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War
AND
WEATHER

A REPORT PREPARED FOR THE AAF
SCIENTIFIC ADVISORY GROUP

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The AAF Scientific Advisory Group was activated late in 1944 by General of the Army H. H. Arnold. He secured the services of Dr. Theodore von Karman, renowned scientist and consultant in aeronautics, who agreed to organize and direct the group.

Dr. von Karman gathered about him a group of American scientists from every field of research having a bearing on air power. These men then analyzed important developments in the basic sciences, both here and abroad, and attempted to evaluate the effects of their application to air power.

This volume is one of a group of reports made to the Army Air Forces by the Scientific Advisory Group.

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WAR AND WEATHER

SUMMARY AND CONCLUSIONS

In the following report the contents of the attached paper on the GAF Meteorological Service have been used in drawing comparisons between the weather services of the AAF and GAF in World War II. A personal knowledge of the care with which the authors have prepared this and other similar papers is believed adequate justification for considering it not only reliable but also the most up-to-date and complete discussion of the GAF Meteorological Service available.

The science of meteorology, particularly that phase dealing with weather prediction, has been advanced only as communications facilities have permitted the rapid collection of simultaneous weather observations from larger and larger portions of the earth's surface and upper atmosphere. Communications remain the backbone of any weather service. From a small beginning in Europe in the middle of the nineteenth century where the telegraphic collection of weather data permitted the development of useful forecasts for periods of 24 hours, the science has advanced until at the end of World War II the application of knowledge developed from a 45-year archive of Northern Hemisphere weather charts coupled with the daily evaluation of surface and upper-air observations covering the same area has permitted the preparation of forecasts of useful accuracy for a week in advance and successful estimates of weather trends for periods of a month or more.

The AAF Weather Service was more efficient in its administrative and technical control than the GAF Weather Service in spite of the larger operational area it covered and the greater number of users it served. It is believed that this was due in part to the completely military nature of the AAF Weather Service. The German Air Force Weather Service was a militarized civil agency and its key personnel were not granted full military status.

The instruments available to the GAF Weather Service were more numerous and varied than those of the AAF Weather Service. Some of the German upper-air sounding devices are believed to be technically superior to those used by the AAF.

The reporting system and communications facilities of the GAF Weather Service were comparable to those of the AAF Weather Service in efficiency but much less extensive.

The short- and long-range forecasting techniques employed by the GAF Weather Service and the AAF Weather Service were about on a par. The professional standards of the two services were also comparable.

It is believed the early efforts of the AAF Weather Service to acquaint the War Department General Staff and the Air Staff with the uses of weather information, to-

gether with the comprehensive weather briefing procedures developed for use in the various theatres of war, resulted in a more effective and consistent use of such information hy our commanders than hy the Germans.

Research and development in the science of meteorology was stressed hy both services. It is believed that the Germans were more active in the development of meteorological instruments of all types than the U.S. Signal Corps which was responsihle to the AAF for the supply of this item. It is believed the AAF researches in short- and long-range weather-forecasting techniques and in forecast verification were more productive than similar projects of the German Weather Service.

In the future, forecasting requirements of the military weather service may be simplified because less detail will be necessary in short-range forecasts. However, predictions will he required for much larger areas; possihly they may be issued from a single weather center to cover the entire world. Long-range forecasts may be employed in planning an entire military campaign instead of one tactical maneuver.

Improvement in communications facilities will permit centralized administrative and technical control, and the employment of fewer personnel on the forecasting staff of the weather service.

The weather-reporting and communications facilities of the future weather service must be world-wide in order to provide adequate data for forecasting and research.

Present weather-reporting methods in wartime may be augmented in the future by meteorological instruments and automatic weather stations suitahle for release over enemy territory and remote areas of the earth from guided missiles. Long-range weather reconnaissance flights may be augmented hy equipping the aircraft with radar and radio cloud- and storm-detection devices.

Atomic energy may he used to control certain weather phenomena.

The importance of pursuing research projects in peacetime, directed at fulfilling the future requirements of the military weather services, cannot be overemphasized in view of the short interval of time within which a future war would take place.

