops 300 miles away. If it is a motorised outfit, you get a different answer. The British incidentally have this same rule of thumb about getting help in three days.

The division should be committed against limited objectives in a rather restricted area, rather than against unlimited objectives in a general area. That is based on the division's lack of transportation and tactical mobility. It is also set up as a principle to endeavour to discourage these higher commanders from giving a division missions which will scatter it out like a bunch of Commandos all over the landscape. In that case, you do not have an airborne division but just a nuisance value.

I have already mentioned that a division will only be committed against objectives of major importance to the force as a whole; it would be regarded as uneconomical to do otherwise.

It will not be employed on a mission which can be equally well accomplished by other ground forces. That is dictated by economy. If you can get normal ground troops to do a job, why should you take specially trained men and specially equipped troops to do the same job?

The plan of employment will take maximum advantage of the element of surprise, which is regarded as the most important single characteristic of airborne operation.

The decision to employ the division will be based on the assumption of the obtainment of positive air superiority during the assembly, during the flight to the objective, during the landing, and as long thereafter as may be considered tactically necessary. If there is any question of the air superiority the operation courts disaster. If that must be risked, it is a matter of decision.

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The plan to govern the action of the division subsequent to landing will be characterized by maximum simplicity and flexibility. It must be; it is complicated enough, as it is.

A division landing area should be as close to the objective as is considered practicable. This distance from the landing area to the objective is regarded as a maximum of 10 miles.

The plan for supplying the division should be based on a six-day operation. That is set up to give the Medical, Signal and other people a sound basis on which to work. While we say the division cannot operate more than three days without help, and we hope it will get help in three days, they will still continue to fight. The supplies sent up are based on a six-day operation and once these supplies start going they are not stopped until by division request.

One thing I neglected to mention; airborne tanks. I think, probably a year and a half ago, the War Department instituted the development of an airborne tank, called the T9 Tank. This has finally been produced. Right this minute at Fort Knox the Armored Force has a tank unit which is being given its ground training. On completion of the ground training, it will be turned over to the Airborne Command for the airborne phase of its training. The unit, I think, is one battalion. How many tanks, I do not know. When we get airborne tanks, we will have something we need very badly.

I would like to make an effort now to discuss the application of the tactical doctrine which I have mentioned. When we consider the employment of airborne troops, we should determine on a likely mission. In determining this mission, we should see that it is in reasonable conformity with what is considered proper doctrine. If there is a good reason to depart from the doctrine, all right. The Commander who departs from approved doctrine, however, is always sticking his neck out, which is also quite alright. The problem of this committee, to get down to brass tacks, is to determine on a procedure and doctrine to govern the units of an assault landing in making a cross-channel invasion against a heavily fortified coast. We are not talking about the weak spots. This heavily fortified coast is within range of our own land-based aircraft. It has been quite patent, from previous discussions, that the British and ourselves accept, without equivocation, the premise that the German doctrine is to defend against invasion on the coast rather than contend with such a proposition inland. Secondly, the coast, and what we have come to speak of as the "crust" or outer shell is the No.1 vital objective. Certainly any mission which will aid in taking that objective is in keeping with any doctrine which will govern employment of airborne troops. They will be used and should be. (There followed a blackboard discussion as to appropriate missions for airborne troops. These are included in the Review of discussion).

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28 May 1943.

DISCUSSION FOLLOWING TALK
BY COL. J.T. DALBEY

A discussion on the present availability of airborne troops and the prospective availability of such troops in the ETO revealed the following information:

a There are two U.S. Airborne Divisions trained and ready for combat at the present time. One of these divisions was known to be either in Africa or scheduled to go there in the near future. The other trained Airborne Division was in the United States and was available to come to the ETO.

b Several parachute regiments (3 or 4), separate from divisions, could be made available to the ETO; however, in this connection, it was the opinion that, at the present time, there would not be sufficient aircraft available to handle more than one Airborne Division.

The use of the glider, CG4, in airborne operations was discussed at length. The development of the glider has continued and much progress has been made. The size of the glider and its load carrying capacity is being increased. The crating and shipping of gliders from the United States has presented quite a problem and experiments are being made in an attempt to break them down into smaller parts for shipment with a resultant saving of shipping space.

A discussion was held on the matter of the proper tactical employment of the different types of airborne units. It was generally agreed, after considerable discussion, that the principle tactical employment for the several type units would be:

a Airborne divisions should be employed against hostile reserves to prevent their reinforcement of the troops defending the beach area and to block the hostile counter-attack. They should be landed at least 1 mile away from their objective by day, and from ½ to 3/4 of a mile by night in order that they have sufficient time to collect themselves and get organized, and in order that hostile small arms fire is not brought to bear against them immediately upon landing.

b Parachute troops should be employed against hostile shore batteries to assist in their reduction from the rear. It was stated that parachute troops seem to prefer landing under cover of darkness, and that in training operations, there were fewer injuries suffered among units dropping at night than there were in daylight. Parachute troops can be depended upon to take any objective assigned to them but should not be employed at such a great distance from friendly troops that they cannot be reinforced and their success exploited before enemy action might eliminate them.

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c Air-transported infantry divisions cannot be employed until such time as landing facilities are available in proximity to the area where it is contemplated using them.

The problems of coordination in the use of airborne units in a landing assault operation were discussed. The use of airborne units is contingent on many factors such as the availability of aircraft, the necessity for diverting a large number of aircraft from other operational missions, the necessity for resupply of these units, weather etc.

The decision as to what airborne units to employ and the details of their tactical employment must be worked out during the planning phase of an operation. There are many factors which limit to a certain extent, and at times prohibit the employment of airborne troops. When it is contemplated to use parachute troops in an operation, unpredictable conditions of weather, visibility, etc., may make their employment impossible and jeopardize the success of the entire operation. Plans must take these matters into consideration and be flexible enough to cope with conditions which limit or make impossible the employment of parachute troops or airborne troops.

The discussion included many opinions as to the best time to land airborne troops. The advantages and disadvantages concerning night landings, dawn landings, daylight landings were brought out, and the relationship of all of these to the other aspects of the whole operation were noted. It appeared that the best time of day for transporting airborne units and for landing them must be given careful thought, and must be viewed in its proper aspect in relation to the other phases of the operation such as the most suitable time of day for Naval gunfire support, air bombardment, infantry landing etc.

The concensus of opinion indicated that the most favorable time for the approach to and passage over the hostile coast should be under cover of darkness, which is a major factor, from the airborne point of view, in determining H-hour.

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29 May 1943
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Review of discussion following the lecture:
"AIRBORNE TROOPS IN A LANDING ASSAULT" by Col J.T.DALBEY

Question 1 - What airborne units are prospectively available in ETO?

Conclusions reached: a. One airborne division plus several parachute regiments can be made available.
b. The division now in Africa may be ordered here.

Question 2 - How is each type of airborne unit employed tactically? Airborne division? Parachute regiments? Air-transported infantry divisions?

Conclusions reached: a. Airborne divisions should be employed as integrated teams against specific objectives, particularly against enemy divisional reserves, and to assist in securing assault division objectives.
b. Parachute regiments can be employed against hostile shore batteries or to assist in seizing airdromes adjacent to the area where the operations are taking place. In the latter case it is deemed an uneconomical use of parachute troops to seize an airdrome that cannot be quickly reinforced and held.
c. Air transported infantry divisions can be used against hostile reserves after secured landing areas are available.

Question 3 - What diversions of transport and fighter aircraft from other operational missions is involved in an airborne operation? How will this affect the use of airborne troops in a landing assault?

Conclusions reached: a. An airborne operation involves a very considerable diversion of transport, fighter and bombardment aircraft from other missions, as the operation must be covered throughout. Consequently, the number of airborne troops which may be used in a single operation is definitely limited. Within the near future not more than two U.S. Airborne Divisions can be used in the European Theater.

Question 4 - How may each type of airborne unit be best used in support of a landing-assault: seizure of airdromes? seizure of ports? destruction or seizure of hostile communication and transportation centers? isolation of beach areas from reinforcements? attack of beach defenses from land side?

Conclusions reached: a. Seizure of airdromes by parachute troops is practicable but is considered uneconomical unless objective is so situated that it can be reinforced promptly and secured by other troops.
b. Airborne troops can assist in seizure of ports by taking specific objectives such as coast defense batteries.
c. Airborne divisions can be used for isolating beach areas from local reinforcements within the divisional area, but they will have to be backed up by air and ground forces in holding up hostile reserve divisions.
d. Parachute troops can be used to attack beach defenses from the land side, but this must be limited to specific objectives and carefully coordinated with the assault force in the planning stage

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in order to avoid confusion in the beach area and bringing them under our own supporting gunfire.

Question 5 - How will the air, airborne and landing assault forces be coordinated? How may each force assist the other?

Conclusions reached: a. Matters of coordination between the air, airborne, and landing assault forces will be mainly settled in the planning phase. After airborne troops take off, communication will be by radio, or by aircraft set up for that duty.

Question 6 - How will each of the following factors affect the employment of airborne troops in support of a landing assault: weather, visibility, night operations, designation of dropping or landing zones, necessity for prompt relief or reinforcements, limitations on armament, ammunition and supplies carried, communications, supply?

Conclusions reached: a. Parachute troops can be dropped successfully at night as well as day.

b. Gliders can approach their objectives by night, but under present limitations, must land by day.

c. Wind must be less than 15 mph if parachutists are to avoid heavy casualties.

d. Flying of gliders by instrument is not presently possible.

e. Dropping or landing zones must be near identifiable landmarks, preferably in the open.

f. Reinforcements are required promptly, as airborne units have limited ability to hold an objective.

g. Communications are the same as for the assault force in an amphibious operation, and are practically limited to radio except for panel and visual signals.

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ADDRESS BY
MAJ. GENERAL P.C.S. HOBART
(79th Armoured Division (Br)

NOTE: FOR REASONS OF SECURITY AND AT THE ORDER OF THE CHAIRMAN, GENERAL HOBART'S ADDRESS WAS NOT RECORDED AND WILL NOT BE INCLUDED IN THIS RECORD.

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29 May 1943
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ADDRESS BY Lt Col C. R. KUTZ (G-5 Section, ETOUSA)

ARMORED FIGHTING VEHICLES IN A LANDING-ASSAULT

I feel a little bit out of character this morning. I would rather have my tank helmet on than this brass hat I am wearing. There appears to be a shortage of tank helmets in this Theater at the moment.

I went into the history of the use of armored vehicles in a landing-assault and it is a little bit skimpy. In the last war, there was one interesting development which came to light. In 1916, before the first British tanks went into action in Flanders, a scheme was drawn up toattack the Belgian coast, using tanks to lead the way in. That was abandoned for various reasons, but the following year it was revived. A great many preparations were actually carried out, but the operation itself had to be called off. Some of those preparations are rather interesting. It was decided the British Army would attack in the Ypres sector and take the town of Roulers. When that town was taken, the seaborne assault force was to come in between Ostend and Newport. The British had prepared, or were preparing at a number of points, 600 foot pontoons of shallow draft. On each of these pontoons would be their Mark IV 30 ton tank, their artillery, their troops and the supplies for this expedition. These pontoons were to be pushed ashore by shallow draft monitors which were in use at that time. The beach conditions were the same as we are liable to encounter on many parts of the French coast today; very flat beach, heavily wired by the Germans and backed by a seawall which stood some 20 feet high. On the top of this seawall was a stone coping that jutted out about 2 feet. On top of the seawall and behind it was a good deal more wire and some machine gun and light field artillery emplacements. The job of overcoming these emplacements was assigned to the tanks. They were to lead off the pontoons, climb the 20 feet seawall and go in to clean out the guns. Once they had cleaned out the guns, they would act as stationary donkey-engines and help haul guns and sleds, carrying stores up the seawall.

