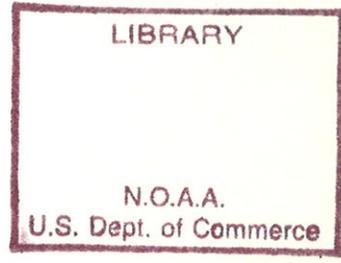


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WEATHER SUPPORT OF THE NORMANDY INVASION

by

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WEATHER SUPPORT OF THE NORMANDY INVASION

Bad weather is obviously the enemy of the side that seeks to launch a project requiring good weather, or of the side possessing great assets, such as strong air forces, which depend upon good weather for effective operations. If really bad weather should endure permanently, the Nazi would need nothing else to defend the Normandy Coast.

General Eisenhower in Crusade in Europe

It is well known that although the general plan for the allied invasion of France was decided by strategic and political considerations, the timing of the invasion itself was determined by the weather. The weather factor was therefore one of the most essential ingredients in the success of the plan, especially during its initial landing phase.

History is replete with examples of military engagements in which unforeseen weather phenomena proved to be the deciding factor. The destruction of the Spanish Armada, often listed as one of England's greatest naval victories, was not so much the result of the strength of the English fleet as the power of a series of violent gales which wrecked some 19 of the Spanish vessels on the coasts of Scotland and Ireland, and more in the open sea; it was "King Winter" who turned back Napoleon's armies in Russia; and it was a sudden and unpredicted storm that destroyed some 30 French and English ships in the Crimean war, and literally changed the whole outlook of the conflict overnight.¹

1. One aspect of the Crimean storm, which occurred on the night of 14 November, 1854, deserves to be noted. After the catastrophe, the French astronomer Le Verrier was commissioned to investigate the storm and determine whether it could have been predicted. After gathering data from all over Europe, Le Verrier drew lines of equal barometric pressure (isobars) on a map, clearly showing the low pressure center that caused the storm. This was the beginning of the modern weather map upon which all present day forecasting is based. Erick, I. P. War and Weather, a Report of the AAF Scientific Advisory Group (Dayton, Ohio, 1946), p. 4.

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These mishaps can hardly be blamed on the military commanders involved. Lacking control over the weather, they would have been most content to have some foreknowledge of it. The simple truth was, however, that until the beginning of the 20th century, there was not enough scientific "know-how" to accurately predict the weather no matter how desperately the information was needed.

At the beginning of World War I, weather prediction was still a matter of concern mostly to farmers and vacationers. No nation, with the possible exception of Germany, had anything resembling a military meteorological service. By the end of the war, however, virtually every major country had such service, although the service rendered was hardly equal to that given in World War II.²

It was World War II that most demonstrated the need of an adequate weather service for the military and made it an indispensable part of combat operations. There were two main reasons for this. The first was the extensive use of airpower. No other combat weapon was so dependent upon weather for its effectiveness. Weather could determine the serviceability of an airplane; whether a mission should take place; and what type aircraft should take part. Weather enroute to and from the target could help determine the amount of fighter cover needed, and since the bombing in World War II was for the most part visual and the target had to be seen to be hit, the weather could in part determine the effectiveness of the mission. Last but not least, air support of ground troops, a new and highly effective technique of tactical warfare in

2. Sherry and Waterman, "The Military Meteorological Service in the U.S. During the War", Monthly Weather Review, April 1919, pps. 215-222.

use for the first time, depended almost entirely upon favorable weather for the accomplishment of its mission.

The other reason for the sudden growth in prestige of the military weather service during World War II, was the tactics of the war itself. As early as 1940, it was evident to many observers that the highly effective "blitzkrieg" of the German armies would become the basic tactic for both sides. In short, the weapons of offense were more effective than those of defense, and the relative static combat zones of World War I, (sometimes referred to as "sitzkrieg") were out of date. It was clear that the operational keynote for World War II would be mobility, and that no commander worthy of the name would dare commit his troops to rapid and extensive operations without considering how the weather would affect them.

The Pre-Invasion Weather Organization

By the time the Allies were ready to launch their great invasion of the European continent, the AAF Weather Service in Europe had grown to a point where it could provide all aspects of the invasion effort with proper weather support. The growth of the organization was swift but in keeping with the usual military way of doing things. Some aspects of the weather organization were the result of foresight, some the result of natural growth, and some did not make their appearance until there was an urgent need for them.

The first AAF weather unit to reach England was the 18th Weather Squadron. It had been activated at Bolling Field, Washington D. C., on 14 May 1942 for the sole purpose of supporting the Eighth Air Force.

Activated only a few months earlier, the Air Force was soon sent to England to begin long range bombing missions of Germany. The squadron followed the Air Force to England in July 1943. It was in full operation by 1 August, only a few days before the Eighth Air Force began bombing the continent.³

The headquarters of the 18th Weather Squadron was established at Widewing, London, which was also the headquarters for the Eighth Air Force. The weather stations of the 18th Squadron were then scattered among the various divisional and combat wing headquarters, operational group headquarters, and were also to be found at certain Air Transport Command bases.⁴

Like the command it supported, the 18th Weather Squadron became a flourishing organization. At the time of its activation at Belling Field, authorized strength was 41 officers and 429 enlisted men, but by 1 January 1944, the strength of the squadron was 244 officers and 1000 airmen.⁵

Although the 18th Weather Squadron was the first AAF weather unit in England, and its members considered themselves better acquainted

3. Hist of the AAF Weather Service, Vol III, 1941-43, p. 259; Hist, 18th Wea Sq, May 1952 - July 1944, p. 24; Statistical Summary of Eighth AF Operations, 17 Aug 1942 - 8 May 1945.

4. Hist, AAF Weather Service, Vol III, 1941-1943, p. 262.

5. Ltr, Adjutant General's Office to CG, Eighth Air Force, Subj: Constitution and Activation of Air Corp Units. 2 May 1942. Copy in AWS Hist Div files; Hist, Office of Directorate of Weather Services, Hq USSTAF in Europe, p. 12.

with the subtleties of English weather than the weather units which came later, it was to play a less significant role than they in the invasion. The 18th Squadron was a fixed type unit. Its bulky equipment precluded easy movement, and its purpose, that of providing weather support for the long range bombing missions, made it imperative that it operate largely on a fixed-facility basis. The invasion would mean an accelerated activity on its part but no great change in the way it was organized or did things.

