Chapter 8
THE TOTALS INDEX

SECTION A—GENERAL

Since the severe-weather forecaster has little time to digest a large amount of information, the MWWC developed several semi-objective forecast short-cuts. One of these time-savers is to use a computer to analyze and plot sounding data. During the past two years, considerable success has been achieved by using the early radiosonde (SLAM) data to prepare a stability analysis based on the 500-mb temperatures and the 850-mb temperature and dew point. This machine-plotted chart is now prepared twice daily by the AFGWC and is available to the forecaster one hour and 30 minutes after data time. The plotted data consists of the 850/500-mb thickness, the 12-hour thickness change, the Showalter Index, the thermal wind, and the Vertical and Cross Totals. Vertical Totals is the 500-mb dry-bulb temperature subtracted from the 850-mb dry-bulb temperature. Cross Totals is the 500-mb dry-bulb temperature subtracted from the 850-mb dew-point temperature.

The significant isotherms at 500-mb for the season of the year are often plotted on the chart. Significant isotherms at 500 mb are a critical or threshold value of temperature at that level for moderate to severe thunderstorm activity during certain seasons of the year. Critical values currently in use by the AFGWC are as follows:

a. December, January, February (-16°C)
b. March, April, October, November (-14°C)
c. May, June (-12°C)
d. July, August, September (-10°C)

These values enable the forecaster to maintain continuity on the advection pattern and serve to alert him to potential threat areas. The temperatures over the threat area are studied, but of more importance are the temperatures upwind of the threat area, especially if cold-air advection toward the area is probable.

SECTION B—STABILITY VERSUS THUNDERSTORM OCCURRENCE

In nearly all cases of major severe thunderstorm outbreaks, little cooling occurs at 500-mb over the threat area. In actuality, slight warming due to advection or the release of latent heat is likely to occur. As long as heat and moisture are added to the lower levels of the air mass, slight warming in the middle and upper levels will not increase the actual stability. The severe-weather forecaster looks for three possible non-adiabatic modifications in the structure of the atmosphere which will cause the air mass to become more unstable (actually and/or potentially):

a. Holding the top of the air column constant or warming it slightly, and adding heat and moisture to the bottom;

b. Cooling the top of the column and holding the lower-level temperature and dew-point values nearly the same; and

c. The simultaneous occurrence of cooling at the top and heating at the bottom of the air column (which seldom happens).

The Totals Chart is very useful in locating potential areas of thunderstorm development. Further refinement of these areas is dependent upon accurate analysis and prognosis of the wind and moisture fields, frontal systems, and areas of positive vorticity advection (PVA).

Vertical Totals (VT's) are analyzed for values of 24 or greater by 2-degree intervals. In the United States the value of 26 appears to be reasonable for a thunderstorm occurrence without regarding moisture, except along the coastal areas of the Gulf States where values less than 26 are often associated with thunderstorm activity. In the British Isles this value is near 22 and in western Europe is about 28. Since the Vertical Totals are derived without regard to moisture, it is not practicable to call for thunderstorm activity based on the VT's alone, except in an island climate or along the windward side of coastal mountains, or over large bodies of water such as the Great Lakes. To further delineate the potential thunderstorm areas and probable intensities, the Cross Totals (CTs) data are analyzed for 2-degree intervals.

SECTION C—USE OF THE STABILITY CHART

The severe-weather forecaster first outlines those areas having Vertical Totals of 26 or greater, Cross Totals of 18 or more, or a Total Total (TT) of 44. These areas are then refined by the 500-mb moisture field. For the area west of the Rockies, significant 500-mb or 700-mb moisture will initiate thunderstorms regardless of the value of the Cross Totals. ("Significant

moisture" is a 6-degree temperature-dew-point spread at either level, or a dew point of -17°C or warmer at 500-mb, and 0°C or warmer at 700-mb.) Lack of 700-mb moisture will not preclude development as long as sufficient 500-mb moisture is present. However, development is more certain and cells are more numerous when both levels indicate available moisture. These thunderstorms are largely orographic in nature and their development is highly correlated with Vertical Totals and the presence of available moisture. Assuming an adequate moisture field the following values are usually effective in producing thunderstorms *west* of the Rockies.

a. If the Vertical Totals are less than 28, forecast no thunderstorms.

b. If the Vertical Totals are between 29 and 32, forecast a few thunderstorms.

c. If the Vertical Totals are over 32, forecast scattered thunderstorms.

Usually these forecast thunderstorms will produce gusts of less than 35 knots and/or small hail only. Heavy and severe thunderstorms require a large supply of low-level moisture at the 850- and/or 700-mb level, depending on terrain height. Moisture need not, of course, be directly over the area of concern, but in a position to affect the area.

East of the Rockies the same relationships hold true with the proviso that low-level moisture is present. Here the Cross-Total threshold value of 18 is used as the lower limit for thunderstorms, and a Total Total of 44 is a minimum. These values are only guides since terrain and local effects will occasionally combine to produce thunderstorms outside the forecast area. However, such occurrences will be in the minority and will usually be confined to the following areas:

a. Along the immediate Gulf Coast and over the Gulf Stream the Cross Totals appear to be the deciding factor. A CT of 16 or more coupled with a VT of 23 or 24 often will produce a thunderstorm.

b. Along the windward slopes of the Pacific coastal mountains the Vertical Totals are most important, especially when associated with positive vorticity advection and cyclonic flow aloft. Vertical Totals over western Oregon and Washington and northern California of 30 or more will usually produce scattered cumulonimbus, a few thunderstorms and hail pellets.

c. Over the Great Lakes, the Vertical Totals are again the most important. A VT of 30 or greater should be suspect, except when the Lakes are mostly frozen over.

After outlining those areas where the air mass is capable of supporting thunderstorm activity, the severe-weather forecaster must further refine his forecast by an appraisal of the changes to be expected in the overall synoptic pattern during the forecast period. The NMC facsimile analyses and prognoses are available and special emphasis is placed on the 12-hour vorticity prognosis. The movement of vorticity centers and any changes in the advection pattern are carefully noted and forecast areas adjusted accordingly. The Vertical, Cross, and Total Totals are used to assign degrees of intensity to the various areas under study according to categories listed in Table 2. The colors refer to intensities of severe weather activity and are discussed in Chapter 11.

