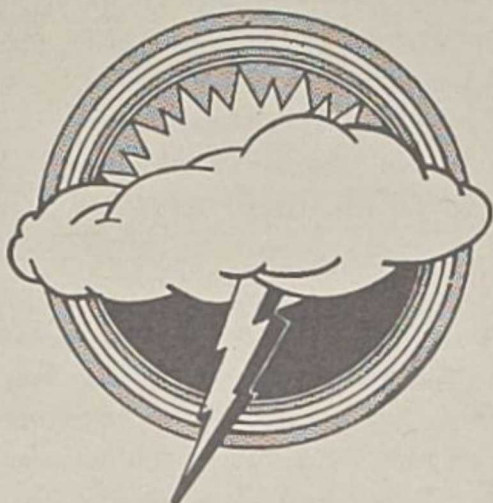


JUNE 1944

VOL. 2 NO. 1

WEATHER SERVICE BULLETIN

ARMY AIR FORCES HEADQUARTERS WEATHER WING
ASHEVILLE, N.C.



1ST WEATHER SQUADRON



6TH WEATHER SQUADRON



15TH WEATHER SQUADRON



25TH WEATHER SQUADRON

THE WEATHER SERVICE AS THE AIR TRANSPORT COMMAND SEES IT

MAJOR GENERAL H. L. GEORGE, Commanding General of the Air Transport Command, in a letter to Lt. Col. Clark L. Hosmer:

"On my recent visit to Grenier Field, where I had the honor and pleasure of decorating a representative group of the total of 59 officers and men of the 30th Reconnaissance Squadron, I had in mind to express my appreciation of the work of the weather squadrons, but a favorable opportunity did not arise."

"In my opinion, one of the most significant reasons why the Air Transport Command is operating so successfully in all parts of the world, and with such a comparatively low casualty rate, is the excellence of weather forecasting over our routes and the untiring efforts put forth to collect accurate weather information."

"I therefore desire to express through you my deep personal appreciation of the work performed by the officers and men of the 30th Weather Reconnaissance Squadron and all other individuals under your command who are, in any part, engaged in weather reporting and forecasting and to commend them for the superior devotion to duty they have shown in the performance of their arduous tasks."

MAJOR GENERAL ROBERT L. WALSH, Commanding General, U.S. Army Forces in the South Atlantic, and of the South Atlantic Wing, ATC, speaking to a conference of Base Weather Officers of the 22nd Region:

"...I don't believe that any service has improved or organized itself as quickly and efficiently as our Weather Service down here. I remember in the old days we had very few reporting stations at all and were greatly dependent upon PAA stations. We didn't have facilities and we had not worked long in this area. When I first got here, nobody ever looked at a weather chart---it didn't do any good to look at one anyway because there was practically nothing on it."

"Now it is much different. We have had a number of inspectors and representatives of many Headquarters in and through this area in the last four or five months, and I never hesitate and almost insist that they see our activities on the base involving the weather section... Only those of you who were here in the early days can realize what has been accomplished. ...We are getting weather sensitive, and that is a good sign; a compliment to you who have developed it!"



WEATHER *at the* FRONTS

by Maj. DAVID M. LUDLUM



The author was officer-in-charge of a mobile weather unit throughout the African and Sicilian Campaigns, providing forecasts and current data at fighter strips as they were hastily prepared just behind the line of Allied advance.

When the Italian mainland was invaded, Captain Ludlum was attached to Fifth Army Headquarters as Staff Weather Officer. The unsuccessful, though powerful, attack on Cassino of 15 March was delayed, then undertaken upon his advice. Lt General Mark W. Clark, commanding the Fifth Army, announced that the attack would be called 'Operation Ludlum' to mark the growing use of weather forecasts in Ground Force tactics.

Spectacular advances along the Italian Peninsula are being forced by a welded unit of Allied ground forces and tactical air support. The union of these two arms behind a common purpose has introduced the potent weapon of weather planning---always a fundamental consideration in aircraft operations---to Ground Force thinking. Experience of the Twelfth Weather Squadron in Tunisia, Sicily, and Italy has demonstrated that conditions of terrain and climate in the Mediterranean Theatre at least, are such that this liaison between weatherman and infantry can produce effective military advantages.

However, it was learned early that one cannot sit at Air Force Headquarters and conjure accurate pictures of rain and mud at the battle front: weather forecasters and observers must operate close to the scene of the fighting. Members of Mobile Units #2 and #7 sport three D-Day stars on their service ribbons for Gela, Salerno, and Anzio. They have always been stationed with front-line troops and with the Advance Command Post of the 12th Air Support Command.

AFRICAN

During the Battle of El Guettar in Central Tunisia, Lt. General George Patton's G-2 and G-3 called on the weather forecasters constantly. The first days of operation were held up by a series of Spring showers which rendered even that semi-desert country a quagmire---impassable for mechanized equipment. Later on, Major General Omar Bradley's II Corps received daily weather forecasts through the Air

Liaison Officer at the Ground Force headquarters.

The final drive on Bizerte was favored by an almost rainless three weeks. Both Air Forces and Ground Forces were able to employ their maximum strength and to break through to the coastal plain with unexpected speed. Such a combined operation could not have succeeded without clear skies and firm ground, as the British First Army learned in the atrocious Tunisian winter of 1942-1943.

SICILIAN

The Sicilian Campaign was short and snappy. Aside from the "Big Wind" on D-Day, weather conditions did not interfere with the thirty-eight days of fighting. Nevertheless, daily forecasts and up-to-the-minute reports on frontline weather, issued by the five mobile units of the Weather Squadron on the scene, were employed advantageously by both air and ground units. Much G.I. grumbling was at first directed "upward" for the orders which put all soldiers in woolen clothing. However, any man who spent a night in the mountainous interior of the island (where the mercury even in mid-summer sinks to the low forties), became thankful for the foresight of the 7th Army's G-2. G-2 had consulted the weatherman and knew the facts.

ITALIAN

Next to the Wehrmacht, the fickle Italian climate has proved the principal obstacle in clearing the Road to Rome. Both the Fifth and Eighth Armies were brought to a standstill for weeks at a time by adverse weather. Excessive rains and deep snows prevented the full employment of mechanized equipment; low ceilings and poor visibilities kept the great potential power of the Air Force in check. All the while, Jerry was perfecting the defenses of the Gustav Line.

The Fifth Army pushed northward from Salerno despite excessive autumnal rains, but at Cassino met a "bottleneck of weather." The mountain heights, crowned by the towering 5,000 foot peak of Mt. Cairo, were deep in snow. The valley floor below was rendered impassable by floods, largely because of enemy sapping which wrecked the Garigliano drainage system. The only all-weather route up the Cassino Valley lay

along Highway 6 around the foot of Monastery Hill. The struggle for this Thermopylae is current history.

Establishment of the beachhead at Anzio was largely an attempt to circumvent the Cassino strongpoint which weather and terrain had rendered almost unassailable. The initial landings were made under favorable weather, but an astute defense sealed a ring around this flanking move before sufficient forces could be brought ashore to exploit the first successes. Here again General Weather took a hand. The small harbor of Anzio-Nettuno lies open to the southwesterly winds which always prevail before the passage of a Tyrrhenian Sea cold front. Landing of supplies was difficult if not impossible. Ernie Pyle has written that one day of adverse weather did more to hamper unloading than a whole month of German shelling.

On the Eighth Army front even more unfavorable conditions existed. The Adriatic shore of Italy lies in an entirely distinct climatic regime from the western slopes of the Apennines. Frequent snows and low temperatures worked innumerable hardships on a force accustomed to desert fighting conditions. Units of the Eighth succeeded in crossing the Sangro River in the face of snow and ice, but subsequent floods prevented sufficient supplies from being brought across to continue the drive's initial momentum. Accordingly, the onslaught stalled short of its goal along the ridge of high ground running eighteen miles from the mountains to the sea.

Cassino then became a focal point of Allied strategy: to break the stalemate existing along the whole line by the complete obliteration of this strongpoint. Full weight of the Mediterranean Allied Air Force was called upon to reduce the city to rubble with an unprecedented concentration of bombs.

The attack was planned in long range for February 24th; or the next day thereafter that a short-range weather forecast would permit. The operation was a peculiarly difficult one in that the weather had to be favorable for both foot soldier and airman. Perfect flying conditions over all the widely scattered bases of the MAAF as well as over the target area in a narrow mountain valley were needed. Furthermore, the ground had to be firm so that a once-mounted mechanized attack could be kept rolling.

From February 24th on, therefore, the weathermen of the 12th Weather Squadron held control of the entire military situation in Italy. Day after day went by with some unfavorable element appearing on the weather map. Finally, after three weeks of waiting, the desired conditions began to unfold on the morning of March 14th. The go-ahead was given and on the following morning a force of five hundred heavy bombers dropped 1,500 tons on the erstwhile city of Cassino under perfect weather conditions. After a month's lull the assault on the Gustav Line had recommenced.

So weather does count heavily as a friend or a foe. The facilities of the 12th Weather Squadron have done much to assist the Allies in being on the right side. Mobile Unit #2 has progressed northward from Salerno with the Advance CP of the Fifth Army, employing its excellent communication system to collect and distribute weather data. Observers are posted with frontline troops and report hourly by radio in cipher to the weather trailer. Their messages are immediately deciphered and relayed to Intelligence and Operations Divisions of both Air and Ground Forces.

Tactical forecasts for twenty-four periods and outlooks for a week in advance are distributed by Headquarters to Corps; and Corps in turn distributes them to divisions and so on down the line. Issue of forecasts is timed to be up-to-date when they are introduced into staff and intelligence meetings.

Of strategic importance are the monthly climatic summaries containing the averages of weather to be met in battle sectors, present and prospective. Statistics from all over the world have been gathered by the Weather Division and put into a usable statistical relationship (see "Weather By the Numbers" on page 11). The "local" meteorologist can receive this information through the wide distribution of the Fifth Army's G-2 Bulletin and adapt it to his particular needs.

Frontline divisional commanders have constantly sought to have weather observers attached to their forward Command Posts, feeling that if they report weather conditions accurately, their requests for air support can be given more effective implementation by the Tactical Air Force. The weatherman at the front, then, is a major link in the long chain of cooperation between Air and Ground Forces which will finally shackle enemy military power.

METEOROLOGY

as a PROFESSION

by LT. COL. T. R. GILLENWATERS



Under the impetus of war, the national pool of qualified meteorologists has increased ninety fold; weather equipment has been refined and developed to meet exacting requirements; forecasting techniques have been tested and improved on the scales of global experience. Military and civil weather authorities know that the coming of peace will not limit the value of this huge system to human society, and have already placed into operation a program to facilitate its ultimate transition to a postwar economy. When the war ends, therefore, it is certain that an accurate and comprehensive weather forecasting service will be at hand to serve the convenience of individuals and to benefit agriculture, commerce, and industry.

Climate may always dominate the success of crops, but forecasts of daily fluctuations in weather can be utilized to improve plowing, planting, cultivating, harvesting, marketing procedures, and crop estimates. Highway and rail transportation rely on the meteorologist to aid in protection from flood waters and to assist the operations of snow-removal and maintenance crews. Large-scale utilities will know the economy of cloudiness and precipitation forecasts in anticipating peak loads on their services. Heating, air conditioning, and electric power production obviously become more efficient if they are tuned to fluctuations in the elements which they combat. Both synoptic and climatic information can provide commercial enterprises with profitable guidance in sales, planning, advertising, shipping, and the protection of perishables. It is possible to extend this list indefinitely without even a word about the grandiose plans for private and public aviation that will have to be associated with private and public weather services.