RECOMMENDATIONS

If a unified command of U.S. Air, Ground, and Naval Forces is established the technical and administrative control of the weather services should be at this level to facilitate the coordination of all civil and military weather agencies in wartime.

Every effort should be made to increase the international exchanges of weather information. The AACS should continue to collect and disseminate such information on as nearly a world-wide basis as possible.

To assist in the maintenance of a world-wide weather collecting system for the AAF and for the establishment of the most effective weather communications facilities in wartime, it is recommended that separate channels for administrative and weather traffic be considered by the future military communications agency. This procedure is similar to that employed by the CAA teletype nets in the U.S.

It is recommended that the AAF maintain an affiliation with the Weather Service Organization of the American Civil Air Operators throughout the world as well as other American weather agencies operating in foreign fields. Such action will aid in the maintenance of a world-wide weather collecting service, will assist the AAF to keep abreast of meteorological developments in all parts of the world and will aid in the rapid world-wide activation of the AAF Weather Service or its equivalent in time of national emergency.

It is recommended that during peacetime, all U.S. agencies capable of productive meteorological research be employed in a well-organized program to continue improvement in weather forecasting techniques, meteorological instrument development and meteorological applications of new communications techniques with a view toward fulfilling the future requirements of the military weather services.

It is recommended that appropriate courses of instruction in the military uses of weather information be included in the curricula at the various Staff Schools. Commanders with this knowledge can utilize weather information to the maximum and are equipped to request the proper information from the weather services.

PART I

HISTORICAL DEVELOPMENT OF MILITARY WEATHER SERVICES

ORIGIN OF SYNOPTIC WEATHER CHARTS

It has long been recognized that weather could change the tides of war, but not until World War II has science offered militarists adequate tools to cope with this enemy. The destruction of the Spanish Armada by an unforeseen storm, the failure of Napoleon's Armies in Russia due to the onslaught of winter's cold, and the damage wrought to the combined French and British Fleets in the Black Sea during the Crimean War about 1855, are three instances where nature became the controlling element in the tides of battle. After this last catastrophe the French astronomer Le Verrier was commissioned to investigate the storm which caused such wide destruction, to determine whether it could have been predicted. Le Verrier collected all available meteorological data for Europe and plotted simultaneous observations on the map. By joining the points of equal atmospheric pressure (reduced to a common datum) with smooth lines (isobars) the contours marking the centers of high and low pressure appeared. A succession of these maps showed that a very intense storm represented by a center of low pressure had moved from England through Europe to the Black Sea in the course of a few days. This discovery resulted in the recommendation that weather observations taken simultaneously throughout Europe be collected by telegraphic means so that such atmospheric pressure maps might be constructed at regular intervals. It was thought that the study of these maps would lead to a better understanding of the laws governing the migration of the atmospheric pressure centers and their related weather phenomena thus permitting the development of weather forecasts. Le Verrier's proposals were adopted and the construction of the first weather charts based upon the collection of simultaneous observations over large areas began.

From these early beginnings, it became clear that communications would be the backbone of any meteorological service, because the rapid collection of weather observations from large areas is a prerequisite for the preparation and dissemination of accurate weather forecasts.

Progress in meteorology was relatively slow and by the end of the nineteenth century, the inability of meteorologists to fathom the laws governing the behavior of the atmosphere had discouraged many workers. Others turned their attention to the compilation of climatic averages rather than the prediction of current weather trends.

WEATHER SERVICES OF WORLD WAR I

At the beginning of World War I, methods of forecasting were not unlike those which were evolved from Le Verrier's investigations. A forecast was essentially a linear

extrapolation of existing atmospheric pressure systems. The advent of radio had permitted the inclusion of ocean areas on the weather maps of the early twentieth century through the transmission of ships' observations synchronized with those overland areas and some investigations of the upper atmospheric conditions had begun. However, the forecasts were of a very general character and seldom extended beyond periods of 24 hours with useful accuracy.