These Cross Totals along with Vertical Totals of 26 or greater are adequate for a first approximation of intensity. The higher the Vertical Totals overlying the area of significant Cross Totals, or the higher the Vertical Totals upwind, the greater will be the severity and certainty of thunderstorm development. The final refinement of the forecast areas is dependent on the accurate timing of the development and movement of anticipated trigger action.

The AFGWC has placed increasing emphasis on the use of the Total Totals (TT) in day-to-day forecasting. While it is still advisable to consider the Vertical and Cross Totals, it does appear that the TT is more reliable single predictor of severe activity in both warm- and cold-air situations. During 1964 and 1965, 92% of all reported tornadoes occurred in air masses having a TT of 50 or greater. Most of the family-type outbreaks accurred with a TT of 55 or greater. However, Total Totals must be used with careful attention to either the Cross Totals or the low-level moisture, since it is possible to have large Total Totals due to the temperature lapse rate with little supporting low-level moisture. Appendix B provides an excellent discussion on the use of Totals charts.

Table 2 - Relationship of Severe Weather Intensities to Magnitude of Cross, Vertical and Total Indexes

FORECAST	CT	VT	TT
Isolated to few Thunderstorms Orange	18-19	26 or more (with excep. prev.noted)	44
Sctd tstms orange, with few green	20-21	26	46
Sctd tstms orange few green tstms isolated blue	22-23	26	48
Sctd green - few blue - isolated red	24-25	26	50
Sctd to numerous green - few to sctd blue - few red	26-29	26-29	52-58
Numerous green - sctd blue and red	30	~~26~~ ≥ 30	~~56~~ ≥ 60

Chapter 9
FORECASTING HAIL SIZE

SECTION A—GENERAL

Hail size forecasts are made from a diagram prepared at the MWWC. This diagram (Figure 48) is based on data obtained in reports of wind-tunnel hail tests and estimates of the updraft velocities in thunderstorms [16].

SECTION B—DESCRIPTION OF TECHNIQUE

The first step in forecasting hail is to determine the Convective Condensation Level (CCL). This parameter is evaluated on the adiabatic chart by finding the mean mixing ratio in the moist layer of the lowest 150 mb, and following this saturation mixing ratio line to its intersection with the sounding dry-bulb temperature curve. Next, the moist adiabat through the CCL is traced up to the pressure level where the dry-bulb air temperature is -5°C. This pressure level, the dry-bulb temperature curve and the moist adiabat through the CCL form a triangle outlining a "positive" area. The horizontal coordinate in Figure 48 is the length of the horizontal side of the triangle in degrees Celsius.

The vertical coordinate in Figure 48 is the length (in degrees) of a dry adiabat through the triangle. This length is measured from the pressure at the base of the triangle to the pressure of the CCL.

SECTION C—EXAMPLE OF TECHNIQUE

In the sounding shown in Figure 49, the CCL is Point A. The moist adiabat from the CCL to the pressure level where the free-air temperature is -5°C is the line AB′. The isobar from the point where the air temperature is -5°C to its intersection with the moist adiabat is the line BB′. The dry adiabat from the isobar BB′ through the triangle to the pressure of the CCL is the line HH′. The base of the triangle (BB′), in degrees Celsius is 6° (from plus 1° to minus 5°). The length of the dry adiabat through the triangle is 21°C (fron minus 4° to plus 17°). The value on the hail graph with a horizontal coordinate of 6 and a vertical coordinate of 21 is a forecast of one-inch hail.

SECTION D—TROPICAL AIR MASSES

Along the Gulf Coast or in any air mass where the Wet-Bulb-Zero height is above 10,500 feet, the hail size derived from Figure 48 is too large. Corrections for this effect are obtained by the graph in Figure 50. The hail size derived from Figure 48 is entered on the horizontal coordinate of Figure 50 and the corrected hail size read off is compatible with the height of the Wet-Bulb-Zero temperature. For example, a hail size of one inch from Figure 48 is reduced to a 1/4-inch hail forecast if the Wet-Bulb-Zero height is 11,800 feet.