The method of getting over that seawall was a huge ramp carried on an A-frame which was mounted on the tank itself, so designed that, when the top of the ramp hit the seawall lip, it would be automatically released. On the ramp were heavy wooden spuds and on the tracks of the tank were blocks which had been fastened, so the tank could scramble up this very steep ramp, very much like a cogwheel railway. They found the tank did have sufficient power to do the job. As I say the battle of Ypres didn't go quite the way they expected it. Roulers was never taken and so the expedition was called off. An interesting feature about it is that they figured that, from the time the monitors or pontoons grounded until the tanks reached the top of the seawall, would be 4 minutes. It's a device which we may have to consider again, the use of these ramps carried on A-frames.

In this war, tanks have been used more extensively in amphibious operations but again they have been very seldom used in leading the assault. Germans, when they invaded Norway, took a considerable armored force, but they landed at Oslo directly from

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seagoing ships, using cranes put over on the quay. This armored force raced up the Central Valleys in Norway and managed to beat the British to the punch in the Trondjhein Sector. The Japs have used tanks, but we haven't got quite so much information on how they used them. We do know that they had a special shallow draft flat deck barge, propelled by an airscrew which could carry one or two of their light tanks. I haven't seen any records of their using these tanks to lead the way in. We know that they used them very early in the game at Singapore. We used tanks to some extent on Guadacanal. There again, I don't believe that they were used in leading the way. They came in somewhere behind it.

The Dieppe Raid was probably the first modern attempt to use tanks in a beach assault. I think all of you are fairly familiar with that show, but from the tank viewpoint it is very interesting. I think there were 29 tanks that started in, only a handful were actually landed. Some were lost in landing. There is one interesting feature for which we'll have to find a solution. As I understand it, one of the LCT's carrying a Churchill tank had its ramp-lowering machinery shot away and the ramp dropped down. The tank commander buttoned up, his engine running, felt the LCT had grounded and assumed the dropping of the ramp was the signal to go ashore, so he takes off. He is still in some 20 or 30 feet of water unfortunately. Of those tanks that got ashore, many threw their tracks in the heavy shingle of the Dieppe Beaches. The Churchill was, but I think that has been corrected, a little weak in the respect of keeping its tracks on in certain difficult terrain. The scheme at Dieppe, as I understand it, was for sappers to breach the seawall behind the shingle and for the tanks to go through the gap. Sappers came under fire, had some difficulty with the demolitions, and were never able properly to breach the seawall. One platoon leader used a fascine, similar to the type used in the battle of Cambrai in 1917. He dropped it in front of a low portion of the wall, and managed to scramble up over it. A few of the tanks reached the center of the town but all of them had to be abandoned, none could be reembarked. So much for the history, which I said at the outset is rather skimpy. I think that probably the reason that tanks have not been used more in amphibious operations is the difficulty in a long sea voyage of having an adequate number of tank landing craft, or even on a short seavoyage. We hope in our request for landing craft here, we have corrected that.

I would like to go now to a brief discussion of the types of armored units we will have in the theater for this operation. I am not going to take your time going into the details of this equipment, that is all in the books and can be dug out very easily.

We have asked for some mechanized cavalry regiments. They will be used for corps reconnaissance, one per infantry corps. It is not contemplated that any part of them would be used in the assault or even in the immediate follow up. They will be used after the bridge head is established and the process of breaking out is being undertaken. Next thing we asked for was some tank groups. Tank groups can be either light or medium. I understand the heavy tank is no longer in production and we won't have any of those. Also a tank group can be mixed, with one or two medium battalions and one light. It normally consists of three battalions. The principal purpose of setting up the separate tank battalion and organizing them into groups was to provide the army and GHQ commanders with a pool of tanks which they could use attached to their infantry units, acting in close support, without pulling out bits and pieces from armored divisions and thus weakening their fighting strength at a time when they are likely to be needed. That is the reason we have included these tank groups in our troop basis. We hope to have a sufficient number of them to put at least

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one tank battalion in support of each infantry division under what might be called normal operations, and more than that for any special job. An armored division of course is a very powerful striking force if it is kept well grouped and used in terrain and under conditions suitable to its characteristics. If it is spread out over too wide a front or has to operate over difficulties beyond its supply range it frequently gets into difficulty, as witness the 1st Armored Division strung out on a 75 to 100 mile front in Tunisia, and split up into four small combat commands. One of Rommel's last acts down there was to field strip it. The tank destroyer battalions are set up on the basis of one attached permanently to each infantry and each armored division. In addition to that, we have a number of separate battalions in the GHQ troop pool and the necessary group headquarters to handle those as a unit if the situation makes it desirable. The distinction there is that the tanks will not normally be attached to the infantry divisions whereas the tank destroyer battalions will.

And that very brief discussion and introduction brings me down to these questions which Col Chase passed to me some two or three weeks ago.

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29 MAY 194[illegible]

ARMORED FIGHTING VEHICLES IN A LANDING ASSAULT
Discussion Following Lecture By
- Lt Col C.R. Kutz -

Until about a month ago I was in the design department which developed the D.D. The greatest disadvantage of the normal displacement type of amphibious tank will be the thinness of the armor plate. Calculations show that a normal displacement tank with the same armor as a Valentine would weigh about eighty five tons. I'm sure that each of you is familiar with the troubles experienced with a heavy tank.

The D.D. which is a means of floating a normal fighting tank is revolutionary, and offers an excellent means of putting the tank ashore. Once ashore, it discards its amphibious attachment and is not impeded in its normal employment. Further, it allows surprise, in that it looks like a small boat but has all the characteristics of a tank.

The D.D. device is a canvas screen which is vulnerable to H.E., but not small arms fire. Collisions should be avoided as it may be sunk, should it strike another craft. D.D. presents a small target and should be landed at dawn during low tide on a very shallow beach. This permits the tank to be employed as such while still 1000 yards distant.

D.D. tanks should be used for encircling movements 15 to 20 miles on the flank of the main assault. They are best employed on a beach with deep runnels and therefore lightly defended.

Lt. Col. Reeves (Br)

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HQ ETOUSA

29 May 1943
KM

REVIEW OF THE DISCUSSION FOLLOWING THE ADDRESS "ARMORED FIGHTING VEHICLES IN A LANDING-ASSAULT" BY LT COL C. R. KUTZ

Question 1 - What type of landing craft are most suitable for transporting tanks ashore during various stages of the operation?

Conclusions reached: The most suitable landing craft for transporting tanks and other motor vehicles are:

a. LCM's for the initial assault.

b. LCT's (4) and (5) for the latter part of the assault phase and the immediate follow up.

c. LST's for use after hostile fire has been cleared from the beach. LCT's (4) and (5) and LST's can cross the channel under their own power; LCM's will have to be transported.

Question 2 - Can fire power of tanks be utilized to advantage prior to debarking as a supplement to boat guns?

Conclusions reached: Tanks can be fired from craft, but it is not profitable to do so unless point targets can be engaged. The degree of accuracy that can be attained must be determined by experiment.

Question 3 - What are the possibilities of tanks taking hull down positions in water and functioning as stationary monitors or pillboxes?

Conclusions reached: It is possible for tanks to take hull down positions in water and function as stationary pill boxes. That is the best means we have at present for close support of infantry

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Question 4 - How early during operations should tanks be landed? What factors influence the decision?

Conclusions reached: The stage of the operation at which tanks should be landed depends upon the mission they are to accomplish and the nature of the obstacles beyond the high water mark. Tanks which are to be used to support infantry in the reduction of beach defenses will be landed in the early wave. The tanks which are to accomplish inland missions would not be landed until gaps had been cleared in the beach defenses.

Question 5 - What are the capabilities and limitations of amphibious tanks? How can they best be used in a landing-assault?

Conclusions reached: a. The capabilities of amphibious tanks are:

(1) They cross off shore bars that would stop landing craft.

(2) They can cross beach runnels.

(3) They can operate over swampy areas.

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b. The limitations of amphibious tanks are:
(1) Their armor plating is thin.
(2) Their armament is light (37 mm guns).

c. Means have been devised for floating standard tanks and the following advantage would be gained:
(1) Small target when landing.
(2) Can cross bars or runnels.
(3) The limitations of amphibious tanks do not obtain

Question 6 - When tanks go ashore should they operate in close support of infantry attacking coast defenses, or on exploitation missions inland? What are the determining factors?

Conclusions reached: The primary mission of tanks in the assault phase will probably be the close support of the assault force.

Question 7 - How many and what type of tanks, if any, should be attached to regimental combat teams for landing assaults? Should attachment of tanks extend down to battalions? To companies

Conclusions reached: There is no categorical answer. As a general rule tank battalions should not be broken up except in a special case, such as a beach assault, Medium tanks are more suitable than light tanks in an assault role.

Question 8 - If tanks are attached to small infantry units during the assault at what point during operations should they revert to control of the higher commander?

Conclusions reached: They should revert to the control of the higher command as soon as the specific task for which they were withdrawn from the control of the higher command has been completed.

Question 9 - How will the use of tanks be affected by underwater obstacles, mines on the beaches and beach exits, sea walls, barricades, tank traps and other obstacles?

Conclusions reached: All obstacles, natural or artificial, will tend to canalize the movement of tanks.

Question 10 - How are tanks affected by such factors as beach gradient, surf, shingle?

Conclusions reached: It is unlikely that beach gradients too steep for tanks will be encountered on the French coast. Runnels, where encountered, will be obstacles if they are deep enough to drown the tank. Highly trained crews, by proper timing, can land in surf higher than the waterproofing of the tank. A surf of over four feet would foreclude the landing of tanks. Thorough tests must be conducted to determine which types of tanks can be used over shingle beaches.

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Question 11 - What problems are posed as regards:
Class III and V supplies?
Waterproofing?
Availability of proper type landing craft?

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Conclusions reached: a. Class III and V supplies present no unusual type of problem.

b. Tanks can be efficiently waterproofed but experience has indicated that great care and close supervision is essential to satisfactory results.

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ADDRESS BY
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REDUCTION OF OBSTACLES & FORTIFICATIONS

31 May 1943

In approaching this subject I would like to quote from the British document on Tactical Problems of an Invasion in Northwestern Europe: "The Commander of an attacking force must look at the start well beyond the initial assault, and consider the battle between his follow up and the build up force, and the German reserves. The follow up force must get quickly thru the beach-head area and fight the enemy well out beyond it, otherwise there will not be room for formations following behind to land and deploy in their turn. This need to gain room for the landing and assembly of the follow up divisions also governs the size of the area which the assault divisions must seize".

As a measuring stick for the task likely to be demanded of an assault division it is likely to be required to:

a. Assault landing beaches on a front of say 3 miles. The total frontage would depend partly upon the size of, and distance separating, suitable landing places, and partly on the number and capacity of vehicle exits and routes inland.

b. Penetrate inland to a depth of about 5 miles, and there hold a defensive perimeter to allow the follow up forces to pass through the beaches and assemble quickly.

c. Clear vehicle exits from the beaches, repair craters, etc., so that wheeled vehicles can land directly inland to their assembled areas.

d. Do all this, and be ready to receive follow up forces within 12 hours of the first craft of the assault touching shore.

Assault battalions will only succeed in their tasks if we win the fire fight. The defense is based upon obstacles covered by fire, and we must subdue the fire before we can clear the obstacles.

