

Allies should have a "second string to their bow", in the form of plans for "JUPITER", as a major alternative to "OVERLORD" (554). However, the great difficulty of attempting to make simultaneous preparations for "OVERLORD" and "JUPITER", and the ultimate fate of the latter project, have been thus described by General Morgan:

It seemed to us that it would be quite impossible for us at COSSAC, constituted as we were, to plan simultaneously both operation 'OVERLORD' and operation 'JUPITER', the all-out invasion of Norway. We considered that the difference in character between the two exploits was so extreme that to plan operation 'JUPITER' would call for the undivided attention of an entirely new staff in addition to COSSAC. For though the resources in troops and aircraft to carry out operation 'JUPITER' would be those allotted now to operation 'OVERLORD', it would be a matter of putting the whole affair on a ship basis rather than a landing-craft basis. Troops could not voyage in landing craft for the passage to Norway as they could for the short trip over to France. The whole problem of the range of fighter aircraft came up once more . . . . Again an expedition to Norway could not be launched from our launching system in Southern England, of which the development was already far advanced. This would entail, therefore, the elaboration almost from scratch of an entirely fresh lay-out presumably in Scotland, which would consume time, labour and materials already hypothecated to the main project . . . our recommendation took the form of a requirement for large additional staffs, not only at COSSAC, but virtually to duplicate lower staffs at Army Group and Army levels . . . to our relief, no more was ever heard of it. (555)

298. The second proposal discussed at Quebec was to have a profound effect on later planning for the invasion. It will be recalled that the COSSAC plan outlined a diversionary operation ("ANVIL") against the southern coast of France as an aid to the Normandy assault. The Prime Minister favoured such diversions; "he advocated 'violence and simultaneity'" in their execution (556). At this stage there was no serious disagreement among the members of the Combined Chiefs of Staff over the proposed operation and they arrived at this conclusion:

Offensive operations against Southern France (to include the use of trained and equipped French forces) should be undertaken to establish a lodgment in the Toulon-Marseilla[s] area, and to exploit northward in order to create a diversion in connection with OVERLORD. Air nourished operations in the southern Alps will, if possible, be initiated . . . (557)

Accordingly, General Eisenhower was instructed to prepare plans for "ANVIL". He was "to plan on the basis of resources already allotted to his theatre, and it was estimated that this would allow him an amphibious lift for only 27,000 troops and 1,500 vehicles -- a lift, in other words, for about one division" (558).

299. The great argument which afterwards developed over "ANVIL" will be described in a later section of the narrative (*infra*, paras 407ff). Here, it may be noted that planning for the operation soon revealed the inadequate nature of the resources allotted to General Eisenhower.

...Augmentation was essential, and in consequence the southern France invasion, though conceived by the Americans as an integral part of OVERLORD, would actually become another competitor for scarce resources. (559)

As will be seen, a solution to this vital problem was not found until late in March 1944.

300. Any consideration of the "QUADRANT" Conference would be incomplete which did not refer to its influence on the great "MULBERRY" project, the construction of artificial harbours for the invasion. The British Chiefs of Staff prepared a memorandum which stated:

The enemy has realized that we can only maintain a large invasion force by using ports and he has, therefore, heavily defended the existing ports and their neighbouring beaches from sea and land attack. He has also made arrangements to render them unserviceable if they should be captured.

It is, therefore, of vital importance that we should be able to improvise port facilities at an early date. Supplies could then be maintained during unfavourable weather conditions and before we have been able to capture and recondition ports. The British Chiefs of Staff have appointed a Committee to study the whole problem and to make recommendation as a matter of urgency. (560)

The development of this revolutionary idea will be outlined in a later section of this report (*infra*, paras 367-376). At Quebec the Combined Chiefs of Staff deliberated the problem of "prolonged cross-beach maintenance" and, in addition, they directed that further study should be devoted to the "MULBERRY" solution, although it was "still very much in the blue print stage" (561).

301. The Combined Chiefs also considered the possibilities of another startling project, known as "HABBAKUK". This was a British design for a floating airfield, one type was largely composed of "pykrete"

(frozen pulp and water), which could be stationed near the French coast. At Quebec the Combined Chiefs approved further Anglo-American work on this scheme, in conjunction with the Canadian authorities (562). However, at a later meeting in Washington the United States representatives adopted the view that "HABBAKUKS" were "still experimental" (563). Although agreement was then reached that a pykrete "HABBAKUK" would be partially constructed, the project was later abandoned as impracticable (564).

#### THE INFLUENCE OF THE MEDITERRANEAN LANDINGS,

JUNE - SEPTEMBER 1943

302. Throughout the summer of 1943 a series of large-scale amphibious and airborne assaults were carried out by Allied forces in the Mediterranean. The capture of the island of Pantelleria (11 Jun) was a preliminary step to the invasion of Sicily (10 Jul). Thereafter, the Italian mainland was invaded by operations across the Strait of Messina (3 Sep) and against Salerno (9 Sep). These attacks, all within three months, contributed much useful information to the Allied assault technique.

303. From the point of view of "OVERLORD" planning this experience was obtained at a fortunate time. There were, however, severe limitations on the extent to which the "lessons learned" in the Mediterranean could be applied to the vastly different conditions of tide and weather of North-West Europe. These differences, having profound effect upon nearly all aspects of amphibious and airborne operations, have been repeatedly emphasized by various authorities. It is also true that the Mediterranean landings, even the invasion of Sicily, were on a small scale by comparison with the massive effort of "OVERLORD". Moreover, with the notable exception at Salerno, the degree of resistance from the enemy (in particular, from half-hearted Italian troops) could not be compared with that anticipated from the defenders of Hitler's "Atlantic Wall".

304. The present report is unable to examine in detail the results of the Mediterranean landings. The chief significance of "CORKSCREW", the capture of Pantelleria, was the information it supplied on the effectiveness of air bombardment against formidable coast defences.

The success achieved by this form of neutralization was very marked and the total land casualties in the initial assault which was carried out in June amounted to one man bitten by a donkey. It was found that although the guns themselves were not destroyed, all the communications and signalling arrangements had been dislocated and the crews were temporarily stunned. (565).

The effect of air attack on these defences was carefully analyzed for future operations (566). Brigadier A.H. Head, of C.O.H.Q., afterwards stated: "I think it may be said that this was the first operation where we learned the tremendous effect of a really heavy and concentrated air bombardment on coast defences" (567).

