WEATHER SERVICE *Bulletin*

ARMY AIR FORCES HEADQUARTERS WEATHER WING

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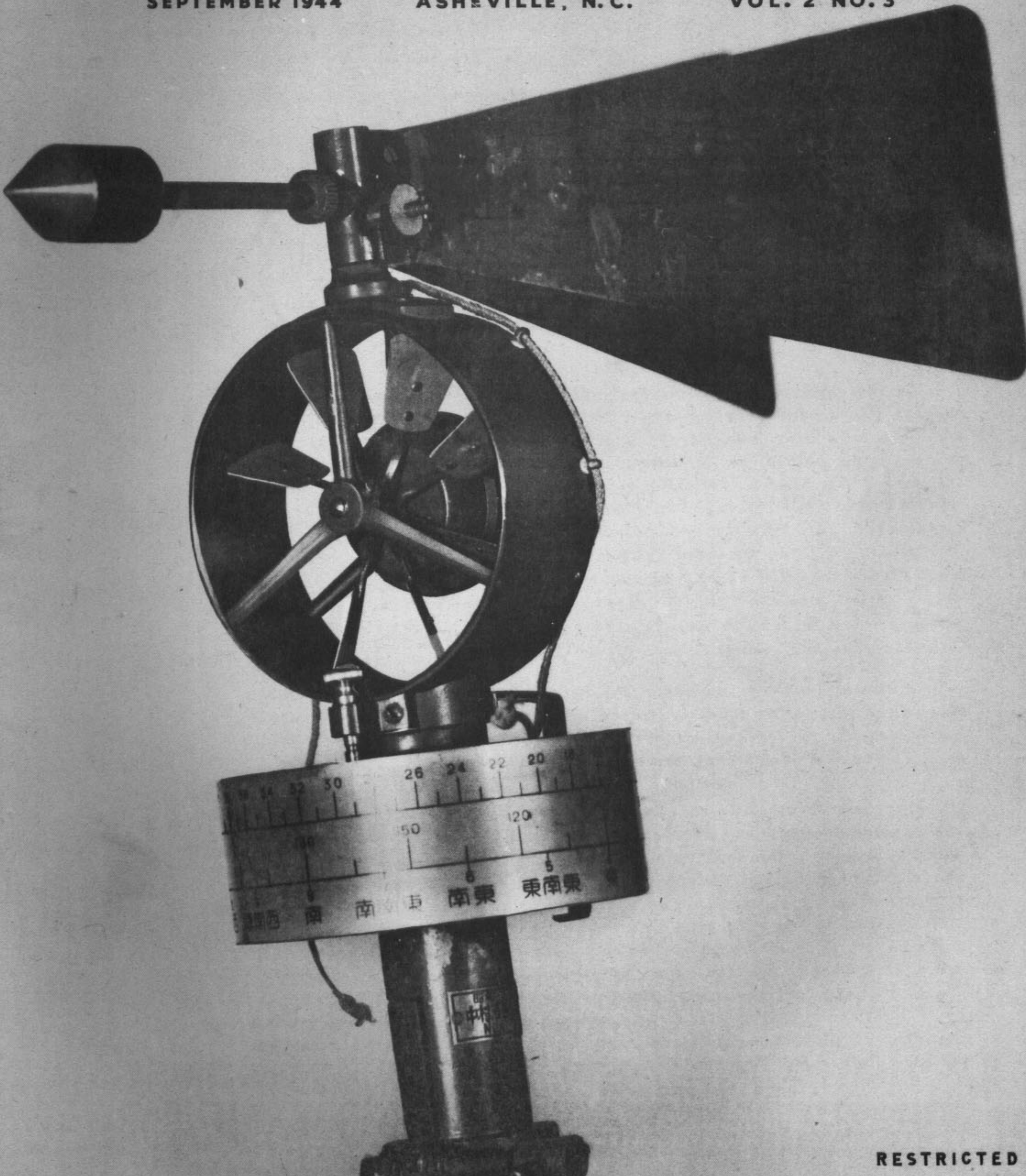

RESTRICTED

JAPANESE PORTABLE ANEMOMETER AND WIND VANE

The instrument pictured on the front cover was used by the Japs in the Pacific Theatre. It is a small (10" high; 13" vane), light-weight wind vane and anemometer combination. The wind vane not only serves to indicate the wind direction, it also keeps the fan-type anemometer faced into the wind.

Due to its small size, compactness, light weight, and ease of mounting the instrument is highly portable and is assumed to have been used by an artillery unit, or a mobile weather unit. Lack of weather proofing indicates that the instrument is not permanently mounted, but that it is installed for specific observations and returned to its case after the readings are taken.

The vane tails, anemometer blades, direction drum, and mounting sleeve are aluminum while nearly all other parts are brass. In general it may be said that while most parts are comparatively crude and of simple design and manufacture, the instrument is quite sensitive and well balanced.

An indicator assembly, integral with the anemometer, registers the passage of so many length units of wind. The indicator assembly is operated by a clutch (controlled by two strings), which actuates a pointer. The pointer is in turn geared to reflect the rotation of the anemometer fan blades, rotating around the face of a calibrated dial when a pull of the strings has engaged the clutch.

The procedure to be followed is this:

First, read the dial; second, engage the clutch at an observed time; third, one minute later disengage the clutch and take another reading. Simple calculations then reveal the velocity of the wind in meters per second, the unit used by the Japs.

A rotary pointer indicates the wind direction on a scaled drum which is graduated in three different sets of scalar units. Since the instrument has no remote indicating facilities, the observer must inspect the scales of the instrument itself to obtain data.

The instrument is orientated by means of compass mounted on top of the direction drum, and when oriented it is clamped to some type of spindle support. The wind vane and anemometer rotate together about a shaft attached to the stationary direction drum, and a pointer arm integral with the rotating parts extends over the edge of the direction drum indicating the direction from which the wind is blowing. The top scale on the drum is graduated for every 100 mils, the center scale for every 15 degrees, and the lower scale for 16 points of the compass. Around the edge of the base of the drum there is another scale graduated to the nearest 400 mils. It is assumed that this scale is used by an observer to obtain a direction reading when the instrument is in a position higher than his head.

SHORT RANGE VERIFICATION

by Maj K. C. SPENGLER, CHIEF, FORECAST BRANCH, WEATHER DIVISION

The more prominent questions of field forecasters about the Short Range Verification Program deserve discussion and forthright answers because these reactions are based on a widespread experience with this evaluation of relative forecasting ability. This report has selected the questions which have been asked often enough to indicate that the answers to them will be of general interest.

QUESTIONS AND ANSWERS

"Wind speeds and direction, at the surface and 10,000 foot level, are far more pertinent to a forecaster's main duty in behalf of aircraft operations and to understanding of weather relationships than surface pressure, surface temperature, or even rainfall amounts. Certainly the new upper air techniques attach less importance to surface temperature than to the mean temperature between the surface and 10,000 feet. It seems that a forecaster who managed to succeed in forecasting the required elements could still lack this information most important to his job."

It may be that there are certain primary weather elements which determine the general weather situation. However, there is ample controversy as to just which ones they are. The elements being used were chosen after long deliberation. The chief motivation was to use elements which are commonplace to all forecasters, and which are also important for flight operations. It was believed that the five elements chosen fill the requirements.

Pressure forecasts are a check on the accuracy of the prognostic pressure map and the gradient winds; surface temperature changes provide an indication of the stability characteristics of the air mass; while visibility, ceiling height, and precipitation are the critical determinants of the state of flight operations. To choose elements which may be more basic, but with which relatively few forecasters are acquainted as yet, would not imbue the program with the generality desired of it. In addition, a forecaster having a correct picture of the development of the weather situation will, in all likelihood, fare well with any reasonable set of weather elements. A poll of forecasters in the Weather Division as to their choice of elements which best indicate forecasting ability, resulted in four of the five elements used in the program ranking highest, with only visibility receiving a low rating. The retention of these five elements in the program is not hard and fast, for consideration is being given to the rotation of weather elements in a manner similar to that being used for the forecast terminals.

"What effort is made to avoid using the verifications of those reporting stations which regularly differ greatly from representative conditions because of micro-local effects? Is it expected of an Arizona forecaster to know that a light northwest wind at Chanute Field will blow from a smoky brick kiln over the Weather Station and cause reports of low visibility even when the visibility may be excellent nearby?"

The stations used in the program are among the largest terminals in the country. There are available to the forecasters a great many reports on these terminals which deal with just the sort of question asked above. Copies of these reports can be requested through the Weather Wing. In addition, a clue as to the effect of a particular wind direction upon the visibility of an air field can be had by examining previous maps when the wind was from the same direction.

The practice of using stations widely scattered over the country, and of rotating the selected stations every four weeks does tend to minimize the possibility of an unequal advantage accruing to one area or station. No satisfactory method is known of establishing nation-wide rankings of forecasters based on their performance with the routine forecasts made at their separate stations. This is because there are no uniform standards of comparison; the flight paths are different, the terminals are not the same, the lengths of forecast are not uniform, and the forecast situations vary in difficulty throughout the country. Thus, the generality attained with the present program would not be possible.

Apropos of this problem, an analysis has been made to determine whether forecasters have done better when forecasting for their own or nearby stations as against forecasting for more remote terminals. The results were negative; that is, there was no indication that they have forecast better for stations in their own area. It may be that the tenure of weather officers at their separate stations has been of too short duration to permit the attainment of sufficient familiarity with local factors.

"How is a just line drawn between those who choose to forecast on selected days of easily predictable weather and those who file forms at random?"

The device of score standardization, which is discussed in a following section dealing with revisions in the scoring procedure, has been adopted to remove the possibility of such an occurrence. The scoring procedure, as it now stands, gives scores which are independent of the ease or difficulty of the forecast situation. See the paragraphs on "REVISION IN SCORING PROCEDURE" which follow later.

"Why are certain elements required to be forecast to an extremely fine point---pressure to fifths of a millibar, for example? Unavoidable inaccuracies of observation, scale, reporting, and forecasting seem to preclude the realization of such accuracy."

The accuracy required on the forecasts is the equal of the accuracy with which these same elements are observed, for the trentile groups are taken directly from the observed data. Thus, the possibility of difficulties of interpretation due to differences in units between the forecast and observed values is averted. In addition, the use of maximum possible sensitivity in describing the forecast values of the elements gives the most efficient test. This means that the ranking of forecasters according to ability will be accomplished with fewer forecasts being required than would be the case with less discriminating measurements. This is because the scoring procedure employed is a deviational score which depends on the proximity of the forecast and observed trentiles, rather than being a score which merely grades the forecasters right or wrong. Thus, the better forecaster will tend, on the average, to place his forecast trentile closer to the observed trentile than will the inferior forecaster. The basic yardstick in this program is not the perfect forecast, but rather the standing of one forecaster as compared to the others. Thus, the men who receive the grade of "A" have not achieved perfect forecasts, but rather have succeeded in placing their forecasts of the elements closer to the observed than have those men with lesser grades.

"Forecasting for the Verification Program under the press of duties in a busy station is much more difficult than in a station where the demands of routine are lighter. How can a just balance be struck for this variable?"

This is a very common problem mentioned by forecasters. Its frequent recurrence makes it seem that the majority of stations are too busy to permit that an adequate amount of time be spent on each special forecast. However, it is suggested that this problem may also be due to the natural uncertainty attached to weather forecasting. The forecaster is seldom completely satisfied when his forecast is done, for the unexpected has happened all too frequently in the past. He feels that if he could work just a while longer he would produce a "hot forecast".
There are three factors which tend to remove these time discrepancies:

1. The assignment of a large number of new weather officers to the field in recent months will definitely ease the problem of personnel shortage at most stations, particularly after the task of acquainting these men with station routine has been completed.

2. The forecasters at the busier stations, particularly those who prepare clearances for flights over wide areas, become more familiar with the weather map and data in the course of their routine forecast than do those men at the less busy stations. As a result, the men at busier stations are better prepared to make their forecasts for the program. The less busy men, in order to obtain equal familiarization with the station, must exercise initiative by studying the weather at greater length than that required by routine duty.

3. In addition, forecasters are required to prepare daily 12, 24, and perhaps 36 hour prognostic maps as their part in station routine, as well as forecasts for their more important flight routes. This extends their scope of interest beyond the purely local weather.

Aside from these indirect effects, there appears no satisfactory way of allowing for this time factor by adjustment of the scoring procedure which will be fair to all concerned.

RESULTS OF ANALYSIS

A number of results concerning forecasting ability have been revealed through analysis of the data accumulated by the Verification Program. These results are of interest because they provide information relating to the accuracy attained with current forecast methods.

