RESTRICTED

WEATHER SERVICE

Bulletin

HEADQUARTERS AAF WEATHER SERVICE
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HEADQUARTERS

RESTRICTED

COELUM AD PROELIUM ELIGE

HEADQUARTERS
AAF WEATHER SERVICE
ASHEVILLE, NORTH CAROLINA

7 July 1945

To All AAF Weather Personnel:

The first and most important step in the Weather Service reorganization has been accomplished.

The "AAF Weather Service" has been established as an AAF command with headquarters in Asheville, North Carolina. The Weather Division (Washington, D.C.) and the Headquarters Weather Wing (Asheville, N.C.) have been consolidated, and together now constitute Headquarters, AAF Weather Service. Units formerly assigned to the Weather Wing have been transferred to the AAF Weather Service.

As soon as the performance of newly-assigned headquarters functions has crystallized, it is contemplated that some changes will be made in the basic organization of the field weather service. Your attention is called particularly to AR 95-150, dated 19 May 1945, and to AAF Reg. 20-58, dated 1 July 1945, on this subject. Such changes will be reported to you promptly in subsequent issues of the Weather Service Bulletin.

D. N. YATES
Colonel, Air Corps
Chief, AAF Weather Service

STATESIDE REASSIGNMENT

Weather officers and men are returning from overseas to the United States in progressively large numbers. Invariably they are glad to be home, and their presence will help to fill the domestic manpower shortage. But the domestic Weather Service has changed in their absence---constant-pressure codes and analysis, Rareps, WBAN forms, new conventions in analysis, revisions to TM 1-235, etc.---and in addition, weathermen certainly have become rusty in the use of techniques which were inappropriate for their overseas duties. The need for a brief retraining is clear, a need which is being solved for every weatherman fresh from an AAF Redistribution Center by the Weather Service's own Redeployment and Training Unit at Goldsboro, North Carolina (Seymour Johnson Field). The commanding officer of the Unit is Major Frank A. Benesh. The operations and training director is Major William F. Gannon.

The Unit conducts refresher training for every returning weatherman, checks on his proficiency and other qualifications, and determines an appropriate reassignment for him to a domestic region. The length of training is not fixed: rather, it is tailor-made to the individual. His ability, his progress, his attitude, and his experience determine how long he remains at Goldsboro. Minimum requirements for forecasters and observers have been set up, and just as soon as a man meets these requirements he is reassigned. A returnee wants to be stationed close to his home in the normal case, and insofar as practicable, assignments are made on this basis. The average weatherman is fitted for domestic field service within 10 to 15 days.

Courses at present are conducted in forecasting, observing, and radiosonde operation. It is expected that weather equipment technicians and teletype maintenance specialists will also be assigned to the Redeployment and Training Unit: since these men should have a secondary MOS of 784, the tentative plan is to give them observer refresher training until an assignment is obtained for them in their specialty.

Forecasters and observers with recent overseas experience may not be familiar with several operating procedures recently made standard for the domestic Service. And returning forecasters in general have lost their grasp of some technical methods applicable to U.S. weather which were not used in their station abroad. Usually they have had little opportunity to utilize or even study certain new forecasting techniques. Observers have new codes and new forms to study. They have U.S. map spotting and Raob plotting to recall; many observers were never required to perform these duties overseas. The Goldsboro training is being accomplished with all these principles in mind (see Tables I and II).

Each subject in the retraining is designed to keep lectures to a minimum and to emphasize *practice*. Formal testing to determine a man's weather qualification is avoided; rather, examinations are given in the form of practical exercises. A "Class A" weather station has been established at Goldsboro to provide a laboratory of typical domestic station procedure.

Present plans call for an instructor student ratio of 1:15. Instructors will be provided by the Weather Service from domestic regions at first, but eventually every instructor will be one who has had overseas service. The Redeployment and Training Unit is continuously enlarging its facilities and, if necessary, it will eventually be able to accomodate as many as 700 returnees at once.

Based on a favorable vote by a group of returnees, the Unit is considering a proposal to present civilian speakers from various industrial and professional fields, including meteorology, who would address groups of returnees on post-war employment opportunities. Polls will be taken among new groups of men to determine in what industry or profession they plan to work, and efforts will be made to obtain speakers from the most representative fields. In the way of other extracurricular functions, the Unit plans to conduct indoctrination lectures on the world-wide organization of the Weather Service and its relationship to the war effort. It also plans to poll returnees on their opinion of refresher training and how it may be improved.

LECTURE SCHEDULE FOR FORECASTER'S INDOCTRINATION PROGRAM

	FIRST TWO HOURS OF MORNING	THIRD HOUR OF MORNING
First Day	Use of Upper Air Charts in Forecasting.	Short Range Verification Program: Raob Code (stressing change to contour charts).
Second Day	Use of Upper Air Charts in Forecasting.	Winds Aloft (code-plotting): Rawins: Analysis of Upper Air Charts.
Third Day	Use of Upper Air Charts in Forecasting; Methods of Prognostication.	Surface Synoptic Code; Hourly Sequence Code; Analysis of Surface Map.
Fourth Day	Methods of Prognostication; Typical Cyclones and Anticyclones.	Analogues; Preparation of Progs.; Scoring Fronts.
Fifth Day	Typical Cyclones and Anticyclones; Air Masses.	Exercise (Upper Air Charts); Analysis Code.
Sixth Day	The Adiabatic Chart, Rossby Diagram, and Raob Analysis.	Organization of the War Dept., AAF, and Weather Service; Briefing.
Seventh Day	The Adiabatic Chart, Rossby Diagram, and Raob Analysis.	Communications.
Eighth Day	The Adiabatic Chart, Rossby Diagram, and Raob Analysis; Thunderstorms, Stability Diagrams, and Tornadoes.	Sferics; Lightning Strikes on Aircraft; Precipitation Static.
Ninth Day	Thunderstorms. Stability Diagrams, and Tornadoes; Fog.	AAF Regulations; Form 23: Preparation of Route Forecasts.
Tenth Day	Fog; Icing and Turbulence.	Exercise (Raob Analysis).
Eleventh Day	Icing and Turbulence; Long Range Forecasting.	Administration.
Twelfth Day	Long Range Forecasting; Observing.	Observing.

Afternoon Session: Four hours of laboratory (analysis of charts and diagrams; forecasting).

MINIMUM OBSERVER PROGRAM
(72 class hours)

	Time
SURFACE CHARTS	
Explanation of 1942 Weather Code (revised). Check chart	04
Plotting of surface charts, four hours per day	28
SURFACE OBSERVATIONS	
Hourly, 3-hourly, and 6-hourly observations	04
Rules for Specials; visibility and precipitation criteria	04
Practice observations	04
AUXILIARY CHARTS	
Explanation of the Raob Code, 1st and 2d transmissions and plotting of adiabatic and Rossby diagrams	04
Plotting of upper-air charts. Procedures for constant level and constant-pressure charts	16
TELETYPE	
Outline of U.S. teletype system. Procedures for sequence collections, Specials, Typnos, etc.	02
Cutting and sending tapes	02
WINDS-ALOFT CHARTS	
Explanation of code. Plotting charts	04
UPPER-AIR OBSERVATIONS	
General discussion. Completion of WBAN forms	04
Total hours	72
METEOROLOGY	
Training films (frontal types, air masses, etc.)	

PROFICIENCY CRITERIA FOR OBSERVERS

Plot surface chart (300 or more signals) in at least 2.5 hours.

Plot winds-aloft chart within one hour.

Demonstrate knowledge and proficiency in meteorology, surface observations, pibals, teletype procedures and upper-air chart plotting.

The training schedule for the Redeployment and Training Unit at Goldsboro, N.C., is given in the two tables above. Forecasters will have three hours of lecture in the morning and four hours of laboratory in the afternoon: observers, four hours each in the morning and the afternoon.

East Asian *Circulation* (Winter)

from a trip report by Dr. J. Bjerknes

The world's largest break in the temperate Westerlies occurs over East Asia and its adjoining seas in winter, when thermal extremes over the land and the ocean contribute to the Siberian High and the Aleutian Low. The general circulation there remains semi-permanent during the winter season. Dr. Bjerknes discusses this situation from the viewpoint given in "On the Theory of Cyclones", a paper by Dr. Holmboe and himself in the Journal of Meteorology's *first issue.*

A circulation pattern which remains semi-permanent produces no systematic deviation from a zero pressure tendency in any part of the system. If, for instance, the surface current is diverging in one region, the upper current must show compensating convergence in that same region, and vice versa (Tool 1).

The surface streamlines actually show definite divergence over the whole shaded area of Figure 2, where a northerly current leads from cyclonic curvature over the Sea of Okhotsk to anticyclonic curvature in the vicinity of Formosa (Tools 2, 3). The Northerlies farther east which branch off cyclonically should not have systematic surface divergence.

Convergence aloft above the shaded area, according to AAFPOA upper-air charts, is implemented in the usual way (Tool 5) by flow from an anticyclonic bend (over Siberia) to a cyclonic bend (over Sea of Okhotsk), both of which seem to be semi permanent throughout the winter (Figure 2). The upper tropospheric temperature field, by advection, will form a warm tongue coinciding with the Siberian upper wedge and a cold tongue coinciding with the Okhotsk upper trough. Wedge and trough should therefore show up clearly all the way up to the tropopause. In the stratosphere the wedge should be colder than the trough, and a gradual approach to a zonal flow would be observed with increasing height.

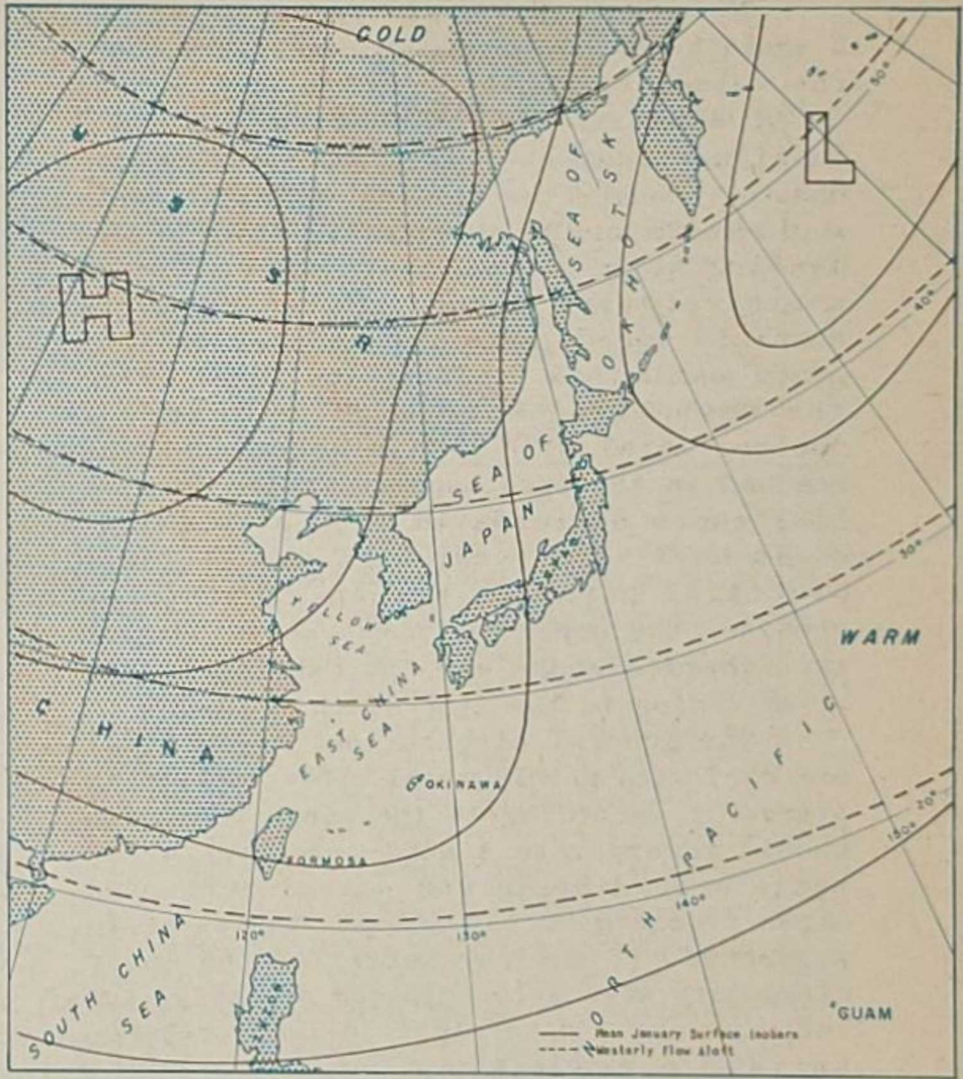


Figure 1: An hypothesis of zonal flow aloft.

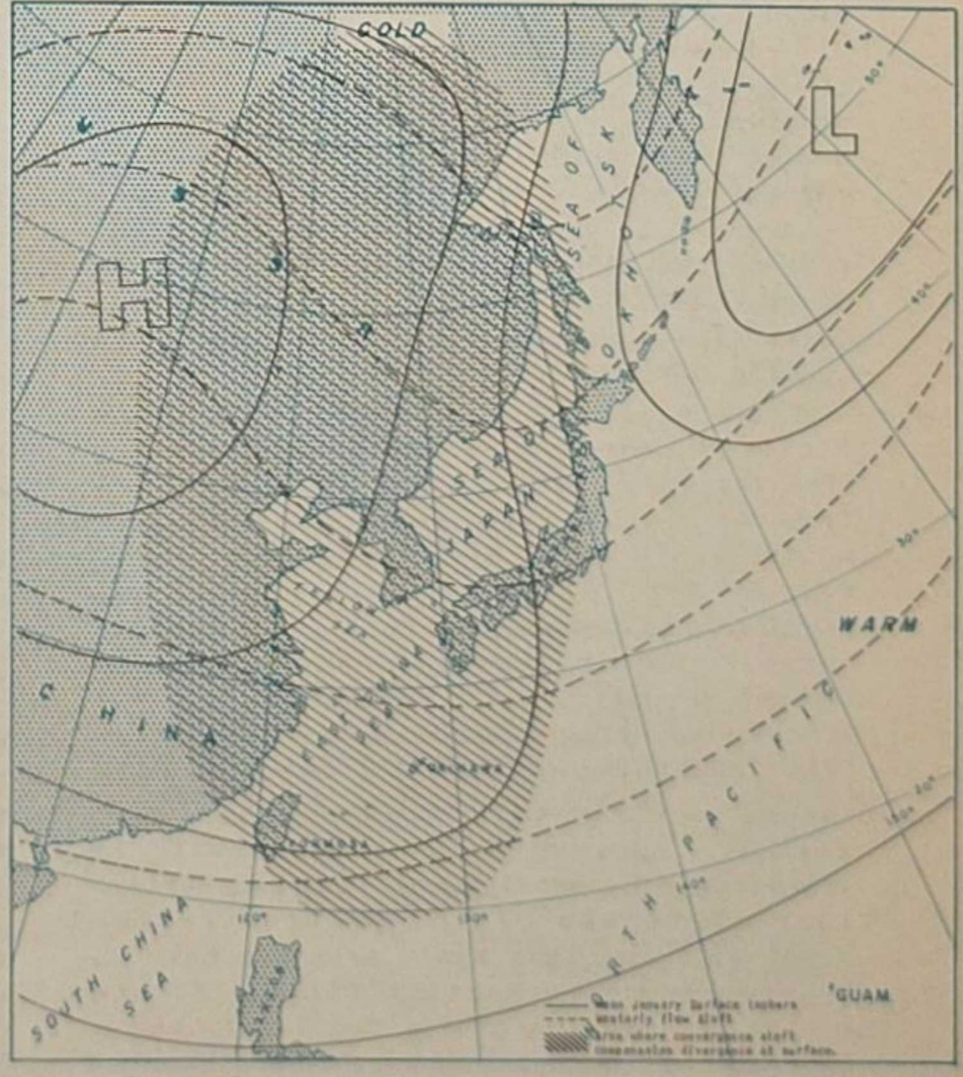


Figure 2: Dynamic reasoning indicates, instead, the semi-permanent existence aloft of a Siberian wedge and a trough over the Sea of Okhotsk.