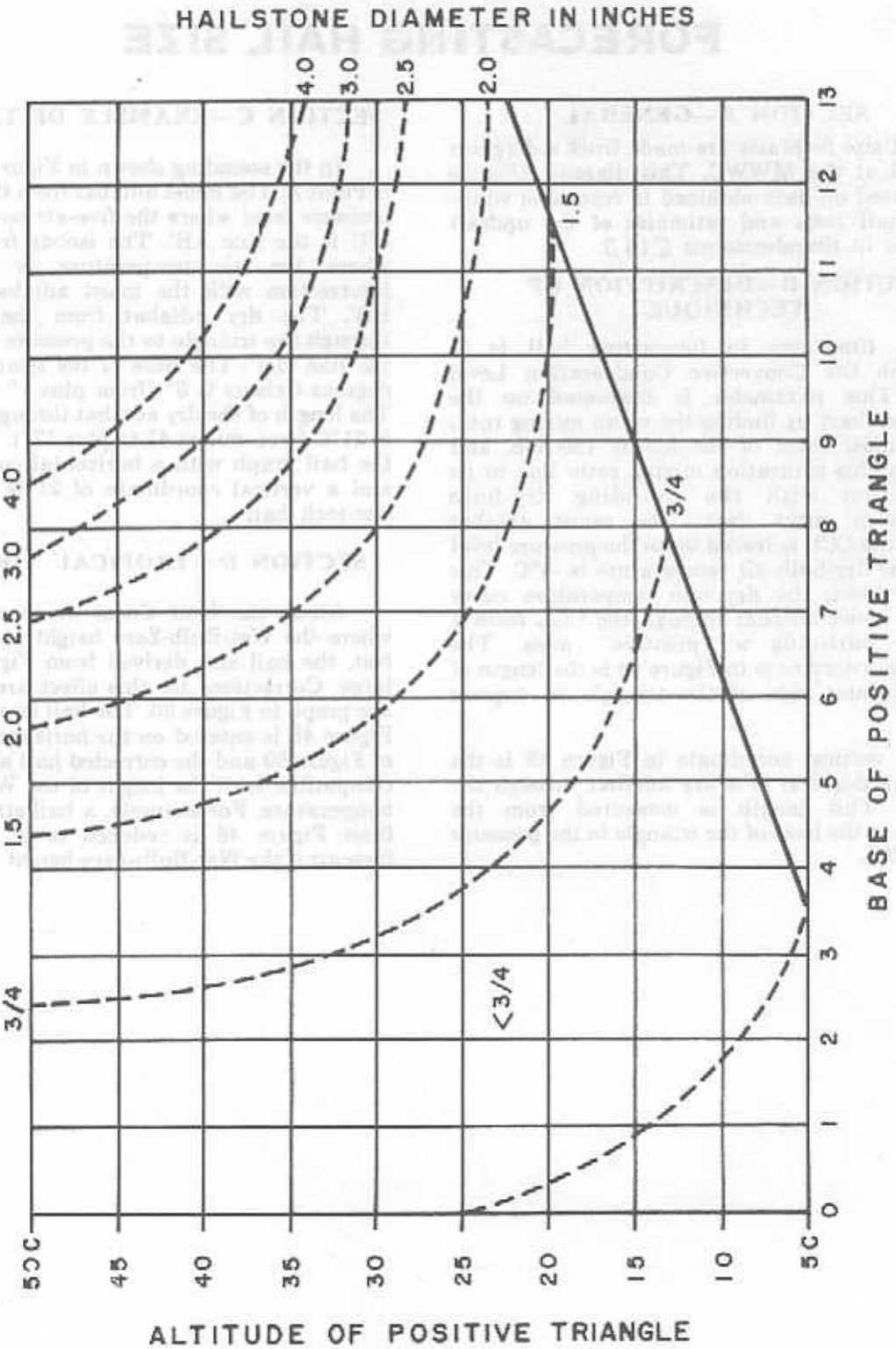

Figure 48. The Fawbush-Miller Hail Graph showing the forecast hailstone diameter in inches. Graph revised November 1965 on the basis of 622 hail reports.

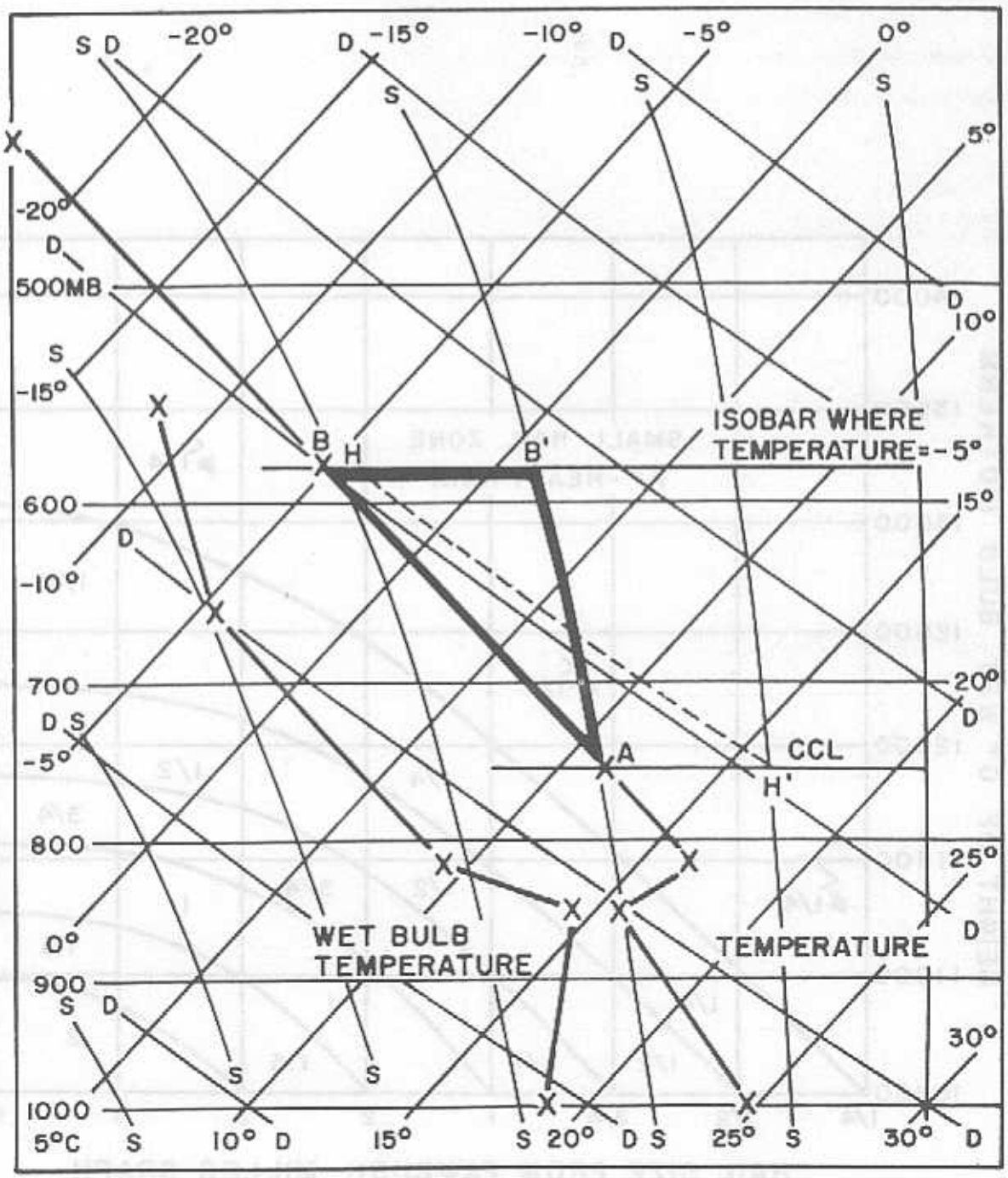

Figure 49. Example of hail size forecast from sounding. BB' is the base of the positive triangle and HH' measures the altitude. In this case 6 and 21 respectively. These values are equivalent to one-inch hailstones in Figure 45.

