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FM 1-50

WAR DEPARTMENT

U.S. Dept. of Army

ARMY AIR FORCES FIELD MANUAL

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WEATHER

May 2, 1942

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ARMY AIR FORCES FIELD MANUAL

WEATHER

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WAR DEPARTMENT,
WASHINGTON, May 2, 1942.

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BY ORDER OF THE SECRETARY OF WAR:

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Chief of Staff.

OFFICIAL:

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The Adjutant General.

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ARMY AIR FORCES FIELD MANUAL

WEATHER

CHAPTER 1

ARMY AIR FORCES WEATHER SERVICE

Paragraphs

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SECTION I

WEATHER SERVICE AND ITS EMPLOYMENT

■ 1. GENERAL.—The Army Air Forces Weather Service is an organization of individuals technically trained to observe weather, to collect, evaluate, and analyze weather data, and to furnish weather information.

■ 2. SCOPE.—This manual is prepared as a general directive for the use of weather personnel in the performance of their duties, and as a guide to personnel who utilize the weather service as to the manner and methods of exploiting to the fullest extent the facilities of this service.

■ 3. MISSION.—The mission of the Army Air Forces Weather Service is threefold:

a. To furnish combat and other Army aviation units with all types of weather advices and information of assistance in the planning or conduct of aerial operations.

b. To furnish such climatic studies and weather information as required by the Army Air Forces in locating and laying out flying fields or other establishments.

c. To furnish forecasts required by division and higher ground headquarters.

■ 4. OBJECTIVES.—In fulfilling the above mission the weather service has the following primary objectives:

a. By efficient forecasting, to improve the percentage of tactical missions successfully performed by the using organizations.

b. To reduce to a minimum the accidents due to weather hazards.

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c. To provide using organizations with an accurate picture of the weather conditions insofar as they may affect operations by the enemy, both on the ground and in the air.

■ 5. FUNCTIONS.—The functions of the weather service are fivefold:

a. Weather observation.—Weather observation consists essentially of taking and recording the readings of various instruments and of observing by eye and recording other phases of the weather which can be determined more satisfactorily by the eye than by instruments. Observations are classified as surface or upper air. In surface observations all data are taken at or near the surface except certain visual data concerning clouds and ceiling. Upper air observations are of two types: pilot balloon observations for determining wind direction and velocity aloft; and meteorograph soundings for determining temperature, humidity, and pressure at various altitudes for weather analysis. Observations must be taken at regular periods and at approximately the same time in order to be of most value. This is particularly true of those observational data used to prepare weather maps and charts. Where communication facilities are adequate, hourly observations are made and reported. Special observations are made when marked weather changes occur.

b. Collection and distribution of current weather information.—(1) Weather information to be of value must be distributed promptly to all who make use of it. Since weather observations may be taken over an extensive area such as the United States or larger, the collection and distribution of these reports require an extensive communication system.

(2) In peacetime, this communication system within the continental limits of the United States consists principally of the Civil Aeronautics Administration (CAA) weather teletype network to which all important Army Air Forces weather stations are connected. At these weather stations the teletype machine is operated by Army Air Forces Weather Service personnel and the local hourly and special weather reports are transmitted. In addition, map signals are broadcast every 6 hours by Arlington (NAA) and San Francisco (NPG), in code, and it is normal for such signals to be copied by a

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radio operator assigned to a weather station to insure receipt in the event of teletype failures.

(3) In wartime it normally will be necessary that certain teletype networks be operated exclusively by the Army Air Forces Weather Service. If the Army network is within or near the United States, the Civil Aeronautics Administration teletype network will either be connected to it or the CAA reports will be retransmitted by a repeater over the Army circuits. Additional weather reports from sources not connected with the teletype circuit will be transmitted by other means such as radio, telephone, telegraph and messenger. A more complete discussion of communication facilities used for the transmission and distribution of weather reports, forecasts, and other weather information is contained in paragraphs 35, 36, and 37.

(4) Additional weather reports may be obtained from friendly reconnaissance and bombardment aircraft, nearby neutral countries, and possibly enemy broadcasts. Weather radio operators should endeavor to receive all such reports.

c. Weather analysis.—There are three general types of weather analysis:

(1) *Climatic analysis.*—Climate is defined as the average weather of a place or region. This is determined through the study of a large number of weather observational reports made over a period of years. Where few reports are available, the analysis is facilitated by comparison with known climates in regions having similar geographical and other local influencing factors.

(2) *Forecasts.*—(*a*) Weather forecasting is the art of predicting what the weather conditions will be at a particular time and place. It is the primary function of the Army Air Forces Weather Service. Current weather reports from numerous points covering a large area are of vital assistance to reliable forecasting. Current weather reports are of value principally because they assist in making forecasts. It is of relatively little value to know that it is clear and unlimited at an airplane's destination sometime before its arrival, if it is going to be zero-zero at the time of arrival, unless this knowledge of current conditions can be of assistance in forecasting the weather changes that may occur. Therefore, it is

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a general practice for the weather service to furnish route forecasts for every cross-country flight just prior to take-off.

(*b*) Forecasts are classed as short, medium, and long range. Forecasts covering periods of up to approximately 12 hours are classed as short range forecasts. The usual period of short range forecasts is 6 hours where this is the interval between regular weather maps. Forecasts for periods between 12 and 48 hours are classed as medium range. Forecasts for over 48 hours are classed as long range. It is common practice to make regular forecasts for periods up to 36 hours, and a fair degree of accuracy may be expected within this range. Forecasts made for longer periods decrease in accuracy, though under certain stable situations fairly accurate forecasts of general conditions may be expected for longer periods.

(3) *Deductions of past and current weather.*—The same types of weather maps, charts, and reports used in forecasting make it possible for the forecaster to deduce or estimate what the weather was at a given time and place in the past, or what it is at the present. Knowledge of the past and present weather is important for estimating enemy capabilities, and hence the weather service may be frequently called upon to furnish this type of information.

d. Dissemination of forecasts and weather estimates to using personnel.—Unless forecasts reach the proper people promptly and are understood they lose much of their value. The best possible manner of presenting a forecast is orally by the forecaster in front of and referring to the latest maps and charts supplemented by a written forecast. The next most satisfactory method is perhaps by telephone or voice radio supplemented by a written forecast. A third method is by the written forecast alone. This method is the least satisfactory and should only be used when one of the two other methods is impracticable. Written forecasts may be sent by messenger, teletype, radio, telegraph, or telephone, and are principally of value as brief summaries of the oral forecasts for reference purposes.

e. Staff functions.—(1) Weather is an important factor in most military operations. This is particularly true in aviation operations. It is the primary duty of the weather officer to keep the commanding officer and his staff informed on the

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weather conditions that may be encountered in planned or contemplated operations.

(2) It is impossible for a forecaster to give his best weather advice concerning an operation if he has only a hazy idea of the operation and thus a hazy idea of what weather information will be of value. He should, therefore, know in detail what he is forecasting for and be sufficiently familiar with the mission to be able to give a specific forecast of all conditions which might affect its performance. Familiarity with the mission is particularly important when the weather is bad or uncertain, calling for several alternative plans. For these reasons the weather staff officer should be in constant touch with the other staff members.

(3) The weather officer should also have some idea of probable future weather information requirements so that he may be prepared to furnish information with minimum delay, as it takes time to prepare forecasts. For example, a forecast of ceiling, visibility, cloudiness, precipitation, temperature, and winds aloft is wasted and unnecessary when one is concerned only with parking some airplanes in the open and is primarily interested in how strong the wind is going to be and from what direction. It would be entirely improper, however, for the forecaster to be asked only for predicted wind velocity and direction without being given any knowledge of the duty or operation for which he was forecasting. With this type of question only, the operations officer responsible for parking the airplanes might fail to get the information that a severe hail, snow, sleet, or thunderstorm was expected or that the field was expected to be flooded. Again, a route forecast between two points calls for a different type of forecast for trucks or foot soldiers than for airplanes. Also, merely asking for a route forecast for a specific time might result in the user's failing to take full advantage of the weather possibilities, even if the forecaster knew aircraft were involved. The route forecast might predict severe weather for the usual route and because of that the mission might be called off. However, had the weather officer known in advance that it was quite important for an airplane or airplanes to be at a certain place on a certain day or within a specified time, he might easily have advised that severe weather was moving in and that by taking-

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off a day or two or even perhaps an hour or two in advance of the scheduled time, the flight could be made in good weather or by alternate routes that might be open. The efficient use of a forecasting service suggested by these examples requires close liaison between the forecaster and the person or organization being served. Therefore, no forecasting service can possibly reach a high efficiency in utility when far removed from the using organization or when personal contact is not maintained.

(4) The ability to utilize fully all available weather information is highly important in military operations. Weather officers not only must provide an adequate weather service but must assist those who use this service to obtain the greatest benefit therefrom. An additional staff function of a weather officer is, therefore, that of keeping the using personnel informed on the capabilities and limitations of the weather service, and of approaching weather conditions favorable to desired operations.

■ 6. FUNDAMENTALS AND DOCTRINE OF EMPLOYMENT.—The following fundamentals and doctrine of employment of the weather service are considered basic, and failure to comply with any one of them presents a serious deficiency in the weather service or in the manner in which it is being used:

a. In most situations the written forecast cannot present as complete and satisfactory a picture of the weather as a personal conference between the forecaster and using personnel in front of and referring to the latest weather maps and charts. Hence, the personal conference should be used whenever possible, supplemented by written forecasts.

b. Weather forecasters, when acting in this capacity alone, have no authority to make decisions as to whether or not a military operation should be attempted or the manner of accomplishment, even though weather may play an important part. Their duty in this respect is to furnish constantly all possible weather information which might affect operations or which might be of assistance to using personnel in their planning or conduct.

c. Perfect honesty and candor are necessities in forecasting. The forecaster should always disclose the degree of confidence he feels in his prediction.

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d. Intelligent forecasting demands on the part of the forecaster a knowledge of the type of mission and of the manner in which it is to be performed.

e. Effectiveness of the weather service depends to a large extent upon the ability of using personnel to make the proper use of available weather information, to discuss it intelligently, to know what information to ask for, and to appreciate the reliability of the forecasts, especially when weather reports upon which to base forecasts are meager.

f. Forecasting stations should be located near the headquarters being served whenever possible.

g. Observer stations should be located best to fulfill the following needs:

(1) Immediate flight needs on airdromes or routes.

(2) Needs of forecasters for map data.

SECTION II

MEANS PROVIDED

■ 7. PERSONNEL.—Weather service personnel are divided into the following classifications in accordance with their primary duties:

a. Forecasters.—Forecasters consist of both officers and enlisted men.

(1) Officers assigned to weather duty are called weather officers. Insofar as possible all weather officers should be qualified forecasters. This is particularly important in the case of forecasting stations.