Weather service requirements during World War I stimulated advances in the science of meteorology. The beginnings of aerial warfare necessitated the inclusion of a third dimension in the weather forecasts. The meager weather information available to neutral countries from the vast expanses of the Atlantic as a result of wartime censorship led to intensive investigations in Norway on the structure of the subtropical storms which normally sweep from west to east in these latitudes, in an attempt to overcome the forecasting difficulties which had arisen. Norwegian meteorologists were successful in determining many of the physical characteristics of these storms through intensive surface and upper-air investigations from available sources of data. The forecasts prepared from the knowledge thus developed were used to guide the fishing fleets off the west coast of Norway in their efforts to relieve the food shortage of the country. It required one or two decades for the results of these investigations which became known as "Air Mass and Frontal Analysis" to find their way into general usage.

Although this important contribution to meteorological knowledge was not actually used in World War I, weather forecasts were prepared by both the Allied Forces and Central Powers in waging the war. The forecasts for the ground forces were rather general in character with the exception of those for the artillery which required observations of upper-air winds and estimates of upper-air densities, and those for chemical warfare which were necessarily quite detailed as to wind direction and speed, vertical temperature gradients and humidity. There were forecasts for air operations which, for that period, represented an advance over the usual surface weather predictions due to the inclusion of cloud thickness and cloud amount, upper-air winds and temperatures.

Climatic studies undoubtedly were consulted for determining the general characteristics of the weather at given seasons of the year and considered in planning major campaigns.

There were no long-range forecasts available to fill the gap between strategic planning from climatic data and the actual operational forecasts for executing a mission. In other words, tactical planning for a few days in advance necessarily was carried out without regard to the weather and must have frequently resulted in last-minute cancellations or changes.

The static nature of World War I and the extremely limited coordination between components of the armed forces greatly simplified the administrative and technical control of the meteorological services.

WEATHER SERVICES OF WORLD WAR II

In the years between World War I and World War II the science of meteorology advanced fairly rapidly due to the stimulus of expanding civil air services. There was a

general application of air mass and frontal analysis and an extension of the observational nets to the upper air. Beginnings were made in the field of long-range forecasting, particularly in Russia, Germany and America. The meteorological requirements of military aviation resulted in the formation of a U.S. Army Air Corps Weather Service.

At the outbreak of World War II meteorologists were trained in increasing numbers by the Air Forces in order to meet the expanding needs of the Weather Service in the event of U.S. participation. After Pearl Harbor, it became apparent that the U.S. Air Forces would be operating throughout the world and would, therefore, require a world-wide weather service. The AAF Weather Service was destined to play a dominant role in not only the operations of the Air Forces but also in the coordinated efforts of the Air and Ground Forces and the deployment of amphibious task forces for landing operations.

The Weather Service was called upon to provide three types of weather information: (1) climatic data compiled in suitable form for use in strategic planning; (2) detailed forecasts for several days in advance and estimates of weather trends for longer periods for use in tactical planning; and (3) detailed operational forecasts for the execution of specific missions. In order to develop the information required in (1) and (2) the Air Forces, with the assistance of the U.S. Weather Bureau, compiled statistical data from world-wide climatic records and prepared a 45-year archive of daily weather charts for the Northern Hemisphere. An extensive research program was initiated by the AAF in an effort to perfect long-range forecasting.

Beginning in 1942, the War Department General Staff and the Air Staff were acquainted with the uses of weather information as an aid to strategic and tactical planning and for the evaluation of enemy capabilities, through a series of weekly weather presentations in the G-2 and A-2 War Rooms. The recognition of the importance of weather forecasting in military planning by these officers who later became our field commanders enabled our meteorologists to be of greater service than might otherwise have been possible.

Apparently in Germany there was a tendency on the part of the High Command to disregard nature and its elements and to distrust meteorological personnel. Nevertheless, the types of weather information supplied to the Allied Forces were available to the German High Command. There is evidence that they began to make more use of the meteorological service in planning their operations as the tides of war went against them.

PART II

COMPARISON OF GAF AND AAF WEATHER SERVICES IN WORLD WAR II

GENERAL

There were several basic differences between the GAF and the AAF Weather Services in World War II. Among them were the following:

The GAF Weather Service was developed by expanding and militarizing the civilian weather service of peacetime, whereas the AAF Weather Service was a completely military organization expanded to meet wartime requirements.