INDUSTRIAL WEATHER CONSULTATIONS

Let us make a random choice from among important industries to examine the details that may be considered by weather specialists in the solution of a specific industrial problem:

The repair of ships in peacetime requires daily calculation of labor-force size and composition---except for a small

permanent force, skilled workers are hired each morning according to the work available for that day. The scale of daily wage is high, therefore, making labor costs by far the largest single item in the final price. Yet the expensive gamble of hiring painters, cutters, welders, and shipfitters for outside work on hulls is lost whenever bad weather interferes; skilled workers sit idle while laborers make temporary shelters. Now, even after extensive preparation, prolonged precipitation diminishes the work output by two-thirds.

Contracts which call for penalties or bonuses on the basis of repair time can be adjusted profitably if the contractor will have been given information about how weather conditions will affect the working time. Often the acceptance of repair orders could be postponed so that peak labor use on dry days would be affected. Examples have occurred regularly where considerations of this kind would have saved enough in costs to pay a weather consultant for years.

An engineer-meteorologist, armed with advance knowledge of the weather, could devise a complete program to make ship repair efficient even under unfavorable circumstances:

1. Organize the sequence of work on a boat so that rainy periods will coincide with operations that are least affected by weather changes. Emphasize work inside the hull during the rainy period.

2. Run a special shift on off-hours to take advantage of better weather when it occurs.

3. Warn laborers *before* the incidence of rain to take necessary preliminary steps so that skilled personnel need not be interrupted at their jobs---erect canopies, affix guard wires, and erect temporary lighting fixtures.

4. Anticipate higher current demands on the powerhouse output that will be caused by weather changes.

5. Having investigated bioclimatologic effects on each of the worker classifications, post suggestions for wearing apparel a day in advance. In winter, workers must often leave the job to change an inept choice of clothing.

6. Add unsaturated hydrocarbon oils to paint supplies to provide for quicker drying when painting is to be done under damp conditions.

7. Order deliveries of electrical equipment, fuels, and high grade lumber on days when ground and platforms will be dry.

Labor and material saving details like these can be multiplied into an effective reorganization of industrial processes which will diminish the hazards of variable weather. The dual capabilities of many military weather technicians as chemists, physicists, and engineers certify that there will be personnel available to apply weather information in a manner that is modulated by understanding and experience with specific industrial problems.

PRIVATE OR PUBLIC SERVICE?

"With improvements in techniques, the opportunities of the meteorologist to play a leading role in agriculture and commerce will be multiplied. So long as the capabilities of the meteorologist were limited to broad advices and forecasts of the type commonly used by the general public, the demand could be pretty well taken care of by relatively few government meteorologists. As the capacity of the profession is developed to give specialized information, demands upon the meteorologist will increase a thousand fold: government weather facilities cannot then be sufficient to all demands upon them," William Burden, special aviation assistant to the Secretary of Commerce, has declared.

Further, "The businessman who can increase efficiency and reduce losses through use of more specialized weather information than that contained in forecasts for the general public will need to employ a company meteorologist for the purpose. He will want his individual interests kept constantly in mind so he can be advised whenever changes in weather will affect his operations. The possibilities in this field up to the present time have been utilized to some extent by the commercial air transport companies."

PROBLEMS OF TRANSITION

There are few Army weathermen who have taken any time from activities of war to wonder about their economic future in world at peace. The possibilities in meteorology as a commercial enterprise are potentially great, but the future's promise will not be realized automatically; that is to say, not without an understanding of the problems nor without adequate planning to meet them.

For example, a determination of the extent to which commercial aviation can

utilize the pool of weather equipment and personnel available at the war's close must hinge upon decisions of state that will be taken toward international air traffic. Fundamental policies of reciprocity may take precedence over the scientific desirability of retaining a weather and communications network to serve world-circling American airships. The immediate nature of this problem is that once these "flight control" installations are deactivated and their equipment is disposed, an almost irrevocable decision will have been made.

The AAF Weather Wing, the Navy Department's BuAer, the Weather Bureau, the University Meteorological Committee, and the American Meteorological Society have been cooperating in the solution of obstacles to professional use of all weathermen at levels for which they are suited. In particular, a Washington conference among the leaders of these groups was held in the first part of March.

The American Meteorological Society was chosen as the organization to act upon the major problems involved in expanding the meteorological profession in preparation for demobilization. A definite program was outlined for the solution of specific difficulties:

1. CREATING A MARKET

Expansion of commercial aviation may be expected to draw heavily on the postwar pool of weather technicians and equipment ---there is a long history of the valuable use of meteorology in aviation problems. However, it will be a more difficult matter to *sell* the use of weather as a "bill of goods" to diverse agricultural, commercial and industrial enterprise.

Not many men, acting as individuals, are dynamic and enterprising enough to put over these ideas to business leaders on a scale appropriate to their value. Furthermore, plans for reconversion of plants and schedules to a peacetime basis will already be well along before most meteorologists can expect to be released from wartime duties. Both of these points evidence the necessity for an accepted professional society to inform management now about the advantages to be expected from weather consultations.

'I would like to see the A.M.S. make a definite plan toward 'selling' private service,' said T. B. Marshall at the U.M.C. conference. 'The way to put this over is to have someone familiar with meteorology address the meetings of various industrial and commercial organizations. The assistance of the association secretaries should be sought!'

2. TECHNICAL QUALIFICATIONS

The question of professional standards and the existence of a recognized agency to govern those standards is an important one. The sudden advent of a great supply of meteorologists with all kinds of experience and training on the professional market will necessitate a careful codification of abilities to avoid competition and misplacement. The airlines and the government services will not err in selecting meteorologists, but industry, lacking a history of weather consultations, can become disappointed and confused by an unorganized approach of individuals.

Dr. H. Houghton is the chairman of an A. M. S. committee on the recommendation of personnel standards. A record of the training and experience of every meteorologist in the AAF weather service will be made available to this committee by the Personnel Division, Weather Wing.

A number of phoney weather forecasting organizations are said to be in operation in the Midwest and elsewhere. Apparently industry is so acutely in need of meteorological service that a surprising number of concerns have subscribed for forecasts that have no basis in science. Planetary movements reportedly are the basis for fake long-range predictions that bear a startling price tag.

"At present, business and industry have no protection against unscrupulous forecasting concerns," Professor H. R. Byers has said. "By plausible sales arguments, many of such firms have obtained large clienteles. However, we believe that manufacturing and business executives approached by weather forecasting services should, before making commitments, check with a local section of the American Meteorological Society, if one exists, or with the local Weather Bureau."

3. CURRENT LEGISLATION

Weather Service technicians have an uncomfortable relation to present legislative provisions for the economic security of demobilized veterans. The "G. I. Bill of Rights" and the National Selective Service Act offer concrete support for the postwar future of veterans in general, but many weathermen will discover that in their own case they can not or will not take advantage of these laws.

Unemployment insurance, hospitalization benefits, real estate loans, and provision for tuition plus subsistence allotments for education will be offered by

the "G. I. Bill of Rights." The advantage that weathermen may accept on this basis will be welcome, but except as an opportunity to complete an interrupted education, the law probably will have important effects only below the level of those who would remain professional meteorologists.

The guarantee by Selective Service that drafted job-holders will be reaccepted into the position they held before the call of war will be of little value to the very many who came directly from university life into the Army. The accent on youth in the Meteorological Cadet program (mathematical and physical theory is firmest in the minds of recent students), has given the Weather Service more than its share of scientists who have no permanent commercial connections.

Even where a weatherman does have a job to which he is entitled to return, the magnificent horizon that can be seen for postwar meteorology may prompt him to anticipate commercial use of the unique experience and education that has been afforded to those in the Weather Service. Why can not a weather technician expect a more remunerative and a more satisfying occupation in this newborn science than depression-ridden industry provided for him before 1942?

PROMINENT OPINION

Dr. F. W. Richelderfer, chief of the Weather Bureau, declared that there is already machinery in existence for expansion of the government weather service after the war to include weather men and equipment with a military history:

"We have authority to establish stations wherever the Secretary of Commerce decides they are necessary---and he would accept the recommendations of the Weather Bureau. Personnel can be demobilized and be accepted to the Civil Service rolls immediately. However, we soon get into questions of international policy. There are several agencies now working on the postwar organization of aviation."

"I think there is a real future in the development of private practice in the profession. Just how soon it will develop depends on just how rapidly private meteorologists can develop the ability to give a specific service that is superior to the general service that is the province of government. One cannot be too sure just how it will develop or of its relationship expressed in Mr. Burden's address." (See above).

"The Bureau itself can absorb a certain number of the young men who came

into meteorology as cadets."

Professor H. R. Byers, acting as chairman remarked:

"I hope that as much of the weather service as possible will be maintained intact. But we have been much aware of the need for employing the large numbers of men who will be available. The office of the U. M. C. secretary has, for this reason, for a number of months been sending out questionnaires asking whether private organizations would be interested in this service and what kind they needed. Mr. Marshall can give us a report on this survey."

REPORT OF T. B. MARSHALL

The committee has had no thought of operating an employment service in the strict sense of the term, but does intend to assist as a clearing agency between meteorologists now in the service and organizations with weather forecasting needs.

The survey included the sending of a letter and questionnaire to a long list of concerns picked at random from as varied a list of types of industry and business as could be compiled. All parts of the country are being covered; meat packers, department stores, newspapers, sports, (including yacht clubs and professional baseball clubs), oil and gasoline refineries, liquor companies, trucking companies, resorts, motion picture companies, construction firms, state commerce commissions, the steel industry, the automobile industry, the chemical industry, railroads, and manufacturers of all types.

In the first group of replies tabulated, only one of every six companies reported that the U. S. Weather Bureau now is supplying it with specialized weather service, but four out of five of the concerns said they would subscribe to the forecasts and reports of private meteorological services. Slightly less than one-third reported interest in receiving climatological reports and forecasts based

on normals for specified periods. Seventy per cent said they wanted a service providing forecasts of the weather 6, 12, 24 and 48 hours in advance, and 50 per cent wanted five to seven day forecasts.

A PERSONAL PROGRAM

What part can the individual meteorologist take in planning for the development of weather science as a major profession?

There are at least as many possible applications of weather knowledge to business problems as there are varied experiences in civilian activities among Weather Service personnel. This fact makes it possible for many army weathermen to equip themselves with plans that are original, unique, and effective for the profitable application of their meteorological knowledge to the phase of agriculture, industry, or commerce with which they are familiar--- a most valuable weapon to meet the economic crisis that is war's aftermath.

In addition, the American Meteorological Society, as the body which will organize and standardize the postwar weather profession, deserves the membership support of military meteorologists. The Weather Wing, the Navy Department, the Weather Bureau, and the University Meteorological Committee have charged the Society with responsibility for war veterans of the profession: the A. M. S. should therefore be able to represent and consult with these men as members. Further, the problem of financing an effective program for expanding meteorology's place among profitable livelihoods can be met in large part by expansion of the Society itself.

Finally, study and continuing effort to achieve an increasing competence in military weather duties* are necessary to keep that awareness of new methods and new equipment which will mean success in the evolving, competitive profession of meteorology.

* The definition of duty as a Weather Service forecaster, stated by Colonel Senter in "Evaluating the Forecaster" (Weather Service Bulletin, March 1944).





keeping the pace

by Maj. C. L. RAWSON

Technical Consultant Teams, composed of experts in pilot briefing and in the use of upper-air data for forecasting, will give a series of three-day seminars throughout the domestic regions in June and July. Forecasters from outlying stations will gather at ten key points within each region to take part in an intensive and methodical discussion of these techniques, under the guidance of weather officers who have become experienced in pedagogic methods as instructors in the meteorology schools. The plan will soon extend beyond this first phase of domestic forecaster seminars to include observers and other weather technicians in every corner of the world.