(2) Enlisted forecasters are graduates of prescribed courses in advanced meteorology and forecasting.

(3) Needs for forecasters in time of war and the period of training required indicate the necessity for peacetime training of such specialists in adequate numbers.

b. Observers.—Enlisted weather observers are graduates of the weather observers' course of the Army Air Forces Technical School or of any weather station where such a course is conducted. Observers are assigned to each type of weather station and one type, the weather observer station, normally consists entirely of weather observers.

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c. Radio operators.—Radio operators are assigned to weather stations where forecasts are prepared to receive weather reports and other weather data which are transmitted by radio.

d. Teletype operators.—Teletype operators for the weather service are trained to operate weather teletype machines which have been provided with special keyboards using weather symbols. Teletype operators are normally qualified weather observers.

e. Maintenance personnel.—The repair and routine maintenance of teletype machines require a man specially trained for this work. Every weather station should have at least one qualified teletype maintenance and repair man. Each weather station will also normally have one man who specializes in minor repair and routine maintenance of weather instruments.

■ 8. UNITS.—Personnel are grouped in units varying in size and special qualifications with the requirements of their operations. A complete description of the various units is contained in chapter 3.

■ 9. EQUIPMENT.—Most of the equipment used in weather stations is furnished by the Signal Corps. Some of the more important items of standard equipment are: anemometer, barometer, wind indicator, psychrometer, thermograph, hygrograph, thermometers, theodolites, plotting boards, and rain gages. Complete lists of all authorized supplies and equipment will be found in Tables of Allowances and Tables of Basic Allowances for the Army Air Forces.

a. Special weather equipment.—In addition to the standard weather equipment, certain items may be classed as special weather equipment as they are for use at only a few selected stations. Such items are radio meteorograph transmitters, receivers and recorders, sounding balloons, and meteorological trailer stations.

b. Signal communication equipment.—The following signal communication equipment is used in most weather stations: teletype machines, radio receivers, timing and telephone sets (for use in plotting balloon runs), radio headsets, typewriter with all capital letters, and telephones.

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CHAPTER 2

TACTICAL APPLICATION OF WEATHER SERVICE

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SECTION I

INFLUENCE OF WEATHER ON MILITARY OPERATIONS

■ 10. GENERAL.—The ever increasing mobility of military forces as exemplified in military aviation and mechanized and motorized ground forces and the expanding areas over which military campaigns may be conducted have increased greatly the importance of weather as a factor in all military operations. Weather is always present and, to varying degrees, is a continuing factor in the conduct of any military action Its effects are so numerous and widely varied that they can be properly evaluated only when treated within their relationship to all other factors contributing to the manner of conducting specific operations. This becomes particularly manifest in the application of weather forecasts to planned or contemplated operations. Any operation, therefore, the conduct of which might be affected by weather conditions, demands a proper consideration of a reliable forecast to cover the action, and appropriate adjustments in plans necessitated by the weather forecast, if effective conduct is to be assured.

■ 11. VARYING EFFECTS OF WEATHER.—The effects of the several factors constituting weather on the capabilities of military forces and on the effective conduct of those forces in action cannot be made to conform to a standard pattern. Their influence will vary greatly in diverse situations and will frequently be contingent on the relationship they bear to other factors which may affect the operation being planned. While it is not practicable, therefore, to consider fully in this manual the influence of weather in all military situations, the following discussion should serve to stress the need for its appropriate consideration whenever its effect may be positive.

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a. Mobility.—The mobility of military forces is affected by precipitation, temperature, visibility, and winds.

(1) Precipitation in the form of either rain or snow impedes the maneuverability and speed of both wheeled vehicles and foot troops. Off prepared roads it may in its extremity completely immobilize wheeled vehicles and seriously handicap the movement of foot soldiers. On airdromes, depending on the nature of the take-off and landing surfaces and roads, it may retard the preparation for air missions, reduce the capabilities of individual aircraft to take-off and sustain themselves in flight, and limit the rate at which missions can be dispatched. Any resultant decrease in aircraft loading reduces the radius of action, or fire power, or both, of participating aircraft.

(2) Temperature affects the mobility of motorized vehicles (air or ground) principally through the problem confronted in starting engines. In extremely cold temperatures special equipment must be provided and extra time will always be required for starting and warming engines. Thaws occurring in previously saturated ground or snow will affect operations in a manner similar to that discussed for precipitation. Temperature extremes reduce the mobility of all military forces—extreme cold requires the provision of special shelter and clothing which add to the burdens of transportation and individual loads; while extreme heat reduces the physical capacity of individuals for sustained marching.

(3) Visibility is affected by fog, haze, dust, smoke, clouds, and precipitation. Visibility limits the rate at which visual control can be maintained in ground movements. Any reduction in visibility tends to reduce the mobility of aviation forces. In air operations it limits the size of formations that can be flown, the rate at which missions can be dispatched, the ability of aircraft to locate and deliver fire on the target and the concentration of fire that can be effected on the target, the ability to land and the rate at which returning aircraft can land back on the airdrome, and the ability of aircraft to move to a new base for operations.

(4) While the effect of wind on the mobility of surface forces is usually negligible it is always a positive factor in air operations. In cross-country movement from one base of operations to another it may either add to or detract from

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the mobility of the participating aircraft depending on its directional relationship to the aircraft flight path. In all operations involving a return to the same base, sustaining winds always, and varying winds generally, detract from the maximum radius of action of aircraft.

b. Surprise.—The influence of weather may frequently be present in military maneuvers seeking to gain surprise in their execution. Restricted visibility that provides cover to maneuvering forces should always contribute to the gaining of some degree of surprise for attacking forces. Exceptional maneuvers conducted under adverse weather conditions might be effective in gaining surprise in special situations or against an unsuspecting enemy. In air operations restricted visibility and adverse weather conditions serve to provide cover for attacking aircraft during the approach to the target and facilitate surprise assaults. An effective cloud layer at an altitude suited to the type of attack which is planned provides an ideal cover for approaching aircraft.

c. Security.—Weather conditions affect the security of different type military forces to varying degrees and in a varying manner. By way of example, ground forces operating beneath low ceilings and restricted visibility that limits or denies air attacks against them derive security against air attack through the weather factor. If the weather is such that attacking aircraft can penetrate to those forces, yet so restricted in visibility and ceiling that defending pursuit is ineffective in making interceptions, the weather factor detracts from the security of the ground force in that it fails to deny air attack while restricting the security provided by defending pursuit. If, for this type operation, ceilings were unlimited and visibility good, pursuit should achieve its maximum effectiveness and thereby make its greatest contribution to the security of the defended force. Bombardment and reconnaissance aircraft habitually utilize the cover provided by clouds and restricted visibilities to cover their air operations. Conversely, clouds and restricted visibility reduce the effectiveness of pursuit aviation in its security mission.

d. Concentration and continuity.—The possible concentration of combat aviation on a target and the ability for con-

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ducting sustained operations against it may be restricted by adverse weather in the form of storms and low visibility.

e. Combined operations.—Joint air-ground operations demanding close coordination both in time and method of attack require that the weather be such that both forces can conduct their operations effectively. If joint operations are essential to success, weather becomes a vital factor and its influence must be correctly determined before the operation is initiated.

f. Estimate of enemy capabilities.—Weather is similar in its effect on the enemy as on our own operations. A knowledge, therefore, of current and forecast weather is necessary to a reliable estimate of his capabilities.

g. Military supplies and equipment.—For effective operations in the field, military supplies and equipment must be continuously protected against the weather elements. To accomplish this protection effectively, weather forecasts issued in ample time for protective measures to be taken are a continuing necessity. For flight in cold seasons or at high altitudes certain equipment must be designed for cold operations. These items include cabin heating, window defrosting, electrically heated or other winter flying clothing where cabin heating is absent, and instruments and cameras designed for cold operation.

■ 12. Relation of Climate to Military Operations.—*a.* Climate must be considered in planning a military operation because it is necessary to provide appropriate clothes for men, food and shelter for men and animals, and because climatic conditions place limitations on military operations. Climate should also be considered in locating camps, air fields, training areas, and other military bases.

b. Air bases and airdromes in time of peace or in war should not only be strategically located but should, insofar as practicable, be in localities relatively free from fog, haze, smoke, dust, low clouds, and other obstructions to vision, in order that flying training or other military missions may be carried out successfully for the maximum number of days of the year. Other areas where precautions must be taken in locating air bases and airdromes are those of frequent strong winds, in the frequented paths of hurricanes or other

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destructive storms, and in regions of extremely cold winters or deep snows. Exception to many of the above rules may be made for strategic purposes, or to provide training of personnel or testing of equipment under adverse weather conditions. It is of great importance that runways or landing strips on landing fields be laid out in the direction of the prevailing winds.

c. The intensity and amount of rainfall should be considered in solving drainage problems. The amount of rise in rivers caused by heavy rains and the prospects of floods should receive consideration in the location and building of camps, highways, railroads, and bridges. Fairly complete climatic data are available for nearly all parts of the world, and it is the duty of the military meteorologist to bring such data to the attention of those concerned in instances where available weather data are pertinent to proper planning.

■ 13. USES OF CURRENT WEATHER REPORTS.—*a.* In wartime a detailed knowledge of existing weather conditions over the theater of operations, over enemy territory, and frequently over the friendly zone of the interior may be of great valu to officers directing or planning campaigns or movements o personnel, motor vehicles, aircraft, or supplies. Usually th future weather is of more interest than present weather i planning, but for certain types of operations the current weather information may be more valuable.

b. Information of current weather conditions is needed to correct for weather effects on range and deflection of projectiles, drift of airplanes, and on the speed and direction of sound travel. It is of use in handling captive balloons and in landing and take-off of airplanes. It enables officers to determine when conditions are such that the enemy is likely to make a gas attack or when conditions are most favorable for such an attack on the enemy. Gas and other chemical agents are very susceptible to atmospheric conditions and can be employed most effectively after due consideration of the existing and prospective weather.