The level of non-divergence in Figure 2 would be found where the Westerlies reach the velocity tabulated under Tool 4. At 50^{o}N, and with a half wavelength of 45^{o} longitude from the Siberian wedge to the Okhotsk trough, the critical relative speed would be 30 knots. Obviously, since we are dealing with a stationary wave, the 30 knots relative speed is also 30 knots absolute speed. The upper-level convergence would thus begin at the level where the Westerlies have a 30 knot speed. Another level of non-divergence would be reached in the stratosphere if the Westerlies there decrease to 30 knots, which would have to be very high up. For all practical purposes we can, therefore, consider the upper-air convergence between the Siberian wedge and the Okhotsk trough as extending to the "top of the column".

The general circulation, tentatively sketched with purely zonal upper isobars in Figure 1, according to the above reasoning should incorporate a semi-permanent upper wedge over Siberia and a semi-permanent upper trough over the Sea of Okhotsk as in Figure 2. If the parameters of the upper stationary wave were adjusted properly, the influence of a divergence in the northerly surface current would be canceled by upper-air convergence so that the pressure field could remain stationary.

In southern China the stationarity of the general circulation offers a simpler problem. The surface current of northerly origin there turns into a straight easterly current which has no systematic divergence. On top of it flows the westerly current from northern India, also without systematic divergence. Stationarity is thus assured, apart from superimposed disturbances to be treated below.

Sometimes the upper trough deepens to a closed center over the Sea of Okhotsk (for instance, with arrival of a deep storm from the south). Such a center, if developed through a deep layer, will move slowly *westward* (Tool 7) and strengthen the Northerlies between it and the Siberian wedge. Thereby the Low should develop thermal asymmetry and a westward tilt. The westward-tilting closed Low will begin to fill (according to Tool 9), and a gradual return to the normal trough condition will follow. Another "return to normal" is conceivable by development of upper Westerlies above the closed Okhotsk center (Tool 11); but that would probably have to be preceded by a partial filling of the center, a lowering of its top level, and a lowering of the level of non-divergence.

In forecasting the slow and seemingly erratic displacements of the Okhotsk Low, it might be well to remember the old rule that a center tends to move parallel to the strongest winds around it (for instance, southwards if the pressure gradients are stronger in the western than in the eastern half of the Low). This rule has a dynamic background and might have been listed among the "tools of reasoning".

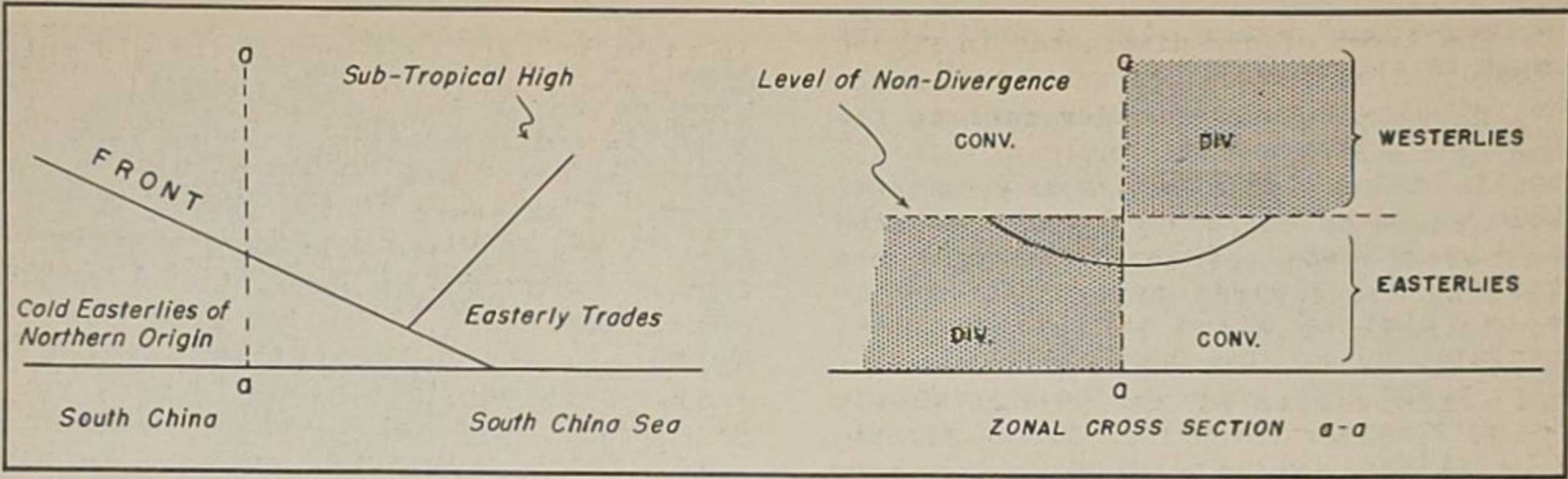
The frontal disturbances from northern Europe usually penetrate into western Siberia but in most cases stop against the cold surface core of the East-Siberian High. Upper disturbances, however, continue across that High and reach the Pacific. The area south of the Asiatic highlands is usually without definite surface fronts, because the Westerlies there seldom extend down to sea level. According to advice from CBI forecasters, only one or two surface disturbances from the west are observed each winter in the "Hump" region: the rest of the disturbances are upper ones.

In most cases it would seem natural to consider the upper disturbances arriving by way *north* of the Siberian High as being separate from those arriving by way *south* of the High. That separation sometimes takes place as far west as European Russia, and it is likely to take place somewhere on the way through Asia, wherever the High at the time may be particularly well developed. In a smaller scale that is what happens in North America. A big stationary High over the Rockies is always associated with disturbances traveling to the north of it (as in Siberia: turning southeastwards after passing the longitude of the High); but it is also associated with independent disturbances in the upper Westerlies over northern Mexico (as in India: without clear surface fronts because the Westerlies do not reach the ground).

1. *Upper Disturbances by Northern Route.*

As the northern upper disturbances enter the northwest current heading for Japan, they encounter, as a feature of the "general circulation", a gradually increasing cross-current temperature gradient (of the sign that calls for strong increase of wind speed with height). That cross-current temperature gradient is of the right sign to produce a backward tilt of wave troughs with height and resultant deepening (Tool 8).

This deepening process is just the same as that occurring above a young wave cyclone, but over East Siberia and Manchuria no frontal wave at the surface can accompany the upper wave because the surface current blows from northeast under an upper current from northwest. It would



therefore seem to be the best procedure not to introduce any surface fronts in the disturbances from northwest until they have deepened enough to show a definite trough (or center) also on the surface map. At times that may not be until the disturbance crosses Japan, where the prevailing surface wind is more parallel to the upper current.

Whenever the combined upper and lower disturbance gets organized, it will be moving towards a warmer geographical region. The rear of the new surface trough (or center) will consequently be colder than the front: the lower part of the pressure trough will be situated ahead of the upper part and will deepen under the influence of upper-air divergence (Tool 11). The later history of the disturbance would be like that of any other occluded cyclone over the Pacific. The deepening finally ceases when the closed circulation reaches high up. Then the level of non-divergence is situated still higher (Tool 11), and the upper air divergence can no longer over-compensate the low-level convergence. I would advise against introducing surface fronts in the Okhotsk region without circumstantial evidence for an upper disturbance having arrived from the northwest. The surface pattern is not by itself frontogenetic in that region, and the surface current is dynamically stable, with cold air to the right (Tool 8).

2. *Upper Disturbances by Southern Route.*

The upper disturbances south of the Siberian High probably can be traced back to the Mediterranean, where they were accompanied by surface fronts. That connection with fronts is lost over Persia and India, but on the east side of the "Hump" a quasi-stationary frontal surface is waiting for the arriving upper waves. The resulting combined disturbance is in principle the same as the northern part of a polar front cyclone (Figure 3). The warm sector is, however, at such a low latitude that the warm sector Westerlies are only to be found aloft. The zonal cross-section at "a - a" is represented by the Chengtu time-sections, which probably as a rule show southeast backing to northeast in the lower layer, and southwest veering to northwest in the upper current during a trough passage. Convergence and divergence have been labeled on the cross section in accordance with Tools 5 and 6. The disturbance will move eastward if the pattern of divergence-convergence in the upper air overcompensates those effects in the lower layer. The divergence function reaches relatively big values in the Easterlies, and the eastward propagation of the joint disturbance therefore cannot be rapid. The deepening would depend on the tilt of the trough, and evidently that is not pronounced in the beginning of the development of Chinese disturbances. The future of the Chinese disturbances as they go out to sea depends on several factors, most of which point towards deepening as the likely development:

a. The disturbance might approach the region of strong meridional temperature gradient in the upper air south of the cold Okhotsk trough. Then it would develop thermal asymmetry and a backward tilt (which means deepening).

b. If the disturbance goes a little north of east, it will develop surface Westerlies (usually in the Formosa region) and the complete frontal wave is started. With the great meridional temperature gradient available, the resulting disturbance may deepen considerably and soon also pick up speed when the warm sector Westerlies increase. In that case, the analyst should not hesitate to forecast the upper wave to move along with the speed of the frontal wave. No dynamical rule would be violated thereby.

c. Interference from disturbances arriving via the northern route may upset the development of Chinese disturbances described in "a" and "b". Quite complicated situations should frequently arise in the Japanese area where the two highways of independent disturbances converge, and where also a stationary trough is situated.

Summary of the Recommendations for Upper-Air Analysis in Winter:

1. There should be a semi-permanent, cold trough in the Westerlies, extending southwards from the Sea of Okhotsk and petering out towards Guam. That trough should move westward or eastward only short distances each day. Disappearance and regeneration of the trough should become frequent in spring, during transition to the entirely different summer circulation.

2. Initially weak, but later intensifying, upper waves should come from the northwest at a rather *rapid* speed. Their frequency, if analogous to European and American disturbances of the same type, should be about 48 hours, but no clock-like regularity should be assumed. As soon as the northwest disturbances acquire surface fronts, upper and lower systems should have the same speed.

3. Upper waves, usually independent of the northern ones, should arrive at slow speed from southern China. They will deepen if they happen to develop a good frontal wave off the China coast. Then they should travel along with the speed of the frontal cyclone, but with the usual difference in phase.

Corresponding Rules for Surface Analysis:

1. Stationary Okhotsk Lows should as a rule be considered as frontless cold vortices, unless there is an adjoining frontogenetic col on the surface chart or unless there is an upper disturbance from the northwest entering the system. This upper disturbance from the northwest should in general be analyzable by isallobaric methods, and some scattered medium clouds should be seen to accompany the disturbance across the Siberian High.

2. The trailing cold fronts forming the southern limits of Siberian-Chinese cold waves are part of the general circulation and should, of course, be maintained even when the evidence is feeble. They are often activated into frontal waves under the influence of the upper waves in the South-China Westerlies.

3. The "Hump" is the western limit of all Siberian-Chinese cold waves. Southwards over Indo-China, the cold waves, shallow but still important, spill into tropical latitudes. In spring that leak is closed by the development of the Thailand monsoon Low, which spells an end to the Indo-China northeasterlies.

* * *

This article has been no complete treatise on the title subject, but merely some notes on the salient problems of analysis and forecasting at Guam gathered during my brief stay in the Pacific Ocean Areas. I am aware of the fact that many beliefs and opinions expressed today will soon be superseded by observational knowledge, and that it is no time now to formulate rigid theoretical systems. Please consider this study to be a very preliminary attempt to view the little aerological experience we have in the western Pacific against the background of dynamical meteorological theory.

Because my theoretical language is not familiar to everybody, a brief digest follows of an article in the first *Journal of Meteorology* written by Dr. J. Holmboe and myself. The textbook "Dynamical Meteorology" by Dr. Holmboe and others (which has just been published) also contains a treatment of what is presented below under the title "Tools of Reasoning..."

TOOLS OF REASONING DERIVED FROM THE TENDENCY EQUATION

1. $$\left(\frac{\partial P}{\partial t}\right)_h = -\int_h^{\infty} g \operatorname{div} (\rho v)\, dz + (g\rho v_z)$$

Last term vanishes when h = 0

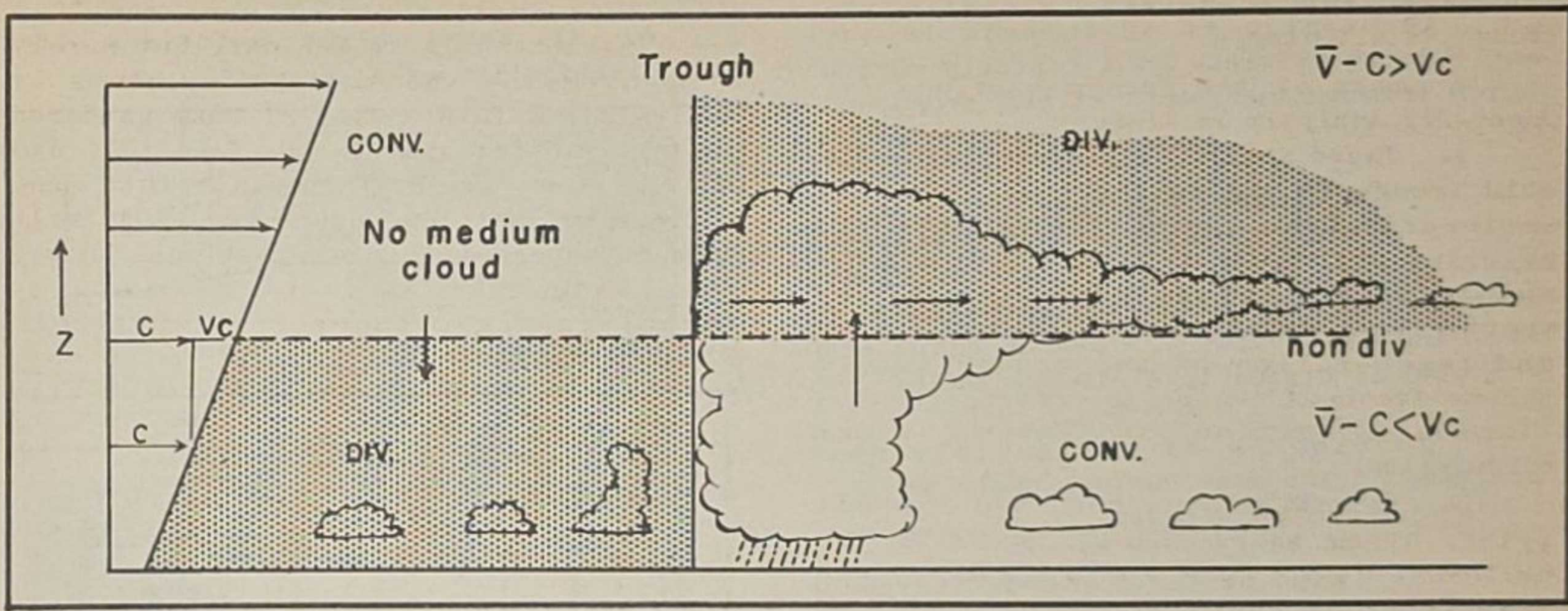
2. Divergence prevails where particles go along their trajectory toward decreasing cyclonic or increasing anticyclonic curvature. Convergence prevails where particles along their trajectory go toward decreasing anticyclonic or increasing cyclonic curvature.

3. In case of weak curvature effects as described under (2), a residual latitude effect is of importance: divergence in currents with a component towards the equator and convergence in currents with a component towards the pole.

4. The level of non-divergence in westerly waves is found where the air speed (determined as an average speed through a whole wave length in the particular level) surpasses the wave speed by the tabulated quantity v_c (called the critical relative speed).

$$\underset{(m/s)}{v_c} = \frac{2\Omega a \cos^3 \phi}{n^2}$$

where a = radius of earth,
n = wave number in 360° longitude



Appendix to tool 4.

Use of table of v_c.

In the *unreal* barotrope case (west wind constant with height) the table gives the wind speeds with which given waves become stationary (Rossby waves).

In the barocline cases (west wind variable with height, of which again west wind increasing with height is the one of practical importance) the table relates wavelength to wind speed *at the level of non-divergence*. The stationary wave (c = 0) is the one for which the opposite div-conv above and below the level of non-divergence cancel each other. Eastward-moving waves are those for which upper-air div-conv overcompensates conv-div at low levels.

