TERMINAL FORECAST REFERENCE FILE

DETACHMENT 15

24th WEATHER SQUADRON

VANCE AFB, OKLAHOMA

15 JULY 1970

83

CONTENTS

LIST OF FIGURES

I LOCATION AND TOPOGRAPHY

1. Geographic Location: Vance Air Force Base is located at 36° 20" north latitude and 97° 54" west longitude. It is four miles southwest of the City of Enid in north central Oklahoma. The field elevation is 1307 feet above sea level with the ground sloping upward to the west toward the Rockies, and slowly downward to the east (Figure 1).

2. Topography and Orographic Effects: There are several large topographical features that affect the weather at Vance Air Force Base. These include:

a. Gulf of Mexico: The Gulf of Mexico is located 500 nautical miles to the south and acts as a moisture source for the central plains. From late fall to early spring, stratus is often advected into central Oklahoma by south to southeasterly winds (or return flow) caused by migratory high pressure cells setting up in the eastern US. As the low level jet becomes stronger at night, the stratus is often advected in during early morning hours and gradually lifts and clears out by early afternoon and then returns shortly after sunset. If quasi-convective, it will dissipate at sunset but reform as stratus before midnight.

b. Rocky Mountains: The Rocky Mountains are located 300 nautical miles to the west of Vance. They are most instrumental in the formation of the Colorado Low. When a cP air mass breaks southward through Montana and the Dakotas, the Rockies act as a dam on its western edge producing a funnel effect between the low to the east and the mountains to the west. This results in accelerated southward movement of the air mass through the north central plains into this area.

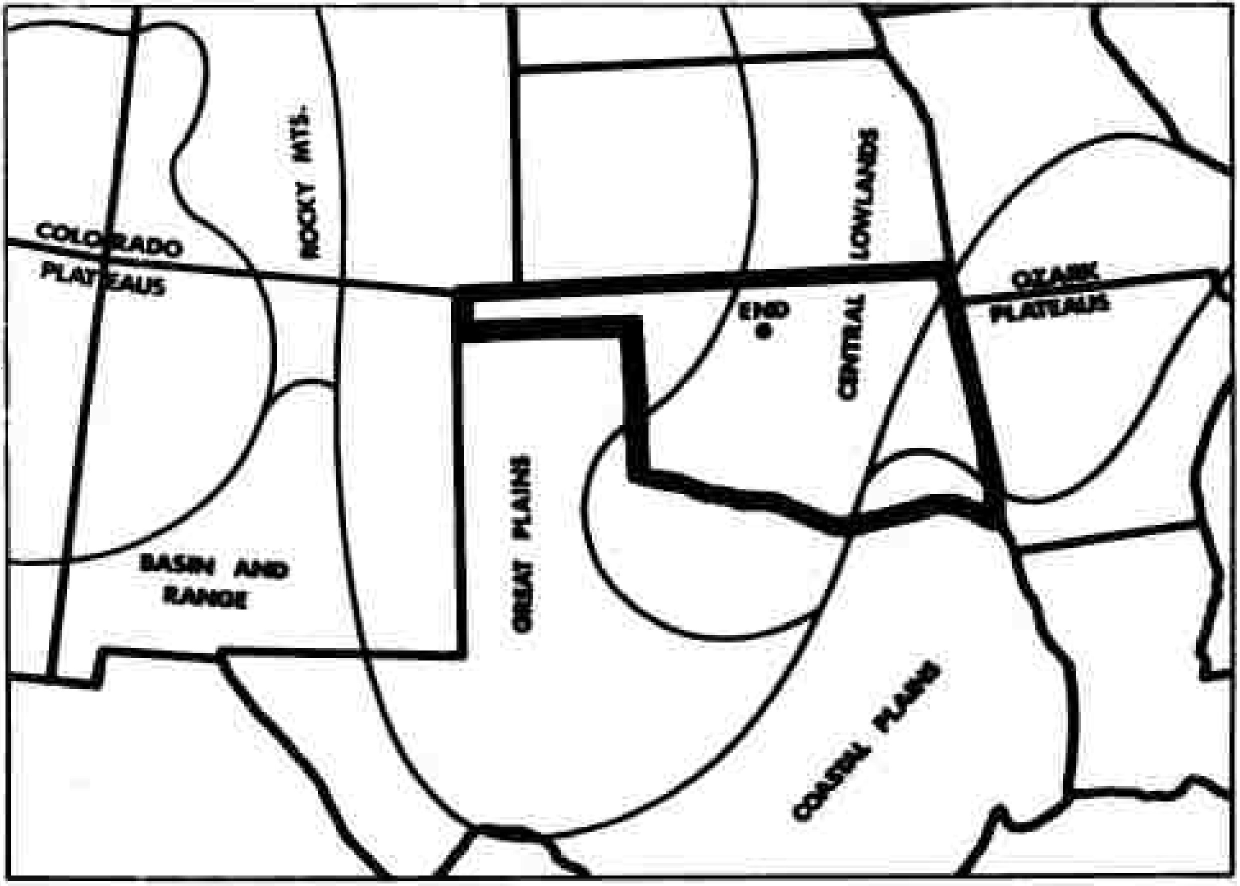


FIGURE 1. - GEOGRAPHIC LOCATION

c. High Plains: The regions of southwest Texas, northern Mexico, and southeastern New Mexico are generally a semi-arid high plateau region. This area acts as a source of dry air and occasionally dust for this station. In spring - early summer, this dry air on encountering moist gulf air further east frequently forms a "dry line" or "dew point front" in eastern New Mexico or the Texas panhandle triggering severe thunderstorms that occasionally reach the Vance AFB area. Vegetation in this region, however, has been increasing in the past few years, thus reducing its significance as a dust source.

d. Local Terrain (Figure 2): The terrain within a radius of 100 nautical miles of Vance AFB consists of gently rolling plains which rise gradually to the southwest, west, and northwest, and drop to the southeast, east, and northeast (Fig 3). The meaning of this is that, although there are no small-scale local features which profoundly affect the weather at Vance, there is a large-scale orographic upslope pattern which favors fog and stratus formation with moist, easterly winds.

3. Local Atmospheric Pollution (Figure 2):

a. Airborne Dust: About the only significant restriction to visibility of a non-liquid nature occurring at Vance AFB is airborne dust. The source of much of the dust is the high plains region mentioned in 2c. However, with increasing vegetation in the high plains, possibly due to increased irrigation, the significance of this region as a source of airborne dust may be diminishing. Generally, the airborne dust at Vance AFB occurs under three different situations. One, occurring primarily February through April (occasionally in the Fall - October - December) is

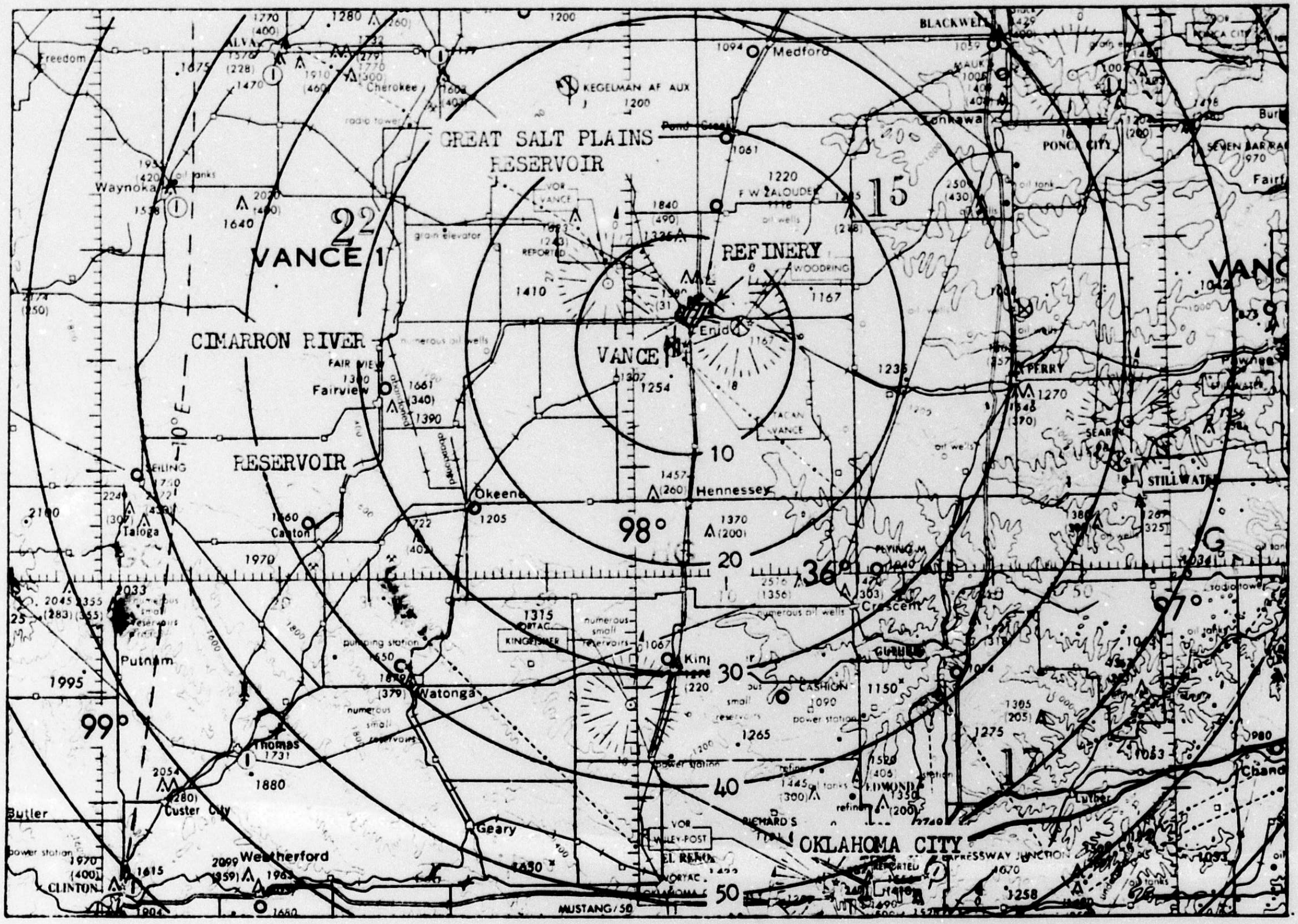


FIGURE 2. — LOCAL TERRAIN

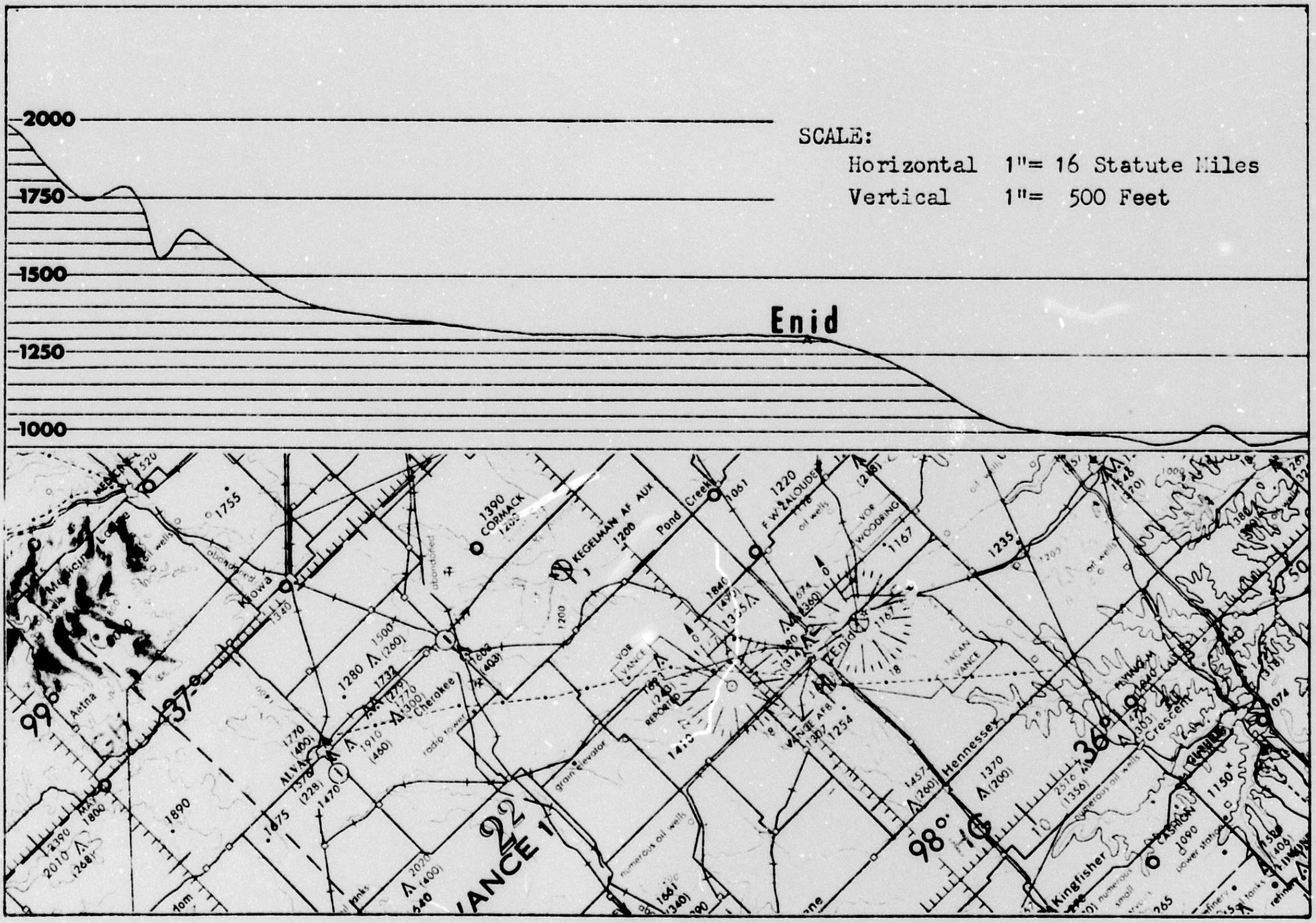


FIGURE 3. - TERRAIN CROSS-SECTION ALONG 135-315 DEGREE AZIMUTH THROUGH ENID

the passage of a strong, deep low pressure system within a region of 150 nautical miles to the north to about 80 miles to the south of Vance AFB. Several fronts are usually involved in such a system (See Figure 4). The airborne dust is usually brought into the Vance AFB area in the strong southwesterly winds to the south and southwest of the low center. The dust may persist for several hours. In recent years, however, visibilities have rarely gone below 2 miles with these systems. The second type occurs when a strong cold front passes through Vance AFB after approaching from the north or northwest. Usually, such fronts are characterized by gusts or squalls behind the front in excess of 40 knots and very strong pressure rises. These fronts have sometimes been seen as a "wall of dust" advancing from the north-northwest to south-southeast across Kansas. The final airborne dust producer at Vance AFB is the thunderstorm (Mar - Sep). Dust produced by squall-line or frontal thunderstorms, while sometimes causing very low visibilities, is not very common and is of very short duration, seldom persisting more than 30 minutes. With "airmass" thunderstorm conditions and dry terrain, airborne dust affecting Vance AFB may be produced by any thunderstorm of moderate or greater intensity within 30 miles of the station. Visibilities may be reduced to near zero with reduced visibilities persisting as long as 90 minutes.

b. Smoke: Smoke is not a significant factor in the terminal weather at Vance AFB, having been carried as an obstruction to visibility only twice in the period Dec 64 - Nov 69. There are, however, numerous "smudge pits" (places where excess low-grade crude oil "mud" is burned)

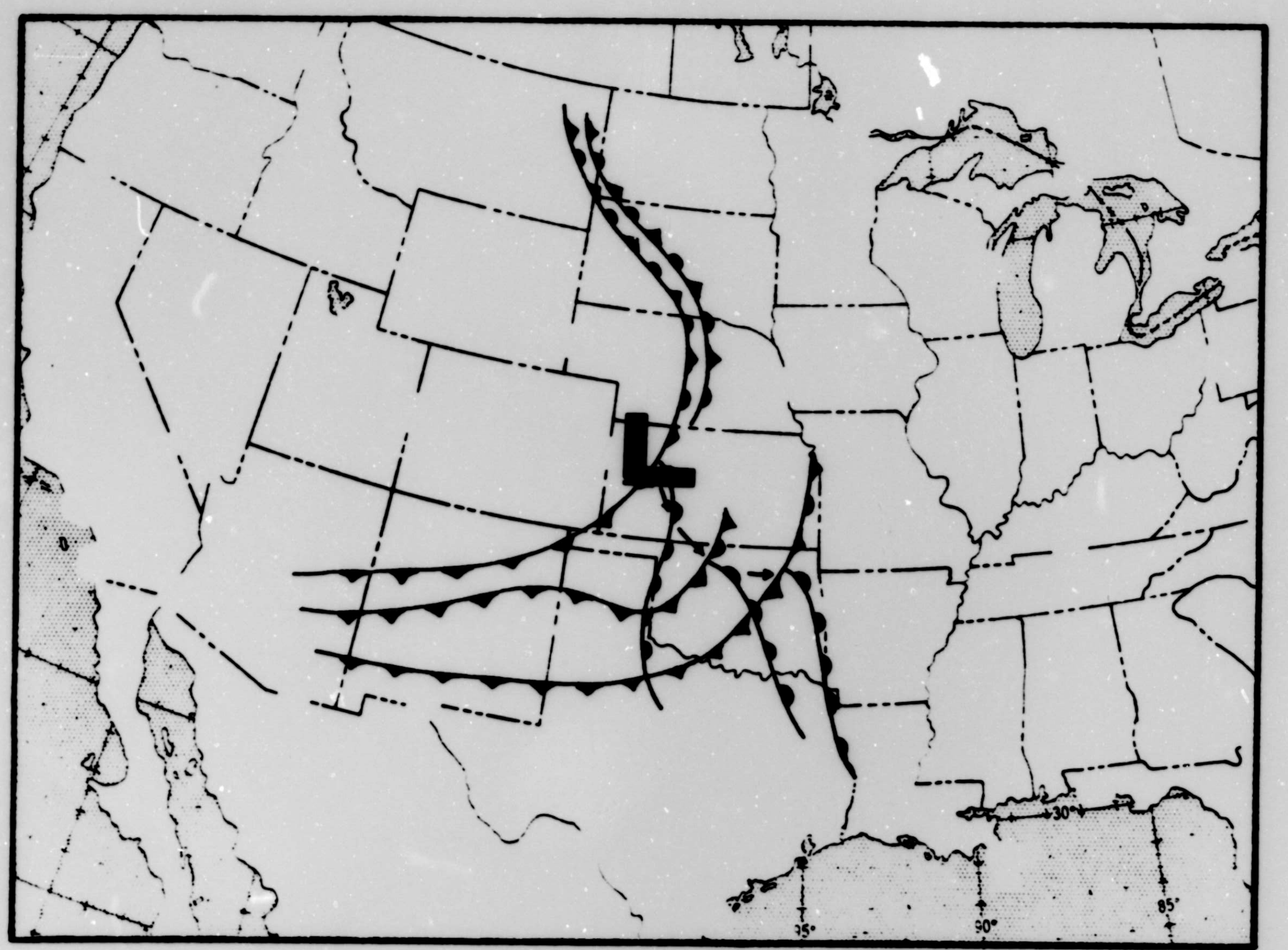


FIGURE 4.- 1800Z 22 DECEMBER 1969 SURFACE FRONT WITH 3 AND 6 HOUR MOVEMENTS

located in oil fields to the west and south of Vance AFB, and these create smoke which is sometimes carried as "K LYR SW-W" on observations on clear days when the wind is not too strong. The principal metropolis in the area is Oklahoma City with a population of 360,000 and centered 56 nautical miles south-southeast of the station. This city has several light and medium-size industrial facilities, but no major smoke-producing industries. Nonetheless, there is still some haze and smoke inherent in a city of such size, mostly from automobile pollution. Occasionally a wind from south-southeast will transport the haze and smoke northward reducing visibility slightly at Vance AFB, but seldom below 10 miles (it is significant to note, however, that in the two occurrences of smoke as an obstruction to visibility the winds were from 140° and 160°). The only other potential smoke pollution source is the Champlin Refinery located on the northeast outskirts of Enid, 5 miles northeast of the station. This plant produces very little smoke, and its pollution is mainly olfactory. In very cold weather, this plant produces a good deal of steam or cold fog.

4. Physical Exposure of the Weather Station and Equipment (Figure 5):

a. Base Weather Station: The Base Weather Station (BWS) is located in the southeast wing of the Base Operations Building (T-156). This building is situated on the east side of the runway complex. The only window in the BWS is the glass doorway on its south side. This window offers a fairly good view of the southeast quadrant, except that hangars and low buildings completely block the horizon and sky below 5° elevation.