The availability of climatological data to forecasters appears to be of considerable assistance to them. Prior to the inauguration of the current program, an experimental program lasting 20 weeks was undertaken. In the earlier program, no climatological data were supplied to the forecasters. They were provided only with blank forms on which to write in their forecast values. In the present program, as is known, the climatological probabilities of occurrence have been placed on the forecast forms. Comparison of the first 20 weeks' scores of the new program with those of the old program showed that the accuracy of the forecasters has materially improved, and the only plausible reason for this improvement would seem to be the presence of climatological data on the forecast forms. This improvement has occurred in each of the four forecast lengths. The possession of climatology provides a frame of reference for the forecasters so that they do not make impossible or unlikely forecasts.

As has been indicated above, the accuracy shown by the forecasters varies considerably with the different weather situations involved. Breakdown of the scores by weather elements has shown that the major contribution to the variation of the total score has come from variations in two of the five elements--temperature and pressure. This has been revealed not only in the day to day variations of the total scores, but also in the differences between forecasters with widely different average total scores. Also, the level of accuracy attained on forecasts of temperature and pressure is above that shown on ceiling height, visibility, and precipitation.

The basis for this statement is given in the following table. It presents a comparison of the accuracy shown by the forecasters on the five elements. The score used gives 100% to a perfect forecast, and 0% to a random climatological forecast, which is a mechanical chance forecast made without regard for the present weather. It has been necessary to convert the trentile scores to this form of score in order to eliminate the lack of comparability introduced by the occurrence of multiple trentile groups in the climatological distributions of ceiling height, visibility and precipitation. The unavailability of the proper data does not permit the breakdown of the accuracy of ceiling height, visibility and precipitation and, as a result, their average combined accuracy is given:

RELATION OF FORECAST ACCURACY TO PERIOD AND ELEMENTS

Length of Forecast	Press.	Temp.	Ceiling, Vsby., and Precip. Combined
12 hours	70%	49%	40%
24 hours	42	42	30
36 hours	36	34	23
48 hours	28	21	13

This result may be indicative of the emphasis in formal forecasting instruction upon the direct prognostication of pressure and temperature. Ceiling height, visibility, and precipitation are predicted indirectly by means of the general properties of the air mass as indicated by its air mass classification, and by persistence as indicated by stations already in the given air mass. Thus it would appear from this table that improvement in forecasts of ceiling height, visibility, and precipitation to a level of accuracy comparable to that achieved with the pressure and temperature forecasts would contribute much to raising the general level of forecasting accuracy.

A valuable derivative of the Verification Program is information relating to the accuracy with which forecasters can, in general, be expected to predict the weather. Thus far, this information is available for the two elements of temperature and pressure. The accuracy is given in terms of the average absolute deviation of the forecast value from the observed, measured in trentiles. In order to interpret these data in concrete terms, the average value of a trentile in terms of millibars and of degrees Fahrenheit has been determined. It is estimated that one trentile is equal to a millibar of pressure or one degree Fahrenheit of temperature, on the average. However, there is a large amount of variation in the value of a trentile, both between stations and within stations, which somewhat disturbs the validity of the conversion which follows:

AVERAGE FORECAST ERROR BY LENGTH OF FORECAST
(1 trentile = 1 millibar = 1 degree F.)

Forecast Length	Pressure	Temperature
12 hours	3.0 mb.	5.1° F.
24 hours	5.8	5.8
36 hours	6.4	6.6
48 hours	7.2	7.9

Thus, the table shows that the average field forecast of pressure for a given station, 12 hours in advance, is within 3 millibars of the observed value, while the error in temperature for this same forecast is about 5° F. The greater relative error in the temperature forecast for 12 hours as compared to the error in pressure (when both are judged against their respective 24-hour forecast errors) is probably due to the greater difficulty experienced by forecasters in predicting the diurnal effect which exerts a strong influence on the 12-hourly temperature change.

A practice found in weather forecasting is that of "hedging", or of being conservative when the developing weather pattern is not easily predictable. A convenient method of "hedging" is to use persistence, which consists in forecasting that the present weather will continue into the future unchanged. A persistence forecast is particularly accurate for the shorter length forecasts, that is, under 24 hours. Nevertheless, comparison of the forecasters' scores for 12-hour forecasts with 6, 12, and 24 hours persistence forecast scores indicates that the forecasters are much superior to persistence. Thus, almost 75 percent of the forecasters beat 6-hour persistence with their 12-hour forecast. This comparison is particularly pertinent because it is possible, under the regulations of the program, to use hourly sequences or other data up to 6 hours after the synoptic hour for which the forecast is made. About 90 percent of the forecasters beat 12-hour persistence, and 99 percent of the forecasters are superior to 24-hour persistence with their 12-hour forecasts. It would, therefore, appear from these statistics that the forecasters cannot rank high by "hedging" on their forecasts through the use of persistence.

REVISIONS IN SCORING PROCEDURE

The present program is the first large scale operation of its kind ever undertaken. Therefore, without the benefit of previous experience to fall back on, it has been necessary that the program develop and adjust itself on the basis of its own operation. As the program has progressed, considerable variation in the daily average trentile scores has been observed. (The details of the scoring procedure used in the verification program are presented in the "Short Range Verification Program," Report No. 602, prepared in Headquarters, Army Air Forces, Weather Division, November 1943).

This variation places a premium upon forecasts for "easy" days, that is, days for which the average trentile scores of all forecasters participating is relatively low. In order to avoid penalizing men who submit forecasts regularly despite the particular situation, the scoring procedure has been amended. This change is furthermore desirable since one of the aims of the program has been to determine rankings of the forecasters which will be independent of the forecast situation.

To accomplish this, the forecast scores have been "standardized". Essentially, score standardization ranks the forecasters within each day's forecast, and permits the valid averaging of scores on different days by making the standard scores independent of the forecast situation. The introduction of score standardization has added considerably to the reliability of the scores as an index of forecasting ability.

A further interest of the program has been to obtain overall scores which will represent a valid combination of forecasters' scores on the four different lengths of forecast. Such a scheme was devised making use of the first 24 weeks of data. Weights were assigned to each of the forecast lengths in proportion to the reliability with which each measured forecasting ability. The reliability was found to fall off with increasing length of forecast. The 12-hour forecasts were most reliable and the 48-hour forecasts least reliable for this purpose. By applying these relative weights to the respective average scores for each length of a given forecaster, his overall forecasting score was determined.

In order to convert these abstract scores into terms more understandable to the users of these results, a program of grade assignment has been inaugurated. A scale of five possible grades is used: "A" indicating the best score, "B" and "C" representing the good and fair results of the middle group, "D" indicating poor results, and "X" being a disqualifying grade. The first grading covered participation during the first 24 weeks, and additional grades are being given for each succeeding eight weeks of participation. Investigation into the reliability of these grades has yielded satisfactory results.

The following tables indicate the reliability of the grading procedure. They measure the degree of correspondence between a forecaster's present grade and his forecasting ability, as the latter would be indicated by a very large number of forecasts. According to the tables, the probability appears to be about 70 out of 100, for a total of 60 forecasts, that a forecaster's grade is identical with his forecasting ability. Also, for 60 forecasts, the probability is practically zero

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Old dogs & new tricks

Yes, we certainly were the target for a lot of information at the forecasters' seminar. I was over in Richmond last week at one of those sessions, you know. Anyhow, the Consultant Team will be here next month so I thought you'd like to hear about it.

The opening gun was the display and explanation of some gaudy cardboard bearing the proud title of "mechanical aids." The Bellamy Pressure-Height Slide Rule was certainly the most spectacular: hydrostatic equation solutions are apparently now only a matter of a "twist of the wrist." This slide rule interconverts all of the familiar units, corrects for specific humidity, and will solve for any one variable in this frequently-required computation.

We had been informed that "R" sections must still use the Bjerknes Tables for reasons of accuracy; but for quick-checking raob data, the height of freezing levels, altimeter corrections, and consistency in pressure-temperature forecasts, this device looked like a natural for forecasting use.

From what I had picked up about the upper-air analysis methods, a main theme seemed to be the consideration of advective temperature and pressure changes in each of the layer-intervals between the significant levels. So when another Bellamy device, the Horizontal Pressure and Temperature Gradient Scale, was explained as an easy method to solve for advective changes I felt that here again was something quite worthwhile. Furthermore, this rule has a pressure-gradient scale on which density is treated as a variable, permitting use on each one of the many upper-air charts now in vogue.

The third mechanical aid, the "Constant Vorticity Slide Rule" seemed to be condemned by its name as an academic plaything. However, the man in the front of the room made a few passes and produced a forecast 20,000 foot wind for Richmond in 24 hours: accurately too. And, believe it or not, I had managed this really simple procedure myself before the session was over.

Fortunately for me, the more subtle complexities of the Vorticity Theory do not enter into the calculations involved. It has been said that instructions for construction of 10,000 foot prognostic charts are in the wind, and I certainly felt anxious to receive important assistance in such a task.

Who said that servants are hard to get nowadays? Here I had picked up three in just about an hour that could do the differential equations of meteorology!

All of us had anticipated the next item to be discussed with a great deal of curiosity, interest, and concern: upper air analysis. Headquarters Weather Wing had directed that forecasts be made on the basis of all the data available, and particularly to have predictions from the surface chart consistent with upper-air indications. Furthermore, the support of so many prominent meteorologists had been given to these new techniques that we anticipated a real improvement in our forecasting ability with their use.

The Olivers' paper, "Forecasting the Weather with the Use of Upper-Air Data" formed the basis of the discussion. So many forecasters have talked knowingly of the principles set forth in this publication that I'm hesitant to admit that this seminar brought the first lifting in the fogginess that had surrounded many upper air ideas in my mind. The informal, question-and-answer discourse encouraged at the meeting was particularly helpful.

Such a great weight of material was discussed that---"A man who dropped his pencil missed three years..." or have you heard that one? Just the same, we forecasters who have been out of school for a while are resigned to intensive work in the next few months to digest all of the points we may have missed.

This intention came to many of us when the Team's analyst was presenting the synoptic map and the auxiliary charts for the current day. One sharp fellow in the class caught the opportunity to apply the isallobaric correlations between the 13 km. and the surface chart, and pinned the analyst down to such a forecast. Some of us then examined the surface chart by itself and arrived at somewhat different conclusion from his---but the verifications were all in favor of the "instructor". The upper-air men, a title which we will all have to deserve immediately if not sooner, succeeded in producing several other examples of excellent forecasts. One could certainly expect, too, that many of the empirical rules given by the Olivers would be even more reliable when the winter's clean-cut synoptic situations come again.

(I was secretly delighted to find that "upper-air analysts" make good and full use of the surface map. Their basis for forecasting is entirely familiar, but they use *additional* aids. My planned defence of the tried and true surface map seemed a little silly when our agreement became apparent).

My reaction to the first two days of the session was an impatience (eagerness?) to put into practice the ideas which were being given. Apparently someone had wisely checked the schedule and removed most of that which would not fit immediately into practical operations. Perhaps the heat and the humidity would have overcome interest in any but these hard-headed and immediately-useful recommendations.

On the third day, the forecasters were given a chance to work out the current analysis themselves by the new methods. The results were bound to be disappointing: the forecasting tools were new, convenient equipment was lacking (ground glass tracing light and a familiar drawing table) and our grip on continuity had been lost in the weekend's travelling. I found though, a very useful orientation to the new procedures in this practice.

None of the new rules were presented as the last word on the subject treated; in fact, we were asked to make a report on our success with the new techniques when the Consultant Team made its second swing around the Region and back into the neighborhood of Richmond.

The final day was spent in a discussion of "Super-Briefer," the Wing's recent treatise on presenting weather information according to the needs of particular using agencies.

This discussion, along with a model demonstration of good briefing technique, pointed out some very familiar mistakes---so familiar in fact that I shrank from the request for men to try out a briefing before the others. We'll all get the practice alright, but it'll be necessary to think continually about introducing these refinements into what has become a pretty-well-fixed routine.

Especially appropriate were some statements about Form 23. Certain abbreviations, "Cig" for example, may mean nothing to a pilot. Furthermore, the presentation of a forecast within a range, "winds 250-270°, 14-17 mph", causes the pilot invariably to select an *average* of the limits as the raw data for his ETA computation (or any other uses). The recommendation was given that words of the forecast should be written out to avoid confusion, saving the time so used by omitting *limits* for a wind forecast.