Assuming that the coast defense artillery has been dealt with, and next problem is to subdue the fire from the beach localities until the attacking troops can reduce them. The general lines on which a solution to this problem are being sought are:

a. Gun support craft cover the approach of landing craft to the shore, and engage by direct fire from shore localities. In addition, the maximum possible fire of all natures is laid down from the landing craft themselves.

b. The first thing ashore should be heavily armored tanks, armed with both a H.E. gun and one or more machine guns. These take up from closer range the engagement of localities defending beaches.

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c. If the defenses are heavily protected by concrete, some of the tanks may need to be armed with concrete buster guns. A liberal use of smoke may prove necessary, although it will make shooting on our side difficult.

d. Under cover of this fire, mixed parties of infantry and engineers clear gaps thru the obstacles, or make ways over them. At this stage these need only be sufficient to pass through infantry with supporting weapons to assault the beach defence localities.

e. Infantry with supporting weapons pass thru the gaps in the obstacles, assault and capture the localities covering the beaches.

f. Thereafter vehicle exits are opened and the remainder of the assault battalions, the floating reserve, and the supporting arms pass inland.

During this stage, the enemy artillery will attempt to bring heavy fire to bear on the beaches from several miles inland, and this must be prevented. It is proposed to deal with this by airborne troops, which might, after destroying the enemy artillery, seize and hold the division final objective until assault divisions can join.

The bottleneck of this operation is the passage thru the beach. This is the most vulnerable point on our landing operation, and the Germans have quite correctly concentrated their efforts at the beach line. As has been stated, the German beach defense is a combination of obstacles and fire power. The purpose at this particular period is to discuss with you the various types of obstacles and fortifications and to summarize the means which have been developed to overcome them. First let us consider the obstacles. There is an infinite number of obstacles which the enemy might devise. However, the war has shaken down the field to a limited number which have been found effective. Manufacturing material and training personnel in their use involves a considerable period of time. While we must expect, and be prepared to see, many changes, I believe it is safe, in planning our training for the next few months for operations against the principal obstacles now known to exist. I will describe briefly some of the more important types of obstacles, and then attempt to give you the latest thought on the means developed for passing them.

First let me emphasize that the Germans, like ourselves, believe that an obstacle must be defended by fire to be fully effective. We must therefore expect to find every major obstacle covered by heavy defense fire. A.P. Mines will be used freely. The combination of obstacles and fire power is axiomatic.

The engineering problem of passing an obstacle not under fire presents no unusual difficulty. It is just a matter of bridging, demolition, movement of earth or some other application of manpower and machinery and it can be planned and executed on a more or less definite time schedule. However, the passing of obstacles under fire is a different case, and in assaulting the German beach defenses this is a problem we must solve.

Now let us examine some of these obstacles which we may expect the Germans to use on their beaches. Again quoting from the British document on Tactical Problems of an Invasion in Northwestern Europe, which is concurred in by our own G-2, the following are the main types of obstacles and defenses to be found:

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a. In general there are two or more continuous belts of

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wire along all open beaches, usually sited between high water mark and the back of the beach. In addition, all strong points are wired, belts varying in depth between thirty yards and two hundred yards according to the importance of the strong point. Beach exits, particularly gulleys in cliffs, are often barried by a dense wire entanglement. The use of antipersonnel and antitank mines is now general along the coasts of France, Belgium and Holland. The former are normally found round the perimeter of defended localities and at infantry exits from the beaches; the latter as AFV exits from beaches in open country behind beaches abd road junctions and road defiles up to five miles inland.

b. Of the various types of beach obstacles employed, walls, antitank ditches, dragons teeth, concrete pillars, rail pyramids, wire knife rests, the reinforced concrete or brick wall are the commonest types. Walls block streets leaving from a beach or harbor, and roads on the outskirts of towns on the landward side, also well-defined exits from open beaches. Road blocks of this type together with existing buildings often form a continuous obstacle along the entire sea front of a town.

c. Antitank ditches are sometimes found in front of a beach, strong point of all types, on the seaward side of antitank of sea walls along the front of towns, and surrounding strong points containing RDF and other wireless installations. Continuous antitank ditches are sometimes found on the landward side of strongly-defended ports. Steel fence obstacles (Element"C") along stretches of open beach is becoming more common.

d. An outstanding feature of the defensive system is the concrete protection provided for troops defending these obstacles. Strong points abound in pill boxes and shelters flush with the ground and constructed of reinforced concrete at least three feet and sometimes six feet thick. Pillboxes with strong points are linked up by highly developed trench systems, sometimes running underground.

You will note no mention is made here of underwater obstacles. The G-2 study, of course, has been based on actual observation, and there is no indication so far of any extensive use of underwater obstacles by the Germans. However, there are several types of underwater obstacles which might be used, and it is possible that as the danger of invasion becomes more imminent we may see a rather more extensive use of obstacles which are not too difficult to construct. Among the commoner type of underwater obstacles are barbed wire, piling, steel stakes, concrete blocks,element "C", land mines, and various types of magnetic mines. You are all familiar with the barbed wire and the concrete blocks. The underwater tank ditch about 10 feet deep, 10 feet wide at the bottom and 15 feet wide at the top, is somewhat a new development. It is covered with a thin brick arch which has a layer of sand at the top, so designed that it will crush with the weight of a tank. The sides of the ditch are rivetted to prevent caving in due to wet sand.

Land mines might be used below the high water mark. Ordinary German land mines are easily waterproofed and adapted for underwater use; these being fired by clockwork fuze, pressure or by trip wires.

A new type of floating mine called an "R" mine has been developed for use in shallow water. It is questionable whether it would be possible to use this in an area where a large range of tides exist.

Element "C", of which there is an extensive quantity now

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on part of the beach defenses, makes a very effective underwater obstacle. This is built up of tubular scaffolding which can be moved readily into water, somewhat similar to the British tubular scaffolding, which has been used as an underwater obstacle.

The navy is responsible for the removal of underwater obstacles seaward from the normal grounding line of landing craft at the time and place of landing. I understand that this task is assigned to units of naval demolition engineers. However, it is a responsibility of the navy which has only recently been undertaken, and is still in a development stage. The program for the development and means of passing underwater obstacles is being undertaken jointly by the army engineers and the navy. The army engineers are responsible for the technique of underwater obstacles in the defense, hence their interest in the project. However, to date, the British are the only ones who have done any extensive work in this field, and they have developed a number of methods which may be effective.

In the case of the "R" mines and the magnetic mines, it appears that the only rapid method of clearing the field would be to sacrifice some craft sending them in ahead of the assault forces. Other methods are slow and laborous and can hardly be relied upon under fire. There is no standard method of operating against sea mines during assault, each type requires special treatment. There is a very definite need for a reliable method of locating these mines, as well as the means of destroying them. Depth charges might be used in some cases. Existing methods require considerable time, since every contact must be investigated. It is possible that if mines are laid in very shallow water, 10 feet or less, they would be visible in good air photographs taken under good conditions from 25-30,000 feet, and air reconnaissance should be used in locating underwater obstacles in general wherever possible.

It is understood that the Japanese have used airplanes intensively in guiding landing parties through underwater obstacles. The destruction of land mines under water by bangalore torpedoes may prove to be fairly successful. These have created gaps up to 39 feet in width. It may be practicable to drop nagalore torpedoes from aircraft. Ordinary bomb or artillery fire might be partially successful.

A flexible rubber tube filled with explosive has been found an effective method of executing demolitions under water. It has also been found that three strands of pimacord wound round a steel wire rope about 140 feet long can be fired from a Chermolly pistol. This has effectively set off mines in an area of about 30 yards by 30 yards.

No means have been developed of passing the underwater tank ditch. However, this type of obstacle involves many constructional difficulties, and it is doubtful if it would be used on a large scale.

A promising development for destruction of underwater obstacles is the air cavity charge. This consists of a demolition charge in a cylindular form enclosed in another cylinder of larger size, so that there is a layer of about 3" free space between the charge and the outside container. This method of placing the explosive seems to increase the shattering effect very greatly. Two air cavity charges of about 45 pounds each blew a gap of about 20 feet through a standard steel scaffolding.

The bangalore torpedo, or the rubber hose filled with explosive appear to be the best ways of passing underwater wire.

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The technique of destroying underwater obstacles is in the process of development. Practical work has just recently been undertaken, hence there is a lack of any very decisive results.

In general, the answer to destruction of underwater obstacles seems to be some type of explosive charge, either hand-placed or prjected by special craft.

Appendix A contains a more complete discussion of underwater obstacles.

Now let us consider the obstacles on the beach. These we are certain to meet. First there is the sand itself. This may be a major obstacle to many types of vehicles. However,we have developed landing mats which can be used to make a roadway across sandy beaches, and these have proved to be fairly effective.

Next there is barbed wire, which has been used extensively. This varies in width from 30 yards to 200 yards. The bangalore torpedo has proved to be the best method of breaching wire rapidly.

Current military intelligence indicates the following concrete and steel obstacles may have to be dealt with by assaulting troops:

a. Enemy vehicles.
b. Reinforced concrete bases.
c. Dragons Teeth
d. Reinforced concrete cube obstacles
e. Reinforced concrete walls up to 6 ft thick
f. Steel and armor plate up to 2 in, with possibly some up to 3 in. thick.
g. Element C and other steel A.T. obstacles

As a result of the experiments conducted by the Canadian Army it was found that the most effective method of disrupting reinforced concrete obstacles is by an explosive charge in close contact with the obstacle. The area of contact should be as great as possible consistent with the thickness. This allows the development of the full velocity, detonation and power of the explosive charge.

The thickness necessary varies slightly with the explosive used, but seldom needs to be greater than about 4 ins. In this thickness of 4 ins. a small portion provides a tamping effect. For the best results the explosive should be primed so that the wire detonating wave proceeds from the priming point through the explosive at right angles to the surface attack. In charges having a large area, it is desirable to have more than one priming point placed symmetrically over the area and contacted for simultaneous fire.

The answer to the above requirements is thought to be a charge which has been named "General Wade", It consists of an arched charge in the form of a half-cylinder, 9 in. in height by 17 in. in diameter, containing a charge of about 24 pounds of pentolite. For practical use the General Wade can be provided with either clips or lugs so that the charges can be assembled quickly on a framework for any demolition requiring a number of charges to be fired simultaneously.

A special engineer tank has been developed to carry explosive charges and accessories to an obstacle. The Churchill tank was stripped to allow it to carry a driver, radio operator, a crew of 4 to 6 engineers and in addition about 1000 pounds of

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explosives and accessories. This tank has also been equipped with a spigot mortar for firing the petard. A tank can be stripped for this purpose in about 48 hours. It is believed that there is a definite need for this type of vehicle in assault operations.

The "petard" and the "flying dustbin" were developed as a method of assault blasting for use in conditions where small arms fire would be sufficient to stop unprotected engineers from advancing to the obstacle. The "petard" is the term applied to the spigot mortar mounted on a tank, and the "flying dustbin" is the explosive charge which is propelled from it. The charge has a total weight of about 40 pounds, and contains approximately 26 pounds of explosive. This has proved very effective in demolishing concrete walls. A tank breach was made in a 6 ft. thick concrete wall using ten rounds of this ammunition. This same type of ammunition with a few changes can be used against anti-tank minefields. The "dustbin" may be equipped with a rod which projects about 1½ft. ahead of it, and detonates it on impact about, 1½ ft. above the minefield. One charge has been found to clear an area about 40 ft. long and 20 ft. wide.