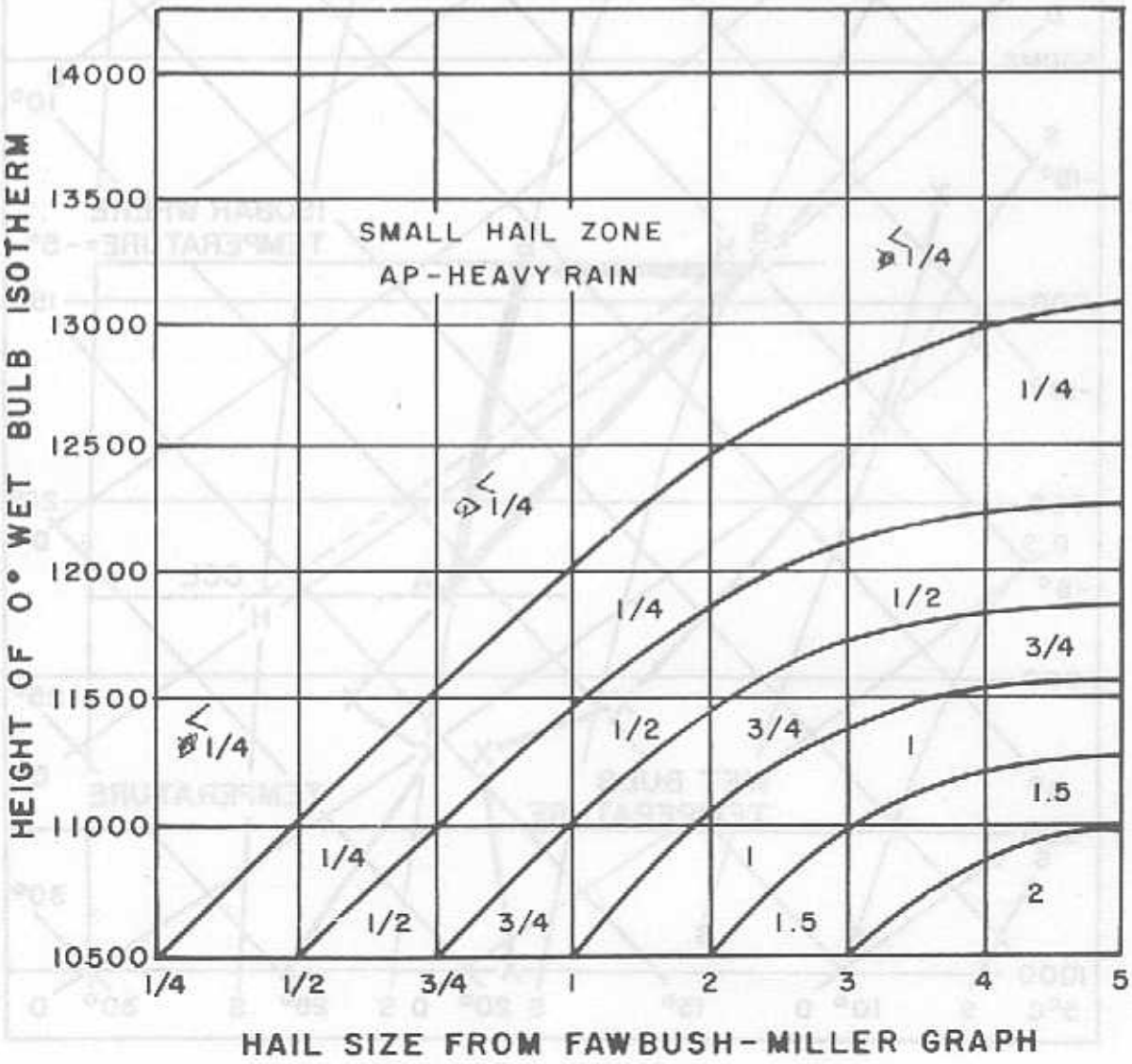

Figure 50. Hail size at surface expected in Type II air mass.

Chapter 10

FORECASTING MAXIMUM WIND GUSTS OF CONVECTIVE ORIGIN

SECTION A—GENERAL

The AFGWC uses Table 3 to forecast the speed of maximum wind gusts. Table 3 is based on the empirical formula

$$(1) \qquad V' = 13 \sqrt{T_1}$$

Since a large number of soundings are evaluated at the MWWC, this formula was devised as a simplification of a more basic formula [41]:

$$(2) \qquad V' = 13 \sqrt{\frac{T_1 + T_2}{2}} + V$$

where:

a. V' is the speed of maximum wind gusts;

b. T_1 is the Dry Instability Index; and is defined in Section B;

c. T_2 is the Downrush Temperature subtracted from the dry-bulb temperature just prior to thunderstorm passage; and

d. V is one-third of the mean wind speed expected in the lower 5,000 feet above the ground. Local forecasters are urged to use the formula of equation (2) for the local refinement of wind warnings. For computing T_1 use Figure 51, and for T_2 use Figure 52.

The T_1 method is quite reliable in indicating maximum average wind gusts. To calculate the probable maximum peak gust, one-third of the mean wind speed expected in the lower 5,000 feet above the ground (V) should be added to the average value obtained.

SECTION B—DETERMINATION OF T_1 AND T_2

T_1 is found in one of two ways:

a. If the sounding has an inversion, the moist adiabat is followed from the warmest point in the inversion to 600 millibars. The temperature difference between the intersection of the moist adiabat at the 600-mb isobar and the temperature of the dry bulb at 600-mb is T_1. The inversion (top) point should be within 150 or 200 mb of the surface and must not be susceptible to becoming wiped out by surface convection.

b. If no inversion appears on the sounding, or if the inversion is relatively high (more than 200 mb above the surface), a different method is used to find T_1. The maximum temperature at the surface is forecast in the usual manner. A moist adiabat is projected from the maximum temperature to the 600-mb level. The temperature difference between the intersection of the moist adiabat and the 600-mb surface and the dry-bulb temperature at 600-mb is T_1.

T_2 is found by first locating the 0°C isotherm on the wet-bulb curve. A moist adiabat through that point is followed down to the surface and the temperature at that point recorded. This temperature is subtracted from the dry-bulb temperature (or the forecast free-air temperature) giving the value of T_2.

SECTION C—DETERMINING THE GUST DIRECTION

For the direction of the maximum wind gust, the mean wind direction in the layer between 10,000 and 14,000 feet above the terrain is used.

The effect of the shift in speed and direction between the existing (or forecast) surface wind and the thunderstorm gust wind must be evaluated, in each instance, by the station weather officer. For example, a strong southwest surface wind which will be followed by a maximum gust from the northwest may require modification of local plans to protect parked aircraft. Hence, local wind warnings should be quite explicit when this type of situation appears likely.