■ 14. USES OF WEATHER FORECASTS.—*a.* The primary requisite of the weather service is to provide reasonably accurate forecasts of future weather. A knowledge of present weather

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conditions is, for most types of operations, of little value if sudden marked changes are pending and forecasts of these changes are not available. Hence, an efficient forecasting service is extremely important from the standpoint of all wartime military operations and most peacetime operations.

b. All branches of the Army need weather forecasts. An army that conducts operations without keeping its staff advised of prospective weather is imposing a serious handicap on itself. The personnel, equipment, and supplies of a field army are usually not well protected against inclement weather. A squall, a thunderstorm, a heavy rain, or a strong wind seldom passes over a temporary army camp or bivouac without doing damage. Freezing weather, coming on suddenly, generally causes damage to equipment and supplies and discomfort to personnel. Much of this type of damage can be avoided if timely warnings are given of the approach of sudden weather changes. It is sometimes possible to save large quantities of supplies if attention is given to weather forecasts in the handling of these supplies. It has been fairly well established, for instance, that potatoes shipped in freight cars cannot endure a temperature below 25° without being damaged. Commercial shippers now take precautions to see that potatoes are not shipped into sections where the temperature is likely to go below 25° without taking care to protect the potatoes. The same type of precautions are taken when other perishable products are shipped. The military service should take similar precautions to protect its equipment and supplies.

c. In the case of military operations involving the movement of personnel, equipment, or supplies, the weather forecast should always be available and should be consulted, since in any plan for operations the weather forecaster may be able to give information that will be of great value to the commander. Examples of the type of information that the weather forecaster may be able to give are answers to questions similar to these: When will a freeze occur that will make it possible to move heavy vehicles over ground now soft? When will a thaw occur? When will rain begin or end, and will it be light or heavy? When will fog begin or end? When will the wind be from a certain direction and of a

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certain velocity? What will the wind direction and speed be at a certain altitude? What is the height of the ceiling and what will it be during the next 24 hours? Will there be icing in the clouds and, if so, will it be intense or mild? These and many other questions assume considerable importance to the army commander under certain conditions.

d. The Army may not always be interested in fair weather when planning an operation. For example, it may be desirable to surprise the enemy by conducting some operation in weather in which the enemy would not expect it to be conducted. Also, while weather is a very important factor, it is not always a deciding factor in planning an operation. There may be important reasons to proceed with an operation even though the weather be adverse.

e. In some cases it may be desirable to start an operation under certain weather conditions and have the weather change during the operation or shortly after its completion. Under such conditions the forecaster may be able to give information which may be the deciding factor as to the proper time to conduct the mission.

■ 15. USES OF DEDUCTIONS OF PAST AND CURRENT WEATHER.—knowledge of what weather existed at a certain time an place from which no reports are available is sometimes quit valuable in estimating enemy capabilities. The forecaste. can estimate past and current weather conditions in most cases with little difficulty, provided the locality involved is not too far removed from other points from which reports are available.

SECTION II

USE OF WEATHER INFORMATION BY AVIATION UNITS

■ 16. GENERAL.—Weather affects the planning and execution of all aircraft missions. Lack of weather information may cause frequent failures of missions and many losses of planes and personnel. In general, every time a flight mission is conducted the flight commander should have an accurate knowledge of weather conditions to be expected during the flight, otherwise both personnel and equipment may be subjected to unnecessary hazard. While weather hazards may be warranted by military necessity they can always be greatly

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reduced by a knowledge of current and forecast weather conditions. Hence, no aircraft should be cleared for flight without appropriate consideration of the weather.

■ 17. TYPES OF WEATHER FORECASTS.—*a.* All Army Air Forces weather forecasting stations commonly furnish medium and short range forecasts.

b. Short range forecasts are the most accurate type of forecasts made. Therefore, they should be given to every flight commander just prior to his take-off. These forecasts should give the weather conditions to be encountered, including state of the weather (overcast, broken, scattered, clear, or combination thereof), precipitation (by type), ceiling, visibility, wind speed and direction, hazards to flight (by type, intensity, and location), and any special phenomenon.

c. Medium range forecasts are used for planning flight operations. Also short and medium range forecasts are necessary in the case of a very long flight requiring 8 to 10 hours or more for completion. For long flights, if the weather is at all uncertain or changeable, the flight commander should, in peacetime, obtain one or more additional short range forecasts by radio, especially for the period of landing and for the terminal. Weather estimates may be made for periods greater than those for which a high degree of accuracy may be expected. They are useful in preliminary planning, after which they are followed by the regular medium and short range forecasts.

■ 18. WEATHER INFLUENCES COMMON TO ALL BRANCHES OF AVIATION.—*a. Ceiling and clouds.*—(1) Pilots must know the ceiling, amount of cloudiness, and types of clouds to be encountered on a flight for the entire route in order to plan and execute the flight properly. If a cloud ceiling exists, the pilot must either fly underneath it, fly on instruments in the clouds, or climb through and fly on top of the clouds. Flying at low altitude is usually hazardous and particularly so at night or in hilly or mountainous country with low visibility. In wartime the low flying plane may be offering a profitable target for enemy machine guns, rifles, or other low caliber antiaircraft fire. Also, there is the ever present possibility that suddenly encountered near zero ceilings will

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force the pilot to instrument flight. For such contingency the pilot should have a definite plan and be completely prepared. If the flight is to be made on instruments or over an overcast, the pilot should have prepared for this by having the plane properly equipped for instrument flight and being himself properly trained. Also, he should be assured of an adequate means of navigation and particularly of a positive means of locating the point at which he is to descend. The ceiling at his destination then becomes of prime importance unless he is prepared to make an instrument landing. In any event, ceiling and the amount, including thickness, of cloudiness definitely limit the flight altitude or require that it be made on instruments or over clouds, which in turn impose additional limitations dependent on the adequacy of available navigational and instrument flying facilities.

(2) Low ceiling or instrument weather at point of take-off should ordinarily be no hindrance to individual planes, provided the weather at the final destination is suitable for safe descent. However, instrument weather offers a very definite handicap to a formation of planes.

(3) The types of clouds also should be considered if instrument flight is to be made, as they will indicate the smoothness or roughness of the air. Generally speaking, in cumulus type clouds, the extreme of which is the cumulonimbus of the thunderstorm, the air will be rough whereas in stratus or layer type clouds the air will be smooth. Under certain conditions thunderstorms may occur in a region covered by stratus type clouds, a condition particularly hazardous for the unsuspecting pilot flying on instruments in the stratus layer. Also, if the temperature is right for icing conditions, normally, the icing in cumulus type clouds will be much more severe than in stratus types since larger water droplets are suspended in the cumulus type clouds. Instrument flight in clouds where thunderstorms or icing may be encountered involves a hazard to the aircraft that must be balanced against the military importance of continuing the mission.

(4) Thus the pilot is much concerned with the ceiling and clouds to be found on every flight, and an accurate prediction of these is one of the most important parts of a forecast for flying.

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b. Visibility.—(1) Visibility is the state of the atmosphere which determines the distinctness with which objects may be seen. It is expressed in horizontal distances that surface objects may be seen with the naked eye. This is the most important single weather element to the pilot. Rain, snow, dust, smoke, and fog interfere with flying principally because they cause poor visibility.

(2) It is easier to overcome the handicap of low visibility in peacetime than in war operations. In war, restricted visibility limits the size of formations and capabilities of military aircraft in navigating to and locating objectives because of the restricted use of radio. This restriction further tends to increase the hazards of landings under conditions of unfavorable visibility. Poor visibility affords protection to all classes of aviation against enemy observation and fire.

c. Weather hazards to aviation.—(1) Fog, low ceiling, and low visibility increase the hazards incident to flight and should always be considered and properly evaluated in flight operations. Extremely heavy rain, hail, sleet, or thunderstorms, or any storm of violent turbulence, and severe icing conditions, present definite hazards to aviation operations. Despite advances in de-icing equipment, moderate to severe icing conditions are dangerous even with de-icers and are therefore to be avoided whenever the mission permits. Even if the flight characteristics are not impaired, the radio antenna may be lost at a time when radio communication is most desired. In peacetime, de-icers should be regarded primarily as emergency equipment to save aircraft trapped inadvertently in icing conditions rather than as accessories which warrant disregard of icing in operations plans. In time of war the importance of the military mission may warrant flight through icing conditions.

(2) Care must be exercised in clearing planes through well developed cold fronts because of the extremely turbulent condition which exists even without the presence of thunderstorms. The common summer afternoon convective type of thunderstorm is only a hazard if one attempts to fly through it. Such storms are generally scattered and can be usually flown around or beneath. The turbulence beneath the clouds, although often severe, will not approach in violence the turbu-

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lence to be found in the storm cloud. However, the frontal type thunderstorms, which may occur either in winter or summer, are likely to cover large areas and it is frequently impossible to fly around or between them. Unlike the summer afternoon convective type of thunderstorm, the ceiling may be, and usually is, quite low in the vicinity of the front and it is likely to be impossible, or at least hazardous, to fly beneath such storms. Due to the violence of the storms, it is hazardous to fly through them. Hence, the only suitable path for flight through such storm areas is over the top. Since thunderstorms usually extend to great heights, flight over the top should not be attempted without an adequate supply of oxygen and a realization on the part of the pilot that the flight may have to be made at 20,000 feet or even much higher to be above the violent turbulence. Thunderstorms also offer the dangers of severe icing and lightning.

(3) High winds, particularly crosswinds, add to the hazard and difficulty of landing and taxiing airplanes, but are not a hazard to flight unless accompanied by violent turbulence.

(4) Extremely heavy rain and hail are normally found only in thunderstorms. Likewise tornadoes normally develop only in thunderstorm areas.

d. Wind.—(1) Wind affects the take-off of all airplanes alike in that the greater the wind, the shorter will be the take-off run. The same is true of landing. Once in the air all airplanes are affected by a given wind in the same manner and to the same extent in a given length of time.

(2) On the ground the wind velocity and direction are of importance in parking and taxiing of aircraft and in providing protection against high winds. Prevailing surface winds should be considered in laying out landing fields.

(3) Winds aloft are of primary interest in that they affect the ground speed and range of airplanes. Aviation operations in order to be executed on any kind of schedule, except locally, must be based on accurate wind-aloft data. If operating airplanes near their maximum ranges, accurate wind-aloft data are essential in determining fuel requirements and thus permissible loading transposabilities.

e. Precipitation.—The effect of precipitation on planes in flight is primarily a decrease in visibility. Precipitation may

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present a hazard in the form of hail or extremely heavy rain or icing conditions if the proper temperatures prevail. Precipitation may take the form of ice or deep snow and may cause floods, muddy flying fields, or other obstacles to operation.

f. Temperature.—Low temperature influences aviation operations primarily from the standpoint of icing of aircraft in the clouds or in precipitation, the frosting of windows, the starting and operation of engines, motors, and associated equipment, the operation of machine guns and other small caliber weapons, the freezing of flying fields, the protection of crews in airplanes against the cold, the protection of water pipes and containers against freezing, the operating of heating plants, and the added difficulties of airplane maintenance in the field. The chief effects of high temperatures are discomfort to personnel and deterioration or spoilage of food and certain supplies. High temperatures adversely affect the operation of engines, motors, and other mechanical equipment unless they are properly designed for such operating conditions. Temperature corrections must be applied to the indicated readings of certain instruments such as altimeters and air speed indicators, in order to obtain true readings.

g. Pressure.—The reading of altimeters must be corrected for known sea level pressures in order to determine the true altitude above sea level. It is necessary to know the altitude accurately for bombing, photography, interception, and rendezvous. A knowledge of correct altitude is also necessary in order to clear mountains or obstructions safely when on instrument flights, in order to make instrument approaches and landings, and in order to fly at specified altitudes to avoid collision with other planes when flying on instruments. Lastly, and perhaps the most important use of barometric pressure is in weather analysis. Without the pressure readings it would be impossible to forecast by use of the present system. The reduced pressure of high altitudes has many other important effects on flight such as decreased power of internal combustion engines, decreased lift of wings, and deleterious physiological effects on the human body.