A brief description of the "onion" and "carrot" might be of interest.

The "onion" is a mechanical charge placer. It is a frame-work attached to a tank so that any charge may be carried by that machine. The frame work is carried vertically by two side arms which can be jettisoned from the tank after demolition is completed. There is a mechanical release cable inside the tank which, on being pulled, allows the frame-work carrying the charge to slide down into position against the target. The tank reverses away, and mechanically operated struts hold the "onion" in place.

The "carrot" may be described in a general way as an elongated rectangular charge carried ahead of the tank so that it can be placed in position and fired from the tank without exposure of the tank personnel. The weight of the carried charge varies from 12 pounds to 664 pounds. The device is connected with the tank by means of a special pin connection which has an explosive charge fitted in a chamber, so that when fired the charge knocks out the pins and releases the tank from the roller attachment, allowing it to back away, leaving the charge in position. When the tank has backed away six feet, wires attached to it pull the safety pins from percussion igniters which light the safety fuzes. These burn for sufficient time to allow the tank to get clear, before the charge is fired.

Neither the "onion" nor the "carrot" is entirely satisfactory. Both must still be classed as experiments.

By far the most important obstacles developed in this war have been the anti-tank mines and the anti-personnel mines. I have here some charts showing how these mines operate. In view of their importance, I would like to briefly describe several of the more known types:

Tellermine, No. 1 and 2
S Mine
French mine
German CVP mine
Non-metallic mines

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So far the most effective means of getting through these has been by hand methods. We have developed a mine detonator which will locate the metallic mines and a drill for the use of

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engineers, or infantry, in the breaching of minefields. It takes a party of about 45 men in the neighbourhood of two to three hours to make a 16 yard passageway through a 300 yard deep minefield. This party can only work if protected from enemy fire, or under the cover of smoke or darkness. Mechanical means of passage to minefields are not entirely satisfactory. One device which is the most promising appears to be the Scorpion.

Scorpions, Pilot Vehicles, Centipedes and Plows: The Scorpion, or "Barron" as the new model is called, as now built, is a medium tank with a revolving drum mounted in the front of the vehicle. Chain and cable flails are attached to the drum which is rotated at about 120 revolutions a minute. The chain hits with a sufficient force to detonate mines. The drum is rotated by a side-mounted auxiliary engine. The 8th Army has a Scorpion Regiment consisting of three squadrons of 12 Scorpions each. The Squdrons are divided into four troops of three Scorpions each. Each troop is commanded by an officer. At present they have only two operating squadrons with a total of 29 Scorpions available. The Scorpion Regiment is a part of the Tank Corps - NOT the Engineers.

The Scorpion advances at a rate of 1½ miles per hour. The limiting factor being the RPM's of the drum. Many mechanical failures are encountered particularly in the Ford V8 motor which drives the drum. The motor is not sufficiently powerful and great difficulty is experienced with the dust kicked up by the flails. The Scorpion is considered to be too slow and it is too wide (14 feet) for many bridges. The 14-foot width would probably be embarrassing in European villages and going through tunnels or across bridges. Visibility is very much limited by dust and requires generally a halt every 50 yards for re- orientation. Rough ground is a serious hazard to a Scorpion. The machine is only about 20% effective on A/P mines. It will clear an 8 foot gap and it is believed to be more economical to use them singly and later widen the gap with Engineers rather than use several Scorpions abreast.

Tactically the Scorpion is always used at night or under smoke cover. It is very vulnerable to A/T fire. It is preceded by a Pilot vehicle and the present idea is to follow it with a Centipede. The Pilot vehicle tries to find the near edge of the minefield and the Centipede detonates the Shrapnel mines missed by the Scorpions. In a recent test the Centipede destroyed 39 out of 40 "S" mines.

It must be realized that in its present development the Scorpion is not an effective weapon. The idea is sound but the machine must be perfected. They were not successful at ALEMEIN due to mechanical difficulties and the Scorpion Regimental Commander actually recommended against their use prior to the battle. At AKARIT they were of doubtful value - out of 6 used, 2 never got into action. A third failed almost at once and two others encountered difficulties before getting through the field and only one was actually fully successful. At MARETH they were quite useful in clearing artillery positions. They could not cross the WADI at MARETH without Engineer help, Wire will snarl the flails and completely destroy the usefulness of the vehicle and is a very simple and practical defense against them. It has not been employed by the enemy, apparently out of ignorance. Experienced Scorpion officers say flatly that a lot of single trip wires would stop the operation. Engineers must be available to turn the vehicle by clearing mines on its turning radius. At ENFIDAVILLE, one Scorpion was actually blown by a mine because it had not started to flail soon enough, and another was knocked out at once by A/T fire. Their only value in that action appeared to be to assist in the recovery of tanks stranded in the minefield.

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The Germans have now devised a simple and effective anti-Scorpion trap by placing a group of unfuzed mines connected to a line of fuzed mines by detonating cord. When the Scorpion is in place over the unfuzed mines they are detonated as the result of its flailing action on the fuzed mines. An anti-Scorpion mine is expected soon. A delayed action mine will do the trick and would be simple to devise.

It must be concluded that the Scorpion in its present state of development is a very unreliable weapon. Also it should be noted that the 14' roller will not fit into many of the existing landing craft.

The Pilot vehicle is simply a truck provi ded with three rollers - two forward and one behind, which cover somewhat more than the breadth of the vehicle. The rollers are concrete filled oil drums with heavy tool steel spikes. The operator is protected by sandbags and drives the vehicle from a protected enclosure. The spikes prevent bridging and add to the effectiveness of the roller in detonating mines - one mine costs one roller which weighs approximately nine hundred pounds.

The Centipede is a newly devised machine consisting of a large number of flexibly mounted concrete rollers. The vehicle is very promising but has not as yet been given any battle trial. In a recent test it detonated 39 out of 40 "S" mines.

An angle plow fitted before a dozer has been tried against mines. The plow is fitted with spikes on its lower edge and plows to a 10" depth; plans are on foot to increase depth to 12½". It is of no use in hard ground but might be quite effective on beaches. It would be badly damaged by trapped mines and the driver must be given protection.

Much experimental work has been carried out in Combined Operations Headquarters, British Army, on the destruction of beach anti-tank minefields. A method of destroying these minefields from a support craft called "HEDGEROW" is nearing completion.

The "HEDGEROW", which is a barge equipped with 24 spigot mortars, has been used to clear a gap 40 feet wide through about 100 yards of mines laid in the dry beach, The "HEDGEROW" fires in a straight line a series of 30 pound charges of TNT which burst just above ground level. The projectile has a total weight of 63⅓ pounds, it is equipped with a striking device in the nose which is about 2 feet long, this causes it to detonate about 2 feet above the surface of the ground and spread a blast effect. It has a range of about 150 to 220 yards.

Another development which is particularly promising is the Rocket craft. This craft is equipped with 790 rockets which are fired 36 at a time at one second intervals. The gun is the 4.2 CW rocket, firing high explosive heavy ammunition. This concentration will cover an area 700 yards wide by 150 yards deep, and it is believed will effectively destroy most of the mines, wire, and any light obstacles within such an area.

Obstacles of this nature may also be destroyed by putting ashore tanks equipped with flails or rollers.

It is slowly becoming realised that beach anti-tank minefields may have to be destroyed well ahead of leading flights of assault craft. The only way this can be done, by means now available, is by the use of aircraft.

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The Road Research Laboratory, which is a Department of

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the Ministry of Suppy, have conducted a series of blast experiments on British bombs. During the course of these experiments mock-ups of Tellermines and British anti-tank mines were buried to a depth of 4 inches into the ground, and various size bombs were detonated above these mock-up minefields. It was found that the blast from any bomb will detonate anti-tank mines to a radius depending upon the size of the charge of the bomb. The optimum radius of destruction is produced by, very naturally, the biggest bombs, but the most efficient size of charge is approximately 100 lb. charge. The radius of destruction is increased appreciably by raising the height of burst of the bomb approximately six ft. from the surface of the earth.

It is thought that practically, the most advantageous bomb to use would be the 250 lb or 500 lb M.C. bomb. 250 lb M.C. bombs are just coming off production. In order to raise the height of bursting the bomb above the ground, the No.44 pistol should be fitted. The effect of this should be as follows: The first bomb will detonate at a height of approximately 6 ins. above the ground, and depending upon the closeness of the stick spacing, this will detonate No. 2 bomb at a height greater than 6 ins; the detonation from No. 2 will detonate No. 3 at a greater height still, etc.

In order to try and detonate bombs subsequent to No. 2 at a reasonable height, i.e., not too high, a No. 44 pistol could be fitted with progressively long delay detonators in subsequent bombs.

The No. 44 pistol Mark II will be a more sensitive diaphragm operated pistol than is the No. 44 Mark I. This might be a better pistol for this purpose - without carrying out a series of actual trials it is impossible to say.

The stick spacing at which bombs would have to be dropped will of course depend upon the size of the bomb used. With 250 lb. bombs it would probably be in the order of 50-60 ft. However, it would be dangerous to be categorical without having carried out an actual trial.

A proposal is being investigated in Combined Operations Headquarters for the destruction of anti-tank minefields by the dropping of lengths of flexible BANGALORE TORPEDO from aircraft into minefields. It is considered that it is a less desirable method than the use of bombs, for it will entail a new technique, and aircraft will have to fly low, which would make them vulnerable to light AA. It would also almost certainly entail major modifications to aircraft.

However, it has been established by experiment, that a Bangalore composed of a two inch diameter BITUMASTIC tube filled with explosive will detonate Tellermines buried to a depth of 1 in. within a distance of about 12 ft. each side of the Bangalore when it is detonated on the ground.

Any special device such as the Scorpion Onion, Petard, Hedgerow etc., is, of course, subject to the general criticism that it will immediately draw the hostile fire, and if such devices are used they must be protected and liberal reserves should be provided.

The following is a summary of the means which have been developed to date for passage of the obstacles indicated. Many of these are still in the experimental stage and have mechanical difficulties to be overcome. However they represent the most promising of the many developments which have been tried:

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Barbed Wire:

1. Hand removal by wirecutting parties.
2. Blowing a gap by "Bangalore" torpedoes and "snakes"
3. Use of hand placed chicken wire roll.

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4. Special carpet laying device on Bren Carrier or Tank.

5. Use of Grapnell and cable towed by tank.

6. Rocket craft, while this will not create a 100% cleared path, if the 150 yd x 700 yd pattern can be placed accurately on a combined wire and mine obstacle the obstacle should be destroyed sufficiently to permit Infantry to pass thru with very few casualties Further clearing will be required for passage of vehicles.

Since wire will usually be protected by AP and AT mines #4 may not be very effective. #2 appears to be the most reliable means of creating a gap for vehicles rapidly.

Concrete and Steel:

1. Hand placed charge. a. The "General Wade" made-up charge is well designed for this purpose. b. Air cavity charge, still in the experimental stage, appears to be a good solution for under water concrete and tubular steel obstacles.

2. Engineer Tank. - This is a means for carrying the engineer party and the explosive under fire to the target where the engineers can place the charge by hand. An excellent means of making a gap in a seawall which is covered by MG fire from a pill box.

3. Petard is still in the development stage. It has a limiting range of between 100 and 150 yards. It is effective against a seawall and other concrete obstacles. It may be used against minefields. The Hendgerow is a group of 24 of these on a landing craft. This may be used to blast a path thru wire and mines on the beach if the craft can be maneuvered to the right point. It is not a very reliable means. However it is the most effective method yet developed for destroying concrete obstacles where personnel cannot advance to place a charge by hand.