SECTION D—ALTERNATIVE FORECASTING METHOD

The AFGWC has a second method for forecasting maximum gusts, which is particularly useful when applied to isolated air-mass thunderstorms and/or squall lines. This empirical system uses the graph in Figure 53. The graph then indicates the probable minimum, mean, and maximum gust speeds. This method also predicts the direction of the maximum gust to be in the same direction as the mean wind between 10,000 and 14,000 feet above the terrain.

SECTION E—SAMPLE FORECAST

Assuming the sounding as shown in Figure 51, a gust forecast is found by the following steps:

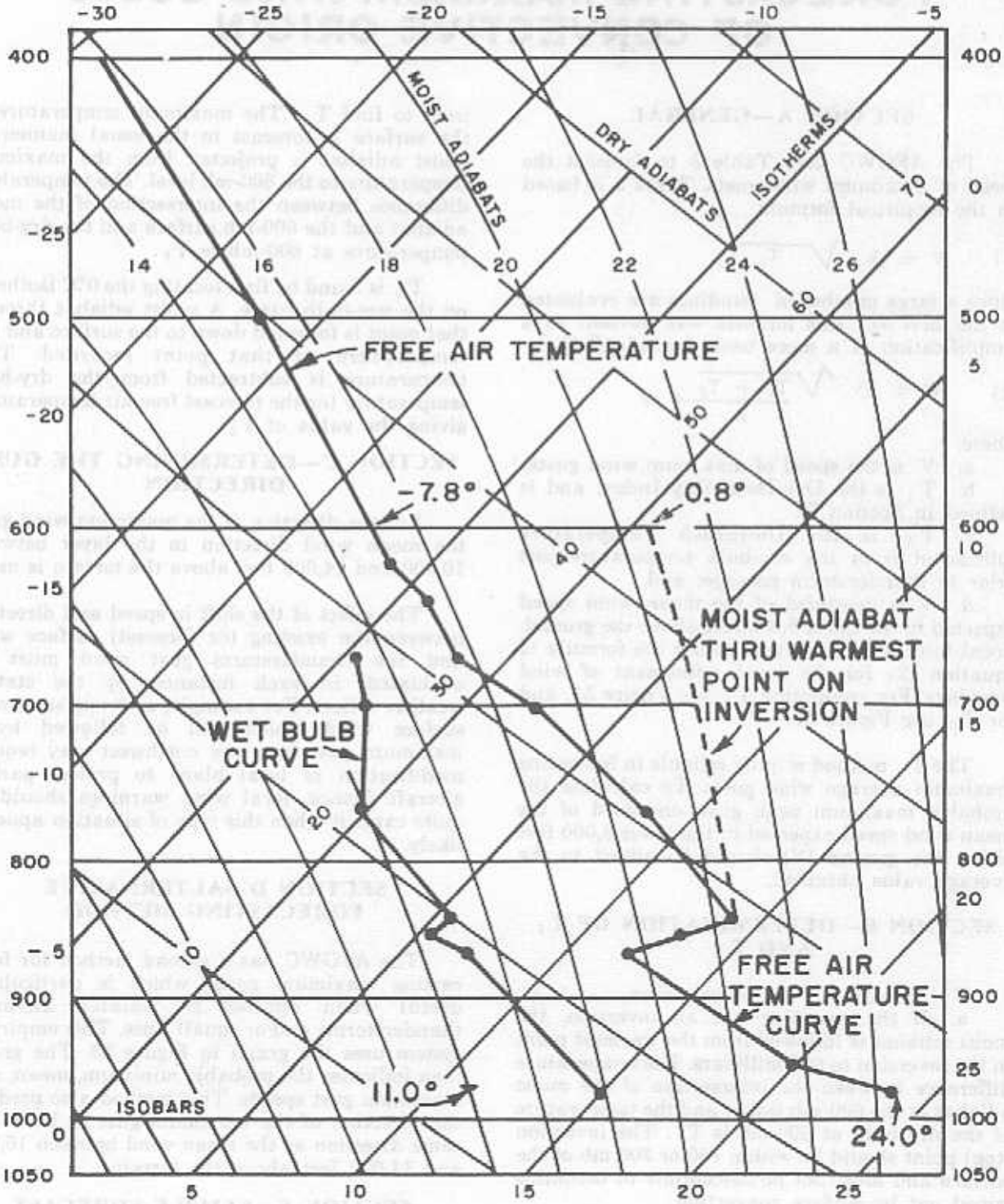

Figure 51. Example of sounding for wind gust forecast.