305. The results of the Sicilian invasion were naturally of much greater significance. However, the differences between this operation and "OVERLORD" were emphasized in a memorandum prepared by General Morgan for the Chiefs of Staff:

. . . I venture to draw attention to the danger of making direct comparisons between Operation 'HUSKY' and Operation 'OVERLORD'. No doubt the experience now being gained in the Mediterranean will prove invaluable when the detailed planning stage for 'OVERLORD' is reached, but viewed as a whole the two operations could hardly be more dissimilar. In 'HUSKY' the bases of an extended continental coastline were used for a converging assault against an island, whereas in 'OVERLORD' it is necessary to launch an assault from an island against an extended continental mainland coastline. Furthermore, while in the Mediterranean the tidal range is negligible and the weather reasonably reliable, in the English Channel the tidal range is considerable and the weather capricious. (568)

306. Nevertheless, the Sicilian operation did provide valuable experience for the Normandy assault. Most important, "HUSKY" demonstrated that a large-scale amphibious attack could safely rely on beach maintenance in the early stages of the operation. It will be recalled that "TORCH" had previously drawn attention to the importance of a Beach Group Organization (supra, para 161). "HUSKY" carried this idea much further:

A significant feature of the scheme was the fact that it did not depend upon the immediate capture of a major port. The assault forces would be maintained in the first instance over open beaches, the process being facilitated by the many novel types of landing ships and craft now available. The successful attack on Sicily has been called a landmark in the development of the technique of combined operations, signalling the transition from the belief in the absolute essentiality of obtaining a port at the earliest possible moment (which, as we have seen, was to a large extent at the bottom of the plan for the Dieppe Raid) to the conception of 'beach maintenance' which was adopted with such brilliant success in Lower Normandy in 1944. (569)

307. Before the operation began two administrative problems were considered in connection with beach maintenance. First, there was the possibility that the beaches might prove less satisfactory than available information indicated -- in particular, that shifting bars might widen the "water gap" between unloading craft and the shore. In reality, however, no serious difficulty arose in bridging the "gap", largely due to the excellent performance of the American 2½ ton amphibious truck, the "DUKW". Second, the "HUSKY" planners feared "lest indefinitely protracted beach maintenance should break down through the exhaustion of Beach Groups, undue wear and tear of craft and DUKWS, or the breaking up of the beaches" (570). Again, this problem did not materialize and during the first two days of the operation over 80,000 troops, 7,000 vehicles and 300 tanks were safely landed (571). But Brigadier Head reported: "Beach maintenance is definitely not practicable in very bad weather, and it would seem that even in moderately bad weather casualties to small craft are likely to be high" (572).

308. The Beach Organization adopted for "HUSKY" could be divided into two phases:

Firstly, the vital period of about three hours after the initial landing when speed in disembarking troops and supporting arms is of the utmost importance and when the initial assault is most vulnerable to local counter-attack. Secondly, the protracted period when normal maintenance is being carried out across the beaches. (573)

It was considered that "speed and simplicity of procedure" were essential during the first phase; thereafter, "normal beach maintenance", with certain improvements in the methods of bridging the "water gap", would be adequate (574). The necessity of adequate training and a standardized organization for the Beach Groups was also emphasized. Out of this experience came many lessons afterwards adopted for "OVERLORD".

309. The Sicilian landings also tested the performance of landing craft.

In this operation the new American built L.S.T.(2) were used for the first time in comparatively large numbers. This ship which had originally been designed for landing tanks and M.T. now emerged as a prime factor in amphibious operations, in its role of carrying to the edge of the beach not only tanks and M.T. but also all forms of equipment and stores. The Naval Bombardment proved its worth very strongly and the support craft (LCG(L) and LCT(R)), which had been converted for the operation, were outstandingly successful. (575)

L.C.T.(R.) were singled out for particular praise. A subsequent report, prepared by C.O.H.Q., stated that they were "the best close support assault craft available" (576). Thus, the experience of earlier operations -- in particular, the Dieppe Raid -- had resulted in further progress towards the evolution of a satisfactory assault technique. This technique was, however, to be carried much further before "OVERLORD" was launched.

310. Admiral Maund has described certain technical improvements which resulted from the invasion of Sicily.

There was seen to be a need for a fighter direction ship with all the radar equipment of a shore station to give warning of the approach of enemy aircraft. The importance of establishing a radar station on shore as quickly as possible was also learnt. Before Normandy there were L.S.T.(2) and other ships fitted as fighter direction ships and work had begun on an ideal fighter direction ship. This development naturally eliminated most of the work of the R.A.F. in the Headquarters Ship. (577)

311. "HUSKY" also contributed useful, though less agreeable, experience on the air aspect of an assault. This was connected with the American and British airborne landings near Gela and Syracuse, respectively. The landings at Gela were dispersed over a wide area because of the wind and the fact that certain transport formations, off their proper course, suffered heavy casualties from Allied guns. In his report on the operation General Eisenhower stated ". . . the most difficult thing we have to solve is to work out methods whereby friendly aircraft can work over our troops and vessels with safety" (578). He added:

A later operation on the British front brought out the lesson that when we land airborne troops in hostile territory, we should not do so in successive waves, but should do it all at once. In the first wave, where we had surprise, losses were negligible, but in the two succeeding waves they were very large. (579)

In a detailed report on the air aspect of the operation a representative of the Air Branch, Headquarters 21st Army Group, remarked on "the similarity between the role assigned to the AOC Malta in 'HUSKY', and that envisaged for the AOC of 11 Fighter Group in a cross-channel operation" (580).

312. Valuable experience was obtained by the Canadian formations which participated in "HUSKY" and the succeeding assault ("BAYTOWN") across the Strait of Messina. As previously mentioned, the 1st Canadian Infantry Division, under Maj-Gen G.G. Simonds, and the 1st Canadian Army Tank Brigade, under Brigadier R.A. Wyman,

took part in the Sicilian assault. After long periods of active operations in Sicily and Italy both commanders returned to the United Kingdom early in 1944. General Simonds then became G.O.C. 2nd Canadian Corps and Brigadier Wyman assumed command of the 2nd Canadian Armoured Brigade.\* Consequently, these commanders and many of their officers brought back to the United Kingdom, at a time when the final details were being settled for "OVERLORD", the practical knowledge they had acquired in the Mediterranean.

313. Brief mention may now be made of the lessons learned in the "AVALANCHE" landings at Salerno (9 Sep 43). Although assaulting formations of the Fifth United States Army made their approach under cover of darkness, surprise was lost and the enemy reacted vigorously.

From AVALANCHE, the fate of which hung in the balance for the first week owing to the speed at which the Germans counter attacked, we learnt two main lessons. Firstly, the limitation of the duration of effective air cover that can be provided from aircraft carriers. Secondly the tremendous value of naval gunfire in support of the army ashore. In this operation when the assault troops were firmly held on a narrow strip of the coast, the gun support provided by the Navy played a very large part in saving the situation. (581)

The need for self-propelled artillery in the assault was also noted (582).

314. A review of these landings in the Mediterranean during the summer of 1943 suggests that their main influence on later plans for "OVERLORD" was twofold: first, these operations demonstrated in a convincing way the tremendous effect which naval and air bombardment could exert on the course of the assault; second, the feasibility of beach maintenance, as an alternative to port facilities, was clearly established. In spite of widely differing conditions of tide and weather the Mediterranean experience was an invaluable aid to final planning for the invasion of North-West Europe.

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\*Two regiments of this brigade, with D.D. tanks, supported the 3rd Canadian Infantry Division in the D-Day assault.

THE PROBLEM OF FIRE SUPPORT: EXERCISE "PIRATE"

AND THE GRAHAM COMMITTEE

Exercise "PIRATE"

315. While Canadian formations were acquiring experience in the Mediterranean the 3rd Canadian Infantry Division, under Maj-Gen R.F.L. Keller, was preparing in the United Kingdom for its assault role in Operation "NEPTUNE". Originally selected for this role in July 1943 (supra, para 244), the division carried out "preliminary work in combined operations at the Division's stations in Southern England, followed by advanced training at Combined Training Centres in Scotland" (583). The Canadian assault troops then returned to the South Coast of England for large-scale exercises of an increasingly realistic nature. The various stages of training through which the division passed are described in another Report (584). For the present narrative, interest centres in Exercise "PIRATE", which was held at Studland Bay, Dorset, during the period 16-21 Oct.