■ 19. INFLUENCE OF WEATHER ON OBSERVATION AND RECONNAISSANCE AVIATION.—*a.* The primary mission of observation

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and reconnaissance aviation being to observe and report, their operations are facilitated (when enemy opposition permits) by high ceilings and excellent visibility over the area where they operate.

b. Observation aviation operates over a small area and most of its flying may be classed as local. An effective weather service for these operations must therefore concentrate on local or limited area forecasts. It must be sufficiently reliable to permit effective planning and conduct of maximum operations permitted by weather conditions. This forecasting service, though not necessarily an elaborate set-up, is necessary for observation aviation operations.

c. Reconnaissance aviation will be required to operate great distances over enemy territory where weather conditions may or may not be known. Whether or not this weather is known will depend in a large measure upon the reconnaissance aviation itself since one of its missions will be to make weather reports from points over enemy territory. Bombardment aviation will also make a certain number of weather reports, and if these are sufficient in number and cover enough territory, it may be possible to make fairly accurate forecasts of weather for the following day.

d. The capabilities of reconnaissance aviation, in the executions of its tasks, are definitely limited by weather, particularly in the matter of visibility and wind. Their effect must, therefore, always be considered in planning missions to determine radius capabilities and number of aircraft required. Reconnaissance aviation may be called upon to operate under all but the worst of weather conditions. It is under such conditions that weather forecasts can be of greatest value from a safety standpoint in advising of weather to be encountered en route and at the home airdrome upon the return.

e. When reconnaissance aviation is engaged in surveying a large area, such as may be the situation when collecting objective folder material, accurate forecasting and even climatic surveys may influence the order in which the area is covered, provided time permits. Thus the maximum utility may be taken of favorable periods of weather. By studying the weather situation, the commander can avoid to a great extent the useless waste of time incident to long flights into

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regions where the reconnaissance mission is temporarily impossible. Thus, where many missions must be flown during a certain period, the selection of the proper time may result in all being performed with reasonable assurance of success, rather than partial success from the same amount of flying haphazardly planned.

f. Since reconnaissance so frequently operates singly and unprotected by escort, it is of paramount importance that full advantage be taken of the security afforded by clouds or very high flight. These conditions can usually be forecast.

g. Both reconnaissance and observation aviation rely largely on photography, for which forecasts of ceiling and cloud conditions are essential. The coverage obtained per film depends on airplane altitude which in turn is limited by the ceiling. Turbulence in general is disadvantageous to the photographic mission. Such a condition is usually found in regions of forecast cumulus clouds, unless the cloudiness is so scattered that the mission may be flown at high altitude above the clouds. Forecasters can often predict the altitude above which turbulence will be absent. This is likely to be above the haze level, another phenomenon that should be included in the photographic forecast since it affects the camera equipment utilized.

h. An important duty of reconnaissance aviation is sea search. In such cases, the planning of the force required is dependent on the scouting interval, which in turn depends on the visibility to be anticipated. Here adequate coverage and economy of force demand the best forecasting service.

i. Another instance of the value of forecasting to reconnaissance occurs when a search is being maintained to prevent the undetected arrival and unloading of enemy surface vessels at ports located along a shore line. Continued searches far at sea usually quickly exhaust the reconnaissance force. Such searches are in general unnecessary provided good weather prevails for port surveillance. In this situation a limited search seaward combined with port surveillance will normally make possible bombardment attack prior to cargo unloading. On the other hand, if periods of weather are predicted in which reconnaissance or attack will be denied, the search should be accordingly extended seaward prior to the arrival of the unfavorable weather.

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■ 20. INFLUENCE OF WEATHER ON BOMBARDMENT AVIATION.—*a. General.*—This branch of aviation has probably the greatest need for weather information. Bombardment units may, and frequently will, be called upon to perform their own reconnaissance. The weather influences described in paragraph 19 therefore apply also to bombardment aviation. Like reconnaissance aviation, it may operate over great distances and return to its home airdrome with gas tanks nearly empty. A forecast before take-off of weather to be encountered upon return is essential. Bombardment may pass through much bad weather en route to and from its objective, but to avoid wasted effort it is very important that the weather be suitable at the objective for bombing, and that this be known before take-off. Weather conditions may change greatly during a bombardment mission since the airplanes may be up for many hours. Objectives should be chosen when possible, based on the weather forecast; that is, objectives should be chosen for which weather conditions will be most suitable. Sometimes attacks must be attempted against particular objectives in spite of the weather. When this happens, special forecasts and recommendations should be made as to the best route, altitude, conduct of the flight, and point of return.

b. Security factors.—Cloud cover and limited visibility, if not sufficiently restricting as to make the execution of missions impossible, provide security to bombardment aviation against antiaircraft fire and hostile pursuit. These factors will also exercise an influence on the altitude and technique of bombing, the size of formations that can be flown, and the concentration that can be obtained on the target.

c. Data.—Bombardment aviation requires special wind data in addition to that required by other aviation units.

(1) *In bombing.*—In attempting to drop a bomb on a target from aircraft, it is necessary to take into account the fact that the wind deflects the bomb from its course as it drops through the air. If one hopes to attain accuracy in bomb dropping, especially from high altitude, he must know all the wind directions and speeds between the level at which he is flying and the ground so that he may make allowance for the distance the winds will deflect the bomb from its normal course. The usual practice followed is for the Army Air Forces Weather Service to furnish information relative to the

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wind direction and speed for each 1,000-foot level from the ground up to the level from which it is expected to bomb. The wind affects the bomb approximately in proportion to the time it acts on the bomb. As the bomb is dropping slowly immediately after it is released from the airplane, the wind at this level has a larger deflecting effect than do the winds at lower levels.

(2) *In smoke laying or gas attack.*—In laying a smoke screen or in making a gas attack, it is very important that an accurate knowledge be had of the surface wind. Light winds are desired. Atmospheric conditions unfavorable to smoke laying or gas attacks are convection currents, strong winds, variable winds, and stagnant air. Since weather data from enemy territory will be by deduction and from airplane observations, it is apparent that accurate and dependable forecasts of wind speeds and direction will normally be difficult to make except for positions a short distance back of the enemy lines. However, such forecasts should usually be fairly accurate within reasonable distances behind the enemy lines, and sometimes over large areas of enemy territory, depending upon the number of weather reports received.

d. Typical mission.—The weather influences on bombardment are so varied and numerous as to preclude their complete coverage. However, a brief discussion of a typical mission will serve to illustrate a few of the details of the role of the weather insofar as it affects normal bombardment operations. The group commander charged with an attack on an enemy establishment must decide the—

(1) Force required.
(2) Time of attack.
(3) Assembly point (altitude, formation, place).
(4) Route out.
(5) Initial point.
(6) Method of attack.
(7) Altitude of attack.
(8) Axis of attack.
(9) Rendezvous point (altitude, formation, place).
(10) Route back.
(11) Weapons employed.
(12) Secondary objectives.

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Upon each of these decisions the weather exerts an important and oftentimes deciding influence.

e. Force required, method of attack, and altitude of attack.—The number of aircraft needed depends on the nature of the target and the bombing accuracy to be expected. This in turn depends on the altitude and speed employed and, to some extent, on the visibility. Accuracy is also dependent on the method of attack, that is, by formation or by individual attacks from a bombing circle. The selection of altitude, speed, and method of attack must conform to the ceiling conditions, with due regard for security considerations. Ideally, a cloud cover at 4,000 or 5,000 feet would permit individual bombing at favorable altitudes and speeds but clear skies may demand formation bombing at high altitude against a defended objective. In such a case a larger force should be employed.

f. Time of attack.—The time selected should primarily be such as to make the mission possible, avoiding fog or hazards at the objective that might nullify the desired accuracy. Normally, daytime bombing is more effective than night attack but against well defended objectives, unless cloud cover is forecast, security may dictate the night attack. If this is the case, the conditions of visibility and nocturnal illumination should be considered since moonlight may be needed for orientation to the vicinity of the objective.

g. Assembly point.—The point selected should be readily found under the weather conditions expected. This is especially important to consider if night assembly is attempted. Under many conditions night assembly will not be attempted, and attacks conducted by individual aircraft. This is particularly true when visibility is low. If formations are used, they must be capable of ready execution in the existing weather. The altitude at the assembly is normally not so high as to require oxygen, but is just under the clouds if these exist and enemy pursuit threatens.

h. Route out.—An attempt should be made to secure the advantage of areas of cloud protection on daylight missions unless excessive deviation from the direct route is thereby involved. The formation used should be sufficiently flexible that, in case of attack by interceptor pursuit, cloud cover can be utilized and, if necessary, the attack continued by in-

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dividual aircraft or by subsequent assembly and formation attack.

i. Initial point and axis of attack.—The selection of the initial point and the axis of attack may be fixed by tactical considerations but, other things being equal, may be determined by the weather. Where the objective is in the clear, attack from the direction of a cloud cover is desirable. Also, the attack may be most advantageously conducted from the direction of the sun to reduce enemy visibility. Where it is desired to pass over the objective in minimum time, for instance against a target heavily defended by antiaircraft artillery, the down-wind attack may offer the greatest security. On the other hand, precision bombing is favored by the slower approach up wind.

j. Rendezvous point and route back.—When cloud cover is available, return by individual aircraft in the overcast is desirable in the event of attack by defending pursuit. In this instance no rendezvous is required. In the case of clear skies, return at high altitude may offer the best security. In the case of a gliding attack at dawn, in the absence of cloud cover, the rendezvous at low altitude followed by the return just above the surface is often preferable. In any event in which a rendezvous is selected it, as well as the initial point, should be readily located under the existing weather conditions. As in the selection of the route, the route back should take advantage of cloud cover when it is available.

k. Weapons employed.—Where high explosive bombs are required, the weather has no effect on the choice of the weapon used. However, when a high wind exists at the target, incendiary bombs may be the most effective weapon. It may be that either bombs or torpedoes will accomplish a naval mission. On the other hand, if very low ceilings prevail at the location of a naval objective, torpedo attack may be the only feasible operation. Wind and precipitation conditions also may be the deciding factor indicating the practicability of gas attack against certain types of objectives.

l. Secondary objectives.—Secondary objectives are targets of importance to be attacked should the primary objective have to be abandoned. Prior to take-off the commander should study with his weather officer the general area weather conditions so that, in the event his primary objective

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cannot be reached, he will have a previously prepared plan for the employment of his force against a profitable secondary objective. This latter attack is frequently against an objective which is undefended or lightly defended. However, it must be chosen from those not prohibited by weather conditions. Also, the effect of forecast conditions must be studied in advance of take-off if the maximum success is to be obtained.