4. Artillery and gunfire will have some destructive effect against concrete and steel, but it is not an economical means.

5. Bangalore Torpedo may be effective against small concrete obstacles but is not a particularly good means against the majority of larger obstacles.

6. Onion and Carrot - These are unwieldy and rather vulnerable devices. It is doubtful if their value justifies the use of the equipment and cargo space involved.

The "hand placed" charge maneuvered into place by means of the Engineer Tank appears to be the most reliable and effective method of destroying concrete and steel obstacles.

AT Ditches.

1. Fascines carried in a special rack in front of a tank with additional Fascines towed in rear should be an effective method if the tank can be protected by fire or smoke. Due to its unusual load, if seen, it will undoubtedly draw hostile fire.

2. Scissors Bridge and Churchill Tank Bridge, can be used to cross gaps of less than 30 feet. Churchill Tank Bridge appears to be the best of the two.

3. Hand labor can pull down the sides by working inside the ditch. Explosives may be used.

The Fascine method is probably the most rapid. The tank bridge next. Both are vulnerable to hostile fire, hence are not 100% reliable. The hand method is the most reliable means. However, both the Fascine method and the tank bridge are well worth trying and are sufficiently valuable methods to justify the special equipment involved.

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Mines.

1. Bangalore torpédo placed by hand is a good method for depths of fields up to 100 yards.

2. "Snake" pushed by a tank can be used up to about 300 yards.

3. Barron or Scorpion will clear a passage at the rate of about 1½ miles per hour if it works and if it isn't put out of action by enemy fire. It is not 100% reliable mechanically. It is noisy and slow and hence vulnerable to enemy fire.

4. Prima cord net fired by a rocket has cleared a path 10 feet wide and about 80 yards in length. Not a particularly reliable method.

5. Armored bulldozer is a good means of clearing shell holes of AP mines and may be of value against the other areas containing large quantities of AP mines.

6. Fowler Rolling device valuable against AP mines, but is vulnerable to AT fire.

7. Hand methods using mine detectors or probes are the most certain, but will require 2 to 3 hours to make a passage through a field 300 yards deep.

General:

Bombing from air and artillery fire will effect sufficient destruction of mine and mine obstacles to permit infantry to get thru with very light losses, but cannot be relied upon to provide a passage for vehicles.

The Rocket craft should be more effective than either bombing or artillery against minefield and wire on the beach. It must be fired at a fixed range of 3500 yards from the target. This requires a very accurate estimating together with ranging rockets from pilot craft.

If the pattern can be placed on the target it will be effective. However its ranging methods do not appear to give 100% guarantee of hitting the target. A greater depth of pattern at the expense of width may be desirable to insure hitting a beach obstacle.

No mechanical devices for rapid passing of obstacles have been developed which are 100% reliable. Due to their unusual appearance they will be likely to draw hostile fire if seen. If used adequate protection must be provided and a liberal allowance made for losses.

The hand placed explosive charge is the most reliable method of destroying concrete, steel obstacles, and the bangalore torpedo for the rapid breaching of wire and minefields.

Hand methods using mine detectors or probes are the most reliable means of creating passages thru minefields.

This covers very roughly the general development in obstacles and the means for passing them,

I want to touch briefly on the question of reduction of fortifications. The obstacle will, of course, be covered by small arms fire, and possibly by anti-tank fire. We may expect machine guns and anti-tank guns to be located in carefully concealed pillboxes, which will have concrete walls of from 5 to 6 feet thick.

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The reduction of these pillboxes presents a very difficult problem in a beach landing. At the Engineer School at Fort Belvoir we have developed a technique for the attack of fortifications having a land approach. We have built 10 of the German type pillboxes at Aberdeen and conducted a series of tests to determine the most effective weapons and the quantity of ammunition required to reduce these types of forts. At the time I left tests have not been completed, but partial results indicate that one shot from a 155 gun mounted on a medium tank chassis at a range of 2,000 yards would penetrate 5 feet of reinforced concrete. About 5 shots of 3" armor piercing ammunition were required to penetrate 5 feet of concrete. It required approximately 30 shots of the 105 HE anti-tank ammunition to make a similar penetration. It is quite obvious that if the 155 can be maneuvered in place where it could obtain a direct hit on the pillbox it would be an ideal weapon for the purpose. This of course, will not always be possible. The technique that we have developed is based generally upon the German system of attacking forts. The fortification is first shelled by heavy artillery. This tends to knock out some of the forts, to destroy the camouflage and to create shell holes in which the assault parties later may take cover. Under protection of this artillery concentration and smoke, flat trajectory direct fire guns from tank destroyer units are moved up into position about 1,000 yards from the pillboxes. When in position they engage the embrasures by direct fire. This direct fire neutralizes the fire of the pillboxes and in many cases will destroy the defending personnel.

Under protection of this direct fire special assault parties of infantry equipped with bazookas, flame throwers and demolition charges advance to within about 150 yards of the box. The direct fire is lifted and the bazookas continue to fire at the embrasures, permitting the advance of the flame throwers and the demolition men to within about 20/25 yards from the embrasure. The flame thrower then attacks the embrasure and under cover of the flame thrower the demolition men advance and place a pole charge under the embrasure. The assault party is considered to be more or less a "mopping" up unit, as we expect that up to 90% of the pillboxes will be reduced by the direct fire guns.

It is planned to use the 155 gun mounted on medium tank chassis in direct fire against those boxes. However, due to the slow rate of fire, and the vulnerability of this gun, we believe it must be used in conjunction with the faster firing gun, similar to calibre 3" and 37mm. The technique planned is to commence firing with the 3" and the 37mm gun neutralizing the embrasure then bringing in the 155 for one or two shots, and pull it out again. We believe this will effectively reduce the box. Obviously we cannot apply this same technique to the reduction of the beach box without the development of some special craft which will permit the firing of a flat trajectory high velocity gun similar to the 3" anti-tank gun or the 155. However, it seems that the attachment of a gun of this type to a barge which might be grounded might not be too difficult a job, and I believe we should attempt to develop immediately some such craft.

I believe it would be possible to assault concrete pillboxes covering beach obstacles by the same general methods employed to assault fortifications with a land approach. If we can develop a weapon which can engage the embrasures directly, air bombardment and naval gunfire can take the place of the heavy artillery concentration, and may continue to neutralize the hostile batteries. Air bombardment will also create on the beach sufficient bomb craters to shelter the assaulting parties. I believe the creation of shell craters for assaulting infantry should be one of the planned objectives of the initial air attack.

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APPENDIX A

UNDER WATER OBSTACLES

In any attempt to evolve a technique for attacking a defended, mined and obstructed beach, the first difficulty which arises is to determine what the defenses are. Obviously technique should be different for a beach where underwater obstructions and many mines are definitely known to exist, as against what should be done where barbed wire and a few beach mines are all that will be encountered. Furthermore, the extent to which beach obstructions are covered with fire must play an important part in the analysis of what is to be done to clear them. The relative nearness of defending troops and first reserves of troops may determine whether or not it is practicable to prejudice surprise by detonating heavy charges in the water near the beach before the actual assault is launched. In other words, the first essential of any plan for clearance of a beach is to have complete intelligence on what obstacles are to be expected and where they are placed. Intelligence on mining is most difficult to obtain , however, and it is not to be hoped that detailed information will be on hand for all beaches.

The extent of passive beach defenses can be rapidly increased. Heavy type obstacles take a considerable time to construct but precast concrete blocks can be relatively rapidly laid by derrick barge. Naval type shallow water mines as well as Army beach mines and anti-personnel mines can be placed quickly. Therefore, the plan of clearing any particular beach must be flexible and subject to change to meet last minute intelligence reports of increased obstructing or mining. The first essentials for flexibility are: the provision of an adequate reserve of both Naval and Army equipment so that all sub-Task Forces may meet unexpected demands; adequate training of Engineer troops in water and on beaches in the demolition of the more difficult types of obstacles and the clearance of thick mine fields; general training for all other arms involved in the assault to give them general familiarity in how to deal with simple obstacles and to avoid mines; and lastly full comprehension by R.C.T. or Brigade Group Commanders and lower unit commanders of what action they are to take if faced by certain types of mines and obstacles.

Given the best intelligence possible on any particular beach the plan for crossing must be worked out in detail and in conjunction with the Navy. Where any indication of mines or obstacles exist it will be most desirable to have some hedgerow craft (Br) or Mousetrap craft (U.S.) and Rocket Craft (Br) or L.C. (U.S.) with rocket attachments. How these are to be used, and when, must be carefully considered. Their use must be carefully integrated in the Army plan. The demarkation of responsibilities between the Armies and Navies for clearance of mines and obstacles is prescribed in joint operation procedure, but the difficulty of the problem requires that each service do all it can to assist and implement the other. For any of the beaches likely to be attacked it is almost certain the Engineer troops must be included in first waves of the assault prepared to cut wire entanglements with bangalore torpedoes, and demine beaches for the passage of vehicles. What further they must be prepared to do depends on intelligence or estimation of what may be expected on the particular beach.

There are two means of neutralizing obstacles which have considerable implications on the tactical plan. For this reason they are discussed separately rather than in the detailed analysis below.

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a. Neutralization by Air Bombing.

Considerable effect on Tellermines and underwater ground mines

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can be obtained by concentrated aerial bombardment. The effect on anti-personnel mines would probably be much less than on other mines. The result on wire or other obstacles is hard to estimate but probably would not be entirely effective. Trials made some time ago in England against a field of Mk. IV and Mk. V (Br) mines gave the following results:-

No. of bombs used - 114 of 250 lbs., direct action fuze.
Bombs which did not explode - 12.
Effect on Mk. IV mines - actuated by blast up to distance of 25 ft.
Effect on Mk. V mines - detonated or completely disintegrated by bombs within 6 feet. damaged by splinters, etc., to greater distance.
Average bomb crater - 7 ft. diameter and 1 ft 8 ins deep (not in sand)
Mk. IV mines detonated - 36.
Mk. V mines detonated - 5.
Mk. V mines with spiders off or severely damaged - 10.

At the conclusion of the bombing it was found that a good clearance had been made through the Mk. IV mines and a negligible clearance through the Mk.V. However, three Cruiser tanks were led through the field by the Troop leader who visually selected the most cratered and hence the safest route.

To clear a passage through a 55 yard depth of field (Mk.IV or Tellermines) it is probable that a total of some two hundred fifty 250 lbs. bombs would be required under combat conditions. This bombardment would only reduce the mine density so that any approaching tank would have a reasonable penetration. If the mines are blast-proof, three or four times that number of bombs would be required.

Against anti-personnel mines it is believed that a greater number of smaller fragmentation bombs would give better results than the 250 lb. bomb.

In operation HUSKY it would be necessary, in order to concentrate the bombs, to bomb the beaches in daylight. This would mean bombing in advance of D Day and consequent compromise of surprise. Surprise could only be maintained by bombing beaches over a widespread area. This would entail a considerable expenditure of air effort for results which might not be completely effective. If it were known that a particularly important beach were thickly mined it might be possible by taking special means to mark it to bomb the beach heavily in the last moonlight just before the assault.

b. Neutralization by Radio Controlled Demolition Craft

The use of L.C.A. or L.C.T. filled with high explosive, steered and fired by remote radio control is feasible. They should satisfactorily clear considerable gaps through heavy underwater obstacles as well as detonate all underwater mines within a considerable radius. No.experimental data are available but the results of the explosion of ammunition ships in harbors give good evidence that 100 tons of high explosive exploded near a beach would have a devastating effect. It might also seriously affect defense forces in the near proximity to the beach and possibly make a gap in false beaches. An ammunition ship exploded by bombing in PALERMO harbor cut a semicircular crater of almost 300 feet radius out of the quay to which it was moored and caused widespread destruction over a far greater area. The use of demolition craft would be most expensive and they would require fitting for remote control. To date there are no indications of beach obstacles sufficiently strong to warrant the use of demolition craft.