316. The objects of "PIRATE" were:

- (a) To exercise the forces of all three Services in their functions during a major combined operation.
- (b) To exercise the embarkation and the 'Turn Round Control' organization within the SOLENT group of ports.
- (c) To exercise a brigade group in the assault on a heavily defended beach.
- (d) To exercise the Army and RAF in the rapid construction and occupation of an Airfield. (585)

The "Combined Plan" divided the exercise into two parts:

Part I - ASSAULT

To exercise one brigade group [7 Cdn Inf Bde Gp] of 3 Cdn Inf Div with one beach group, Naval Force 'J' and RAF in an assault landing on a strongly defended beach.

Part II - BUILD-UP

- (a) To exercise Force 'J' in its Build up function during a major combined operation.
- (b) To exercise the 'Turn Round Control' organization within the SOLENT group of ports in the build-up phase of a combined operation using the following troops:-



3 Cdn Inf Div (less one brigade group)  
24 Airfield Construction Group.

- (c) To afford an opportunity for the forward elements of a composite group RAF to carry out a signals exercise with the object of testing the effectiveness of the precautions taken to protect signals equipment in a wetshod landing. (586)

For the purposes of the exercise Studland Bay was "assumed to be a heavily defended portion of the coast of German occupied Europe" and "actual defences" were constructed on the beaches (587).

317. The forces taking part in "PIRATE" were carefully selected with a view to their intended role in the invasion. As previously described (supra, paras 129-31), the Dieppe experience had led to the evolution of Force "J", under Commodore J. Hughes-Hallett, as a permanent nucleus for the naval component of the invasion. The 3rd Canadian Infantry Division had also received advanced training for its share in the "NEPTUNE" assault. Responsibility for supporting air operations was given to No. 11 Group R.A.F. and No. 83 Group R.A.F. under Air Vice-Marshal H.W.L. Saunders and Air Vice-Marshal W.F. Dickson, respectively. It will be recalled that No. 83 Group had been formed as a result of the experience of a Composite Group with First Canadian Army in Exercise "SPARTAN".

318. "PIRATE" had great significance for all three Services. In his subsequent report Commodore Hughes-Hallett wrote:

From the naval point of view the launching of this exercise was a bigger undertaking than the raid on Dieppe. The fact that it could be undertaken with a smaller staff than was used for that operation, and within a short time of other large scale exercises, reveals satisfactory progress in the general organization of the Force which has now reached a state which would enable a prolonged major operation, involving dealings with a succession of Military Commanders, to be undertaken with confidence. (588)

His "Summary of Recommendations", which contained 22 items, made suggestions for improving the combined planning arrangements of such an exercise or operation; for decentralizing the loading plans in order to obtain the maximum loads in landing craft; for reviewing the composition of the "Naval Assault Force"; and for improving navigational and loading facilities. Hughes-Hallett also made specific recommendations for the improvement of the fire plan. (The latter will be considered in conjunction with the military aspects of the exercise.)

319. Admiral Sir Charles Little, Commander-in-Chief, Portsmouth, also wrote a report on "the organization and arrangements in the Solent Area" (589). These two reports were considered by Admiral Sir Bertram Ramsay, Allied Naval Commander, Expeditionary Force, who then prepared his own comments on "PIRATE" (590). In his covering letter (29 Nov) to the Secretary of the Admiralty Admiral Ramsay stated:

The exercise was of the greatest value despite bad weather in the opening stage which necessitated a change of the general plan and which shut down again after the assault and terminated the exercise prematurely. (591)

The Allied Naval Commander's report pointed out that "a large number of the lessons learnt" were "applicable within the Assault Force" (592). He dealt with other aspects, such as assembly and embarkation, code signals, loading facilities, organization of "Turn Round Control" and maintenance. Discussing the numbers of ships and craft required to embark an assault division his report noted that:

The planned lift for Force 'J' is as follows:

4 Assault Battalions @ 22 L.C.A.	
per battalion =	88 L.C.A.
(24 L.C.A.(HR) =	51 craft
(27 L.C.S.(M)	
TOTAL	<u>139</u>

This can be provided by:

2 L.S.I.(L) @ 18 craft . . . =	36 craft
3 L.S.I.(M) @ 8 craft . . . =	24 craft
2 L.S.I.(S) @ 8 craft . . . =	16 craft
11 L.S.I.(H) @ 6 craft . . . =	66 craft
TOTAL	<u>142</u> craft
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	(593)

The figures for the L.C.A.(H.R.) and L.C.S.(M.) had been reached by agreement with the Commander-in-Chief 21st Army Group (594).

320. "PIRATE" was a very significant exercise from the military point of view. It was "the first occasion on which Force 'J' had worked with the staff of the 1st Canadian Corps, or with the 3rd Canadian Division" (595). During the planning stage a special staff was detached from divisional headquarters to work out the details of the exercise, and this procedure was later used for "OVERLORD" (596). Thus, as a result of "PIRATE", there began a close association of Force "J" with General Keller's formation which ended only on D Day, when Force "J" put the 3rd Canadian Division ashore in Normandy.

321. Apart from the foregoing, the chief military interest of "PIRATE" lay in the training it gave "a brigade group in the assault on a heavily defended beach" (supra, para 316). This training was vitally affected by developments in connection with the combined fire plan and it is now necessary to consider the military contribution to that plan.

322. The extensive and complicated arrangements for supporting fire were outlined in the "Combined Plan":

This assault will be preceded by Naval bombardment and air support . . . and will be covered by L.C.F., Close Support Craft, L.C.A. (HR) and Rocket Craft as well as Army weapons, i.e. 2" and 3" Mortars, LMGs, and Divisional Field Artillery firing from L.C.T. Smoke laying aircraft and L.C.P. will also be available to cover the right flank of this assault from H minus 40 to H hour and smoke laying L.C.P. from H hour onward. (597)

It will be seen that the main military contribution was "Divisional Field Artillery firing from L.C.T.". Exercise "TRIMROSE" had shown that seaborne field artillery could be fired effectively in a close support role (supra, paras 219-20). "PIRATE" represented a further stage in the development of this technique. Thus, the "Combined Plan" stated that seaborne support for the final approach and landing would be provided, in part,

by two field regiments carried in L.C.T. who will open fire at 11000 yds and cease fire 4000 yds off shore or when the Close Support Craft (Beach Forts) touch down, whichever is the earlier. (598)

323. The actual results obtained from this support were afterwards described by Commodore Hughes-Hallett as follows:

The 25 pounder fire from the Field Regiments during the approach started somewhat late and the firing was unsatisfactory. The system of control at present employed for these guns will be modified and further tried. (599)

In his report Admiral Ramsay stated: "It is agreed that the results of the 25-pdr. firing in Exercise 'PIRATE' were disappointing. It is hoped that further practice will bring about considerable improvement" (600). This experience was particularly disappointing in view of the fact that the assault had been carried out "under conditions of flat calm, light wind blowing parallel to the beach, and excellent visibility" (601). However, a C.O.H.Q. report on the firing suggested some of the reasons for the unsatisfactory results:

The opening salvos from L.C.T. carrying the Divisional Artillery were about 800x [yards] short and remained incorrect for a considerable time. Fire was opened at 11,000x but the beach area was NOT effectively shelled until the range had closed to about 7,550x. The guns were not S.P. but field carriage equipments; it is understood that the Regiments had had no previous experience afloat and no forward F.O.O's were used. In spite of this the fire effect and pattern was good when the correct range was found. THIS OPENING INEFFECTIVE FIRE WOULD HAVE BEEN AVOIDED IF RADAR HAD BEEN FITTED IN ONE CRAFT OF EACH L.C.T. FLOTILLA provided that the assault beach is not abnormally flat. (602)

324. It is important to draw a distinction between the results of the firing and the assault technique tested on exercise "PIRATE". The results clearly indicated that further practice, and certain additional equipment, was required for the seaborne artillery. On the other hand, the technique -- which had been constantly developing since the Dieppe Raid -- was shown to be essentially sound. The divisional report on the exercise noted that the "firing of Artillery from craft is practical for carrying out an area shoot" (603). Subsequently, the divisional artillery received further practice in its fire support role during exercise "TROUSERS", which was carried out at Slapton Sands, Devon, during April 1944 (604).