■ 21. INFLUENCE OF WEATHER ON PURSUIT AVIATION.—*a. Interceptor pursuit.*—(1) The weather service supporting the operations of interceptor pursuit aviation must provide a high degree of precision in short range forecasts covering localized areas for effective operations and minimum weather crashes. This special type of weather service is dictated by the nature of interceptor pursuit operations.

(2) Pursuit planes used in local defense such as the interceptor type have small gas capacity and hence little reserve for emergencies. If ceiling and visibility become zero or quite low at the home airdrome, with planes in the air, reserve airdromes to be useful must be near at hand and must have suitable weather conditions. However, all airdromes may be closed in at about the same time, and with little or no warning if forecasts are not available.

(3) It frequently happens that an early morning ground fog would offer little or no obstacle or hindrance to the bombing of objectives. The target might stick up through the fog or even be in the clear. Yet there would be considerable hesitation in sending pursuit planes up to meet the enemy with the home airdrome, and all others nearby having zero-zero conditions unless weather forecasts indicated clearing of the fog in time for the planes to land.

(4) When low clouds are present, the planes in the air will usually be above the clouds at high altitudes. Hence they are in no position to look out for lowering ceiling and visibility and can, in the absence of weather forecasts, frequently become trapped in the air with low ceiling and visibility at one or possibly all airdromes within range. Accurate weather forecasts could prevent such situations.

(5) Weather which may be perfectly suitable for instrument descent and approach for landing by other classes of

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aviation may be dangerous for pursuit. While pursuit planes can quite successfully be flown on instruments, under ordinary conditions, they are not at the present stage of development considered suitable for instrument landings. Due to their inherent instability even instrument approaches are not considered safe in rough air or with as low ceilings and visibilities as can be safely negotiated with more stable airplanes.

(6) An additional advantage of an adequate forecasting service is that it gives not only the local weather but the general weather conditions over large areas including enemy territory. This information is extremely valuable in estimating the enemy situation; the probability of attacks and their intensity; the probable times of attacks; probable objectives of enemy planes, and many other situations.

(7) An efficient weather service will contribute to high morale. A pursuit unit served by an adequate forecasting station can be expected to maintain a much higher morale than one not so served. This will be particularly true during periods of bad weather.

(8) Hence, it is believed that in most locations and under most situations pursuit aviation in local defense cannot afford to operate without adequate forecasting service.

b. In protection of bombardment.—Pursuit aviation in the protection of bombardment or other aviation may accompany it deep into enemy territory. Pursuit used for this purpose will normally be of the fighter type, having a fairly long range. Hence, it will have needs for the same forecasts as the bombardment aviation.

■ 22. OTHER AVIATION SERVICES.—Weather forecasts are needed by all flying schools in making and maintaining training schedules and in clearing cross-country flights. Transport squadrons operating as units or by individual planes require weather forecasts, as they will be required to operate under almost any kind of weather condition.

■ 23. INFLUENCE OF WEATHER ON AIR FORCE OPERATIONS.—*a. Climatic conditions.*—When a major air offensive is being planned, the total effect of weather conditions on the regions of air operations should be considered. It may happen that operations may be desirable in regions widely separated geo-

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graphically or climatically. In such a case, the mass effort is most economically employed in each region during the seasons favorable to air operations. So also, one season in any locality may present weather conditions most suitable for air operations of a certain type, such as reconnaissance or dive bombing, while another season may be more suited to high altitude attack.

b. Weather conditions.—(1) The primary operation in a major air offensive is the movement of the units into the combat zone. Here the higher command must make initial allocations of units to airdromes most favorably situated for anticipated operations. A few examples illustrate the weather considerations involved. Pursuit units must be ready to take-off at any desired time. Hence, pursuit should avoid airdromes in valleys subjected to fog when nearby airdromes can be selected in areas of less frequent low visibility conditions. When a choice exists in the location of bombardment of different types, those having restricted range should be based insofar as possible in areas where weather conditions will favor a route back to convenient airdrome rather than long detours occasioned by unfavorable weather. Such situations are more readily negotiated by bombardment whose fuel range makes possible a wide choice of return airdromes.

(2) Air operations may in general be divided into two classes: those specifically ordered by the higher command against individual objectives and those covered in general letters of instructions and lists of organization objectives whose destruction is to be accomplished as expeditiously as possible over a period of time. Even in the case of the former class, all possible leeway should be given the lower echelons in the selection of the time of attack in order that the most favorable weather conditions can be utilized.

(3) When a task force is conducting an air offensive against objectives for operations over a period of time in accordance with a letter of instructions, the weather officer must cooperate closely with the operations section to insure that daily operations are dispatched on missions for which weather conditions are most favorable. With due regard for priorities, minor shifts in schedules should usually be possible to permit air attacks under conditions conducive to success with

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security. The weather will usually be an important factor not only in the selection of daily specific objectives but also in the actual time of attack.

(4) When the higher command decides to direct the major air effort against a specific objective or objectives, the weather again has a profound influence on the commander's decisions. An example illustrating such a situation might occur should several enemy naval dispositions simultaneously be directed against the east coast of this country during a weather situation in which the coastal plateau from Maine to the Carolinas was in the path of a violent line squall accompanied by fog and severe icing, but with favorable weather southward to the Gulf of Mexico. At once the forces required for the destruction of the naval objectives would have to be selected with due regard for available return airdromes and the fuel range of the attacking aircraft. Sufficient warning should be given by the Army Air Forces Weather Service to permit air echelons where necessary to proceed to other airdromes from which operations could be expeditiously conducted, and probable return airdromes warned of the supplies needed for continued operations therefrom. By proper planning and the flexibility of an adequate supply system, operations not otherwise possible can frequently be maintained even in the face of extremely adverse weather conditions.

(5) Continuing the above example, it might happen that initial operations in the Caribbean area were favored by weather conditions, operating in the region of the Middle Atlantic States possibly utilizing return airdromes in Florida, but that one bombardment commander in Maine was charged with the destruction of an enemy naval force several hundred miles offshore. In view of the approaching line squall conditions and a necessity for attack and return to base prior to its arrival, the commander might decide to utilize search attack methods rather than delay his take-off until reconnaissance aviation had located the objective.

(6) This example illustrates an air offensive dictated largely by approaching weather conditions. Each situation of air operations, whether in the planning or execution stage, must be studied by the appropriate commander before an intelligent order can be issued or a mission conducted at maximum efficiency.

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CHAPTER 3

OPERATIONS OF WEATHER SERVICE

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SECTION I

OBSERVER STATIONS

■ 24. GENERAL.—Mobile weather stations are normally both weather forecasting and observing stations. There are many points where there is no need for forecasting stations and yet from which there is a great need for current weather reports. To meet this need, observer units will be stationed at various points from which reports are desired. Weather observations are made primarily for the purpose of forecast ing, and in meeting this need, two of the more importan considerations are location and number of stations. The sta tions should be well spaced so as to cover the area to th best advantage. If greater accuracy of forecasts is required in a particular area, the density of observer stations is increased in, and immediately around, that area. For economy, as few stations should be used as will adequately furnish the necessary reports. An understanding of the required number and distribution of weather observer stations may best be had by a consideration of the operation of the weather service within the theater of operations and the zone of the interior.

■ 25. THEATER OF OPERATIONS.—*a.* Within the theater of operations, whether it is within the United States or a foreign country, there will normally operate an air task force and a ground force. The air task force may have its units scattered throughout the theater. There will be one or more air bases, one or more sub-air bases, and the various combat units. For example, if the air force consists of a headquarters and three wings of two groups each and a logistical establishment of

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nine air base groups, there should be several mobile and fixed weather sections, each capable of furnishing forecasts and local weather observations.

b. If weather reports are required from points within a theater of operations where no weather stations are located, special observer stations must be established at these points. Such weather observer stations will be established, where needed, within both the combat zone and the communications zone by an Army Air Forces weather squadron.

c. There will be a great need for weather reports from outside the theater of operations from adjoining or nearby neutral territory, from enemy territory, and from the zone of the interior, since such reports normally contribute to efficient forecasting. Where it is not feasible to establish weather observer stations, the use of weather observing airplanes will be necessary. It is quite probable that many reconnaissance airplanes will be sent over enemy territory for the primary purpose of observing and reporting weather. In addition, all reconnaissance airplanes and many bombardment airplanes will be required to report the weather on many occasions when operating over enemy territory.

■ 26. ZONE OF THE INTERIOR.—Within the zone of the interior, weather observer stations will be established by the Army Air Forces where necessary. Within the continental United States few, if any, observer stations would be needed in addition to those normally maintained and operated by the Weather Bureau and other activities.

■ 27. STATION LOCATIONS—*a.* Mobile weather sections assigned to tactical units, will normally make weather observations at or near the point where their headquarters are located.

b. In locating weather observer stations it is necessary to determine the points from which weather reports are most desired. It may be impractical to establish observer stations at all of these points, or even at any of them in the exact location most desirable from a weather standpoint. A compromise in location will frequently be necessary. Generally weather observer stations will be located to augment or fill vacancies in the existing network.

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c. After deciding the general location where an observer station is desired, consideration must be given to the communication facilities available or the difficulties of providing same and the problem involved in establishing, maintaining, and operating the stations.

d. Weather observer stations for adequate coverage of an area should be spaced from 50 to 100 miles apart. A closer coverage is useful for checking the current weather, particularly along air routes, but may give too many reports for all of them to be entered on most weather maps. In areas some distance from the theater of operations and where no operations are contemplated, the density of stations may be considerably reduced and still be satisfactory.

e. An additional factor in the location of an observer station is that it should be such that all data collected will be as representative as possible of the weather of the surrounding area. This will not always be possible in the case of observations made by a forecasting station as the forecasting station must be located at or near the headquarters being served. However, all observer stations should be located and instruments exposed in accordance with standard practice insofar as possible. If the country is rolling, consisting of many hills and valleys, the station should be located on a hill. A hill which has the shape of a mound, that is, circular in its formation, is preferable to one which is long and narrow. Ridges should be avoided as they alter both the speed and direction of the wind and thus a truly representative velocity will not be indicated by a wind vane and anemometer. If the station is to be placed in the vicinity of a lake or river, a place should be chosen at a moderate distance from the body of water so that the general condition of the surrounding air will be recorded by instruments. If the station is near woods, the instruments should be placed at least ten or twelve times as far away from the woods as the height of the trees in order to get a good record of the wind. If the station is to make observations in the vicinity of a flying field, a clear view should be had of the field to facilitate determining visibility.