The squadron did, however, provide qualified staff weather personnel to the higher echelons. In addition, it was responsible for the gathering of a great deal of the raw weather data on which the all important forecasts and weather studies were later based. It thus had an indispensable role to play in the pre-invasion weather organization.

It was clear however that it did not fill all the requirements for such an organization. The realization that there were other requirements which the 18th Squadron could not fill led to the establishment of another weather squadron, which was destined to play a more active role in the invasion force.

Early in 1942, the newly activated VIII Air Support Command, a tactical air unit, conducted a series of exercises in the ZI designed to test the capabilities of tactical air support. The exercises, so mobile that they were referred to as aerial leapfrogging, were supported by the only weather units available, i.e., fixed type stations with bulky and delicate equipment which could be moved only with the greatest effort.

The exercises were naturally hampered by this type of weather organization. Capt. Foster V. Jones, the Staff Weather Officer to the VIII Air Support Command, made a note of this in his report of the exercises to the Headquarters, VIII Air Support Command.

Weather service [he wrote] for these exercises was non-existent, because in the present organization of the weather squadrons of the AAF, no provision has been made for the highly mobile unit needed to provide the service. The entire weather system is at the present time based on a static organization. The impracticability of this was demonstrated on one occasion when the CP [Command Post] was located within two miles of an AAF weather squadron. The information obtainable at this station could not be communicated to the CP by telephone for security reasons, and there was not at the station sufficient personnel to draw the necessary additional maps and charts. It was impossible to move the station to the CP because of its fixed location.

After further analyzing the problem of weather support of tactical air operations, Captain Jones made as his primary recommendation "... the immediate establishment of a Mobile Weather Service by the activation of a Mobile Weather Squadron. This squadron [would be] identical with the established squadrons as far as personnel is concerned...but the equipment would be entirely mobile".⁶

The VIII Air Support Command easily saw the wisdom in Captain Jones's recommendation. Early in 1943, it wrote to its senior echelon, the Eighth Air Force, declaring that the establishment of a mobile weather squadron would be a "successful solution to the weather problem" and requesting that such a squadron be activated. In spelling out its needs, the VIII Air Support Command drew an interesting analogy.

6. Hist, 21st Wea Sq, 1 May 43 - 5 Jun 44, pps. 2 and 4. Captain Jones's report, while not available to the author, was obviously available to the historian for the 21st Weather Squadron who quotes it at length in the squadron history.

The military weather service is like an expanding or growing public utility in which we have the main power plant with its radiating lines along which have grown modern cities. Anywhere along the established lines, we may plug in and have power, but out beyond the end of the line, to get power means the running or construction of an extension. In applying this to an Air Force weather service, we find Bomber and Fighter Command Stations built along the main line, but the Air Support Command becomes the pioneer, extending the service from that last permanent station to the most forward positions of the Air Force. To make this extension requires a different type organization from that in use by the Bomber and Fighter Commands, but which must furnish, in the end, the same service.⁷

The Eighth Air Force quickly added its approval to the request and passed it on up to the Commander of the European Theatre. On 21 March, only six weeks after the VIII Air Support Command had initiated the request, the Commanding General of the European Theatre of Operations cabled the Director of Weather Services in Washington, requesting that a mobile weather squadron be activated forthwith and moved to England not later than July. The cable further specified that the squadron be staffed by some 383 qualified officers and enlisted men, and have enough mobile weather equipment, prior to departing the ZI, to equip 32 weather stations.⁸

While these negotiations were under way, the need for mobile weather units was being demonstrated in a more urgent way in North Africa. There, tactical Air Forces on both sides, restricted by the limited range of their fighter planes, followed each advance by laying down

7. Ltr, Hq VIII Air Support Command to CG, Eighth Air Force, Subj: Proposed Mobile Weather Squadron for the VIII Air Support Command. 11 Feb 1943. Copy in ANS Hist Div files.

8. Hist, 21st Wes Sq, 1 May 43 - 5 Jun 44, Appendix A.

literally hundreds of hastily made, feverishly used, and soon forgotten airstrips. Weather support for such operations was very vital, but the fixed type weather stations simply could not be moved from one temporary strip to another. It was obvious that for this type of fighting, highly mobile weather support was needed.⁹

The lesson was not lost on Washington. While the fighting in North Africa still raged, the 21st Weather Squadron, the first fully mobile weather squadron in history, was activated. The squadron was activated at Bradley Field, Connecticut on 1 May, 1943, with the specific responsibility of supporting the VIII Air Support Command, which by now had been appointed as the organization to provide the tactical air support for the invasion of France. The squadron was of course unaware of its destiny at this time, but the combat training which the weathermen received, their hasty departure for England in July, and their support of a tactical air unit, undoubtedly caused some of the squadron personnel to surmise that when the invasion came, they would have a part in it.

The 21st Weather Squadron had begun its career with an authorized strength figure, but like the 18th Squadron which preceded it, it soon outgrew its legal limit. By 1 January 1944, the squadron had 600 men assigned, was operating 37 detachments, and was still growing.¹⁰

9. "Mobile Weather Stations", a press release of the Weather Service Information Services, 24 May 1948. Copy in AWS Hist Div files.
10. Hist, 21st Wea Sq, 1 May 43 - 5 Jun 44, p. 21. Common to the Weather Service policy at the time, the first detachment was numbered "A", the second "B" etc. After "Z", the letters were doubled as "AA", "BB", etc., proceeding from there into broken letters such as "BD" and "EZ".

When the 21st Squadron arrived in England, both it and the 18th Squadron were supporting elements of the Eighth Air Force. Early in October, however, the Ninth Air Force, after a successful campaign in Africa, was secretly moved to England to become the tactical air force to spearhead the invasion of the continent. The Ninth Air Force promptly absorbed the VIII Air Support Command and with it the 21st Weather Squadron.¹¹ It was indeed an appropriate union. The first mobile weather squadron in history was now joined with a numbered Air Force which had as its motto "Keep Mobile".