There were sighs of relief of course when the series of meetings ended: the course had been intensive and the days long. But the main point was that everyone understood that there was a *necessity* to absorb as much information from these limited sessions as possible for many reasons: personal pride as a forecaster, pressure from headquarters, and responsibility---man-to-man---for the users of our forecasts. Over-a-glass-of-beer discussions among my old class mates during our Richmond stay showed an agreement that experience was still a most valuable attribute for a forecaster, but that he could not afford to coast on that distinction: his position of preeminence depended on keeping up with both the new and the old.

BE SCOTCH WITH THAT TAPE!

Enterprising radiosonde operators have discovered that a drafting tape used by the Army Engineers makes an excellent substitute for the white Scotch Tape which is needed to seal raob transmitters for flight. Its proper nomenclature is "Tape, drafting, manila, opaque, 1" wide, 72 yard roll, stock number 883000-625." This tape can be stored anywhere and will not pull apart in cool weather. There is one catch: no authorization exists for issuing it to weather stations.

The reinforcing material used on the inside edges of the waterproof wrapper in which the transmitter is shipped has been used successfully for sealing of the radiosondes. This reinforcement can be pulled off the wrapper easily without any loss of its adhesiveness.

TRAINING FOR WEATHER

REFRESHER

A nine-week review of meteorological theory and practice emphasizing recent developments, services to many using agencies, and special techniques is now being given at Chanute Field. Eight courses are to be held after the current one, making a total of ten.

Forty key personnel from domestic and foreign regions and other AAF commands are eligible for each session: most of those chosen are officers who have long since graduated from formal courses of instruction in weather.

STAFF WEATHER OFFICER

Weather officers of above average ability stationed in the domestic regions (who have the requisite personality qualifications) are being chosen to attend the one-month course given by the AAF School of Applied Tactics, Orlando, Florida. 25 men will be admitted to each of the indefinite number of future courses.

FIVE-DAY FORECASTING

Theory and practice of the extended forecast techniques of Namias and Willett will be given to ten selected weather officers with specific aptitudes for this seven-week training. The first class began 10 July 1944, but whether future courses will be given is not known.

The first four weeks of this training is given at M.I.T., and the final three weeks at the Extended Forecast Unit of the Weather Bureau in Washington.

TROPICAL METEOROLOGY

An informal training program covering tropical weather considerations is currently being held at the Institute of Tropical Meteorology for six forecasters from the 6th, 9th, and 22nd Regions. A *formal* course at I.T.M., beginning in the first week of September, will instruct 40 forecasters that have been chosen from domestic regions for the most part. The domestic Region forecasters were required to have had four months of station experience. They will be given assignments to foreign duty after this training.

CHEMICAL WARFARE

Weather requirements for chemical operations in warfare and the forecasting of such situations are being studied by 15 weather officers picked from domestic assignments for their education in and their experience with chemistry. Dugway Proving Ground, Utah is the scene for this training which is being given in four-week courses, the first of which began 1 August 1944.

WEATHER CRYPTOGRAPHY

Seven experienced observers are presently on temporary duty at Asheville for two months to learn the theory and practice of enciphering weather data. The second class in this series began in the last week of August.

The number of future cryptography classes needed will depend on the decisions of the Combined Meteorological Committee about the proposed declassification of weather information in several areas where codes are now being used.

BROADCAST INTERCEPTION

Enlisted weathermen who have tinkered with radio or electrical equipment as a hobby are eligible for training in the radio reception of weather broadcasts and radio traffic in general. The second of these eight-week courses began 10 August 1944 with a class of fifty men. Asheville is the scene of this training, which will be repeated in an indefinite number of courses.

COMMUNICATIONS

Familiarization with weather communications equipment including its maintenance, installation, uses, and operation is being taught to 15 weather officers chosen for their education and/or experience in electrical communications. Their studies of these matters are being taken in a four-month assignment with the Facilities Section of Headquarters Weather Wing.

ELECTRONICS

Weather Officers who can pass an examination in basic electronics with high marks will be sent to Harvard University for seven months to study the military applications of this subject. The first class graduated 1 September, with a total of ten classes of 15 men each scheduled: the last scheduled class will begin, therefore, 1 November 1944.

RADAR WAVE PROPAGATION

Weather conditions in the lower levels of the atmosphere exert considerable influence on the propagation of radar waves. Such effects form the curriculum for a six-week class of 10 weather officers at Spring Lake, N. J. Hand-picked meteorological officers with high scholastic records and radio backgrounds have been chosen for the current course which will be completed 22 August. One more class is tentatively scheduled to begin on an unspecified date.

WEATHER EQUIPMENT

Training and ability in mechanics and electricity will form the basis for a screening by the Signal Corps to determine the 20 observers who will be chosen to study installation and maintenance of meteorological equipment at the Ground Signal Agency, Spring Lake N. J. The training takes 12 weeks, and will be accomplished in eight overlapping courses. The first class began 7 August, with the second to start 18 September 1944.

Thunderstorm Intensities

The 0700 local forecast for Walterboro AAF predicted local thunderstorms in the area. Now that prediction is a good one for any June afternoon in South Carolina, but on this 24 June a deepening, sharply defined cold front was expected to pass the station. Also, a closed low aloft was anticipated at 10,000 feet.

By 1530E the surface temperature was 102° and cumulus was building up to the NW of the station. Upper winds from the NW began to bring in an exceptionally black cumulonimbus two hours later, so a warning was given to all post organizations concerned that a thunderstorm with gusts over 30 mph could be expected within half an hour.

Wind gusts of over 80 mph *and heavy rain showers worked havoc with field installations and tied-down aircraft when the disturbance struck 20 minutes later. Fifteen small planes were ripped from their moorings to be wrecked around the field's periphery. The platform on the weather station roof was stripped off, wrecking the anemometer and the ceiling light. Three large planes were damaged also, as were several post buildings. (See accompanying photographs).*

A consensus of forecasters is that a forecast of such excessively high winds in such a unique thunderstorm cannot be expected.

RAWIN

The Weather Service has for many years been completely dependent on the pibal for vital winds aloft data, but the Service is no longer so restricted. A network of RAWIN reporting stations has been established in American regions, providing wind information from electronic devices with a regularity, an accuracy, and an extent never approached by the pibal.

Forecasting during general situations of poor flying weather is the major problem of the weatherman, but yet the visual methods for wind determination regularly prove ineffective when low ceilings, poor visibilities, precipitation, and high wind speeds exist. Now high frequency energy pulses are used to penetrate such obstructions to vision, either echoing or emanating from a free balloon to report the drift during its ascent. Wind data will now be available when it is needed most, and complete climatological records for upper levels will be made possible.

Even when pibals can be taken, their reliability is brought into question by the dubious assumption of a fixed ascent rate. Disappointing errors are thereby introduced into the observations: deviations in balloon rubber tension, hydrogen free lift, or temperature lapse rate from standard conditions are always present to invalidate the assumption underlying pibal data. Extensive tests of ascent rates have revealed that the vertical velocities of two runs may differ by as much as 400 feet per minute on the average during a 50,000 foot run because of these unconsidered variables

RADAR methods, however, permit a measurement of the *total* motion of a free balloon, because the object is completely fixed in space by direct measurement of the slant range and both the angular directions at every observation. This technique for determining the horizontal wind vector is not affected by variations in vertical velocity.

Radio methods for wind-aloft observations fall into two categories, RDF and RADAR, both of which are called RAWINS. The position of the high frequency pulse transmitter makes the difference between these methods: the RDF balloon carries its own transmitter aloft very much like a radiosonde, while the RADAR wind balloon carries a target to reflect pulse transmissions from a ground set.

The RDF transmitter is attached to a 350 gram balloon and sent aloft. The sending set emits a constant signal which is received by a small directional antenna on the RDF ground set. An oscilloscope (a recording screen similar to those used in radar equipment) shows a picture of the signal received. By the same stereoscopic principle which people use to judge distances by sight and hearing, the visible signals or 'pips' are equalized by rotating the directional antenna. When this is accomplished, the antenna points directly at the balloon's position, so that the indicator dials which show the orientation of the antenna indicate the azimuth and elevation angles of the balloon.

A baroswitch unit, similar in construction to the baroswitch unit in the radiosonde, is attached to the RDF transmitter. This switching device interrupts the steady signal at given changes in pressure, supplying the necessary data for computing altitudes by using pressure-height relationships obtained from local climatic studies. The pertinent pressure-height scale is chosen according to the synoptic surface maximum temperature, which is expected to be an approximate function of the mean virtual temperature.

The elevation angle, the azimuth angle, and the altitude of the balloon are determined for every minute of ascent according to this method. Use of the tangent function of the elevation angle permits computation of the horizontal distance and then the wind speed. RDF equipment is effective under all weather conditions and observations to 40,000 feet are common. Under favorable conditions, runs have been made to 75,000 feet.

RADAR

The fundamental principle used in RADAR observations of the winds aloft is to transmit narrow-beam pulses of high frequency until an echo is obtained from a balloon-borne target with a certain azimuth and elevation setting of the ground set. Such reception permits direct measurement of slant range to the target as well as the azimuth and elevation angles.

This principle is applied by existing field RADAR equipment, most of which can be used for wind determinations. It is true, however, that the differences in the design of RADAR installations allow a variation in reliability from little better than single-theodolite accuracy to better than double-theodolite accuracy. RDF equipment used for RAWIN observations is designed for the specific purpose of measuring vector winds, and as a result the reliability of RDF varies little from station to station.

RELIABILITY

Existing weather conditions have no apparent effect upon the operation of modern RADAR wind devices. Messages have been obtained every day through the worst weather situations, including heavy snow, rain, overcasts, fog, and extremes of surface temperature.

Apart from the fact that RAWIN data is obtainable in all weather conditions, the accuracy of data obtained by radio methods is far superior to that of the pibal. Electronic equipment is far more complex than that needed in visual methods, so errors may occasionally appear in RAWIN data---caused by failure of the human element in the observation. This will be true particularly while radio equipment is still relatively unfamiliar to its operators. But the number of these errors has already been minimized to a very satisfactory extent, and RAWIN authorities look forward to their elimination.

It is incontestably true that RAWIN *methods* represent a meteorological development of outstanding value.

RAWIN Reporting Stations

Reports available on domestic teletype circuits

STATION	IDENTIFICATION		CIRCUIT HEADING	
	Letters	Numbers	Skj C	Skj O
Boise, Idaho	DQB	681	PB 11	
Bradley Field, Conn.	DVU			
Chanute Fld. Ill.	DNU			
Dyersburg, Tenn	DZB		PB 5	
El Paso, Texas	EO	270	PB 9	
Fairfield, California	DFA		PB 35	
Grenier Fld. N.H.	DUR			
Hunter Fld (Savannah) Ga.	DCH	207	PB 3	
Los Angeles	LA	295	PB 9	
Medford, Oregon	MF	597	PB 11	
Olmstead Field, Pa.	DME	(511)	PB 2	
Orlando, Florida	DOA	205	PB 31	PB 9881
Patterson Field, Ohio	DPK		PB 2	
Pittsburgh, Pa.	PT	520	PB 2	
Portland, Maine	GFW	606	PB 30	
Presque Isle, Maine	DZQ	7/1	PB 30	PB 318 9
Richmond, Va.	RW	401	PB 3	
Salina, Kansas	DSN		PB 7	
San Diego, California	SQ	290	PB 9	
Santa Maria, Calif.	DYL	394	PB 12	
Seattle, Washington	SA	793	PB 10	
Spring Lake, N.J.	DSL		PB 30	
Tonopah, Nevada	DRY	485	PB 12	
Watson Lake, Y.T.	UQH	953	PB 9880 2	
Adak, Alaska		992	PB 34	PB 318 9
Amchitka, Alaska	UAM	005	PB 34	PB 318 9
Cordova, Alaska	UKA	971	PB 34	PB 318 9
Ft. Morrow, Alaska	UZG	017	PB 34	PB 318 9
Ketchikan, Alaska	UKG	048	PB 10	PB 302
Shemya, Attu, Alaska	USS	549	PB 34	PB 318 9
Yakutat, Alaska	UVY	963	PB 34	PB 302

Unscheduled reports available on Schedule O

Keflavik, Iceland	VT	581	PB DZQ	
Goose Bay, Labrador	YR	816	PB DZQ	
Gander Lake, Nfld.	UQX	803	PB DZQ	
Narsarssuak, Greenland	JY	589	PB DZQ	
Borinquen Field, P.R.	UIH	014	PB UIH	
Cayenne, Fr. Guiana	URD	874	PB WYTD	
Bermuda		925	MB 8279	

"CLEVELANDIA"

by Cpl. JOHN CLAAR

Many Brazilian coastal cities are scarcely the havens of civilization that weathermen of the 22nd Region dream about. But they seemed close to ideal when a call came for volunteers to penetrate the interior jungles along the French Guiana border. Weather reports from that blank area to the north of existing Brazilian stations were needed, so the RCO decided to establish a "D" station near the minute, isolated, native village of Clevelandia.