The level of non-divergence can be found if we observe the wave speed as well as the wavelength. The level of non divergence is then at the height where the west wind, averaged over a wavelength, is equal to the wave speed c plus the tabulated critical relative wind v_c. If we are uncertain about wavelength and wave speed, as may often be the case over Japan, we have the following indirect ways of reasoning:

a. The level of non-divergence is also close to the level of maximum upward relative-to-downward velocity. The upward velocity in front of the trough decreases upward from the level of non divergence to a level of v_z = o, which can probably be identified with the top of medium cloud build-up. The level of non-divergence should therefore always lie below the tops of medium cloud. Most likely the level of non-divergence should even be slightly lower than the base of medium cloud. If that is right we could formulate the basic explanation of medium clouds as being the clouds formed by vertical shrinking and horizontal divergence just above the level of non-divergence.

b. With the level of non-divergence being at roughly 12,000 feet, a little more than half the weight of the atmosphere lies above the level of non divergence, and the upper-level pattern of div-conv will regularly be able to overcompensate the lower pattern and produce eastward propagation of the wave (all of course depending on the absolute amounts of div-conv in the level-for-level patterns).

c. The upper pattern of div-conv should not too strongly overcompensate the lower pattern because that means excessive pressure tendencies. The level of non divergence should therefore not be too low, either. Non-divergence just under the base of medium clouds seems to be the best bet when no other, or more accurate, information is available.

LATITUDE	LONGITUDE					
	Meters per second					
	180°	120°	90°	60°	36°	18°
70°	9.3	4.1	2.3	1.0	0.4	0.1
60°	29.0	12.9	7.3	3.2	1.2	0.3
50°	61.6	27.4	15.4	6.8	2.5	0.6
40°	104	46.3	26.0	11.6	4.2	1.0
30°	150	67.0	37.5	16.8	6.0	1.5
20°	193	85.6	48.3	21.4	7.7	1.9
10°	221	98.2	55.3	24.6	8.9	2.2
0°	232	103	58.0	25.8	9.3	2.3
	Nautical miles per hour					
	180°	120°	90°	60°	36°	18°
70°	18	8	4	2	0.8	0.2
60°	56	25	14	6	2	0.6
50°	119	53	30	13	5	1
40°	197	90	50	22	8	2
30°	290	130	73	33	12	3
20°	373	166	93	41	15	4
10°	428	190	107	48	17	4
0°	449	199	112	50	18	4

Table I: Critical Relative Wind Speed, V_c

An example of an impossible wave analysis at 40° lat. in a westerly current which reaches 200 knots at the tropopause would be:

18° wavelength,

15 knots wave speed.

Wind at level of non-divergence in this case would be 15 + 2 = 17 knots, which is certainly too low an estimate of the wind just below the medium cloud when the wind at cirrus level is 200 knots.

* * * *

An example of a plausible wave analysis in the same current would be:

36° wavelength,

40 knots wave speed.

Wind at level of non-divergence then is 40 + 8 = 48 knots.

Or even:

60° wavelength,

30 knots wave speed.

Wind at level of non-divergence is 30 + 22 = 52 knots.

In other words, a strong westerly current does not carry short and slow waves.

Low latitude example:

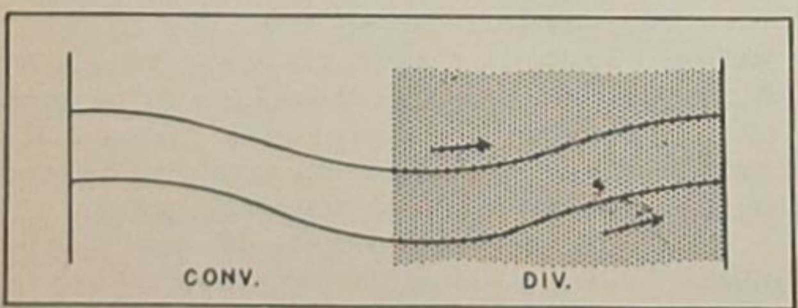
20° latitude,

18° wavelength,

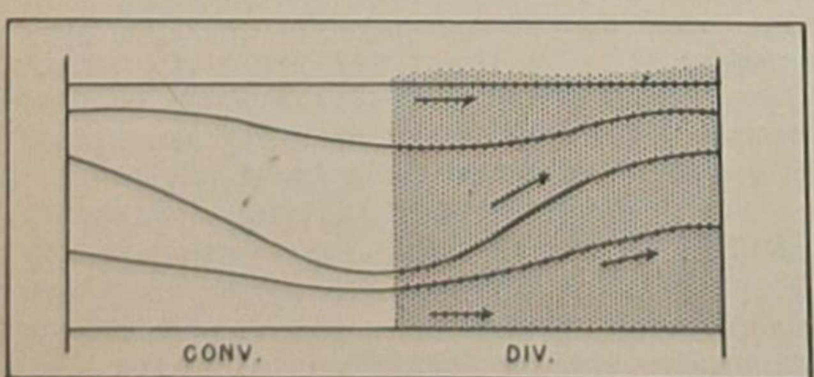
15 knots wave speed.

Wind at level of non-divergence is 15 + 4 = 19 knots, plausible if that speed is observed just under the base of medium cloud.

5. In Westerlies of supercritical speed (above the level of non-divergence in the normal case of Westerlies increasing with height) the distribution of divergence is:

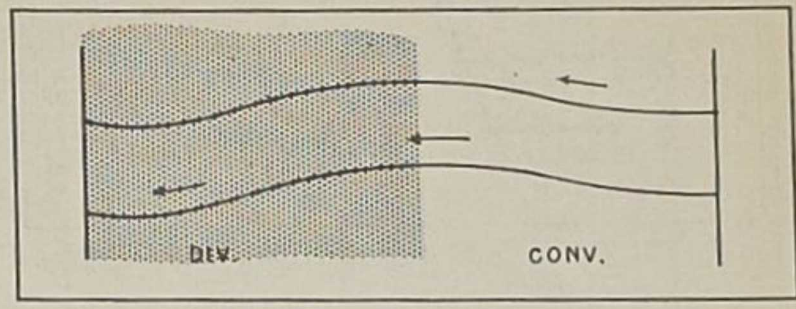


Still stronger values if the wave amplitude decreases northward and southward:

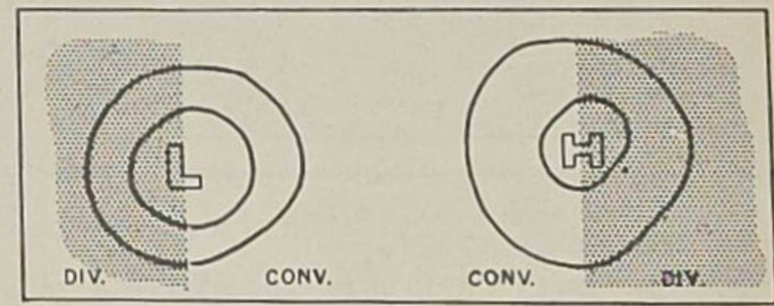


For this pattern the critical relative air speed is somewhat lower than tabulated.

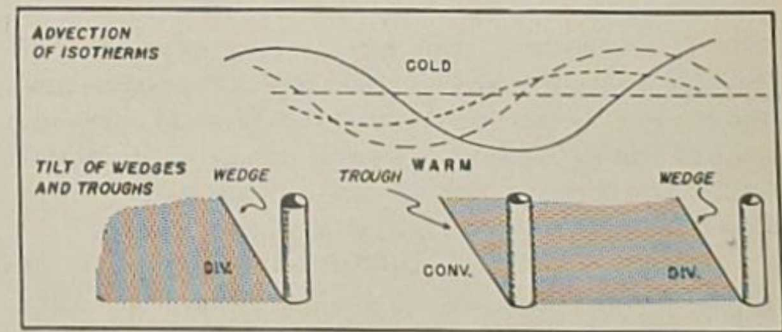
6. All waves in the Easterlies have this distribution of divergence:



7. Closed centers:



8. Incipient waves in a current with warm air to the right (northern hemisphere) will develop thermal asymmetry and tilt in such sense that deepening of troughs and building-up of wedges will result. Such currents are dynamically unstable and sponsor all superimposed perturbations.

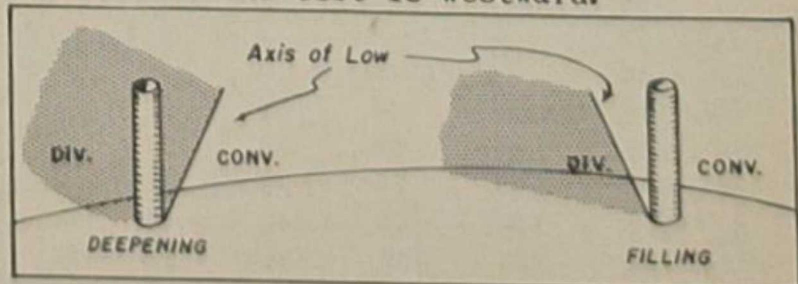


A vertical column taken from any point on the trough line lies in a region of divergence, and pressure falls result at its base. Vertical columns over points on wedge lines lie in a region of convergence, and pressure rises result at their base.

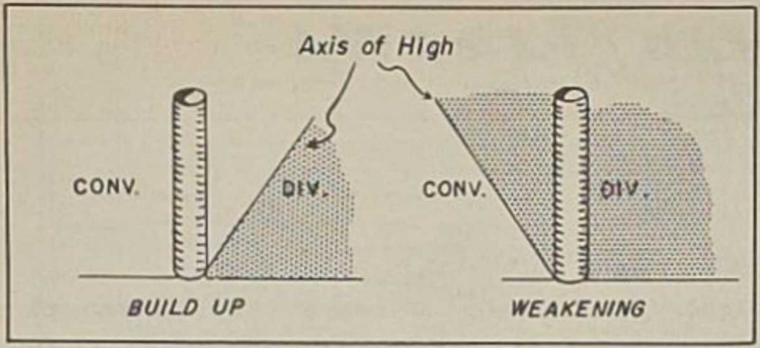
The same thing happens if an old wave moves into a region where isotherms and isobars initially coincided.

In currents with the opposite cross-current temperature gradients, waves are damped out.

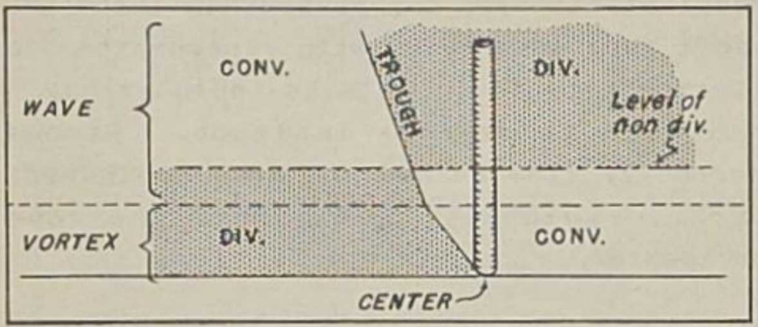
9. A closed Low extending through a deep layer will deepen if it tilts eastward and fill if the tilt is westward.



10. A closed High extending through a deep layer will build up if it tilts eastward and weaken if the tilt is westward.

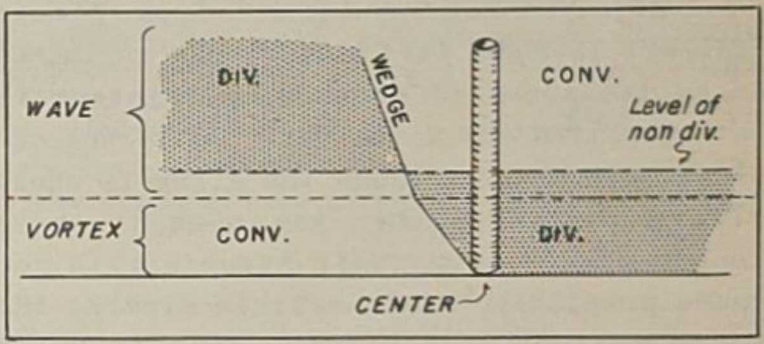


11. A closed Low surmounted by a wave in the Westerlies:



Deepening of a Low depends on upper-air divergence. It will be strong with a good phase difference between vortex and wave, with a good westward tilt of wave trough, and with a low level of non-divergence.

12. A closed High surmounted by a wave in the Westerlies:



Build-up depends on upper-air convergence. It will be strong with a good phase difference between center and upper wedge, with a westward tilt of upper wedge, and with a low level of non-divergence.

MONTHLY REVIEW OF AIR INSPECTORS' REPORTS
(for April 1945)

Average Rating	TOTALS Excellent No.	%
Reports Received	97	100
No Deficiencies	33	34.0
No Irregularities	25	25.7
Improper Care and Maintenance of Instruments	29	29.9
Inadequate Security Precautions	41	42.2
Filing System Inadequate	9	9.3
Improper Management of Station	31	32.9
Maps and Charts Improperly Analyzed	26	26.7
Forecasts (including AAF Form 23 Improperly Prepared	30	30.9
Maps and Charts Improperly Plotted	14	14.4
Training Program Inadequate	26	26.7
Improper Military Correspondence Procedures	8	8.2
Non-compliance with AAF Letter 50-65	11	12.4
Weather Records Improperly Maintained	14	14.4

(Items 1 to 14 defined in previous issues)

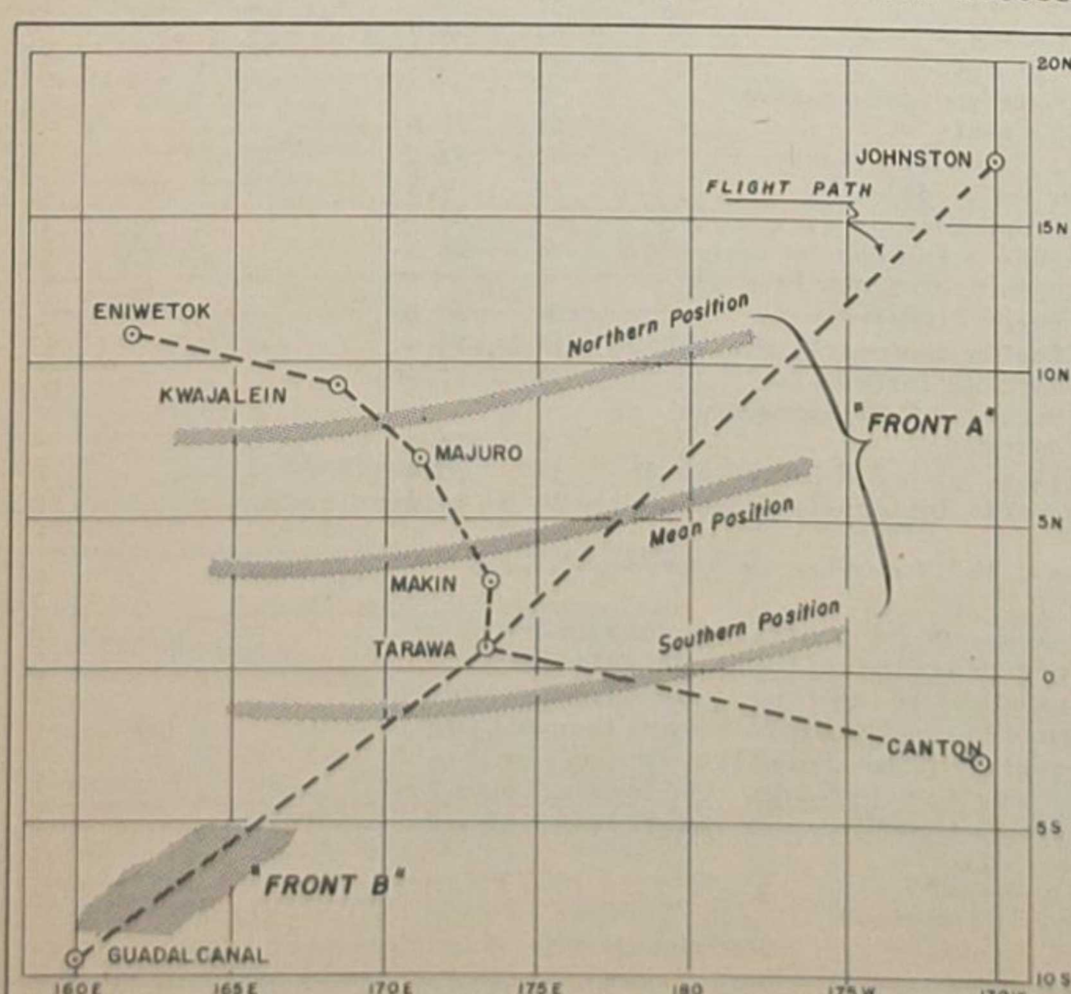
Weather Records Improperly Maintained: This items contains all irregularities and/or deficiencies and/or recommendations which indicate improper compliance with existing directives relative to the maintenance of weather records, the recording of observations thereon, and the forwarding of these records.