The GAF Weather Service operated exclusively within Germany and the occupied countries utilizing existing facilities, whereas the AAF Weather Service operated throughout the world and was obliged to extend its observing nets and forecast services far beyond those of the peacetime U.S. weather services.

The GAF Weather Service supplied information to the Luftwaffe General Staff but exercised no control over the forecasts of lower echelons or other branches of the service. The Army and Navy had separate weather services. The AAF Weather Service had the responsibility of supplying forecasts to all branches of the U.S. Army and in some instances to the Supreme Commander of Allied Forces. (In the ETO, USSTAF was responsible for SHAEF weather information.)

The militarization of a peacetime weather service has the advantage of bringing into action a team of experienced meteorologists. The professional standards of such an organization will be relatively high. However, the administrative difficulties which arose in the GAF Weather Service through a weak, decentralized organizational structure, bickering at high levels and the fact that the professional meteorologists were not commissioned as army officers, thus restricting their knowledge of operational plans, nullified any advantages that might have been derived from the high technical standards of the organization. The AAF on the other hand inducted into the Weather Service a number of highly trained civilian weather experts both from the U.S. Weather Bureau and other civilian institutions to augment its nucleus of regular army officers. This action aided in the development of high professional standards in the AAF Weather Service and eliminated to a large extent the inherent difficulties arising when an essentially civilian organization, such as the German Weather Service, is placed under military control.

TRAINING

In Germany a comprehensive training program was inaugurated by the semi-military organization responsible for weather services in an effort to meet wartime

requirements. However, lack of coordination between this group and the High Command resulted in the induction of its trainees by the Army before they graduated.

In the case of the AAF an extensive meteorological training program was inaugurated both within the Air Forces and under contract to civilian institutions. The men undergoing this instruction were inducted into the Air Forces prior to their enrollment and were thus not lost to other branches of the armed forces during the course of their training. The high quality of these trainees, and the fact that a nucleus of the experienced men inducted into the service was maintained throughout the war within the AAF Headquarters and the highest command echelons in the theatres of operations, permitted the maintenance of professional standards comparable to those of the GAF Meteorological Service.

TECHNICAL AND ADMINISTRATIVE CONTROL

Centralization of administrative and technical control in the AAF Weather Service together with the complete coordination of forecasts throughout all command echelons and the emphasis which was placed on effective weather briefing of air and ground force commanders is believed to have resulted in a better use of weather information by the Allied Forces and an altogether more efficient weather service than that of the Germans. One example may be cited. In the European Theatre of Operations the centralized control of meteorological information was essential to the efficient operation of the various coordinating arms and services of the U.S. and Great Britain. The dissemination of divergent weather forecasts among these using agencies could have resulted in endless confusion. The necessary coordination was accomplished up to the time of the invasion of Normandy by the SHAEF Meteorological Section whose chief acted as chairman at daily telephone conferences between Allied meteorologists. This team of weather experts was composed of forecasters from USSTAF, the British Air Ministry and the British Admiralty. During the latter phases of the war the Weather Information Section of USSTAF was delegated the responsibility of providing operational weather advices to the Supreme Commander based upon an evaluation of the information available from all sources.

INSTRUMENTATION

Instrumentation was highly developed in the German Weather Service. They encouraged research and development in this field, resulting in the production of numerous and varied upper-air sounding devices and automatic weather stations. In this respect it is believed that the Germans were more advanced than the weather services of the Allied Forces.

In the case of the AAF Weather Service the responsibility for instrumentation lies with the Signal Corps. Although the Signal Corps has supplied the AAF Weather Service with instruments for determining upper-air conditions utilizing the same principles as those of the German Weather Service, it is felt that research and development in this field should be encouraged within and by the AAF. Such action would aid in the perfection of devices which might be required in the foreseeable future, such as a rocket meteorograph similar to the German device developed for flight in the V-2 and various type automatic weather stations.

REPORTING SYSTEM AND COMMUNICATIONS

It is believed that the GAF Weather Service had an adequate communications service and that their collection and evaluation of weather data was performed with an efficiency comparable to that of the Allied Forces. However, the communications problems of the German Weather Service were, in many respects, much simpler than those of the AAF. They merely converted their peacetime system to military use and exercised supervision over the existing facilities in the occupied countries, whereas the AAF was called upon to expand its observing nets to areas outside the U.S., in fact, to practically the entire world.