325. "PIRATE" was also a significant exercise from the air point of view. In his report of 29 Oct Air Marshal J.H. D'Albiac, Air Officer Commanding, Tactical Air Force, wrote:

Owing to bad weather the full air programme for the actual assault could not be carried out and only advanced echelons of the R.A.F. formations were landed on to the beaches. However, in spite of this serious curtailment in the scope of the exercise, many interesting problems arose and much valuable experience was obtained. (605)

Unfortunately, the bad weather prevented a full test of "the co-ordination of air and surface bombardment during the critical period of the assault and the touch-down of the assault forces". For the same reason it was not possible "to try out the practicability of directing air support aircraft in the air from the Headquarters Ship on to opportunity targets during the follow-up period" (606).

326. As a result of the exercise there was some disagreement between Air Marshal D'Albiac and General Paget over the possibility of air superiority in an assault. The former feared that a large assembly of shipping and assault craft in daylight would be "liable

to heavy attacks by enemy aircraft . . . no matter how strong the air cover" (607). He therefore suggested that a night approach and a dawn assault should be reconsidered by the naval authorities.\* Commenting on this proposal General Paget gave various reasons why a daylight assault was preferable; on the question of air superiority he wrote:

I fully realize that no degree of air superiority can eliminate the possibility of periodic penetration by hostile aircraft, particularly of the low flying type. There is, however, a fundamental difference between that and heavy air attacks. The former risk is appreciated and accepted, and must be countered by adequate AA defences. The latter, in my view, implies an air situation which can only be regarded as unacceptable. The reduction of the German Air Force in WESTERN EUROPE and the provision of a high degree of air superiority at the time of the projected operation were clearly stated in the COSSAC Outline Plan to be a pre-requisite to success.

I consider, therefore, that any examination of the assault problem must be based in the first place on the assumption that the necessary conditions in the air have been attained. (608)

327. Air Marshal D'Albiac had also emphasized the danger to low-flying aircraft from the failure of Allied ground troops to recognize their own aircraft. His report stated:

My main conclusion is that as soon as troops get within a certain distance of the shore, defence against enemy low flying attack must rest with A.A. guns, which should be given freedom to fire up to certain heights, and that none of our aircraft should fly below this height. I realize that this will prevent us carrying out close air support from low altitudes after a certain stage of approach has been reached, but I consider that the greater protection which is possible by A.A. defence more than offsets any possible benefit which might be derived from our low flying close support aircraft during the critical period of the landing. This efficacy of massed A.A. defence was fully proved recently in the Straits of MESSINA. (609)

General Paget's reply contained the following comment:

I fully recognize the difficulties of recognition and the danger of our own low flying aircraft being shot down by our own side. Nevertheless, I do not agree that we should solve these

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\*The question of timing in relation to the assault is considered, infra, paras 346 ff.

difficulties by a measure so drastic as to rule out the employment of ground attack aircraft, at a most critical moment of the assault. Fighter bombers and RF aircraft coming in at the last moment will be invaluable. (610)

The truth of the latter observation was later demonstrated, not only in the Normandy landings, but also in the critical assault against Westkapelle of 1 Nov 44.

328. Perhaps the chief significance of "PIRATE", from the air aspect, was that it focussed attention on "a number of problems concerning the control of Air Forces during the Assault Phase of Operation 'OVERLORD'" (611). These problems necessitated further detailed study before satisfactory solutions were found.

329. In spite of limitations on the performance of seaborne artillery and supporting aircraft, Exercise "PIRATE" showed that the assault technique had reached an advanced stage of preparation for "NEPTUNE". It was obvious that further training and certain modifications to equipment were necessary; but the essential principles of the technique had been tested and proved satisfactory.

330. Viewed as a whole, the combined fire plan was considered to have been a success. In the preliminary naval bombardment by three "Hunt" class destroyers "the range of the beach areas was quickly found and maintained" (612). The Commodore Commanding Force "J" reported:

In general . . . the assault was well carried out by the various landing craft involved. The fire of the rocket craft appeared to be well-timed and well-directed. (613)

This conclusion had an important bearing on the ultimate significance of "PIRATE":

Analysing the results of the exercise, those responsible concluded that this fire plan had shown itself practicable and provided a sound basis for planning. A foundation had in fact been laid for the tactical scheme put into practice on the Normandy beaches eight months later. During the intervening period many details were worked out; but it is fair to say that in these early exercises the 3rd Canadian Division established the technique of the 'Overlord' assault, and that they founded it upon the experience so dearly bought by the 2nd Canadian Division at Dieppe. (614)

#### The Graham Committee

331. Exercise "PIRATE" tested a combined fire plan which was the product of intensive study and operational experience. However, it is important to

realize that detailed consideration of that plan was a continuous process, lasting right up to D Day, with many alterations as the result of further study, experimentation and improvisation. Thus, before and after "PIRATE", an important inter-Service Committee (known, from the name of its Chairman, as the Graham Committee) was meeting at C.O.H.Q. to consider the provision of adequate fire support for a landing on a heavily defended coast. It is now necessary to examine in outline the work of this Committee, which submitted its report to the Chiefs of Staff in December 1943 (615).

332. At C.O.H.Q. the first serious study of fire support for an invasion had been made in September 1942, shortly after the Dieppe Raid. A paper prepared at that time discussed the types of targets to be engaged, the scope and limitations of naval bombardment, fire from support landing craft, counter-battery fire, the use of land service weapons in craft, the use of seaborne self-propelled artillery and rocket projectors and the role of air bombardment (616). An Assault Committee had then been set up at C.O.H.Q. to carry these investigations further and, by December 1942, this group had arrived at the following conclusion:

Generally speaking the problem can be divided conveniently into two main portions:-

- (a) The production of fire support of a direct and indirect nature to assist the assault on and beyond the beach. It is considered that this is fundamentally a military problem, even though, in the initial stages the weapons must be waterborne.
- (b) The production of fire support to neutralize enemy battery positions covering the beach. It is considered that this is fundamentally a joint naval and air problem.

Conclusion - Thus the problem as a whole resolves itself into one which can only be solved by a properly balanced fire plan in which naval, military and air action must all play their parts. (617)

The Assault Committee, which had an important influence on the work of the Graham Committee, emphasized that, in addition to the maximum naval and air bombardment, other methods of producing fire support were essential in order to ensure that the assaulting troops could get ashore and could "maintain their attack beyond the beach" (618). Dealing with the role of seaborne artillery (25-pounders), the Committee stated that these guns would have to be "capable of direct fire at opportunity targets both when afloat and beached" (619).