AIR ROUTES THRU TARAWA

by Lt. Myron Simons and T/Sgt. Robert Rothlein

The air routes to and from Tarawa (Gilbert Islands) last winter were influenced by two zones of weather, persistent in both position and intensity. No forecaster clearing a plane through the Gilberts could afford to ignore the existence of these zones, even though their structure is not known precisely. This article studies the route weather from October 1944 to March 1945, on the basis of pilot reports. These reports were saved, classified, and reviewed in the light of five months of forecasting experience at Tarawa.

The zone to the north of the other (we shall call it "Zone A" for convenience) formed a smooth line with a slight southerly curvature as it crossed two air routes to the north from Tarawa (Figure 1). The zone was from 50 to 150 miles wide and characterized by an altostratus overcast, broken to overcast swelling cumulus, rain showers, and light turbulence. No consistent wind shift was observed, but pilots regularly reported a temperature discontinuity across the zone of magnitude three degrees on the average. The zone was quasi-stationary, but changes in the winds aloft were associated with fluctuations in its position from north to south within a range of 11 degrees latitude. Strong northerly flow pushed the zone southward: strong southerly flow pushed the zone northward.

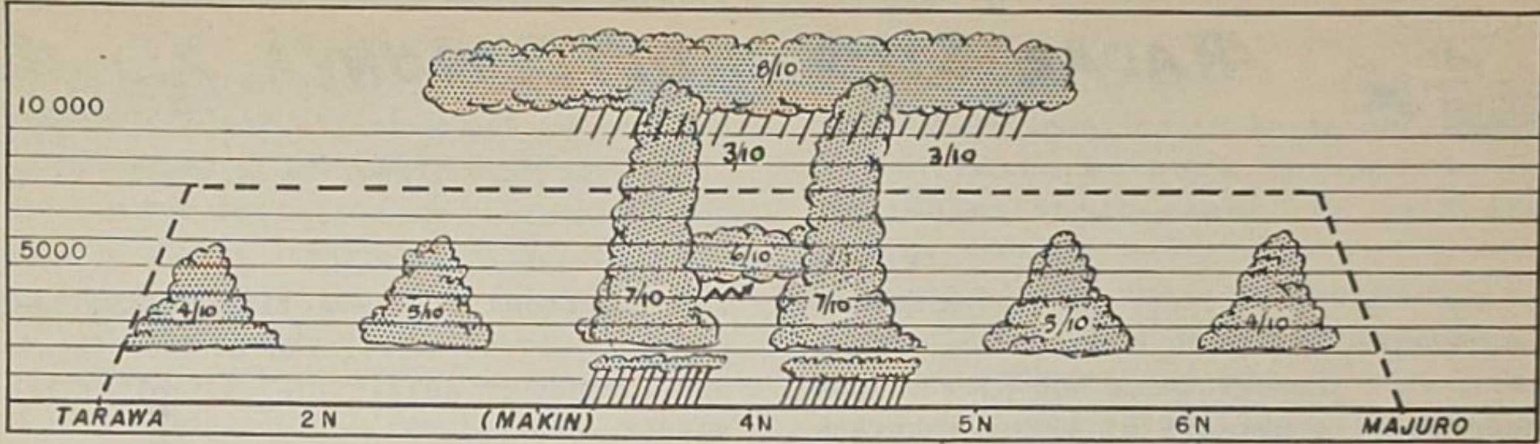


LOCAL CONDITIONS AT TARAWA

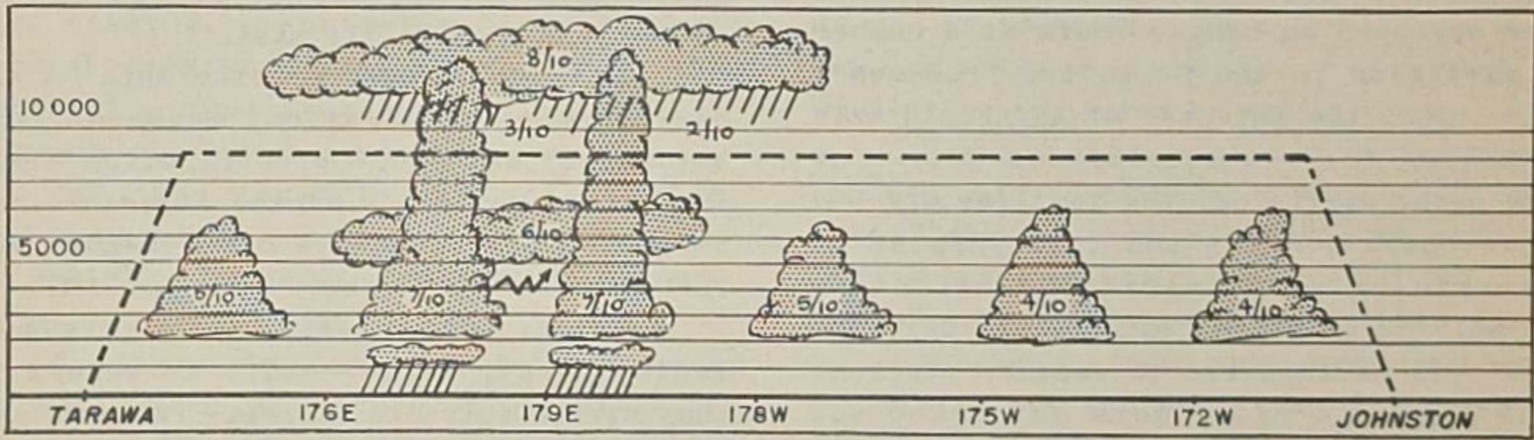
Ninety percent of the bad weather at Tarawa was caused by "Zone A" in its southernmost position. At such times Tarawa experienced from one to five days of intermittent showers, broken to overcast altostratus, and extensive cumulus formations. Ceilings over the airfield usually remained above 1,000 feet, although the minimum ceilings over the ocean nearby were 300-500 feet. Instrument approaches were often necessary at times when the field itself had contact weather.

When "Zone A" was not in its southernmost position, good terminal conditions could be expected.

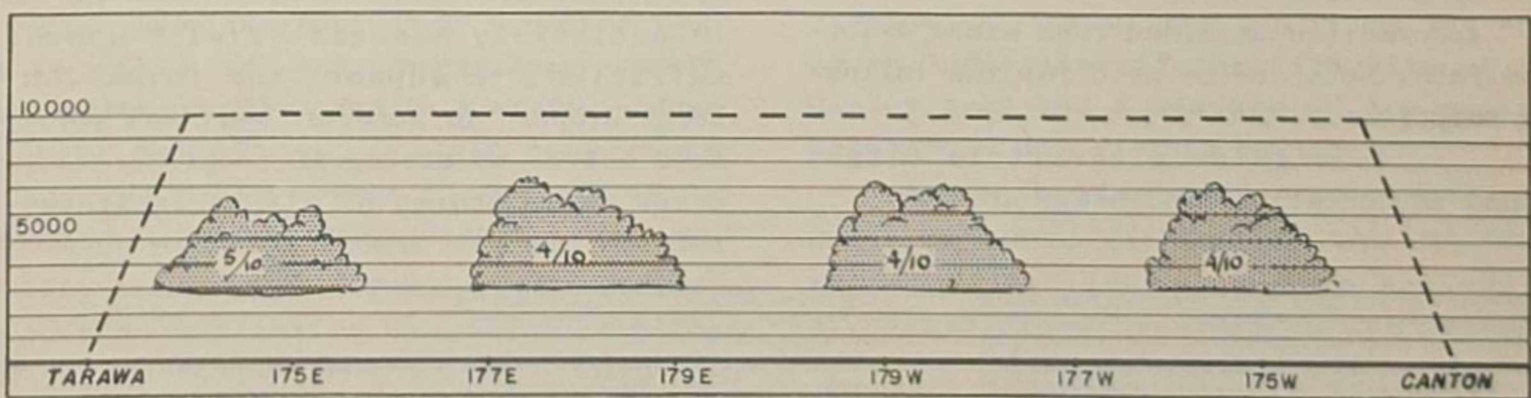
The authors wish to emphasize that they make no conjectures about the weather before October 1944 or after March 1945. However, they hope that the information given above can be pieced together with other data, and that progress will be made thereby toward new knowledge of the causes and characteristics of weather in the tropical Pacific.



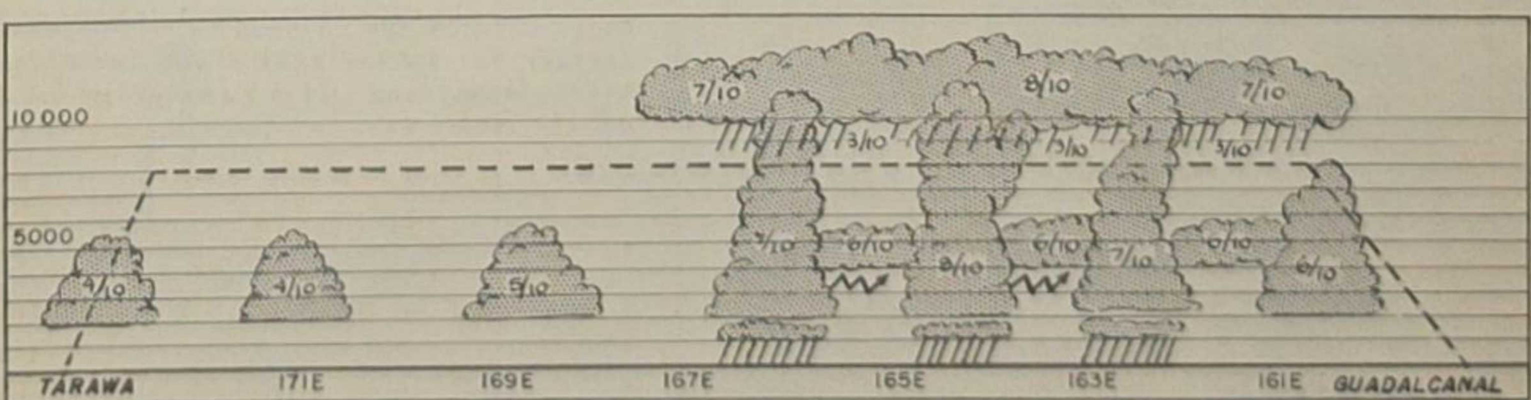
TO MAJURO AND KWAJALEIN: Weather on this route varied with the position and width of Zone "A". Occasionally, a shear line from the northwest moved down over Kwajalein and caused weather of greater-than-average intensity over a wide area. However, this section was typical of the route.



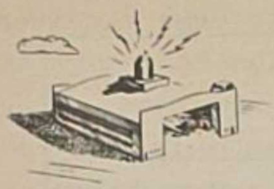
TO JOHNSTON AND HICKAM: The position and width of Zone "A" determined the route weather between Tarawa and 179°W. Sometimes a shear line from the northwest caused weather near Johnston and Hickam. This cross-section represents the conditions which prevailed over 90% of the time.



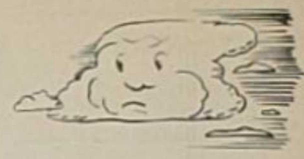
TO CANTON: When Zone "A" was in its extreme southern position, poor flying weather occurred on the first 150 miles of the Canton flight. At other times, only 4 to 5 tenths of fair weather cumulus and stratocumulus were met en route. This cross-section was typical.



TO GUADALCANAL: When Zone "A" was in its southernmost position, it caused bad weather on the first 150 miles of the Guadalcanal flight. Normally, however, only 4 or 5 tenths of fair-weather cumulus and stratocumulus were encountered until Zone "B" to the south was reached, consisting of 200-250miles of overcast altostratus, 8-10 tenths of swelling cumulus and cumulonimbus, moderate rain, and moderate turbulence. Normal weather is shown above.



RADAR STORM DETECTION



by Lt. George Austin

The utility of radar for storm detection reaches its peak during the summer season, when thunderstorms and showers are widespread. A network of radar stations has been established in the United States and is primed to provide an extensive field test of the operational value of radar weather data. The curious blisters which have sprouted on hangar roofs at a number of airfields in the South are "radomes", which house the antennas of AN/APQ-13 sets installed for weather lookout duty. At some other airfields, the familiar SCR-584 is in operation for the dual purpose of determining winds aloft and detecting storms. In addition, radar storm information will be supplied to weather stations from numerous radar sets not owned and operated by the AAF Weather Service. Included among the latter are a few powerful, long-range sets operated by the Aircraft Warning Service.

Information obtained from storm detection radar sets can be used for the following purposes:

-To guide aircraft in flight around thunderstorms and heavy showers.

-To give warning of the approach of violent storms so that precautionary measures can be taken to avoid damage to aircraft on the ground.

-To provide a constant check on the locations of convective disturbances which may affect airfields in the vicinity, and thereby to assist the control of local flight operations.

-To furnish additional synoptic data for the use of forecasters. The amount of activity detected by radar is an indication of the extent of convective activity in a given air mass.

-To furnish precise data on the development, dissipation, movement, and horizontal extent of precipitation areas for use in the study of the structure and formation of convective disturbances and for meteorological research in general.

A radar set transmits short pulses of radio energy, which return as echoes if they strike suitable targets. When echoes are detected from meteorological disturbances, it is assumed that the targets are large drops of water or particles of ice in heavy concentrations, the existence of which is ordinarily associated with updrafts sufficient to support the formation of large drops. In general, vertical currents need not be as strong in tropical disturbances as in storms of higher latitudes to release the same amount of condensed water. Consequently, climatic differences will be noted in the types of weather capable of detection. Furthermore, consideration must be given to the characteristics of the

Radio set SCR-584 is used by the Weather Service for taking rawins and for radar storm detection. It is installed in a mobile van, even at U.S. stations.

Radio set AN/APQ-13, on duty at a Weather Service station in India for radar storm detection. The tower at the left is topped by the 'radome', which houses the set's antenna. At the right appear controls and indicators of the AN/APQ-13, installed on the ground in a grass shack near the tower.

particular type of set employed, notably its frequency. The following statements, however, apply in general to radar weather detection, in all climates and seasons and with all types of microwave equipment:

1. Precipitation which reaches the ground is almost invariably associated with echo sources.

2. Dense nimbostratus from which precipitation is falling, well-developed cumulus congestus, and cumulonimbus can be detected to ranges which vary with the amount of water which they contain. Regardless of range, radar equipment in current U.S. field use cannot ordinarily detect fog, stratus, altostratus, altocumulus, cirrus, stratocumulus, or clouds of the convective type from cumulus humilis to moderate cumulus congestus.

3. The absence of precipitation echoes within the effective range of the set reliably denotes the absence of thunderstorms and heavy showers.

4. The maximum range to which a radar set will detect a meteorological disturbance depends upon the characteristics of the set and the intensity of the disturbance. Heavy showers can be detected to considerably greater ranges than light showers. When the horizon is unobstructed, the AN/APQ-13 can detect heavy rain showers to at least 50 miles and to a maximum range of about 125 miles. Certain long-range search sets often detect thunderstorms at distances which are even greater.

5. The intensity of the echo received from a source of precipitation decreases as the range of the source increases. The rate of attenuation is known only between wide limits because it depends upon variables which cannot be evaluated. Echoes from thunderstorms and heavy or moderate rain showers can usually be identified by their intensity and range.