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Demolition craft would have to be used well in advance of the assault waves. They would require one or more control ships and extra navigational aids. Their early appearance might lead to earlier detection of the assault by E.D.F. Some sort of markers for the gap they clear would be necessary.

Obstacles which might be encountered.

a. The following sub-paragraphs list obstacles which might be encountered in assaulting a thoroughly defended beach. They represent the worst possible case, and it is most improbable that all obstacles mentioned will be met at any one beach.

b. In order that they may be encountered in an assault, obstacles are:-

(1) At any depth, naval mines of the drifting type.
(2) In water 24 feet or more deep, naval mines of the moored type.
(3) At varying distance offshore, anti-landing craft booms and small naval mines corresponding to British "K" mines.
(4) In 6 to 120 feet of water, naval ground mines (Magnetic)
(5) In 4 to 8 feet of water, such obstacles as concrete blocks with steel rails projecting upward from them.
(6) At varying distances offshore, but probably not more than 100 yards out and on the beach, oil fire defenses.
(7) In 5 feet of water or less, controlled mines, scaffolding and possible concrete or steel tetrahedrons.
(8) In 3 feet of water or less, steel stakes driven into the bottom, beach or anti-tank type mines, barbed wire, chevaux de frise, etc.
(9) On the beach itself, beach mines, anti-tank and anti-personnel mines, barbed wire, scaffolding, concrete walls "eggs", "Dragon's teeth", tetrahedrons, ditches, and other normal types of anti-mechanized obstacle. It may be expected that these will be covered by fire.

Means Available for Removal or Passage.

(1) This paragraph dexcribing various means which it is expected may be available,

(2) Suggested means are:-

(1) Normal naval minesweeping methods.
(2) Naval and other gunfire. Besides the fire of destroyers and larger ships, this may include:-
  (a) Fire from British L.C.T.(R)'s. Each of these craft mounts 792 5" rocket projectors firing rockets filled with 7 lbs of H.E. Elevation is fixed at 45^{0} giving a fixed range of 3,500 yards. No lateral adjustment is possible. The projector may be fired in salvos of 33 rounds each, or all 792 may be fired in less than a minute.
  (b) Fire from U.S. L.C.S's. It is understood that the majority of these carry 24 4.5" rocket projectors each. These have no lateral adjustment but are adjustable in elevation, normally fire at about 45^{0} and have a range of about 1,100 yards. They may be fired single or in salvo, either H.E. or smoke. British L.C.S's do not have this armament.
  (c) Fire from 20 mm, 40 mm and similar A.A. guns carried on ships and craft.
  (d) Fire from 25 pds. mounted on L.C.G's.
  (e) Fire from tanks and self-propelled artillery,

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either on land or from craft.

(3) Depth charges, either dropped overboard, thrown from the normal K or similar gun, or thrown from U.S. "hedgehogs" or "mousetraps". A "mousetrap" is a beam mounting 4 or 8 mortar-like throwers which throw small depth charges a distance of about 100 yards. A "hedgehog" is a battery of mouse-traps totalling 24 throwers. Both are carried by mine-sweepers and submarine chasers. The standard British depth charge contains about 300 lbs. of explosive; U.S. types include the small "mousetrap" type weighing about 65 lbs. with 35 lbs. of explosive, a 300 lbs. and a 600 lb. type. If used in less than 10 feet of water, the small "mousetrap" depth charge must be fitted with a special fuze. 20 or more 300 lb. depth charges can be carried in a L.C.A. or L.C.V. (P)

(4) Various charge-throwing devices. These include British spigot and ordinary mortars or varying sizes and U.S. 81 mm and 4.2" mortars. Both types can be mounted in craft. The British "hedgerow" consists of 24 spigot mortars mounted on four beams, each firing a 62 lbs. bomb with a nose tube which causes it to detonate 18" above ground. This is mounted in an L.C.T. or L.C.A. Its range is only about 100 yards to the edge of the pattern. 5 hedgerow craft will be available to Force 545.

(5) Hand-placed charges. These may include:-

(a) Bangalore torpedoes. These are usually made of metal pipe filled with explosive and detonated electrically or by safety fuze. The most common size is 2 or 3 inches in diameter up to 12 inches have been used, sections 5 feet or so long are joined to give the required length.
(b) Explosive in burlap (Hessian), canvas or rubber bags.
(c) Flexible (rubber or canvas) hose fitted with explosive
(d) Oildrums or similar containers filled with explosive.
(e) Primacord (Cordtex) net. This may be placed by hand or multiple strands of Cordtex may be projected in a special pistol.
(f) Specially shaped charges for use against a particular type of obstacle or for a particular purpose. An example is a collar charge for cutting off steel stakes. "Beehives" and "Hayricks" are hollowed charges designed to concentrate the blast in one direction. A Beehive is conical in shape, while a Hayrick is elongated.

(6) Large explosive charges known as "Carrots". These vary in size from 12 to several hundred pounds and are ordinarily fitted on a roller frame in front of a tank and placed by it. They are usually packed and shaped to give the maximum blast effect forward.

(7) Aerial bombing.

(8) Demolition craft (L.C.A's, L.C.T's, etc.) filled with explosive and wireless controlled.

(9) Pigs, sheep, donkeys, or other animals driven through beach anti-personnel minefields ahead of the troops. Whether or not it is feasible to swim animals ashore from landing craft in large numbers and drive them across the beach is a matter for test.

(10) Water jets from fire hose to uncover beach mines.

(11) Scorpions or Fowler Roller devices. The latter consists of four individually sprung rollers mounted in front of a tank, two in front of each track.

(12) Normal methods of mine detection and removal.

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(13) Ordinary "carpets" for crossing barbed wire.

Details.

a. Moored or Drifting Naval Mines.

(1) These contain sufficient explosive to sink or damage craft or ships of any size. They may be contact type or magnetic.

(2) Deep sea approaches may be mined. Their removal is accomplished by normal mine-sweeping and/or counter-mine methods and is entirely a naval responsibility.

b. Anti-landing Craft Booms.

(1) Except at entrance to ports, these are likely to be light affairs consisting of rafts or buoys connected by cables or nets.

(2) There have been no indications as yet of booms off the beaches. Their use in the near future except to cover comparatively short important beaches, appears unlikely.

(3) Removal of booms is a naval responsibility; however, in some cases it might be necessary for the Army to assist in placing charges.

c. Mines Similar to British "R" Mines.

(1) These are 15 inches in diameter and have a negative buoyancy of 1 lb. They are laid in rows off beaches and are suspended from floats attached to a trot laid between two buoys. The mines are suspended about 1 foot below the surface.

(2) No definite indications of this type of mine have been discovered; however, it seems probable that something of the sort will be used in shallow water at important points.

(3) British "R" mines are subject to countermining. The removal of such mines is a naval responsibility.

d. Naval Ground Mines.

(1) These rest upon the bottom and are usually of the magnetic type. They may contain charges of the order of 1,000 lbs. or more.

(2) Since ground mines have frequently been used by the Axis in other locations, it appears very likely that they will be found off the important beaches of HORRIFIED

(3) Small landing craft such as L.C.A's and L.C.V.(P)'s can probably pass over magnetic ground mines with a considerable degree of safety, and it is believed that L.C.I(L)'s and L.C.T's are not in great danger from them. It probably would be necessary for an L.S.T. to pass directly over a mine in order to detonate it. Ground mines cannot ordinarily be countermined (detonated by an explosive nearby) unless the charge is in actual contact with the mine. There is, however, a good chance of a charge which explodes within 10 to 20 yards of a mine so damaging its mechanism as to cause it to fail to function. Therefore, depth charges or other large

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charges dropped at frequent intervals from a small landing craft might create a fairly safe, narrow channel. Neutralization of ground mines is a naval responsibility, but it may be necessary for the Army to assist in placing fixed charges.

e. Concrete and steel Underwater Obstacles.

(1) These might consist of large concrete blocks (say 3 or 4 feet on a side) with steel spikes or rails projecting upwards, steel concrete tetrahedrons laid individually or linked together by cables or chains, steel stakes or rails driven into the bottom in very shallow water, or obstacles of a similar nature.

(2) No indications of the presence of this type of obstacles have as yet been found on aerial photos Their presence might or might not be detected. The Germans are known to have used such obstacles on the coast of France. Rails projecting from concrete blocks have been employed by the Allies, Tetrahedrons and similar blocks are likely to sink into soft sand. A great deal of time, material and labor are involved in producing such obstacles on a large scale. However, it is possible that precasting of concrete obstacles may have been in progress for some time, and as stated above, they could be placed fairly rapidly by a derrick barge at night. If used they will probably be on beaches near ports and will most probably be sited on bars or false beaches. If this type of obstacle is known to be present, the best solution is to choose another beach.

(3) Large (4" or more) bangalore torpedoes have proved effective in clearing a gap through concrete blocks of the type described above. Placed between blocks, they throw the obstacles aside, making a clear path of 40 or 50 feet. A series of depth charges close together might be expected to have a similar effect. Bangalore torpedoes should also be effective in making gaps in steel stakes. Large demolition craft should be very effective. As a last resort, collar charges or flexible hose charges may be placed by hand on steel stakes or projections from concrete blocks. No type of gun or rocket fire can be expected to be effective against such obstacles since complete disintegration is required. Fractured blocks remain an obstacle to boats. Removal is a naval responsibility, but it will undoubtedly be necessary for the Army to cooperate and assist.

f. Oil Fire Defense.

(1) A mixture of fuel oil, petrol, and diesel oil is piped under water from a tank to the desired location. When released, the oil rises to the surface and is ignited by calcium phosphide. A 2 inch pipe discharging 12 to 14 tons per hour will produce a patch of fire 30 yards in diameter with flames 60 to 70 feet high. Storage difficulties must limit the duration of flame barrages to a total of not many minutes.

(2) This defense requires so much time, labor, and oil that it would probably be reserved for harbor entrances. It is considered unlikely that any will be encountered.

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(3) The best solution, other than destructions of the oil source, is to avoid the flame-covered area, but if patches of flames are narrow with clear water inside, rapidly moving assault boats should be able to pass through.

(4) Another variety of this type of defense releases oil under pressure on the beaches themselves. Control may be from a distance. Flame barriers of this sort would be impossible.

g. Controlled Mines.

(1) These would probably consist of fairly large charges (100 lb. or more of explosive), placed in shallow water or on the beach. Anti-tank, anti-personnel, or naval mines, wired for control might be used. They might be detonated both by control or contact.

(2) The employment of controlled mines at strategic points and along important beaches seems rather likely. Since such mines would normally be buried aerial photos would not be likely to reveal their presence, although traces of the work involved in placing might be seen.

(3) The best method of reducing losses from controlled mines is to neutralize the observation posts from which they are controlled, either by attack under cover of darkness by previous capture (parachutists or rangers (commandos) of the commanding ground, or by smoke. If not actuated by enemy observers, methods described for use against naval ground mines, underwater mines in general, or beach mines should prove effective.

h. Tubular Steel scaffolding.

(1) Such obstacles are made of 2" or 3" steel tubing, clamped together in 3 to 5 foot panels, 7 to 10 feet high, and braced by diagonal members extending to the rear. It may be placed either on the beach or in shallow water. If in the water, it is an effective obstacle to small craft.