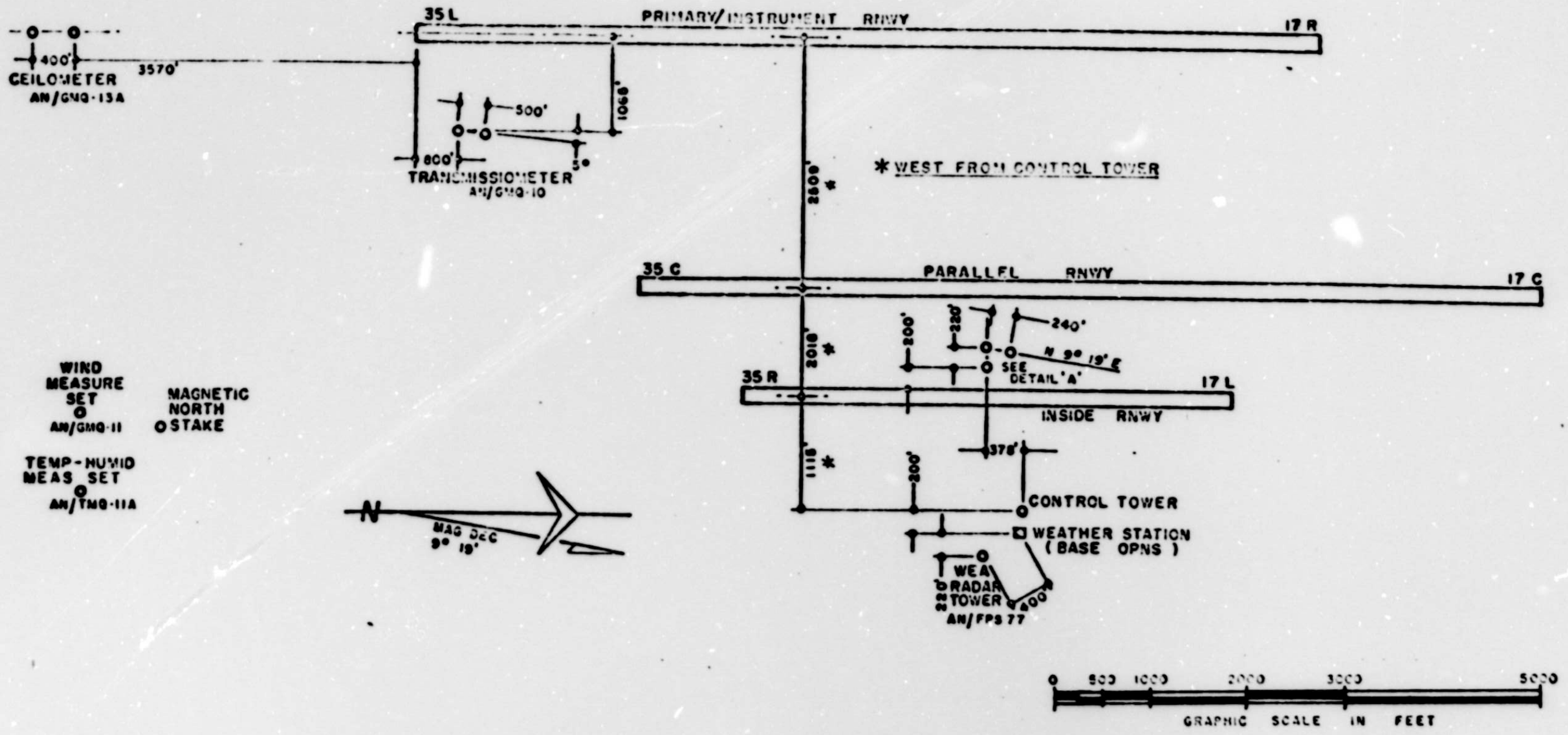


FIGURE 5.— VANCE AIR FORCE BASE, OKLAHOMA

b. Representative Observation Site: The Representative Observation Site (ROS) is a cab located about one-third the way up the control tower, 32 feet above the ground. This tower is located on the east edge of the flight line apron between the Base Operations Building and the east taxiway. This ROS has extensive window areas affording the observer a fine view of the sky on the south, west, and north sides. For an excellent view of the eastern sky, the observer need only walk out the door to the catwalk located on the east side of the ROS. The view of the horizon is good with the exception of small sections to the north-northeast and south-southeast which are blocked by hangars, 550 feet and 225 feet away, respectively, and a section to the east-northeast which is blocked by a low ridge 1 1/2 miles away. Instrument deployment within this ROS is good. Visibility markers range upwards of 11 miles at night and 30 miles in daytime. Night time visibility at the ROS is sometimes hampered by the proximity of apron and ramp lights.

c. Instrumentation (Figure 5): The transmitter AN/TMQ-11 Temperature/Humidity Measuring Set is located on the landing field 200 feet west of the inside runway (35R - 17L) and between the two center east-west taxi strips. The indicator for the AN/TMQ-11 is located inside the ROS cab. The AN/GMQ-11 Wind Measuring Set transmitter is located 220 feet due west of the AN/TMQ-11 transmitter. The recorder for the AN/GMQ-11 is located inside the ROS cab with additional non-recording indicators located in the BWS, RAPCON and the control tower. The AN/GMQ-10 Transmissometer complex is located about 1300 feet northeast of the approach end of runway 35L with a 500 foot baseline. The AN/FMN-1 Runway Visual Range

Computer (a computerized readout of the AN/GMQ-10), as well as a recorder for the AN/GMQ-10, are located in the ROS cab. The AN/GMQ-13A ceilometer detector is located 3570 feet south of the approach end of runway 35L and the projector is located 400 feet south of the detector. The elevation of this complex is 32 feet lower than field elevation, but this difference is accounted for by the observer when he measures cloud heights. The indicator for the AN/GMQ-13A is located inside the ROS cab. A standard eight-inch (ML-17) rain gage is located 50 feet east-southeast of the weather station. This gage is fairly well exposed to the west, north, and east, but somewhat sheltered by the Base Operations Building and other low buildings located 50 feet northeast, 70 feet southeast, and 80 feet south. A barograph, ML-563A/UM, and altimeter (aneroid) ML-102 are located in the ROS. An ML 512/GM mercurial barometer is located in the BWS.

d. Radar: The radar equipment in operation at Det 15 is the AN/FPS-77 Storm Detection Radar. Its antenna, RTM unit and 70 foot tower are located 400 feet south-southeast of the weather station. Its radial extent of coverage is excellent except for a narrow 1° "blind spot" to the east (probably caused by the water tower). The console for this radar is located inside the forecasting section of the weather station and is so situated that its PPI scope is visible to pilots being briefed.

e. Communications: The ROS has "hotline" telephone contacts with RAPCON, control tower, and the BWS, as well as a class "C" telephone with an unlisted number. The ROS also has a send-receive electrowriter with connections to the BWS, Base Operations, control tower, Command Post, RAPCON, 3575th PTS, 3576th PTS, and Det 14, 43 ARRSq. The electrowriter in the BWS is also send-receive unit with communications to all aforementioned agencies including the ROS. The ROS also has an intercom connecting it with BASOPS, BWS, and the Command Post. In addition to the aforementioned electrowriter linkages, the BWS has intercom communications with Det 14, 43 ARRSq; Stan Board, the ROS, 3575th PTS, 3576th PTS, Command Post, Base Operations, DCO, and Transient Alert. The BWS also has "hotline" telephone contacts with the Wing Commander, Control Tower, RAPCON, ROS, 3575th PTS SOF, 3576th PTS SOF, and the civilian T-41 contractor located at Woodring Airport. In addition, the BWS has a dual "hotline" telephone on the radar console connecting it simultaneously to 3575th PTS and 3576th PTS for transmission of RAREPs and hourly sequences. Teletype communications include: Comet I (receive), located in the forecaster's counter in the BWS; Comet I (send) located in the ROS; and Comet II (send-receive), Comet III (receive), and 8030 located in the communications room adjacent to the forecast section in the BWS. Two NAFAX receivers are also located in this room.

II WEATHER CONTROLS

1. Major Synoptic Features:

Vance AFB, Oklahoma, is located near a region of very frequent cyclogenesis. This is particularly true in the months November through May, when many strong cyclonic storms develop in SE Colorado, NE New Mexico, SW Kansas, or the Texas-Oklahoma panhandles. This factor, caused by the induced troughing in the lee of the Rocky Mountains, makes long-range forecasting at Vance AFB very difficult. These cyclonic storms usually form as lows or troughs in the aforementioned region, well ahead of a frontal or trough system and remain stationary and continue to develop until the parent system catches up with it. Once developed, these storms usually move rapidly due east through Kansas or Oklahoma, then northeast toward the Great Lakes (See Figure 4).

Vance AFB is also located in a region of frequent severe thunderstorm development in the months March - June and in September and is near the southwest end of what meteorologists often call "tornado alley" (See Figure 6). The most persistent airmass in this area is of tropical origin. This is particularly true in the summer and early fall when the Bermuda ridge is strongly developed into the Gulf coastal region and the thermal low is developed over Old Mexico and the southwestern United States. Even in mid-winter, when the air mass near the surface often is of polar origin, it is frequently shallow with a tropic airmass immediately over it. Surface winds at Vance when a tropic airmass is present are usually southerly. An easterly component of this southerly

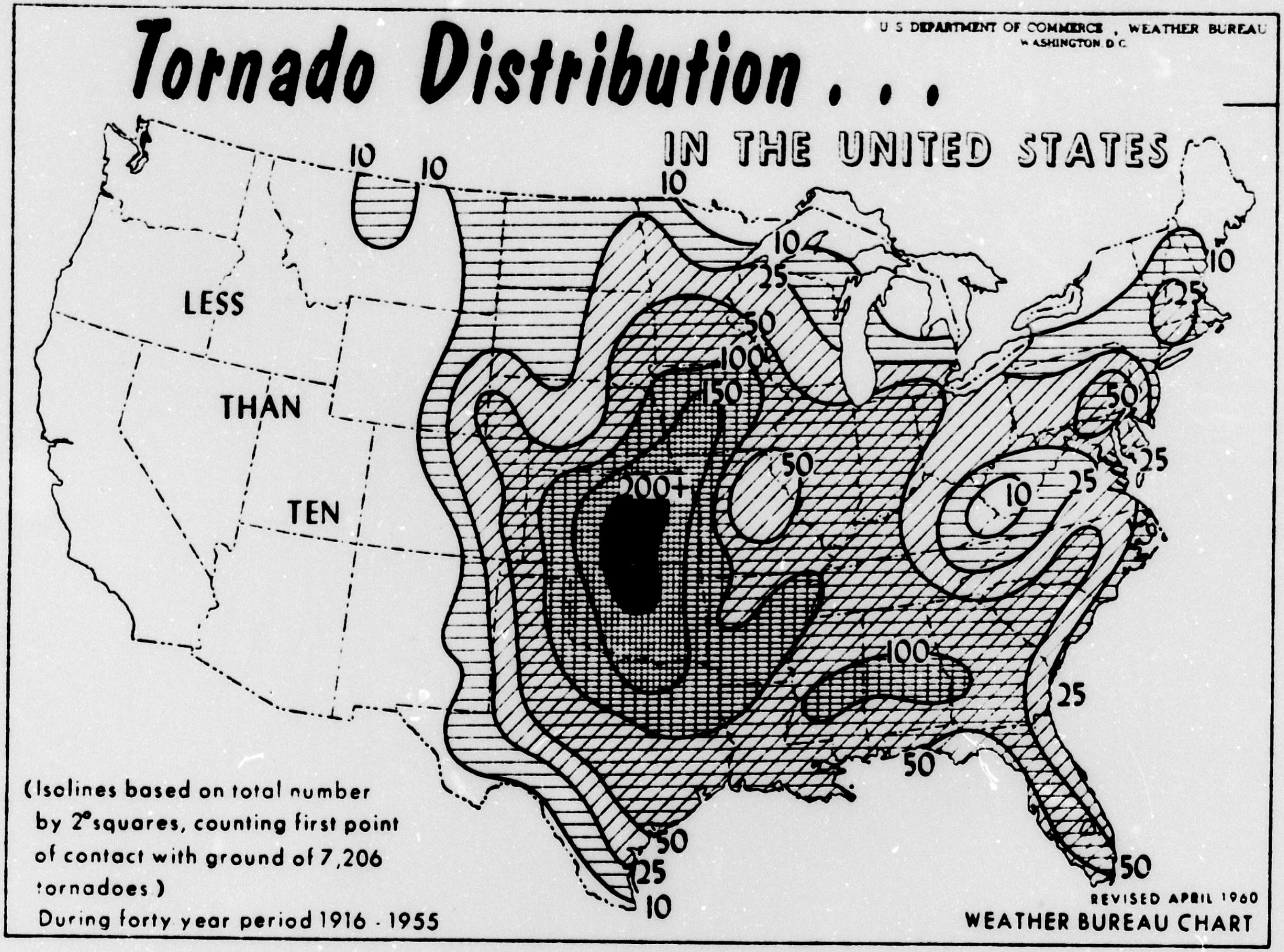


FIGURE 6. - TORNADO DISTRIBUTION IN THE UNITED STATES

wind tends to advect Gulf moisture and a moist Maritime Tropic Airmass usually prevails. At such times, fog, low stratus, precipitation, and thunderstorms (especially in spring - early summer and in early fall when approaching fronts and troughs create pre-frontal squall lines) become more likely. A westerly component on this southerly wind, especially in the summertime, often (but by no means always) advects a dryer Continental Tropic Airmass into the Vance AFB area, bringing with it dry, fair weather.

From August to March, the surface water of the Gulf of Mexico is much warmer than the ambient overriding air. As a result, airmasses with a trajectory over the Gulf during these months gain considerable moisture in their lower levels. When southerly winds move these airmasses inland over cooler land surfaces they become stabilized, producing fog and low overcast stratus which, as was previously stated in Section I, Para 2a., often advects into this area.

Many of the Continental Polar cold fronts (excepting those of moderate or greater strengths) which move into this area southeastward down the eastern slope of the Rockies (refer to the "funnel effect" Section I, Para 2b.) display a pronounced diurnal effect in their movement. They generally slow down during the period of daytime heating and speed up at onset of nighttime cooling. This diurnal variation can also be seen on east-west oriented quasistationary fronts in Oklahoma or Kansas. During the period of heating, these fronts sometimes tend to move northward, possibly due to frictional effects of the overrunning south winds, and advance southward during nocturnal cooling, possibly due to cold-air drainage from mountain slopes.

At Vance, Continental Polar (cP) frontal passages are often preceded a few hours by Maritime Polar (mP) frontal passage. Since the Rocky Mountains usually dry out these mP airmasses below 10,000 feet before they move on to the Great Plains. This means that Continental Polar frontal passage usually takes place in dry air and little more than a wind shift accompanying its passage. The northwest flow aloft that often accompanies such a passage helps to keep things dry. Sometimes, however, Gulf moisture gets drawn around the east side of the low accompanying the front, overruns the shallow frontal surface, and follows the front into the Enid area in the form of low stratus and, sometimes, fog. (Example VI, page II-32).

Because of its inland position, tropical storms and hurricanes seldom affect the weather at Vance AFB. Occasionally, however, a hurricane or tropical storm will make landfall on the Gulf coast of Texas or the west coast of Old Mexico. The disturbance then usually moves inland as a well-developed but weak and localized low-pressure center at the surface and a larger-scale disturbance aloft. In the case of the storm coming ashore on the Texas Gulf coast, this disturbance will be accompanied by low ceilings and locally heavy rainfalls. Winds, however, will be negligible, having spent their fury when the storm makes landfall and the storm will generally show up only as a small-scale cyclonic circulation. If a storm makes its landfall on the western coast of Old Mexico, it will display similar characteristics after crossing the mountains of Mexico, except that it shall not be accompanied by low ceilings or locally heavy rainfall unless low-level moisture is already present in the area east of the mountains.

When warm air at the mid levels enters the western United States from the Pacific High, part of it breaks off in Idaho, Nevada, Utah, western Colorado, or northern Arizona as the Great Basin High. This air then stagnates and settles into this "basin" and acts as a block to MP fronts coming in from the Pacific. Such fronts still move inland but are kept at higher latitudes and, consequently, do not often affect the Vance area. When this High is present, Vance weather tends to be quite good. When a cold airmass does penetrate this High, it breaks down and fronts are able to move directly into this area once again.

A low aloft over the coast of southern California, creating southwest flow aloft over Oklahoma, (a not uncommon situation in winter or spring) often brings middle and upper level moisture into the Vance AFB area. When a shallow cP airmass is present at Vance and/or when southerly flow brings in low level Gulf moisture, several days of light rain or snow and low ceilings and visibilities will result. The precipitation is heavier if the low aloft is slow moving. If a shallow cP airmass is present over Enid in the wintertime in such a slow low situation, freezing precipitation may result. If this low moves rapidly, little precipitation may be expected. Such fast-moving lows are usually accompanied by a fast-moving MP cold front.

It is noteworthy in Figure 20 that the months of greatest rainfall accumulation are April - September. This is also the period of greatest thunderstorm activity. In this period, approaching frontal systems often trigger a great deal of thunderstorm activity in the form of pre-frontal squall lines. In the remainder of the year (October - March), most precipitation is caused by overrunning of shallow cP airmasses lying over the Great Plains, either from the Gulf of Mexico at lower levels (below 10,000 ft), or from the Pacific Ocean at middle and high levels (above 10,000 ft), or from both sources.

As Vance AFB is located in a relatively dry subsoil region, nocturnal evaporation from the soil is weak. Therefore, radiation fogs at Vance are infrequent and of short duration, usually burning off by mid or late morning. Fogs associated with fronts, on the other hand, are fairly persistent, and, in the wintertime, rather frequent. These occur, usually following a slow moving cold front, ahead of a warm front, or north of a quasistationary front. Thus the visibility at Vance AFB is not as much of a problem as at other bases, averaging 10 miles or more 82.5% of the time.

The following is a more seasonal breakdown of the weather controls at Vance AFB.

2. <u>Fall Weather Controls</u>:

Fall is generally a period of transition from summer to winter and may properly be divided into two periods: early fall (September through early October) and late fall (mid October through November).

In the early fall, summer-type weather still predominates in the Vance AFB area with prevailing tropic airmasses, light southerly winds, hot temperatures, cumuliform clouds, forming late morning and dissipating around sunset, and an occasional airmass thunderstorm. However, in this period, the Bermuda high begins to retreat eastward, allowing mP and cP outbreaks into this area to become more numerous and to penetrate further south into Texas. Due to this increased frontal activity and the high moisture contents of the prevailing mT airmasses, thunderstorm activity, including the more severe variety, increases in the month of September. Also, due to the increased frontal activity, is an increase of the average wind velocity at Vance.

In the late fall, mP and cP airmasses become more prevalent and thunderstorm activity is inhibited, except when associated with the stronger frontal systems. Severe thunderstorm and tornadic activity drops sharply and remains negligible through mid March. In this period, frontal systems become stronger, move more rapidly, and, especially in November, can have very strong surface winds associated with them. Such systems, moreover, tend to have increased blowing dust and turbulence hazards associated.

One type of predominant frontal system in the fall (and occasionally in springtime) is a mP front which enters the United States from the Northwest and approaches this station from the northwest, oriented northeast-southwest (Figure 7). The parent low of such a system will usually travel across southern Canada or the northern part of the United States. This front rarely produces more than high or middle cloudiness. However, when the airmass ahead of the front is sufficiently moist and unstable, these fronts will set off squall lines through this area. The problem at this station is to determine if the squall line will develop east or west of this location. Winds ahead of these fronts will switch to the southwest before frontal passage, usually bringing in dryer air from the Texas Panhandle. In situations of this sort, the squall line will form east of this station, even though moist air may have been present a few hours before frontal passage. Close observation of the Amarillo and Tinker RAOB's will help determine whether advection of dry air from the Texas Panhandle will prevent thunderstorm formation to the west. Another indication of dry air advection will be rapidly dropping dew points with the southwest winds. Should these winds have peak gusts of thirty-five knots or more, depending on current soil conditions downwind, moderate blowing dust is possible. If this situation exists, frontal passage will bring only a wind shift and improving visibilities. (Example I, page II-17).

Fog and stratus due to moisture advection from the Gulf is not too common during the early part of this period. As the season progresses, however, it becomes more frequent and persistent. If, as was mentioned in the introductory portion of this section, this stratus gets drawn around the eastern side of a low pressure center on a cP front approaching from the north or northwest, the moist air comprising this stratus will overrun the shallow frontal surface and will follow the front into the Enid area in the form of low stratus and fog. This is a rather common fall and wintertime situation. (Example VI, page II-32).

Perhaps the most important feature, however, of fall weather is that it is generally considered the most pleasant time of the year, both for human comfort and for flying operations. This is due, primarily, to a tendency of long-wave ridges aloft to remain west of this station and the long-range trough aloft to remain east of this station. Perhaps the greatest problem, from the forecaster's standpoint, is in adjusting from forecasting diurnal variations of a persistent airmass to forecasting a more dynamic situation in which the airmass changes much more frequently.

3. Winter Weather Controls:

Aircraft hazards during this period include icing, low ceilings, and low visibilities due to fog, rain and snow.

By early winter, polar outbreaks have become quite common with the result that cP air or one of its modifications is the prevailing airmass over this area during the winter months. Occasionally, mT air will invade the region behind a retreating cold front resulting in periods of unseasonably warm, humid weather (Figure 9).

A common frontal type during this period is one which moves through from the west oriented north-south (Figure 8). The low associated with this front will usually move through southern Canada or the northern part of the United States. These fronts become ill-defined over the mountains and may be followed best on the 850 and 700 mb charts. As they pass the lee side of the Rockies, however, the front becomes more apparent at the surface. The forecaster must watch situations of this sort very closely because the front will move eastward rapidly once it has passed the mountains.

Weather associated with this front will usually consist of south to southeast winds, low ceilings, and rain showers, or, on rare occasions, thunderstorms, as the front moves into this area. Frontal passage will bring a wind shift and rapid clearing (Example II, page II-19). Fronts of this sort often set off a squall line west of this station providing the airmass ahead of the front is sufficiently moist and unstable.

Fronts of this type which pass this station nocturnally will often produce the following weather in the one-or-more-day period ahead of it: Stratus and fog due to moisture advection from the Gulf will form during the morning, gradually lifting and clearing from the west in the afternoon and forming again rapidly at dark. There will be no precipitation and rapid clearing will occur after frontal passage.

Lows frequently develop along the lee of the Rockies in advance of such fronts, or as they move into the lee side trough (Figure 9). This low will cause strong southerly winds and rapid moisture advection from the Gulf into this area. If these south to southeast winds persist long enough, low stratus will move into this area prior to frontal passage. These low ceilings may be forecast by watching the moisture advection through stations in southern Oklahoma and northern Texas. This low usually forms, as was mentioned in the introductory portion of this section, in southeastern Colorado and moves east-northeast or east-southeast, passing just north of or right over this station. In a situation such as this, there will generally be low cloudiness accompanied by rain showers, or even, occasionally, thunderstorms, with frontal passage, followed by rapid clearing and west to northwest winds. This clearing, however, is normally only temporary as the low stratus associated with overrunning on the frontal wave advects into this area, often following the passage of a secondary front, only one to five hours after frontal passage. The stratus (occasionally bearing light precipitation) will persist in this area until the low center moves sufficiently far to the east (Iowa, eastern Missouri, southern Illinois, and eastern Arkansas). This persistence is especially true if the low passes south of Enid and/or moist Gulf air has been advected to the east of the low (Example VI, page II-32). This is the same type of low which, if intense enough, can produce low visibilities due to blowing dust and very strong winds. If the forecaster is to receive warning of dust-reduced visibilities at this station, he must monitor stations in the Oklahoma-Texas panhandle.

Another situation which closely parallels the above is that of a low moving into the United States on the southern California coast, traveling across Nevada and New Mexico into the southwestern plains states (Figure 10). A low such as this is often associated with a very deep trough aloft over the western coastal states which makes forecasting its involvement very difficult. These systems may sit over southern California as long as a week before moving eastward.

As with the aforementioned front, these lows will become very diffuse over the mountains, but upon passing the eastern slopes will reform and move eastward rapidly. The problem of the forecaster at this station is to predict the path of a low once it moves east of the Rockies. If the low moves through northern Texas or southern Oklahoma, weather is about the same as that of a Colorado low moving south of this station, consisting of low ceilings and moderate to heavy precipitation. Should the low move through southern Texas in the Brownsville area, this station is usually on the edge of the precipitation, receiving only middle clouds (Example IV, page II-32).

A system which occurs quite frequently during this period is that of a cold front entering the United States through Montana and moving rapidly southward (Figure 11). (In the sample shown, the front moved rather slowly, but it was a very strong system of the type that occur only about once a winter, but bring the coldest temperatures of the year with them. Most other fronts of this type are weaker but more rapidly moving.) Situations like this usually occur when a 500 mb low or minor trough moves across the northern United States (Figure 12) and a large, strong polar high is situated in western Canada (Figure 11). As the low or wave moves into the Dakotas, the front begins moving southward with a speed, depending on the degree of northwesterly flow behind the wave aloft, as fast as forty knots. Weather with such fronts generally consists of middle and high clouds, due to the fact that there must be north to northwesterly flow aloft over the central plains in order for them to break rapidly southward. This northerly flow cuts off Gulf moisture with the result that the airmass over this region prior to frontal passage is very dry. Strong northerly winds and rapidly falling temperatures will follow these fronts. If it has been an extremely dry year, moderate blowing dust can be expected for a short time immediately after frontal passage. Visibilities in northern and western Kansas should be monitored for reduced visibilities. If, however, northerly to northwesterly flow is not occurring aloft, and this was the case in the example shown (Example V, page II-24). (In this case, southerly to southwesterly flow existed ahead of the cutoff low in eastern New Mexico, bringing in a great deal of overrunning at lower levels), and moisture is existing at lower levels, this system is preceded and followed by low ceilings and fog and sometimes by light precipitation. Behind such a front, there may also be a band of freezing precipitation and/or sleet. A great deal of snow can also be produced by such a system.

A much-dreaded situation is the stalling out of this type of front after passing this station, but before reaching central or south Texas (usually the San Antonio-Austin area) caused by southerly or southwesterly flow persisting aloft (frequently from a low aloft over the southwestern states or over northwest Mexico). When this occurs, moist flow from the Gulf of Mexico usually exists at lower levels overrunning the frontal surface. In addition, such a situation usually produces easterly or southeasterly surface flow in this area. With the addition of the Gulf moisture, this will produce persistent fog and stratus and possible light drizzle with very low ceilings and visibilities. If the frontal inversion is very strong and surface temperatures are below freezing, sleet or the dreaded freezing drizzle may result. In January, 1969, this fog and stratus persisted five days in a row and occurred in thirteen out of sixteen days in such a situation. The following January, about the same thing happened and low ceilings persisted for a week.

Small perturbations will usually form on the stationary front causing precipitation in this area. When a low develops on such a front in the Texas panhandle and moves eastward through northern Texas or southern Oklahoma, this station will receive extremely heavy precipitation. The forecaster must constantly monitor systems of this type because frontal movement of only a few miles may greatly affect the weather at this station.

After passage of a cP outbreak cold front, even when southerly or southwesterly flow does not exist aloft, if the cP airmass is extremely cold, instability clouds around 1500 ft AGL, caused by the rapid movement and mixing of cold air over warm ground will follow the front into this area. Forecasting such clouds is quite difficult, and the forecaster should watch stations in Kansas for their appearance prior to moving into this area. Precipitation occurring under these conditions is usually very light, consisting of snow flurries.

If a cP outbreak enters the United States through North Dakota or eastward, the main push of cold air will be to the east of this station. These fronts will sometimes back into this area from the northeast, but there is little weather associated with them.