The 18th and 21st Weather Squadrons together made up the bulk of the AAF Weather Service in Europe during late 1943 and early 1944, totaling at the beginning of the year some 1965 men. The squadrons were, however, supporting different units, and at the functional level at least, were nominally independent of each other. But both fell within the boundaries of the 18th Weather Region, a geographical area which took in all of Europe, and as such were under the supervision of a Regional Control Officer and his staff.

As the allied forces began to gather in England for the coming invasion, and new and higher headquarters were created, it became necessary that a corresponding expansion take place in the weather organization. In January, 1944, the Headquarters of the United States Strategic Air Forces in Europe (USSTAF) was created and put under command of Lt. Gen. Carl Spaatz. The USSTAF promptly assumed control

11. Hq. Ninth Air Force, GO No. 101, 16 Oct 43.

of both the Eighth and Ninth Air Forces, a development which required that another echelon be created to act as a staff weather agency to General Spaatz and to provide the necessary liaison between the general and the weather squadrons assigned to him.

But there were also other factors to prompt the organization of a higher weather echelon. It was becoming more and more evident, especially to the meteorologists, that the weather would be an essential factor in the choice of D-Day, and that the D-Day forecasts would involve decisions that should be made only by the most expert talent available. The British had two well equipped weather forecasting centrals, one belonging to the Air Ministry and the other to the Admiralty. The Americans, on the other hand, had no such center. Obviously if there was to be American representation in the group that would make the all important forecasts, a central would have to be set up.

Accordingly, on 12 February 1944, a joint forecasting central and administrative headquarters was set up known as the Office of the Director of Weather Services.¹² The Directorate, which now controlled all the weather units in the United Kingdom, was placed under the command of Col. Donald N. Yates, the ranking weather service officer in Europe, and attached to Headquarters, USSTAF.

The establishment of the USSTAF Weather Central, as it was called, opened the way for the formation of still another weather unit made up of representatives from the American and British centrals together with the Chief Meteorological Officer at SHAEP, the meteorological

12. Hist. Office of the Director of Weather Services, USSTAF, 10 Jun 45, p. 15.

officer on the staff of the Naval Commander in Chief and the Chief Meteorological Officer, Headquarters, Allied Expeditionary Force. This group, assuming the self chosen title of Combined Meteorological Section or Committee, had the responsibility of coordinating the forecasts issued by the three centrals, determining one that all could agree on, and then passing the information on up to the Supreme Commander and his staff.¹³

The committee operated under the joint chairmanship of Colonel Yates, the senior U. S. meteorological officer in Europe, and Group Captain J. M. Stagg, of the Royal Air Force, who enjoyed an equivalent status among the British and was Chief Meteorological Officer on General Eisenhower's staff. Although the chairmanship was a joint affair, Stagg was senior to Yates and it was usually he who gave the weather briefings to the Supreme Commander and the Combined Chiefs of Staff.¹⁴

It is uncertain just when the Committee became an official organization. Evidence seems to indicate that it was the creation of the allied meteorologists concerned acting on their own initiative. But if so, it is certainly safe to assume that if they had not taken care of the matter themselves, they would have been ordered to do so. At any rate, the Committee filled an urgent need in the pre-invasion weather organization by providing the necessary coordination between the three centrals and insuring that General Eisenhower as Supreme Commander received the best weather advice obtainable.

13. Col Thomas S. Moorman Jr. "The Weather Service and Operations in Europe", Lecture delivered at Ft. Leavenworth, Kansas, 1946. Copy in AWS Hist Div files.

14. Ibid.

The weather organization was now complete and the weather units were operational. The machine was functioning and everything was in place for the crucial D-Day forecast. It would have to do its job well; there was no margin for error; the success or failure of the initial landing phase would depend on it.

The Problem

It had been recognized almost from the beginning and widely voiced that the choice of D-Day would rest ultimately with the weatherman. General Eisenhower himself pointed this out when he jokingly said that one morning a corporal would test the wind, find it favorable, and the assault would be on.¹⁵

The Combined Meteorological Committee was no sooner established than preparations for the D-Day forecast began. It was recognized by all concerned that the task ahead would not be an easy one. Air, ground and naval forces, each with different weather requirements, would have to be integrated into one operation for which there could be no such thing as an ideal set of weather conditions. For example, the best conditions for the landing of airborne forces at H-H hours would be considerable cloud coverage as a safeguard against enemy fighter attacks. But these same conditions would restrict the effectiveness of the bombers and fighters, who, coming a few hours later in support of the troops on the ground, required visual contact with the target with preferably no clouds at all.

15. Reynolds, Cushman. Manuscript History of the AAF Weather Service, p. 126. This manuscript, completed in 1946 but unpublished, is in AWS Hist Div files.

The only solution seemed to be to establish a set of "minimum" conditions under which all forces could operate, albeit some of them uncomfortably. These factors, in turn, had to be coordinated with certain allied considerations such as tides and swells, channel currents, phases of the moon, etc.

As a first step toward an adequate solution of the problem, the Combined Meteorological Committee requested each major military element in the attack to submit an estimate of the minimum weather conditions under which it could operate effectively. The plan was then to fit the data into an overall requirement which would allow all the forces to operate with a reasonable degree of effectiveness.

The navy, the air force and the ground forces were all heard from. Their replies indicated what had long been suspected: that there was no need for such an optimum condition as a cloudless sky and unlimited visibility.