Twenty of these instructors have been selected for transfer to the Weather Wing from the Training Command to carry out a program for *decentralized* technical training. On 8 June, the instructors gathered at the University of Chicago to be oriented in methods for solving problems which are anticipated for the touring groups. A "team" for each of the domestic regions (made up of one civilian meteorologist, two forecasters and one briefing specialist) was composed on 15 June to begin tours of the regions.

The AAF School of Applied Tactics (AAFSAT) has trained the briefing specialists in the particular requirements of many different using organizations: Quartermaster, Engineer, Infantry, and Artillery for example. A manual of briefing techniques has been prepared at this headquarters to be the standard guide for weather officers in determining the "level of detail" appropriate to each using agency in weather briefing.

The forecasting specialists, products of the various schools of meteorological thinking (CIT, California, Chicago, NYU, MIT, et al), will present those concepts which link frontal activity with pressure, temperature, and moisture conditions in the *layer* between the surface and 10,000 feet. Vorticity, mean values of data in this layer, thermal wind relationships, and studies of convergent wind flow are to be considered in relation to expected weather patterns.

The highlights of these seminars are to be recorded and transmitted to this Headquarters. The Technical Advisor will examine these reports and prepare a technical bulletin, giving a methodical outline

of the subjects as they were treated, for distribution to all regions.

This undertaking is directed at a solution of the difficulties associated with a continuing, fundamental growth in the science on which the military mission of the AAF Weather Service is based. Not a single forecaster can be permitted to perform his responsible tasks unless he is equipped with the latest and best techniques that are available.

Up to the present, the Technical Training Command has maintained a flow of technicians, trained in the latest results of theoretical and practical experience, into the Weather Service. However, now that personnel strength has been multiplied by 90 in the past two years, the requirements for expansion and new men have been satisfied.

The *centralized* (or formal, scholastic) training of forecasters and observers has been abandoned, therefore. For example, the class of Aviation Meteorological Cadets which graduated on 5 June 1944 is the last of its kind at the universities.

The responsibility for keeping weathermen of the AAF in step with advances in meteorology, then, must patently be taken at this opportune time, in part at least, by the method of conferences with travelling experts. Men are reached on the job, and men are reached when they can examine the products of research in the light of field experience.

The two subjects to be covered by the Technical Consultants indicate the details which need the most careful attention by the Weather Service at the present time. Instruction in the use of upper-air data aims at an improvement of forecasting results: discussion of briefing procedures looks toward a more satisfactory use of weather services by various military activities.

There is yet another consideration which justifies this system: the domestic Weather Service has not reached that standard of efficiency which would satisfy its Commanding Officer. Now that whole-hearted attention has achieved success in growth and expansion of the service, an equal effort must be initiated toward a corresponding *refinement*. Technical Consultation Teams are playing a significant role in this project.

Over the Seas

by MAJ. LYNN T. IRISH

Forecasting at terminals to long, non-stop routes like that from Gander (Newfoundland) to Prestwick (England) involves several novel problems beyond familiar weather station responsibilities. In particular, the meteorologist is called upon to provide an accurate forecast of wind velocities for the whole course, well in advance of an anticipated takeoff; certainly before a detailed account of the winds by sections can be computed and often before a sufficiently recent pressure analysis is available.

On hops of transoceanic dimensions, the weight of fuel supply and the flight duration (both of which can be derived from a knowledge of the wind flow), loom large in planning the distribution and amount of payload. For most cargo and passenger transport the important variable of fuel load must be fixed well in advance.

Equally important requests for advance notice of the winds aloft are received. For example, arrangements for oceanic flights by inexperienced crews who have been assigned to combat aircraft must wait for a forecast of short flight duration.

The device used at this weather station (Gander) is to compute a "Zonal Index" from the gradient of pressure across the rhumb line course to Prestwick. Obviously this parameter is a measure of the west to east component of the wind along the route. A running history of fluctuations in Index

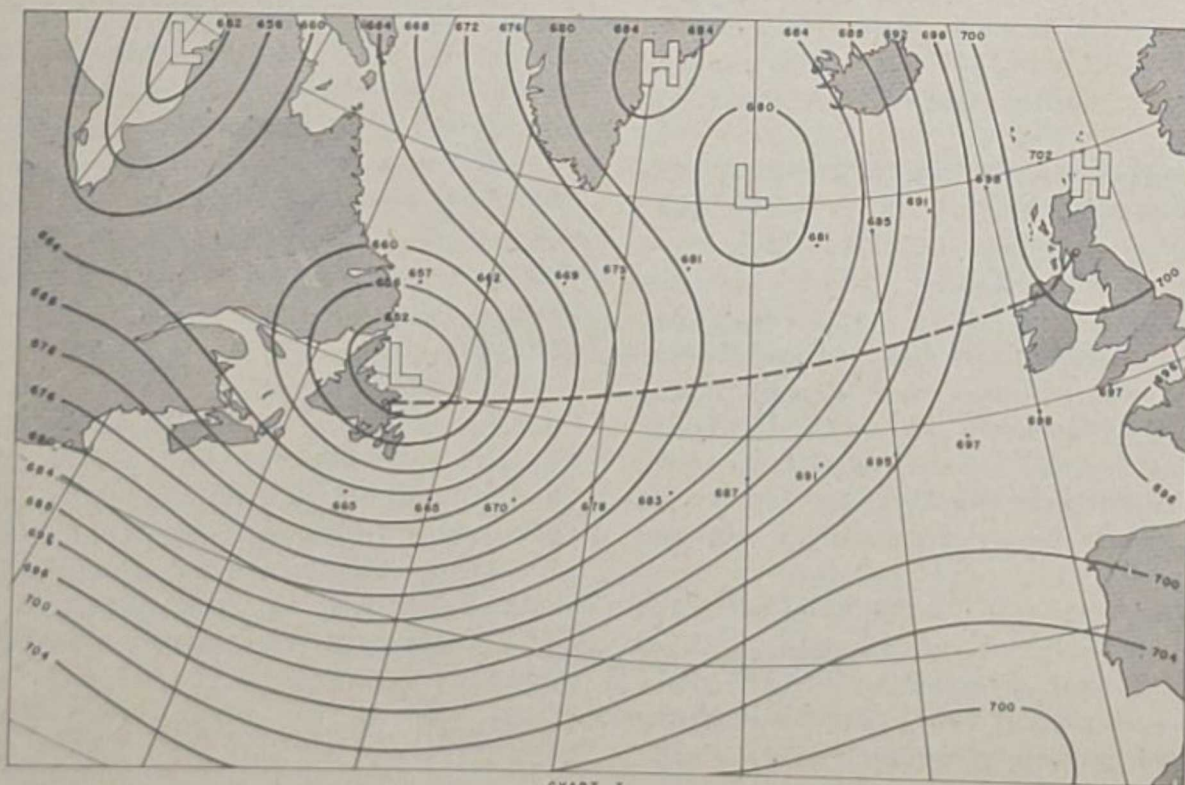
has disclosed that variations occur with a definite persistence; that is, a major oscillation of approximately two weeks occurs with only minor daily fluctuations. This continuity permits accurate extrapolation of the Index up to the expected time of departure.

Conventions which have been adopted in computations of the Zonal Index are as follows: Consider an imaginary line drawn parallel to, and five degrees of latitude to the north of, the rhumb line course to Prestwick (Chart I). Sum up the 10,000 foot pressures at the eleven intersections of this imaginary line with each five degrees of longitude along its entire length. In like manner, compute a sum of pressures along a similar line to the south of the aerial route.

The difference between these sums gives a measure of the pressure gradient across the rhumb line course, the Zonal Index. After a few months of operations, an experimental curve of Zonal Index in relation to flight time was derived empirically. Considerable success has and is being obtained in predicting flight durations and necessary fuel loads by this method.

If the difference in the pressure sum is divided by the number of five degree longitude zones *plus one*, then the dividend would be the Zonal Index expressed in millibars. Because of the necessity for regarding the route as a unit, this was not done. Chart II shows a portion of the account of Index changes with time that has been kept since May 1943.

The flight time of planes that have just landed after a crossing from England is an important aid in the forecasting of



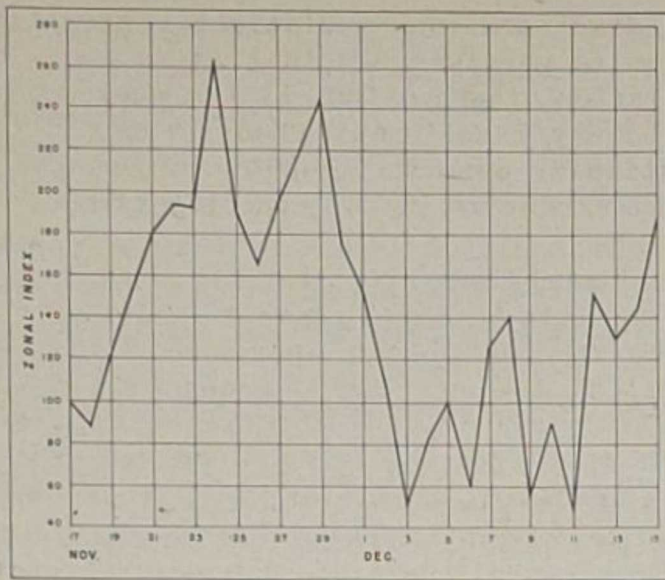


Chart II A history of Zonal Index values, showing their long-term (thus predictable) nature.

trends in the Index. In fact, when data for the upper air chart is sparse, such reports serve as a check on the isobaric analysis.

A reasonably accurate 10,000 foot map series for the North Atlantic is an obvious essential; fortunately, the present number of radiosonde and aircraft observations is adequate for most cases. A template which is marked with the aerial route and the parallel lines with their eleven points of intersection with meridians (as noted above) is a handy device to use with this method.

Over a period of several months, a careful study of the flight times of several types of aircraft under conditions of varying Index was made. The results have been codified in Chart III, which is a graph of the Index against flight time for various true air speeds at altitudes between 7,000 and 13,000 feet. It is believed that errors previously introduced permit the useful consideration of flight levels within 3,000 feet of the standard level from which the Index was computed.

The relationship between the westerly component of the wind and prognostic pressure differences for each section (in millibars therefore) is shown in Chart IV. If a wind forecast by sections is required, a prognostic 10,000 foot chart must be drawn compatible with anticipated developments in the pressure field and compatible with the forecast Zonal Index. It is then a simple matter to produce the direction and speed of the geostrophic wind.

The forecast Zonal Index will quickly give the total flight time before the detailed wind forecast by sections can be made. It will also serve usefully as an independent check on the subsequent upper wind forecast and as a check on the current and prognostic 10,000 foot analysis.