4. Spring Weather Controls:

Spring is a season of strong winds, dust, and violent thunderstorms. During the early and into the middle part of this season, the Bermuda high has not yet become well established over the southeastern states, and cold fronts will move through this region fairly strongly. As the season progresses into the last half, however, the Bermuda high becomes stronger, and cold fronts begin to move very erratically through this area. For this reason, spring is perhaps the most difficult season of the year, so far as forecasting is concerned. In the early spring the cP outbreak from the north is still fairly common, bringing periods of very cold weather and occasional snow or sleet. As the season progresses, the cP outbreaks gradually give way to mP fronts moving in from the west or northwest. The Colorado low will become very intense, especially during the latter part of February through March, creating strong, gusty surface winds from the south or south-southwest and such related hazards as low-level turbulence and possible blowing dust.

Weather with these systems is much the same as has previously been discussed in the fall and winter seasons, except that thunderstorms occur much more frequently and tend to be more violent. This is because the airmasses of the northern hemisphere are being heated up. Most of this airmass heating takes place in the lower levels, especially in the proximity with the earth's surface. Therefore, airmasses tend to be a good deal more unstable. Additionally, springtime brings greater influxes of air from the Gulf of Mexico so that warm, moist air is more frequently present in this area ahead of frontal systems or disturbances aloft. During this season, the forecaster must remain continually aware of such things as: the lifted index, the existence, position, and movement of the dry line (also known as the "dew-point front" or "Marfa front"), Small-scale waves on a frontal system; the intersection of a squall-line (this can mean either an instability line or a line of thunderstorm down-rush wind shifts) with a front; and, most important, any weather detected by the AN/FPS-77 radar.

Fog and stratus are also a problem during early spring, but become very rare during the latter part of this season.

The frontal and pressure systems that occur in the spring are very similar to those that occur in the fall. For a further discussion on these systems, read the section on Fall Weather Controls.

5. Summer Weather Controls:

In the summer, this area is almost entirely dominated by the Bermuda high, causing extremely hot days and warm nights. The prevailing cloud form is cumulus. These form in the late morning (1600 to 1700Z) and dissipate at sunset. Height and cloud cover may be forecast by use of the Skew T log P diagram. Using the Tinker RAOB, find the CCL and read the temperature where the dry adiabatic through the CCL intersects the surface isobar. If the maximum temperature of the day is forecast to exceed the temperature taken from the Skew T log P, then cumuliform clouds should be forecast with bases at the height of the CCL. These clouds are generally scattered, but occasionally go broken for short periods of time. Should they become overcast, dissipation will not be complete at sunset and there is a good chance of scattered thunderstorms developing around 0300Z.

Cold fronts that approach this station during the summer generally become stationary. The front will frequently remain north of this station during the day and move southward at night as the usual diurnal decrease in the surface winds ahead of the front takes place. There may be little or no weather associated with the front in the day; however, thunderstorms may build at night when the front starts its southward movement. Indications of frontal movement may be obtained by pressure tendencies deep behind the front and considerably in advance of it. Some fronts will oscillate back and forth several times across the station before dissipating.

6. Illustrations and Examples:

a. Example I (Reference Fig 7): The front oriented north-south moved into the United States on the Pacific Coast. As the low moved across Montana and into North Dakota, the southern end lagged behind, causing it to move into this area with a northeast - southwest orientation.

Moisture in the form of clouds with bases of two to three thousand feet was pulled up from the Gulf around the west side of a high centered in Alabama. As the cloud deck moved to a point about thirty miles south of this station, the winds aloft, about one thousand feet, came around to the southwest (240 degrees) at about thirty knots. Consequently, the lower cloud deck moved southeast of here. Strong south-southeasterly winds prevailed on the surface with velocities of twenty-five knots, gusting to thirty-nine. Visibilities were restricted for a time to five miles in locally blowing dust. The frontal passage brought only nine thousand foot ceilings and shifting winds, however, low ceilings and drizzle prevailed from Oklahoma City southeastward until frontal passage.

Although this system moved through in January, it is a very good example of fall systems. This is also a good example of the fact that systems which occur most frequently in one season may occur at other times of the year.

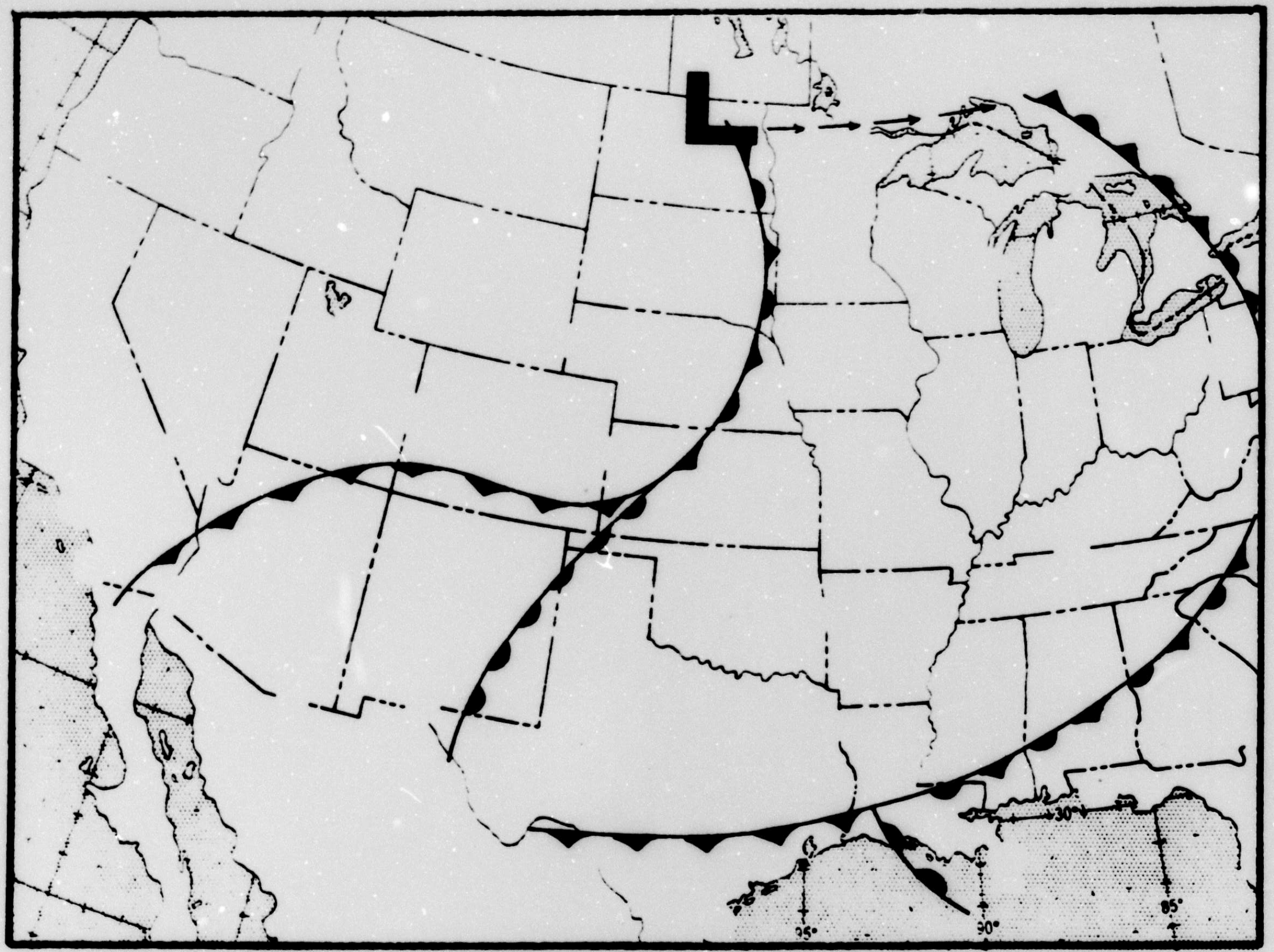


FIGURE 7. - 14 JANUARY (YEAR UNKNOWN) AND 24 HOUR FRONTAL MOVEMENT

b. Example II (Reference Fig 8): The front in this example moved from the west coast through this area with an almost straight north-south orientation. The low entered the United States through Washington and Oregon moving southeastward. When this low moved against the mountains, it degenerated into a trough with several weak centers; one in Montana, one in Utah, and one in Mexico. As the front moved east of the mountains, the northern-most low became predominant.

Weather associated with this front consisted of strong south winds during the day prior to frontal passage. Ceilings were generally around five hundred feet, and visibilities three to five miles in fog. These extremely low visibilities and ceilings were due to several things; a cool air mass (temperatures in the lower thirties), moisture advection from the Gulf, and moisture from a melting snow cover over this region. There was no precipitation at this station; however freezing drizzle and snow fell at Gage, Wichita, and northward through Kansas. Frontal passage brought a wind shift to the northwest and rapid clearing. The above weather is typical of this type front except that showers or thunderstorms will generally precede frontal passage.

c. Example III (Reference Fig 9): The low and accompanying front in this example moved into the United States through southern California, becoming stationary in that region for several days due to a deep trough aloft over the Pacific coastal states. As the system began to move eastward, it became very ill-defined on the surface, however, the 850 and 700 millibar charts showed the movement very clearly. Upon reaching the eastern slope of the Rockies, the low deepened rapidly and began to move

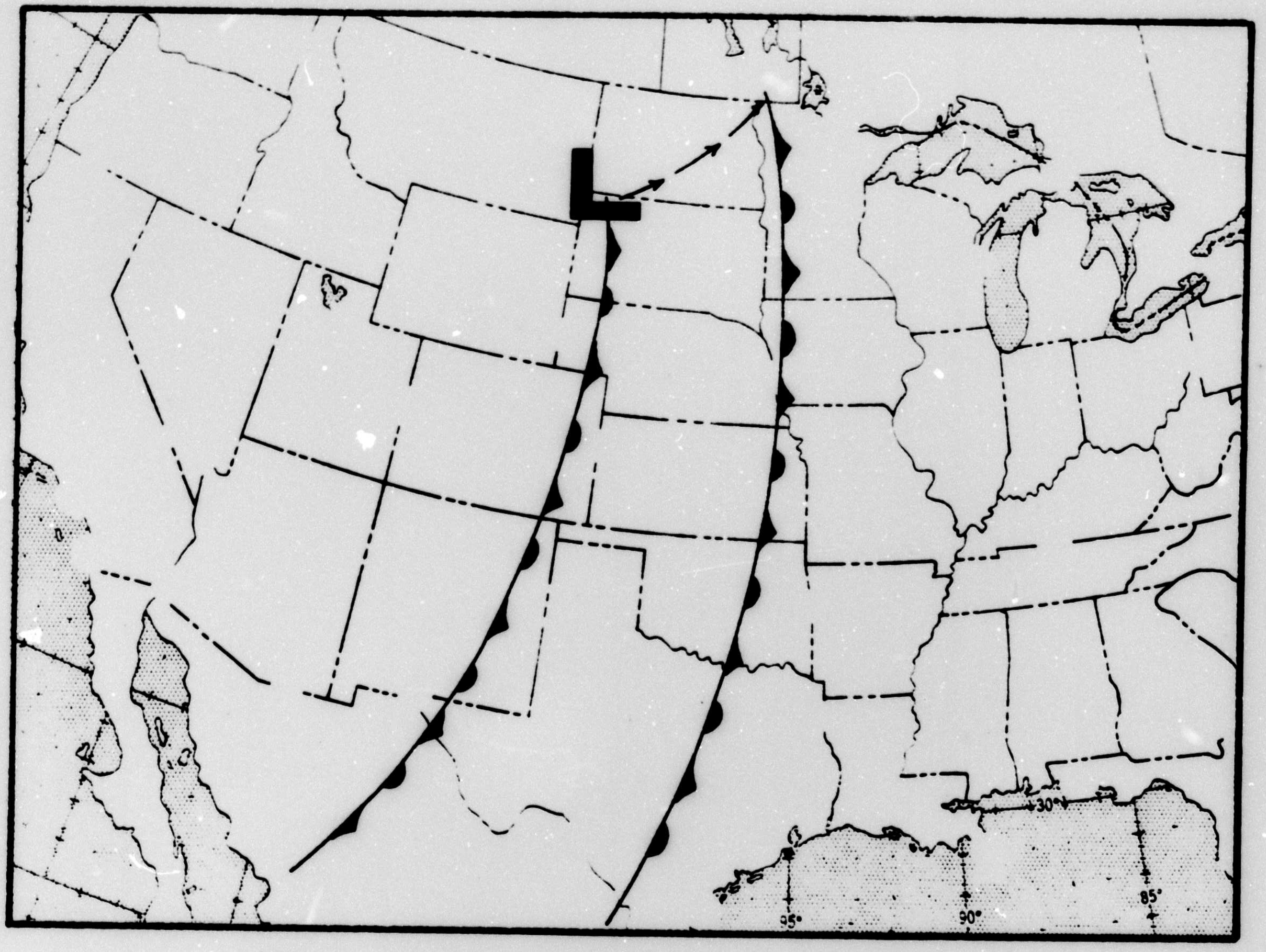


FIGURE 8. - 0630Z 20 JANUARY (YEAR UNKNOWN) AND 24 HOUR MOVEMENT

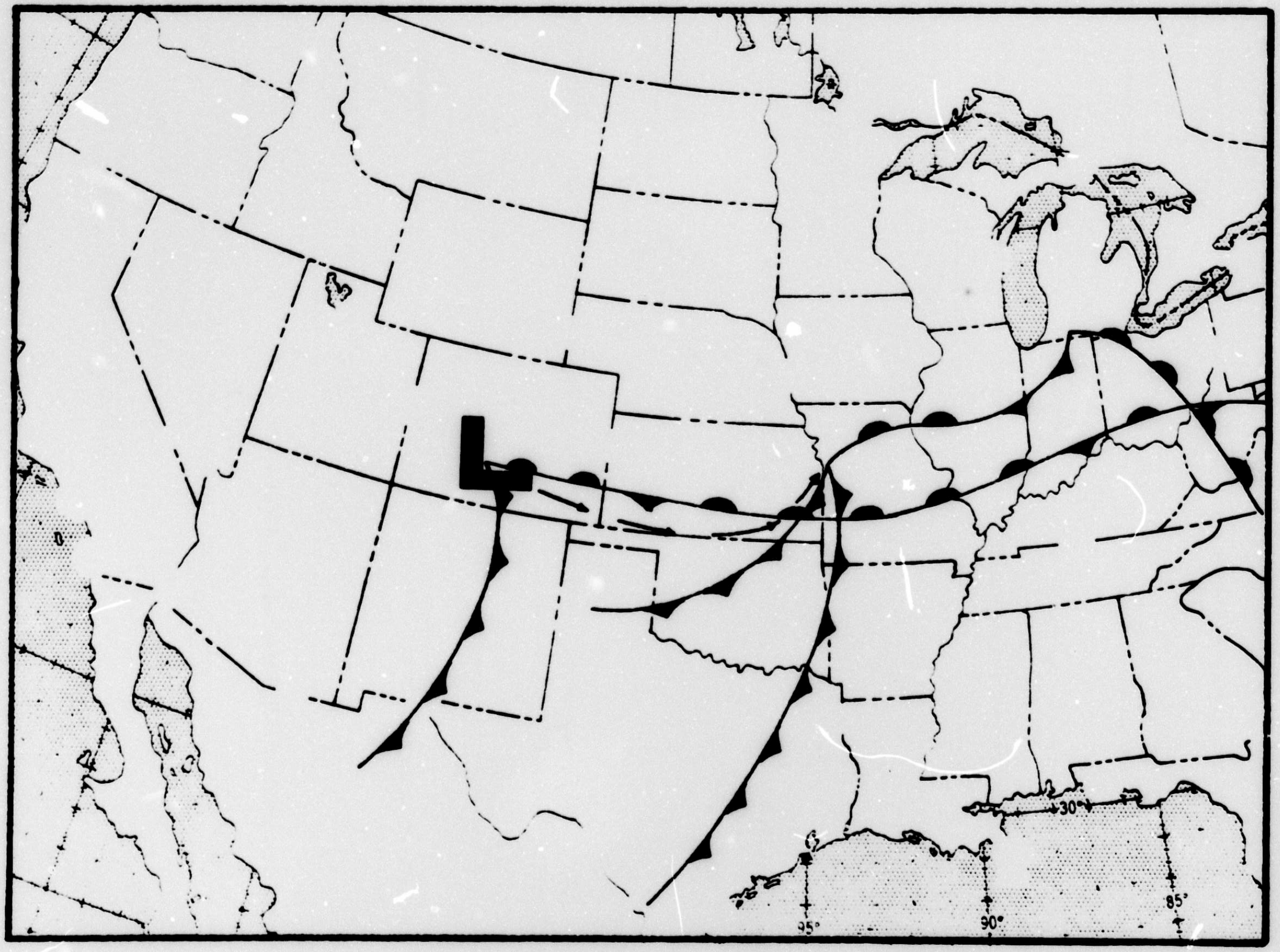


FIGURE 9. - 1830Z 4 JANUARY (YEAR UNKNOWN) AND 24 HOUR MOVEMENT

eastward in the path shown. This is not a true Colorado Low in that it moved into Colorado from the west coast; however, the behavior of this system east of the Rockies and the weather associated with it is very typical of that type of low.

Low stratus, fog and drizzle persisted throughout this region for three days prior to frontal passage due to strong moisture advection from the Gulf. Ceilings would lift somewhat in the morning, break away for a short time in the afternoon, and return at dark. A very cold cP air mass lay north of the stationary front in southern Kansas. Severe overrunning on this front caused very low ceilings with freezing drizzle and snow to persist throughout northern Kansas and Nebraska. With the passage of the mP front, this station cleared rapidly. The secondary front formed as the low moved into central Kansas. As this front moved through, winds shifted to north-northwest and became very strong, gusting to thirty-seven knots. A twelve hundred foot cloud deck moved in, gradually lowering to five hundred feet with drizzle as the trough aloft passed. After this, the ceiling gradually began to rise and clearing began as the low moved into northern Illinois.

d. Example IV (Reference Fig 10): This low moved in from the Pacific coast through southern Arizona and New Mexico. The front moved through this area from the north accompanied by severe overrunning which produced low ceilings and occasional rain and sleet showers. Although this front did not become stationary, its southward movement through central and southern Oklahoma was so slow that the weather produced was typical of a stationary front. As the low moved into the San Antonio region, ceilings

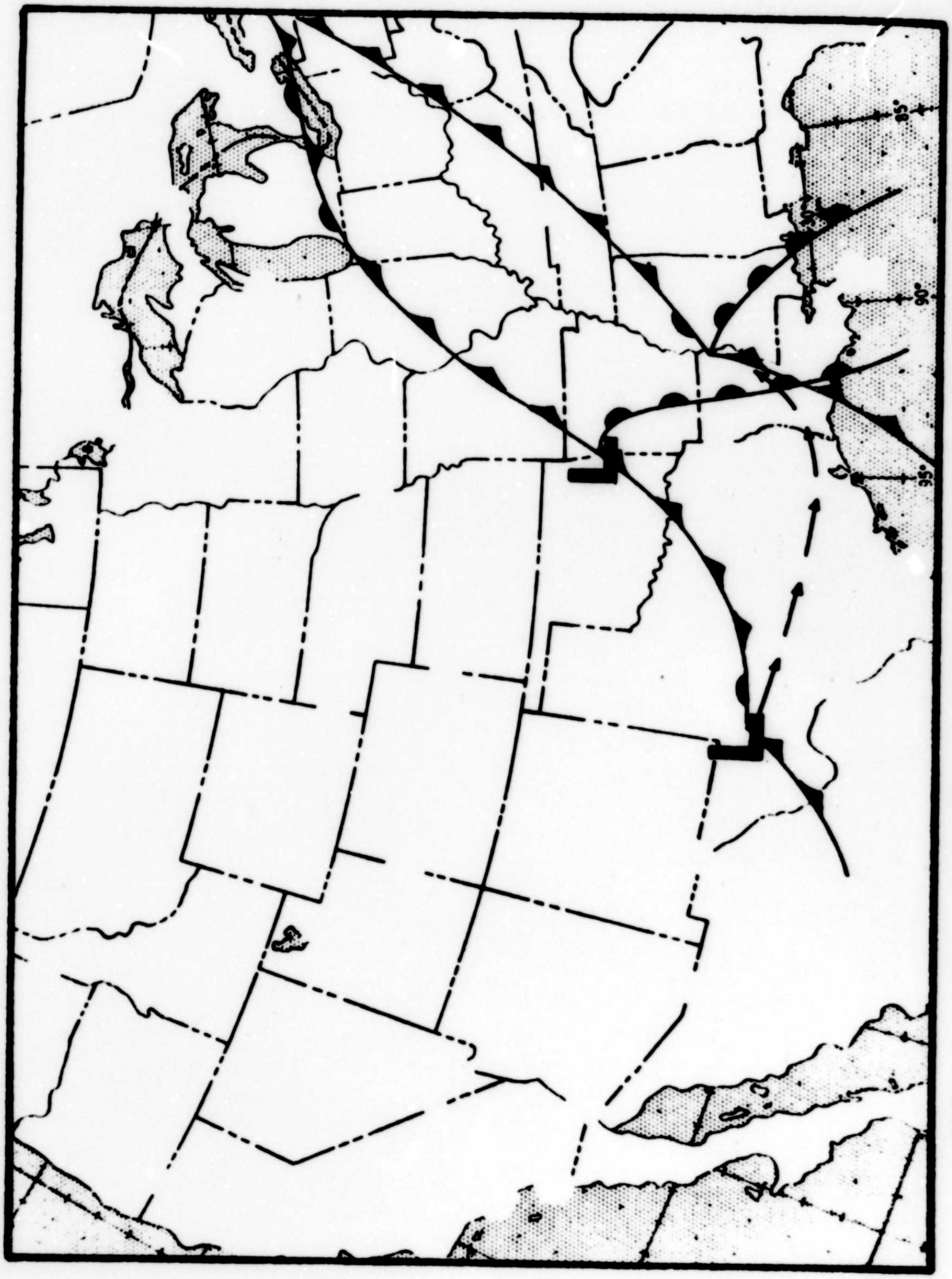


FIGURE 10. - SURFACE FRONT 0030Z 28 DECEMBER (YEAR UNKNOWN) AND 24 HOUR MOVEMENT

at this station rose to four thousand feet. However, about twenty miles south of here, low ceilings and heavy snow prevailed. When the low moved into southern Mississippi, it began to deepen rapidly because a trough aloft which had been lagging along the lee side of the Rockies suddenly moved eastward. The ceiling lowered to four hundred feet, and visibility dropped to one mile in heavy snow. This station was right on the edge of the snow and received only one inch. Oklahoma City and stations south and east of here measured as much as eight to ten inches.

This example shows very clearly how the weather at this station can be greatly affected by either an upper air trough or the small movement of a frontal system.

e. Example V (Reference Figures 11, 12, 13, 14, and 15): The front along the U.S. - Canadian border (Fig 11) remained virtually stationary for about four days while the airmass behind the front continued to cool and the front intensified. The extent of this cooling of the airmass and of this intensification of the front is indicated by the very intense isotherm ribbon at the 850 mb level through British Columbia, Montana, Wyoming, and South Dakota (Fig 13). Figures 11, 12 and 13 show the situation after the intensification of the airmass high in southern Yukon and northern British Columbia had very slowly pushed the front southward into the northern plains. This movement was so gradual, however, that the front may be regarded as stationary.