The Germans relied a great deal upon aircraft weather reconnaissance flights to obtain data from areas where reports were denied them. Their practices in this respect were, for the most part, similar to those of the AAF and other Allied weather services.

Installation of radioteletype for the transatlantic exchange of weather data during the latter phases of the war was an important development resulting from the demands placed upon the AACS by the AAF Weather Services. The use of line and radio-facsimile for the transmission of weather charts and briefing material from a central point to satellite air bases and command points was another innovation which was used effectively in the latter stages of the war.

There is no indication that the Germans used either radioteletype or radio-facsimile, but they did employ wire-facsimile to exchange weather information between weather centers and to transmit weather charts for the preparation of briefing material from their principal forecast center to the Air Staff Headquarters.

FORECASTING AND BRIEFING TECHNIQUES

The forecasting techniques employed by the Germans were, for the most part, analogous to those used by the AAF. The preparation of strategic studies from climatological data was carried out in an almost identical fashion by the two services. The German forecasts for 24 hours were prepared by generally accepted and more or less standard procedures and were exchanged between forecast centers in the form of prognostic weather charts showing pressure contours and air-mass boundaries. They prepared five-day forecasts of average sea-level pressures as an aid in the preparation of weekly forecasts and gave indications of monthly or seasonal trends when required. The AAF prepared prognostic pressure patterns and frontal analyses for periods of several days in advance. One chart was drawn for 1200 GMT each day of the forecast interval. Weekly, monthly and seasonal trends were issued as required.

Some of the techniques at Dr. Baur's Institute of Long-Range Forecasting were similar to those used by the AAF, particularly the methods of analogue selection using Baur's 60-year "Weather Type" calendar. However, it is doubtful that the information was used as directly by the German High Command as that of the AAF long-range units. Apparently, long-range forecasts from several sources were collected at the German Weather Center and an opinion then rendered to the officer responsible for briefing the staff.

At high AAF Headquarters the officers directly responsible for the preparation of the long-range forecasts were also required to brief the Commanding General and his

staff. In the course of their work the AAF forecasters were fully acquainted with the plans of the Commanding General, knowledge which aided in the presentation of weather information and placing a confidence rating on the forecasts.

It is believed that the confusion and indecision which could result on occasions from the rather indirect briefing of the German High Command may have been a partial cause for their distrust and rather haphazard use of meteorological information. Of course, the failure of their meteorologists to anticipate the invasion of Normandy must have seriously affected the confidence of the High Command in the weather service.

PART III

FUTURE TRENDS IN MILITARY WEATHER SERVICES

GENERAL

The value of a weather service can be measured by the completeness and accuracy of the weather information it provides and the confidence of the user.

In Part I of this report it was made clear that the science of meteorology and its military applications have improved steadily with the perfection of communications facilities and the extension of the observing nets, both surface and upper-air. For example, in World War I weather information was restricted to climatic summaries and the short-range forecasts which could be prepared from the relatively small portions of the earth's atmosphere from which simultaneous observations could be collected and evaluated within a reasonable interval after the time of observation.

In World War II longer range forecasts and more accurate and detailed short-range forecasts became possible through the development of relationships permitting the use of past weather data for the Northern Hemisphere in the development of forecasts from the daily collection and evaluation of observations from this same area.

A complete understanding of the laws controlling the atmospheric circulation must await the preparation and study of a similar archive record prepared from data representative of the entire atmosphere, both surface and upper air. To make use of knowledge acquired from such investigations, communications facilities must be developed for the daily collection and evaluation of surface and upper air weather observations, from the entire world.

INTERNATIONAL COOPERATION FOR METEOROLOGICAL DEVELOPMENT

Weather is one of the fields where considerable international cooperation exists. There have been international radio exchanges of weather information for many years. Such cooperation should be fostered and expanded during peacetime to permit continued research and development of the science and its applications in fields of human endeavor affected by atmospheric conditions. The meteorological requirements of civil and military aviation within the next decade will most certainly provide a fertile field for such a program. The perfection of radioteletype, radio-facsimile transmission and other technical advances in communications services will greatly facilitate this entire movement.