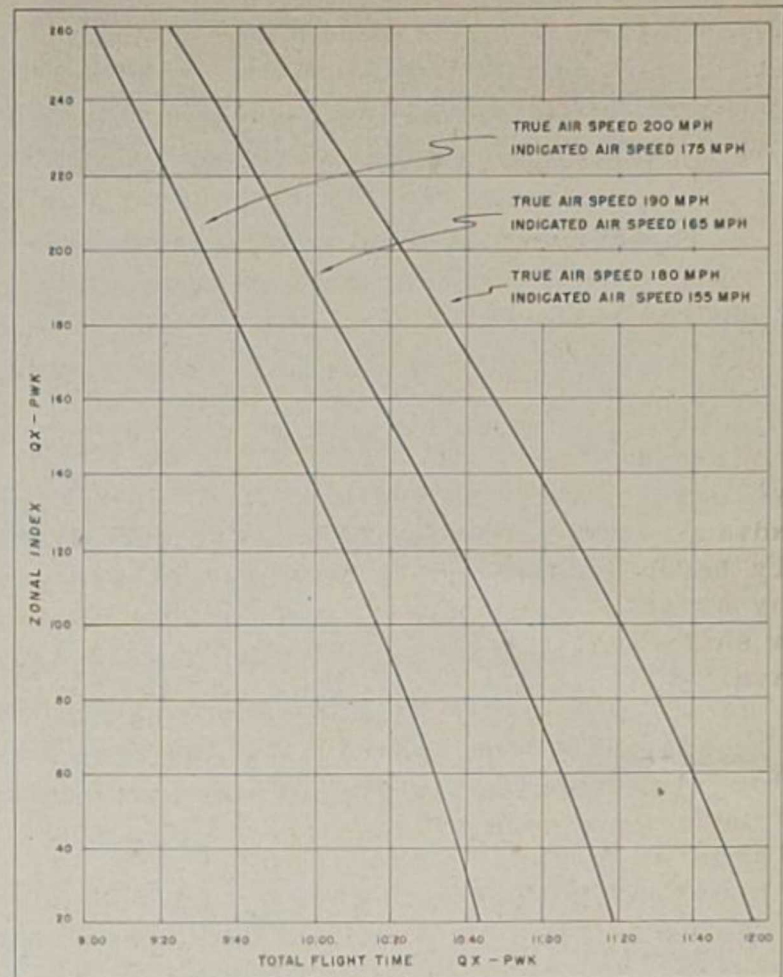


Chart III Graph for determining flight time when Index and Indicated air speed are known.

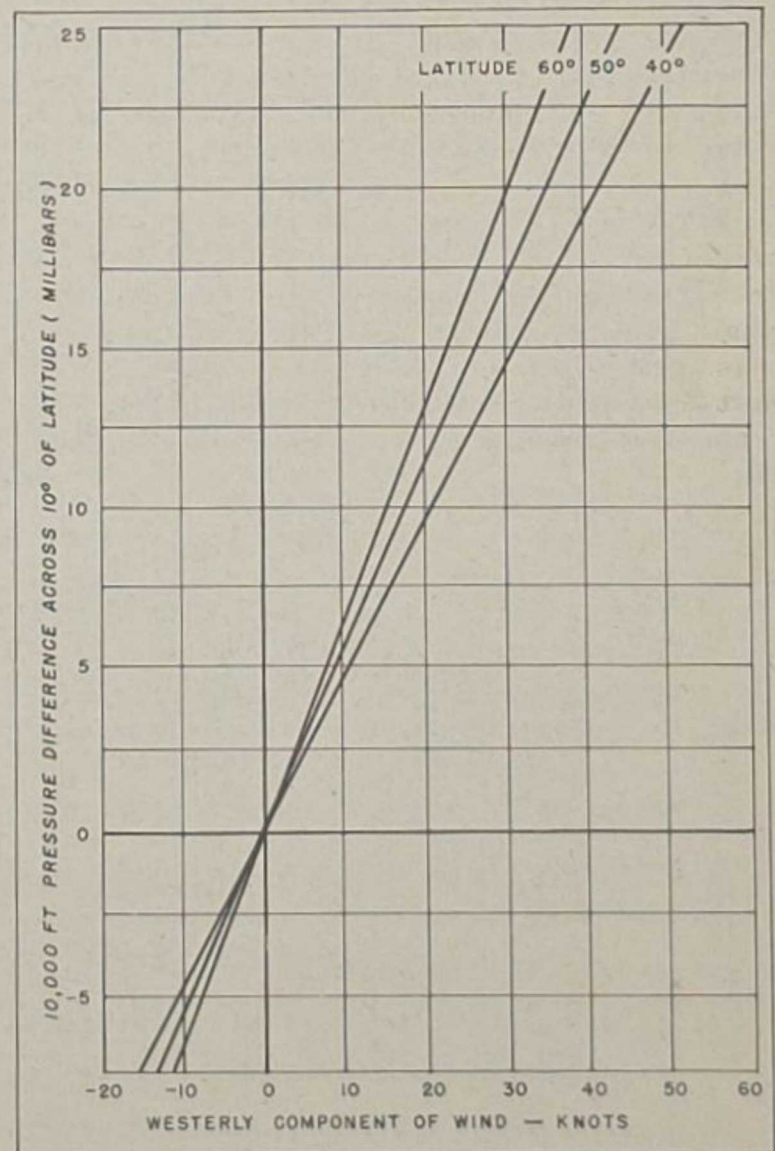


Chart IV Wind forecasting for each section, 5° of longitude in width, QX to PWK.

weather by the numbers

by Maj. J.R. DEHART



Everyone in the Weather Service knows what a tiring and monotonous job it is to make a copy of hourly records, bundle up the forms, make out a letter of transmittal, and send them through the R. C. O. to the Climatological Section in Washington. *How can a bunch of old weather reports do anyone any good?* Maybe you think that some stodgy clerk locks them away in a musty storeroom after other equally stodgy clerks have pored over them, made a few arithmetic passes, and come up with a meaningless total. The real story of the Climatological Section is this:

In the past year, severe modifications of classical climatology have been adopted to serve specific requirements of the Air Staff and the General Staff. Modern machine methods and a clear idea of operational needs now permit the preparation of information by which even day-to-day tactics can be carried out after the long-range plan has been accomplished on a climatic basis.

Consider, for example, the techniques adopted in preparing bombing missions from the Aleutians to the Kurile Islands:

Suppose submarines and reconnaissance planes could transmit a few signals directly from the target. If this were done, could a good synoptic analyst make the necessary detailed and long-range forecast from such sparse information? Could he advise on the choice of targets in the mountainous Kuriles where weather varies greatly within a few miles? The answer is, of course, that he could make a forecast, could give advice, but he would be skating on very thin ice. Here is where the Climatological Section enters the picture. They have a technique which provides the synoptic analyst with a codified experience, greater in detail and duration than any individual could have accumulated.

Climatic records have established that a certain pattern of target weather, suitable for the mission at hand, occurs when a particular type of cyclone makes its presence felt far to the east, at say, Kiska. Choice of a pinpoint with the best weather history in such a synoptic situation, as well as a good bet for a secondary target, can then be made by comparing records for each of the enemy stations with all of the others. Such statistical acrobatics are almost impossible for the unaided senses,

but International Business Machines reduce the problem to an easy solution.

Speaking in general terms, the present plan is to determine whether a particular synoptic pattern always produces the same target weather. If such a correlation can be established, restriction of the area and restriction of weather features in the analysis will produce very specific forecasting rules. Then only the sparsest of synoptic signals by reconnaissance or, better, a concentration of reports from the nearest friendly territory, will suffice for operational forecasting.

Great masses of weather data for those areas in which no AAF weather stations are located have been obtained. No less weighty and certainly more reliable are the stacks of Form 94 which have been arriving in Washington for many years. "Can't see the forest for the trees" is avoided through I.B.M. summaries from the raw data punched into such a card as shown in Figure I. Each hourly observation made by an AAF observer anywhere in the world has its final end in a pattern of holes!

Once all of the available data is punched into I.B.M. cards, the establishment of any intercorrelations that operations or research may demand can readily be performed. Consider a simple question first: "On how many observations in a certain area has the ceiling been less than 1,000 feet when the visibility has been less than one mile?" Machines buzz through 600 cards per minute, once for each qualification (twice in this case), and produce the answer.

A much more complicated question can be answered: "On how many occasions can one expect low ceilings, poor visibility, high winds, medium temperatures, and absence of rain, smoke, and fog within a 24 hour period in the month of April?" As might be expected, however, machine time increases in proportion to the complexity of the problem.

Even a simple summary from Form 94 will take several weeks if the records for a station under consideration have not been placed on I.B.M. cards. However, most of the period would be used in translating the weather data to code numbers and, in turn, punching them into the cards. This is a

tedious process of handwork, and necessarily precedes all machine operations.

Coders must be careful and skillful workers, and under wartime conditions such persons have been found to be as numerous in Pittsburgh and New Orleans, for example, as in Washington. So you can see that your Form 94 travels a long and devious route

before finally coming to rest in Weather Bureau archives.

Simplified summaries of weather records will be published just as soon as the backlog of old data now on hand can be handled. When this project has been completed, even the shortened delay in making climatic surveys which has been achieved already will be eliminated.



EFFECTS OF WEATHER

How serious can the effects of adverse weather be on the operational effectiveness of combat aircraft? Headquarters IX Bomber Command, directing B-26 bombers in strikes over Europe from England, has codified its experience into a quantitative answer.

This Bomber Command has compiled a study of weather's importance, because determinations of operating policy must hinge upon a knowledge of how far unfavorable weather can reduce the effective strength of a bomber force by preventing accurate attacks. For example, it was found that maximum effort---dispatching all available aircraft against all available targets regardless of weather---would result in somewhat less than one-half of the force being unable to attack.

If that one quarter of the targets least favorable from the weather point of view was ruled out, the number of "abortions" due to weather would be reduced to a little more than one quarter of the aircraft on the mission. If only the more

promising half of all targets was selected, just about as many bombers would return without having accomplished the mission as in the previous case. However, if a choice of the most promising third of all targets was made, weather "abortions" would fall to a miniscule figure and could be dropped from consideration.

Selecting only a small fraction of available targets is inconsistent with the strong effort demanded by strategy. Greater damage can be inflicted on the enemy by dispatching more aircraft and accepting a certain expectancy of lost effort due to weather. Decision of what percentage of objectives is to be turned down and when, its of course a decision for the individual organization to make. Certainly that decision will be based on many factors of which weather is only one. However, it is obvious that a proper appreciation of the relation between weather conditions and efficacy of effort can contribute much to important planning.

PRIVILEGE FOR STAFF WEATHER OFFICERS

Very many Staff Weather Officers are now receiving copies of the WEATHER SERVICE BULLETIN through the mail. Continuation of this service for such individuals whose mailing address has been changed will necessitate the forwarding to Headquarters Weather Wing, Public Relations Office, of both old and new addresses.

Staff Weather Officers who are not on the mailing list for the BULLETIN may request this service from the address given above. However, copies of Volume 1, Numbers 1, 2, and 3 are out of print and cannot be supplied.



GLOWBAL

by CPL. ALAN HARRINGTON



A raw gust of the northwest wind which dominated Newfoundland that day gave a dangerous tug at the pilot balloon in the hands of Pfc. George Smith. He turned so that the great white globule was sheltered by his body. As its lurchings subsided he had a chance to glance toward Sgt. Stanley Mingewski, who at that moment was glaring at the sky with more than a trace of chagrin.

On the northwest horizon a solid sheet of stratus had appeared. Smith saw it too and said, "That stuff is going to be on top of us pretty soon; maybe we ought to inflate a red one just in case."

"Not if we hurry it," his partner replied, somewhat nettled at having his choice of a white pibal seem unwise. He fixed on the visibility point and worked the theodolite screw until he had it just right. "O.K., let's go."

"Ready," Smith cried, "Warning!" He raised his arm, "There she goes."

The balloon lifted, spun, and whipped upward, and Mingewski sighted it toward the southeast. After jotting down several readings Smith remarked, "It's almost in the clouds already. I told you we should have used a red balloon; this won't last another two minutes up there."