A wave aloft at 500 mb (Fig 12) (the remains of a system which had earlier entered the United States on the north Pacific coast, but which had lost its identity at the surface upon crossing the Cascade and Northern

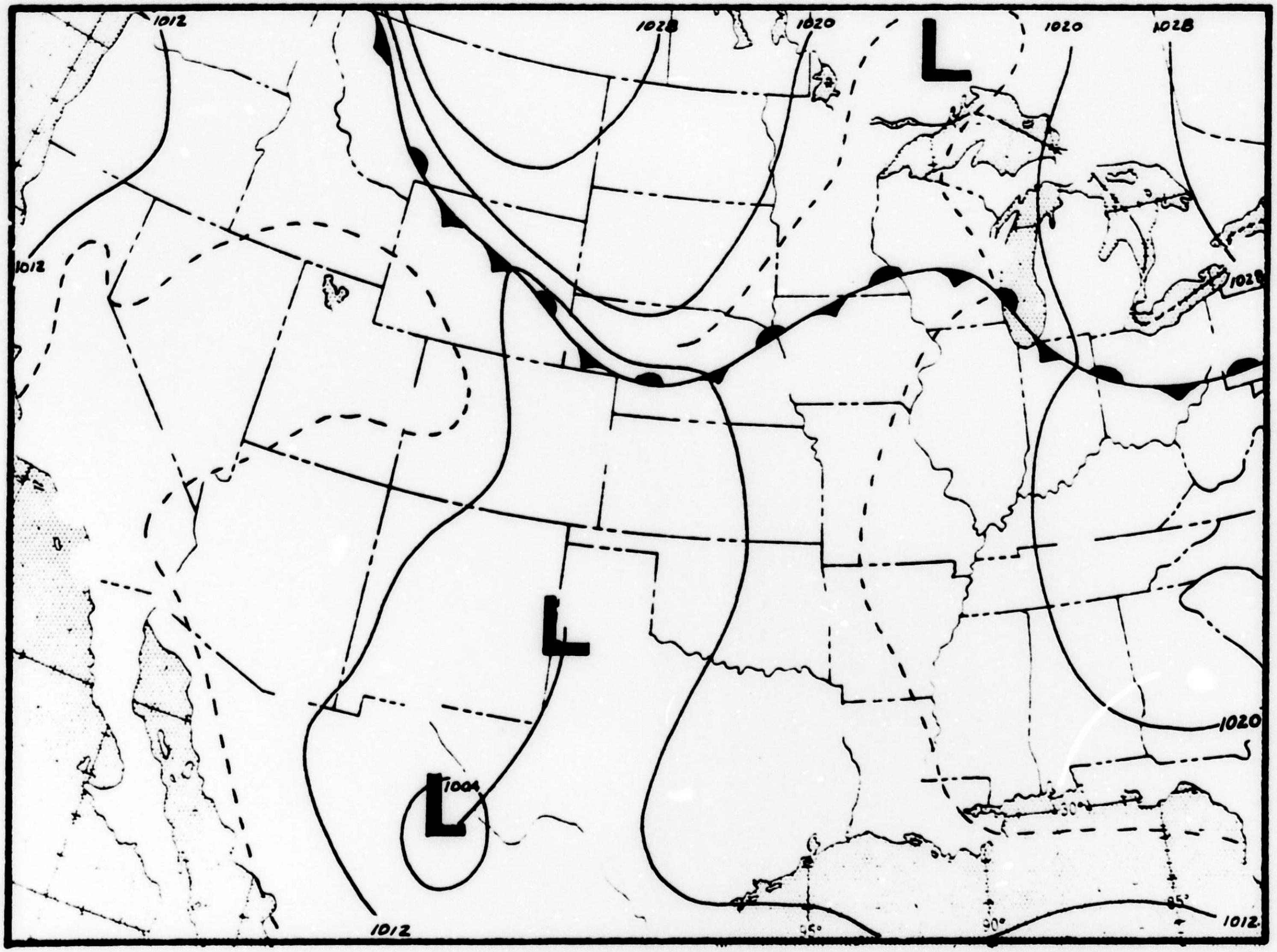


FIGURE 11. - 0000Z 16 JANUARY 1970 SURFACE ANALYSIS

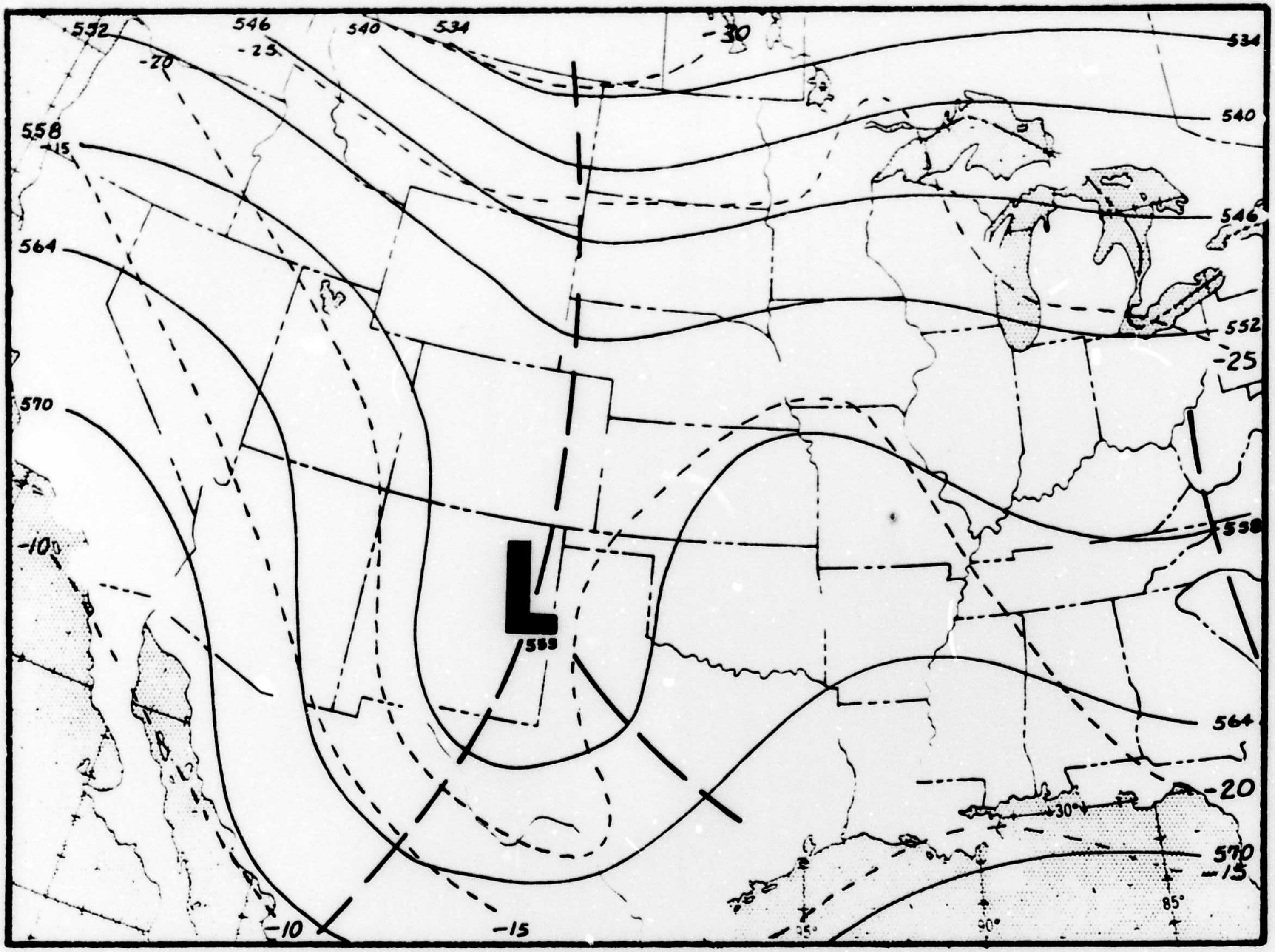


FIGURE 12. - 0000Z 16 JANUARY 1970 500MB ANALYSIS

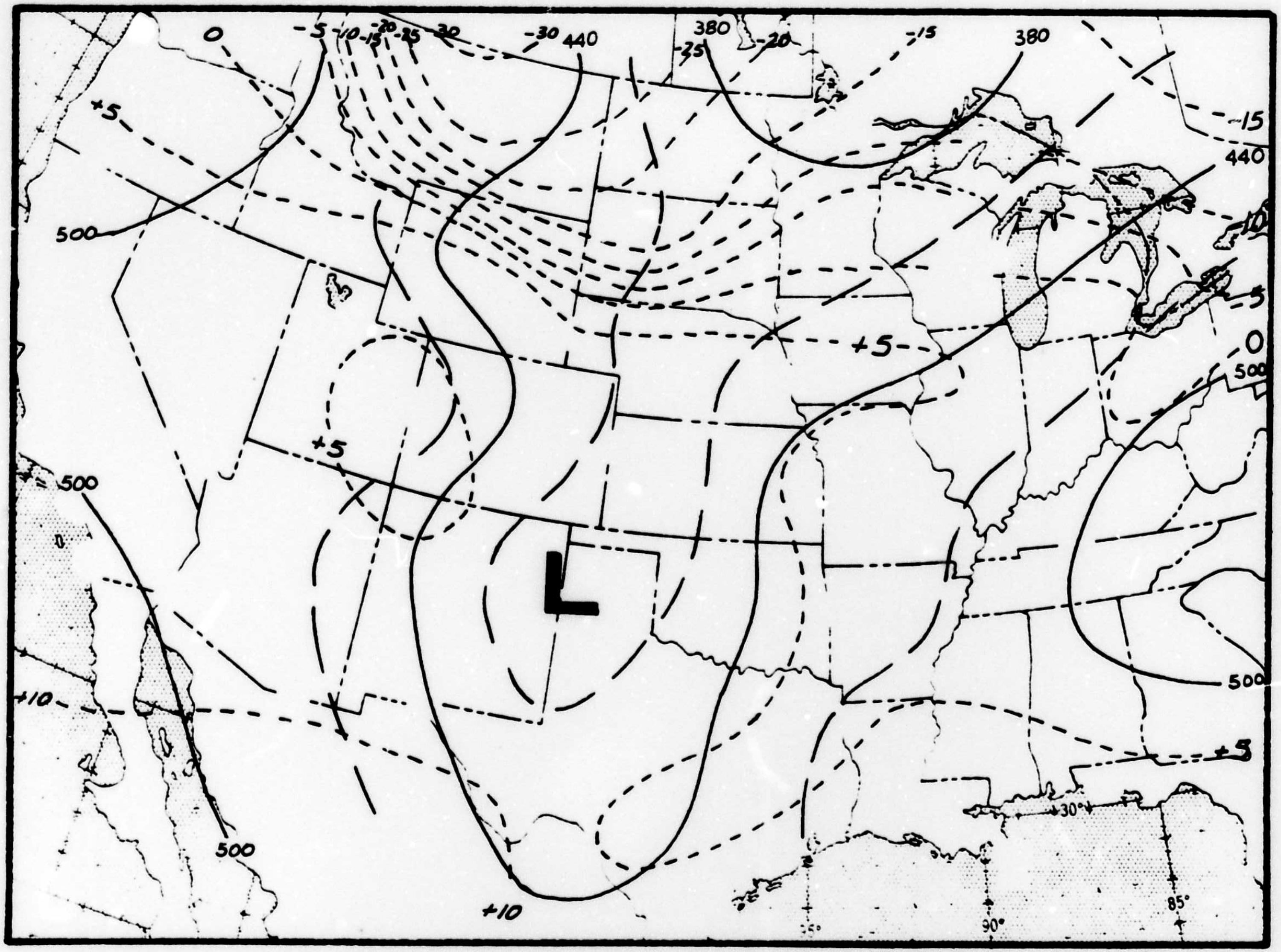


FIGURE 13. - 0000Z 16 JANUARY 1970 850MB ANALYSIS

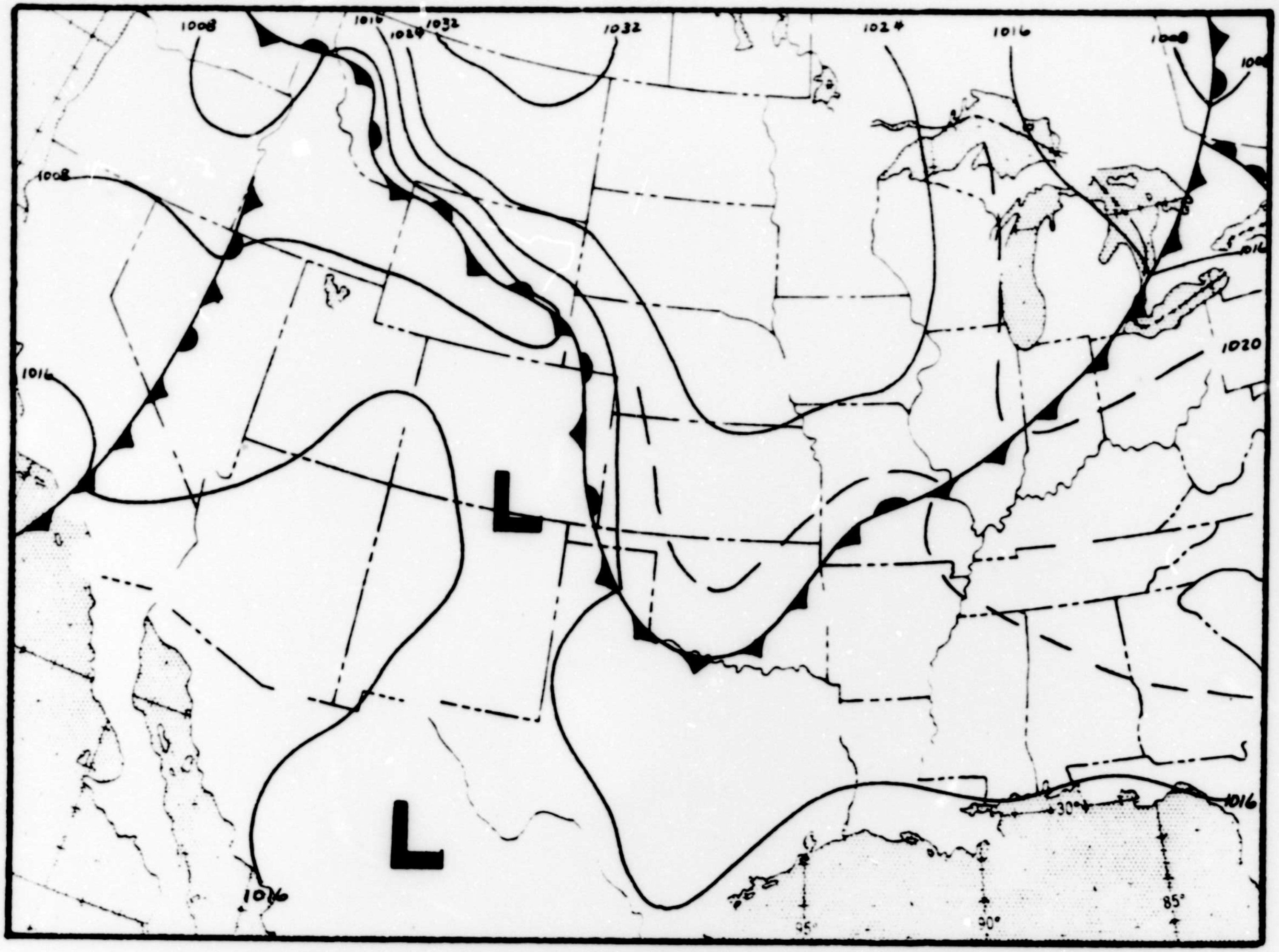


FIGURE 14. - 0000Z 17 JANUARY 1970 SURFACE ANALYSIS

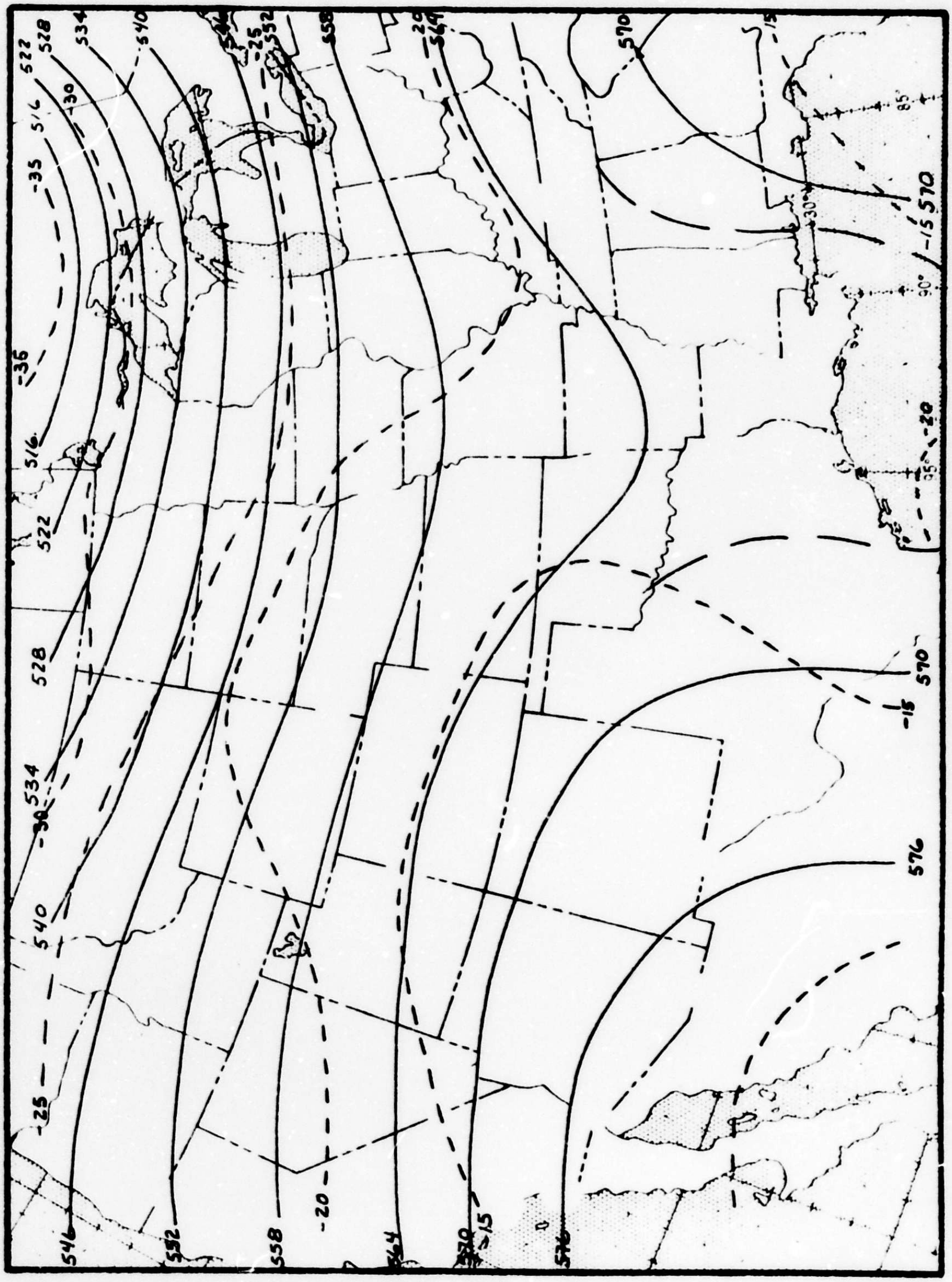


FIGURE 15. - 0000Z 17 JANUARY 1970 500MB ANALYSIS

Rocky Mountains) had entered Eastern Montana, Wyoming, Colorado, and New Mexico, and into the Mexican state of Chihuahua. The slight northwest flow that existed at levels below 500 mb over the northern plains was just enough "spur" to begin the southward movement of this very powerful airmass and frontal system.

Ahead of this front, a great deal of moisture was present in the form of low stratus and fog in the central and southern plains which had advected into this area on southerly flow induced by the low aloft over New Mexico (Fig 12). Also induced by this low aloft was a weak surface trough along the Texas - New Mexico border (Fig 11). This surface trough moved through Vance AFB ahead of the front at 1300Z, 16 Jan. The only change this created in the terminal weather, outside of the wind shift, was a gradual lowering of the ceiling and visibility from around 1000/5 to around 200/3/4 probably due to the upslope effect of the northeasterly winds behind the trough. The front passed through Vance at 1555Z accompanied by a wind shift to the north, a sharp increase in wind speed, a drop in the temperature (from 39°F at 14Z to 28°F at 18Z), a sharp pressure rise, but only a slight increase in ceiling and visibility. The stratus persisted for a variety of reasons including: the overrunning by the southerly flow ahead of the trough aloft; a slight upslope component of the northerly surface wind; PVA aloft; and instability of the very cold air overrunning the warm ground. At 2312Z, freezing precipitation, due to some of the factors listed above including the fact that the air overrunning the front was quite warm and above freezing, began and accumulated to 0.2" by 1800Z the next day.

By 0000Z, 18 January 1970 (Figs 14 and 15), the front had moved slowly past the Red River and the trough aloft had moved east of here and northwesterly flow existed aloft over Vance. The fog and stratus persisted, however, due to continued northeasterly surface wind and the absence of any overnight drying at the low levels. By mid-morning on 17 January, the flow aloft had become more westerly, allowing more overrunning at lower levels on the frontal surface and light freezing precipitation accompanied by occasional light snow grains began again. Not until the next day did levels above the front cool so that snow could occur. Due to the persistence of the front to the west and south of Vance, post frontal clearing did not occur until 21 January, and this was only a temporary condition due to a slight southward movement of the front and the post-frontal cloud band.

This weather system is typical of those that occur perhaps once a winter and bring the year's coldest temperatures with them. One important difference, though, was the presence of the cutoff low aloft to the south (Figs 12 and 15) and the failure of significant northerly or northwesterly flow aloft to persist. This might have impelled the front out of this area, or, at least, cut down on the overrunning on the portion backed against the eastern slope of the Rocky Mountains.

This weather system is also very much like the more common-type cP outbreak except that the average cP front is much weaker than this and, due to the greater northerly flow aloft, moves much more rapidly and is accompanied by little more than middle and high clouds, a wind shift, a temperature drop, and a pressure rise. This type of system is very common in the late fall, winter, and early spring.

f. Example VI (Reference Figures 10, 17 and 18): This weather situation is included as an example of what happens when Gulf moisture is advected around the east side of a low accompanying a cP frontal system. This moisture overruns the shallow frontal surface and in a short period of time, stratus has been advected into, or develops over, a large area behind the front.

This mP front, supported aloft by the 500 mb wave from Oregon to Arizona (Fig 18) passed through Vance AFB at 2043Z on 17 November 1969 while a low on the front moved through the Kansas City area (Fig 17). Gulf stratus had been advected to the east of here by the southerly Gulf flow ahead of the front (Fig 16). This moisture and stratus then overran the front (Fig 17) through Missouri northeast of the low. This stratus then advected into and developed in a large area to the rear of the front. This stratus then advected into Enid at 1438Z and persisted until mid-morning the next day.