333. The early work at C.O.H.Q. resulted in closer examination of the equipment required to produce the necessary fire support. A meeting held at this headquarters on 22 Dec 42, and attended by General

McNaughton, discussed these requirements and reached agreement on designs for "close support Gun Craft" (620). At later meetings during the spring of 1943 details of armament, including the conversion of L.C.T. to L.C.T.(R), were settled (621). Meanwhile, important exercises such as "PRIMROSE" explored the tactical side of the problem.

334. With the progress of planning for the invasion these developments entered a more significant phase. In June 1943 the C.C.O. organized a conference ("RATTLE") of senior Service representatives, including General McNaughton, "to study the various combined operations problems of OVERLORD" (622). Thereafter, the Chiefs of Staff were advised that a number of significant problems, including fire support in the assault, required "immediate and authoritative decisions" (623).

335. Partly as a result of the "RATTLE" recommendations, and partly in response to a submission by the Admiralty, the Chiefs of Staff decided in August 1943 to set up a special inter-Service Committee to deal with the problems of fire support in an assault. This group, which came to be known as the Graham Committee, had the following composition:

Chairman:

Air Vice-Marshal R. Graham - C.O.H.Q.

Members:

Rear-Admiral W.R. Patterson - A.C.N.S.(W). Admiralty.  
Major-General J.A.C. Whitaker - D.M.T.) War Office.  
Major-General W.J. Eldridge - D.R.A.)  
Air Vice-Marshal W.A. Coryton - A.C.A.S.(Ops) Air  
Ministry.

Professors P.M.S. Blackett, G.D. Ellis and S. Zuckerman, Scientific Advisors with the Admiralty, War Office and C.O.H.Q., respectively, also attended the meetings of the Committee, as did representatives of COSSAC, C.-in-C., Portsmouth, Headquarters 21st Army Group, Air Ministry, Fighter and Bomber Commands, the Tactical Air Force, C.O.H.Q., and the United States Air Forces.

336. The Graham Committee held a series of meetings beginning on 4 Sep and ending with the preparation of a detailed report on 1 Nov 43. The terms of reference were:

To consider all existing means of providing fire support when landing forces on a heavily defended coast and to make recommendations as a matter of urgency, for improving the degree of support. (C.O.S.(43) 190 (O) item 6). (624)

The Committee were instructed to consider the reports on the Pantelleria operation and the results of certain bombing trials on beach defences in the United Kingdom. Their work was not restricted to the requirements of the Normandy invasion, for "it was noted that the



provision of fire support for Operation 'OVERLORD' was already being dealt with by the appropriate Commanders and the Service Ministries" (625). However, agreement was reached that "any findings of the Committee requiring urgent attention in relation to 'OVERLORD' could be brought to the notice of the appropriate authorities by their representatives who attended the Meetings of the Committee" (626). Consequently, either Lt-Gen W.D. Morgan, C.G.S., or Brigadier C.F. Loewen, B.G.S.(Ops), represented Headquarters 21st Army Group at all meetings. Moreover, it was apparent from the examples taken for study (such as the Fécamp area) that the Committee were thinking primarily in terms of an invasion of Normandy. Indeed, their final report stated that "the defences of the North coast of France as in September, 1943" had "been taken as typical for a heavily defended coast" (627).

337. At their first meeting the Graham Committee agreed that the requirements of the fire plan could be conveniently discussed under three main headings:

- (1) Destruction or neutralization of the coast defences;
- (2) Destruction or neutralization of beach defences;
- (3) Tactical fire support of landings. (628)

They also agreed that

. . . the fire effect on land (type and volume) is an Army requirement, and that the method of producing such effect is a Naval and Air problem until the Army has deployed its own support weapons, when all three Services share the responsibility of producing the required result. (629)

At this meeting the Committee decided to take the enemy defences in the Fécamp area as a typical example and Lt-Gen Morgan arranged to provide the necessary information. As regards beach defences, they concluded that

the basis of investigation . . . should be the volume of fire required in a given area, say, 2,000 yards by 1,000 yards. Part of this fire would be against visual targets, part by observation and part by drenching fire. The Army would state the effect required and the Navy and Air would assess what could be done with the existing means to meet this requirement. (630)

Suitable targets for tactical fire support of the assault were thought to be:

- (1) Enemy batteries behind the beaches;
- (2) Enemy strong points;
- (3) Artillery O.P.s;

- (4) Obstacles;
- (5) M.T. on roads and road junctions;
- (6) Personnel. (631)

338. During their second meeting (18 Sep) the Committee discussed the type and weight of bombardment required to neutralize coast defence batteries. Professor Zuckerman suggested that a concentration "similar to that put down on Pantelleria would in his opinion disrupt the ground surrounding the batteries, incapacitate the gun crews, and neutralize the guns" (632).

The Chairman stressed the importance of improving accuracy, whether in air bombardment or naval bombardment, in order that the desired result might be obtained with less effort. How this was to be done would be for each Service to decide. (633)

In order to thicken the supporting fire the Committee were at this time considering the possibilities of the Maunsell Tower, a concrete vessel mounting two 6" howitzers. This project was afterwards abandoned.

339. At later meetings the Committee were chiefly concerned with details of their final report. It was recognized that "a special intelligence survey of appropriate beach areas should be made so that mean points of impact, and salient topographical features, could be plotted for recognition both from the sea and from the air as a means of improving the degree of fire support" (634). The duration of air action in the initial stage of the assault was also considered. Air Vice-Marshal Coryton observed that

. . . it would be undesirable for the air effort to be spread over a long period before the assault, and during discussion the Committee considered that while it would be unwise to start air action prematurely as personnel manning coast and beach defences could be replaced, it would be equally unwise to leave too many air tasks until the last moment, when every available aircraft would probably be needed to support the assault. The Committee agreed, however, it would be for a Force Commander to assess the pros and cons of long or short preliminary air action in relation to his air resources available for the particular operation, observing that the air should not be called upon to undertake tasks that can be done by other means. (635)

The Committee stressed the necessity of finding "some effective means of dealing with C.D. guns encased in thick concrete". At the third meeting (9 Oct)

The Committee discussed means of providing close fire support and noted that destroyers and L.C.G.(M) would form part of the Force

allotted for this task. Brigadier Loewen (21 Army Group) emphasized the difficulties of landing the leading tanks and breaching obstacles when the drenching fire had lifted, and pointed out that observation of fire would be one of the principal problems during this phase. It was agreed that fire support would not deal with obstacles; at present Army must deal with these. At the same time urgent measures should be taken to improve the means at our disposal, e.g. hose pipes with explosive. (636)

Lists were prepared showing "the existing means of fire support and notes on their limitations", together with "targets and the means available for attacking them" (637).

340. The report by the Graham Committee to the Chiefs of Staff reviewed the whole problem of fire support in considerable detail. The report stated:

The problem of fire support in a seaborne assault is to produce sufficient sea and air bombardment to destroy or neutralize the enemy defences and to render the defenders permanently or temporarily incapable of strong and organized resistance. (638)

Excluding air superiority and control of sea communications (which were described as "inherent in any seaborne operation"), the report divided the seaborne assault into four phases:

Phase 1. Any preparatory action that may take place before Phase 2 starts.