The Navy wrote that the winds for D-Day and for two days following should not exceed Force 3 (8-12 mph) onshore, or Force 4 (12-18 mph) offshore in the assault area. Winds might be as high as Force 5 (19-24 mph) in the open sea, but only for limited periods.¹⁶ The Navy further suggested that for several days preceding D-Day there should be no prolonged periods of high winds in those Atlantic areas which are likely to produce a substantial swell in the British Channel. Finally,

16. Wind velocities at the time of the Normandy invasion were given according to the Beaufort Scale. The scale listed Force 1 as winds from 1-3 mph; Force 2, 4-7 mph; Force 3, 8-12 mph; Force 4, 13-18 mph; Force 5, 19-24 mph; Force 6, 25-31 mph; Force 7, 32-38 mph; Force 8, 39-46 mph; and Force 9, 47-54 mph.

the Navy listed three miles as the minimum visibility that could be tolerated for successful naval operations.¹⁷

Air Force requirements were more detailed and more exacting. For the transports, which would be most active between HH-6 and HH-4, a ceiling of at least 2500 feet along the route to and over the target, not less than three miles visibility, and at least 50% cloud cover; for heavy bombers, not more than 5/10 cloud coverage below 5000 feet and a ceiling not lower than 11,000 feet. Fighters, which would begin attacking the German positions at HH-18, required a ceiling of not less than 1000 feet, but by HH-2, at which time friendly troops would be in the area, the minimum ceiling would have to be 4500 feet or higher. All air units listed three miles as minimum visibility, and all required suitable weather for landing after they returned from their missions.¹⁸

The most critical Army requirements were those concerned with air-ground operations. For paratroops, the surface wind over the drop area was not to exceed 20 mph and could not be gusty. The gliders could land safely in winds up to 35 mph, but no higher.

The ground forces further wanted the Normandy soil sufficiently dry to allow heavy vehicles to move readily over unprepared soil. For night operations, they wanted an intensity of ground illumination of not

17. Combined Meteorological Committee, Supreme Hqs, Allied Expeditionary Force, Report of the Meteorological Implications in the Selection of the Day for the Allied Invasion of France, June 1944. Rpt dated 22 Jun 44. Copy in AWS H1st Div files. This report will hereafter be referred to as "Meteorological Implications".

18. Ibid.

less than half moon at 30° or its equivalent in diffuse twilight.¹⁹

Nor were these the only factors to be considered. General Eisenhower and his staff were well aware that the gently sloping Normandy coast had a mountainous channel tide that rose some 19 feet from low to high water. This meant that at low tide, the German Commander's assault boat obstacles, of which there were many, would lay well exposed perhaps half a mile behind a moist, sandy beach. It meant too that at high tide, the water almost reached the sea wall behind the beach chosen for the landing. If the demolition experts were to have time to destroy some of these obstacles and others were to be avoided, some daylight and low tide were essential requirements. But if the tide were too low, the troops would have to walk unprotected into enemy fire across a wide exposed area of beach; if too high, the underwater obstacles would fulfill the purpose of their creation. Also, the landing would have to be accomplished on a rising tide, so that the landing craft could be grounded and then get away to avoid congestion.²⁰

The Army preferred to approach the coast under cover of darkness and to touch the beach at the first light of dawn when the rising tide was halfway between low and high tide. This would enable the troops to land far enough up the beach to obviate a large portion of the long hazardous march through wet sand which would be inevitable if the landing was attempted at low tide. At the same time, it would allow the landing

19. Ibid.

20. Edwards, Keith. Operation Neptune (London, 1946), p. 107; Eisenhower, Dwight D. Crusade in Europe (New York, 1948), p. 239.

craft to run aground before reaching the obstacles. The Air Force and Navy were in complete agreement with the Army's plan. They insisted however, that H-hour be at least 30 minutes after dawn to allow some daylight for the preliminary air and ^{naval} bombardment.²¹ X

These were all important factors, none of which could be ignored in the planning of the invasion. They had the uncomfortable effect however of limiting the choice of D-Day very materially.²²

The problem that the Combined Meteorological Committee now had to contend with was to find a plausible minimum requirement for all these factors. Once that was determined, the forecasters would at least know what they were looking for.

After considerable consultation and compromise, the Committee agreed upon a set of conditions that was accepted by General Eisenhower and the Combined Chiefs of Staff. They were as follows:

- a. D-Day must fall within a period of one day before to four days after a new or full moon.²³
- b. D-Day itself and the three days following must have winds of less than Force 3 onshore and less than Force 4 offshore.
- c. Cloud coverage must be less than 3/10 below 8000 feet with bases not lower than 3000 feet.
- d. Visibility to be three miles or more.²⁴

21. Edwards, Operation Neptune, p. 107.

22. Eisenhower, Crusade in Europe, p. 239.

23. This five day period was set pending a decision on the necessity of ground illumination. When this was declared to be essential, the period was narrowed to three days.

24. Combined Meteorological Section, Meteorological Implications, p. 3.

While these basic issues were being decided at the higher levels, lower echelon weather units were also busy with problems directly connected with the invasion. For many days prior to D-Day, AAF Weather Service units were kept busy preparing staff studies for the commanders concerned. The engineers, armored units, mechanized units, and air-field construction people, for example, were all interested in the type of soil found in Normandy, the amount, intensity, and duration of rainfall that could be expected during May, June or July, and the effect that moisture would have on the ability of the soil to support heavy vehicles, and studies were made for them on these subjects.²⁵ Other studies were made of such things as the prevailing wind direction at various points on the continent, the number of flying days that could be expected for the evacuation of wounded personnel from the continent by Air transport, the strength of channel swells at various times of the year and other similar subjects. As Col. Thomas S. Moorman Jr., Commander of the 21st Weather Squadron, was to remark, "Eventually the majority of the general staffs and special staffs of the several air and ground commands asked us for specific studies of how weather would affect a particular phase of their planning".²⁶

One of the more interesting studies was the statistical investigation made by the Combined Meteorological Section to determine the probability of obtaining the minimum conditions agreed upon for various periods from

25. Col. Thomas S. Moorman Jr., *The Weather Service and Operations in Europe*, p. 11.

26. Ibid. p. 8.

April onward. Applying the methods of synoptic climatology to the records of actual channel weather for the preceding several years it was found that the chances of obtaining the minimum requirements over a period of three days were quite low: 24 to 1 against in May; 13 to 1 against in June; and 33 to 1 in July.²⁷

Whatever else the survey proved, two things at least were obvious. The requirements would be hard to meet, and that June, the month scheduled for the invasion, was statistically the best month of the three for the endeavor.²⁸

The D-Day Forecast

The weather services meanwhile were devoting themselves to their primary responsibility, that of predicting the weather. As early as February 1944, efforts were made to establish a routine forecast for several days in advance, with the goal set at five days. To prepare the forecasts was relatively easy, but to agree on them was another matter. The British Air Ministry Forecast Central, following the accepted canons of meteorology, prepared a basic forecast, as did the USSTAF Forecast Central and the British Naval Forecasting Central. All