Mingewski twisted the tangential screw right, then left, but the thin stratus was already on the pibal and he could catch only glimpses of its bobbing form.

"Can you see anything?" asked Smith, "I've lost it already."

"So have I; no, wait..."

"Personally, I think this run is a dead pigeon," said the recorder, "but anyway, warning!... Read it."

"Three five point seven," Mingewski began haltingly, "and...Two two three point eight."

Smith was laughing as he wrote the figures down. "You know you're kidding yourself. Let's call it a day... 'low clouds' ...and go home."

The run had reached that eye-straining stage where the shape of the balloon melts into the cloud contours, emerges again to tantalize the observer, and continues bobbing through the veil of clouds until the eyepiece seems to catch twenty different balloon shapes. Mingewski had a puzzled look on his face: "Hold it; I think I see something."

"Are you crazy? I don't see anything, but...well, there's a sunspot showing through the breaks." What Smith saw was a small, very bright disc burning through the sheet of stratus---to the Southeast.

"That's not the sun," Mingewski cried, "It's our balloon! No sun ever jumped around like that, and besides, what would the sun be doing way off there? The pibal is *above* the overcast and the sun is shining on the white balloon to give off that glow".

"So what about it?" Smith looked bewildered.

"Listen, so long as the overcast doesn't get too heavy, I'm going to follow that balloon up ten or fifteen thousand feet just by the reflection."

Smith stared at the shining, undeniably moving spot of light as might a spectator at the Hindu Rope Trick. "Alright," he said, "I see it, but I don't exactly believe it. Anyway, warning!..."

That day Mingewski followed the balloon through a 2,000 foot overcast to a height of 14,000 feet. Three days later, he tracked another white pibal for 10,000 feet through a thin, broken stratus deck. Thereafter whenever the opportunity presented itself---when a thin to moderate broken or overcast sky condition existed---he deliberately sent aloft a *white* balloon and, with few exceptions, stayed with the pibal until it travelled far above the cloud layers. The occasional failures of his *glowbal* runs he attributes, naturally enough, to deceptively thick cloud layers misjudged from the ground.

Glowbal runs, Mingewski explains, are possible only when the broken or overcast stratus condition is light to moderate, never when it is heavy. The height of the clouds seems to make little difference, for he has run a white balloon through an altostratus layer at 10,000 feet to a height of 20,000 feet.

A troublesome moment or two may be in store for the observer who uses this technique in the few minutes when the balloon is within the cloud layer, but when the sun has not yet had a chance to get at it. Although actual sight of the pibal may be lost for some seconds, an experienced observer can make a successful guess at the probable course from the trend of veloci-

ties while the object is still in actual sight. Barring an unexpectedly rapid change of direction, he should be able to pick the balloon up as soon as the sun begins to shine on it with full intensity.

Mingewski makes no claim that his *glowbal* technique is sensational: for all he knows, it may have been tried before. But he does claim, and he has recorded runs to prove it, that this method will succeed consistently in obtaining winds aloft data through thin to moderate cloud layers. In

other words, information can be obtained that is impossible to record with the orthodox red balloon under identical conditions.

Given that there are times when winds aloft information is vitally necessary on short notice, and thin overcast conditions hinder the effectiveness of a red balloon run, Mingewski's accidental experience on a Newfoundland hilltop may well turn out to be a valuable supplement to the weather observer's technique.

EQUIPMENT-O-GENESIS

It wouldn't take an old timer in the Weather Service to know that the instruments and equipment of a modern station can do the weather job more efficiently and in new ways than their counterparts of a month, a year, or a war ago. For every item that is added to tables of equipment, however, a hundred ideas for new devices are discarded. Unless new plans for weather equipment offer an efficient method for accomplishing a necessary operation that cannot be done as well (if at all) by existing arrangements, those plans will be turned back somewhere along the channels of evaluation that are routine for every weather equipment project.

Suppose someone in the Weather Service convinces his superiors that "there ought to be a gadget..." Headquarters Weather Wing then performs an examination to determine need for the novelty, its potential effectiveness, and possible duplication. Approval in this headquarters results first in the preparation of a summary giving functional and other military characteristics of the desired instrument, and then in forwarding the whole case history to the next authority---Headquarters Army Air Forces'

Of course General Arnold delegates his authority in the approval of weather equipment; and it is the Assistant Chief of Air Staff, Materiel, Maintenance, and Distribution who must place the next stamp of approval on the project. Favorable reaction in AAF Headquarters initiates action by the Signal Corps laboratories to experiment with and develop the original idea--and to forward models to Headquarters AAF for further review. Where a laboratory technician or an instrument manufacturer submits a new meteorological device to the

AAF for consideration, the steps are just about the same.

In any case, however, the models or samples submitted back to Washington by the Signal Corps are sent to the Army Air Forces Board at Orlando, Florida, for evaluation. This organization (a general technical advisory body to the Commanding General AAF, described as "Combat Laboratory" in *Air Force* magazine for March 1944) has for one of its functions the direction of equipment tests. One member of its Equipment Division is a weather officer who helps prepare "Test Directives" which pass the "burden of proof" of weather equipment to the Eglin Field Proving Ground and to the 26th Weather Squadron.

These agencies investigate the instrument's functions and limitations; whether a significant military requirement really exists or whether some present equipment or modification will serve as well; what tactical use the AAF can make of the project when it is completed; whether changes in the material or design would improve the device; and what the basis for its issue should be. Upon conclusion of the tests, a report is made to the AAF Board covering the items of the Test Directive. As one might expect, the report follows back along the path by which it reached Orlando to AAF Headquarters. Finally, a basis for issue is established, an initial quantity is procured, and the new equipment is finally available for distribution to the field.

It is apparent, then, that weather equipment which reaches field distribution has been given careful evaluation. On the other hand, no claim of perfection is made, and a welcome to original thinking from any source for improving and developing our present instruments is assured.

Doodle OF THE BAYOUS

by T/SGT. CARLYLE FRAREY



S/Sgt Neil Dautel, known to his ground crew colleagues as "Doodle", had lived in southern Louisiana all his life, and was amused no end that the army should send "damyankee" forecasters to his country to predict the weather. Although he was merciless when we of New Orleans Base Weather busted a local forecast, he overlooked our shortcomings enough to ask for our predictions nearly every day to check them against his own. As his interest in weather station activities grew, his spirit of competition was whetted no less.

Naturally he had little faith in complicated apparatus, and his distrust of the synoptic map and auxiliary charts was well known. Doodle expressed his philosophy succinctly: "I don't care what all them lines say, sergeant, it still ain't goin' to rain today."

We tolerated Doodle with a sort of *noblesse oblige* and laughed among ourselves about his theories. While he did hit the local weather sometimes, his errors were obvious enough. We were smug in our Elaborate Physical Explanations.

Doodle Hits the Jackpot

One day an unstable mT airmass covered Louisiana, prompting our forecast of "sctd tstms in lcl area." On other occasions the gustiness which accompanied such storms had been strong enough to imperil planes on the line, so now we kept close contact with the alert crew, headed by none other than Doodle.

When finally the sun had set and the cumulonimbus on the horizon had flattened out completely, we felt that most of our worries were over. The winds aloft seemed to certify that what few thunderstorms remained could not move in our direction--- "Go on to bed, Doodle," I told him when the crew chief next came in to ask about winds, "it won't rain or blow here tonight."

"You're wrong, sergeant," he asserted, "we're goin' to have rain here at nine o'clock. Wait and see. All them lines and colors don't mean a thing. What can you Yankees know about bayou weather?"

"O.k., o.k., you've got the ships tied down anyway; what the devil are you worrying about? Just the same, it's too late for us to get any storms now. Look around you, man! The clouds have all broken up."

"Just wait till nine o'clock," he said as he loped out the door, his muttering about "damyankees" dying away in the distance. There wasn't anything special to do until the observer finished the map. All of our ships were in, the Hondo cadets had not come over that night, and the ATC cargo ship wasn't due until 2230, so the dispatcher and I started a discussion about the virtues of southern women.

Pretty soon "Bing" Hale, the observer on duty, let out a yell: "What are you going to tell Doodle now?" Sure enough it was sprinkling, and even worse, it was just 2110.

"But then it's only a sprink ---" thought I when the whole sky opened up, a couple of jagged streaks of lightning lit up the northern horizon, thunder rolled around the sky a few times, and both Bing and I soaked up plenty of RW+ before we made the station. Doodle never let us forget that one; even if we had had a perfect record for the next year his deep, dark suspicions would not have been shaken.

Doodle Moves Up

After that little experience we looked on Doodle's forecasts with a new respect. They weren't perfect, but he sniffed out thunderstorms pretty accurately. He missed a time or two, but so did we. Certainly Doodle's warnings of rain caused us to peruse our maps and soundings a little more closely.

Our "Cajun" volunteer really achieved the phenomenal on the day when he spotted the first tropical storm of the season in late July. For six or seven days the heat had been oppressive, unrelieved by a breeze. We had been watching the development of a cyclonic circulation in the upper winds along the Gulf coast, but there was no conclusive evidence that a disturbance was brewing. Such a vorticity had developed before with weak waves in the Gulf, but nothing unusual had come from them.

On Friday Doodle collared me outside of Operations with the pronouncement that a hurricane was coming up and that preparations ought to be made for it. His record of success and that cyclonic circulation caused me to question him, but the reply, "The lake ain't right!" relieved my nervousness. Despite some skepticism, I spoke

to the officers and in solemn procession we marched out to the sea wall, climbed up, and surveyed Ponchartrain. To our unsophisticated eyes, the lake looked as it always had. "sctd Cu bcmng bkn at 1400 LST," we said.

Sunday morning, however, a veil of cirrostratus began to cover the sky, and the 5,000 foot wind at Pensacola jumped from 11 to 45 mph in a six hour period. After 1300, coastal pressures began to fall rapidly and we were certain of danger. The next forecast included mention of a "tropical disturbance." The Cajun had won again. The storm developed, as many readers will recall, and caused considerable damage along the Texas coast.

Proof that Doodle, good as he was, was no more of a forecaster than his people was given one day when he returned from a 3-day pass to his home at Lake Charles. "Hey, sergeant," he said, "there's something out there in the Gulf!"

This time we did think he was crazy. There wasn't even a cyclonic circulation aloft, and no one in our station had considered the likelihood of a hurricane. We questioned him closely to draw out his reasons for such a startling statement. "The lake ain't right" was familiar. His other evidence, though, was wholly new. "The ducks are flyin' high," he said, "and the Booglies are comin' out of the swamps; I saw 'em."

We were puzzled by this last offering and asked for an explanation. It developed that on his trip back to New Orleans he had noticed the swamp dwellers pulling out of smaller streams into the larger waterways

of Southern Louisiana with their most valued possessions piled high in their pirogues. They were on their way to higher and safer ground.

Two days later, while we were "sweating out" a clearance we'd given General Marshall, the official warning service notified us of a hurricane reported in the southern Gulf. The U. S. Weather Bureau began sending daily advice on its position and intensity. It moved slowly but surely towards the southern coast of Louisiana and recurved for Lafayette, midway between New Orleans and Lake Charles.

Our excitement increased as the storm moved closer to shore, and we were kept busy issuing hurricane alerts to the installations for which we were responsible. Doodle stepped with a pacific mien into the midst of this feverish activity. He assured us that there was no danger, that the storm would not be of any consequence, and that "the Booglies will be headin' back into the swamps as soon as it stops rainin'."

Both the Army and the Weather Bureau disagreed with Doodle and the Booglies, and retained their storm warnings. The forces of science were doomed with that opposition, however, and the hurricane promptly wore itself out over the Gulf!