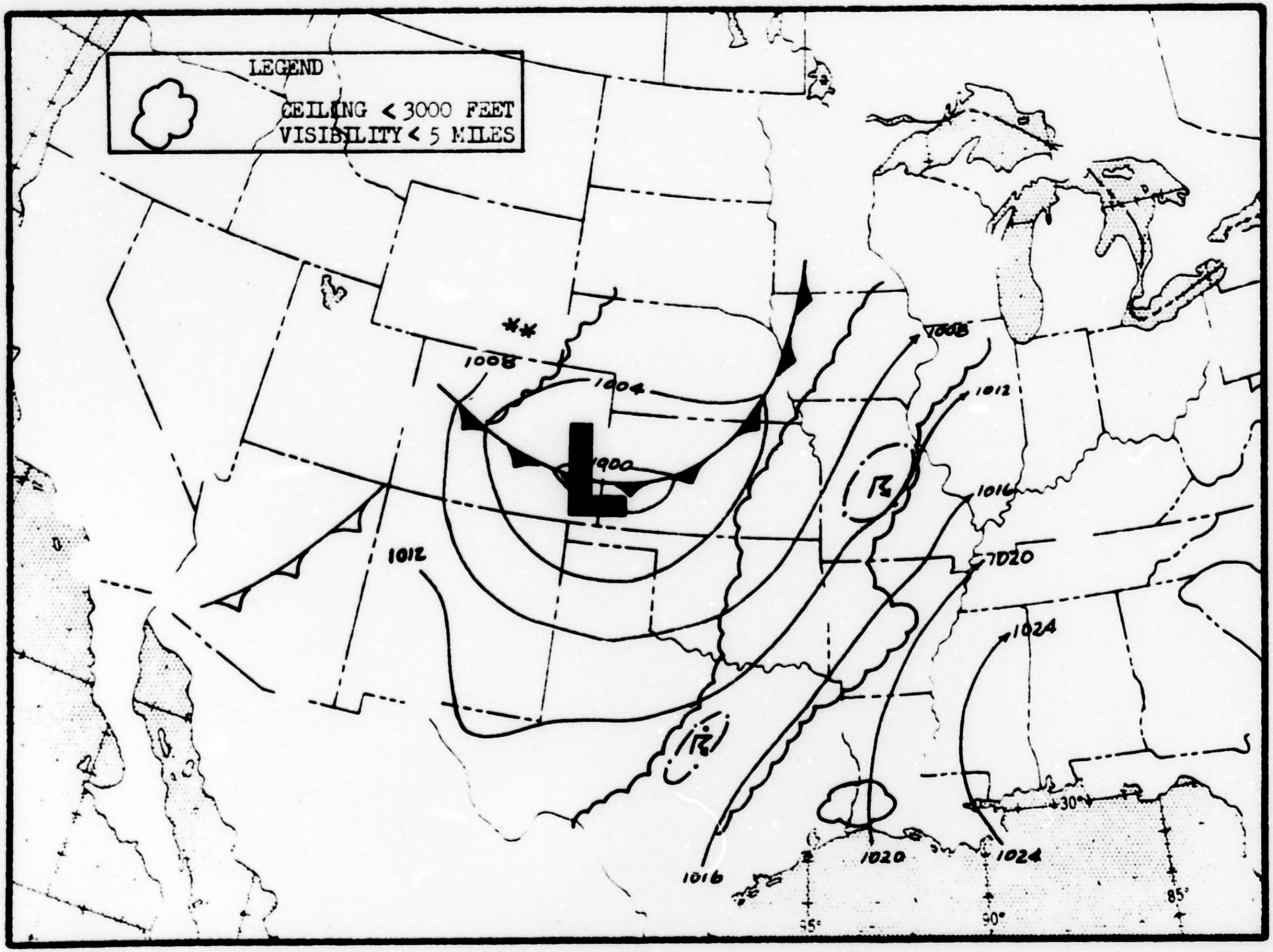


FIGURE 16. - 0600Z 17 NOVEMBER 1969 LOCAL AREA SURFACE ANALYSIS

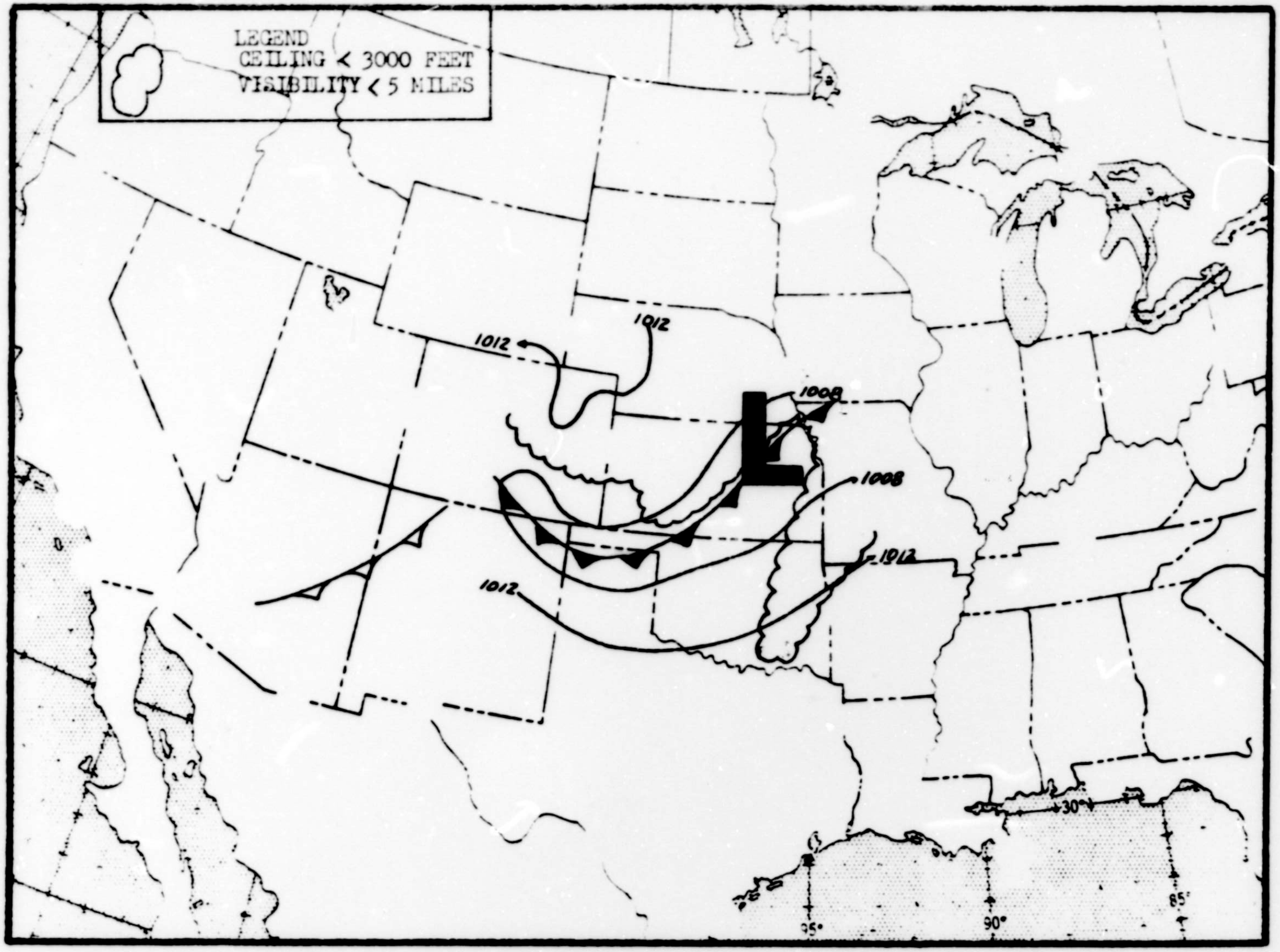


FIGURE 17. - 1500Z 17 NOVEMBER 1969 LOCAL AREA SURFACE ANALYSIS

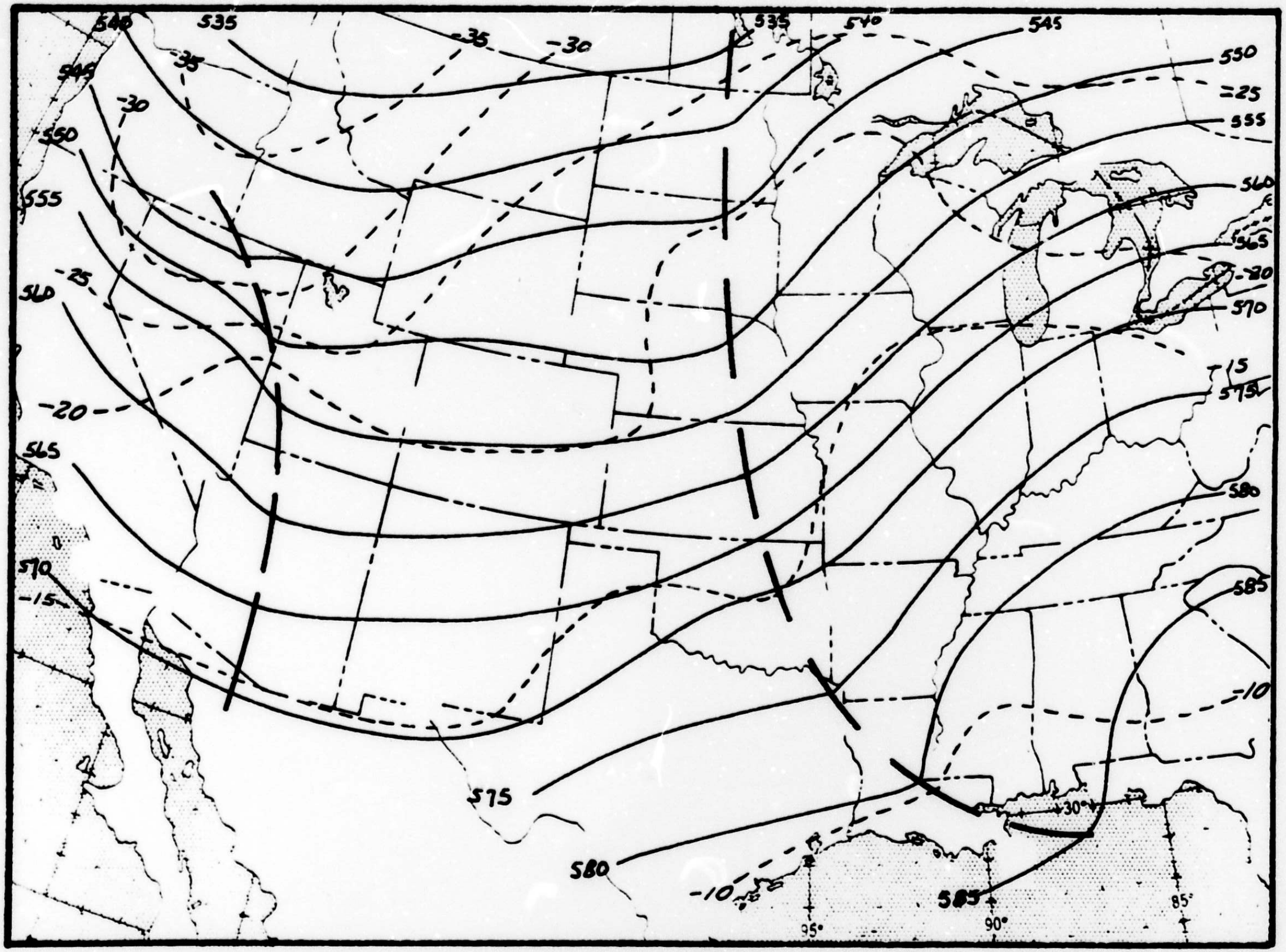


FIGURE 18. - 0000Z 17 NOVEMBER 1969 500MB ANALYSIS

III CLIMATIC AIDS

All the data used in preparing these Climatic Aids, except tornado occurrence by county, were extracted from the Revised Uniform Summary of Surface Weather Observations for Vance AFB, Enid, Oklahoma, prepared by the Data Processing Division USAF ETAC, Air Weather Service (MAC), Grove Arcade Building, Asheville, N.C., 13 September 1968.

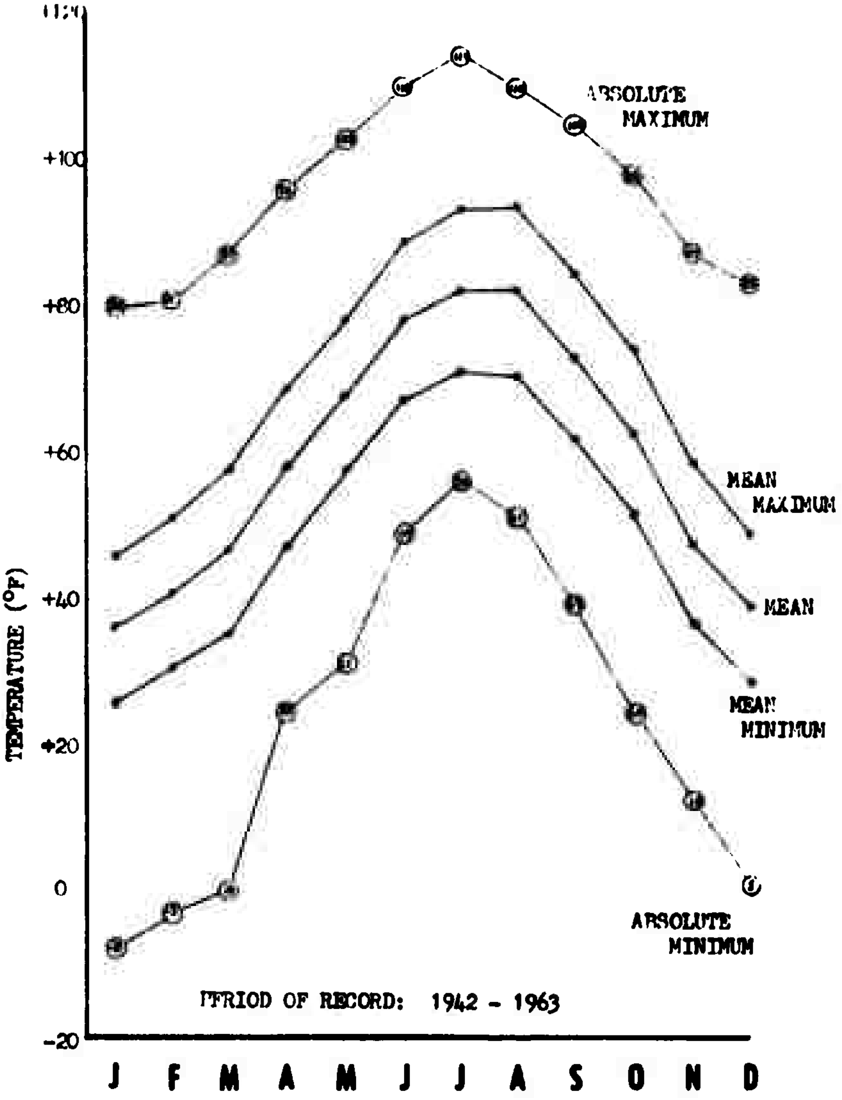


FIGURE 19. - MONTHLY TEMPERATURES

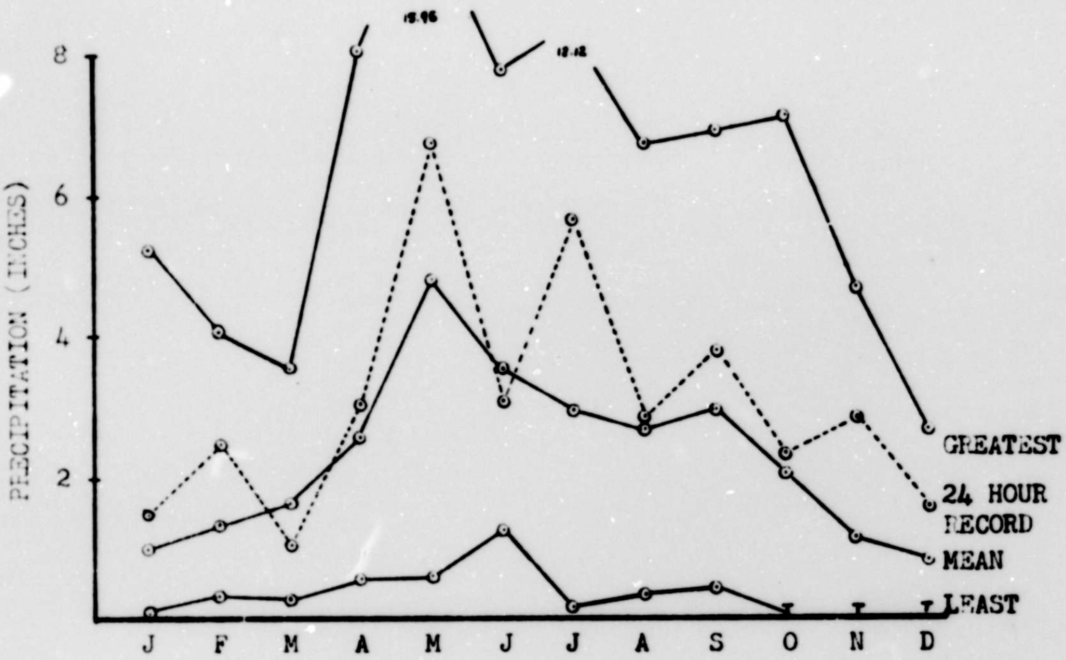


FIGURE 20. - MONTHLY PRECIPITATION: PERIOD 1942 - 1960

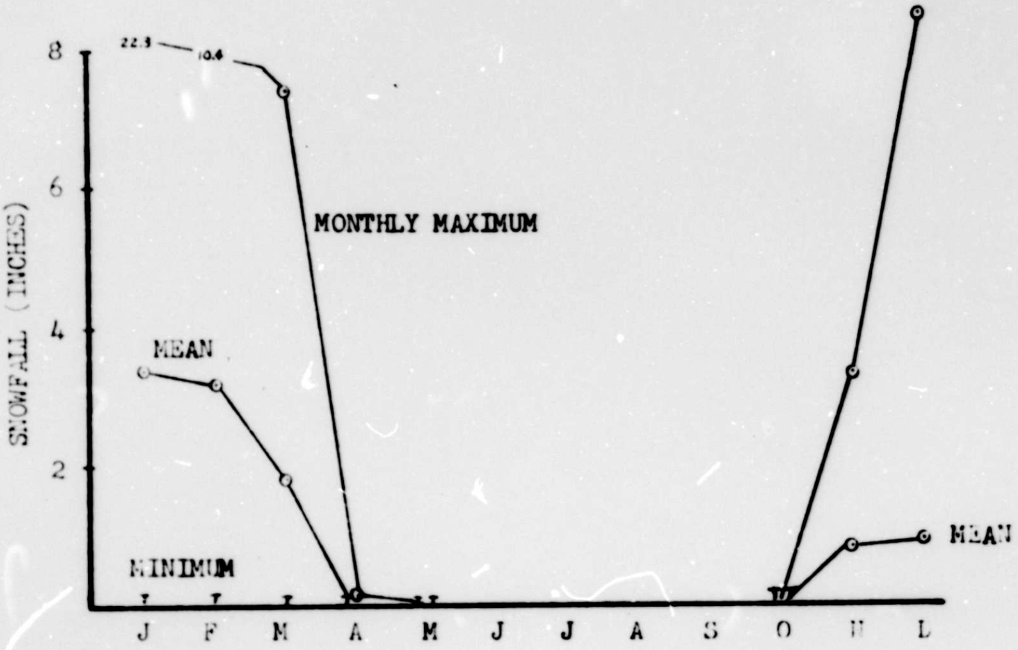


FIGURE 21. - MONTHLY SNOWFALL: PERIOD 1946 - 1960

VANCE AFB

PERCENT FREQUENCY OF OCCURRENCE-LESS THAN 3000 FEET AND/OR 5 MILES

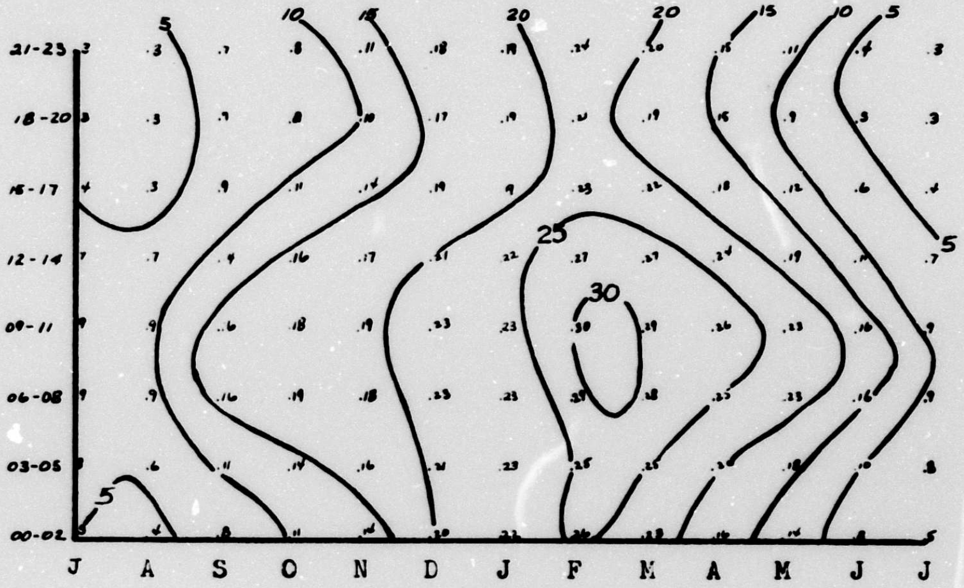


FIGURE 22. SOURCE: RUSSWO-POR 1942-1967

PERCENT FREQUENCY OF OCCURRENCE-LESS THAN 1500 FEET AND/OR 3 MILES

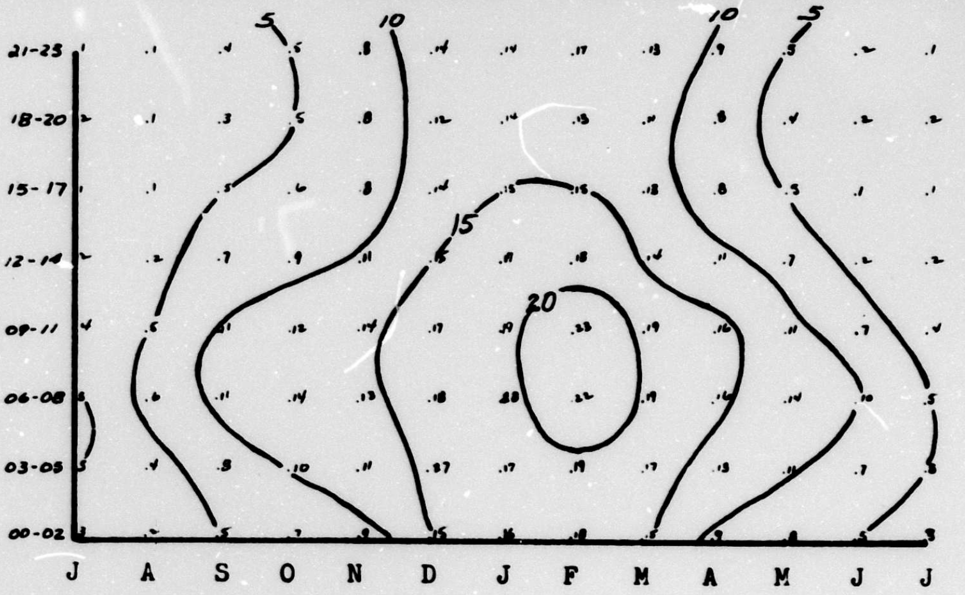


FIGURE 23. SOURCE: RUSSWO-POR 1942-1967

VANCE AFB

PERCENT FREQUENCY OF OCCURRENCE OF CEILINGS OF 3000 TO 10000 FEET AND VISIBILITY 10 MILES OR MORE

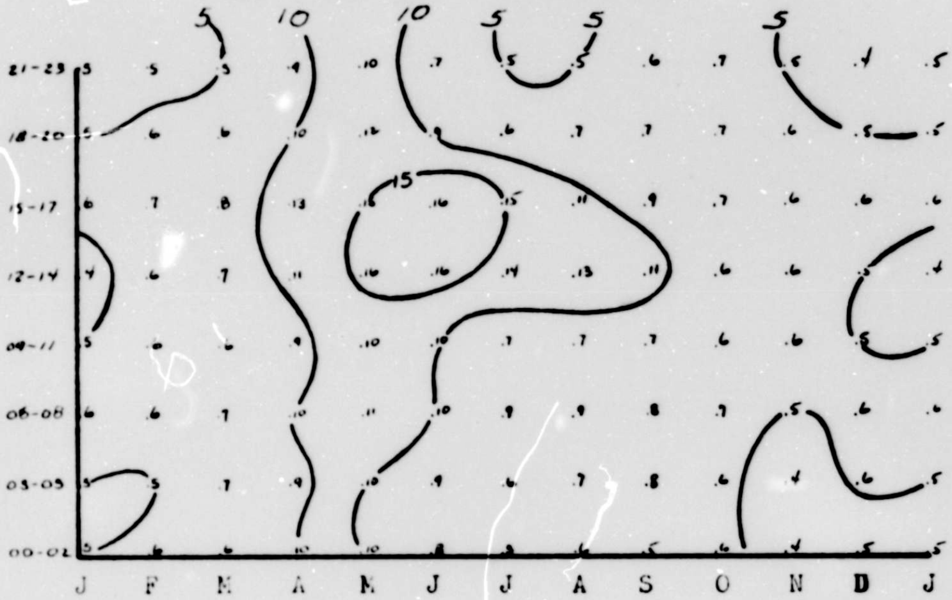
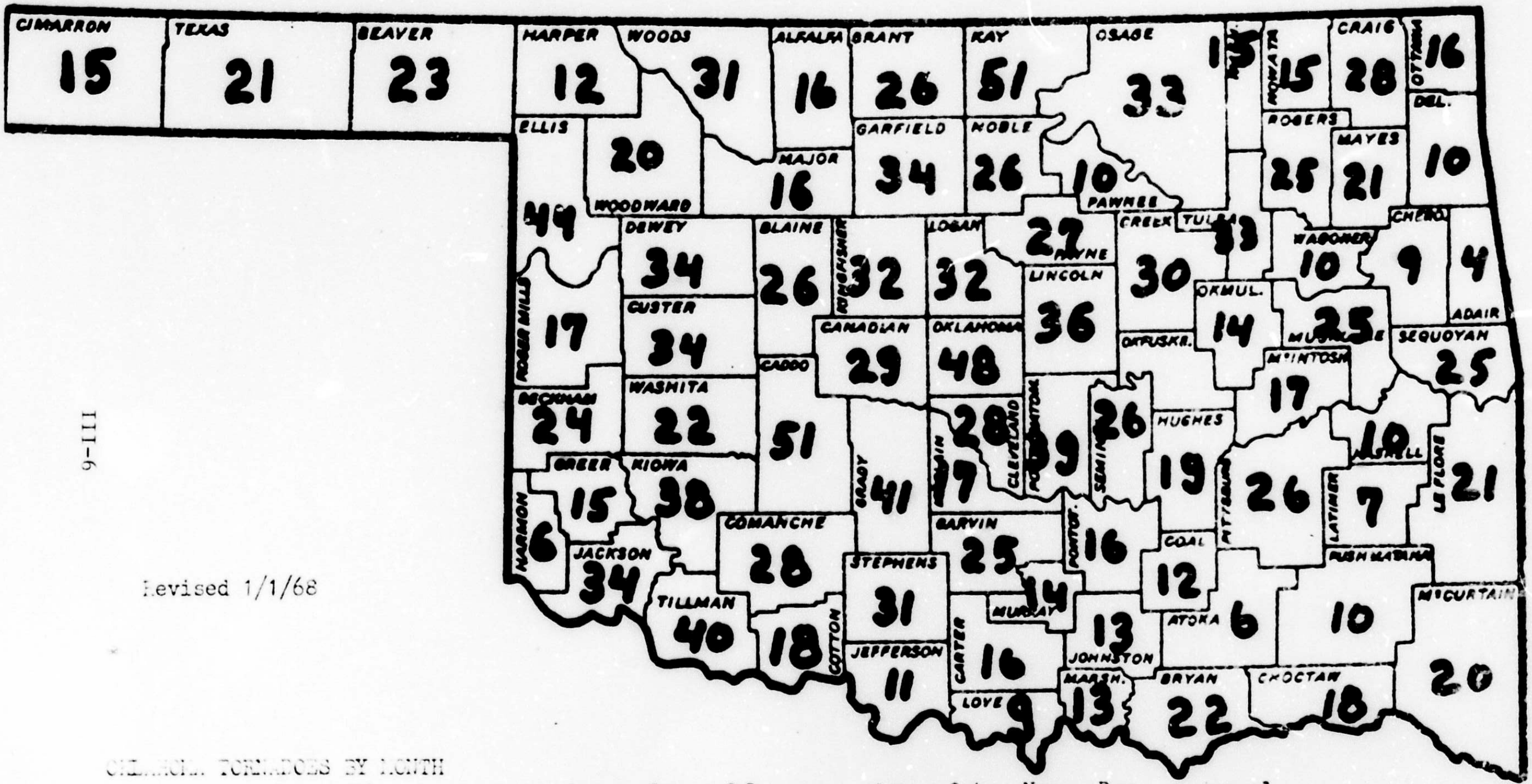