Phase 2. The approach up to the touch down.

Phase 3. The touch down to the establishment of adequate fire support ashore. This postulates the capture of an area sufficiently large to enable the Army weapons to deploy . . . this area will be referred to as the covering position.

Phase 4. The advance inland up to the establishment of the main bridgehead. (639)

The Committee reported that, parallel with these phases, there were four main tasks in a fire support plan:

- (i) Task 1. Silencing of coast defence batteries and of such inland batteries as may bring fire to bear on naval ships, assault craft and the beaches.
- (ii) Task 2. Drenching and aimed fire at beach defences and field batteries, including any C.D. guns in the area which may have survived the first attacks in Task 1.

- (iii) Task 3. Provision of fire support for the touch down and for the establishment of the covering position.
- (iv) Task 4. Subsequent support for the establishment of the main bridgehead. This task is not strictly within the fire plan but it must be considered at the same time. (640)

341. The present narrative is unable to give a full description of the detailed studies which the Graham Committee made of each of the four above-mentioned tasks. In each case targets were defined and various factors affecting the naval, military and air effort were assessed. Thus, dealing with the military role during the third phase, the report stated:

S.P. artillery afloat can help to support the assault run-in until the leading wave is within approximately 500 yards of the beach, when the fire will have to be lifted further inland. Flat trajectory infantry weapons fired from landing craft will give direct close support until the touch-down. (641)

The Committee also discussed many other important factors, such as the timing of the assault\*, the use of smoke and the methods of dealing with obstacles. In the latter connection the report pointed out that

Fire support at the required density can be provided only for a limited period and, therefore, the speed at which obstacles can be overcome will be an important factor in the fire plan of any seaborne assault. With the present means available naval and air bombardment will have little or no effect on obstacles such as anti-tank walls, wire, minefields and under water obstructions. These will have to be dealt with by the Army unless special measures can be developed within the fire support resources. (642)

342. In their "Conclusions and Recommendations" the Graham Committee reported that the "existing means of naval and air support" were satisfactory (643). However, they made suggestions for certain improvements. They felt that "immediate action" should be taken to improve the accuracy of naval and air bombardment by obtaining good air observation for naval fire, by attaining greater accuracy in precision bombing and by gathering "detailed information about the enemy coast and beach defences in probable operational areas" (644). Likewise, the Committee recommended action to "augment the fire support from landing craft and special craft

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\*See, infra, paras ~~329~~ ff.

in any way practicable", to "reduce to a minimum the safety zone of L.C.T.(R)", to investigate the possibility of improving the destructive effect of rockets, and to "consider the tactical use of L.C.T.(R) for providing smoke" (645). Similarly, they urged that special measures should be taken to deal with "coast defence guns in turrets and casemates by means of air bombardment", to destroy obstacles, including minefields, which could not "be dealt with adequately by the existing means available to the Army" and to use certain bombs "for filling the gap following the initial lift of support fire" (646). Finally, the Committee recommended that COSSAC "should be invited to apply the suggested basis of assessment to operation 'OVERLORD' with the object of judging whether it forms a reasonable method of approach" (647).

343. On 23 Dec 43 the report of the Graham Committee was considered by the Chiefs of Staff Committee (648). Out of their deliberations came a decision of great significance to invasion planning. For the Chiefs of Staff "agreed that the proposals submitted for improving the degree of fire support in a seaborne assault, in so far as they affected operation OVERLORD should receive attention on the highest priority, and when promising, should be developed on high priority" (649).

344. The work of the Graham Committee and the experience of Exercise "PIRATE" exerted a profound influence on the evolution of a satisfactory technique for the invasion. The true measure of that influence became apparent when the Joint Fire Plan of 8 Apr 44 was tested on D Day. It was then apparent that the Plan followed "fairly closely" the lines laid down by the Graham Committee (650), and that the assaulting formations used the technique of Exercise "PIRATE".

#### CONSIDERATIONS OF TIMING AND WEATHER

345. There is no need to stress the importance of timing and weather in relation to the launching of "OVERLORD". These factors had been carefully weighed by the enemy when, in 1940, he was planning to invade England. The original German plan for "SEA LION" contained the following observations:

The day is the safest time for embarkation, as our air supremacy and strong A.A. defences can only avail us then. The crossing is to be made in such a manner that by daybreak the transport ships arrive simultaneously at all points on the English mainland.

An essential condition for success is favourable weather which will allow the smallest ships to make the crossing and permit the operation of the Air Force and of parachute and airborne troops. (651)

These considerations, and many more, were the subject of exhaustive study during the later stages of "OVERLORD" planning. The present account is able to give only a brief outline of certain aspects of these two great problems.

#### Timing

346. Following the preparation of the overall COSSAC plan for the invasion, the various headquarters concerned gave increased attention to the correct timing of the operation. In August 1943 a planning syndicate at Headquarters 21st Army Group produced a paper which contained this statement:

It should be assumed that the initial landings will take place by daylight as shortly after first light as Naval considerations will permit, preceded by airborne troops and commandos, landed under cover of darkness.  
(652)

This was an interesting anticipation of the general principle behind the timing of the "NEPTUNE" assaults.

347. The matter was discussed in great detail at a meeting at Headquarters 1st British Corps on 6 Sep. Dealing with the purely military aspects of H hour -- afterwards defined as "the time at which the leading wave of assault craft should hit the beach" (653) -- this meeting decided that the decision depended on the availability of D.D. tanks and A.V.R.Ls. The report of the discussion continued:

The success of the operation depends on the very early capture of a beach head, which in turn depends on the simultaneous operation of breaching the major obstacles and neutralizing the enemy localities which cover them and then the capture of the localities themselves  
...

If AVREs are to work efficiently they require enough light to see, and if we are to gain the maximum advantage from our available fire support from DD tks, the air, and sea-borne craft, some daylight is required. Apart from LCT(R) fire support in a night assault is likely to be of negligible value.

From the Army point of view, therefore, H hour should be as early as possible in the morning, provided there is telescope light, once the DD tks are touched down and ready to shoot. DD tks should therefore touch down at about 20 mins before sunrise, and this time should be selected for H hour. (654)

If D.D. tanks and A.V.R.Es would not be available, the meeting agreed that "H hour should be about two hours before very first light" (655). It was realized that naval considerations might require a landing after sunrise; but, in this event, H hour should "not be later than absolutely necessary" (656).

348. However, as so often happened in combined operations, all three Services had differing requirements. From the point of view of air operations, it was desirable to have the timing considerably later. This argument was advanced in a paper prepared by Brigadier C.C. Oxborrow, B.G.S.(Air), at Headquarters 21st Army Group. He prefaced his remarks with the statement that, "if the assault is to be based on the fire power, it is considered that air bombardment is one of the prime factors in making this fire power effective". He added:

My view, therefore, on the assumption of an assault based on fire support, is that Zero hour should be in daylight, some one or two hours after first light; that the assault will be preceded by a period of intensive air bombardment during the last hours of darkness by heavy night bombers, the attack being taken up after daylight by heavy and medium day bombers; that this concentrated bombardment will continue until the leading assault craft have reached the limit of the safety area, probably one mile off-shore. If the leading assault wave consists of DD tanks, this safety margin can be reduced considerably; that from the moment this air bombardment is lifted for safety reasons the attack will be taken up by the air weapons of precision, rocket aircraft, fighter bombers, etc., that these precision air weapons will take the leading assault wave right into the beaches, and will continue to attack points of resistance even during the actual assault across the beaches. (657)

Nevertheless, it will be recalled that other factors, arising out of Exercise "PIRATE", afterwards led the Air Officer Commanding, Tactical Air Force, to recommend a reconsideration of the possibilities of a night approach followed by a dawn assault (supra, para 326).