Many forecasters who have listened to Cajun advice would be behind a move to enlist a platoon of the natives and issue them Cajun, ML- () one each to stations in Louisiana. Certainly few meteorologists are qualified to interpret the height at which the ducks fly or the "rightness" of Louisiana lakes!



\$205.20 FOR FAIR WEATHER INSURANCE

*Army Air Forces
Army Emergency Relief
Washington, D. C.*

26 December 1943

A check for the sum of \$205.20 is enclosed for addition to the Army Emergency Relief Fund on behalf of the group which was Aviation Meteorological Cadet Class 43-1 at the AAF Weather School, Grand Rapids, Michigan.

This money represents the excess of receipts over expenditures from the cadet graduation ball which was held on 6 September 1943.

*Vincent J. Stanley
2nd Lt., A.C.*



EQUATORIAL FRONT

by LT. BENNETT ROBERTSON



The effects of the Equatorial Front on weather along the Atlantic flying routes were discussed in the WEATHER SERVICE BULLETIN for March by Lieutenant C. K. Reynolds. In this article, the eastern, equatorial Pacific Ocean is investigated from the same point of view. Criticisms of these articles and original contributions based on forecasting experience at stations under the influence of the Equatorial Front will be welcomed.

Accurate predictions of weather along the western coasts of Central and South America are a powerful weapon in defence of the Panama Canal. The tropical storms of that area, which could hide the approach of an enemy task force, normally can be forecast only after examination of the position and activity of a major atmospheric discontinuity: the Equatorial Front.

This pronounced line of horizontal convergence separates the moderately strong Northeast Trades from the Doldrum Belt (the earth's "Heat Equator.") Northward movement of the Equatorial Front introduces stations in the Trade Wind Belt to the light and variable winds, the low flat pressure field, and the warm, moist, convectively unstable air mass of the Doldrums.

More significant for purposes of military aviation than this change of regime are the squalls, heavy precipitation, and cloud barriers associated with the northern boundary of the Doldrums. The southern boundary is not as important a discontinuity; it merely represents a limit to Doldrum instability. During periods of intense activity, however, squalls and showers may intensify and spread from the Equatorial Front to form large storm areas extending over most of the Doldrums.

Effects of Insolation

The General Circulation Theorem associates the Doldrums with maximum insolation, and observation does show that position of the "Heat Equator" is a function of the sun's declination. The Equatorial Front therefore can be expected to penetrate farthest into the Northern Hemisphere when summer is occurring there. Frontal trends lag behind the corresponding solar positions north or south of the Celestial Equator and do not even approach the Trop-

ics of Capricorn or Cancer. For example, the farthest penetrations of Doldrum air into each hemisphere are to 5° S. and to approximately 15° N.

As the Equatorial Front approaches the northern limit near Guatemala in the beginning of June, that area has its worst weather of the year. Four or five major disturbances in which the whole Doldrum Belt is covered with storms may be expected there in the month of June.

"Veranillo" or "little summer" brings a period of temporary improvement to Guatemala and the coast of Panama in a two to six week period during July and August. At that time, the Azores High is so well developed that its southwestern edge extends over the Caribbean and strengthens the Northeast Trades. A short dry season is produced off Guatemala because reinforcing of the Trades and increases in pressure force the Equatorial Front southward.

Equatorial Frontal weather returns to Guatemalan waters, then recedes in September, October, and November. In December, cold fronts move down from higher latitudes and produce fast-moving line squalls off the Pacific coasts of Guatemala and Salvador.

From May to November, then, the Front is well to the north of the Galapagos Islands, and no instability is noted there. In fact, a deck of stratiform clouds prevails in this period of dry weather, associated with a low-level inversion produced by low temperatures of the sea surface. Southeasterly prevailing winds and subsidence of a high-level inversion testify to domination by the South Pacific High over the Islands.

Break in Front

A significant point to be mentioned is the all-year, good-flying-weather route to the mainland from the Galapagos Islands. Analyses of the windflow below 7000 feet show a divergence in the circulation between 84° and 87° West Longitude which produces a semi-permanent break in the Intertropical Front. Squall activity is rarely reported here, and flying weather is consistently better than to the west or east.

Ocean Temperatures and Weather

The well-known fact that variations in the sea-surface temperature about a maritime station contribute to the development of stability or instability in the prevailing weather obtains in the case of the Galapagos Islands. For example, when the Equatorial Front is to the north of the Islands, upwelling of cold water south of the Islands is associated with the stratiform clouds and the low inversion mentioned above. From May to November, furthermore, the total precipitation near the coast in any one month consists of no more than a trace of drizzle.

With the movement of the Equatorial Front to the south of the Galapagos Archipelago, upwelling decreases and warmer sea temperatures are observed. January precipitation then changes to light showers; in the February to April period, more rain falls in any week than fell in a whole month when the surrounding ocean surface was cold.

"El Nino," a warm current found along the west coast of South America, achieves its greatest strength in February and March. An extraordinary southward extension of El Nino may be associated with unusual atmospheric disturbances. For ex-

ample, the Salinas and Talara stations have long climatic records of dryness, but reported heavy precipitation in 1943. Measurements of the extent of strong ocean currents are a useful tool, therefore, in weather forecasting.

Winds Aloft Data

Distribution of the winds aloft is a matter of concern to planners of aircraft missions in the Canal area. Flying north from the Southeast Trades, the lower level winds are observed to shift to southwesterly or westerly on entering the Doldrums. On gaining altitude within the Belt, the westerly winds veer to northerlies at 3000 to 7000 feet and then to easterlies above 8000 feet. At the northern edge of the Doldrum Belt, (at the Equatorial Front), another but more marked wind shift takes place in the lower levels as the westerly winds veer to northeasterlies and easterlies. In the Northeast Trade belt the winds are easterly up to 10,000 feet or more before shifting to the westerly Anti-Trades. The northerly winds at intermediate levels over the Doldrums appear to be an extension of the Northeast Trade circulation.

SHORT RANGE VERIFICATION RESULTS

Statistical evaluation of participation in the first 24 weeks of the current short-range verification program has recently been completed, establishing a ranking of field forecasters insofar as a numerical statement of forecasting ability can be made. The data available on participating forecasters who have submitted at least 12 completed forms is considered sufficient to warrant a reasonable judgment of relative, general forecasting ability.

These results summarize the forecasts submitted in the first 24 weeks of the program, from 4 October 1943 to 19 March 1944.

Each participating forecaster is assigned a grade on a relative basis; that is, the top 8% in the rankings are given a Grade 'A' classification, indicating best results. 'B' and 'C' represent the good and fair results of the middle group, 'D' indicates poor results, while 'X' is a disqualifying grade. The distribution of the grades is as follows:

Grade:	A	B	C	D	X
Number of Forecasters:	190	724	951	317	132
Percent	8.2	31.3	41.1	13.7	5.7

Tabulation of Results by Regions

	Forecasters Competing	Forecasters In Class "A"	Percentage In Class "A"
Second Region	180	21	.116
Fourth Region	622	63	.101
First Region	309	30	.097
23rd Region	331	25	.076
Third Region	495	29	.060
24th Region	212	12	.060
26th Region	49	2	-----
16th Region	3	0	

RANKING	NAME	RANK	REGION NO.	STATION	NO. OF FCSTS.
1	BOWERS, D. C.	2LT.	24	MEDFORD AF., ORE.	14
2	JORDAN, H. J.	MSG	4	SMYRNA AF., TENN.	82
3	WHITELEY, JR., G	CPT	2	ROMULUS AF., MICH.	17
4	CLARKE, R. F.	SSG	23	BRUNING AF., NEBR.	49
5	CARLSON, W. D.	2LT	2	CHANUTE FD., ILL.	14
6	HIRSCHFELD, W. P.	SSG	25	FT DIX AB., N. J.	23
7	KAUTZ, E. D.	MSG	1	TONOPAH AF., NEV.	60
8	BYRN, J. S.	2LT	23	COFFEYVILLE AF., KANS.	16
8	STOUSLAND, B. R.	2LT	23	MALDEN AF., MO.	18
10	REED, C. K.	1LT	23	ROSECRANS FD., MO.	33
11	COHEN, D.	2LT	4	HATTIESBRG AF., MISS.	54
11	TOYLI, M.	MSG	4	JACKSONVL AF., FLA.	28
13	MELHORN, W. N.	2LT	3	GALVESTON AF., TEX.	71
14	PETERSON, R. R.	1LT	1	SALINAS AB., CAL.	26
15	MOORE, R. L.	CPT	1	HAMMER FD., CAL.	37
16	BLUMENTHAL, J. H.	2LT	4	COURTLAND AF., ALA.	30
16	OLIVERI, A. S.	2LT	2	CHICAGO, ILL.	22
18	CAREY, J. R.	2LT	4	KEY FD., MIS.	32
19	JOHNSON, C. R.	2LT	4	GUNTER FD., ALA.	17
19	WUEBBEN, R. L.	SSG	3	HONDO AF., TEX.	14
21	SHANNON, JR., J. G.	1LT	3	PYOTE AF., TEX.	66
22	SHELTON, A. M.	2LT	2	BOWMAN FS., KY.	30
23	GREENE, P. C.	MSG	4	CHARLESTON AF., S. C.	38
24	ENGLANDER, D. L.	CWO	1	LOS ANGELES, CAL.	15
25	HOFFMAN, R. E.	2LT	4	JACKSONVL AF., FLA.	25
25	CAMPOCHIARO, J.	TSG	3	PYOTE AF., TEX.	38
25	JOHNSON, P. A.	2LT	1	FAIRFLD SUISNICAL	26
28	MACMILLAN, A. J.	CPT	1	PASADENA, CAL.	23
29	BLAKELY, R. F.	2LT	2	BOWMAN FD., KY.	13
30	PARSONS, JR., F. J.	2LT	2	CHANUTE FD., ILL.	16
30	KATZ, Y. H.	MSG	1	STOCKTON FD., CAL.	40
30	SCHUMAN, M. P.	SSG	1	PALMDALE AF., CAL.	44
33	GRAVES, W. D.	TSG	3	ABILENE, TEX.	84
33	BOENKER, H. F.	2LT	2	SCOTT FD., ILL.	15
33	DOAN, J. E.	TSG	23	MALDEN AF., MO.	50
33	HOFSTADTER, L. J.	CWO	2	PATTERSON FD., OHIO	22
37	ANDERSON, D. R.	2LT	23	STROTHER FD., KAN.	16
37	STOFFER, D. R.	2LT	2	STOUT FD., IND.	23
39	HARMS, R. W.	2LT	4	COURTLAND AF., ALA.	42
39	STELZER, M.	TSG	1	DAVIS MONTHAN, ARIZ.	22
41	SAUCIER, W. J.	1LT	4	GREENWOOD AF., MISS.	64
41	WORTHMAN, P. E.	CPT	4	ASHEVILLE, N. C.	43
41	DAVIDSON, M.	2LT	25	NEW CASTLE AB., DEL.	14
41	GRAY, B. G.	2LT	3	CLOVIS AF., N. M.	26
41	MOORE, P. P.	2LT	4	COURTLAND AF., ALA.	39
46	SNETTING, O. H.	SSG	1	LOS ANGELES, CAL.	17
46	TOMCHEK, E. J.	MSG	4	MAXWELL FD., ALA.	80
48	HOFFMAN, C. E.	1LT	2	CHANUTE FD., ILL.	46
49	JOHNSON, A. H.	TSG	23	LINCOLN, NEB.	30
49	MCCARTHY, W. J.	CPT	2	PATTERSON FD., OHIO	26

The reliability of the short-range verification program, of course, increases with the number of forecasts that are scored. Actually, it has been found that those who make a large number of forecasts receive somewhat higher grades than those who make few forecasts. This is not due to any imbalance in the scoring system, it merely reflects a fact; perhaps explained by the theory that proficient forecasters find it interesting to participate as often as possible. Nevertheless, it must be recognized that many who made few forecasts either entered the program only recently, or for various reasons are no longer assigned to forecasting duty.