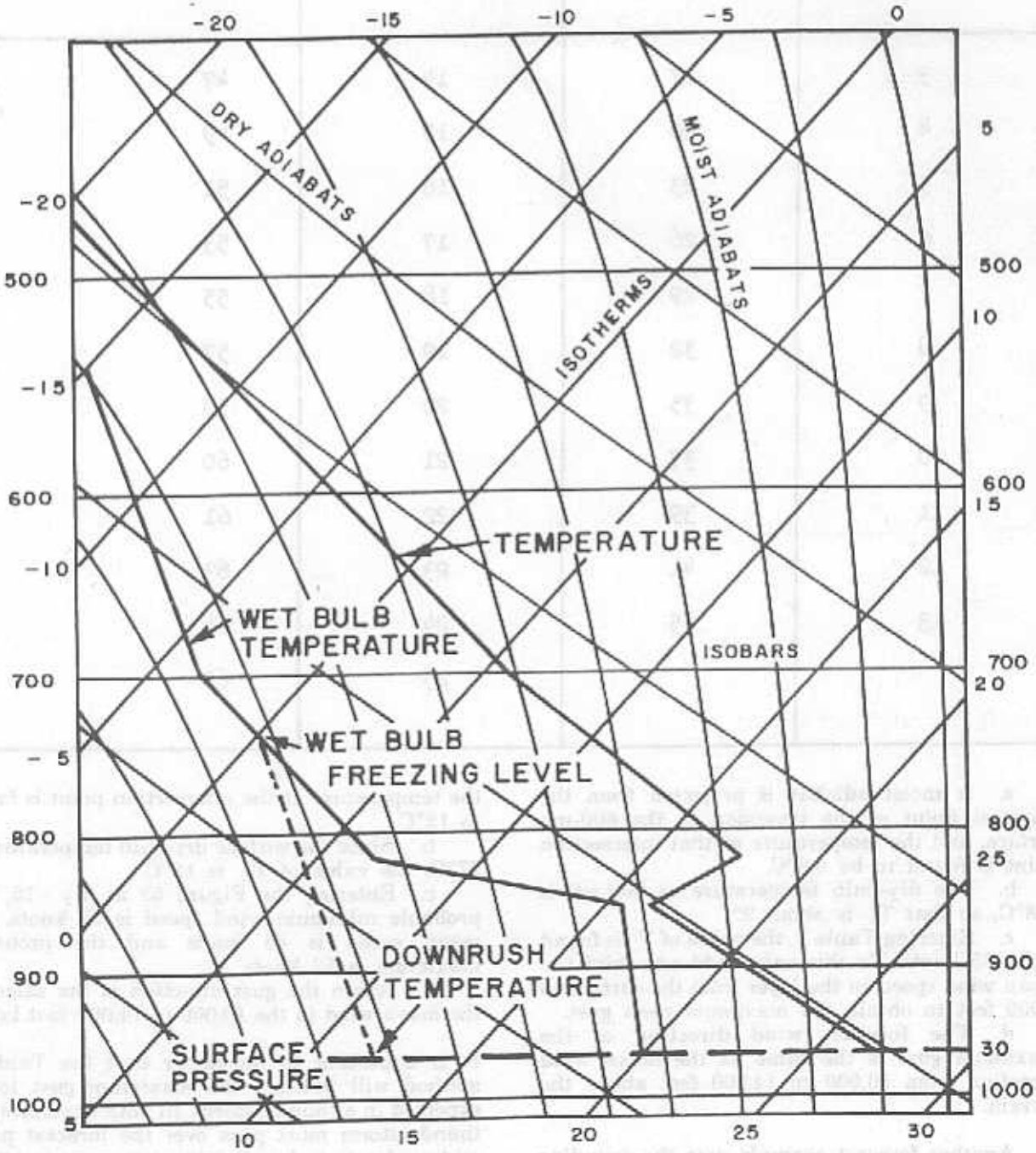

Figure 52. Determination of downrush temperature by tracing a saturation adiabat from intersection of wet bulb curve and 0°C isotherm to the surface pressure.

Table 3 - Use of T_1 for Maximum Wind Gusts

T_1 Values in °C	Maximum Gust Speed (V')	T_1 Values in °C	Maximum Gust Speed (V')
3	17	14	47
4	20	15	49
5	23	16	51
6	26	17	53
7	29	18	55
8	32	19	57
9	35	20	58
10	37	21	60
11	39	22	61
12	41	23	63
13	45	24	64
		25	65

a. A moist adiabat is projected from the warmest point of the inversion to the 600-mb surface, and the temperature at that intersection point is found to be 0.8°C.

b. The dry-bulb temperature at 600-mb is -7.8°C, so that T_1 is about 9°.

c. Entering Table 3, the value of V' is found to be 35 knots. To this value add one-third the mean wind speed in the layer from the surface to 5,000 feet to obtain the maximum peak gust.

d. The forecast wind direction of the maximum gust is the same as the mean wind direction from 10,000 to 14,000 feet above the terrain.

Another forecast example uses the sounding of Figure 52.

a. A moist adiabat from Wet Bulb Freezing Level is projected downward to the surface and the temperature at the intersection point is found to 12°C.

b. Since the surface dry-bulb temperature is 27°C, the value of T_2 is 15°C.

c. Entering the Figure 53 at T_2 = 15, the probable minimum wind speed is 38 knots, the mean speed is 45 knots and the probable maximum is 52 knots.

d. Again the gust direction is the same as the mean wind in the 10,000 to 14,000 foot layer.

It is important to remember that the Table 3 method will indicate the maximum gust to be expected in a thunderstorm. In both examples the thunderstorm must pass over the forecast point and moderate to heavy rain must occur to attain the gust speeds forecast. If these unique conditions are not fully met, the method will appear to overforecast gust speeds.