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■ 28. COMMUNICATION.—Every weather observer station must have a means of transmitting its weather reports to the forecasting stations. This may be by telephone, telegraph, radio, messenger, or other means. If possible, the station should be located where communication facilities are already available. The Signal Corps may be called upon to furnish wire communication if none is available. In unusual instances the weather observer station may be equipped with a radio transmitter for transmitting its reports where wire communication is impractical. The reports should be delivered or transmitted by the most convenient method to a teletype station, except when transmitted by radio. Communication requirements and facilities are further discussed in section III.

■ 29. OPERATION.—The operation of weather observer stations, including the taking of observations and the preparation and submission of reports, will be in accordance with the appropriate Army Air Forces regulation and memoranda. The number of weather observations and the time of taking and submitting observations will vary with the situation and depend upon a number of factors. Such questions must be determined for each station individually by the weather squadron commander or other officer in charge of observer units.

SECTION II

FORECASTING STATIONS

■ 30. GENERAL.—*a.* The technical phases of weather station operation, such as the manner and methods of making weather observations, of drawing weather maps and charts, preparing forecasts, etc., are in general the same for both fixed and mobile weather stations. The chief difference between fixed and mobile weather station operation is that the fixed stations are required to maintain numerous permanent and semipermanent records which mobile stations are not required to maintain except when especially directed to do so. All weather stations conform in the technical phases of their operation to the instructions in appropriate Army Air Forces regulations and memoranda.

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b. The routine operations required of the various types of weather stations are those which are deemed essential to the proper functioning of the using organizations. These operations cannot be performed without the proper complements of trained personnel. Every effort should be exercised to maintain the status of training of the Weather Service at a point where it can adequately perform its mission.

■ 31. FORECAST TERMINOLOGY.—*a.* The forecasts issued by various classes of stations will vary in numerous ways such as the time of issuance, the areas and routes covered, and the number of forecasts issued daily. However, the information contained in a forecast and the terminology used should be fairly standard throughout the Army Air Forces even though the terminology of a forecast is very difficult to hold within fixed limits. The basic doctrine is that the forecast must present to the flight commander a brief picture of the weather situation and the conditions which will be encountered during flight. Ambiguous phraseology or terms defined locally should be avoided, since they will generally not be fully understood. Under this category fall such terms as "poor," "good," "favorable," "high," "low," "early in period," "we portion of route," and other terms which require definitio To avoid uncertainty, geographical locations should be give by name, directions by points of the compass, and numbe used whenever possible. Times and periods should be designated in the 24-hour clock system.

b. Forecasts should contain the following information:

(1) State of weather (overcast, broken, scattered, clear, or combination thereof).

(2) Precipitation (by type).

(3) Ceiling (in thousands of feet if above 2,000 feet; in hundreds of feet if below 2,000 feet).

(4) Visibility (in miles and fractions thereof).

(5) Surface wind velocity (by direction and intensity).

(6) Upper air wind velocities (by direction and intensity).

(7) Hazards (by type, time, and location).

■ 32. DISPLAY OF WEATHER INFORMATION.—*a.* All weather information and displays thereof except for written forecasts are normally located in the weather station proper rather

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than in the post operations office, or operations offices of groups or other organizations which have their own weather stations.

b. In each weather station, surface observations and weather sequences are posted on file boards or other holders in the order of their receipt. These boards should be conveniently arranged adjacent to maps of the routes involved, to explanations of the call letters used, to printed forecasts, and to other pertinent data of assistance to flying personnel in their study of route or zone weather conditions.

c. Primary requisites of weather displays and services are—

(1) Convenience to flying personnel.

(2) Completeness with which the display describes the weather situation, both present and future.

(3) Availability of weather personnel for interpretation of the weather reports and for other necessary weather consultation.

(4) Promptness and accuracy in making available all current reports.

(5) Avoidance of confusion to using personnel or organizations.

d. These requirements necessitate that throughout the Army Air Forces Weather Service there be a standardization of the arrangements of weather offices, of weather displays, of symbols and codes used, of forecasting technique, and of operation routine to the end that using personnel will be indoctrinated rapidly into the proper use of the Weather Service and will, when on transient missions, encounter a system similar to that of their home stations.

■ 33. FIXED WEATHER STATIONS—*a. General.*—The following procedure outlines in general terms the method of operation of the fixed weather stations of the Army Air Forces Weather Service. Much of the routine contained herein is also applicable to mobile stations. In view of the widely varying demands on the weather service, rigid adherence to minutely defined instructions is not conducive to the best results. However, a general similarity in operation should be employed throughout fixed weather stations of similar type since such a standardization favors increased utility of the weather service activities.

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b. Climatic research.—Each regional control office is prepared to conduct, on call from the office of the Commanding General, Army Air Forces, studies of seasonal climatic conditions within the control area. To this end the station records are carefully preserved as prescribed in current weather service regulations.

c. Base weather station operation.—(1) *Current weather reporting service.*—(*a*) Each base weather station maintains a 24-hour current weather observation and reporting service. Observations are made and recorded as prescribed by existing weather service regulations. These observations should be furnished to the proper Signal Corps or other available communication network for radio transmission to interested offices.

(*b*) Upper air observations of wind velocity by pilot balloons are made at least twice daily, including Sundays and holidays. These observations are made to an altitude of at least 15,000 feet, unless the balloon is unavoidably lost at a lower altitude. A balloon-run failure because of personnel error or faulty material should be rerun. Additional balloon runs or higher altitude requirements may be prescribed at the discretion of the regional control officers. At least one night balloon observation should be made each month except at those stations where fire hazard renders this training undesirable.

(*c*) Each base weather station maintains 24-hour weather teletype machine operation for the reception of information furnished by the Civil Aeronautics Administration teletype lines. Station hourly and special observations are, wherever possible, placed upon the local teletypewriter in accordance with existing Weather Bureau and Civil Aeronautics Administration regulations on a 24-hour schedule.

(*d*) Information for radio broadcasts of local weather conditions are made available half-hourly to the airdrome control station. Whenever the ceiling is less than 1,000 feet, the visibility less than 3 miles, or whenever hazardous weather conditions exist or are anticipated within an hour, information for radio broadcasts of local weather conditions are made available to the local airdrome control station every 15 minutes. Special weather reports are furnished to the local airdrome control station immediately upon the occurrence of material changes in weather conditions.

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(*e*) Weather reports received from aircraft in flight are transmitted by teletype in accordance with Civil Aeronautics Administration regulations and in peacetime furnished to the Signal Corps or other available radio network for transmission to all interested air stations.

(*f*) The base weather station maintains a continuous watch at all times to guard against unexpected developments in the weather, and in the event of hazardous weather to issue warnings to operations offices and, when advisable, to aircraft in flight.

(2) *Forecasting service.*—Forecasts issued by base weather stations are such as to fulfill the purpose outlined in AAF Regulations 105–7. The hours at which regular forecasts are issued and the periods and routes covered therein vary to meet the requirements of the using organizations and stations. Special forecasts will be made available in any direction from the station on call at any hour of the day or night. Regular forecasting service at base weather stations should be maintained on a 24-hour basis.

(3) *Weather maps and charts.*—(*a*) The specific weather maps and charts drawn at the base weather stations vary to suit the conditions imposed by geographical location and current Army Air Forces operations. Complete information essential to forecasters and flight personnel is, however, maintained on display at all base weather stations.

(*b*) The following maps and charts are prepared daily in the United States including Sundays and holidays:

1. Two surface synoptic maps of the North American continent and adjacent oceans, or other appropriate territory, as of 08:00 and 20:00 ES.
2. Two surface synoptic maps of the United States, or other appropriate territory, as of 02:00 and 14:00 ES.
3. Three upper air wind velocity and cloud maps as of 05:00, 11:00, and 18:00 ES on chart ML–108, or an equivalent upper air chart.
4. One 3-hour pressure change map as of 08:00 ES, when necessary for kinematic analysis.

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5. Rossby diagrams, tephigrams, or equivalent charts or diagrams prepared from selected aerograph reports in sufficient quantity to effect a complete upper air mass analysis and the necessary estimates of atmospheric instability.
6. Auxiliary surface synoptic maps of smaller areas when necessary for detailed analysis of frontal movement.

(*c*) When the state of personnel training renders it practicable, a physical air mass analysis is made four times daily from the maps and charts enumerated above, in accordance with modern weather practice. These analyses, in connection with a continuous study by the forecaster of all radio and teletype reports received at the station, form the bases for the forecasts and weather advice issued from the weather station.

(*d*) Changes in the technique of forecasting and map preparation are anticipated with the advancement of weather knowledge. However, uniformity is maintained throughout all Army Air Forces stations. This is essential to facilitate the indoctrination of using personnel and to reduce to a minimum the inevitable confusion caused to pilots by widely varying methods at different locations. Experimentation with new methods is encouraged, but in every case a discontinuance of prescribed practices should be approved by proper authority

(4) *Radio reception.*—Within the limitations of available equipment base weather stations are trained and equipped to receive twice daily the coded weather broadcasts of data for surface synoptic maps. In addition they are prepared to receive pertinent air line hourly radio weather reports in the event of teletype failure.

d. Post weather station operation.—(1) *Current weather reporting service.*—Each post weather station within the limitations of available communication equipment maintains the current weather reporting service prescribed in *c*(1) above for base weather stations with the following exceptions:

(*a*) If balloon observations are taken at an adjacent base weather station or commercial airport, balloon observations may, on recommendation of the regional control officer, be made at the post weather station for training or other essential purposes only.

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(*b*) If the post does not operate a radio beam, surface observations may be made but once hourly and upon the occurrence of material changes in the weather conditions.

(2) *Forecasting service.*—Post weather stations maintain the forecasting service prescribed in *c*(2) above for base weather stations with the following exception:

The forecasting service is normally maintained 16 hours daily. When the necessities of Army Air Forces operations require longer service for temporary periods, every effort is made to amplify the forecasting service to meet the emergency requirements.

(3) *Weather maps and charts.*—Within the limitations imposed by available communications facilities, post weather stations construct the maps and charts prescribed in *c*(3) above for base weather stations, including those maps for which the data are received during the periods in which no forecaster is normally on duty.

(4) *Radio reception.*—Post weather stations are trained and equipped for the radio reception of weather data as prescribed for base weather stations in *c*(4) above.

e. Squadron weather station operation.—(1) *Current weather reporting service.*—Squadron weather stations maintain the current weather reporting service prescribed for post weather stations in *d*(1) above.

(2) *Forecasting service.*—Squadron weather stations maintain the forecasting service prescribed in *c*(2) above for base weather stations, with the following exceptions:

The forecasting service is normally maintained during the hours of local Army Air Forces operations only. When the necessities of Army Air Forces operations require a more complete service for temporary periods, every effort is made to amplify the forecasting service to meet the emergency requirements.