27. Combined Meteorological Section, *Meteorological Implications*, p. 3.
28. In the earliest planning stages, D-Day had been set for 1 May, but General Eisenhower, shortly after his elevation to the position of Supreme Commander, succeeded in postponing it a month. The General felt that an existing shortage of landing craft and other equipment demanded such a delay, as he put it in a report to the War Department on 24 January. "Rather ... than risk failure with reduced forces on the early date", he wrote, "I would accept a postponement of a month if I were assured of then obtaining the required strength". Omar N. Bradley, *A Soldier's Story*, p. 220.

used essentially the same data, but all did not draw the same conclusions from it. The responsibility for comparing the three separate forecasts, and agreeing on a single prediction that could be passed on to the Supreme Commander, was given to the Combined Meteorological Committee. They achieved this coordination by holding three way telephone conferences two or three times a week in which basic forecasts were compared, discussed, and an agreement reached.

By mid April, these conferences were being held each day. There were two main reasons for this increase in tempo. The first was that only if the weather conditions were abnormally stable could the forecasters predict the weather for a five day period with any degree of confidence in the accuracy of the forecast. The other reason was that a five day forecast was, in the nature of things, too general to be of use to the operating echelons. A daily modification of the basic forecast was necessary therefore to keep the operational echelons satisfied.²⁹

The telephone conferences would become longer and more frequent as D-Day approached, and with good reason. On 8 May, General Eisenhower set D-Day for Y plus 4, or 5 June, the first of the three days in the early part of the month that the moon, tide and time of sunrise would be favorable.³⁰ This was, of course, the logical choice. If for some reason 5 June were to be unfavorable, then the following day could be chosen. If, however, these three days were passed over, the next period

29. Combined Meteorological Section, Meteorological Implications, p. 4.

30. Gordon A. Harrison, Cross-Channel Attack, p. 269.

of favorable tide and sunrise would not occur until 19 June. The consequences of so long a delay were, in the words of General Eisenhower, "almost terrifying to contemplate". The General expressed his reasons for feeling that way in the following words:

Secrecy would be lost. Assault troops would be unloaded and crowded back into assembly areas enclosed in barbed wire, where their original places would already have been taken by those to follow in subsequent waves. Complicated movement tables would be scrapped. Morale would drop. A wait of at least fourteen days, and possibly twenty-eight, would be necessary, a sort of suspended animation involving more than 2,000,000 men! The good weather period for major campaigning would become still shorter and the enemy's defenses would become still stronger! The whole of the United Kingdom would become quickly aware that something had gone wrong, and national discouragement there and in America could lead to unforeseen results. Finally, always lurking in the background, was the knowledge that the enemy was developing new, and presumably effective weapons on the French coast. What the effect of these would be on our crowded harbors, especially Plymouth and Portsmouth, we could not even guess.

What made the tense period even worse, the general went on to say, speaking of the weather, was that "the one thing that could give us this disastrous setback was entirely outside our control".³¹

It was obviously best for the invasion to go off on schedule, but up until the last few hours before D-Day, no one could be certain that it would do so. No wonder General Eisenhower later wrote that despite the number of details to be ironed out before D-Day, "the big question mark always before us was the weather that would prevail during the only part of early June that we could use, the fifth, sixth, and seventh".³²

With the establishment of an exact date for D-Day, operations stepped

31. Eisenhower, Crusade in Europe, p. 239-240.

32. Ibid. p. 248.

up. The troops began congregating in their isolated marshalling centers; aircraft strikes against the continent increased in intensity; and the three forecasting centrals began holding their telephone conferences three times a day. A preliminary conference was held in the late afternoon at 1730 to allow the centrals to discuss the overall synoptic picture for the next five days. Then, later in the evening at 2100, the main conference was held during which the terms of the five day forecast were agreed upon. The next morning, another conference was held between 0630 and 0830 to discuss the forecast agreed upon the night before, and to issue, if necessary, a modified forecast. This revised forecast was then given to the Supreme Commander at his regular 1000 meeting.³³

The weather over England and the Channel area during the early part of May turned out to be much better than the chances given it by the statistical survey mentioned above.³⁴ While some considered this a good omen, others felt that the stable weather was too good to last, and that before 5 June, a period of bad weather would surely come to pass. The three forecasting centrals watched the trend of the weather very closely, hoping to notice at the earliest possible moment, any sign or change which might have a direct bearing upon the weather for the vital day.

33. Combined Meteorological Committee, *Meteorological Implications*, p. 4.

34. Eisenhower, Dwight D. Report by the Supreme Commander to the Combined Chiefs of Staff on the Operations in Europe of the Allied Expeditionary Force, 6 June 1944 to 8 May 1945 (Washington 1945), p. 5.

Despite impatience on the part of both the service commanders and the meteorologists, no formal forecast for D-Day was issued in May. The forecast given on Monday morning, 29 May, for the remainder of the week looked quite favorable, but the forecasters would not venture a guess beyond Saturday.

On Wednesday, 31 May, the meteorologists noted a disturbing change in the general synoptic situation. The high pressure area near the Azores, which was the reason for the generally stable weather in May, was beginning to weaken. Higher headquarters was duly informed that if the high pressure center gave way and another did not build up to take its place, the weather outlook after Sunday, 4 June, would not be good.³⁵

The forecast given on Thursday was not much changed from that of the day before and did not include a forecast for D-Day as it was not yet certain that the high pressure center was definitely breaking up. The appointed day, 5 June, was now within the five day forecasting period, but until the high pressure center showed its intentions, a formal forecast for D-Day was out of the question.