FIGURE 24. SOURCE: RUSSWO-POR 1942-1967



Revised 1/1/68

OKLAHOMA TORNADOES BY MONTH

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Number	22	33	104	339	556	234	75	45	43	24	36	5	1516
Percent	1.5	2.2	6.9	22.3	36.7	15.4	4.9	3.0	2.8	1.6	2.4	0.3	100

FIGURE 25.-COUNTY OCCURRENCES OF TORNADOES 1875-1967

VANCE AFB

PERCENTAGE WIND SPEED AND DIRECTION

MONTH ALL PERIOD OF RECORD: 1942 - 1967

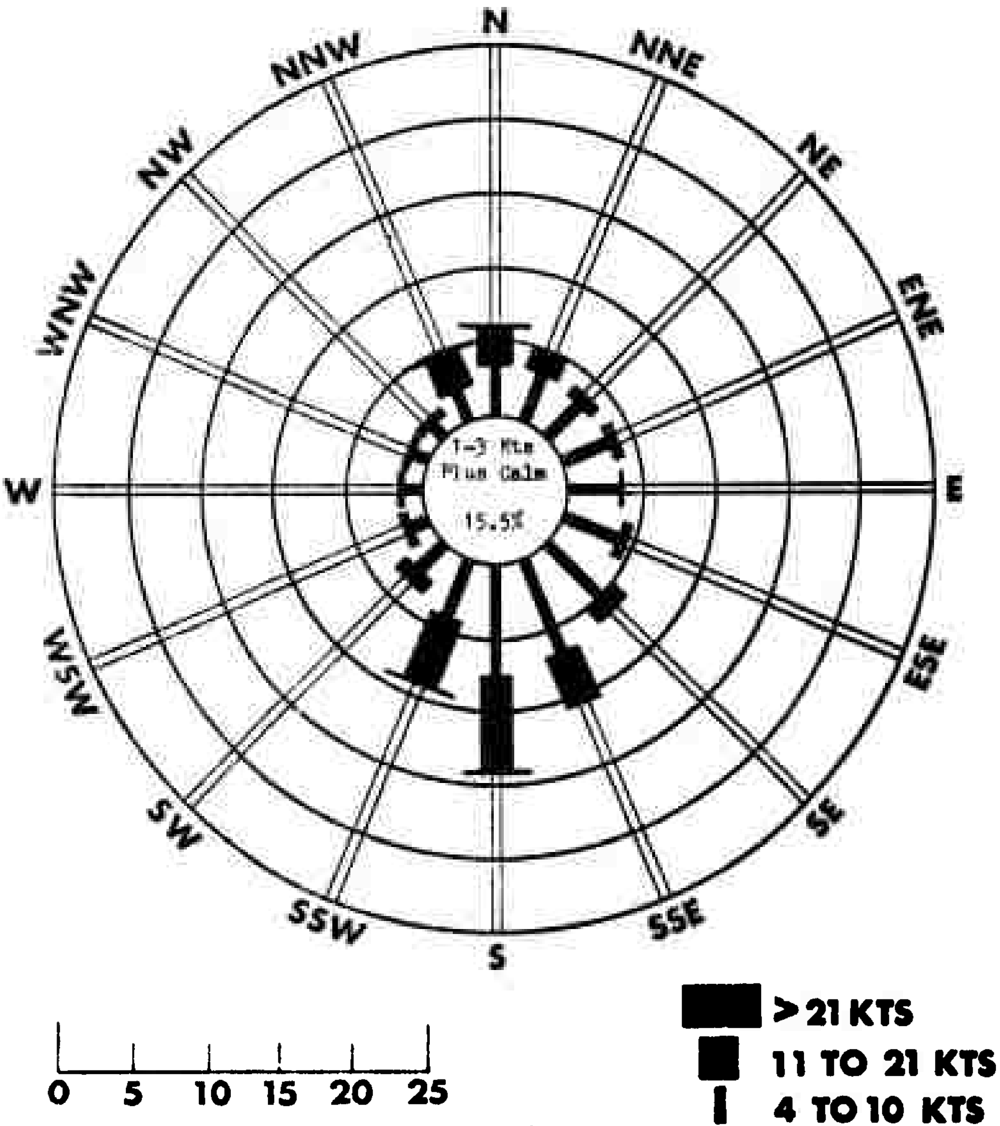


FIGURE 26.

VANCE AFB

PERCENTAGE WIND SPEED AND DIRECTION

MONTH JANUARY

PERIOD OF RECORD: 1942 - 1967

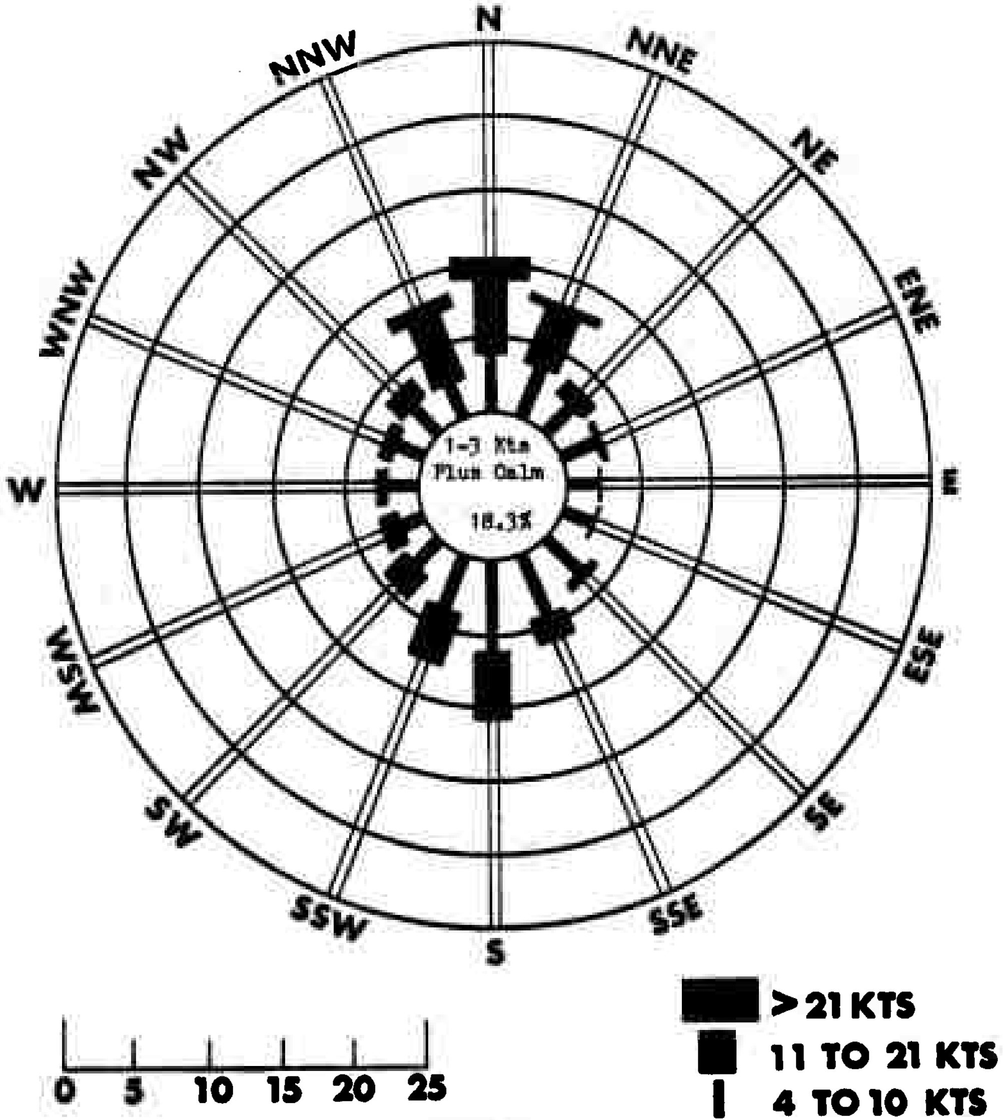


FIGURE 26a.

VANCE AFB

PERCENTAGE WIND SPEED AND DIRECTION

MONTH FEBRUARY PERIOD OF RECORD: 1942 - 1967

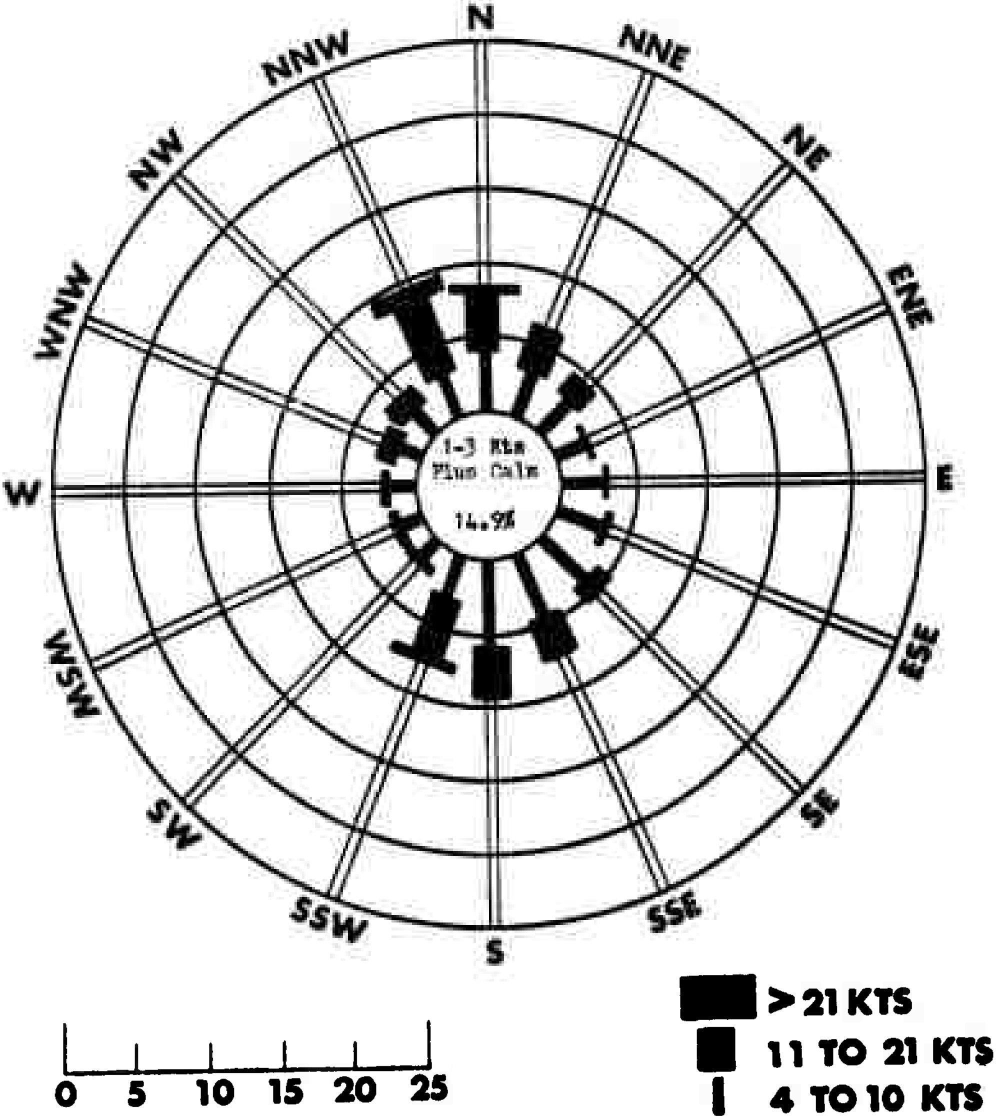


FIGURE 26b.

VANCE AFB

PERCENTAGE WIND SPEED AND DIRECTION

MONTH MARCH PERIOD OF RECORD: 1942 - 1967

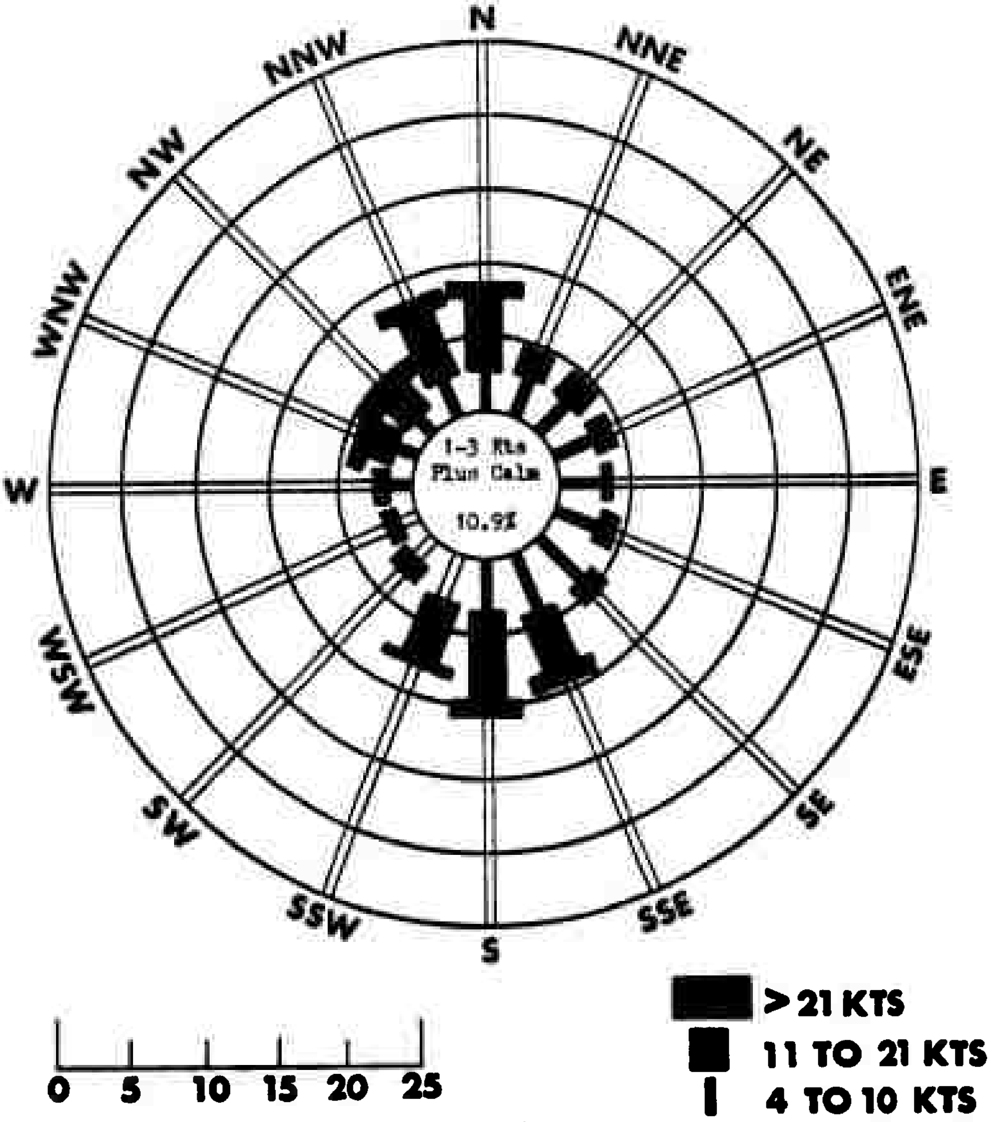


FIGURE 26c.

VANCE AFB

PERCENTAGE WIND SPEED AND DIRECTION

MONTH APRIL PERIOD OF RECORD: 1942-1967

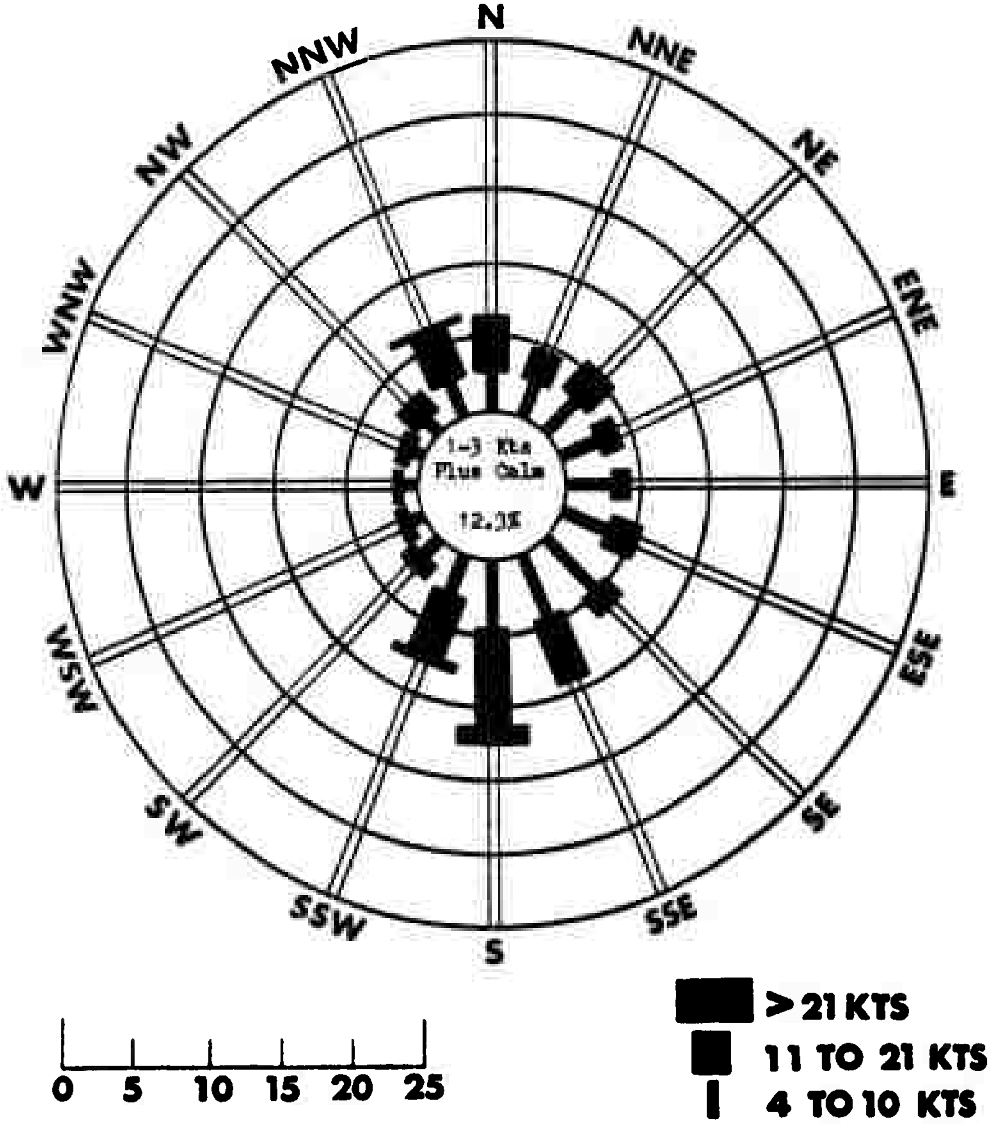


FIGURE 26d.