Engineers of the Airport Development Program were the forerunners of weather service for Clevelandia, flying in to organize native labor for the building of barracks and shelters sufficient for a contingent of five men. An emergency landing strip already existed, and of course the weather installations were placed nearby. The ADP wasted no time in rushing back to civilization post-haste when they were through, reporting that it was "rough up there."

These remarks scarcely stimulated the recruiting campaign for volunteers to face the jungle's terrors and see that the weather would get through. The enlistment was encouragingly easy, however. Sergeants Stuart, Lesses, Burth, and Corporal Byrd were the bold young men who were to be the Clevelandia station's founders. A three month supply of rations and a set of 30-30's took a prominent and solicitously guarded place in their baggage.

The strong constitutions of these men stood them in good stead after they arrived at Clevelandia and set about making their residence livable. They felled trees, grubbed stumps, and seeded a lawn: now you are impressed by a habitable clearing and the letters USAF written in white sand, visible as you approach from the air.

LIFE IN CLEVELANDIA

The single artery of communication running through this wild country is the Oyapock River, just two miles from the weather station. Whenever a little opening in the dense growth along the river banks has been hewn, one may find a small huddle of shacks---a native "village." The river is always dotted with dugout canoes of all sizes and descriptions, plying their way from one community to another.

Our social life is made up of visits to these little communal centers. Extreme kindness and hospitality have always marked our reception at the native villages. This feeling is very welcome, except that the natives seem determined to have us shake hands with the entire gathering when we leave or arrive. Then too, few of us can match the native genius for absorbing intoxicants, but apparently this is our only serious shortcoming in native eyes.

The Oyapock River is part of the boundary between Brazil and French Guiana, so weathermen often found themselves involved in a Babel of tongues. The confusion might be worse than it is if the situation wasn't met in a very practical way. The boys just say "si" on one side and "oui" on the other and pray that they are not agreeing to anything that might be fatal.

An outpost of the Brazilian Army is our neighbor to the north by a few miles of twisting river. We are occasionally invited to that garrison for a field day of volley ball, swimming, meals, and perhaps an inspection of the post by the native officers and ourselves. A most fraternal spirit exists between the two encampments and we look forward to these days very much.

Social life in Clevelandia is focussed on the native dances. A small room lighted by a single, smoky lamp---ridiculously small for the hordes who throng there---is the scene of incessant shuffling of feet in a monotonously simple pattern like our two step throughout every weekend. Scores of natives file into this 'ballroom' early Saturday evening, maintaining a profound dignity that northerners scarcely associate with a dance. That dignity still remains when the intermittent dancing finally terminates on Monday.

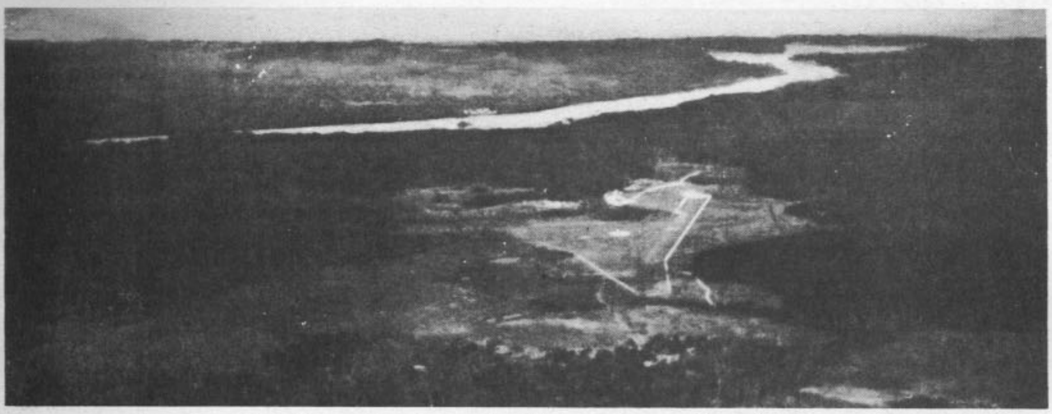
Music is provided by native players of drum, fife, two guitars, violin, and the rattlers which are so much a part of all South American music. Army weathermen have proven themselves adept at the local jitterbug style, and so these affairs have the aspect of a bizarre USO dance.

Should you decide to visit us on a Sunday that is not a rainy one, let me warn you not to be startled by what appears to be a mass of sepia humanity passing by at 30 mph and suspended in air. You see, Sunday is visiting day and natives come from afar to the weather station. We suspect that their principal motive is to be enticed away after a few hours by our despairing offer of a ride in the jeep. Along about meal time, the chef for the day takes one look at that multitude of hungry people and hurriedly suggests that we ride them all back to the river *before* luncheon.

On each trip the jeep is literally swamped with humanity. A favorite spot to sit is on the radiator directly in front of the unfortunate driver. With the assistance of a little Portugese, emphatic sign language, and facial distortions he eventually makes it known that he must have a hole to see through. Then the strangely-laden conveyance disappears into the jungle.

The pibal detail on Sunday feels particularly conspicuous. A Grand Central Station atmosphere is provided by more than a dozen open-mouthed spectators who are a most attentive audience. Their interest of course stimulates the observers to put on a good "show."

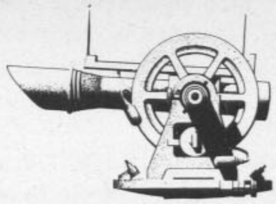
Although this story has been told in a facetious manner, no Clevelandia weatherman would permit a derisive tone to enter his remarks about the natives. The neighbors of the station have earned a sincere respect and friendship by their unfailing sincerity, friendliness, and good humor.



The sluggish Oyapock, the only link between Clevelandia and civilization, winds its way close by the AAF base in the foreground toward the Brazilian coast in the distance. Aerial perspective does not reveal the foreboding height and the impassable matting of the jungle which forms an ever-encroaching ring around the airfield and weather station.

"U.S.A.F.," bravely written in white sand, identifies the Clevelandia airfield on emergency landing field on the Belem-Atkinson route. "Visibility poor, ceiling low, and precipitation in progress" would verify more often than not for this field, and so ordinary landings were never attempted at Clevelandia. When the staff and the supplies were flown in, they came by "Duck" or flying boat and used the river instead.

This typical Clevelandia thoroughfare "invites" the G.I. weathermen to squander his three day pass. Eighty inches of rain in a year turns village streets, airstrip, and jungle alike into a steaming, unbearable morass---populated by deadly carnivores, just-as-deadly mosquitoes, and harried humans. After six months duty at Clevelandia, the entire weather staff came down with malaria and had to be replaced.



UP AND UP: HIGHER AND HIGHER

By this time practically all weather stations have used the new Neoprene (synthetic rubber) balloons. It is recognized, however, that many stations are finding the new balloons more likely to burst during inflation or at low levels of ascent than their unavailable originals of natural rubber.

This shortcoming theoretically can be overcome by heat treatment prior to release, because Neoprene's elasticity is greater at higher temperatures---contrary to the reaction of natural rubber. From reports received from the field, however, it is evident that the "Boiling" method described in TB 11-2405-1, "Heat Treatment of Neoprene Balloons," is not the final answer.

Persistent investigation of this problem is being conducted, and it is expected that a new and better method will be forthcoming shortly. Reports of experience and suggestions for improvement from the field Weather Service have often been of definite benefit in solving similar difficulties and are requested in this case.

The Meteorological

A MILITARY VIEWPOINT

During my recent visits to regional conferences, weather officers and enlisted men alike have frequently asked, "What are our chances to get a job in weather when the war is over?" This anxiety is a natural result of the sacrifice of personal interest that soldiers make while absent from the national economy in wartime.

Fortunately however, military meteorologists have a champion: the American Meteorological Society. Eminent scientists, government and military officials, and outstanding representatives of business within this organization have combined to work toward the creation of key positions in commerce, industry, and agriculture for those weathermen who will seek productive application of their military experience at the war's close.

Despite preoccupation with Weather Service duties, many of us have followed with keen interest the concrete steps already undertaken. The A.M.S. has reorganized and expanded to act as a clearing house between industrial leaders and demobilized weathermen, to publicize the profit potential in the use of weather forecasts, and to provide the recognized authority for standards, ethics, and personnel information within the profession.

The AAF Weather Service, BuAer Aerology U.S.N., the Weather Bureau, and the Air Transport Association have agreed that it is appropriate and necessary for the A.M.S. to assume the role just outlined. At a meeting of these organizations (which represent a very large percentage of the future demand for public meteorological services), it was decided to urge forecasters, observers, and technicians in every phase of weather activity to seek affiliation with the Society.

Cooperation with the American Meteorological Society by applying for membership is, of course, entirely voluntary, but I feel that all of us can derive material benefit from the present program of the Society. Furthermore, the stimulus that this organization can give to the civilian use of weather will relieve official concern that a reserve of meteorological knowledge will always exist to meet future national emergencies.

I invite careful consideration by all those in the Service to the program of the reorganized American Meteorological Society.

W. O. Senter

W. O. SENTER
Colonel, A.C.
Commanding

Profession Organizes

THE A.M.S. PROGRAM FOR PEACE

For the past 25 years, the American Meteorological Society has been an academic group of all the prominent weather scientists. In fact, meteorology itself has been principally an academic subject, except for a limited application by the airlines and the government.

The unbelievable mushrooming of the military weather service within the past few years and the development of novel and effective forecasting techniques has been widely interpreted to promise a lucrative, professional standing in commerce, agriculture and industry for meteorologists. The A.M.S. has verified this opinion with a questioning of representative concerns in many fields. It has undertaken a reorganization and an expansion of functions accordingly, to fit itself for the status of a professional society---the representative, the governing body, and the information center for weathermen engaged in the national economic life.

The primary concern underlying this expansion is the necessity for an immediate stimulation of a market for meteorological services, for preliminary work to establish personnel files and standards, and to maintain a central agency to promote development of the weather science through research.

The ten-issues-a-year A.M.S. Bulletin will be retained as a "house organ" of the Society, but the requirement for a scientific publication will be met by a quarterly publication as yet unnamed. The first copy of this journal will appear before the year's end, at an annual subscription price of $4.50 to non-members.

The A.M.S. maintains a book service, which enables Society members to obtain meteorological books and publications originating from anywhere in the world. The library of the Blue Hill Observatory, Harvard University, is open to the mail use of A.M.S. members. Many rare and valuable papers have been made available in this manner, and those items which may not be so loaned can be copied and transmitted to members wherever they may be.

Local branches of the Society are or have been maintained in 25 U.S. cities, and it is expected that regular meetings of these branches will be resumed shortly to discuss scientific, technical, and professional problems.

Applications for A.M.S. membership have been distributed to Navy aerological offices and AAF weather stations. Meteorologists who have not been able to obtain these forms can get them at these centers, for enough have been distributed for all weather trainees: forecasters or observers, whether in formal weather service or not.

rain n' more rain!

MAXIMUM POSSIBLE PRECIPITATION OVER THE PANAMA CANAL BASIN

Prepared for the Corps of Engineers, AUS
by the Hydrometeorological Section
U. S. Weather Bureau

No hurricane will ever have much chance of reaching the Isthmus of Panama. Coastal outlines in this region make it impossible for a hurricane to approach the Canal without first having to cross extensive stretches of land. Since hurricane circulations are principally supported by evaporation from a water surface and are filled rapidly by the frictional effects of rough surfaces, these land trajectories weaken and finally destroy the dangerous circulation. That no hurricanes have ever penetrated to the Panamanian isthmus is verified by climatic records.

The causes of rainfall in the Panama Canal Basin are discussed in this report from a fundamental point of view, making the reasoning applicable to other regions. In addition to statistical rainfall data, considerable analytical information of direct meteorological interest is given.

A notable example is the preparation of mean surface convergence patterns for various seasons from resultants of wind vectors. The seasonal variation of convergence is then compared graphically with the seasonal variation of rainfall. Except for a two month period (September-October), there is a good qualitative agreement between these variables.

Most of the prolonged precipitation is ascribed to orographic effects, with local maxima on the windward slopes of marginal mountain ranges around the Basin well defined by statistics. A distinctly dry season for the four months of January to April is to be expected, while the remainder of the year comprises the rainy season. Within the latter classification the major storms producing widespread rainfall over the Isthmus are mostly confined to the months of October, November, and December.