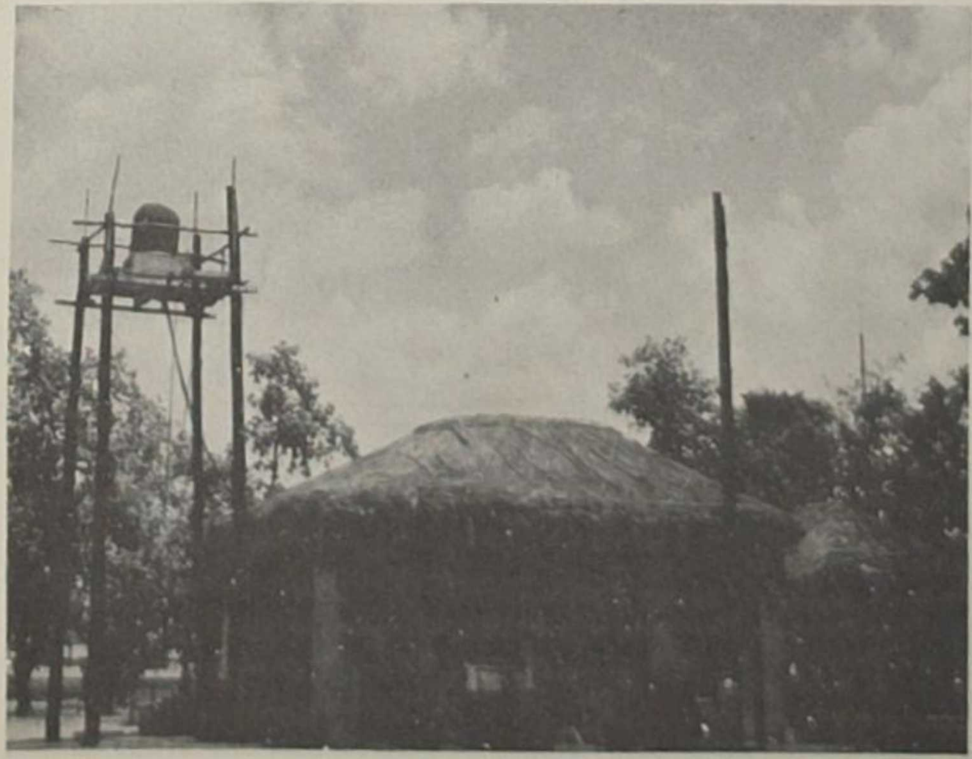
6. Radar does *not* detect fronts, although it does detect some of the precipitation associated with fronts.

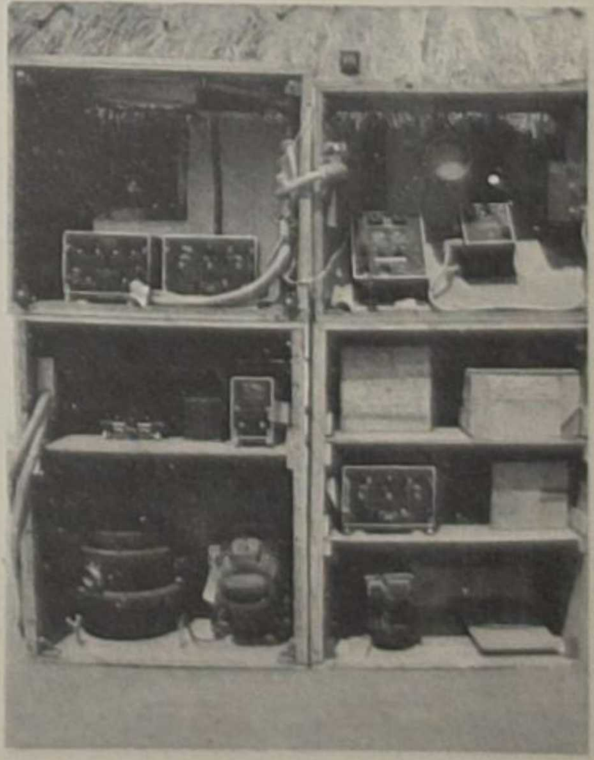
7. Radar detects the precipitation associated with hurricanes. If the eye of the storm passes close enough to the set, it can be identified as an area from which no echoes are detected but which is completely encircled by echo sources.

8. Tornadoes can be detected if cumulonimbi are associated with them, or if a sufficient amount of debris is swept up into their vortices.

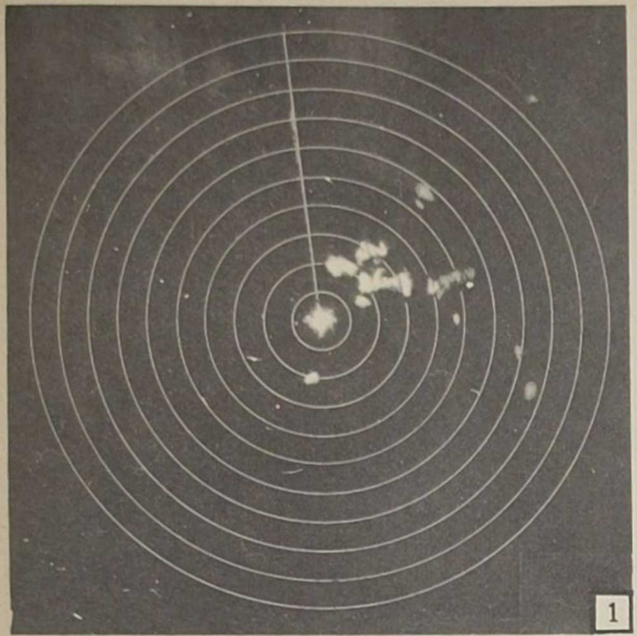
9. Radar cannot measure the altitude of cloud tops. *Some* radar sets can *sometimes* measure the altitude of the top of the echo source. The top of the echo source is merely the boundary of that portion of the disturbance which is capable of reflecting a detectable echo. The vertical extent of the source of the echo is an indication of the intensity of the disturbance and a measure of the minimum altitude of its visible boundary.

A plan view of all targets which are capable of reflecting echoes to the radar





At an installation of radio set AN/APQ-13 for storm detection in India, these photographs were taken to compare radar scope presentations with visual observations. To explain the radar scope photographs: the station is at the center of the scope, surrounded by concentric range markers at intervals of 10 nautical miles; the bright radial line points north; and the bright area covering the scope's center is characteristic of all such photographs, and is not an echo.



1

2

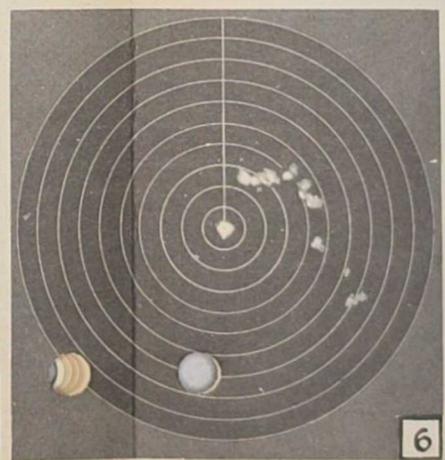
The radar scope in photo #1 showed storm echoes to the northeast of the station, although visual observations in that direction (photo #2) revealed only light cumulus, undetected by radar. Scope monitors saw precipitation echoes moving toward the station from the northeast, and forecast the arrival of a disturbance (photo #3)

3

Above, a threatening sky at the station three hours later verifies a forecast made earlier with the use of radar data. The "radome" of the installation can be seen in the right foreground.

4

5



6

Photos #4, #5, and #6 were taken simultaneously, at 1420 LST on 14 April 1945 at the radar station in India. A well-developed cumulonimbus which is within sight to the northeast (photo #4) is associated with a radar storm echo source, while cumulus humilis to the southwest (photo #5) returns no echoes. In photo #6, precipitation echoes appear in the northeast quadrant between 25 and 50 miles, and toward the southeast at 70 miles.

Radar storm detection is valuable even when the echo source is within sight of the station, because only radar discloses reliably the location, horizontal extent, velocity, and development of the most active centers of a storm.

All photographs on this page were submitted by Lieutenant Harold Neal of the Second Weather Reconnaissance Squadron.

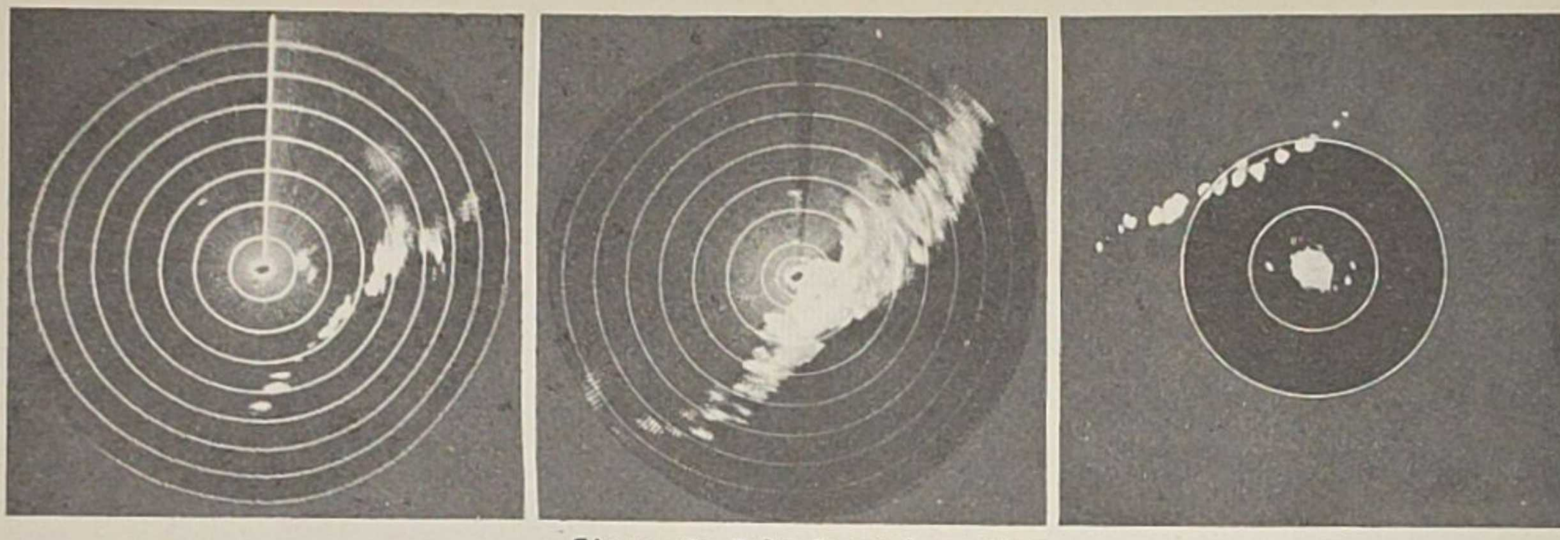


Figure 3: Cold frontal weather

set is presented on the Plan Position Indicator (PPI scope). The visible indication of the presence of a target is a bright spot on the scope at a point corresponding to the range and azimuth of the target. In radar terminology, the bright spot itself is called an "echo". The arrangement of precipitation echoes on the PPI usually assumes one of three general patterns, depending upon the synoptic situation:

1. Thunderstorms and showers associated with sharp cold fronts and squall lines appear as a solid or a broken line of echoes stretching across the PPI scope (fig. 3)

2. Air-mass thunderstorms and showers produce an irregular pattern, with echoes scattered over the scope according to the random distribution of convective cells (figure 4).

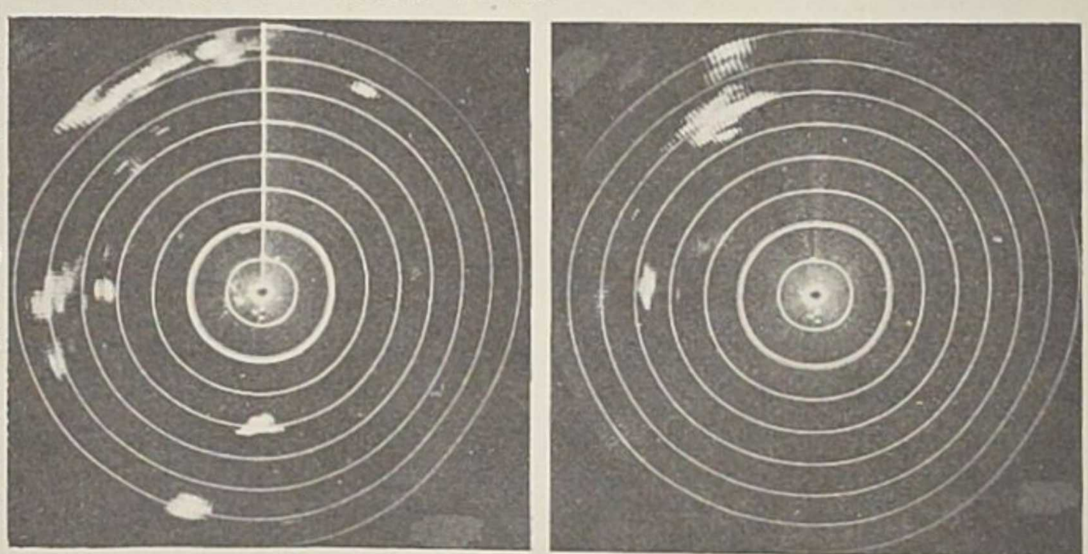


Figure 4: Air mass weather

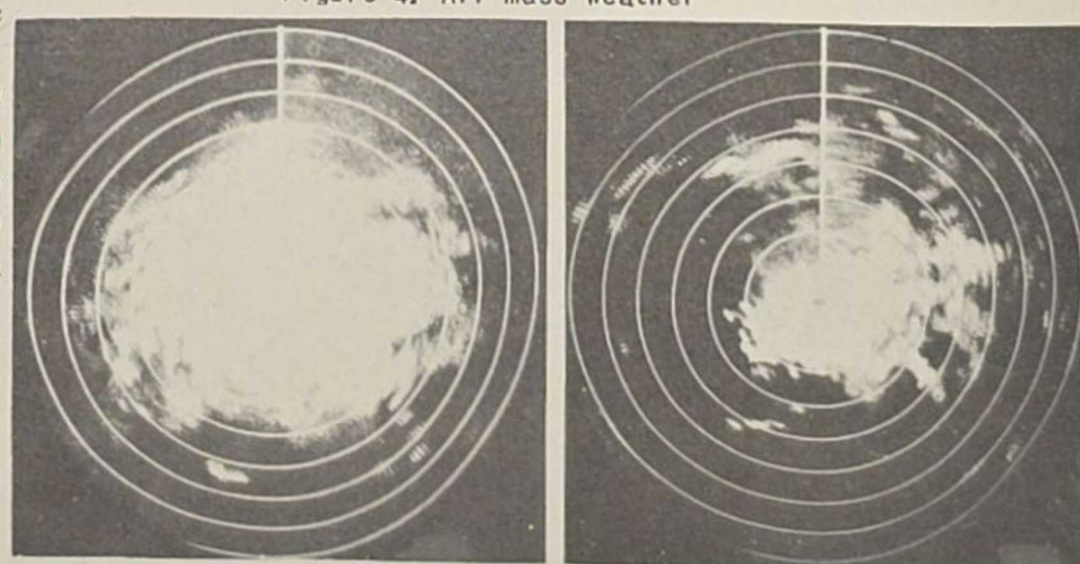


Figure 5: Warm frontal weather

3. Echoes from precipitation associated with nimbostratus usually appear as an area of brightness concentrated about the center of the scope with no echoes appearing at the outer edges (figure 5). This gives the illusion that a disturbance is centered overhead. Actually, rain may be falling from nimbostratus over the entire area of radar coverage, but it cannot be detected at long range.

Figure 3, echoes from:
a) light to moderate rain showers associated with a cold front.
b) severe thunderstorms and heavy rain showers detected during passage of sharp cold front.
c) rain showers along a squall line 200 miles ahead of a cold front. (Echoes within the first range marker are from ground targets. This photo has 20-mile range markers; others on this page have 10,000-yard markers.)

Figure 4, echoes from:
a & b) moderate and heavy rainshowers, most of which were associated with thunderstorm activity.

Figure 5, echoes from:
widespread precip out of dense nimbostratus.