By the following morning (Friday), the synoptic weather situation was definitely deteriorating. A complex of storms had developed overnight in the North Atlantic area, making the weather maps look more as if they had been made up in January than in June. There was a very deep low centered in the middle North Atlantic, with other lows on each side. All carried frontal weather and all were moving eastward. In short, the

35. Combined Meteorological Committee, Meteorological Implications, p. 5. Unless otherwise noted, the section of this paper dealing with the pre-invasion forecasts is based upon this report.

high pressure barrier, that had been protecting England, was definitely breaking up.³⁶

Group Captain Stagg presented the Friday morning forecast to General Eisenhower and his Chiefs of Staff at the regular 10-o'clock conference. The assembled officers were told that unstable conditions prevented an accurate forecast, but that they could probably expect westerly winds in the Channel and particularly in the Normandy area between 2 and 6 June. The winds would generally not exceed Force 4, but they might reach Force 5 at times, especially in the western part of the Channel and toward the end of the period (Monday and Tuesday).

Group Captain Stagg forecast cloud coverage for Monday and Tuesday to be 7/10 to 10/10 in the early morning in the operational area, with partial clearing in the forenoon. Stagg cautioned those assembled, however, that these cloud conditions were uncertain and were given with a "very low" degree of confidence. To add a final note of alarm, Group Captain Stagg remarked that there was now some "indication that the present relatively quiet weather may end about Tuesday".³⁷

At a similar meeting later in the day, Stagg told the Supreme Commander and his staff that the morning forecast was still valid, but added, "The outlook for cloudiness is very uncertain; considerable periods of 10/10 cloud cover with bases about 1000 feet must be expected.

36. See weather maps in Appendix B.

37. These may or may not be Captain Stagg's exact words. The report specifically states that it attempts to record the exact words of the briefing officer although this was not always possible. For the purpose of this paper, therefore, excerpts taken from the weather briefings are usually given as direct quotes from the briefing officer.

The times of the periods cannot be forecast accurately".

The meteorologists heartily disliked having to predict the weather in a flood of conditional statements, but under the circumstances, they felt they had no other choice. "The whole development", they informed the commanders, "is...sluggish and slow to show its hand".

For some reason, the meteorologists did not meet with General Eisenhower or his staff on Saturday morning. The word was sent up through channels however, that there was no indication of improvement from the terms of the forecast presented to them the previous evening. If anything, there was a chance of further deterioration. The Force 5 winds, previously forecast for Tuesday, were now possible on Monday or even late Sunday. The cloud coverage and heights would probably remain about the same, and there was still no opinion as to when these conditions could be expected to improve.

The information again included a note of caution. The synoptic situation had now become "extremely difficult", and forecasts as to details could not be given with any great degree of confidence.

At 2130 Saturday evening, the Supreme Commander was given a more complete D-Day forecast. He was told that the high pressure area over the Azores was "rapidly giving way" and that the series of depressions (low pressure areas) noted the day before, were now moving rapidly eastward across the Atlantic. "These depressions", the briefing officer said, "will produce disturbed conditions in the Channel and assault area".

The winds were forecast to be from the west-southwest, at Force 5 on the English Coast and Force 3-4 on the French coast. These winds could

be expected to continue until sometime Wednesday, when the passage of a cold front would bring more stable conditions.

Cloud conditions were forecast to be even worse than the forecast the previous day indicated. "From Sunday morning onwards, cloud will probably be mainly 10/10 with base 500-1000 feet in the morning hours. This cloud may break in the inland areas during the day and become about 5/10 ... with considerable patches of 10/10. Bases will be at or below 1000 feet".

When General Eisenhower asked whether something might not come up to make the forecast in the morning more optimistic, he was given little hope.

There is very little chance, [the forecaster reported] of any information being received before 0300 which is likely to give a more optimistic turn to the forecast. Since at least yesterday (Friday) morning, the whole meteorological situation has looked very unpropitious for a Monday assault, but the outlook has been finely balanced in that it might swing to better or much worse. On Friday evening there was a very slight tip of the balance on the favorable side but the balance now has swung too far to the unfavorable side for it to be quickly counteracted.

In the midst of such unfavorable weather reports and with L-Day now only hours away, some decision as to postponement was obviously necessary. After some discussion, General Eisenhower decided to wait until morning before making a decision.

The meeting held the next morning (Sunday) at 0430 hours was short. The forecast of the night before would stand pat, except for some moderations in the sea conditions. The Navy might be better off, but the overcast would not permit the use of aircraft.

General Montgomery was for going ahead on schedule, but General Eisenhower, rejecting the proposition that the operation was a sound

one unless the Allies had air supremacy as well as ground superiority, ruled that the invasion would be postponed for 24 hours. Tuesday, 6 June, now became the scheduled day of the assault.

When the High Command met again Sunday night at 2130, Group Captain Stagg was waiting with some important news.

A front from one of the deep depressions in the northwest Atlantic has moved much further south than was expected and is now traversing the Channel, at least on the English side, overnight. When that front has passed, there will be an interval of fair conditions which, from the evidence we now have, should last until at least dawn on Tuesday.

Under these "fair conditions", Captain Stagg reported, the winds could be expected to decrease to Force 3-4 on the French coasts and the cloud coverage to become mainly less than 5/10 with bases between 2000 and 3000 feet.

This was indeed good news. The forecast weather had moved from "unbearable" to "barely tolerable". There was no time to lose. After listening to the forecast, Admiral Ramsay, the Commander of the Allied Naval Expeditionary Force, made the disturbing announcement that the Commanders had only about a half hour to decide whether to go ahead on Tuesday or not. He reminded them that very shortly certain Naval forces in Northern England would set sail for the Tuesday rendezvous. If they were to be called back, they would have to refuel before going out again, making another rendezvous on Wednesday out of the question.³⁸

General Eisenhower was in favor of letting the Tuesday schedule stand, as were other members of his staff. Others, including Air Chief

38. Harrison, Cross-Channel Attack, p. 273.

Marshals Leigh-Mallory and Tedder, were skeptical of the ability of the heavy and medium bombers to operate effectively under an overcast, and favored a postponement.

After listening to the opinion of all who cared to venture it and then weighing the situation for several minutes, General Eisenhower announced his decision. "I'm quite positive we must give the order I don't like it, but there it is I don't see how we can possibly do anything else".³⁹

But there was still a chance that the weather might deteriorate to the critical point before Tuesday morning, and the order was not made irrevocable. To go over the situation once more, just in case the situation changed even more for the worse-- a meeting was scheduled for 0415 the following morning.