(3) *Weather maps and charts.*—Squadron weather stations construct the maps and charts prescribed in *d*(3) above for post weather stations, with the following exceptions:

(*a*) Normally but three surface synoptic charts are drawn daily, including Sundays and holidays. The six-hourly map that is omitted from the daily routine is that of least value to flight operations.

(*b*) Normally but one upper air wind velocity and cloud

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map is drawn daily, including Sundays and holidays.

(4) *Radio reception.*—Squadron weather stations are trained and equipped for the radio reception of weather data as prescribed for base weather stations in *c*(4) above.

f. Detachment weather station operation.—(1) *Current weather reporting service.*—Except as referred to in *g* below, detachment weather stations maintain the current weather reporting service prescribed in *d*(1) above for post weather stations.

(2) *Forecasting service.*—Within the limitations of available personnel, detachment weather stations maintain the forecasting service prescribed for squadron weather stations in *e*(2) above.

(3) *Weather maps and charts.*—Except as referred to in *g* below, the following weather maps and charts are drawn and displayed at detachment weather stations daily:

(*a*) Two surface synoptic charts on map ML–100, ML–86A, or their equivalent.

(*b*) At least one upper air wind velocity and cloud map on chart ML–108 or its equivalent.

(*c*) Rossby diagrams, tephigrams, or equivalent charts or diagrams, prepared from selected aerograph reports.

(4) *Radio reception.*—(*a*) At stations of this category equipped with teletypewriter weather service, radio reception may be limited to that of the air line voice weather broadcasts during periods of teletype failure. The coded map signals are not normally received by radio at the weather station.

(*b*) Stations of this category not equipped with teletypewriter service are trained and equipped for the radio service prescribed for base weather stations in *c*(4) above. These stations, unless equipped with weather teletypewriter machines, vary in operation routine since in some cases radio facilities may not be available for the transmission of local observation reports during all periods of the day. Appropriate authorities should prescribe in such cases the services to be performed at the weather station, in order that the most expeditious use be made of available personnel.

g. Operation of weather stations located in the vicinity of base weather stations.—At weather stations in the proximity of base weather stations, departures from the routine

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prescribed above are often advisable in order to avoid duplication of effort and to furnish the maximum possible service with the limited personnel available. Such variations should be authorized by proper authority.

h. Airway observer station.—(1) *Current weather reporting service.*—(*a*) Airway observer stations whose personnel complement is four enlisted men maintain the current weather reporting service described for post weather stations in *d*(1) above insofar as the limitations of equipment permit.

(*b*) Airway observer stations whose personnel complement is two enlisted men maintain a similar current weather reporting service throughout a 12-hour period daily.

(*c*) The hours of operation of airway observer stations should be coordinated by the proper authority to insure a maximum uniformity throughout the weather service, and to utilize to best advantage communication facilities.

(2) *Forecasting service.*—Enlisted men at airway observer stations do not prepare forecasts for dissemination to Army Air Forces flying personnel, but furnish to using individuals and organizations the forecasts received from other governmental agencies or from Army Air Forces forecasting stations.

(3) *Weather maps and charts.*—The weather maps and charts to be drawn at airway observer stations are prescribed by the regional control officer. When the personnel situation warrants and communication facilities permit, it is desirable that one surface map be drawn daily at each observer station.

(4) *Radio reception.*—Radio reception at the airway observer stations is in general limited to those reports received from the air line broadcasts and from transient aircraft. Where the coded radio map signals can be obtained and utilized in the construction of a daily weather map, this is desirable.

i. Temporary field weather station.—(1) Each base weather station is required to be trained and equipped to install and operate a temporary auxiliary weather station in the field in addition to maintaining the uninterrupted operation of the base weather station. Such temporary field weather stations should be installed when needed by Army Air Forces operations.

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(2) No fixed number of men is specified for temporary field weather stations, but such stations should normally consist of about seven trained enlisted men and one weather officer. The station should normally maintain 24-hour observation and reporting service and about 12-hour forecasting service. If necessary, a 24-hour forecasting service should be maintained for short periods.

■ 34. MOBILE WEATHER STATIONS.—*a. General.*—(1) Mobile weather sections are assigned or attached to certain tactical and service units and are required to move with the units on any change of location or station. At each new location a mobile weather station should be set up and operated to serve the unit unless adequate weather service is available from some other source, such as a fixed weather station.

(2) The routine operations required of the various mobile weather stations, while generally similar in different stations, cannot be fully standardized and must be varied to meet different situations. Technical duties such as drawing and analyzing weather maps, making weather observations, etc., are an exception and should be standardized as far as possible in accordance with existing weather service instructions.

b. Station location.—(1) An important consideration in locating a station is that of utility. The more convenient the station is to those who utilize weather forecasts and other weather data, the greater will be the use made of the station. from the airline broadcasts and from transient aircraft. be located as near as possible to the operations office of the unit being served.

(2) It is also important that any weather data collected through observations be as representative as possible of the weather of the area surrounding the station. This requires that the station be located and the instruments exposed in accordance with standard practice. If the station cannot be in the best location for utility and still obtain sufficiently accurate and representative observational data, it may be necessary to have the observations made some distance from the weather station proper.

c. Setting up the station.—(1) The first step in setting up a station is to find a suitable location conforming to the

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above requirements. In general, a room adjacent to the operations office is preferable to a trailer. A trailer may be the best solution where buildings are not available.

(2) Connection should be made to the most convenient source of electricity to provide lights and power for radio and teletype machine. The teletype should be connected to the nearest Civil Aeronautics Administration teletype circuit or to the air force weather teletype network. If no teletype facilities are available, telephone, messenger, and/or other communication facilities should be used to obtain and distribute weather information. Under certain circumstances radio may be authorized. If electricity at standard voltage is not available, it will be necessary to use battery operated radio receivers.

(3) As soon as weather information becomes available, either by radio, teletype, or otherwise, the station should be ready to operate. A forecaster should plot data on a map and study the existing situation preparatory to issuing regular forecasts. The first forecasts will normally not be as dependable as later ones, as the region covered by the forecasts may be new to the forecaster and he may not be familiar with the past weather. Prior to operations in a new area, forecasters should have secured and studied past weather maps and other weather data in order to be as familiar as possible with climatic conditions and local influences. Contacts should be made as soon as possible with local weather authorities and other available sources.

d. Station operation.—(1) Station operation consists in general of the following procedure: providing weather forecasts; observing and reporting the local weather periodically, including the making of balloon runs to determine winds aloft; and providing a suitable display of all available weather information for use of the forecasters, pilots, and other using personnel.

(2) A mobile weather station, unlike a fixed station, does not have a fixed operating schedule for all situations. The hours of operation and the work done depend upon the demands made upon the station due to the particular situation. For example, at one time the hours of operation may be 24 a day and at other times only 12. At one location balloon runs will be made and at others this may not be required.

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In one location it may not be necessary to make weather observations, they being available from another source, while at other locations it may be necessary to make half or quarter hourly observations.

e. Forecasting service.—(1) The forecasting service provided by a mobile weather station conforms aproximately to that of a fixed weather station of about the same size. Mobile weather stations assigned to the headquarters of air task forces, air forces, bomber commands, interceptor commands, air support commands, and wings will, when on field duty, operate to furnish forecasting service 24 hours daily, the same as a fixed base weather station. The operating technique is as described for a base weather station in paragraph 45c. The normal schedule will require the construction of at least four synoptic maps daily and regular and special forecasts therefrom.

(2) Group weather stations normally provide a limited forecasting service for approximately 12 to 18 hours daily, as explained in *f*(4) below. Where the weather sections of two or more groups combine to operate one weather station as when two or more air base groups are stationed together, such a weather station should furnish forecasting service 24 hours daily.

f. Forecasts for air force units.—Should a theater of operations be within continental United States, many of the fixed weather stations would probably be located in the theater and continue to function and augment the mobile weather service. In this case it might be possible to temporarily attach group or other mobile weather sections to a number of smaller units such as squadrons, which normally have no weather sections. However, for the purpose of indicating the normal functioning of the mobile weather service, it is assumed in the remainder of this section that no fixed weather stations are located within the theater of operations. The forecasting service furnished by the various mobile weather stations within the theater is as follows:

(1) The weather station of the air task force headquarters furnishes forecasts and weather service to its own headquarters for planning purposes.

(2) Where wings are in operation it will be a normal function of each wing weather station to furnish its own head-

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quarters all necessary weather forecasts. In addition, each wing weather station will prepare general area forecasts, from each regular weather map, for all areas in which its units or other units to which it furnishes forecasts will operate. A fixed policy cannot be made as to all of the units to which each wing will furnish these forecasts. However, as a general rule, each wing will be responsible for furnishing general area forecasts to each group and separate squadron assigned to and operating under the wing and to each air base, sub-air base, transport group, and separate squadron which is operating in the wing area and to which general forecasts cannot be more satisfactorily furnished by other wings or higher headquarters. All aviation units, except headquarters higher than the wing, will normally receive the general area forecasts from one of the wings. The decision as to which wing is responsible for furnishing these forecasts to particular units will depend primarily upon the communication facilities available.

(3) The mobile weather stations of the bomber, interceptor, and air support commands normally operate to furnish forecasts and weather service for their own headquarters only, provided wings are assigned and are the only units operating directly under these headquarters. Where no wings are assigned and the groups and separate squadrons operate directly under the bomber, interceptor, and air support commands, the weather station assigned to the headquarters of each of these commands will, in addition to preparing all necessary forecasts for its own headquarters, prepare the general area forecasts for all areas in which units of the command will operate, and will furnish these forecasts to all aviation units assigned to or operating within the particular command area, in the same manner as described for wings in the preceding paragraph, unless such units can be furnished these forecasts more satisfactorily from other sources.

(4) The group weather station of each tactical group furnishes a limited forecasting service for its headquarters and the squadrons assigned to the group. The normal procedure is for each group weather station to draw two or more weather maps daily, interpret and enlarge upon the general area forecasts furnished by the wing or higher headquarters, using them as a basis for the preparation of detailed special

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and route forecasts required by group operations. When squadrons of a group are located at separate airdromes, forecasts and weather advices are normally furnished to them by wire or messenger and, if justified by circumstances, by radio. Reconnaissance squadrons are furnished weather service by groups unless adequately served by wings or higher headquarters. While limited forecasting service is the normal requirement of group weather stations, each such station should be prepared to furnish a 24-hour forecasting service for short periods when needed. This can only be temporary, however, due to the limited number of forecasters assigned.