Frontal analyses that are typical of Canal Zone weather are given. Particular emphasis is placed upon the type of storm occurring in the very rainy months at the point where the Polar Front intersects the Intertropical Front, because this situation is held to be associated with the most widespread heavy rains in the Canal area.

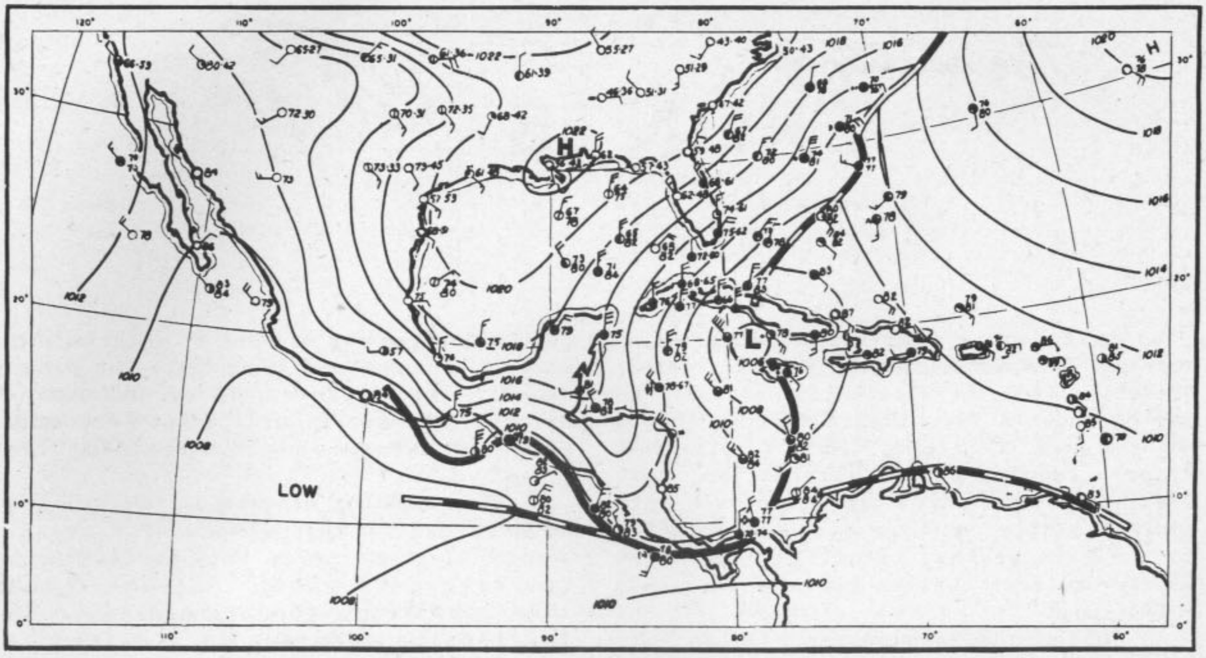
Such a synoptic situation occurred in the case of a cold front which had been forced down across Central America and into the Intertropical Front when the latter was lying across the Isthmus (Figure 1). The authors suggest that where the Polar Front has merged with the Intertropical Front over the Canal Basin, the original tropical air (Northeast Trades) has been occluded by intrusion of Polar air into Equatorial air (from the Southern Hemisphere).

Whatever the true structure of this system, definite frontal activity is indicated. In the case pictured, stable waves subsequently developed along the front and moved *eastward* across the Isthmus causing intermittent rain.

Study of pilot balloon observations from all station in the West Indies, the Gulf of Mexico, and the Caribbean area showed that the cyclonic circulation of the hurricane south of Cuba extended to well above 10,000 feet. Even at that level (as at the surface) its cyclonic flow covered the Isthmus, carrying warm, moist air from the Caribbean around the cyclonic center and then southward across Panama.

The case depicted is a characteristic outbreak of polar air with the continental high extending southward into the Gulf. In the vicinity of eastern Cuba the front has been dissolved by the hurricane in progress in that area. The edge of the Doldrums (the Intertropical Front), lies immediately north of the Panama Canal Zone, extending as a flat but sinuous curve eastward from Costa Rica to Trinidad.

The Polar Front has merged with a portion of the Intertropical Front and the combined or occluded system has passed beyond the stations on the north coast of Panama. Under the influence of strong northwest winds and the convergence which resulted at the front, vertical motions were induced sufficient to release the potential instability of the air masses involved. For a period of about 36 hours, moderately heavy rains occurred over the basin.



A vigorous outbreak of continental polar air has flooded the central United States and has pushed on through the Carribbean, meeting and occluding the Intertropical Front over the Panama Canal Basin. The latter front as pictured is at its most northerly seasonal position. The development of a hurricane along the Polar Front near Cuba is shown.

TAIL CHEWING

Lt. George Smallfield was piloting a B-24 in formation over California, when his wing man overshot in closing and chewed off the tail assembly. The tumbling and lurching of the uncontrollable aircraft prevented any crew member from attaching chutes to the harness that each was wearing.

Smallfield gave the order to bail out, and arose from the controls to follow his own command. However, a sudden roll picked up the chuteless pilot and threw him into the open hatch. His left ankle fortunately became caught in the hatch mechanism, preventing a plunge to certain death. At that moment, a chute was accidently thrown from the heaving plane and landed in his arms. The freeing of Smallfield's ankle was almost coincident with his snapping of the last chute buckle.

Smallfield then made the mistake of pulling his ripcord too soon, and was dragged toward the deadly split-tail fins. However, he passed by exactly where the tail had been chopped off and descended until his parachute opened at about 100 feet. Then Smallfield observed with horror that he was directly over the crashed and burning B-24 from which he had just jumped. His frantic attempts to avoid descent into the flaming wreckage were unavailing until updrafts over the fire caused his chute to veer off, permitting a safe landing 25 yards from the pyre. His only injury was a slight ankle cut. There were no other survivors.

The reality of

FRONTS

Just before take-off time, a pilot receives his picture of the general weather situation from the station forecaster: he may be shown a flight path that is cut by nothing more terrifying than a few isobars. After a landing at his destination, however, this same pilot can often walk into another station and see a second solution to the same weather situation; one which loudly declares that he has come through a cold front!

There is an obvious conclusion that such a client of the Weather Service with limited meteorological training can draw: one of the two conflicting map-solvers would have given him an erroneous weather briefing. It's easy then to see a good reason why frontal solutions ought to be "standardized."

Does this mean that the jealously guarded right of every forecaster to his individual solution should be annulled? Of course not; except in many cases where the discrepancies among solutions are due to someone's warped idea of how to tell where and what a front is. The basic indices of a front on the surface map are widely accepted and undisputed, but not so widely used in their entirety or correct proportion.

There we have the stimulus for Weather Wing Memorandum 55-13, "Standardization of Analyses." Under this authority, every time that a forecaster in a domestic region (1st, 2nd, 3rd, 4th, 23rd, 24th, 25th) enters a front on his surface synoptic map after 1 October, he will have to evaluate his decision according to a check list of basic frontal indices. This requirement will be in effect for 30 days until each forecaster has graded his own frontal locations on a minimum of 15 maps.

The arithmetic of jotting down and adding up this "score" for a front is not going to take the place of good weather judgment---something that can't be replaced by any forecasting tool---but rather it will act as a check on the use of all the basic indications of a front in something like their proper proportion. An intelligent understanding of weather relationships will even be needed to compute the proper score: diurnal, orographic, and dynamic effects (all non-frontal) must be compensated in determining the reality of a given front.

This grading program is not going to be a permanent thing, because a certain amount of practice in this tabulating of scores brings about that *habit* that characterizes a good forecaster: the instinctive reaction to a pattern of signals that takes in *all* the information in its correct *order* of importance.

Here is a statement of the Memorandum which deserves careful note: *"When too much emphasis is placed on eliminating indefinite fronts by means of grading, there is a tendency to omit important features of the frontal structure and development (frontogenesis, frontolysis, and potentially active fronts). Map standardization will not be accomplished in a manner which eliminates everything except the idealized features of the analysis."*

A table is supplied with the Memorandum which gives the weight to be given to each index of a front. For example, if clouds and precipitation agree with the type of front and the position selected, plus two points would be awarded: if the surface temperature shows no discontinuity across the front, minus one point enters the computation.

The scoring system gives more certain results where observations are concentrated, but single-station data can give excellent evidence of frontal characteristics. Observations before and after the passage over the station are compared and checked according to the weighting table.

A surface front in motion that has a definite existence will be found to receive a score from plus 3 to plus 16. Stationary fronts that are definite should have a total from plus 2 to plus 13. For an upper front to be considered as real, at least plus 2 should be scored. Insufficient, but still positive scores indicate a doubtful existence of the front or a location that has been misplaced somewhat.

TABLE OF WEIGHTS FOR SCORING FRONTS

DIFFERENCE IN PRESSURE CHANGE

Favorable to front	Weight	Wrong Direction for Front	Weight
Over 4.9 millibars	+3	0.0 to 0.3 millibars........................	0
2.9 to 4.8 millibars....................	+2	0.4 to 1.7 millibars........................	-1
0.4 to 2.8 millibars....................	+1	1.8 to 3.4 millibars........................	-2
		3.5 millibars or more......................	-3

SURFACE WINDS
(Surface fronts and simple occlusions only)

Favorable to front	Weight	Unfavorable to Front	Weight
Good shift, velocity 30 mph or over.....	+3	Variable winds both sides..................	0
Good shift, velocity 15 to 29 mph.......	+2	Consistently same with velocities below 15.	0
Consistent windshift, velocity under 15 mph..................................	+1	Consistently same with velocities 15 or above..................................	-1
Consistent increase of 15 mph or over...	+1	Divergent, 1 to 14 mph.....................	-1
		Divergent. 15 mph or over..................	-2

CLOUD DIRECTIONS, WINDS ALOFT, RAOBS

Favorable	Weight	Unfavorable	Weight
Large shift, many stations near front all consistent.........................	+3	Variable, no shift evident.................	0
Large shift, many stations good ageeement	+2	Consistently same both sides...............	0
Large shift, few stations good agreement.	+1	Some evidence of divergence................	-1
Small shift, but consistent..............	+1	Frontal surface impossible as indicated by RAOB....................................	-1
Frontal surface at proper location indicated by RAOB...........................	+1	Consistent divergence......................	-2

TEMPERATURE DIFFERENCES
(Surface Fronts only)

Favorable	Weight	Unfavorable	Weight
25°F or more...........................	+3	Few stations, 2°F. to 4°F irregular or uncertain................................	0
15°F to 24°F...........................	+2	Many stations both sides same, consistent to 2°F...................................	-1
5°F to 14°F...........................	+1	3° to 5° in wrong direction................	-1
		6° or more in wrong direction............	-2

DEW POINT DIFFERENCE
(Surface fronts only)

Favorable	Unfavorable
(Same as for temperature)	(Same as for Temperature)

PRECIPITATION AND CLOUDS

Favorable	Weight	Unfavorable	Weight
Precipitation and clouds agree with type of front.......................	+2	No evidence.............................	0
Precipitation and clouds agree fairly well with front......................	+1	Clear, or only cirrus, or precipitation and clouds do not agree with type of front..................................	-1
Clouds in good agreement with type of front...............................	+1		

ISOBAR SYSTEM

(5000 foot isobars may be referred to in the United States from Rocky Mts. to Sierra-Cascade Ranges)

Favorable	Weight	Unfavorable	Weight
Definite trough......................	+1	Flat field	0
		High pressure ridge or strong straight gradient................................	-1

RADAR *Coverage*

Abstracted from JANP 101, June 1944, published by the Joint Communications Board and titled, "Variations in Radar Coverage."

Variations in the range and coverage of radio and radar equipment are caused by meteorological conditions which influence the propagation of very short (VHF) radio waves. Army costal radar installations have tracked convoys on some occasions to 20 or 30 miles beyond normal ranges: the same radars, a few hours later, may have failed entirely to pick up targets clearly visible to the eye.

False evaluation to the extent of serious errors in radar "fixing" has resulted on occasion from an ignorance of weather influences. Such effects on radar reports are threefold: (1) "echoes" may be produced by clouds or rain, rather than by tactical targets, (2) actual range may have to be determined by second or third sweeps, and (3) radar coverage may be variable. Each of these factors has a grave tactical significance, but non standard meteorological effects do not make radar equipment less valuable if they are understood and utilized.