It hardly seemed a good morning to make the decision. General Eisenhower recorded that prior to leaving for the meeting at the Naval Headquarters, "the camp was shaking and shuddering under a wind of almost hurricane proportions and the accompanying rain seemed to be traveling in horizontal streaks. The mile long trip through muddy roads to the Naval Headquarters was anything but a cheerful one, since it seemed almost impossible that in such conditions there was any reason for even discussing the situation".⁴⁰

The weathermen did not have so gloomy a picture. Group Captain

39. Ibid. p. 274.

40. Eisenhower, Crusade in Europe, p. 250.

Stagg tried to brighten the meeting by reminding the assembled officers that this was to have been the day of the invasion, and that weather conditions in the assault area were such that if the invasion had taken place, it would most certainly have resulted in a "major disaster".

Then came more heartening news. The forecast for substantially improved conditions, issued the night before, was still valid. "There has been no substantial change", Stagg reported, "in the information available since, or in the forecast presented at the meeting yesterday evening".

With the wind outside still lashing the building, General Eisenhower heard the forecast once again, and quickly made his decision. The invasion would proceed as planned. Tuesday, 6 June 1944 would be the day the Allies would invade France.

Although the conditions forecast for the 6th were already beginning to appear on the night of 5 June, it is doubtful that the forecasters or the allied side faced D-Day devoid of worry and uncertainty. They had staked their reputations and the success of the invasion on the forecast. Until they were vindicated, they would hardly be at ease.

The commanders too were uneasy. General Bradley was probably not alone in his anxieties as he fell into bed worrying about the effect of the wind and surf on the new amphibious tanks and whether the overcast would prevent spotter aircraft from effectively directing the naval gunfire.⁴¹

41. Bradley, A Soldier's Story, p. 264.

D-Day Weather

As the great allied invasion force closed in on the Normandy coast, the weather was substantially as forecast, although there was still cause for concern. Reports varied with who was making the observation and where, but the official observation was that given by General Eisenhower in his report on the invasion to the Combined Chiefs of Staff.

On D-Day [the General wrote] the wind had, as forecast, moderated and the cloud was well broken, with a base generally above 4000 feet. This afforded conditions which would permit of our airborne operations, and during the hour preceding the landings from the sea large areas of temporarily clear sky gave opportunities for the visual bombing of the shore defenses. The sea was still rough, and large numbers of our men were sick during the crossing. The waves also caused some of the major landing craft to lag astern, while other elements were forced to turn back.⁴²

To the seasick troops and the crews of the swamped landing craft, it hardly seemed like the ideal day for the invasion. But the weather was operational and it could have been worse. Although it would have been hard to convince them of it at the time, they could actually be grateful that it was no better.

It can be safely said that the most astonishing aspect of the entire invasion, and upon which nearly all the allied commanders commented, was the lack of opposition by the Germans while the assault troops were still in the channel. The German forces had been schooled for this moment, and supposedly were on the alert waiting for it. Why then did not the

42. Report by the Supreme Commander to the Combined Chiefs of Staff on the Operations in Europe of the Allied Expeditionary Force, 6 June 1944 to 8 May 1945, p. 19. The damage due to the 3-4 foot waves at the beaches caused much more damage than the report indicates. For example, of the 32 DD tanks (dual drive, which could supposedly operate in both water and on land) launched on D-Day, 27 foundered forthwith in the heavy surf.

Luftwaffe strike while the troops were still congregated on the ships, and where was the German navy?

Dozens of theories have been advanced to explain the negligence on the part of the Germans, which left them all but blind to the tremendous invasion force approaching the French coast. Suggestions include estimates of the deterioration of the German armies, their lack of communications, complacency on the part of the German generals. All are agreed however on one thing: that what really fooled the Germans, was the weather factor.

Under normal weather conditions, the Germans would very likely have known about the invasion from the first. They had intercepted messages to the French resistance movement, indicating that the invasion was imminent, but considering the inclement weather, they concluded that the alert was for an exercise or maneuver or else a ruse intended to confuse them. The German naval experts had long since concluded that an allied invasion would be possible only when the winds were below 24 knots, and the wave heights were less than five feet. Visibility, they reasoned, would have to be three miles or better.⁴³

The German experts were, of course, correct in these basic assumptions. They completely misjudged the situation, however, in further concluding that at least five consecutive favorable days would be necessary for the landing to be a success.⁴⁴

This latter mistake may or may not have been important. The fact

43. Harrison, Cross-Channel Attack, p. 276.

44. Ibid.

was that none of these conditions were met on 5 June. Lowclouds and high winds were the order of the day, and for all the Germans knew, they would continue indefinitely. They even cancelled their navy and air patrols of the Normandy area for the sixth of June.⁴⁵

Why didn't the Germans foresee the break in the weather that Captain Stagg announced to General Eisenhower on the evening of 4 June? A well known chink in the German armour was the lack of weather stations to the west, where most of the channel weather developed. To partially fill the gap, the German aircraft had been making daily weather reconnaissance flights into the North Sea area, but these observations, at best, had only limited usefulness.

There is no conclusive evidence that the German meteorological Service ever told the Nazi high command that an allied invasion on 6 June was impossible. It is safe to say however that they did not consider it likely, and that the generally bad weather on 5 June contributed considerably to the lack of German alertness on the day of the invasion. As General Bradley so aptly put it, "In this capricious turn of the weather, we had found a Trojan horse".⁴⁶

The 21st Squadron in Action

The allied meteorologists had had their great hour and had played their role well. Now, the fortunes of war, more than weather would determine what had to be done and when.

The well-oiled weather machine continued to function and to render

45. Bradley, A Soldier's Story, p. 266.

46. Ibid.

the invasion forces indispensable support. The 18th Weather Squadron, from its fixed stations, continued to support the long range strategic bombing fleets. The weather centrals and the Combined Meteorological Section continued their high level operations, and the 21st Weather Squadron, which had actually been marking time until the invasion began, became a part of the invasion forces and began providing weather support to the forces on the firing line.