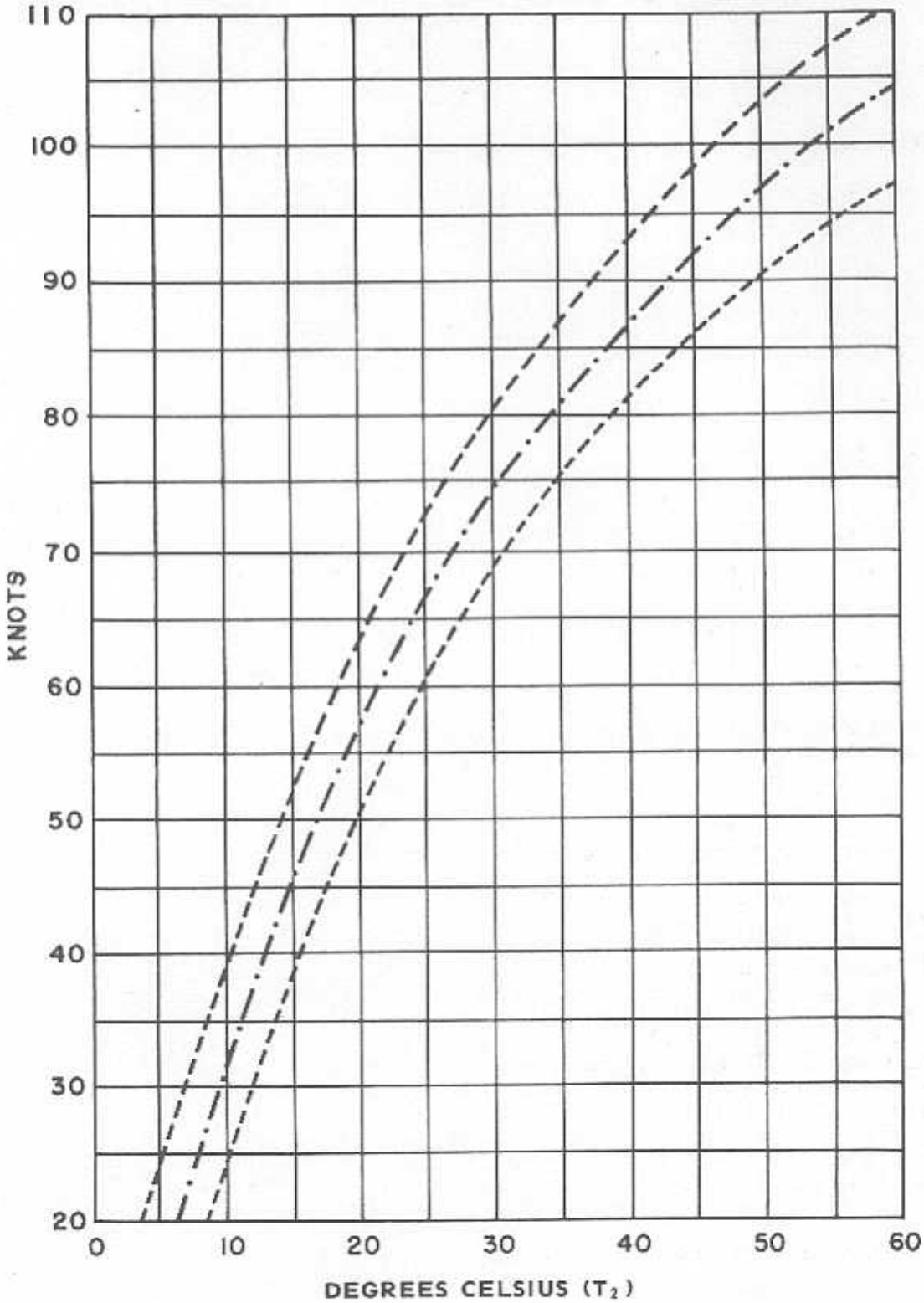

Figure 53. Alternative gust forecasting technique. Useful in the Type II air mass.

Chapter 11

CENTRALIZED AND LOCAL ADVISORIES AND WARNINGS

SECTION A—GENERAL

The AFGWC has the unique mission and capability as the primary centralized severe weather warning facility within the Department of Defense (DOD). As such, the AFGWC provides centralized severe weather advisories and point warning service to designated military organizations and installations of the DOD and provides other meteorological services related to severe weather as directed by the Commander, AFGWC.

The AFGWC prepares and issues general area advisories and specific point warnings of potential or expected severe weather covering the 8 different phenomena shown in Table 4; and conducts studies and research to develop and apply improved severe weather forecast methods, with primary emphasis on computerized products.

Technical liaison is also maintained with the National Severe Storms Forecast Center (NSSFC) of the National Weather Service, Department of Commerce, Kansas City, Missouri. This is accomplished by direct hot-line contact with the NSSFC.

A color code has been adopted to identify the intensities of severe weather. This code reduces communication time and alerts the field forecasters to the most intense severe-weather areas. The colors and the corresponding intensities are often used for shading maps to display the warnings.

Advisories and point warnings of AFGWC are for the use of authorized military activities and personnel, and are not issued to other governmental agencies or civilian organizations.

SECTION B—AFGWC ADVISORIES AND WARNINGS

The ultimate objective of the AFGWC is to indicate, within the smallest possible area of space and time, the probable intensity of unique severe weather occurrences which threaten the life, property, and operational capability of military installations. To accomplish this, two basic forecast products are provided: general area advisories and specific point warnings.

The area advisories provide basic guidance of expected broad scale severe weather developments to the forecaster in the field. The point warning specifically alerts the forecaster or installation authority at a location which is expected to be affected by severe weather.

The area advisories are disseminated over COMET II weather teletype circuits and the facsimile net operated by the Air Force Communications Service. Point warnings are disseminated over the COMET II weather teletype circuits and also by phone when conditions dictate. In addition, AFGWC provides severe weather input to other functions such as the low-level support function, terminal forecast function, and special mission support.

MWA The Military Weather ~~Warning~~ Advisory ~~(MWWA)~~ is prepared every six hours and amended as necessary. It describes, in combination map and text format, the areas throughout the conterminous United States where phenomena which meet warning criteria are expected to occur during the subsequent 12-hour period. It is an estimate of the weather producing potential of the existing synoptic pattern and air masses, based on the assumption that subsequent changes in these features occur as forecast.

Although the forecaster must analyze and integrate large amounts of complex data to prepare the advisory, limited time is allowed for its completion and transmission. Thus, the data which it incorporates and the information which it conveys is made available to the user at the earliest feasible time. As a result, the forecast areas may be considerably larger and the valid period constantly longer than desirable for operational use. Nevertheless, this method of preparation and presentation effectively applies the concept of centralized forecasting. Since the relocation of the MWWC from Kansas City to the AFGWC, the preparation, dissemination, and overall accuracy of the ~~MWWA~~ has been vastly MW improved by heavy utilization of the analytic and prognostic information provided by the AFGWC data base.

The advisory makes available to the field forecaster, in directly useful form, the specialized

attention, experience, and techniques which are available in the AFGWC. It alerts him to the probability of severe weather in his own area of concern. It serves him as an aid in briefing flight and control personnel on the broad-scale patterns of severe weather activity. It gives the field forecaster more time to solve his specific forecast problems and to apply the answers to the operation he supports. Since the advisory is an integral part of the AFGWC data base, it also provides input to other functions within the AFGWC in the preparation of forecast products.

Specific point warnings are the second and equally important product of the AFGWC. While area advisories provide general guidance to all military forecasters in terms of synoptic and mesoscale developments, point warnings are issued for and to specific locations in the smallest scale of space and time consistent with the availability of data and state of the art.

The approximate 500 locations for which the AFGWC has warning responsibility are listed in Volume II, AWSM 105-2. Since some of these locations include two, three, or four installations in one locality, the total number of installations served is well over 500. Approximately 50% of these are Air Force, 45% Army, and 5% Navy. Included are National Guard units, arsenals, ammunition plants, radar sites, and those civilian activities under contract to the Department of Defense.

Although the area advisory is issued at scheduled intervals for fixed valid periods, point warnings are issued as the situation warrants and amended, extended, or cancelled as necessary. Obviously, it is desirable to issue a warning sufficiently far in advance for the user to plan and take adequate protective measures with minimum interference to his operation. For the sake of forecast accuracy, however, the optimum lead time is that just long enough to permit necessary protective action. Developing an optimum lead time for each phenomena is a constant objective of the AFGWC; current efforts are concentrated on developing a lead time of 3 hours.

SECTION C—DATA AVAILABLE TO AFGWC

Although the area advisory and point warning differ in content, format, dissemination, and use, they are closely related products of a joint team effort supported by the flow of observed data and forecast information from the AFGWC data base. In addition, the AFGWC has access to analyses and prognoses received by facsimile from the National Meteorological Center of the National Weather Service (NWS).