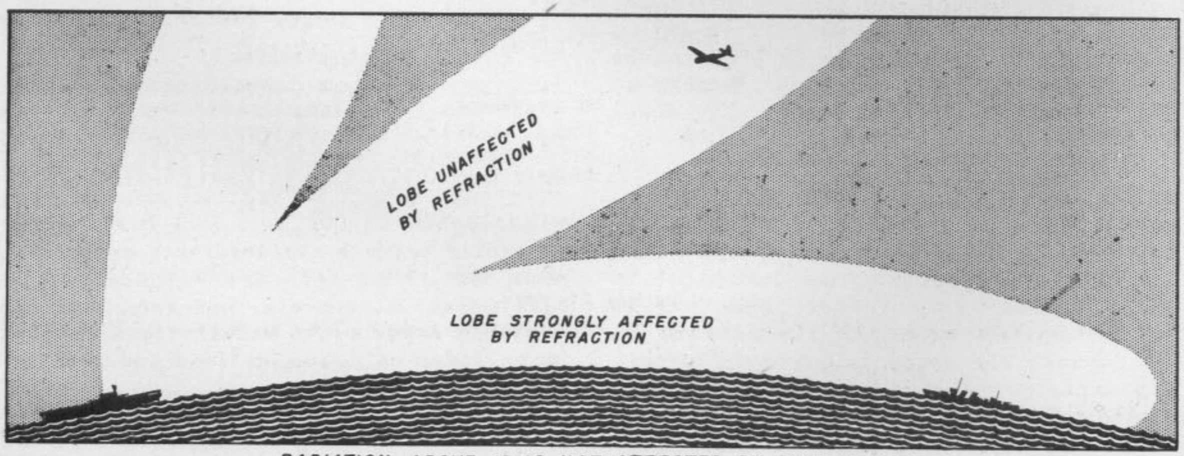
Unusual ranges, problem (3), are caused by bending or refraction of radio waves in the atmosphere. We are all familiar with the long range of short wave radio, brought about by the reflection of such signals from the ionosphere back to earth (sky waves). But radar signals do not travel that far. Unusual radar coverage depends on extending the *ground wave*, which would travel into space without ever getting beyond the horizon except for refraction by the troposphere.

Radar signals are refracted *toward the earth* because the density of the troposphere always decreases with height. In this sense, radar waves act just like light waves being bent by a glass prism: "rays are bent away from the perpendicular in going from a more-dense to a less-dense medium."

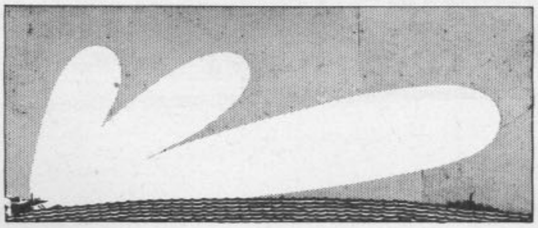
Changes in density (temperature, pressure, and mositure) with height in the troposphere normally are very small compared with the change from water to air, and the resulting refraction is relatively small. Nevertheless, it is of great importance in radar operations and radio communications above 30 megacycles because the curvature of the earth is small. The horizon distance is increased 15% by tropospheric refraction *in a standard atmosphere*.

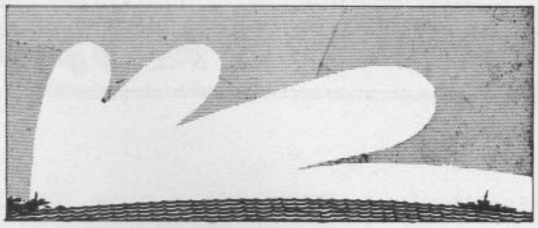
It is rather inconvenient to draw curved rays in radar coverage and calibration diagrams. This is avoided in practice by assuming a radius for the earth that is 1/3 too large. Then the rays appear as straight lines in coverage diagrams. The operator can then ignore the effects of *standard* refraction while doing his work.

Weathermen know, however, that there can be many types of density distribution with height depending on the synoptic situation. Wave propagation then differs from standard. In fact, if the most favorable (steepest) density lapse-rate for



RADIATION ABOVE 1° IS NOT AFFECTED BY REFRACTION





"super refraction" exists, a "duct" may be formed in the lower layers which will channel radar waves around the earth's surface for amazing distances and prevent their escape aloft.

This useful situation occurs when there is a rapid *decrease* of moisture with height and a rapid *increase* of temperature with weight. The most pronounced cases of extraordinary refraction occur when both these conditions prevail at the same time in the lowest levels.

Those who have had high-school physics will understand that radar duct formation is like the internal reflection of light that can't come out of a prism if the interface is struck at less than the "critical angle." The size of this maximum angle for reflection varies directly with the density contrast, so we may guess correctly that the critical angle of incidence for radar waves on the "lid" of the duct is very small.

This is actually the case, and radiation leaving the transmitter more than one degree above or below the horizontal is not containable in a duct.

Ducts are ordinarily found only in the lowest few hundred feet of the atmosphere, because the greatest lapse rate of density is found there, even in a standard atmosphere. In certain regions, however, notably under the sub-tropical high pressure cells, "super refraction" may occur up to 5,000 feet.

If radar is used for fire control, searchlight control, or fighter intercept control, the targets are usually at medium or short ranges and the angle between the line of sight and the horizontal has to be larger than one or two degrees. The operational characteristics for radar in such uses can safely be calculated on the assumption of a standard atmosphere, because all *non-standard* meteorological effects are negligible.

However, when the same equipment is used for long range search (and this is within the instrumental limitations in most cases), the story is quite different. With early warning radar, the target may be an airplane 50 or 100 miles away, flying at an elevation of only a few thousand feet. The elevation angle of this target is only part of one degree as seen from the radar. Naturally the angle of elevation of sea borne targets sought by radar is even less.

Only low-angle search is affected by meteorological conditions.

SYNOPTIC SITUATIONS

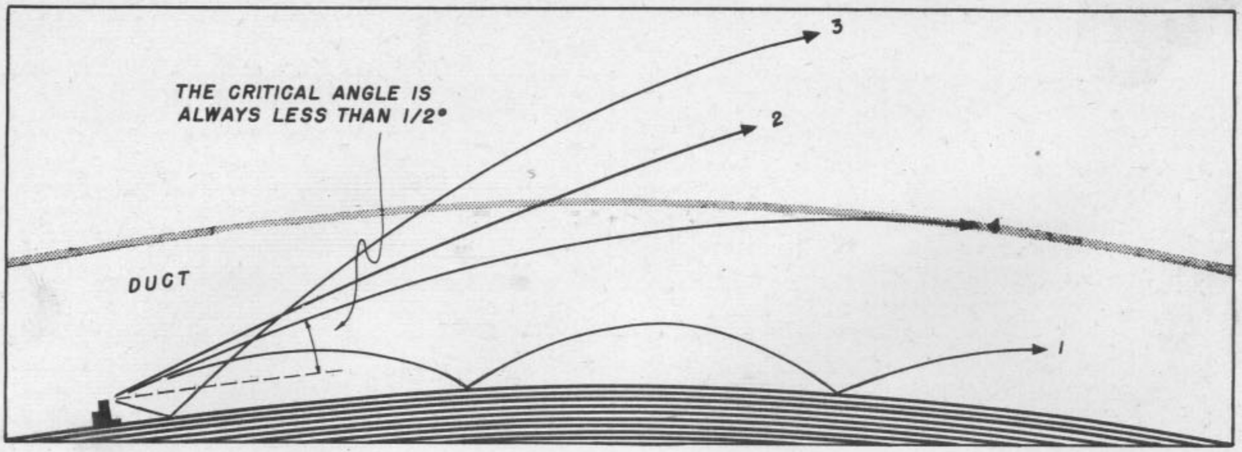
We have mentioned above that the most favorable condition for extraordinary radar ranges is a low-level inversion of temperature with a sharp decrease of mixing ratio with height. Meteorologists will immediately think of several synoptic situations which produce such a condition where duct formation would occur:

ADVECTION---When air from an arid source region is blown over an adjacent ocean in summer, evaporation into the lowest layers occurs in combination with formation of a steep low-level inversion. An example in point is the Mediteranean Sea during summer where dry land areas are found to the east, west, and south. In the Central Mediteranean, ducts have been observed on 9 days out of 10 during the summer months of 1943.

Similar conditions are often caused by westerly winds blowing from land to sea across the eastern boundary of a continent. Even such small-scale effects as land and sea breezes may influence radar operation along a coast line. Whenever unusual propagation is observed by coastal radar stations, a record of prevailing winds at the time should be taken as historical data to establish a basis for the local forecasting of radar coverage.

SUBSIDENCE---*Lower* subsidence inversions (1,000 to 2,500 feet) along the southwestern coast of the U.S. are known to produce stable layers affecting low-angle radar coverage. Such inversions occurring at high levels (4,000 to 5,000 feet) do not generally produce extraordinary propagation when the radar sets are situated at low altitudes. It appears, however, that such a stable layer might materially affect air borne radar or communications equipment.

RADIATION---Nocturnal cooling, which is common under clear skies and over dry land, is a common producer of "super refraction".



Such an inversion as would be found over a desert at night is an excellent example.

Turbulence has the obvious effect of destroying moisture and temperature discontinuities along the vertical, and thereby of destroying ducts. Moderate to strong winds, convergence, cloud developments, and mountains are associated with vertical mixing that will standardize the radar ranging.

In order to determine weather's influence upon radar in a quantitative way, the lapse-rate of density with height must be determined. This requires *detailed* knowledge of pressure, temperature, and moisture in the lowest few hundred or a thousand feet of the atmosphere. The radiosonde is not well adapted to measurements of this type because the measured points on an ascent are usually spaced several hundred feet apart.

Among the methods which have been developed for closely-spaced observations, the one most widely adopted uses a captive balloon or kite which carries aloft electrical temperature and moisture-measuring elements. These instruments report to a meter on the ground over thin wires attached to the balloon cable.

Aircraft soundings have been used with good success for radar purposes. (See "APOBS without Aerographs" in the Weather Service Bulletin, August 1944).

There are really *two* kinds of ducts, *ground-based* and *elevated*.

The former has just one atmospheric boundary as a "lid", acting with the earth's surface to keep low-angle radar waves reflecting back and forth.

The latter, or elevated duct, has two atmospheric boundaries, with refraction being approximately normal both below and above the duct. Rays oscillate between the upper and lower boundaries; maximum ranges in or near the duct may be even greater than with the ground-based type.

Extraordinarily long radar wave propagation occurs in a manner analogous to the guiding of sound waves in a metal tube. Within the duct there is less of a signal strength decrease with distance than there is above it, and radar ranges are increased up to four times the normal ranges.

A change in echo strength from day to day is not necessarily caused by the weather, but might simply be caused by a variation in performance of the set. A forecast of duct formation may very well not verify because of lowered set performance.

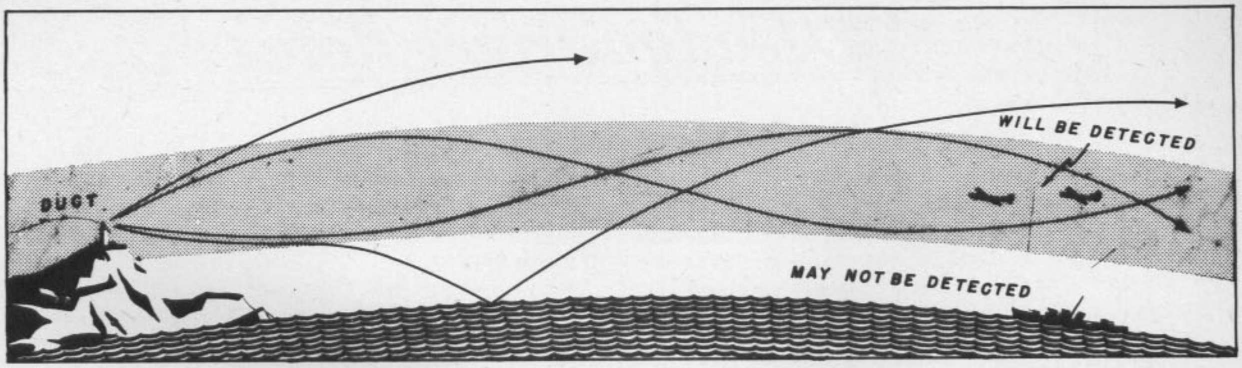
Equipment for making checks of radar sets is not usually available in the field. The change in intensity of nearby fixed echoes may be a measure of the set's working order, but in the absence of more elaborate checks, this test can be misleading.

CLOUD ECHOES

Cloud echoes (precipitation echoes would be more precise) are frequently observed on radar scopes. At times they have caused confusion by blotting out other targets, or confusing the identification of tactically important objects.