(2) This type of obstacle should be visible on aerial photos. Its employment on important stretches of beaches is feasible.

(3) If a beach is known to be defended by metal scaffolding, it is best to avoid it. If on the beach and so situated that a "run" of 25 yards or more on hard beach can be obtained, a medium or heavy tank can ordinaroly penetrate it. If in the water it is necessary that a gap be cleared, 3" bangalore torpedoes placed below water against main members (reported to have blown 55 foot gaps) or flexible hose charges woven through the members at about 5 foot intervals are effective. Two 45 lb. oil drum charges, one in gap, as does a 200 lb. Carrot charge. Thrown depth charges are comparatively ineffective, and gunfire of any kind produces little result. Demolition craft should produce large gaps.

j. Beach, Anti-tank and Anti-personnel Mines.

(1) Standard types of anti-tank and anti-personnel

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mines may be used in beach minefields. Many of these can in all probability be waterproofed and laid in shallow water. It is doubtful that the "S"(jumping) type of anti-personnel mine would operate satisfactorily in water, but other types might be so used. Special large "beach" mines might be found, either above or below water. The Germans have been reported to have used their heavy, box-type mine (37 lb. explosive) inbeach minefields.

(2) Since they are capable of being rapidly laid and are probably available in large quantities, it is reasonable to assume that, with wire, mines of various types will be the commonest form of obstacle encountered. There is no guarantee that minefields on beaches will be visible on aerial photos; however, traces of the work of placing them made by daily reconnaissance pictures of beaches should be taken if possible. Troops must in all cases be prepared to deal with beach minefields.

(3) Strictly speaking, neutralization of any type of underwater mine is a naval responsibility. However, it is impossible to attempt to draw a hard and fast line, and the Army will undoubtedly have to remove many mines in shallow water. Suggested means for neutralization are:

(a) Late trials of the British "Hedgerow" mounted in an L.C.A. indicate that it is a very efficient means of blasting out beach minefields, producing a gap 20 feet or more wide and over 300 feet deep. It may be possible to produce similar effects with U.S. "mousetrap" depth charges since they can be projected as far as "Hedgerows" providing they can be fitted with the type of fuze necessary.

(b) Rocket fire from British L.C.T.(R)'s and from U.S. L.C.S's (if enough of the latter are concentrated) should detonate beach mines over a limited area. Rockets should be effective in inducing detonation of mines in shallow water. Any type of artillery fire, naval or military, must be very concentrated to achieve the required effect and involves enormous expenditure of ammunition.

(c) Large depth charges dropped from an L.C.A. or similar craft in shallow water should detonate underwater mines within a considerable area. In order to clear lanes for L.S.T. and follow up craft, it has been suggested that, after the assault waves have landed, L.C.A's approach the beaches at several points, guiding on markers set up on shore and dropping depth charges at frequent intervals to neutralize ground mines. If charges are fitted with proper delay (not depth) fuzes, thus could be continued in very shallow water.

(d) Any large charge (bangalore torpedo, oil-drum, explosive in bags, etc.) exploded under water should detonate underwater mines within a considerable radius.

(e) Against minefields on the beach, 2" or 3" bangalore torpedoes will clear effective gaps

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provided that the mines are not buried too deep.

(f) On land, Cordtex strands of nets will detonate mines which are immediately under the strands. Their effect in water is not certain.

(g) A 200 lb. Carrot has produced a gap 60 ft. deep in a field of British Mark IV mines laid on 20 foot centers each way.

(h) Demolition craft should detonate underwater mines for some distance. It is doubtful, however, what effect they would have or minefields on the beach.

(i) Animals driven ashore from landing craft might detonate a considerable number of beach mines and some underwater mines. To be effective a large number of animals would be required, and consequently a great deal of shipping space. If wire or other obstruction is employed, the use of animals does not seem feasible.

(j) It is doubtful that the flails of a Scorpion would detonate mines in water. Furthermore, the detonation of a mine underwater within a few feet of the machine might damage the tank. Scorpions or Fowler Rollers should, however, be very useful in cleaning up the beaches, and to be landed in assault waves to make gaps through minefields on the dry beach.

(k) Once the beach is secured, minefields on land may be detected and removed by the ordinary methods. Probably the majority of beach minefields will be finally removed in this manner. The detector cannot, however, be expected to function properly in more than a few inches of water.

WIRE.

(1) The Germans employ both concertina type wire similar to dannert and an entanglement much like the U.S. double apron fence. Either may be used in deep belts on the beach or in shallow water. It has been reported that an extra heavy type of wire 3/16th inch thick and with barbs very close together has been used on the coast of France. Thick belts of wire in water are effective antiboat obstacles and probably would stop a wading tank. Mines and/or alarm devices could be used in conjunction with wire.

(2) Wire is the one obstacle which is almost certain to be encountered. It has already been observed on many beaches and additional wire is constantly being placed. All wire observed todate is on land rather than in the water's edge. Intelligence is doubtful, however, whether wire in the water can be seen on aerial photos, and there is little seaweed to mark it. It is possible that on shifting sand beaches wire placed in water or on the edge of the beach might quickly become sand covered. However, since it is available in quantity and quickly placed, it must be assumed that wire will be encountered in the water.

(3) In order to cut heavy wire by means of explosives, either considerable fragmentation or great blast effect must be produced. This may make it difficult to blast out under-

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water wire. The following means are suggested:

(a) Hedgerows and similar devices which throw heavy concentrations of explosive should effectively blast out wire as well as mines, whether on land or in water.

(b) The concentration of rockets put down by an L.C.T (R) or by a group of U.S. L.C.S's should produce good gaps in beach wire. The effect on water is doubtful.

(c) Accurate artillery fire with instantaneous fuzes will cut wire on land but probably not in water. A considerable amount of ammunition must be expended. Enfilade fire is most effective.

(d) Bangalore torpedoes are a very effective means of cutting gaps in wire on land. Probably unusually large (4" or more) bangalores will be required to cut it underwater, as much of the fragmentation effect will be lost.

(e) Flexible hose containing 3 lb. per foot of explosive thrown over the wire has been used to cut a 15 foot gap in double apron or dannert low thick wire. It probably would not do well in water.

(f) Thrown depth charges or any charges placed by hand should produce a considerable effect on wire under water.

(g) A 200 lb. Carrot with fragmentation plates has blown a gap 50 feet deep in loose tangled wire in a gulley.

(h) Demolition craft should produce large gaps in underwater wire.

(j) Providing craft can approach shore closely enough for men to wade ashore, troops may be able to cross wire with the aid of wire netting or other "carpets".

(k) After a beach is taken and one or two tractors are ashore, it should be possible to clean out remaining underwater wire by dragging it ashore with grapnels and lines. There are some possibilities in the idea of throwing grapnels into the wire with a line-throwing gun and dragging it out to sea with an L.C.I., L.C.T., or destroyer.

Concrete Walls, "Eggs", "Dragon's Teeth", etc. on the beach.

(1) This type of obstacle might take a variety of shapes. Almost certainly any concrete obstacle would be reinforced.

(2) Obstacles of such a deliberate nature require great expenditure of time, labor, and material. They should be easily detected on aerial photos and thus far no indications of their presence have been seen. Their use to cover important beach exits cannot, however, be ruled out. Sea walls may exist in front of some towns, and these may be improved by excavation in front of them.

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(3) Direct fire with 37 mm (2 pdr) or larger caliber weapons has been found effective against concrete obstacles but a considerable number of direct hits must be made. 2 pdr. and 6 pdr. (57 mm) fire has demolished obstacles up to 30 and

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200 cubic feet, respectively. A long 3" bangalore torpedo is effective against dragon's teeth laid in direct contact with them. A 200 lb. Carrot charge has been found ineffective against a 70 cubic foot "egg" but a 700 lb. Carrot blew a gap for a tank in a 7 foot concrete wall, 6 feet thick at the base and 3½ feet thick at the top, as did a 350 lb. "Hayrick". Properly located hand-placed charges should destroy any such obstacle and are better than "Carrots" placed by tanks in that contact between the charge and the obstacle cannot be relied upon when using the latter method.

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DISCUSSION FOLLOWING
TALK BY COL E.P. LOCK

31 May 1943

A review and discussion of the methods available to overcome underwater obstacles was held. The means were described in detail but the effectiveness of all these means is not definitely known. Hand or mechanically placed explosives were described as being the only sure means at present. The possible use of aircraft to assist in the breaching of underwater obstacles was discussed, along with the problems involved. This use of aircraft would appear desirable but it involves some considerable problems of dispersing of aircraft and lowering the air effort from other missions.

It was indicated by a naval officer that the Navy has discarded the idea of sweeping mines in shallow water. Small support craft with detonating charges may be employed against controlled mines. The exploding of other detonating charges nearby was described as the principal means now in use for eliminating mines. It was pointed out that German A-T Tellermines have been ascertained by research to be dependable after immersion of 2 weeks. The use by the Germans of A-T and anti-personnel mines in shallow water is anticipated.

Permanent heavy underwater obstacles such as reinforced concrete, structural steel, pilings or combinations of these are not anticipated to any great extent since the expense in time, labor, and materials is very considerable.

It is obvious that 100% clearance of underwater obstacles in front of a beach where an assault landing is to take place would be the most desirable, but to do this is a considerable and almost prohibitive task. In view of this fact, a discussion developed on the number and size of gaps required through underwater obstacles in order to get the assault troops on to the beach.

It was generally agreed that a minimum of 5 or 6 gaps, each 50 yards wide, would be required on a battalion front. The gaps must be sufficiently wide to permit of the succeeding waves going into the beach and the craft transporting earlier waves retracting at the same time. The possibility also exists of craft being sunk in these channels or gaps and creating hazardous defiles. The number and width of gaps required for each beach must be decided and the necessary means to create them must be provided in the planning.

The effect of a storm on the underwater obstacles off beaches was described as being very considerable, and storms may wash out some of the obstacles. In a landing-assault executed immediately following a heavy storm the difficulties presented by underwater obstacles might be considerably reduced. The use of precast concrete obstacles, placed in position a short time prior to the anticipated attack, was stated as a possibility. Other underwater obstacles were discussed, such as the various types of Naval mines and smaller mines, controlled mines, steel stakes or rails, barbed wire, and oil fire defense. Oil fire defense, which might be employed some 200 yards off shore and/or on the beach within the tidal area, was described as being most effective while burning, but would be of comparatively short duration and very costly in

labor and fuel. It would necessitate standing by until the fire had burned itself out.

It was pointed out that the "Snake" might be adapted for the purpose of creating gaps in underwater obstacles. It is possible to push out lengths of the snake from an LCT, as it has been tried out. This operation would require heavy gunfire and smoke cover.

The discussion indicated that methods of dealing with underwater obstacles are presently unsatisfactory and new developments must yet be proved. It was also indicated that weather conditions preclude to a large extent the extensive use of underwater obstacles.

The possibility of locating and marking underwater obstacles by aircraft was discussed briefly.

The various types of beach obstacles, especially those known or suspected to be contained in the German coastal defenses, were discussed along with the means available to overcome these obstacles. It was brought out that minefields are most difficult to locate as they are not identifiable on aerial photos. Aerial bombardment or shelling are not adequate to create gaps in the beach defenses, although they have great value in neutralizing hostile defenses during the time these defenses are subject to the bombardment and shelling. To create specific gaps through minefields and wire, hand or mechanically placed explosives must be used. Mine detectors may be used but would require 2 or 3 hours time to get through a mine - field. The use of the "snake" to create gaps through minefields and wire has been tested and is a means capable of further developments. An estimated minimum number of gaps through beach obstacles was determined through discussion to be 3 gaps, each 16 yards in width.