REPORTS FROM THE REGIONS



REPORT FROM THE 23RD WEATHER REGION

TEMPLATES FOR FLYING ROUTES

The increased demand for cross-sectional forecasts at this station was a natural stimulus to devise a method for preparing them rapidly and easily. Nearly half the time required to prepare Form 23-A, often 15 to 20 minutes, was taken up by the necessity for depicting an accurate outline of the topographic relief along a route in question. Time used in completing clearance is a sore point with some pilots anyway, and a chance to shorten the process could be expected to excite a more favorable reaction to weather services.

T/Sgt. W. F. Moler conceived the idea of making templates or models of the topographic relief over the various routes from an air base that were flown by an appreciable number of planes. Meticulous care in the preparation of accurate terrain features on these models is worthwhile, since careful preparation of a template is repaid by the simplicity and quickness of tracing off the relief features on innumerable cross-sections.

Here's the method: Lay out the most commonly flown routes on a map composed of

several sectional charts. Select significant points of elevation above sea level along a line of flight, using the highest elevation within a 25 mile strip on either side of the direct route. Because of the small scale of Form 23-A (1 inch is equivalent to 5,000 feet), only changes of more than 50 feet can be considered representable.

Therefore, points determining the outline of terrain are entered whenever a differential of 50 feet in elevation with the last point is encountered. Stencil cardboard is probably the best material for the form.

A variable horizontal scale, diminishing with greater route lengths, is chosen for each line of flight so that the full course can be fitted on Form 23-A. The significant changes in elevation are plotted and connected by a smooth curve; the form is then cut out along that line.

When a cross-section forecast from, say home base to WA, is asked of the forecaster, he need only take up the template listed under WA, lay it on the Form 23-A, and outline the terrain for the route.

REPORT FROM THE 15th WEATHER SQUADRON

PICTORIALIZATION OF FORECASTS by Lieutenant W. Caspers

The General Staff of the Fifth Air Force receives its long-range weather forecasts as that "quick and clear picture" so often requested by airmen who are not meteorologists. The 15th Weather Squadron cooperated with operations experts to classify air missions into six major groups, nicknaming them with the initials "A", "B", and so on. Then weather predictions were fitted into one of these classifications; announced for example as *Rabaul DA10*, which meant that at the beginning of the forecast period this target would be in "D" weather, changing to "A" weather at 1000 LST.

Descriptive Weather Classes

Class A white	Less than .4 cloud Vsby 6 mi. or more	All types of bomber and fighter opns.
Class B yellow	.4 to .6 cloud btwn gnd lvl and 18,000 ft., vsby 6 mi. or more	No weather danger, but target occnly hid by clds. Full fighter cover ok.

Class C blue	.7 or more cloud btwn 10,000 and 18,000 ft. with .5 or less cloud below 10,000 ft. Vsby 6 mi. or more	Medium lvl bmbng below middle cld, Close fighter cover.
Class D purple	.6 or more cloud btwn 2,500 and 10,000 ft., Vsby 3 mi. or more	Bombing or straf- ing from low levels only
Class E orange	.6 or more cloud btwn 1,000 and 2,500 ft., or vsby 1 to 3 mi. Intmnt precip. Turb.	Occnl instrument flight, unsuitabl for bombing; stra- fing luck dbtful.
Class F red	.6 or more thick cld., bases below 1,000 ft. or vsby less than 1 mi.	Prolonged instru- ment flight condn Terminals closed; no operations.

The final form of the forecast is an area map that is splotched with colors, each representing the type of operation which will be feasible within its boundaries. The familiar association of red for danger, yellow for caution, and white for opportunity provides a universally understood key to the forecasts.



ABSTRACT

SPEEDING THE RADIOSONDE PROGRAM

Our prewar economic system produced articles according to the effective demand for them. The meagre requirements of the few sounding stations in peacetime existence bought only a minor place for radiosonde transmitters on the production schedules of the Friez Instrument Corporation and the Washington Institute of Technology.

Confusion in this production, as in many another, was produced by the sudden thrust of exorbitant demands upon these concerns by the emergencies of military and naval disaster in a global war. The domestic sounding network was to be doubled; radiosonde stations were to be established in foreign regions on ships, on islands, and over continents. The influence of the new emphasis on the use of upper-air data in forecasting had made aerial meteorological measurements a vital concern.

The novel exactions of war necessitated changes in design--unfortunately for hopes of a satisfactory production. Shipping damage, inroads of weather extremes, and deterioration in storage were accentuated by the great distance to and within war theatres. The hair humidity element gave no data at low temperatures and "lagged" at any temperature---precluding accurate forecasts of tactically important condensation trails.

The *Signal Corps Technical Information Letter* for March 1944 tells this story behind the complaints about the radiosonde shortage in the war's early years:

The Joint Meteorological Committee, various departments, of the Signal Corps and the Weather Bureau drew up a program in the early months of 1943 to eliminate restricting factors in radiosonde production and to improve the instrument according to its wartime duties.

1. Moisture and contact difficulties which had caused the failure of radiosonde relays to a serious extent were removed by a complete redesign of the instrument.

2. A large percentage of pressure element switching units had been rejected in factory inspections. The manufacturing procedures were expanded to include additional finishing processes. The production of a very fine surface finish on the commu-

tator at the factory can only be useful in increasing the number of usable sondes if that surface is protected from oil, fingering, and foreign materials after the instrument has been unpacked. Otherwise, frictional resistance and a poor contact connection may alter the indicated calibration an indeterminable amount.

3. The AAF, the Navy Department, and the Weather Bureau agreed to the use of a standard battery connector to avoid an existing duality in production.

4. Directions for radiosonde operation and repair were clarified by coordination among AAF, Navy, and Weather Bureau authorities.

5. "Get the equipment out!" had been the only possible answer at first to impossible quotas. Later, however, the introduction of a scientific production analysis proved successful in stepping up the output. Reorganization of the production line, the installation of improved testing equipment, and an improvement in the quality and distribution of the labor force overcame several obstacles.

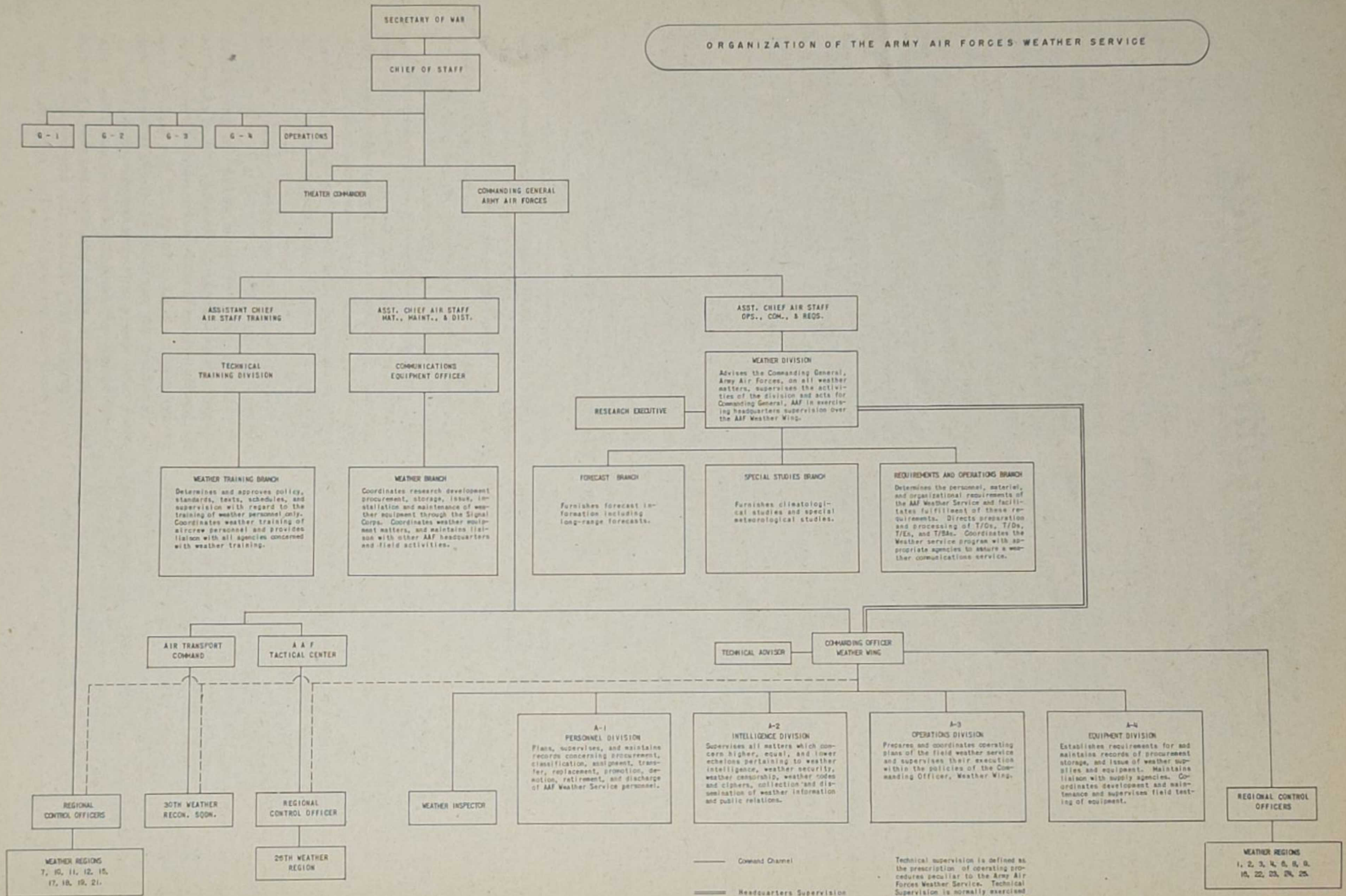
6. Substitution of a ceramic temperature element for the liquid-electrolyte element increased shelf life and decreased shipment breakage.

7. Two different types of hygrometers were being incorporated in radiosondes, leading to considerable confusion in production planning and in distribution of the specific type required by each service. A sweeping change to the electric hygrometer and 3-volt filament operation was introduced. (Headquarters, Weather Wing will answer questions about the new Radiosonde AN/AMQ-1-() described in #6 and #7).

8. The Fort Monmouth Signal Laboratory and the manufacturers of radiosondes have been instructed to perform a complete investigation of transmitter design to accomplish uniform and satisfactory transmissions.


It is certain that a far greater proportion, and a greater absolute total of radiosonde transmitters will be available and satisfactory for service as a result of this program.

ORGANIZATION OF THE ARMY AIR FORCES WEATHER SERVICE



— Command Channel
 — Headquarters Supervision
 - - - Technical Supervision Channel*

Technical supervision is defined as the prescription of operating procedures peculiar to the Army Air Forces Weather Service. Technical supervision is normally exercised through the medium of technical publications, such as technical orders and specifications, technical manuals, and regulations.



Headquarters Notes

A reorganization of the Weather Division, Headquarters AAF, has recently been effected in a manner shown by the table on the opposite page.