(5) (*a*) Each air base and sub-air base weather station will normally furnish a limited weather forecasting service for its own headquarters only. The general area forecasts furnished by wings or higher headquarters should be used as a basis for the preparation of required special and route forecasts. This will normally require the construction of two or more weather maps daily. Each air base group weather station should be prepared to furnish forecasting service for 24 hours daily for short periods when needed.

(*b*) The air base may consist of two or three air base groups, each with its own small weather section. In such cases, where two or more air base groups are assigned to the same station, their weather sections should be combined to operate one weather station, and thus provide a more adequate weather service.

(*c*) All weather forecasts prepared by wings or higher headquarters for distribution to lower units will be transmitted to these units by the best means of communication available. This will normally be by means of the tactical or administrative teletype circuits, and in certain instances by telephone. The weather teletype circuit described in the succeeding section should be used for this purpose only in special instances.

g. Forecasts for division and higher ground headquarters.— (1) The Army Air Forces is charged with the furnishing of weather forecasts required by division and higher ground headquarters. Such forecasts are seldom required in peacetime except during maneuvers. They are furnished, when required, by designated fixed weather stations.

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(2) In wartime the question of who will furnish forecasts to division and higher ground headquarters depends largely upon the location of the units involved. In general, within the zone of the interior it is a function of the fixed weather service to furnish forecasts required by division or higher ground headquarters. Within the theater of operations such forecasts should normally be furnished by mobile weather stations assigned to the field army headquarters.

SECTION III

DISSEMINATION OF WEATHER INFORMATION

■ 35. GENERAL.—This section explains in general terms the manner and methods of distributing available weather information so that proper use can be made of it. Weather information is disseminated to and between weather stations and from the weather stations to the using personnel and organizations.

■ 36. DISSEMINATION OF WEATHER DATA TO WEATHER STATIONS.—*a. General.*—(1) Weather observer stations observe the weather and transmit periodic reports but normally have no need for reports from other points. An exception is an observer unit stationed with a squadron or other aviation unit which has no forecasting station. All mobile weather stations, on the other hand, which both observe and forecast the weather must have as many weather reports from other points as possible. The distribution of these reports requires an extensive communication system.

(2) Within the continental limits of the United States, in peacetime, the distribution of weather reports from Weather Bureau and other reporting stations is made to all Army forecasting stations as well as to the Weather Bureau and most civilian forecasting stations by the extensive weather teletype system of the Civil Aeronautics Administration. In addition, weather data are broadcast periodically by certain radio stations. All larger Army Air Forces fixed weather stations are connected to the Civil Aeronautics Administration teletype system and periodically transmit their local weather reports to other stations on the circuit in addition to receiving reports from these stations.

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(3) In wartime if one or more theaters of operation is within the United States, the Civil Aeronautics Administration teletype system will presumably continue to function, outside the theater, as in peacetime. Within the theater of operations, however, this system may be discontinued or become part of the Army Air Forces teletype network.

b. Communication.—(1) When the air force is operating in a theater of operations in which no weather facilities other than those of the Army are situated, in order to facilitate proper forecasting each mobile weather station should receive, periodically, weather reports from as many as possible of the following sources:

(*a*) Fixed and mobile weather stations in the theater of operations.

(*b*) Weather observer stations in the theater of operations and areas adjacent thereto.

(*c*) Friendly airplanes operating over enemy territory.

(*d*) Enemy ground radio stations.

(*e*) Zone of the interior, if nearby.

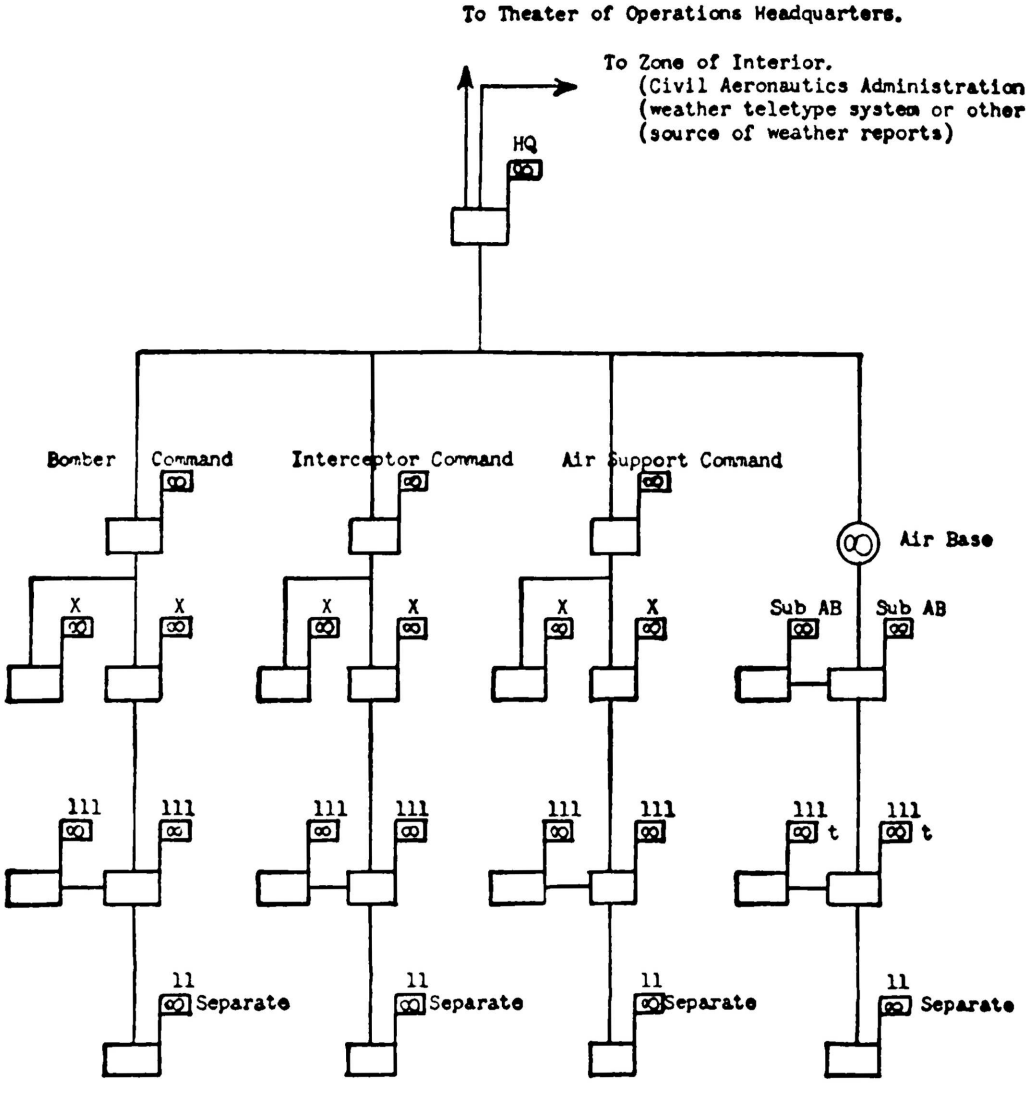
(*f*) Nearby neutral countries.

(*g*) Ships at sea, if within reasonable distance.

(*h*) Other possible sources.

(2) A special air force teletype network devoted exclusively to the transmission and reception of weather data is necessary. Each teletype machine in the network must have a special weather keyboard, as distinguished from the standard keyboard of machines used in the administrative network. The following diagram shows a typical air force teletype network extending down to groups and separate squadrons:

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HQ—Air Task Force HQ.

(3) At air force headquarters a separate teletype machine is connected to a circuit from the zone of the interior, if this is practicable, and the weather information from this source is of value. Where wire communication facilities are not available, necessary weather reports must be sent by radio, normally in secret code. Such radio weather reports are received by the air force radio station, decoded, and turned over to the air force weather station for transmission over the teletype network to all stations. In addition to reports from the zone of the interior, weather reports may be available from certain neutral sources either by wire or radio. It will sometimes be desirable to establish a special weather

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collecting radio station at air force headquarters, particularly if many reports are in secret code.

(4) The air force weather teletype circuit will normally not be used for the transmission of weather forecasts. However, it is available for this purpose at any time the necessity arises. Weather forecasts may be transmitted over this circuit, for example, if the air force headquarters desires to furnish a special forecast to all units.

c. Circuits.—(1) Commercial circuits will normally be used when available. When commercial circuits are not available, special military wire circuits must be constructed.

(2) When practicable, each special weather observer station will be connected by telephone to the nearest mobile weather station for the transmission of reports. When this is impractical, the reports from the observer stations will be transmitted to the most convenient mobile weather station by the best means available.

(3) For a more detailed discussion of communication circuits and their installation and maintenance, see FM 1–45.

d. Operation of the teletype network.—(1) The operation of the air force weather teletype network must be on a fixed schedule. All circuits will normally remain connected together. At a designated time during each period, usually each hour, all mobile weather stations connected to the network will transmit their local reports and special weather reports they have received from other sources, in succession, in a prescribed order. Each station will receive all of these reports.

(2) Each mobile weather station may receive a certain number of special weather reports from other sources, which it should transmit to all stations over the teletype network. These reports may be received by radio from friendly airplanes, from enemy radio stations, neutral countries, ships, and from special observer stations. In order to avoid numerous duplications of these reports, arrangements should be made to have only certain designated stations copy radio reports and transmit them over the teletype. Radio weather reports from friendly airplanes are normally not received directly by weather stations except when special arrangements are made for this. The headquarters radio station of

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each separate squadron, group, or higher headquarters will normally maintain a radio listening watch for, and will copy, all reports transmitted by airplanes of their organizations. Any weather reports so received should be turned over to the nearest weather station for transmission over the weather teletype network.

(3) At air force headquarters a large number of weather reports may be received by teletype from outside sources, such as the CAA teletype system. Periodically these reports will be transmitted by repeater equipment to all stations connected to the air force teletype network. Also, numerous reports may be received by radio in secret code, decoded, and transmitted over the teletype in the clear.

(4) The headquarters of the theater of operations and of armies are connected to the air force teletype network, through which they will receive all weather reports.

■ 37. DISSEMINATION OF WEATHER DATA TO USING PERSONNEL.—*a.* The Army Air Forces Weather Service is operated for the purpose of obtaining and analyzing weather data and furnishing these to using personnel and organizations. Weather data of primary interest to using personnel are observation reports, forecasts, and climatic studies.

b. As previously stated herein, the most satisfactory method of presenting a weather forecast is orally by the forecaster in front of the latest weather maps and charts, supplemented by a written forecast. This method should therefore always be used when practicable. The second best method is by voice over the telephone or radio, supplemented by a written forecast. This method should be used, when possible, to deliver forecasts to squadrons, or other units and to individuals, located where no weather station is available. This method should normally be used to transmit forecasts from group weather stations to squadrons of the group located at separate fields. The third method of presenting forecasts is in writing alone. This method should be used where neither of the other methods is practicable.

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