349. The question of a "day or night assault" was examined at some length in a letter of 13 Nov from General Paget to Air Marshal D'Albiac.

The factors which have led us to the conclusion that a daylight assault is the preferable alternative are not solely naval, although the naval aspect is one of the most important. I hold the view that the success of a seaborne assault on defended beaches is conditional on the fire power, including air bombing, at the disposal of the assaulting forces being such that the enemy defences on the fronts selected for attack will be largely neutralized or destroyed.

Darkness may be regarded as a handicap to accurate hostile fire, but it also imposes such limitations on our own supporting fire that the above conditions will not exist.

The effect of darkness on the air situation also seems problematical. However satisfactory the air situation which has been achieved by day may be, darkness will permit air attacks with relatively little interference, and the results from hostile air action might well be more disastrous by night than by day.

In addition, I do not subscribe to the view that the assault armada will be subjected to concentrated artillery bombardment from the shore; on the contrary I anticipate that the majority of the hostile coast defence guns which could engage the armada will have been neutralized or destroyed. (658)

Early in December a paper on this same subject, from the air point of view, was prepared at C.O.H.Q. This study reached two conclusions: if an early enemy counter-attack would be "the greatest menace to the success of the operation", it was considered that a night assault would give the Air Forces "the maximum scope for countering this threat"; on the other hand, if "the maximum fire support" was essential, an assault in daylight was considered preferable (659).

350. There was another important aspect of the timing problem. In his report on "PIRATE" Air Marshal D'Albiac observed:

The Exercise brought out yet another very important lesson concerning both the R.A.F. and the Navy. The effectiveness of tactical air support for the assault is very largely dependent upon attacks being delivered at the planned time in relation to the touch-down of the first craft wave, i.e. H. Hour. H. Hour is in turn dependent upon the ability of the Navy to effect the touch-down of the first craft at the planned time. With a slow moving convoy, which is considerably affected by wind and currents, this is a difficult task and adjustments may have to be made during the last two or three hours of the approach. Notification of any adjustments must, however, be received in ample time in order to make possible the appropriate alteration in the timing of air attacks. There will come a time after which, however, it will be impossible to advance the timing of air attacks. After this time the air support can only be delayed or cancelled, and cannot be advanced. Furthermore, if there is any postponement of H. Hour after our aircraft have become airborne, it may be quite impossible to make corresponding delays in time of attacks. (660)

This opinion was supported by Admiral Ramsay:

Postponement of H-hour could only be accepted in conditions of dire necessity, owing to the very large numbers of aircraft which will be co-operating in the Assault and the consequent



difficulty of amending their time-table. It should not be assumed in planning that postponement is readily possible. (661)

In the same connection General Paget wrote:

I also agree on the vital importance of accurate timing. In this connection, as against the evidence of the 'PIRATE' Exercise, there is that of the 'TORCH' and 'HUSKY' operations where, with much longer sea passages and much larger numbers of craft, the Royal Navy has proved equal to the task of conforming to timetable to within a matter of minutes. (662)

Nevertheless, it was realized that there were certain limits to the accuracy which might be attained. Lt-Gen J.T. Crocker, G.O.C. 1st British Corps, remarked that:

Precise timing will be difficult and I am sure we must be careful to avoid planning to split-minute accuracy. It just will not work. The tasks given to the air must be such as to allow some latitude in time and space. (663)

351. By the end of 1943 tentative conclusions had been reached with respect to the timing of H hour for the assault. As stated in a staff study prepared at Headquarters 21st Army Group:

It has been agreed that H hour shall be so timed that a minimum of 30 minutes of aimed fire can be directed at the defences before the leading craft touch down. This means that at H - 30 minutes there must be sufficient daylight for the air observation of Naval fire and for daylight precision bombing to begin. This has been estimated to be about Nautical Twilight plus 70 minutes. The earliest time, therefore, at which H hour is acceptable from the point of view of fire support is at Nautical Twilight plus 100 minutes. (664)

It was, however, necessary to revise this definition over succeeding months because of a complication introduced by the enemy.

352. The accelerated work on the "Atlantic Wall", initiated by Field-Marshal Rommel during the spring of 1944, resulted in the erection of further obstructions along the beaches selected for the invasion. This development compelled the Allied planners to reconsider the tidal conditions, which were of paramount importance from the naval point of view. As afterwards described by Admiral Ramsay:

No single question was more often discussed during planning than that of H hour. As H hour was linked to tidal conditions, D day was dependent on it. Until obstructions appeared on the assault beaches, the argument was largely confined to the determination of

the ideal balance between a sufficiency of light for aimed air and naval bombardment and the minimum daylight approach, taking into consideration the number of days to which postponement in the case of bad weather would be acceptable in view of the different tidal conditions on later days. But as beach obstructions in some numbers were erected on the beaches, the need to deal with these dry-shod, and therefore to land below them, overcame all previous arguments and H hour and D day were finally largely determined by the position of these obstacles.

As on the western (U.S.) beaches the obstructions were known to be in place further down the beach than on the eastern (British) beaches and as in Force J's sector near low water there were some rocks which would be a danger to the assault craft, it was finally necessary to select five different H hours, ranging over a period of one hour and twenty-five minutes. (665)

Field-Marshal Montgomery has pointed out that "this inevitable compromise resulted in the right hand beaches having the bare minimum period for observed fire prior to the assault, whereas the left hand beaches had considerably more than had been deemed essential" (666).

353. Finally, reference must be made to the important influence of airborne operations on the final selection of D Day. The "TRIDENT" and "QUADRANT" Conferences had set 1 May 44 as the date for the launching of "OVERLORD". This date was later changed so that the invasion could begin during the period 15-20 May (667). However, at the next big meeting of Allied leaders -- the "SEXTANT" Conference at Cairo in November-December 1943\* -- the Chief of Combined Operations\*\* pointed out that a full moon would be required for the airborne phase of "OVERLORD". His memorandum stated:

The only period when suitable moon conditions will obtain in May is between the 7th May and the 12th May. As so many calculations are being based on the date of 'Overlord' I would suggest that even a difference of eight days is unacceptable and that therefore it should be agreed that the target date for 'Overlord' is the 8th May. The next suitable moon period for Operation 'Overlord' occurs between the 5th June and the 10th. (668)

354. The decisive influence of the landing craft shortage on the final selection of D Day will be outlined in a later section of the narrative (infra,

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\*See, infra, paras 377 ff.

\*\*Maj-Gen R.E. Laycock, who succeeded to the appointment on 10 Oct 43. (Lord Louis Mountbatten had relinquished his duties as C.C.O. on 25 Aug 43 to become Supreme Allied Commander in South-East Asia.)

paras 406 ff). Here, it will suffice to point out that earlier discussions on D Day and H hour were influenced by many factors of which the most important were: the progress of German construction along the Normandy coast; the tidal, lunar and meteorological considerations; the effect on air operations and the requirements of close support fire for the assault. In point of fact, "the final decision as to D day and H hour was not made until 17th May when 5th June was selected, with postponement acceptable to 6th and 7th June" (669).