Also received are pilot reports from all military and civilian sources. Hourly synoptic charts of all weather radar data are plotted by the AFGWC observers from data received over the NWS RAWARC Circuits. This is an inter-office teletype network which ties together all principal NWS offices.

Hourly surface observations are received from all civilian and military reporting stations. Observations are computer scanned and those pertaining to specific parameters of interest to the severe weather forecaster are routed to special teletype circuits. Flash reports of severe activity are also available as transmitted over the NWS RAWARC Circuits.

SECTION D—SYNOPTIC PATTERNS AND LOCAL EFFECTS

Forecasters must consider all aspects of the broadscale synoptic pattern in order to evaluate the influence of a severe-weather advisory or point warning on their local area of responsibility. In particular, they should consider the following general meteorological conditions:

a. Position and movement of fronts, troughs, and other discontinuities.

b. Source, trajectory, and modification of air masses.

c. Wind flow at all levels.

Also, local influences play an important role in accelerating or modifying the development of severe weather. These influences include:

a. Terrain and other geographical peculiarities of the area.

b. Intensity of wind and weather critical for the installation and lead time required for adequate precautions.

c. Antecedent weather conditions and tendencies.

SECTION E—RADAR OBSERVATIONS

Local radar observations have many uses, including:

a. Comparison with observations from surrounding stations.

b. Discovery of approaching squall lines.

c. Detection of the area of maximum echo intensity. If the area is upwind of the mid-level wind flow, the station probably lies in the path of the most severe storms.

d. Recognition of severe-weather echoes. Photographs in recent years have identified certain echo configurations as being productive of

tornadoes and damaging winds, the most prominent of these being the "hook" echo. Such echoes should be viewed with suspicion. However, in most cases the hook is not in evidence, perhaps because it may be masked by precipitation.

e. Detection of perturbations on squall lines. Lines of echoes or squall lines are rarely smooth. Mesoanalysis of the direction of motion and the speed of movement of segments may indicate points where wave development is taking place. Such perturbations are favored locations for severe storms.

f. Monitoring the movement and characteristics of individual cells.

(1) Cells that move more rapidly than others are likely to produce the maximum downrush velocities. When two cells merge, intensification results and severe weather phenomena often result. Eyewitness accounts of numerous tornadoes indicate formation when two cells or thunderstorms merge. Usually one comes from the west and one from the southwest.

(2) Many observations of severe storms on radar have shown dark spots within echoes. Altering the antenna angle shows the dark spot to extend to great heights and tilt somewhat forward in agreement with the speed of upper-level winds. These dark spots sometimes termed "vaults" [6] [7] appear to occur often with the most severe storms and tornadoes. Some recent radar photographs indicate these dark spots, or holes, are connected with the lower "hook" portions of the echo.

(3) Careful interpretation of radar echoes, coupled with mesoanalysis of surface observations, permits identification of intersecting lines of activity. These intersections locate and follow mesolows which serve as triggering mechanisms for tornadic activity.

SECTION F—TERMINAL OBSERVATIONS

Local terminal observations provide useful information, including:

a. Ceiling and cloud cover.

(1) In some instances, lower clouds will decrease with the approach of a severe storm, even an hour or more in advance.

(2) Any advance of middle clouds should be studied for evidences of mammatus. The paths of severe storms are generally south of the lowest axis of mammatus formation. If the mammatus is below 14,000 feet, the barometer trace may be erratic indicating turbulent conditions aloft. This sign may be indicative of rapidly developing severe weather.

b. Pressure:

(1) Increasing instability of the air structure is generally reflected in erratic behavior of the barometer.

(2) Without contradicting the concept of falling pressure with the approach of the storm, it is sometimes noted that, with the approach of a fast-moving squall line or bubble, the fall will decelerate or even a slight rise set in prior to a more rapid fall.

(3) If the barometer is falling very rapidly, there usually is intense vertical motion in the local area.

c. Temperature and dew point.

(1) An increase in temperature and dew point greater than the normal diurnal change shows that heat and moisture are being added to the lower levels of the local air column. If comparison with surrounding stations indicates that the maximum positive change is in the local vicinity, the station is, or will be, in the area of maximum severe activity.

(2) If a falling barometer accelerates its fall simultaneously with an increase in temperature and dew point, the probability of a storm occurrence is substantially increased.

d. Wind.

(1) The surface winds usually decrease in speed and back with the approach of a severe storm; however, this tendency is generally too late to be of much help.

(2) If the surface wind increases in speed and shifts from southerly to westerly, the disturbance is probably developing north of the station.

(3) If the surface wind increases in speed and shifts from easterly to southerly, the storm is probably approaching.

(4) If the wind above 8,000 feet MSL increases rapidly in comparison to previous observations and the speeds exceed the geostrophic, the installation is probably near the area of destructive winds.

(5) If the wind above 8,000 feet MSL shows a sharp decrease in speed, the probability of tornadoes is increased, for the station is in the vicinity of a sharp horizontal wind shear and/or strong vertical currents are developing.

e. Remarks of neighboring stations should be monitored constantly for indications of the formation and movement of instability phenomena. Each station should include pertinent remarks in its own transmission for the benefit of its neighbors.

SECTION G—SUMMARY

If the general air structure is favorable for tornado and other severe-storm development, the correlation of the synoptic situation and radar observations with a mesoanalysis of the local area and fluctuations of station instruments will provide guidance on the activity to be expected at least an hour in advance. While it is often

difficult, the problems involved in forecasting local storms are not insurmountable for the persistent and conscientious forecaster.

Table 4 - Definition of Severe Weather Intensities by Color

Color	Severe Weather
Red	Tornadoes or tornado waterspouts.
Blue	Severe Thunderstorms (those with maximum wind gusts of 50 knots or greater or hail greater than one inch in diameter or locally damaging windstorms).
Green	Moderate Thunderstorms (those with maximum wind gusts greater than 34 knots but less than 50 knots and hail, if any, one-half inch or greater but equal to or less than one inch in diameter).
Orange	Thunderstorms (those with maximum wind gusts less than 35 knots and hail, if any, less than one-half inch in diameter).
Black	Strong surface winds (35 knots or more and not associated with thunderstorms).
Purple	Heavy Rain (two inches or more in a 12-hour period).
Hatched Purple	Heavy Snow (two inches or more in a 12-hour period).
Brown	Freezing Precipitation (other than very light).

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