The first weatherman to reach France was S/Sgt Charles J. Staub, who parachuted into Normandy at 0100 hours (H-5) 6 June, with members of the 101st Airborne Division. He was followed by Cpl. Warren F. Wolf and S/Sgt Robert A. Dodson, who jumped with members of the 82d Division at 0130 and 0230 hours respectively.⁴⁷

These three men went into enemy territory as individuals and not as members of a weather team. Temporarily assigned to the paratroops, each parachuted into a different area, carrying a small radio and psychrometer with which to send back hourly reports on the wind direction and velocity, visibility, cloud coverage and height, temperature and dew-point.

The three weathermen fared quite poorly in their assignment. Dodson injured his knee on landing, but he continued to perform his duties until 21 June, at which time the front lines had overtaken him and he was sent back to a hospital for treatment. Staub became a casualty before he ever

47. Hist 21st Wea Sq, 6 Jun 44 - 31 Dec 44. Unless otherwise noted, this section dealing with the movement of the 21st Squadron is based on this document. It is perhaps necessary to note that the historian (name unknown) for the squadron was a dedicated historian and a very able writer who seems to have spared no effort to make his history complete and readable.

made a report, receiving gunshot wounds in the hand, leg, arm and face. Wolf was never heard from, ending up on the official casualty lists as "missing in action".

These men preceeded H Hour. They were followed by weathermen assigned to "Air Support Parties", who waded ashore with the first assault troops. These parties, usually consisting of eight men, a half-track and radio-equipped jeep, had the task of guiding friendly air strikes to the target. The weathermen assigned had the particular responsibility of briefing the incoming pilots on the weather conditions at the target and sending back hourly surface observations to ships waiting in the Channel for such data.

After the "Air Support Parties", came whole detachments, each capable of providing a weather service as complete as that given by the fixed stations back in England. None of these landed on D-Day, however. Detachment "YF", attached to the 49th AAA Brigade was scheduled to land at Omaha Beach at H plus 12 hours, but as the LCT approached its assigned landing area, it was greeted by such an intense barrage of mortar, 88 mm and small arms fire, that a landing was out of the question. Debris prevented the craft from moving to a cleared area, so the LCT commander was ordered to remain offshore overnight.

At 0630 the next morning, the LCT tried again. The first attempt was a failure because of deep water. The second attempt, made after 35 exciting minutes of hugging the shore while shells "literally rained down on the craft", also failed when the anchor caught on a submerged

truck, making it necessary to go to sea again to free it. The third try was a success although the truck which left the LCT directly ahead of the weather van received a direct hit from an 88 mm shell, blocking the exit. The weather van had to push it aside to get out.

On the beach there was further trouble. A temporary roadway was blocked, and the van had to travel along the edge of the water to get around the obstructions. Then, it couldn't get back up on the road, requiring the help of a "borrowed" bulldozer. Detachment "YF" finally became operational on D plus 3, at a small air strip near Laurens-Sur-Mer.

It is an interesting commentary on the invasion tactics that the next two weather detachments to come ashore were assigned to air units. Detachments "S" and "EE", both under control of the IX Tactical Air Command, which in turn provided air support to the First Army, landed on 8 and 9 June respectively. Detachment "S" was attached to the 70th Fighter Wing and "EE" was the command weather detachment, acting as the advanced weather section for the 21st Squadron.

The detachments now began arriving on schedule. "M", with the Headquarters, First Army, arrived on the 10th. On the 11th, "Y", attached to the 266th Fighter Group, came ashore, to be followed four days later by "E", which supported the V Corp Headquarters. "R", supporting the 368th Fighter Group, also landed on the 15th, and "IL", with the 84th Fighter Wing, landed the following day. On the 17th, "K", with the 354th Fighter Group and "HH", with the VII Corp, landed.

There was a short lull until the 23d, when "ZH", supporting the III Corp, arrived. "U", attached to the 371st Fighter Group, landed on the 28th, and the following day, "ZI", supporting the 50th Fighter Group, came ashore.

By 1 July, the assault phase of the invasion was officially over.⁴⁸ In the 24 days since the first wave of troops waded ashore, some 14 complete weather detachments of the 21st Squadron had landed in France and had begun front-line operations. The other detachments of the squadron would soon follow, but their arrival would be routine. It would lack the hazards, thrills and pride of wading ashore with the assault troops.

The invasion was fairly launched. The AAF Weather Service, which had helped to make the initial landing phase a success, had an equally important role to play in the further success of the invasion. It was a role for which the Weather Service was fully prepared and was playing well.

48. Harrison, Cross-Channel Attack, p. 442.

APPENDIX A

In view of the fact that postponement of the invasion until the 18th, 19th or 20th of June was, until General Eisenhower's momentous decision on the morning of 5 June, a distinct possibility, it is possibly of interest to review the weather the invasion would have encountered had it been launched at that time.

The weather forecast for the morning of 18 June, issued the day before by the Flagship Augusta, called for fair to cloudy skies, good visibility and moderate (Force 3) winds.¹ The forecast, however, was a "bust". By late evening, with no new forecast issued, the wind velocity had reached Force 5 and the barometer was falling rapidly. This was obviously not invasion weather. A storm more severe than that which blocked Napoleon's plans at Boulogne was in the making.

The storm, which General Eisenhower erroneously but sincerely called a hurricane, struck on the 19th and raged for four days, virtually stopping all landing activity on the beaches and rendering all offensive fighting extremely difficult. Winds reached Force 7, driving literally hundreds of helpless vessels onto the beaches.

The damage was appalling. Mulbury A, one of the two vastly important prefabricated landing piers, was destroyed; eight hundred assorted vessels were stranded on the beaches with more than three hundred of them severely damaged. Some were even wrecked beyond salvage.

1. Edwards, Operation Neptune, p. 208.

It was, in short, the worse Channel storm in 40 years,² accounting for a greater destruction of shipping and supplies than the Germans had been able to inflict since D-Day. It is obvious that if the invasion had been delayed until the latter part of June, another postponement until July would have been necessary, and by that time, the chances of success would have narrowed down even more.

2. Reynolds, Manuscript History of the AAF Weather Service, p. 139.

APPENDIX B

Synoptic Weather Maps, 1 - 6 June 1944

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