FUTURE WEATHER SERVICE REQUIREMENTS

The weather requirements for a war in the foreseeable future will be different from those of World War II. The weather service must necessarily be world-wide.

Even from a defensive point of view data from the world is essential if adequate policing by the Air Forces is to be accomplished.

Presumably the duration of such a war would be shorter and the operations less dependent upon weather than in World War II if we are to employ missiles propelled by atomic energy and loaded with atomic bombs. This would minimize the necessity for the preparation of numerous weather surveys for strategic planning such as those required in developing each campaign in World War II. However, there would be a need for certain types of short- and relatively long-range forecasts, particularly during the initial phases of such a war.

It is probably safe to assume that area bombing would be done through the use of guided missiles, strategic bombing of small pin-point targets by piloted aircraft, and the occupation of enemy territory almost solely by airborne armies.

The weather service requirements for strategic bombing operations carried out against pin-point targets would be very similar to those of World War II, certainly in cases where a visual target is desired. Base and route forecasts would not be as critical since the perfection of radar would permit a close approach to all-weather flying. However, forecasts of icing in clouds, visibility and vertical distribution of wind and temperature at the target and winds at altitude over the routes to and from the target would be required. Since targets may be at greater distances from bomber bases than in World War II, the forecast service would necessarily cover a larger area. However, increased speeds of aircraft would minimize the period covered by forecasts.

For area bombing with guided missiles a forecast of cloud thickness at the target area, icing in the clouds and winds at altitude throughout the trajectories would be required.

The difficulties of defense against either aircraft or guided missiles would undoubtedly increase during periods characterized by thick cloud, icing and turbulence.

The problems of landing airborne armies and resupplying such units would be very similar to those encountered in World War II. Future improvements in radar will aid in dispatching aircraft and in formation flying enroute to the target, but conditions for the drop and the landing of gliders in enemy territory should be reasonably favorable as to ceiling, visibility and wind. Thus a weather service comparable to that used by the Allied Airborne Armies in World War II is indicated.

ORGANIZATION

To maintain the required weather services the Air Forces must have access to experienced technicians. As in World War II these may be trained within the Air Forces and inducted from civilian agencies.

An organizational structure permitting centralized control of both administrative and technical phases of the weather service would be a prerequisite to the efficient operation of a world-wide organization. In the event that the armed forces are unified, at least in the higher echelons of command, it would be desirable to vest the control of the weather service at this level to ensure proper coordination of the forecasts for all elements of the combat team and to facilitate the coordination of all civil and military weather agencies in wartime.

COMMUNICATIONS

With the continued development of radioteletype and radio-facsimile, it will soon be possible to transmit required data, weather charts and briefing material from a central weather agency to outlying bases and combat elements in distant theatres of war. The advantages of such centralization were becoming apparent during the latter stages of World War II and it is felt that continued improvement in this direction will permit a marked reduction in the future personnel requirements of the weather service, particularly among the forecasters.

The communications problems of the AAF Weather Service in World War II have focused attention on the necessity of obtaining priority for weather traffic due to the perishable nature of this item. Experience has shown that although neither weather nor operational and administrative messages consume the entire periods available they are simultaneously at a peak when operational problems are encountered leading to the necessity of message priority, which has never been satisfactorily solved by a single net. It would, therefore, be highly desirable in the future to develop the AAF Communications Services so that administrative traffic and weather traffic are handled on separate and independent channels. Thus the weather service in a sense should control its own communications network. Since data from larger and larger portions of the earth must be collected and processed in the future, the functions of the weather communications facilities take on increasing importance.

WARTIME REPORTING SYSTEM

There is a possibility that the duration of World War III would be such that a single long-range forecast could be prepared to cover the entire operational period thus eliminating the necessity for the subsequent collection of data over enemy territory. However, we must be prepared to meet any situation which arises and, therefore, to continue the operation of a world-wide weather-observing net. In wartime it is customary to discontinue weather broadcasts or to encipher them. In order to obtain information over enemy territory it was necessary in World War II to use aircraft reconnaissance flights. The development of longer-range aircraft and the perfection of radio and radar cloud- and storm-detection devices with which they might be equipped would aid in overcoming temporary or permanent losses of such weather information. Another approach to this problem would be the development of instruments for release from guided missiles. Such instruments would be equipped with the required meteorological elements and radio-transmission devices to relay observations from the point of release to any desired reception center.