These cloud echoes are caused by a reflection of the radar pulse from the rain drops in clouds or storms. The amount of reflection increases very rapidly with increases in the transmission frequency, and cloud echoes are not found with waves of less than 1,000 megacycles. In micro wave radar they first were considered a nuisance, but more recently they have been put to practical use. In tropical climates they are very helpful in aerial navigation.

Cloud echoes may be distinguished from other signals by their fuzzy and diffuse appearance. Not all clouds show up on a scope with equal strength: the strength of



the echo seems to depend primarily on the water droplet size within the cloud or rain storm.

Non-turbulent clouds like stratus are not usually visible on the scopes; the droplets in these clouds are so small that they reflect very little energy. Violent showers and cumulonimbi, however, give intense echoes on the scopes. In fact, storm echoes can be seen much farther than normal land targets, even under standard conditions, because of the clouds' great vertical extent.

In discussing cloud reflections, it must be clearly understood that there is no physical relation between cloud echoes and refraction; the mechanics of duct formation is not related to clouds and with respect to the bending of radio waves. A cloud is merely another airborne target.

THE TOP OF YOUR MAP

I was until recently one of those forecasting students who sat in a futile but tacit rage while the instructor gave "The Official Analysis" for fronts and weather in the Canadian areas along the upper edges of the school maps.

"Now people," he might say, "Look at station 968. We have placed a cold front type occlusion just to the east of that point. Its pressure, temperature, wind velocity, and cloud types are all unrepresentative, but LOOK AT THAT PRESSURE CHANGE!"

No doubt many souls in the class felt like I did; that this was skullduggery designed to lower the scores of us who had relied on some other choices of frontal evidences in the bewildering maze of conflicting Canadian data. However, a recent lecture by George Brewster (Weather Bureau liaison officer with Headquarters Weather Wing) about an official trip he took through northern Canada explained the criterion on which a reliable selection of data can be made.

Most Canadian weather station in the Far North have been established at the fur trading posts of the Hudson Bay Company by correspondence: weather authorities have sent up equipment with a request that the fur traders observe, record, and report certain weather changes.

The handicaps of this system---the only one practicable when manpower was short---are obvious. In the first place, the men who set up, care for, and read the complex instruments under this system are totally untrained; nor can they be held responsible for accuracy and efficiency. Secondly, fur trading posts have been prelocated for purposes in conflict with that of obtaining representative weather data. Nearness to water bodies, shelter by rough terrain, and location close to trees and windbreaks are the normal situation of these posts. The dew point, temperature, wind direction and speed, and even the cloud types are all open to serious question. In the third place, the altitude of the station above sea level is often in doubt. Consequently the "reduction of pressure to sea level" is less than a precise operation.

They key to mystifying manipulations with northern Canadian data seems to be to rely on reports from military stations and those certain civilian installations that possess a reputation for accuracy. Mr. Brewster mentioned Nottingham Island (908) as one of these favored few.

Headquarters Notes

MACHINED WX

The Automatic Weather Station, SCM 19-T2, is not suitable for standardization as an item of Weather Service equipment. Extensive tests have demonstrated that a further development of this equipment will be necessary to eliminate some of the unsatisfactory features of the current design.

There were three primary difficulties with the test unit:

First, the weather reports were not sufficiently accurate to meet forecasting requirements. Secondly, the communications equipment used in automatic transmission was not sufficiently reliable to insure operation for the period of time desired. In the third place, manual reception of the radio signals is now necessary and the nature of the signal provides opportunity for error in this process.

If these three undesirable features can be corrected, the automatic weather station will be adopted for use in localities where fixed installations are impossible or undesirable.

BREEZY BEACHES

Amphibious landings have become a specialty of Allied Forces, whether they be Army, Navy, or Marine. Weather forecasting has many vital applications to the tactics of such operations---knowledge of prevailing wind determines the choice of beach and information about the beach structure, the passage of storms may permit surprise if used so as to impair the aerial observation and radar detection of the enemy, and rainfall considerations affecting soil trafficability and mechanized operations can make the choice of initial equipment for the landing most effective.

Another weather forecast gives the micro-local wind current in the layer next to the earth's surface to permit the laying of smoke screens. Sea breeze effects are important on every coast in this technique, which protects the landing forces in their most vulnerable moments during the attack. Forecasts of sea breezes are valuable in the understanding of anomalous radar propagation in the long-range search devices that would give early warning of approaching amphibious forces. (See "RADAR Coverage" on page 17 of this issue).

The forecasting problems associated with sea breezes have been divided into three parts:
(a) research on the east coast of continents is to be conducted at the AAF Weather Research Station at M.I.T., (b) the U.C.L.A. and C.I.T. AAF research stations will devise methods appropriate for the west coast of continents, and (c) the particular considerations applicable to sea breeze forecasting on tropical islands.is to be done at the Institute of Tropical Meteorology.

ARTILLERY

Weather Division has made available to this headquarters 1,000 copies of an Altitude-Pressure-Density Chart (WRC 10-1) which effects a considerable saving of time in the preparation of forecasts of ballistic densities and temperatures. Copies of the chart have been sent to the RCO of the 21st Region for use in the European Theater and to the RCO of the 15th Region for use in the Southwest Pacific Theater. "Weather Forecasting for Artillery Fire," Weather Division Report No. 735, is the basic source material for meteorologists serving artillery units.

OBSERVERS

Forecasters have had their share of the evaluation spotlight in the Short Range Verification Program and the Forecasters' Proficiency Exam, and now something similar has happened to the observers. The machine-graded, tabulated results of the Weather Wing's Standardized Observers' Examination by regions have been forwarded to the Regional Control Officers, and are being considered at this headquarters as well.

The Statistical Unit at Winston Salem, N. C. has performed an elaborate presentation of the results that will enable the determination by a glance of: the relative ranking of observers within the region; the score of any observer on any question; and the number of observers within the region who missed a certain question.

The first 80 queries in the 100 question exam were the same for every region, the final 20 were submitted by each R.C.O. for his own region. The following tabulation of mean scores for a region has been separated to rank the regions according to the results on the questions that were common to all of them:

STANDARD OBSERVERS' PROFICIENCY EXAM

Region	Mean Score (percent) questions 1-80	Mean Score (percent) questions 1-100
24th	78	80
3rd	76	77
9th	76	76
2nd	75	76
1st	74	75
23rd	74	71
25th	73	73
4th	71	70
26th	69	69
6th	65	66
22nd	64	69

It will be noticed that the mean grades on the 100 questions for a region are not much different from the mean grades on the standardized questions.

The exam questions can be broken down by subjects:

Questions	Subjects
1-16	Meteorology
17-29	Instruments
30-42	Surface Observations
43-48	Winds Aloft
56-61	Raob Spotting
62-64	Winds Aloft Map
65-66	10,000 foot map
67-68	Isentropic Map
69-72	Form 1
73-75	Form 2
76-80	Form 94

The Regional Control Officers have been directed to analyze the results of this examination, taking action that may be deemed necessary to correct the training deficiencies or the training lapses of weather observers.

As an experiment, a large group of *forecasters* in one of the domestic regions was given the *observers'* examination with very interesting results. The mean score for the observers of the region was the same as the mean score for the forecasters. The highest mark for each group was comparable, and the lowest mark for the forecasters was just as bad as the worst observer grade.

Weather Region	TOTAL	Meteorology	Instruments	Surface Observations	Wind Aloft Obs	Surface Chart Plotting	Radiosonde Plotting	Wind Aloft Chart	10,000ft. chart	Isentropic Chart	Form #1	Form #2	Form #94	RCO Questions	Highest Individual Score	Lowest Individual Score	Number of Examinees	Number of Scores less than 60	Percentage of Scores less than 60
1	75	73	74	71	70	66	70	86	83	64	79	87	93	78	100	20	667	54	8.1
2	76	78	74	69	69	63	76	86	90	70	76	84	91	78	99	34	516	37	7.2
3	77	76	76	71	67	65	72	89	85	75	80	88	90	83	97	32	911	73	8.0
4	70	68	71	66	64	63	68	88	86	71	70	84	89	68	95	31	885	151	17.1
6	66	65	69	62	69	58	42	72	53	38	81	79	79	73	88	33	154	41	26.6
8	Grading not yet completed																		
9	76	79	79	72	71	66	69	89	83	55	84	86	89	77	97	48	270	11	4.1
16	Grading not yet completed																		
22	69	71	66	61	57	55	57	79	74	49	86	82	82	81	89	45	104	19	18.3
23	71	72	72	70	61	68	79	89	90	74	75	86	91	59	98	40	570	89	15.6
24	80	76	75	73	69	70	79	93	88	82	84	90	95	90	96	38	321	7	2.2
25	73	71	71	69	66	64	68	89	88	65	77	84	92	73	94	34	528	49	9.0
26	69	71	68	63	66	61	64	83	71	62	65	80	88	72	89	42	104	19	8.3
AVERAGE	73	73	72	68	66	64	68	86	81	64	78	84	89	76					

continued from page 4

that a forecaster's present grade deviates from his forecasting ability by more than one grade on either side. This calculation is based upon the assumption that forecasting ability is a slowly changing attribute.

RELATION OF S.R.V. GRADES TO FORECASTING ABILITY

1. Assuming a total of 12 forecasts:

Probability that his true ability is:	If a forecaster gets a grade of: A	B	C	D	X
A	43%	16%	2%	0	0
B	44	51	23	6	1
C	13	29	56	42	28
D	0	3	17	38	32
X	0	1	2	14	39
Sum	100	100	100	100	100

2. Assuming a total of 60 forecasts:

Probability that his true ability is:	If a forecaster gets a grade of: A	B	C	D	X
A	72%	9%	0	0	0
B	28	70	15	0	0
C	0	21	72	32	4
D	0	0	12	58	31
X	0	0	1	10	65
Sum	100	100	100	100	100

The tables are read as follows: Consider the table for 60 forecasts. The probability is 72 out of 100 that a forecaster who is given grade A actually has A forecasting ability, or the probability is 21 out of 100 that a forecaster with grade B actually has C forecasting ability, or the probability is 0 out of 100 that a forecaster with grade A actually has C, D, or X forecasting ability.

The purpose of including tables based on both 12 and 60 forecasts is to demonstrate the effect of increasing numbers of forecasts in bringing about increasing correspondence between a forecaster's grade and his ability. The reason that there is not perfect correspondence between grade and ability is the presence of random errors which are part of all problems of statistical estimation. Larger numbers of forecasts tend to reduce the random component, and therefore help to increase the correspondence between grade and ability. A more technical discussion of the above points is given in Supplement I to Report No. 602, referred to above.

SHORT RANGE VERIFICATION RESULTS

Thirty-two weeks of Short Range Verification competition among domestic field forecasters between 4 October 1943 and 14 May 1944 have just been summarized by the Statistical Unit at Winston Salem, N. C. Successive reports will be completed and issued at eight-week intervals.