RADAR FOR LOCAL OPERATIONS

A forceful and conclusive demonstration of radar's unique ability to protect aircraft operations from severe storms occurred recently in central Alabama.

The radar weatherman at Maxwell Field on 28 April 1944 observed a line of strong echoes, sweeping toward his station from the northwest. The disturbance was 48 miles distant and moving at 50mph. Maxwell Field immediately telephoned a warning to three Army airfields which were in the storm's path, giving an estimated time of arrival which proved correct. A rawin run taken earlier at Maxwell had revealed winds aloft consistent with the storm's movement.

The radar warning to Tuskegee AAF was received at a time when visual observations were reporting only harmless clouds and winds below five mph. It was an hour before the storm arrived---60 minutes of grace in which flying operations were terminated, ramps cleared of aircraft, and emergency precautions completed. At nearby Moton Field, however, operations went on as usual: a misunderstanding had occurred somewhere in the channels of communication. The storm struck just when and as forecast, throwing Moton Field into destructive confusion. Before the disturbance abated, 27 aircraft had been damaged severely, and 13 flying personnel had suffered injuries.

Tuskegee AAF and Moton Field are protected by an outlying network of civilian observers, instructed to telephone a central station when severe storms are seen. Significantly, no information whatever was received from this network on 28 April. This situation does not reflect unfavorably on the observers: those involved declared that the storm did not seem to be of sufficient intensity, as seen from their stations, to warrant a report.

The ground personnel at Moton Field itself were unaware of danger until it was upon them. The tower instructor, who was on duty at the time, later said, "The storm was first sighted 15 miles away, but it did not then appear to be moving fast. There was no indication of high winds (surface obs: SE, 5mph). By observation, the storm seemed to be quite ordinary: one which was local in character and easily avoidable. There seemed to be adequate time to complete preparations, but this storm struck furiously in less than 15 minutes."

In 1944, more than 1,500 aircraft were damaged on the ground in the U.S. alone by hail or gusts associated with thunderstorms or heavy showers. Weather Service radar installations are helping to reduce damage of this type in 1945.

RADAR FOR STORM RESEARCH

Radar has promising applications to weather research. The ability of radar to furnish precise information on the location, horizontal extent, intensity, velocity, development, and trajectory of convective storm centers is entirely without precedent and is expected to answer some fundamental questions in meteorology.

For example, the movement of storm centers in relation to the winds aloft has long been a debatable subject. One theory suggests that increased pressure on the side of a thunderstorm where the cyclonic circulation about it opposes the wind flow and decreased pressure on the opposite side where the circulation follows the wind flow result in a pressure force tending to move the thunderstorm to the right of the wind direction. There exists very little verification of this theory because of the difficulty heretofore experienced in determining the track of small-scale disturbances. This difficulty is eliminated where observations can be made by radar.

On several occasions radar observers have actually located the eye of a hurricane; have determined its diameter, velocity, and trajectory; and have noted a pattern of echoes which suggested the existence of a remarkable horizontal shear between vertical currents.

The weather service set at Maxwell Field, Alabama, was on the air at a time when a tornado was reported in the area. A precipitation area shaped like a "6" was detected. This configuration was preserved during the activity of the tornado vortex, but later assumed a circular shape. The long axis of the 6-shaped area was aligned with the mean upper wind between 5,000 and 10,000 feet. The echo source moved in a direction which was about 25° to the right of the mean wind, which was from the SSW at 50mph.

Most scope photographs present a quasi-horizontal cross-sectional view of the precipitation areas which surround the set. However, at least one photograph of the *vertical* cross-section of a thunderstorm has been made, using an unusual type of equipment not available in the field. This photograph (figure 6) clearly shows the vertical currents through the storm. The updraft at the front of the storm and its accompanying downdraft immediately behind are quite apparent. Other downdrafts may be hidden in this radar presentation because the gain control was not adjusted to eliminate the echoes from light precipitation which appear at short range. The top of the echo source is at 32,000 feet. It is anticipated that special radar sets some-day will give a detailed picture of the principal currents within a thunderstorm.

Radar storm detection is in its infancy, and has certain of the problems which might be expected to affect a new program. Although many standard radar sets can be used to take weather observations, none were constructed for that purpose. The storm detection characteristics of present equipment are only by-products of tactical considerations in design, and they differ considerably from one model to another. Detailed interpretation of storm echoes requires a knowledge of the individual characteristics of the set. Forecasters should seek the assistance of radar personnel before attempting to interpret storm echoes for research purposes.

These are two immediate suggestions for research that can be made to microwave radar units now in the field. First, to collect a great deal of data which compare the trajectories of storms with winds aloft measured at approximately the same time. Second, to take photographs in sequence of echoes from severe thunderstorms and rare phenomena, and to coordinate the radar photographs with visual observations. In these early days of storm detection practice, any and all information from radar sources can advance meteorological knowledge.

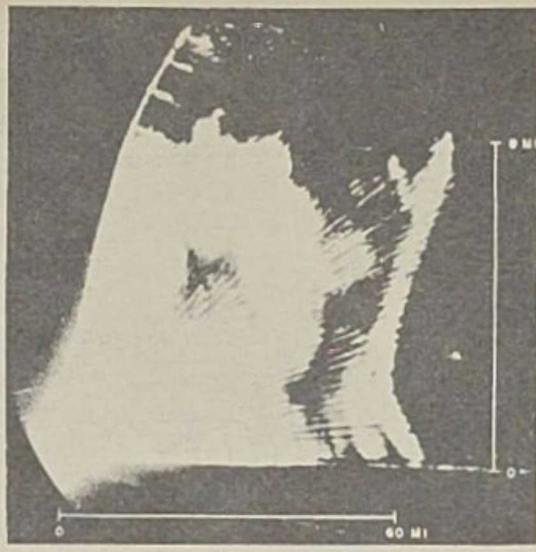
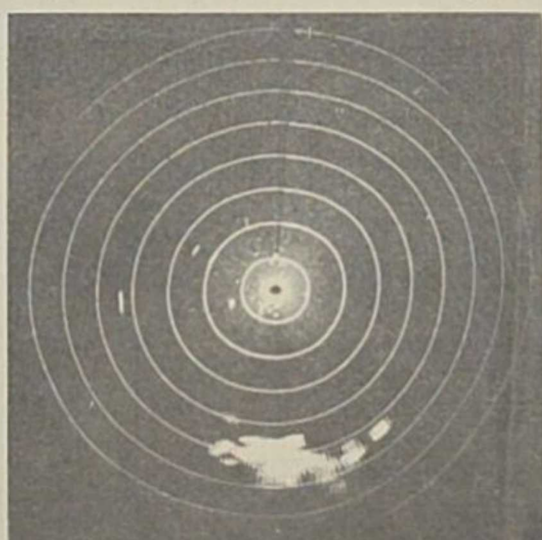


Figure 6: Vertical cross-section view by radar of a thunderstorm, taken with an experimental set.

RAREP: RAdar REPort

The Rarep below was derived from view like this of the PPI scope at DGI. Distance to the storm is measured by the concentric range markers of 10,000 yds each. The small, bright echoes to the west at ranges of 4.3 and 2.7 represent aircraft in flight.



DGI ⦶/8 183/85/81/6/ RAREP STG ECHO 25 MI S 100 SQUARE MI MVG E 30 MPH

From the remarks of the hourly sequence report above, it is learned that a convective disturbance capable of reflecting strong precipitation echoes from a range of 25 miles lies south of the station. The cross-sectional area and velocity of the disturbance are given. The range reported is understood as range to the nearest edge of the echo source. Weathermen classify the echo source as a thunderstorm, heavy rain shower, or moderate rain shower because the radar observer has been instructed to report only such disturbances. There is no absolute criterion which enables the radar observer to determine the extent of the weather associated with the echo source. His judgment is guided by the intensity of the echo, the range and vertical extent of its source, the characteristics of his radar set, and his knowledge of the type of weather which can be detected. Any visual observations which help to establish the nature of the echo source, such as observations of thunder and lightning, precede the Rarep in the remarks.

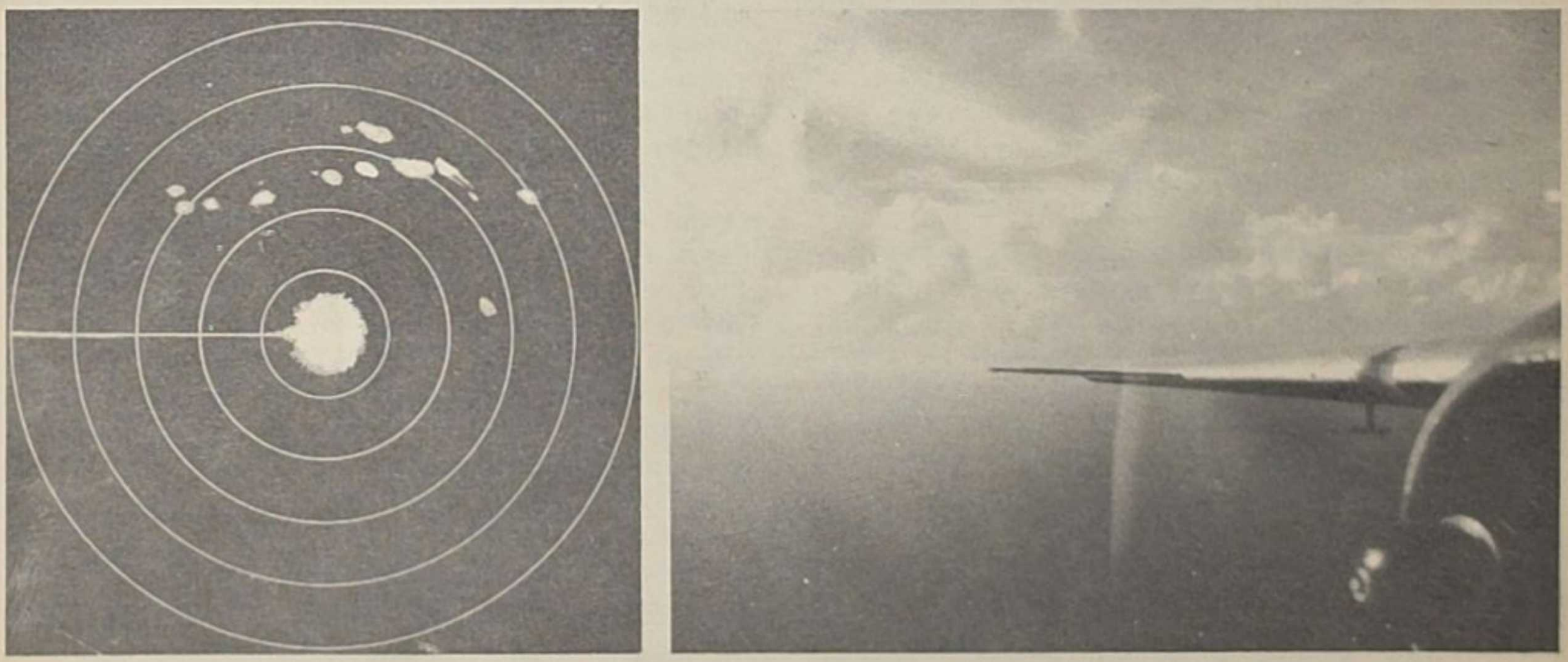
Worded Rareps transmitted via teletype provide information on the position, horizontal extent, intensity, and velocity of severe convective disturbances. The information given is more accurate, extensive, and precise than that which can be derived from visual observations.

Weather reconnaissance observers on aircraft equipped with radio set AN/APQ-13 "see" severe disturbances within 100 miles of their flight path. Information obtained by radar sight is included in the coded weather reports broadcast from the aircraft to ship and shore bases, where it is used immediately to reconstruct the synoptic situation and to plan flights.

Aircraft on weather duty, required to fly long missions in all types of weather, frequently encounter hazardous convective storms astride their flying route. This has often meant increased fuel consumption, loss of time, and considerable uncertainty even when evasion of the storm was to be successful. Airborne storm-detection radar, however, now provides a sure guide in such circumstances. The PPI scope shows the location of the centers of activity and the safest flight route. Enthusiastic reports have been received from the field regarding the use of radar for guidance through areas of severe storm activity.

Radio set AN/APQ-13 in aircraft can also be used to determine wind at flight altitude and to obtain "fixes" of position. The determination of wind requires only that a fixed target exist within range of the set. Radar pilotage requires the identification of any fixed targets which exist, so that its usefulness depends upon the nature of the underlying surface. There is a sharp contrast between land and water surfaces shown on the scope, and excellent results in radar pilotage are obtained over coast lines, lakes, or rivers. Mountains, cities, and other prominent features can usually be identified when flying over land.

Radar coverage is much greater than that of human vision and is unimpaired by surroundings of darkness, smoke, haze, fog, and most clouds.



On the left is a photograph of the PPI scope of an AN/APQ-13 installed in a B-25 flying parallel to the Zone of Intertropical Convergence. Precipitation echoes, representing the centers of Zone activity, appear clearly on the scope and offer a sure guide to the pilot if he should decide to penetrate the Zone. The range markers are at intervals of 10 nautical miles, and the bright radial line indicates the heading of the aircraft. The photograph at the right was taken at the same time, showing part of the B-25 in the foreground and the Zone of Intertropical Convergence in the background.

AAF WEATHER SERVICE DOMESTIC RADAR STORM DETECTION STATIONS

Wea Rgn	*Call Ltrs*	*Location*
2	DNU	Chanute Fld, Rantoul, Ill.
3	GS	Galveston AAFld, Texas
4	DGU	Gulfport AAFld, Miss. (Biloxi)
3	TZ	Davis-Monthan Fld, Tuscon, Ariz.
3	DPY	Pyote AAFld, Texas
3	DBY	Barksdald, Fld, Shreveport, La.
3	DCV	Clovis AAFld, New Mexico
4	DCH	Chatham Fld, Savannah, Ga.
4	DXW	Maxwell Fld, Montgomery, Ala.
9	DZI	Miami AAF, Miami, Fla.
4	DVT	MacDill Fld, Tampa, Fla.
4	DVQ	Eglin Fld, Valparaiso, Fla.
8	DUR	Grenier Fld, Manchester, N.H.
23	DSN	Smoky Hill AAFld, Salina, Kan.
23	RZ	Rapid City AAFld, S. D.
23	DPU	Pueblo AAFld, Pueblo, Col.
24	DZE	Hill Fld, Ogden, Utah
24	GT	Gore Fld, Great Falls, Mont.
25	DWP	Greater Pittsburg Apt., Caraopolis, Pa.
25	RW	Richmond AAB, Richmond, Va.
25	DLY	Langley Fld, Hampton, Va.
25	DSL	Spring Lake, N. J.

THETA-E CHART

Thunderstorms, the greatest weather hazard to summertime flying, are one of the most difficult weather elements to forecast. Many synoptic techniques aimed at coping with this problem have been developed, of which recently the Theta-E chart has received the most animated discussion and investigation.

Theta-E charts present the fields of equivalent potential temperature and of a moisture indicator, both drawn for the 10,000 foot (or 700mb) level. The moisture indicator is usually expressed as the number of millibars lift required to bring about saturation, but the mixing ratio is sometimes used instead. Study of geographic, seasonal, and synoptic conditions surrounding the past occurrence of thunderstorms is said to reveal a table of "critical values", such that where the Theta-E and the moisture are "supercritical", thunderstorm activity can be anticipated within 24 hours.

Some weathermen point with satisfaction to the rapidity and ease with which a Theta-E chart and forecast can be prepared, and they hail the success which many field forecasters have reported in its use. Others, in opposition, quote verification studies which declare Theta-E forecasts to be no better than persistence; they question whether such a thing as "critical" Theta-E values really exist; and they stress that isentropic analysis is a more comprehensive and a more valid procedure.

The Theta-E technique has been championed by Captain R. W. Beart and others in the 23rd Weather Region, where preliminary use of the chart last year seemed so successful to the RCO that he required its construction daily in all of his stations.

The value of Theta-E charts is still a debated question. For the information of weathermen who may have to decide the answer for themselves, this article reviews two important publications on the subject.