It is recommended that intensive research on such devices be pressed forward. In peacetime, automatic weather stations would be useful to obtain reports from remote points of the globe such as the arctic and antarctic regions. Such a program, coupled with the development of new instruments for exploration of the higher levels of the atmosphere, will extend the observational nets and provide the world-wide coverage of both the surface and upper air necessary to the development of any revolutionary improvements in weather forecasting techniques.

The counterpart of the mobile weather observing and forecasting stations attached to both our Tactical Air Forces and the German Air Corps in World War II

would probably be found in the future in the form of weather units which could be landed with airborne troops.

In peacetime, the maintenance of strategically located AAF bases throughout the world and affiliation with American interests operating world-wide communications and weather services, will aid in the development of international exchanges of weather information and the collection of data for research and development by the AAF. In the event of a national emergency, such bases and agencies would be valuable in obtaining suitable weather data for the immediate establishment of world-wide air-transport and combat operations.

ATOMIC ENERGY APPLIED TO METEOROLOGY

The controlled use of atomic energy by meteorologists may result in the synthesis of certain weather phenomena or forced local release of atmospheric instability since the magnitude of the energy within local convective storms and that required for the dissipation of fog is of the order of that available from atomic sources. Of course, the need for fog dissipation may be completely minimized in the near future by the perfection of blind-landing devices. Furthermore, it is conceivable that the peacetime applications of such concepts may be more significant than their military uses.

RESEARCH

In World War II the AAF Weather Service attained technical achievements comparable to those of Germany by pursuing an aggressive research effort particularly in the field of long-range forecasting. In peacetime it is imperative that research in the various fields affecting the future weather requirements of the AAF be continued and expanded. Such investigations may be carried on both inside and outside of the AAF.

Such a program is essential to our preparation for a war in the foreseeable future since its duration will undoubtedly be too limited to permit productive research as it was conducted during the period of hostilities in World War II. For example, it required from 1942 to the middle of 1944 to prepare the archive file of Northern Hemisphere daily weather charts which were essential for the preparation of adequate weather information in undertaking the invasion of Normandy.

Scientific research in the field of meteorology should be organized in a manner similar to that of radar and rocket-propelled missiles in World War II in order to prevent a return to the lethargy which has been characteristic of meteorological development in the past. An aggressive program under sponsorship of the AAF along lines similar to those pursued by the AAF in World War II should lead to continued advancement in both the pure science of meteorology and in its military and civil applications.

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AIR TECHNICAL INDEX

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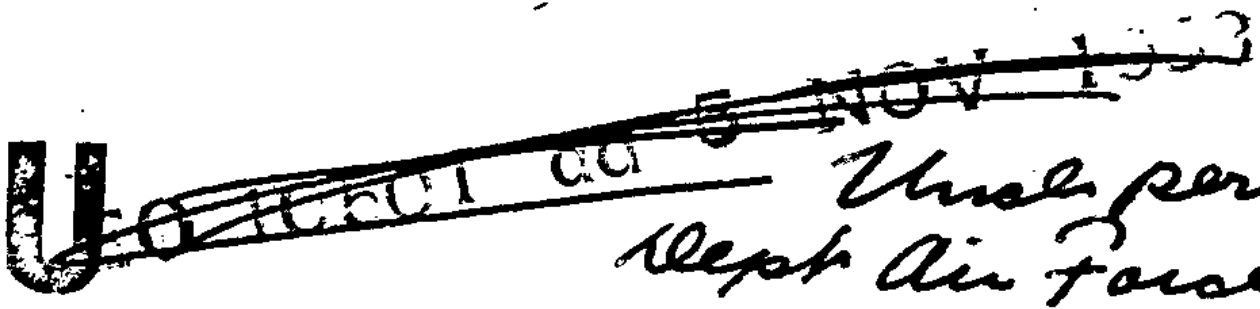

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