The always-interesting occupation of comparing verification success by regions is most conveniently accomplished by computing the percentage of forecasters in a given region who have been ranked within the first one hundred positions, as has been done below:

TABULATION OF RESULTS BY REGIONS

	Forecasters Competing	Forecasters In Class "A"	Percentage In Class "A"
Fourth Region	569	70	0.123+
Second Region	163	20	0.123-
23rd Region	315	35	0.111
Third Region	432	43	0.100
24th Region	129	12	0.093
First Region	371	32	0.086
25th Region	234	13	0.055
16th Region	10	1	
26th Region	49	2	

SHORT RANGE VERIFICATION PROGRAM
FIELD FORECASTERS
GRADING REPORT, WEEKS 1 - 32
(4 OCT. 1943 THRU 14 MAY 1944)

RANKING	NAME	RANK	REGION NO.	STATION	NO. OF FCSTS.	'S' SCORE
1	JORDAN, H. J.	M/S	4	SMYRNA AF	115	389
2	HIRSCHFELD, W. P.	T/S	25	FORT DIX AB	46	629
3	OLIVERI, A. S.	2 LT	2	CHICAGO	49	635
4	CLARKE, R. F.	T/S	23	BRUNING AF	77	637
5	KAUTZ, ED.	M/S	1	TONOPAH AF	92	701
5	DOAN, J. E.	T/S	23	MALDEN AF	76	701
5	SCHUMAN, M. P.	S/S	1	PALMDALE AF	61	701
8	AUSLANDER, H.	S/S	23	SEDALIA AF	52	715
9	KOLLER, C. R.	2 LT	4	SARASOTA AF	27	716
10	MELHORN, W. N.	2 LT	3	GALVESTON AF	75	720
11	REED, C. K.	1 LT	23	ROSECRANS FD	56	736
12	JONES, M. V.	M/S	4	SARASOTA AF	60	743
13	ROMBERGER, R. L.	2 LT	4	SARASOTA AF	43	744
14	YORRA, A.	1 LT	4	BOCA RATON AF	47	765
15	HOFFMAN, R. E.	2 LT	4	JACKSONVL AF	45	766
16	STOUSLAND, B. R.	2 LT	23	MALDEN AF	22	767
16	JOHNSON, P. A.	2 LT	1	FAIRFLD SUISN	53	767
18	KATZ, Y. H.	M/S	1	STOCKTON FD	60	770
18	KLEYENSTEUBER, C. J.	T/S	1	U C L A	84	770
20	LEES, W. H.	M/S	23	BUCKLEY FD	73	775
21	MOORES, R. L.	CAPT	1	HAMMER FD	53	776
22	MOLER, W. F.	T/S	23	SMOKY HILL AF	65	778
23	GILLESPIE, L. V.	CAPT	1	LONG BEACH	78	780
24	SHANNON JR, J. G.	1 LT	3	PYOTE AF	85	782
25	TOYLI, M.	M/S	4	JACKSONVL AF	42	788
25	FRANK, D. A.	2 LT	4	SMYRNA AF	35	788
27	HOFFMAN, C. E.	1 LT	2	CHANUTE FD	68	789
27	SHELTON, A. M.	2 LT	2	BOWMAN FD	36	789
29	TOMCHEK, E. J.	M/S	4	MAXWELL FD	105	791
29	GRAVES, W. D.	T/S	3	ABILENE	104	791
31	HOFSTADTER, L. J.	CWO	2	PATTERSON FD	30	792
32	DALE, A. C.	2 LT	4	NASHVILLE AP	30	795
33	MACMILLAN, A. J.	CAPT	1	PASADENA	32	796
34	HARMS, R. W.	2 LT	4	COURTLAND AF	70	800
35	HEGGIE, G. D.	1 LT	23	PETERSON FD	65	805
35	CABLE, D. A.	T/S	4	SARASOTA AF	48	805
37	FINDLAY, W. W.	T/S	4	COURTLAND AF	85	806
38	CAREY, J. R.	2 LT	4	KEY FD	49	807
39	MCCULLOUGH, W. J.	2 LT	1	KINGMAN AF	21	808
39	WETZEL, W. E.	2 LT	25	BOLLING FD	65	808
41	ROSSI, M. E.	S/S	23	BUCKLEY FD	48	810
42	LEIGHT, W. G.	2 LT	3	BERGSTROM FD	71	812
42	COOPER, W. W.	1 LT	4	HILLSBORO AF	29	812
44	CHAPMAN, L. E.	2 LT	3	GALVESTON AF	20	813
45	LAWLESS, K. R.	2 LT	4	MORRIS FD	74	815
46	BRANCHE, J. B.	1 LT	4	TUSKEGEE AF	77	817
47	PARRISH, R. H.	M/S	4	WINSTON SALEM	104	819
47	GETTY, R. J.	2 LT	23	SEDALIA AF	48	819
47	WUEBBEN, R. L.	S/S	3	HONDO AF	26	819
50	LUCK, E. C.	CAPT	4	SARASOTA AF	55	820
51	ARBANAS, A. A.	M/S	1	SALINAS AB	61	821
51	LEE, G. M.	M/S	24	MCCHORD FD	59	821
53	MCGOVERN, F. J.	2 LT	24	MCCHORD FD	34	822
54	WELCH JR, A. E.	M/S	4	MEMPHIS AP	101	823
54	GREENE, P. C.	M/S	4	CHARLESTON AF	62	823
54	PROCTOR, D.	S/S	4	GRENSBO HI PT	41	823
57	ONSAGER, G. G.	T/S	24	REDMOND AF	59	824
58	ALEXANDER, H.	2 LT	3	ARDMORE AF	21	826
59	BABSON, S. S.	M/S	24	WALA WALA AF	23	828
60	CRISCILLIS, PA	2 LT	4	MEMPHIS A P	31	830
60	DEMARZO, C. A.	T/S	23	COFFEYVILE AF	58	830
62	NEFF, R. E.	T/S	23	MCCOOK AF	46	832
62	PETERSEN, V. L.	2 LT	4	KEY FD	54	832
64	SEARL JR, T. D.	2 LT	4	NAPIER FD	58	833

RANKING	NAME	RANK	REGION NO.	STATION	NO. OF FCSTS	'S' SCORE
65	MCCRODEN, T. J.	2 LT	3	KIRTLAND FD	37	834
65	KHOURI, F. J.	S/S	16	GORE FD	27	834
67	GLASSCO, R. G.	M/S	23	MARSHALL FD	65	835
67	WILLIAMSON, G. A.	1 LT	4	MAXWELL FD	106	835
69	CERWONKA, E.	1 LT	4	GUNTER FD	46	838
70	HAMMOND, C. V.	T/S	3	DALHART AF	71	839
71	DRAPER, A. L.	2 LT	1	COOLIDGE AF	22	840
72	MLEZIVA, M. L.	WJG	4	CP DAVIS AF	80	841
72	KLIVANS, N. R.	CAPT	23	LINCOLN	16	841
72	BARROW, D. C.	2 LT	4	ATLANTA	38	841
72	GRAY, B. G.	2 LT	3	CLOVIS	28	841
72	SOLOMON, M. L.	S/S	24	PORTLAND	46	841
77	BELL, W. L.	M/S	23	ROSECRANS FD	51	842
77	WIMBISH, C. A.	T/S	4	GRENSBO HI PT	51	842
77	WAGNER, I	T/S	4	WM NORTHRN FD	30	842
80	KIMBALL, G. W.	M/S	4	JACKSON AB	31	843
80	MCGOUGH, R. J.	1 LT	23	GREAT BEND AF	85	843
80	BERRI, R. E.	2 LT	2	ROMULUS AF	16	843
83	WRIGHT, P. H.	1 LT	25	NEW YORK ADW	79	844
84	LAWSON, J. D.	2 LT	3	ARDMORE AF	23	844
85	JONES, E. L.	CAPT	1	DAVIS MONTHAN	127	845
85	SQUIRE, J. J.	1 LT	1	TONOPAH AF	74	845
85	OSLIN, E. A.	T/S	4	EGLIN FD	32	845
85	MURPHY, E. E.	S/S	3	MUSKOGEE AF	48	845
89	VANDERZEE, C. E.	2 LT	23	LINCOLN	47	846
90	WAGNER, W. H.	2 LT	1	KINGMAN AF	13	847
90	BUFFALOW JR, O. T.	2 LT	4	WM NORTHRN FD	27	847
92	ZENNER, G. P.	T/S	3	WOODWARD	61	848
92	UNGERER, G. M.	1 LT	23	MCCOOK AF	97	848
92	HALL, A. R.	M/S	4	MAXWELL FD	36	848
95	BENJAMIN, L. W.	T/S	4	MEMPHIS AP	46	849
95	HERMAN, J. D.	2 LT	3	ALTUS	41	849
95	ERICKSON, C. O.	S/S	26	ORLANDO AB	55	849
98	HEFFERNON, D. P.	CAPT	2	LOCKBOURNE AB	83	850
98	MCCARTHY, W. J.	CAPT	2	PATTERSON FD	44	850
100	PARKER, R. L.	CWO	4	MAXWELL FD	73	851
100	BUTSON, K. D.	2 LT	24	GOWEN FD	32	851

THE FORECASTER WITH THE CRYSTAL BALL!

Master Sergeant Herman J. Jordan has been given an unrivalled accolade by the S.R.V. results as the best forecaster in the domestic weather regions. While relative positions are often determined by a few points difference in 'S' score, Jordan is 240 of these arbitrary units ahead of his nearest competitor. Furthermore, the reliability of this statistical estimate of forecasting ability theoretically is higher for a greater number of forecasts---and Jordan has submitted more than any of his competitors.

Sergeant Jordan had three years of college engineering and commercial life insurance experience behind him when he was inducted in January 1941. From January to March 1942 he prepared successfully for the RCO Observers Exam, proceeding then to forecasting school. Jordan graduated from the Chanute Field course in September 1942. His present appointment as station chief at the Smyrna Airfield in Tennessee came just one year later.

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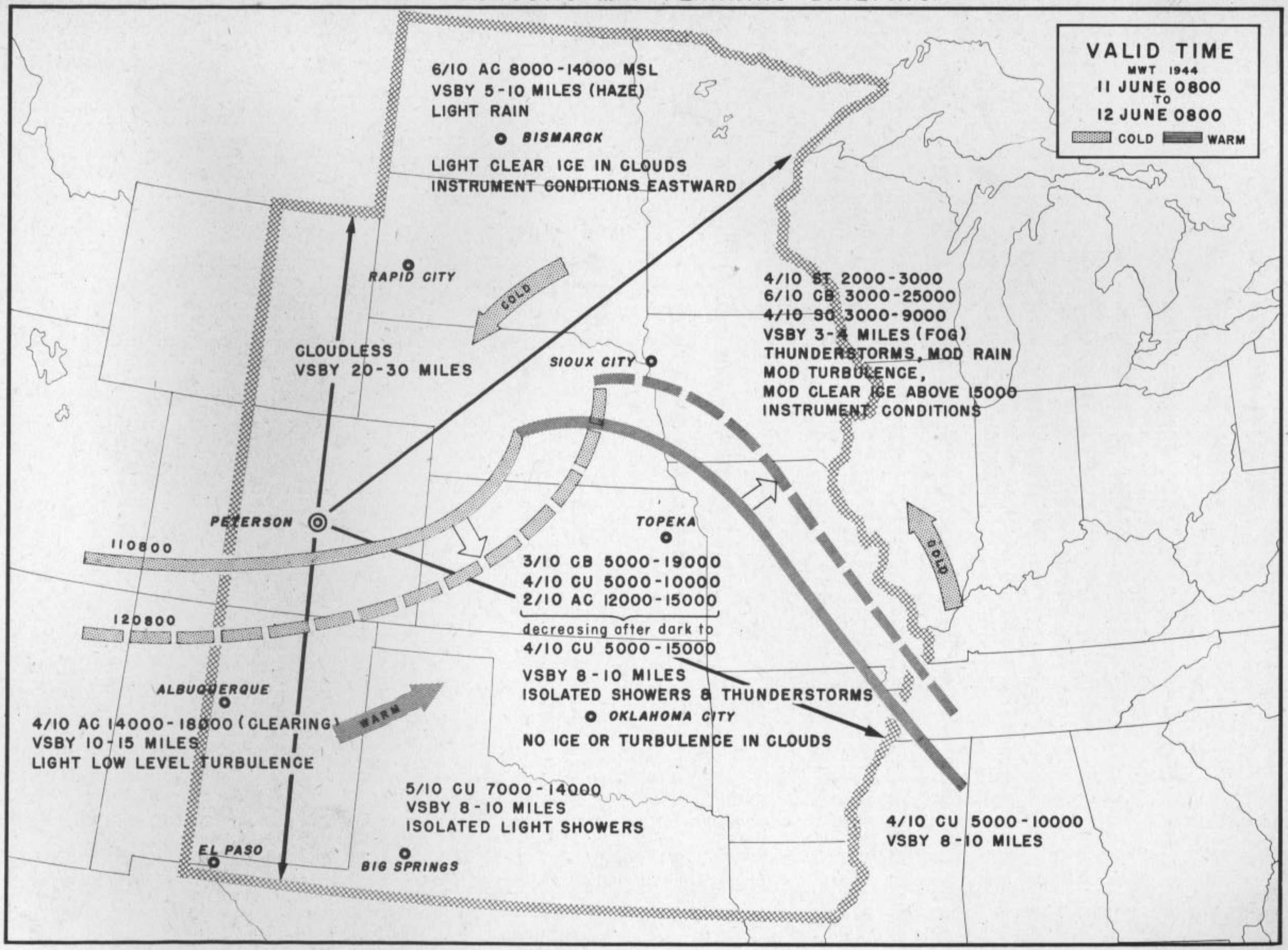
TYPE PROGNOSTIC MAP PLANNING BRIEFING



You will prepare a "visual aid" such as this if called upon to brief an AAF Commanding Officer and his immediate staff when they are interested in immediate operations---recommends a manual of weather briefing recently prepared by Headquarters Weather Wing.

Widespread experience in domestic and foreign regions was consulted in the preparation of this publication, which has organized both recent improvements and tested methods into a standardization of weather presentations. The precise needs of the user are stressed in each case of a specialized briefing.

Distribution of this manual will be made to all RCO'S, all forecasting stations, and to other arms and services which may submit requests to this headquarters.