#### Weather

355. Invasion planning was naturally much concerned with the influence of the weather. Here, more than in any other respect, the experience of other theatres was of little value. Reference has been made to the widely differing conditions common to the coasts of the Mediterranean and North-West Europe. These conditions were discussed at a meeting of senior British and American Air Force officers held on 10 Aug 43.

It was agreed that meteorological conditions were very much more favourable in the Mediterranean than in North West Europe, specially the visibility, to which airborne forces were particularly sensitive . . . Against this, cross-Channel meteorological forecasting was extremely good -- better than in North-West AFRICA where conditions were so consistently good that less attention was paid to forecasting . . . ) (670)

356. A COSSAC paper examined the possible effect of bad weather on the build-up and maintenance of "OVERLORD" during the first fortnight of the operation. This paper stated that "the following basic assumptions are implicit in the 'OVERLORD' outline appreciation and plan":

- (a) The landing of vehicles and stores over the beaches will not be practicable when the wind exceeds a velocity of Force 3 on-shore and Force 4 off-shore.  
These days will be referred to as 'bad' days and those on which the wind does not exceed these critical velocities will be referred to as 'quiet' days.
- (b) The meteorological experts will be able accurately to forecast a quiet spell of not less than four days from D Day inclusive. (671)

The crucial relationship of the weather to the success of the assault was emphasized:

The plan does not contemplate the capture of a major port (or existing sheltered anchorages of any size) for at least fourteen days. It is essential, however, to the success of the plan that we defeat the enemy forces, including

reserves immediately available, during that period. To ensure this it will be necessary to land a quantity of stores at least sufficient for current maintenance requirements and in addition, under average weather conditions, to build-up an initial reserve in accordance with the reserve policy.

The first fourteen days are, therefore, critical . . . ) (672)

The COSSAC study then discussed the ramifications of the weather under three headings: in an "average period", in an "average bad period" and in the "worst acceptable period".

357. It was obvious that the selection of D Day would be vitally affected by meteorological factors. A report drafted in September 1943 by Headquarters 21st Army Group noted that "conditions are required that will satisfy, so far as possible, the frequently conflicting demands of the three Services" (673). In view of later developments the following extract is significant:

It will be seen that the probable number of mornings that will satisfy the conditions of wind, cloud and visibility required, and that are the first of a four day quiet spell as required for maintenance, is:-

APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
2.3	3.3	5.7	5.0	5.6	3.9

The target date set for OVERLORD is 1st May: it is for consideration whether the operation will not have greater chances of success if undertaken in June. (674)

358. While the problem was being studied from a theoretical point of view, the practical experience of exercises in the United Kingdom also emphasized the far-reaching ramifications of bad weather. This influence was particularly evident in connection with air operations. Thus, although excellent weather conditions prevailed in the Studland Bay area when "PIRATE" began, "fog on inland airfields prevented the smoke-laying and bombing aircraft taking off and with the exception of the provision of air cover to the convoy at sea and dummy attacks by Typhoon aircraft against prearranged targets on the beaches, the air support plan as arranged was not carried out" (675). Commenting on this aspect of "PIRATE" the Air Officer Commanding, Tactical Air Force, wrote:

This incidence of fog over airfields occurred also during Exercise 'Spartan' and although it is hoped that the time of year chosen for Operation 'Overlord' will be such as to exclude the likelihood of fog, it does serve to remind us of the risks we must face if such conditions do arise. Although this probably requires no

emphasis, it confirms the need of distributing our resources on airfields at home, and for the early establishment of airfields in the area of the landing. (676)

Yet it would obviously be well-nigh impossible to expect favourable weather conditions for all three Services, at the same time, across the wide area needed for the mounting of "OVERLORD".

359. As early as October 1943 detailed study had been given to the effect of postponing the assault because of bad weather. Such a postponement would impose a severe strain on embarkation facilities.

It will of course be impossible to avoid starting the embarkation of personnel before the final weather forecast has been given. If however the embarkation of personnel does not start earlier than twelve hours before sailing, i.e. about Z - 32, it may be possible to obtain at least a negative forecast; that is to say, we should know by that time if there is no chance at all of suitable weather on D Day. If however it appears at that time that there is some chance, however slight, of D Day being fine, it will probably be necessary to order embarkation and accept the possibility of a last moment postponement.

It will not be worth while disembarking troops if the postponement may be only for twenty-four hours, but if it is certain to be longer, then troops should be disembarked and the original procedure repeated. It is however necessary to ensure that disembarkation and embarkation can each take place within twelve hours, if troops are not to be kept on board indefinitely. (677)

Intricate calculations were made with the object of ascertaining "the average length of a quiet spell" and "the duration of a bad spell" (678).

360. In order to estimate the extent to which the weather might interfere with beach maintenance, the planners examined the meteorological records of the previous ten years (679). However, grave limitations were attached to the results of their research. Commenting on a COSSAC paper prepared during October Admiral Ramsay's Chief of Staff wrote:

The paper is based on the hard and fast assumption that an onshore wind of more than Force 3 or an offshore wind of more than Force 4 would prevent the landing of vehicles and stores. It is considered that conditions may well vary at different beaches and at different states of the tide. Furthermore, the risk that would be acceptable in landing stores or vehicles under bad conditions would vary with the existing military situation.

In general it is considered that when applying this paper to planning it must be clearly stressed that it is only to be taken as a very broad guide. (680)

Rear-Admiral Philip Vian, then (24 Nov) commanding Force "J", pointed out that "the limiting conditions under which a beach can be worked depend on the height, length and period of the sea which, although caused by the wind in the first place, are also dependent on a variety of other conditions such as depth, under-water gradient, etc" (681).

361. Various aspects of the weather problem were discussed at some length in a report prepared on 22 Nov 43 by the Director of Plans, Admiralty, for the Chiefs of Staff Committee. This report was circulated at the Cairo ("SEXTANT") Conference as a memorandum by the British Chiefs of Staff (682).

362. Reviewing the overall weather prerequisites for "OVERLORD", the memorandum noted that:

Suitable weather conditions are required for two phases of the operation, firstly, the assault for which a four-day fine weather period is required; secondly, the maintenance and build-up period for which suitable weather for a decreasing degree of beach maintenance is required for about three months. (683)

The memorandum stated that "a quiet spell of four days with winds of Force 3 or less" was desirable for the assault and that, from this point of view, the attack "could be postponed up to the month of September" (684). However, additional complications narrowed the choice considerably:

For tidal reasons the assault is limited in each lunar month to two periods of five or six days, which occur at times of full and new moon. The air lift can only be carried out in the full moon period. It therefore follows that if the full moon period is missed on account of the weather conditions being unsuitable, the assault must be postponed for 24 days. By sacrificing the air lift this postponement could be reduced to 10 days. (685)

363. The memorandum confirmed previous opinions that "any day with wind of not more than Force 3 on shore and not more than Force 4 off shore" would be acceptable for the maintenance and build-up period (686). However, the weather problems of that critical period could be greatly reduced by the great artificial harbours then under construction.\* The COSSAC plan had stated that, "making full use of every captured port, large and small,

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\*See, infra, paras 367-376.