The "Petard" is a most promising development in overcoming reinforced concrete obstacles.

The "General Wade Charge" is very effective in clearing assembled steel obstacles and reinforced concrete, but it invclves deliberate placing. Anti-tank ditches may be surmounted by means of fascines or may be reduced with the aid of a bulldozer.

The "Scorpion", as developed by engineers of the British 8th Army, was claimed by them to be unsatisfactory in its present stage of development. It was described as being slow, having but a short useful life, being too wide for landing craft, having an underpowered motor for operating the flail, and several other deficiencies.

A discussion developed on the matter of special "Engineer Tanks" which are being designed specifically to assist the troops charged with breaching obstacles. These furnish protection against small arms fire.

In discussing the planning of an assault landing operation and the effect that underwater and beach obstacles would have on the plans, many points were raised. Detailed and accurate intelligence of the locality where the contemplated operations are to take place is mandatory. Knowing the situation, a decision must be reached as to whether it is best to land on a defended beach or whether to land on a shore less favorable from a geographical and terrain point of view. Well defended beaches should be avoided if possible; otherwise all obstacles must be taken into consideration in the planning and the necessary troops and materials provided.

The cratering of the beaches by aerial bombardment was suggested as being a means for giving the assaulting troops cover from fixed fires.

The use of small (10 Man) rubber boats was suggested, and their various characteristics pointed out. Experiments have shown that they are difficult to hit, they can wend their way between, over, or around underwater obstacles. They can be equipped with a small outboard motor. They have limitations on speed and load carrying capacity which must be considered, however.

It was indicated that the Far Shore Engineers should not be used in an assault or combat capacity, but that they should be used in the beach area to expedite and maintain the build-up of troops and supplies.

In reference to the matter of responsibility for the removal of underwater obstacles, the conclusion that was eventually reached was that the Navy is responsible to the point where boats ground at the time and place of landing, and that the Army was responsible from that point. However, it was the opinion generally that, in an operation of this nature, it is wrong to assume that one or the other Service is assigned full responsibility, since the planning and training are joint responsibilities. Planning must designate the removal of specific obstacles by specifically designated units.

Methods of mine removal were discussed. The principal methods are aerial bombardment, (cannot blast specific gaps in mine field, but can soften it up through heavy bombing), hand or mechanically placed bangalore torpedoes and "snakes" for creating gaps, the mine detector for the removal of mines, and the slow and laborious probing method. Some samples of mines were exhibited and described, including the German Tellermine (2 models), the French A-T mine, the German "S" mine. Also exhibited were various igniters and adaptors. It was pointed out that initially the Germans used the "S" mine in their A-T minefields at the ratio 1 to 30, but this was gradually increased until the proportion of about 1 to 5 was being used. Reports from Africa indicated that in minefields encountered, mines had been laid two deep in some cases. That is, when the mine detector disclosed a mine and it was removed, the second mine remained unnoticed and remained an active hazard.

The Germans have a china mine, containing no metal. It operates by means of a chemical detonator which breaks when the lid is crushed down. This type mine is not subject to being picked up by our present mine detector.

A discussion of the means available for an assault mission of the type contemplated was a more detailed explanation of the means described in the Appendix to Col Lock's lecture. Some figures that were mentioned follow:

(1) It has been ascertained that a shell from a 155 mm mounted on a medium tank will penetrate 6 feet of concrete.

(2) A 105 mm is effective for penetration of 3 feet reinforced concrete but has a much more rapid rate of fire than the 155 mm.

(3) A British training film was shown which demonstrated ir a limited way various means under development and trial. In each film it was pointed out that the 2 pdr. was effective against reinforced concrete up to 30 cu. ft. The 6-pdr. attained its limiting effect with 200 cu. ft.; each shot being capable of shattering approximately 12 cu. ft.

The pictures also depicted the use of the Scissors Bridge and the Churchill Bridge Layer, a mobile bridge for crossing Anti-Tank ditches not to exceed 30 ft. in width. British technique in their use contemplates (tentative) that this mobile bridge will normally be used in following armored forces when acting independently cross country over strange terrain. For approximately five

minutes during the laying operation the tank is immobilized and has no weapons for its own defense except individual small arms which may be fired through slits.

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1 June 1943.

Review of discussion following the lecture
"Reduction of Obstacles and Fortifications"
by Colonel E. P. LOCK, CE.

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1. What type of underwater obstacles may be encountered?

Conclusions reached:

(1) Naval mines (moored and drifting).
(2) Anti-landing craft booms and smaller mines.
(3) Naval ground mines (magnetic)
(4) Permanently constructed concrete blocks with rails (could be prefabricated and laid upon threat of landing operation).
(5) Oil fire defense, (limited by fuel availability and storage facilities).
(6) Controlled mines on beaches and shallow water.
(7) Steel stakes or rails driven in sand.
(8) Barbed wire.
(9) Anti-personnel mines and anti-tank mines.

2. What means are available to overcome these obstacles during an assault?

Conclusions reached:

(1) Explosives, either mechanically placed or placed by hand are at present only sure methods.
(2) Since storms destroy or impair the effectiveness of underwater obstacles, landing operations immediately following a storm might encounter less difficulty from the standpoint of underwater obstacles.
(3) Consideration should be given to the use of small rubber assault boats in leading waves.

3. What types of underwater obstacles cannot be overcome by means now available during an assault operation?

Conclusions reached:

(1) Mines cannot be swept from shallow water with present means available.
(2) Methods for dealing with controlled mines are yet unsatisfactory.
(3) In general the idea seems to be that present methods for shallow water clearance of obstacles are not satisfactory.

4. What types of beach obstacles are apt to be encountered above the high-water line, and what means are available for their removal during an assault operation?

Conclusions reached:

(1) Anti-tank and anti-personnel minefields, anti-tank obstacles, barbed wire, reinforced concrete blocks and walls, trihedrals, steel scaffolding, and any possible means that the enemy can employ can be expected to impede progress of landing troops.
(2) The following means are now available for removal of beach obstacles, some with limited effectiveness.

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a. Small assault craft for firing at fortifications, pill boxes, gun positions, etc.
b. Small engineer detachments with bangalore torpedos, explosives and wire cutters.
c. Cortex.
d. Scorpions or flails.
e. Air bombing (cratering of beaches for protection of troops coming ashore, detonating of mines, and breaching of wire).
f. Snakes.

(3) Air bombing is not adequate to reduce beach defenses.
(4) Use of mine detonators or probing methods may require 2 or 3 hours to get through mine fields. (Slow process)
(5) Hand placed explosive charges by engineer trpops, during which time it is necessary to keep small arms fire off them, is most effective method now in use. Mechanical means which have been developed have not yet been perfected and cannot be entirely relied upon.

5. Which of these obstacles cannot be overcome during an assault operation by means now available?

Conclusions reached:

(See (4) above).

6. To what extent should the answers to (3) and (5) govern the plans for the attack?

Conclusions reached:

(1) In planning an attack all obstacles must be considered, and a definite plan must be laid for their removal or neutralization.
(2) Avoid well organized beaches if possible.
(3) Decision must be made as to whether landing on a less suitable area from a geographical and terrain standpoint is more desirable than landing on a well organized beach.

7. What types of fortifications are apt to be found and where will they be located with reference to the beachline?

Conclusions reached:
(1) Concrete protected coast defense batteries are apt to be situated on very difficult terrain from an attack point of view.
(2) Reinforced concrete bunkers and pill boxes will be placed to give enfilade fire on the beach.

8. What means are available for their reduction during an assault operation?

Conclusions reached:
(1) Reference Col. Lock's speech.

9. Assuming that any plan for an assault operation must be carefully plannned and rehearsed, what are the essential elements of information which must be obtained on the obstacles and the fortifications ?

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Conclusions reached:
(1) Accurate information is vital to success of the operation and detailed information must be obtained concerning all defense installations, obstacles, fortifications, enemy troops, etc. however plans and training must provide for reducing unexpected obstacles and resistance.
(2) Minefields are most difficult to locate and are usually not identifiable on aerial photos.

10. What means are available for obtaining this information? How much time will be required tp make the necessary reconnaissance?

Conclusions reached:
(1) Submarines, agents ashore, raids, aerial reconnaissance.
(2) Reconnaissance must be made cpntinuously over a period of months.

11. What width and how many gaps are required for passage of underwater obstacles? Beach obstacles?

Conclusions reached:
Underwater Obstacles:
(1) 100% clearance of the approaches to the beach is most desirable, but not practicable.
(2) Number and width of gaps must be decided in the planning phase.
(3) Five or six gaps, each 50 yards, in width, are the estimated minimum for a battalion front.
(4) Too narrow and too few gaps will create hazardous defiles, taking into consideration the possibility of craft being sunk and the necessity for two way traffic through the gaps.
(5) The clearing a width of 500 yards through underwater obstacles is a considerable task.
Beach Obstacles:
(1) At least three gaps, each 16 yards wide, are necessary through beach obstacles on a battalion front.

12. What means are available for making these gaps?

Conclusions reached:
(1) Dropping buoys to mark the channel.
(2) Darkness and smoke make the finding of these channels very difficult.

13. What size parties of engineers, (or other troops), are required for each gap and how long will each party require to accomplish its mission?

Conclusions reached:
(1) The number will vary with each specific task to be performed.
(2) Development of means of passing underwater obstacles is still in the experimental stage and no definite time figures are available.
(3) Creating a passage for armored vehicles is a time consuming operation and may require two or three hours. Mechanical means are yet unreliable.

14. What are the separate responsibilities of the combat engineers organically part of the landing force and the far shore party engineer components?

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Conclusions reached:
(1) Shore party engineers must expedite the build up of troops and supplies over the beach and cannot play a part in the assault.

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(2) Organic engineers of the landing force must assist in the assault. Their primary mission is to create passages through obstacles.

15. Should not the proportion of combat engineers in a R.C.T. conducting landing operations be greater than normal?

Conclusions reached:
(1) Emphatically yes. The normal component of engineers in a tactical unit must be augmented in this type of operation. The definite need must be analysed for each particular landing and the necessary engineers and special troops provided.

16. Who is responsible for the removal of underwater obstacles and how should work be coordinated between the Army and Navy?

Conclusions reached:
(1) The Navy is responsible for the removal of underwater obstacles to the point where boats ground at the time and place of landing,
(2) The Army is responsible landward from point indicated in (1)
(3) The joint planning must designate specifically the responsibility for the removal of every obstacle.

17. How can mines on the beaches and beach exits best be disposed of? How does the problem differ from normal mine removal tasks? To what extent can aerial bombardment of the beaches help eliminate mines?

Conclusions reached:
(1) Engineers using normal mine removal methods, with mine detectorsm flails, scorpions, or other special equipment, must move in and make gaps through the minefields as required. No special technique has been developed.
(2) Aerial bombardment of a beach area will detonate many mines and will be partially effective, but cannot be relied upon to clear a passage for vehicles. Channels or gaps cannot be blasted through the minefields by the air bombardment.
(3) Aerial bombardment can be effected at night.

18. What methods are available for the assault of strongly defended localities, "hedge-hogs", and the like?

Conclusions reached:
(1) Reference: Colonel Lock's speech.

19. What special equipment may be needed in the above tasks?

Conclusions reached:
(1) Reference: Colonel Lock's speech.

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