VANCE AFB

PERCENTAGE WIND SPEED AND DIRECTION

MONTH MAY

PERIOD OF RECORD: 1942 - 1967

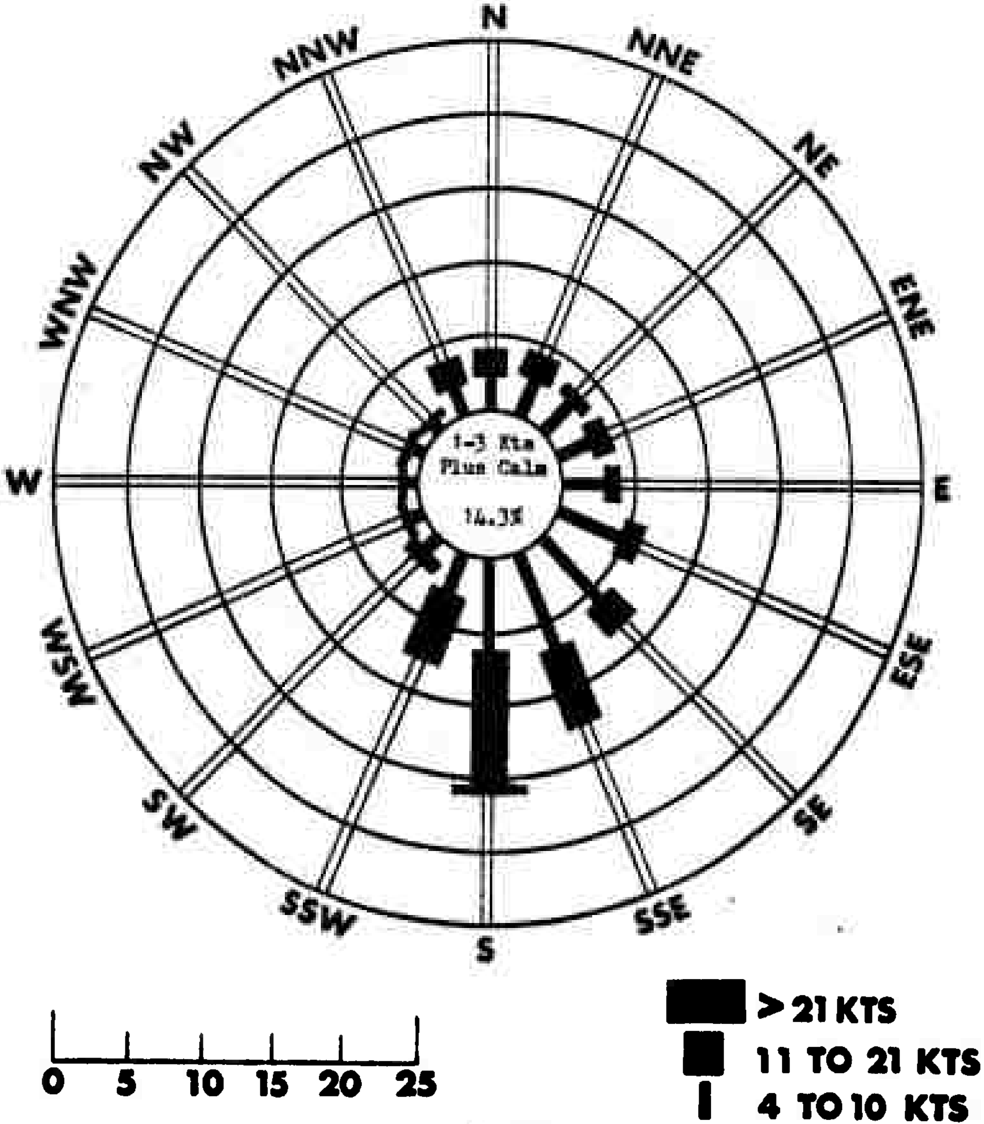


FIGURE 26e.

VANCE AFB

PERCENTAGE WIND SPEED AND DIRECTION

MONTH JUNE

PERIOD OF RECORD: 1942 - 1967

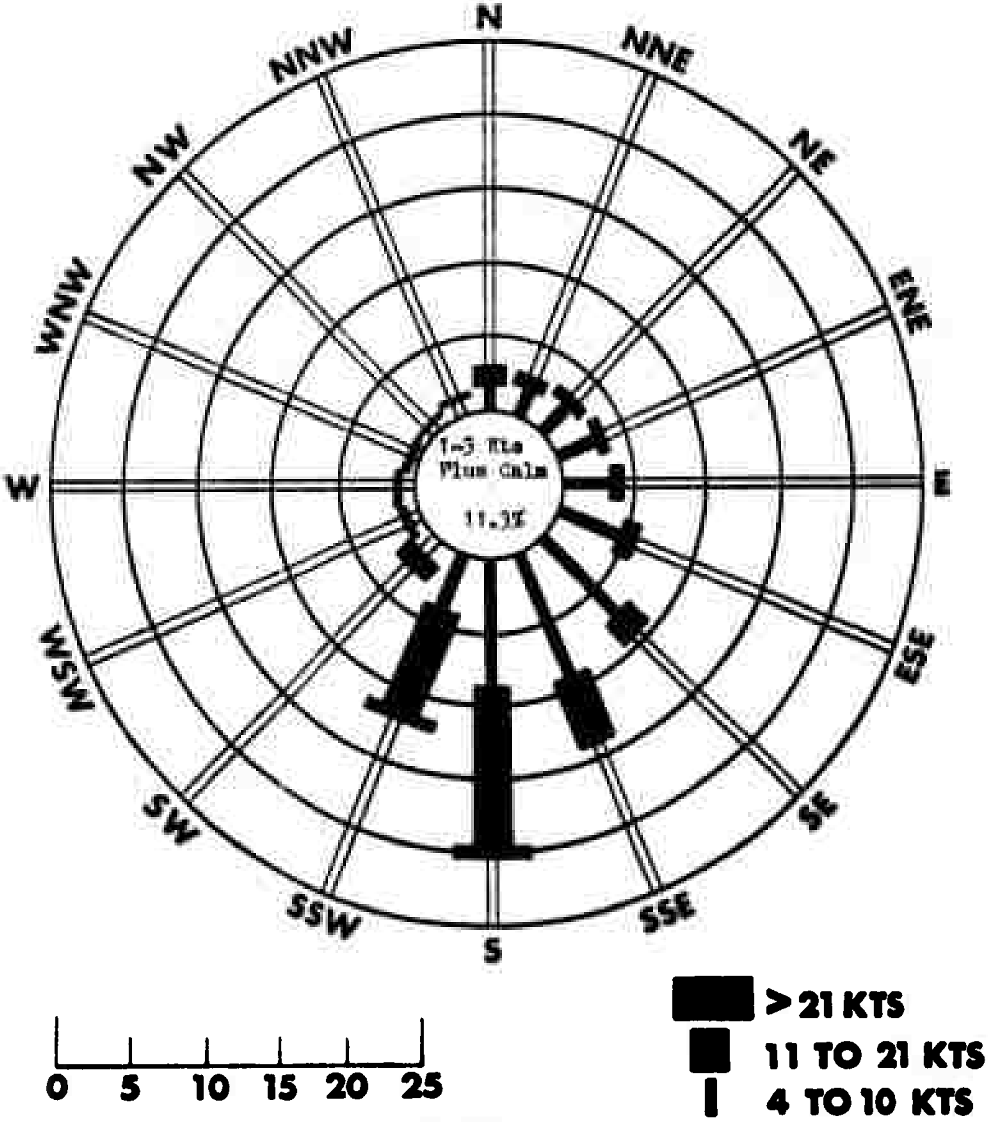


FIGURE 26f.

VANCE AFB

PERCENTAGE WIND SPEED AND DIRECTION

MONTH JULY

PERIOD OF RECORD: 1942 - 1967

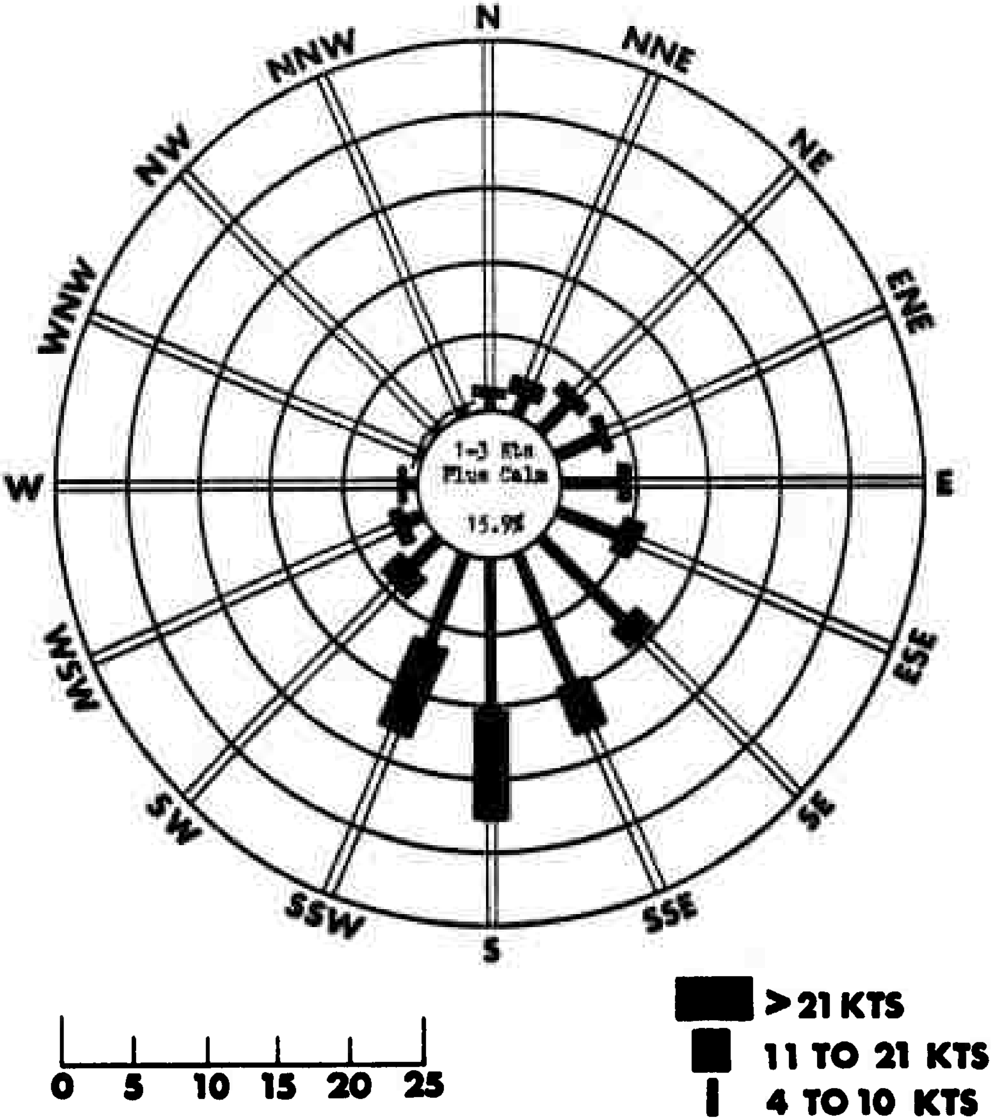


FIGURE 26g.

VANCE AFB

PERCENTAGE WIND SPEED AND DIRECTION

MONTH AUGUST

PERIOD OF RECORD: 1942 - 1967

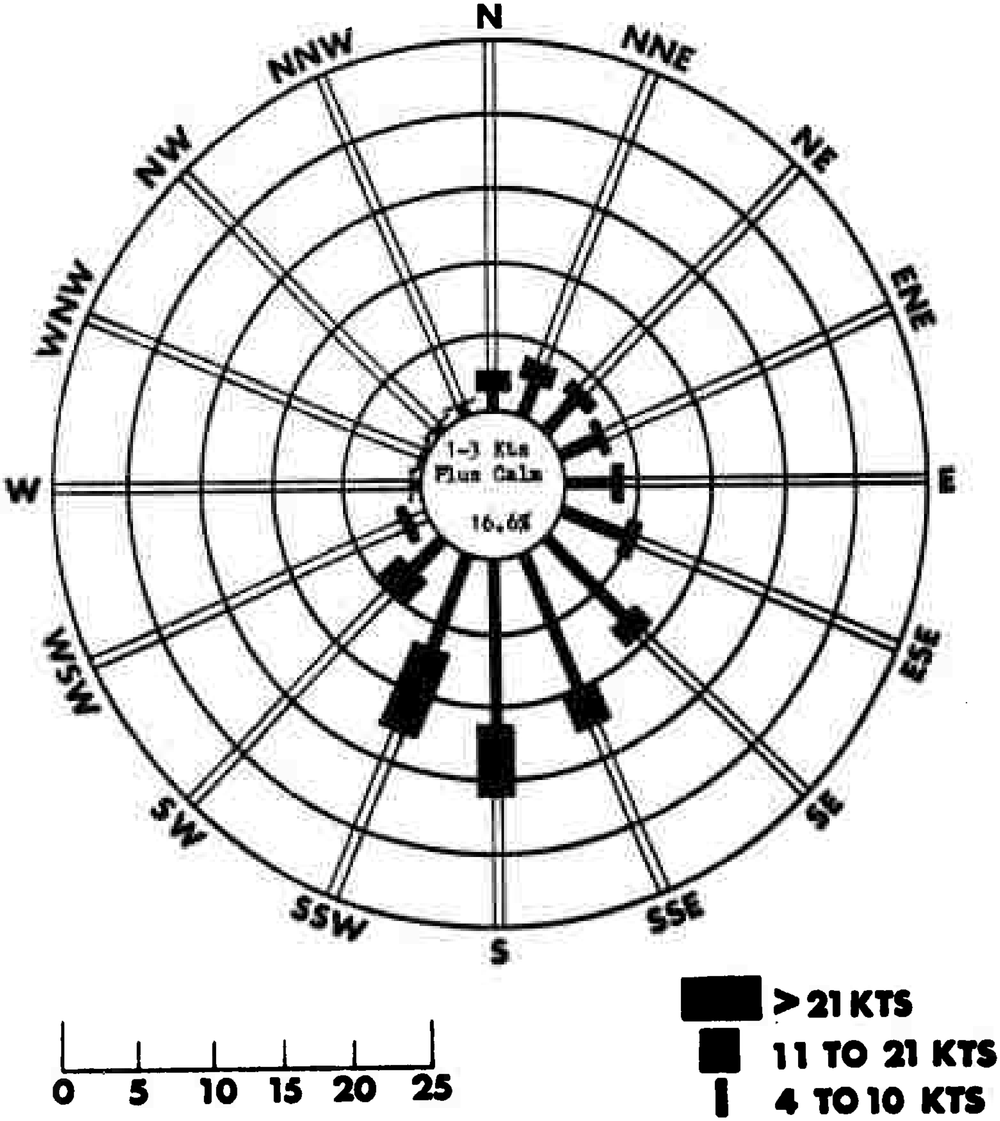


FIGURE 26h.

VANCE AFB

PERCENTAGE WIND SPEED AND DIRECTION

MONTH SEPTEMBER PERIOD OF RECORD: 1942 - 1966

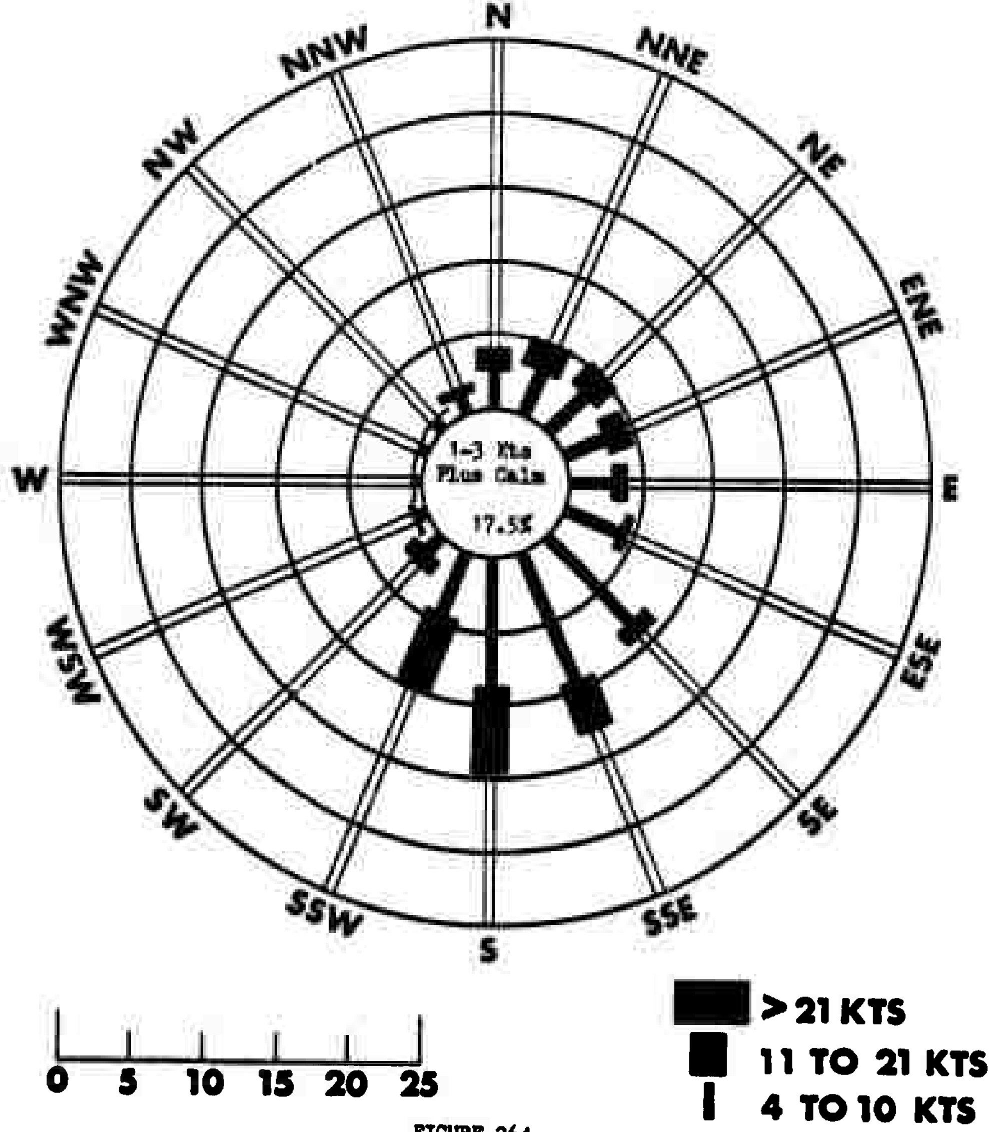


FIGURE 26j.

VANCE AFB

PERCENTAGE WIND SPEED AND DIRECTION

MONTH OCTOBER

PERIOD OF RECORD: 1942 - 1966

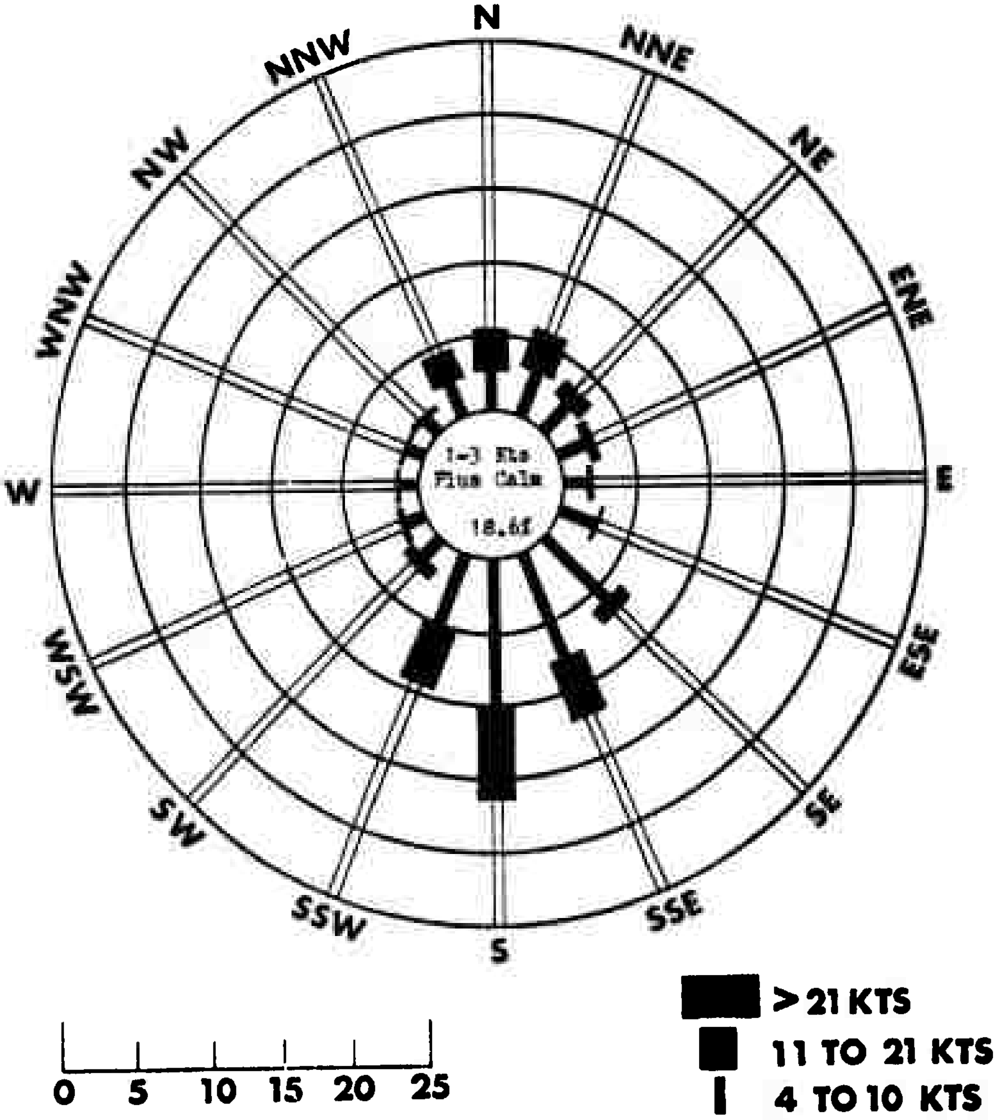


FIGURE 261.

VANCE AFB

PERCENTAGE WIND SPEED AND DIRECTION

MONTH NOVEMBER

PERIOD OF RECORD: 1942 - 1966

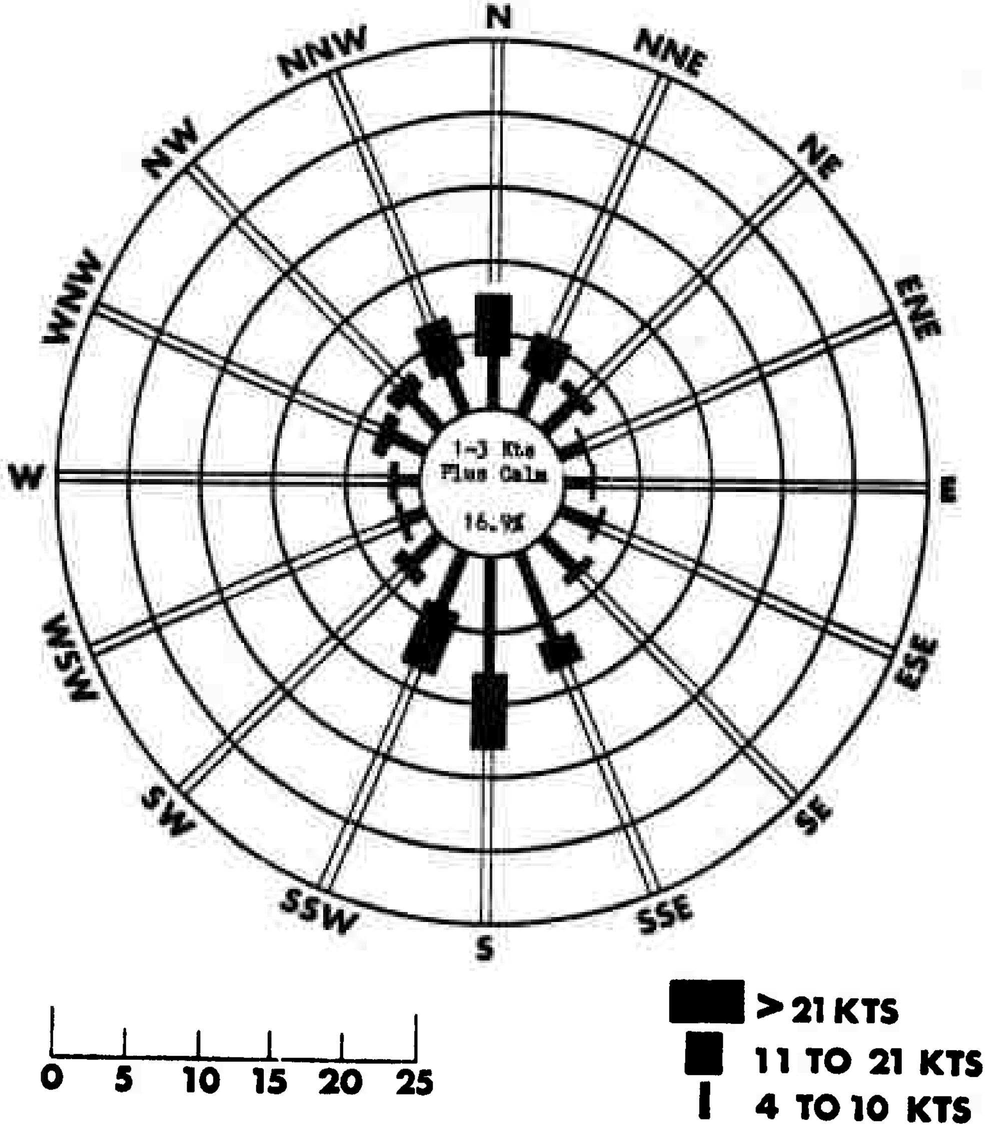


FIGURE 26k.