The Wing weather station gave a favorable report on the Theta-E procedure for local forecasting at Asheville in the Appalachian mountains. Thunderstorms were forecast to occur within sight of the station in 24 hours if three conditions were fulfilled at 10,000 ft: equivalent potential temperature greater than 320°A, a lift required for saturation equal to or less than 100mb, and a circulation over the station which did not produce marked downslope motion or divergence. The last condition was evaluated by superimposing the 10,000 foot isobars on the Theta-E chart. The following results were obtained in 11 summer weeks of verification:

Percent of Forecasts which were Correct:

Theta-E	86
Persistence	75
Climatology	62

The report also asserts that the Theta-E chart is uniquely easy to construct and to interpret; that it defines thunderstorm areas at least as well as any other method; but that considerable research is necessary for the determination of critical values, which are said to vary geographically, seasonally, and with the synoptic situation.

The Weather Division verified Theta-E thunderstorm area indications for 61 summer days in 1944 between July and September, from charts submitted by the 23rd Region. Three simplifications were introduced by Weather Division to facilitate its verification: 1) precipitation, ratner than thunderstorms or comulonimbi, was used as the verifying element; 2) the charted (not the forecast) position of the supercritical areas was considered; and 3) a single critical value for the whole U.S. was used to delineate the positive forecast area.

An important quality of a thunderstorm area forecasting criterion is that it should not include an excessive area of the chart. If the Theta-E critical values were made low enough, almost every thunderstorm could be forecast, but at the cost of many false warnings. The super-critical values in the Weather Division analysis on the average occupied 26% of the U.S.

Spot verification was accomplished for 116 equally-spaced points in the U.S. Precipitation within 24 hours was evaluated at those points where the chart had shown a Theta-E of more than 326°A and a mixing ratio of at least 6.0 gr/kg. Rain fell within 24 hours at 54% of all points within the favorable area, but also at 29% of all points outside the area. Persistence forecasts (if it rained on chart day, it would rain the next day) verified just as well: 55% on the average. Climatological probabilities of verification averaged 40%. Correlation of the moisture field with precipitation showed that moisture indications are quite reliable in a negative sense: areas requiring 200mb or more of lift had only 8% of the rain frequency.

Evidently, Theta-E forecasts in which a single critical value is assumed for the whole country as a generality are not better than persistence. In this regard, the Weather Division study says, "There is considerable variation in the probability of rain...within the chosen area (on the Theta-E chart). Point #98 fell within this area on 25 occasions of the 61, and rain was observed to occur there on 92% of these occasions. (When) this point did not lie within the chosen area, rain occurred 50% of the time. It would appear that the criterion is of appreciable value in forecasting rain for this point.

"On the other hand, point #67 fell within the chosen area 33 times, and rain there was observed only 30% of the 33 occasions...But of the 28 times when the point did not lie within the chosen area, rain occurred but once. It would appear that this criterion ($>326^{\circ}$ Theta-E and ≥ 6 gr/kg) can more often tell when rain would not occur at this point."

* * *

In summary, it appears that detailed statistical analysis is needed for the determination of critical Theta-E values in specific environments of season and topography. Even then, the Theta-E chart would be most effective in the hands of an experienced forecaster. The chart is not a mechanical device: variations from any table of critical values are produced by changes in the synoptic situation. Although scientific appraisal of the Theta-E technique has not yet been completed, it is difficult to ignore the widespread acclaim which the method has received from field forecasters in many domestic weather regions.

PRIVILEGE FOR STAFF WEATHER OFFICERS

If you are a Staff Weather Officer, in the U.S. or abroad, you are entitled to receive an individual copy of the Weather Service Bulletin *each month. Requests should be transmitted through channels to:*

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GUST FORECAST

(After M. Margules and G. Brancato)
by WOJG Herman Jordan

The maximum gust speeds to be expected in any particular air-mass or prefrontal thunderstorm can be computed from a simple formula, according to results of a preliminary investigation. The data used are obtained from a Raob representative of the air mass. Several thunderstorms in the summer of 1944 were examined from this point of view, and satisfactory forecasts of maximum gust speeds were made. Whether or not the forecast winds do occur, the maximum speeds will be recorded at a station only if the storm moves directly overhead, or nearly so.

Figure 1 is an actual Raob of an air mass in which a thunderstorm did occur and produced its maximum gusts over a station. The step-by-step procedure for computation of maximum gust speeds is given below, and is illustrated on page 23. The directions may seem complex, but only because they are given in detail: once mastered, the technique is simple.

PROCEDURE

(parenthetic expressions are values from the example worked out on the opposite page.)

1) Determine the Convection Condensation Level, or CCL.

2) For each reported point on the Raob, determine and plot the corresponding wet bulb temperature (points "a" through "i").

3) Draw two moist adiabats, one up through the intersection of the sounding with the CCL, and the other down between the two lowest values of wet-bulb potential temperature aloft (points "h" and "i"). Extend each adiabat to the extremity of the other.

4) Find the difference in degrees (8.7^{o}) between these two adiabats along the isobar through the CCL.

5) As in 4), for the isobar through the lowest value of wet-bulb potential temperature (point "i") find the temperature difference between the adiabats ($13.0^{o}C$).

6) Average the two values found in 4) and 5) $\left[\frac{13.0 + 8.7}{2} = 10.8\right]$, calling the result ΔT.

7) Substitute this result in the formula

$$c = 13\sqrt{\Delta T} + V$$

where c = maximum gust speed (mph).
V = average wind speed (mph) between 6,000 and 8,000 ft.
ΔT = as in (6) above.

The solution for the example given, where V = 15 mph, is

$$c = 13\sqrt{10.8} + 15 = 58 \text{ (mph)}$$

This example was an actual case: a thunderstorm on 14 June 1944 at Smyrna and Berry Fields, Nashville, Tennessee. The highest recorded wind at Smyrna was 60 mph. To reiterate, only if a storm passes overhead (or nearly so) will a station be able to record the maximum gusts.

HISTORY OF THE METHOD

Margules has formulated the wind speed to be expected from rearrangement of two different air masses lying side by side:

$$c = \frac{1}{2}\sqrt{gh\frac{\Delta T}{T_m}}$$

where c = wind speed

g = acceleration of gravity

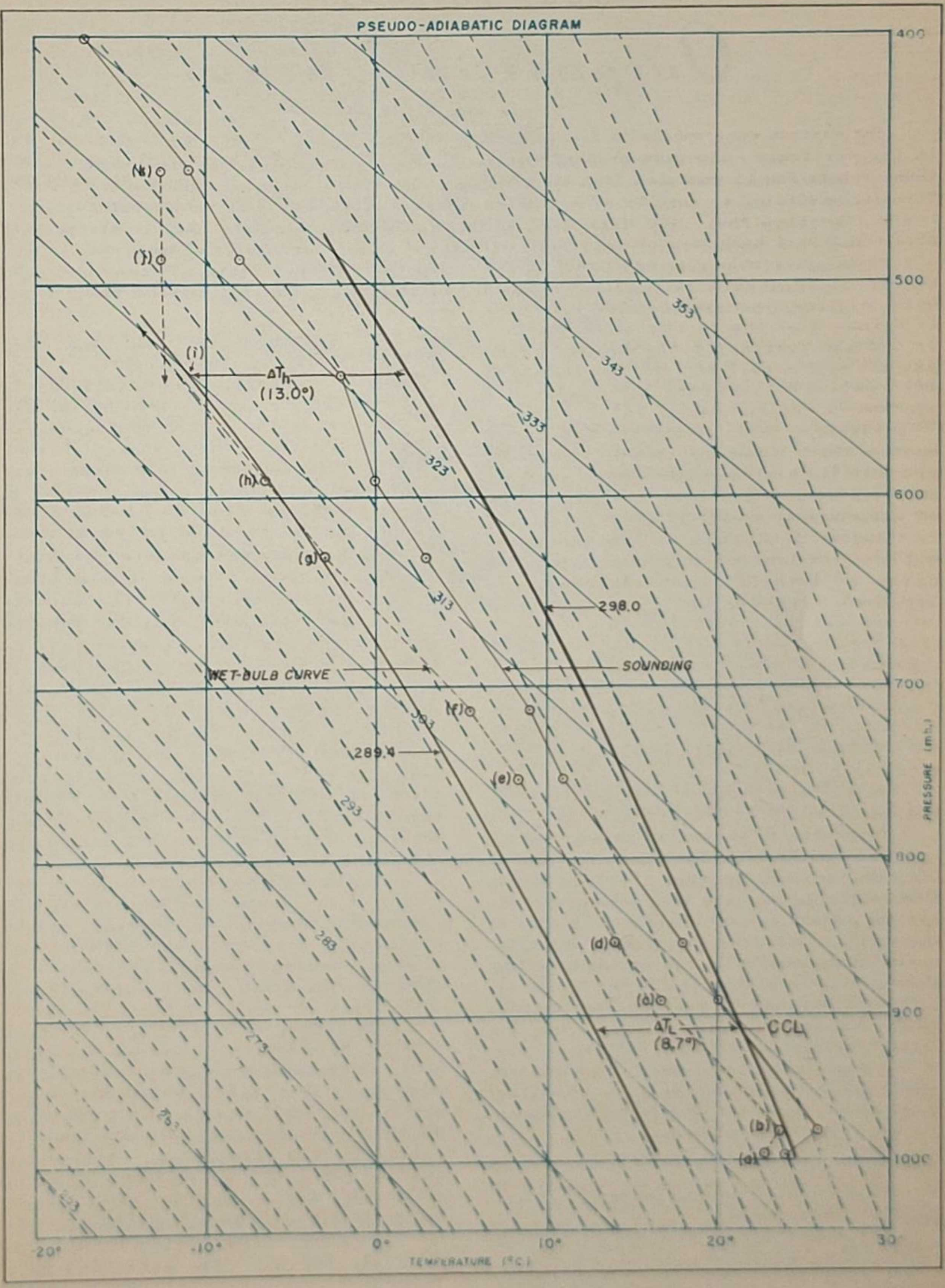
h = height

ΔT = difference between the mean temperatures of the air masses

T_m = mean temperature of the two air masses

In a thunderstorm, Brancato says* there is a similar juxtaposition of different "air masses", one being the moist air lifted by convection and the other being the descending air cooled by evaporation. These "air masses" are brought into gusty conflict at the surface when an air-mass thunderstorm appears overhead. To find the maximum gust speed, the speed of the thunderstorm relative to the earth's surface (the resultant wind speed between CCL and cloud top) is added to the wind speed, c, derived from the Margules formula. The author of this article has found that it is practicable to assume constant values for g, h, and T_m: respectively, 9.8 m/s; 4,000 m; and $280^{o}A$.

Brancato, G.N., "The Meteorological Behavior and Characteristics of Thunderstorms."



PSEUDO-ADIABATIC DIAGRAM
400
500
600
700
800
900
1000
PRESSURE (mb.)
-20°
-10°
0°
10°
20°
30°
TEMPERATURE (°C)
353
343
333
323
313
303
293
283
273
263
253
ΔT_h
(13.0°)
ΔT_L
(8.7°)
CCL
298.0
289.4
SOUNDING
WET-BULB CURVE
(a)
(b)
(c)
(d)
(e)
(f)
(g)
(h)
(i)
(j)
(k)

Outpost in China

by Cpl. Irving Ripps

They lived and worked in foxholes, and slept in palaces, and dined with maharajahs. They swept onto the beachheads with forward echelons, and parachuted into enemy-held territory. They endured relentless air raids and pin-point artillery fire. They fought disease, hunger, and deadly monotony. They operated from captured enemy trucks and pillboxes, from the torn bellies of their own bombers, from wigwams, from snow caves, and from Chinese pagodas. These are experiences of the weathermen awaiting reassignment at the Redeployment and Training Unit in Goldsboro, N. C. These and many more.

You ask them how it was over there and they merely shrug their shoulders. You tell them you want to write a little bit about them and their experiences so that other weathermen might know what it is to be a weatherman overseas. They say most of the best-remembered experiences they had in foreign countries wouldn't look too good in print, anyway, so there isn't much to talk about. Besides, they go on to say, who is interested in weathermen---there are no heroes among them. You explain some people have a different idea on the subject of heroism, and besides, you can read about the heroes every day in the newspapers. A weatherman's life is different. They say, it sure is, what do you want to know. You start off by asking some routine questions, and after a while the stories begin to unfold.

"I worked in Calcutta, Bombay, Agra, Gaya, Allahabad, Dum Dum, Kunming, and a few other places in China that you won't find on the map." This is S/Sgt. George W. Muller talking. Muller's home is in Washington, D. C. He enlisted in the army on Christmas Day, 1941. Following a period of in-station training at Bolling Field, he worked in Weather Central in Washington, doing research in climatology. On the first anniversary of Pearl Harbor, he was on his way to Bombay, India. In civilian life, Muller attended M. I. T., studying chemical engineering, and later worked in the sugar refining business.

"How long were you overseas?"

"27 months."

"I see you're wearing two battle stars. How did you get them?"

"It wasn't much," George says. "They wanted some weather reports from some combat areas so a couple of boys and myself went out there to get them. That's all."

"Just like that. How about telling us the story?"

"Well, I was stationed in Kunming at the time and the air raids there were pretty hot---three or four a week. So when this assignment came along I was glad to get out. The three of us left Kunming on 15 May 1944. Sgts. Bernard Lefkovich and Kenneth Shafer were the other two men. We were sent to an unexplored region in the southern part of China near the Hump to set up a "D" station. We were there for 10 months and were the first EM to operate a "D" station in China. Our reports were sent to Kunming and used for bombing operations over Burma, Thailand, and French Indo-China. Lefkovich and Shafer later came down with malaria and were replaced. There was a Chinese village in the vicinity that once had a population of 50,000. Malaria, plague, cholera, and earthquakes reduced it to 1,000.

"A few AACS men had preceded us by a couple of weeks and they were to transmit our reports for us. An emergency landing strip of a sort had been laid out for planes returning from raids over Jap targets. The strip wasn't much but it got quite a bit of use.

"We left Kunming by transport plane, a C-46. We took with us our station equipment, a three-month supply of rations, and some small artillery---a bazooka, a submachine gun, two carbines, and a .45 pistol. We also took along a plentiful supply of rat powder and insecticide. These items turned out to be pretty precious---we practically had to sleep in the stuff every night on several different occasions.

"We got lost over a stretch of mountain ranges. The pilot had never flown that area before and wasn't familiar with the terrain, especially those big mountains you have to fly around. They looked pretty ominous to us at the time. The gas supply was down to about 15 minutes when we finally picked up the AACS control tower. The tower told us that the plane was practically over the strip, but that it couldn't be seen from the ship because the monsoon rains had covered the area with two feet of water. The tower advised the pilot to go back. If the situation weren't so serious that crack would have called for a big laugh. The pilot called for bearings and said he had to come in because he didn't have enough fuel to stay in the air for another ten minutes. The tower wished us good luck and started directing us in. We got quite a drenching but it was a perfect landing. I'd hang my hat next to that pilot's anytime. That boy sure did a wonderful piece of flying.

"The AACS installation, besides being located in a valley, had no facilities to provide us for setting up the station. The second day we were there, Lefkovich and I discovered a Chinese pagoda on top of a hill about four miles from the airstrip. It was a perfect spot for taking obs, especially pibals. This became our home and our weather station for the next 10 months. It took us about four days to haul the equipment through the woods and up the hill. We got a couple of Chinese from the village about a mile away to help us. Once we got all the equipment inside the pagoda, it took two days to start operating. The pagoda had three floors. We set up the station on the first one, living quarters on the second, and something we called a day room on the top floor. We hooked up a telephone to the AACS post and sent them our reports to be radioed to Kunming."

George stopped long enough to light up a cigarette.

"A while ago you said this station was located in a combat zone. What first-hand evidence did you have of Jap activity in the region?"

"Well," Muller continued, "we received a couple of Jap visitors on several different occasions."

"Jap patrols?"