HYDROGEN GENERATOR DIFFICULTIES

1. Requisitioning Replacement Parts

The procedure for requisitioning replacement parts for ML-185, Hydrogen Gas Generator, is clarified by the following information.

This equipment is initially issued in two packages: one holds a cylinder and the other, all removable parts, spare parts, and other accessories. These two packages are not supplied separately, except in unusual circumstances.

Economy and limited supplies demand that *only the parts that are actually unserviceable* be requisitioned as replacement parts. If a valve body is defective, for example, the individual part should be ordered, and not the entire valve assembly.

2. Preventing Stripped Threads

Several Hydrogen Generator ML-185 cylinders have been damaged by careless use of the metal-tipped cleaning stick. Inserting and removing this stick has ruined the threads in the opening to such an extent that the threads on the large plug assembly, being of a softer metal, are also ruined. In some cases this has continued until the plug can no longer be held in the opening or is blown out under conditions of high pressure. To prevent such damage and danger, a protector for the threads in the opening on top of the generator is recommended for use during the cleaning operation.

Such a protector could easily be made by weathermen in the field from old tin cans or scrap metal. A style similar to a "top hat," without the top of the crown, would do the trick. The inside diameter of the opening at the top of the cylinder is $2 \frac{3}{4}$ ". The threads extend approximately $1 \frac{1}{2}$ " into the opening. The thickness of the cylinder at the opening is $\frac{1}{2}$ ". This width of cylinder at the opening would be covered by the brim of the "top hat", so that this inside protector would not fall down into the generator.

This thread protector must be removed when residue is being drained out. The

metal used in making the thread protector will otherwise be corroded by the residue and eventually be decomposed. After the residue has been removed, therefore, the thread protector and the threads themselves should be cleaned thoroughly.

GASOLINE ENGINE FAILURE

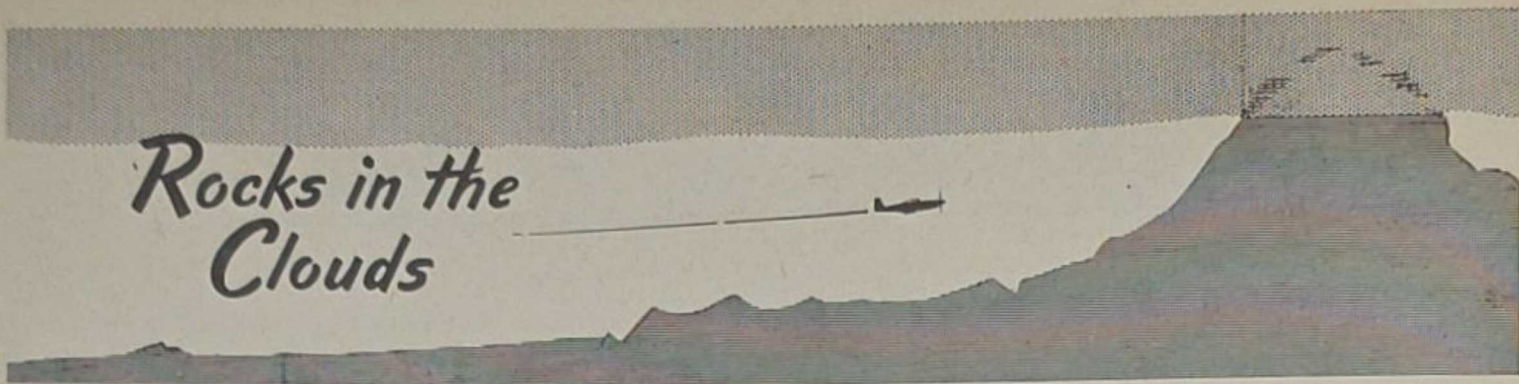
When Model PE-95 and similar gasoline engines fail after lengthy field use, their exhaust valves usually deteriorate first. It is well known that the burning of these valves is accelerated greatly by the organic compounds of lead which are added to gasoline issued for general field use. Adding a certain quantity of tetraethyl lead is done to increase the fuel's octane number to 80, but valve degeneration is not due directly to this higher anti-knock rating.

Inexpert opinion, in an attempt to explain valve failures, has falsely asserted that these engines have been designed to consume fuel of a low octane rating. Performance of engines on 80 octane gasoline is actually far superior to that obtained by lower-rated fuel. The practice of diluting 80 octane gasoline with kerosene has the disadvantage of lowering the engine efficiency without reducing (per unit of work output) the lead compounds which actually cause the burning of valves.

The Automotive and Power Branch of the Signal Corps Ground Signal Agency is attempting to eliminate valve failures caused by leaded gasolines. A chemical process which will "de-lead" the 80 octane fuel is under development. Of course, this method will introduce a lowered efficiency of the motor corresponding to the lower octane rating. Perhaps a more efficient means for preserving the life of gasoline engines, by improvement of the part which fails most readily, would be the use of Stellite (a chrome alloy which is extremely resistant to burning) in the manufacture of exhaust valves.

These projects are still in the first stages of experiment, however, and there is no known preventative maintenance technique at present. Replacement of the valves can be expected in periods which will vary from about 450 hours of continuous operation to 1,000 hours of intermittent use. The latter figure is more representative of field use, particularly where the engine is throttled down during part of its running time.

Rocks in the Clouds



Captain Warren Collins entered the weather station at Pecos, Texas, last December to complete clearance for flight in a UC-78 to El Paso. This event receives notice now despite its routine character, because Captain Collins and his passenger were burned to death in the wreckage of their plane shortly afterward. *Was there an incident connected with weather service that contributed to this disaster?*

The pilot did not have an instrument rating, and depended upon a forecast of contact weather conditions to permit his making the flight. Synoptic and sequence reports for the terminals and the reporting stations on route indicated overcast skies with a ceiling of 1,000 feet: the contact minimum. It was this information alone, apparently, that determined the clearance entry of weather conditions and classification of the flight as contact.

However, a study of sectional aeronautical charts, a familiarization flight over the route, or use of a contour map would have warned that Guadalupe Pass, at an elevation of 1,500 feet higher than that of the nearest weather reporting station, must be traversed on a line of flight to El Paso. Certainly the fact that mountainous terrain will produce lower ceilings than those experienced over a general area has been repeated at length, in AAF Memorandum 105-1 and elsewhere; yet the forecaster at Pecos was either oblivious to even such an obvious phenomenon, or else he was ignorant of relief features on the flying route. Either alternative describes an inexcusable and costly unconsciousness.

A forecaster must know the terrain along the routes for which he makes clearance entries. The ceiling height as forecast may verify from station reports, but hills, mountains, or ridges can stick up into a cloud deck to trap an unwary and unwarned pilot.

When weather conditions are reported just at contact minimum, issuing a contact forecast to a pilot who does not have an instrument rating is foolhardy. The Regional Control Officer of the Third Region said in the Accident Report:

"This office has repeatedly warned of this condition (instrument conditions may be anticipated in high, rough terrain when minimum contact conditions are reported at lower stations). Forecasts at contact minimum have been discouraged repeatedly."

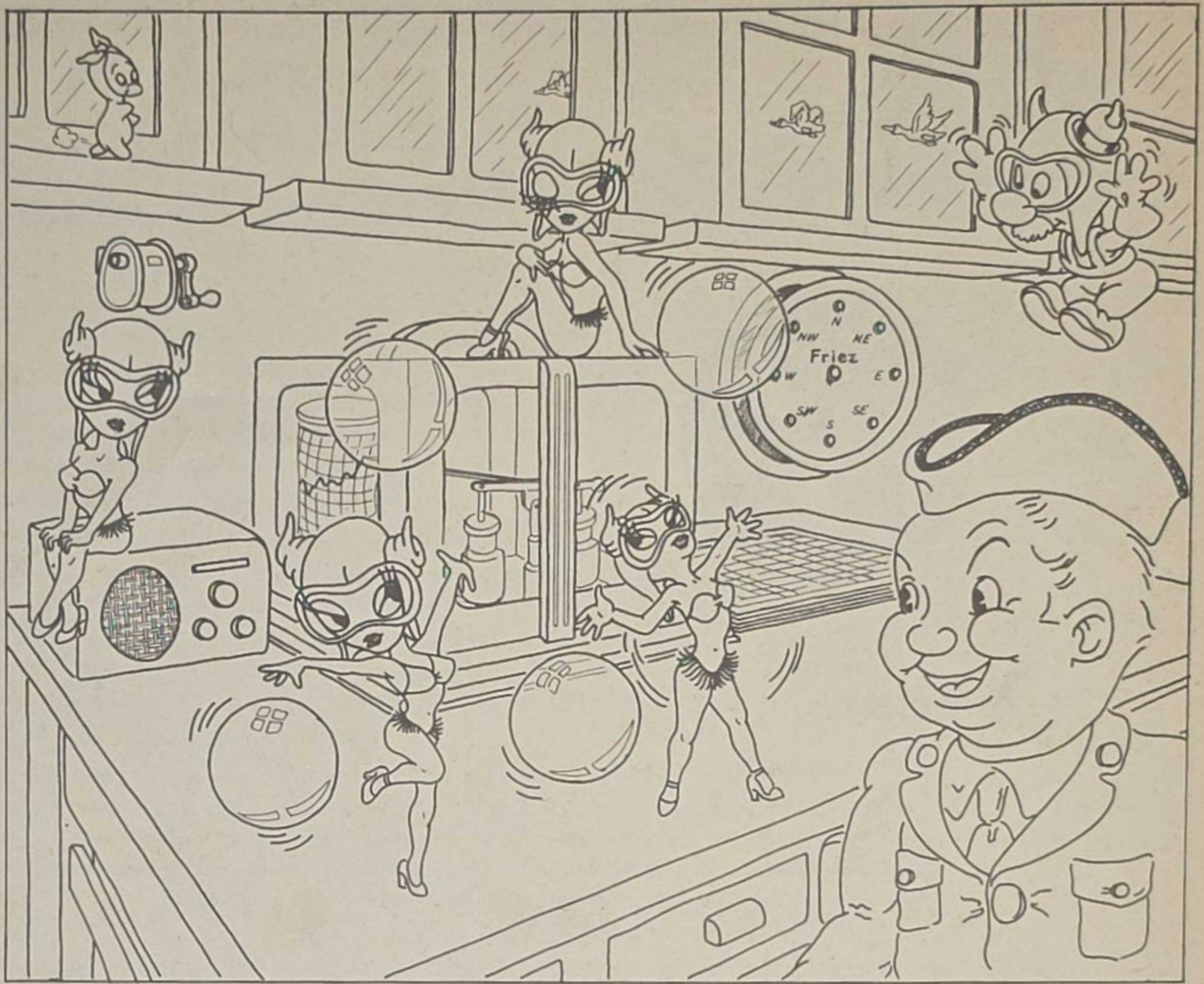
Are these admonitions too obvious? Old stuff? Just one month later, a P-38 was flown into the side of a 2,400 foot mountain that extended up through an overcast based at 1,800 feet. A contact clearance was filed in this case for a route on which instrument conditions were to be encountered with fatal results.



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D ON'T BLAME IT ON THE GREMLINS

HERE IS OUR OBSERVER BUSY

WAY UP IN HIS TOWER DIZZY.

THE CLOUDS MAY FROWN AND RAIN COME DOWN,

HE'LL BE ON THE JOB— BUT IS HE ?

FIFINELLAS DANCING BY

CATCH OUR HERO'S GLANCING EYE.

JUST WAIT AND SEE, HE'S SURE TO BE

OUR PRIVATE (J.G.)— BY AND BY !