"Not exactly. We had been operating for about two weeks when two Chinese walked into the pagoda one day. We knew some of the natives in town---our station was regarded as a museum by the villagers and we were always getting a visitor or two. So when these two boys walked in we thought nothing of it. It was close to pibal time and we figured they came around to watch a balloon inflation. That was a big show to them---that and the actual run. Well, they hung around for about 20 minutes. They didn't talk much, but when they did speak, they used English. Very few Chinese in that region knew English. I asked them where they learned the language and they said they had done a lot of travelling in China and had worked as houseboys for the British and the Americans. To me, that didn't click because their English was just a little too polished for a houseboy's. But there was nothing unusual in their behavior. So when they left we just resumed what we were doing. A couple of days later we heard that they were picked up by the Chinese as Jap intelligence men. That same thing happened several times. It was a pretty embarrassing experience each time, but you can't blame us too much for not recognizing them as Japs. Take a tall Jap, dress him like a Chinese native, and you'd have to toss a coin to tell the difference. I'll bet I rubbed elbows with hundreds of Japs while I was in China and never knew it.

"The Japs always maintained a flexible line of troops about 30 miles to the southwest of us. We never did know what they accomplished by their visits. Jap planes flew over on many occasions but seldom bothered us. The AACS men were supposed to spot Jap planes and report them to Kunming. But they'd often miss the planes because they couldn't hear them on account of the noise their own generators would make. We took over the job, which was just as well; we were located in a much higher spot than AACS. I don't mind saying we could have used a lot more aircraft recognition time than we had.

"We were strafed once and they busted up the hydrogen generator shelter---that's when the generator broke down and we couldn't shoot any pibals for a couple of weeks. Another time we got word from the village that some Jap tanks were seen moving through the woods and we started packing up the equipment. Lefkovich said it would be a good opportunity for us to use the bazooka that we brought along. But nothing came of it. The AACS installation was bombed the same day we got the strafing and one of their boys was hit. That was the sum total of Jap activity in the area. We figured the reason they didn't bother us was because they were picking up our reports and using them for their own benefit. The ciphers were changed pretty often, but they were easy to break."

"Outside the time that the generator broke down, did you ever have any trouble in operating the station?"

"Not much. We were pretty lucky, I guess. There were times when we'd run out of supplies and couldn't get any for a couple of weeks because Kunming was short on gas for planes. Otherwise, we functioned pretty well. Sometimes our reports wouldn't be accepted by Kunming because of raids going on at the time. Our work was practically wasted then. But we never worked too hard. Took our obs every hour from 6AM to 8PM, and during the monsoon season when the weather was pretty much the same every day, we only took one pibal a day. On clear days we could follow that balloon for 72 minutes."

"It's encouraging to know that an outpost station such as yours didn't lack for equipment."

"That's right. It makes you have a lot of faith in the Weather Service. Take our RCO---Colonel Ellsworth. There is an officer for whom every man in the 10th would go through hell and high water because that's just what he's done for us. There were times when we'd be waiting for our mail, or back pay, or a replaced thermometer, and we'd be reconciled to waiting for weeks before a plane would fly over because of bad weather or lack of fuel, when suddenly from out of a low thick overcast we'd hear a plane heading in. Twenty minutes later Colonel Ellsworth himself would be standing in front of the pagoda with the things we'd been waiting for. His feats in flying through impossible weather just to help out a couple of ordinary GIs have become legend in the CBI theatre."

"Did you have much of a food problem?"

"Not much. We did some hunting and occasionally shot some duck, wood grouse, quail, and pigeons. We'd get invited to dinner by some of the Chinese once in awhile, or we'd trade some cigarettes or chocolate with the villagers for some food. We invited the Chinese to have dinner with us but they didn't care for American cooking, which kind of hurt my feelings a little because I was the cook for the outfit. We rarely bought anything in the village because food there was very expensive. Eggs cost 30 cents apiece, pork $1.50 a pound, sugar sometimes as high as $6 a pound. Besides, there were many Chinese soldiers quartered in town and we'd have to get to the market too early in the morning in order to get the food before they did."

"How often did you get food supplies from headquarters?"

"Roughly every three months---depending on the weather and the fuel. It was usually dropped to us by parachute from L-5's. We got K-rations most of the time. Sometimes the pilot would misjudge the wind and the bundles would go lost for a day or two. In this connection we had a strange experience once. Shafer and I were searching the woods for some packages that had been dropped the day before. About 400 yards from the pagoda we came across some torn cardboard cartons. We continued walking on when Shafer suddenly said 'what are torn paper cartons doing in these woods?' The significance of what we had just seen didn't dawn on us until this moment. We returned to the spot to examine the cardboard more closely. When we picked it up we noticed some cord lying on the ground. The cord looked as though it had been chewed up. Part of the cardboard did, too, and the rest of it seemed to have been torn very unevenly. What clinched it were the tiny crumbs of food that lay scattered around. Shafer and I looked at each other and decided that we better get back to the pagoda. The atmosphere around us seemed to have become unhealthy all of a sudden. We eliminated the possibility of Japs having done the job because they would have just walked off with the stuff. I got on the phone and called AACS. I spoke for about 20 seconds and then hung up. What Shafer and I suspected had just been verified. The AACS boys had forgotten to tell us about it when we moved in but there were wild animals in the vicinity."

George sort of smiled as he took out a handkerchief to wipe his forehead. The memory of the experience he had just related was evidently close to him at the moment.

"What kind of wild animals were they?"

"The usual kind---lions, tigers, panthers. It's a funny thing, but sometimes when we'd get up in the morning we'd ask each other if any of us had heard any strange sounds during the night. Several times I could have sworn that there was somebody or something moving around downstairs. But that happened in the early days and we passed it off as nerves. Later on there was no question about the noises."

"What happened?"

"We started to raise chickens---mainly for the eggs. As I said they were pretty expensive to buy. Well, we never had very much success with the chickens. The big cats saw to that. We thought of taking turns guarding the coop but the nights were pretty black, and if one of those babies took a notion to stroll over of an evening, we'd have as much chance against him as the chickens would. They bothered our horses, too. We had three of them. That's how we got around in the area. One night---it must have been about 2AM---we heard a piercing scream. We had come back from the village a little while ago---we had been on a Chinese party drinking 'jing-bao' juice, which is not the kind of juice you drink in the morning for your breakfast. It's a type of rice brandy and the literal meaning of the word is 'air raid'---the idea being that a couple of shots of it makes you feel you're in a raid. Well, that scream practically rocked us out of bed. Lefkovich, who was pretty tight when he left the party, began hollering 'air raid!' and grabbed a carbine. I don't know what he expected to do with a gun in an air raid but I figured in his condition we'd all be better off if he didn't have it. Then we heard the scream again---a couple of them ---and I knew it was the horses. We ran toward the corral---I had the gun now and Shafer was flashing a big searchlight. What we saw was really appalling. Two of the horses were down---one ripped wide open across the neck and belly and the other writhing on the ground so much we couldn't tell what was the matter with him. Lefkovich's horse was gone and he was mad as hell about it---kept yelling all over the place like a crazy man. I saw some movement at the edge of a small, dark clump of woods about 40 yards away. I grabbed the searchlight from Shafer, pointing it in the direction of the woods, and handed him the gun. I started running, yelling for Shafer to follow me. We were very excited and scared and I guess we didn't realize what we were doing---I mean, running *toward* and not *away* from a man-eating animal. That *jing-bao* juice was still working, I guess. Anyway, when we reached the edge of the woods, there was nothing there. Shafer and I looked at each other, deliberating our next move. Shafer mumbled something about mice and men and started to move into the woods. I grabbed his arm as a sign to let me precede him since I had the searchlight. We were in about 20 yards when we saw the lion. Spotlighted in the glare of the searchlight, he stood there very calmly, blinking his eyes at us. Shafer and I were practically petrified; all we could was stare back at him. It seemed to me somewhere I heard that if you shoot at a lion and miss, he'll rush you. Anyway, I nudged Shafer to start the fireworks. I would have given a million dollars at that moment if Lefkovich had grabbed the sub-machine gun instead of the carbine when this whole business started. Shafer fired three shots, the lion roared and jumped about 10 feet into the air, and we made a fast about-face and ran like hell out of the woods."

"What happened to the lion?"

"We never found out. After awhile we realized we could do nothing about stopping the cats from prowling around the pagoda at night."

"This whole discussion started with the subject of food. What was the longest period of time you ever went without food?"

"Well, once when our stock was down to about three days' supply, we were put in the embarrassing position of having to act as host to an entire B-29 crew for about 15 days. Their plane had been forced down in the woods four days ago. They thought they had landed in headhunter country and therefore stayed away from the Chinese natives. Through binoculars they saw our GI blankets hanging out of the second floor of the pagoda and that's what brought them in. For about two weeks we ate nothing but bread baked from yeast made out of fermented wine."

"A while ago you said something about having to sleep in rat powder. How come?"

"The rats were as thick as fleas in that area. Every night there were at least a dozen of them running all over the pagoda. We'd spend a good part of the night shooting and throwing things at them.

"A pitiful thing happened once. I had promised three Chinese children---all brothers---to meet them outside their school and take them over to the weather station. I waited about an hour and they didn't show up. I went to their home and found out that they had been taken home earlier in the day because they hadn't felt well. When I got to their house they were already dead. They were the first victims of a plague epidemic that had just hit the town."

"Was plague the most prevalent disease in that area?"

"It seemed to take a great toll among the Chinese soldiers. But they were all prevalent---plague, cholera, dysentery, and malaria. When we left Kunming we got our plague and cholera shots. We beat dysentery by thoroughly cooking our food and boiling our water. But there was very little we could do against malaria. The mosquito was around all year except a little in January. All the AACS boys had it at one time or another, and I've already mentioned that Lefkovich and Schafer were knocked out by it. Those poor guys suffered for about four months before a plane arrived for them. It was the same old story about fuel for the planes. It was no picnic for me while they were laid up because in addition to doing the cooking and taking care of the boys, I was the only weather observer on duty. I kept asking for replacements and it took four months to get them."

"From your story, George, you've certainly earned your pay the hard way. How about your recreation---how did you spend your leisure time?"

"It was a pretty monotonous and isolated life for the most part. The village offered little in the way of amusement. Occasionally we'd get invited to a Chinese festival. They ran those things for political or religious motives and they'd usually last for about three or four days without a let-up. A very interesting feature about these celebrations was the practice they had of killing the devil. The Chinese living in primitive localities believe that the devil is always following you, but that he travels in a straight line. That's why the Chinese streets in these villages are curved---so that the devil's course may be deflected. The first time we went into the village we'd see a villager every once in awhile run directly in front of a passing Chinese military truck. The drivers would go out of their heads trying to prevent accidents. The person would wait until the truck was practically abreast of him and then quickly scoot past it. The devil, following closely behind, would in this way be killed because he wouldn't have a chance to beat out the truck.

"The people would dress in weird costumes for the festival and form long snake lines, weaving in and out of the crooked streets and cover every street in the village over and over again. Occasionally they'd fall out of line long enough to puff on an opium pipe or drink some rice brandy for stimulation. Once the three of us were invited to tag onto one of these processions, and not wanting to be impolite, we accepted the invitation. It was really a gruelling experience. If there were any devils behind us, we certainly made it pretty hectic for them.

"For the most part, though, it was a pretty dull life. I guess I minded it less than the other men. The boys would lose their tempers pretty often and argue over the silliest things---Shafer once accused Lefkovich of removing the heel from his shoe. Once the both of them disappeared for about 30 minutes and when they came back Shafer was holding a bloody handkerchief to his mouth and Lefkovich was nursing a broken finger. They got along fine after that for a couple of weeks. Being NCOIC I tried to inaugurate a regular routine for us during off-duty hours. We had a volley ball and some baseball equipment which we used a little every day. We got in the habit of writing at least one letter a day. We would have gladly paid $1,000 or more for a small radio, but we could never put our hands on one."

"What finally happened to the station?"

"I think some radiosonde boys took it over eventually. It's a good spot for winds-aloft data and should give valuable information to airmen flying the Hump."

"Did you go home from there?"

"Not directly. I went to a rest camp in India first. I had quite an interesting time in India. In a place just north of Calcutta between Nepal and Bhutan, I was the guest of Sir Basil Gould for about two weeks. Sir Basil held a sort of ambassadorial post in the region, representing the British colonial government. The grounds on which he lived once belonged to an Indian prince. Hollywood couldn't have dreamed up anything more beautiful. I'll never forget it. Another time, I didn't do so well. I was in a city on the Bay of Bengal one afternoon looking at the stone carvings on the outside of the 'love' temples that the vicinity was noted for, when a couple of local policemen took me into custody. I never did find out why. Maybe they thought I was British---the people here were staunch followers of Ghandi. At any rate they had never seen an American soldier before. It took me three days to establish my identity. I certainly left town in a hurry."

"Muller, how does it feel to be home?"

"Say, are you kidding, soldier?"

CONTENTS

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CONTRIBUTORS

Jakob Bjerknes at 21 established himself in meteorological circles by writing "On the Structure of Moving Cyclones" in 1918. Born in Norway to a distinguished family, he rose to an unsurpassed eminence among his colleagues. From his father, Vilhelm, he took over the administration of the weather department at the famous Geophysic Institute in Bergen. Dr. Bjerknes came to the United States in 1938 to make his home here and to give a series of lectures. In 1940 he became chairman of the Department of Meteorology at UCLA. He has served the AAF recently as a technical consultant to weather centrals in ETO, MTO, and POA.

Herman Jordan was camping with a field artillery outfit in California shortly after Pearl Harbor. One day he was summoned to headquarters and asked whether he'd like to become a sergeant and be sent to artillery OCS. Otherwise he was to proceed at his own expense, in grade of private, to Maxwell Field, Alabama, for in-station weather observing training. He chose Weather. His forecasting career began with his assignment to Smyrna, Tennessee. Now a warrant officer, Jordan has been taking top national honors in the Short Range Verification Program.

Lt. George Austin is presently at Headquarters Weather Wing, working with the operational aspects of radar storm detection. Recently, he wrote "Radar Weather Reconnaissance" and "Radar Storm Detection," manuals which satisfy a long-felt need in the Service's expanding radar program. In civilian days, Lt. Austin studied electrical engineering at M.I.T. He took his cadet meteorological training at the same university, graduating with the September class of 1943.

Lt. Myron Simons, a B.A. from Harvard, left the merchandising field in New York for the AAF Weather Service. He was a member of the September '43 cadet class at N.Y.U., where he had previously done graduate work in merchandising. His army career has taken him to Canada and to the Pacific Ocean Areas. Information about T/Sgt. Rothlein is not available.

THE *BULLETIN* BOARD

The Bulletin *this month is designed to assist the concentration and effort of many AAF weathermen on two of their major projects: diminishing the forecast "errors" related to the summertime thunderstorm, and solving forecast problems associated with war in the Pacific.*

TSTMS

Certain Radar sets which can detect thunderstorms and rain showers to several times the limit of human vision have been installed at almost two dozen AAF fields in the U.S. (many others abroad); primarily to protect local aircraft operations, but also to provide data for meteorological research and for teletype weather reports, or "Rareps". Radar provides uniquely precise and accurate information about the location, area, velocity, development, and intensity of air-mass storms. See "Radar Storm Detection" on pages 12ff.

A review of extant literature about the Theta-E chart appears on page 20, to help clarify the controversy about its use in forecasting the broad areas within which thunderstorms will or will not occur.

A brief and simple procedure for forecasting the maximum gust speeds to be expected from an air-mass or a prefrontal thunderstorm appears on page 22. While this procedure has given good results in a few trials, it is derived from preliminary studies only. Nevertheless, field weathermen who can establish for themselves its validity by test forecasts will thereby gain a valuable technique.

PACIFIC

Dr. J. Bjerknes, outstanding pioneer in meteorology, visited the AAF weather central on Guam last winter. While there, he analyzed the available observations according to dynamic principles and formulated important theories about the systems which influence East Asian winter weather. Dr. Bjerknes' discussion in this issue (page 3), derived by the editor from his trip report, illustrates dynamic principles which are general in their application: it is reading recommended for forecasters everywhere.

Two AAF forecasters who spent last winter in duty on Tarawa carefully collected and reviewed in-flight observations of the weather on air-routes which radiate from that strategic island. Their report (page 10) gives an objective account of the winter weather found in a 3,000,000-sq.-mile circle around Tarawa, including that produced there by the Intertropical Convergence Zone.

The fruits of the Weather Service's first full season of experience in the Western Pacific, the winter of 1944-45, will be priceless when November again falls upon Allied operations against Japan. Then forecasts issued to military units can have greater success, because they will be based upon the detailed reviews which have been made of last winter's forecasts and observations in the Pacific.