VANCE AFB

PERCENTAGE WIND SPEED AND DIRECTION

MONTH DECEMBER PERIOD OF RECORD: 1942 - 1966

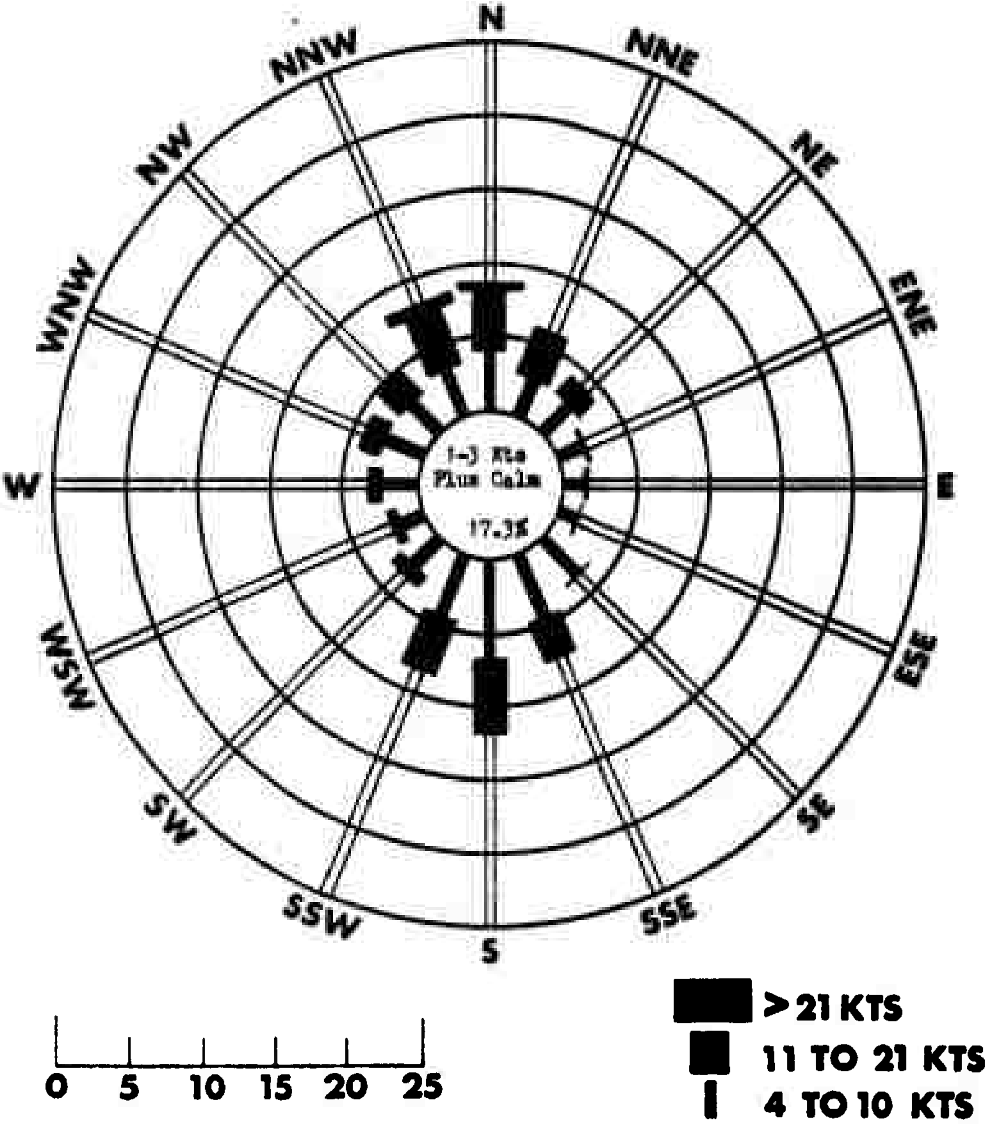


FIGURE 261.

IV LOCAL FORECAST STUDIES

1. Operational Weather Requirements:

a. Operational requirements for the base are as follows:

(1) 100 ft and/or 1/4 mile is the radar approach operating minimum when operating on Runway 35L.

(2) 200 ft and/or 1/2 mile is ILS minimum to 35L.

(3) 200 ft and/or 3/4 mile is the minimum for T-38 dual tube or T-38 flagpole or T-37 block plan or T-37 flagpole when operating on Runway 35.

(4) 300 ft and/or 3/4 mile is the operating minimum when operating on Runway 17.

(5) 400 ft and/or 1 1/4 mile is the minimum for the options listed in 1a(3) when operating on Runway 17.

(6) 700 ft and/or 2 miles is the minimum for Rescue operations.

(7) 1000 ft and/or 3 miles is the VFR minimum.

(8) 1500 ft and/or 3 miles with 5 miles air-to-air is the minimum for all options listed in 1a(3) plus T-37 dual patterns when operating on either runway.

(9) 2000 ft and/or 3 miles with 5 miles air-to-air is the minimum for T-38 dual tube or dual pattern, T-37 block plan or T-37 dual tube, and T-37 dual/solo patterns.

(10) 2500 ft and/or 3 miles with 5 miles air-to-air is the minimum for T-37 block plan or T-37 dual tube, T-37 dual and T-38 dual/solo patterns.

(11) 2500 ft and/or 4 miles with 5 miles air-to-air is the minimum for the operations listed in 1a(10), plus VFR GCAs/Straight-ins to Center Runway.

(12) 11,000 ft and/or 3 miles with 5 miles air-to-air is the minimum for unrestricted operations.

(13) Surface winds of 25 knots from any direction is the maximum tolerable for the T-41 program and for Rescue operations.

(14) RVR of 16 is the precision approach minimum for 35L.

(15) RVR of 24 is minimum for TACAN on 35 Left and ILS and localizer for 35L.

(16) A crosswind component of 13 Kts is the maximum tolerable for the flying of T-37 solos.

(17) A crosswind component of 15 Kts is the maximum tolerable for the flying of T-38 solos.

(18) A crosswind component of 17 Kts is the maximum allowable for T-37 operations.

(19) A crosswind component of 25 Kts is the maximum allowable for T-38 operations.

b. The most critical terminal forecast problems for the mission are:

(1) Restricted ceilings and/or visibilities during student flying.

(2) Aircraft icing.

(3) Thunderstorms with associated hazards.

2. Objective Forecast Studies: At the present time, Detachment 15 has no forecast studies in use.

3. Special Synoptic Studies:

The Arctic Outbreak of 12-13-14 December 1958 into the mid-plains area of the United States brought record breaking minimum temperatures and record snowfall to Vance Air Force Base, Oklahoma. A total of 4.6 inches of snow fell in a 24 hour period, bringing the depth on the ground to 6 inches. At 0757Z on 14 December 1958 the dry-bulb temperature was recorded at 1.2 degrees Fahrenheit.

The key to this intrusion appeared on the 500 mb analysis 0000Z 11 December. The mean trough was located on a slightly tilted axis southwest-northeast from Texas to the Great Lakes while the mean ridge was over the Pacific coast line. Superimposed on the mean long waves was a short-wave perturbation located just east of the west coast ridge. A weak thermal trough accompanied the perturbation. A fairly large pocket of moist air was also present. The 11/1200Z 500 mb analysis (Figure 28) moved the minor perturbation about 10 degrees east and at the same time introduced a second minor trough coming in on the west coast of Washington. The axis of the long wave ridge and trough had now moved about 5 degrees further east. On the 12/0000Z 500 mb chart, the old perturbation was not much in evidence, but the second short wave had now moved about 10 degrees east and was breaking down the mean or long wave ridge. The long wave trough continued to move easterly about 5 degrees. At this time the surface chart showed the polar front extending out of a low off the North Carolina coast looping down into the Gulf of Mexico and broken off in Northern Mexico. A weak Arctic front was located along the southern periphery of an elongated Canadian High. This front extended from Montana southeast into Oklahoma. In the meantime, the combined efforts of the two minor perturbations were beginning to deepen a well defined thermal trough over central Montana at the 500 mb level. Also a low was beginning to deepen on the surface in the Texas panhandle. This mechanism set off the precipitation in the area just east of the Rockies from southern Oklahoma to Montana. In the meantime the minor waves were entering the long wave trough and beginning to flatten out the bottom of the long wave trough, and by 13/1200Z (Figure 32) had formed a minor axis from Texas northward up through Nebraska. The combination of the deepening of the thermal trough and the flattening out of the small wave perturbation set up the short-lived baroclinic feature that deepened the low over the Texas panhandle resulting in easterly flow over Oklahoma, bringing record snowfalls. The minimum temperature, of course, was associated with the subsequent arrival of the Arctic high and clearing as the Arctic front extended itself further south.

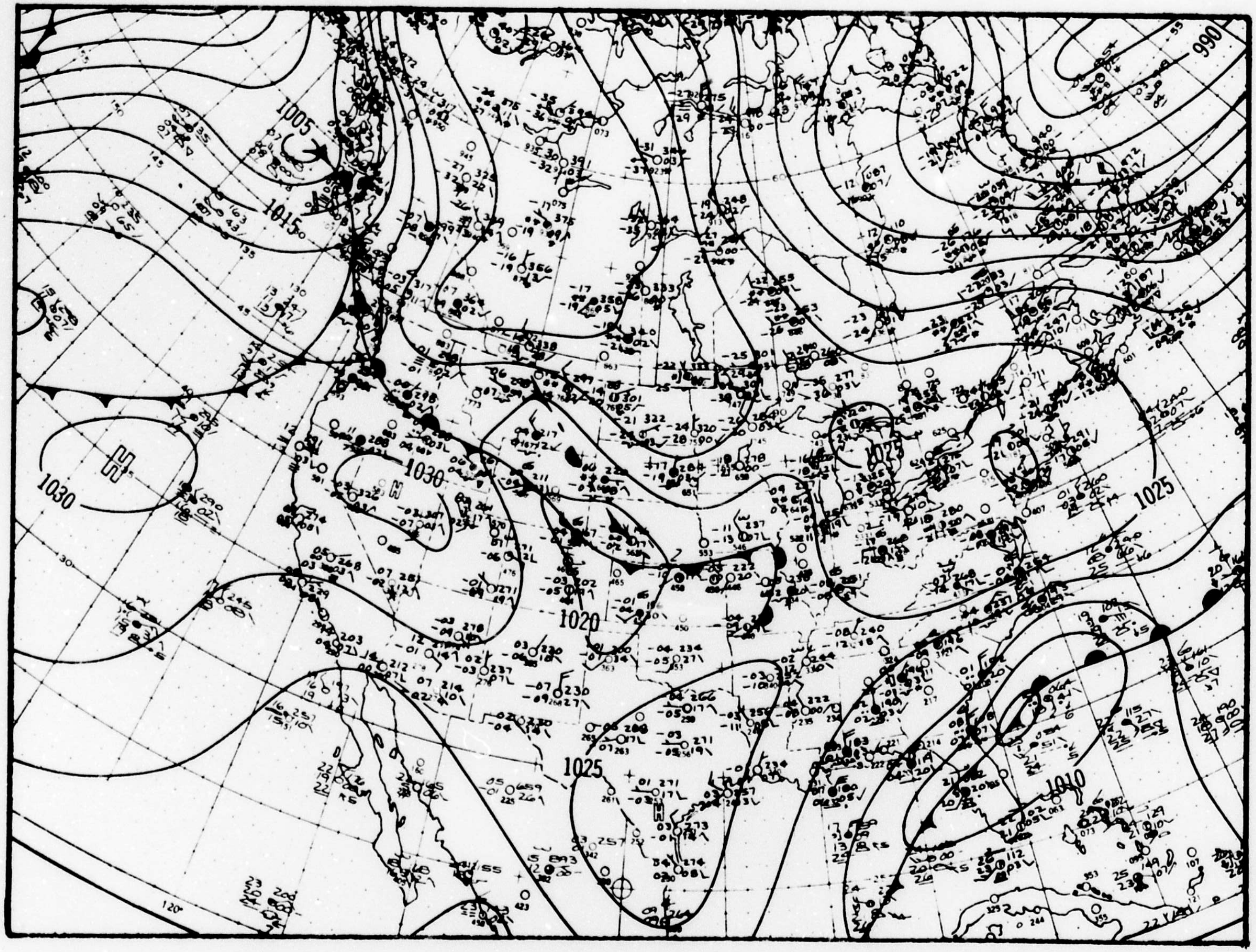


FIGURE 27. - 1200Z 11 DECEMBER 1958 SURFACE ANALYSIS

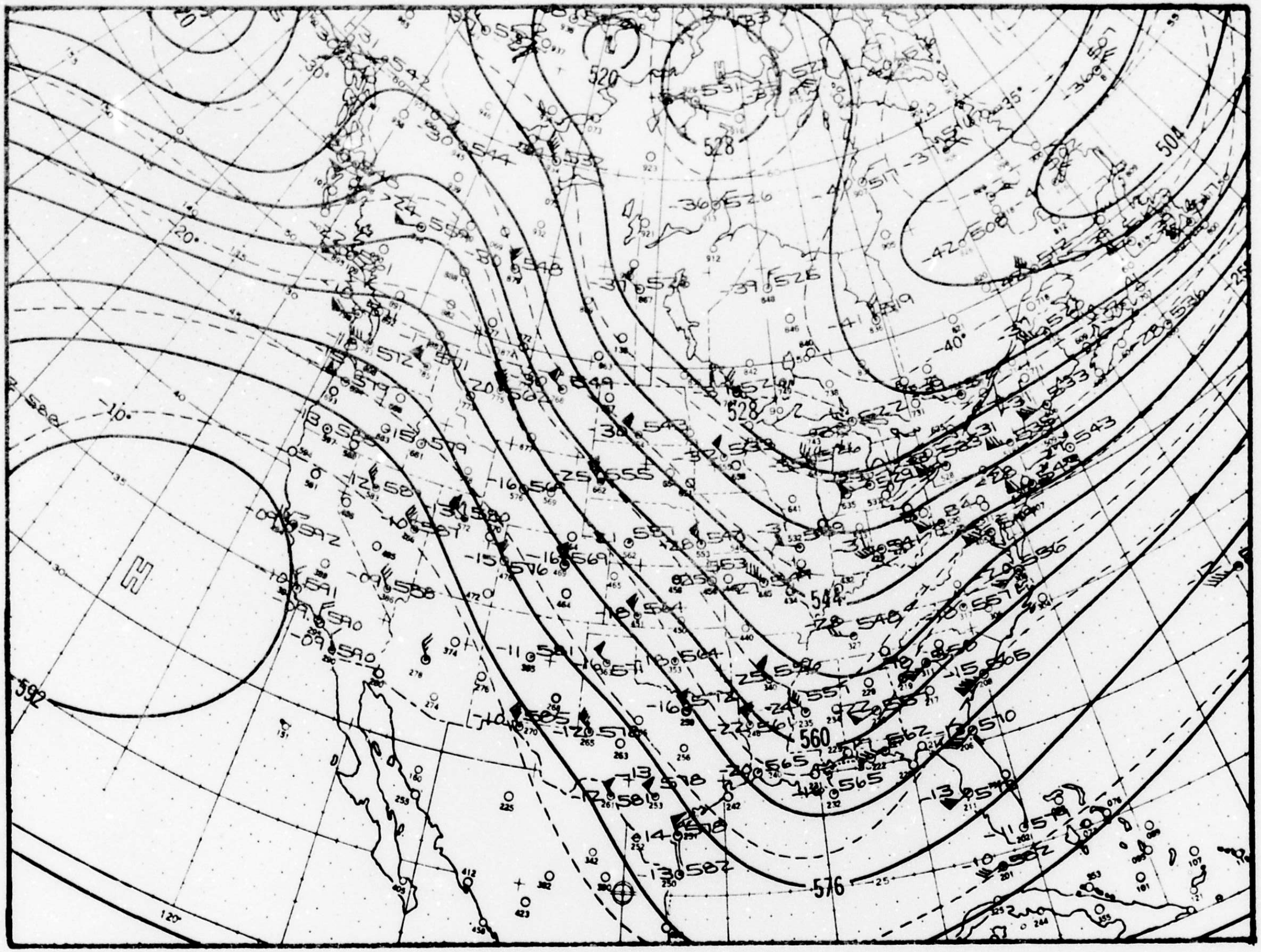


FIGURE 28. - 1200Z 11 DECEMBER 1968 500MB ANALYSIS

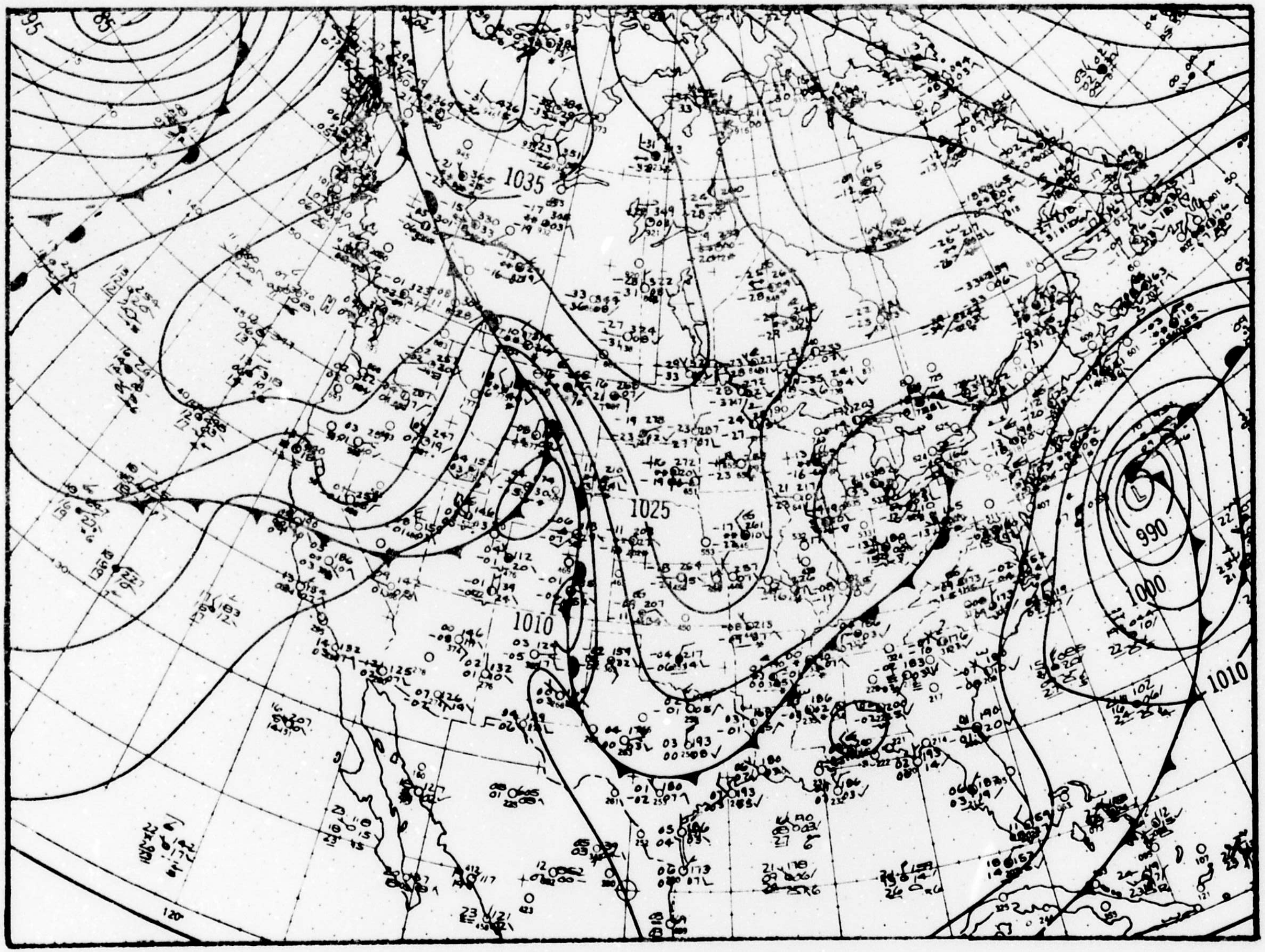


FIGURE 29. - 1200Z 12 DECEMBER 1958 SURFACE ANALYSIS

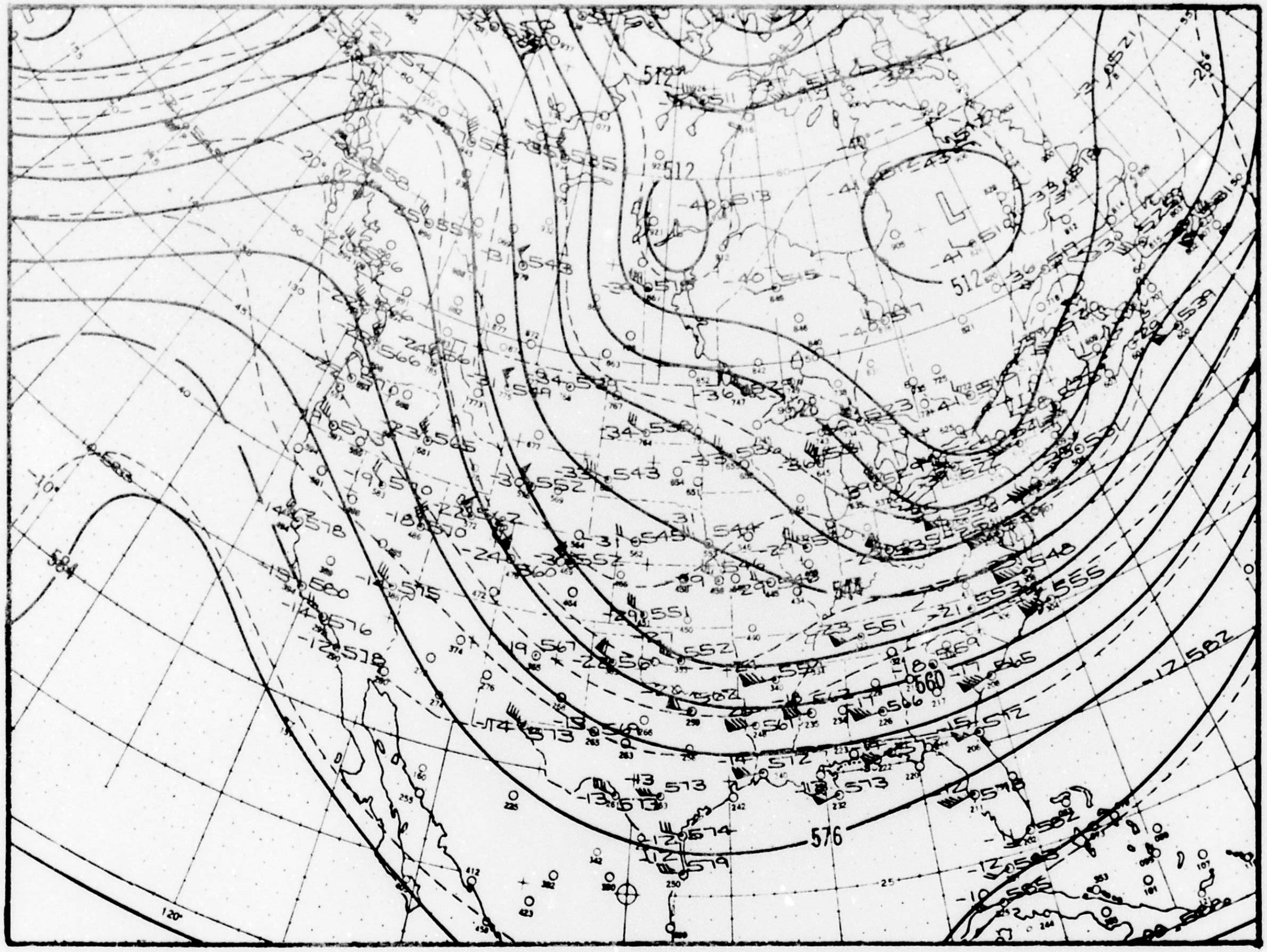


FIGURE 30. - 1200Z 12 DECEMBER 1958 500MB ANALYSIS

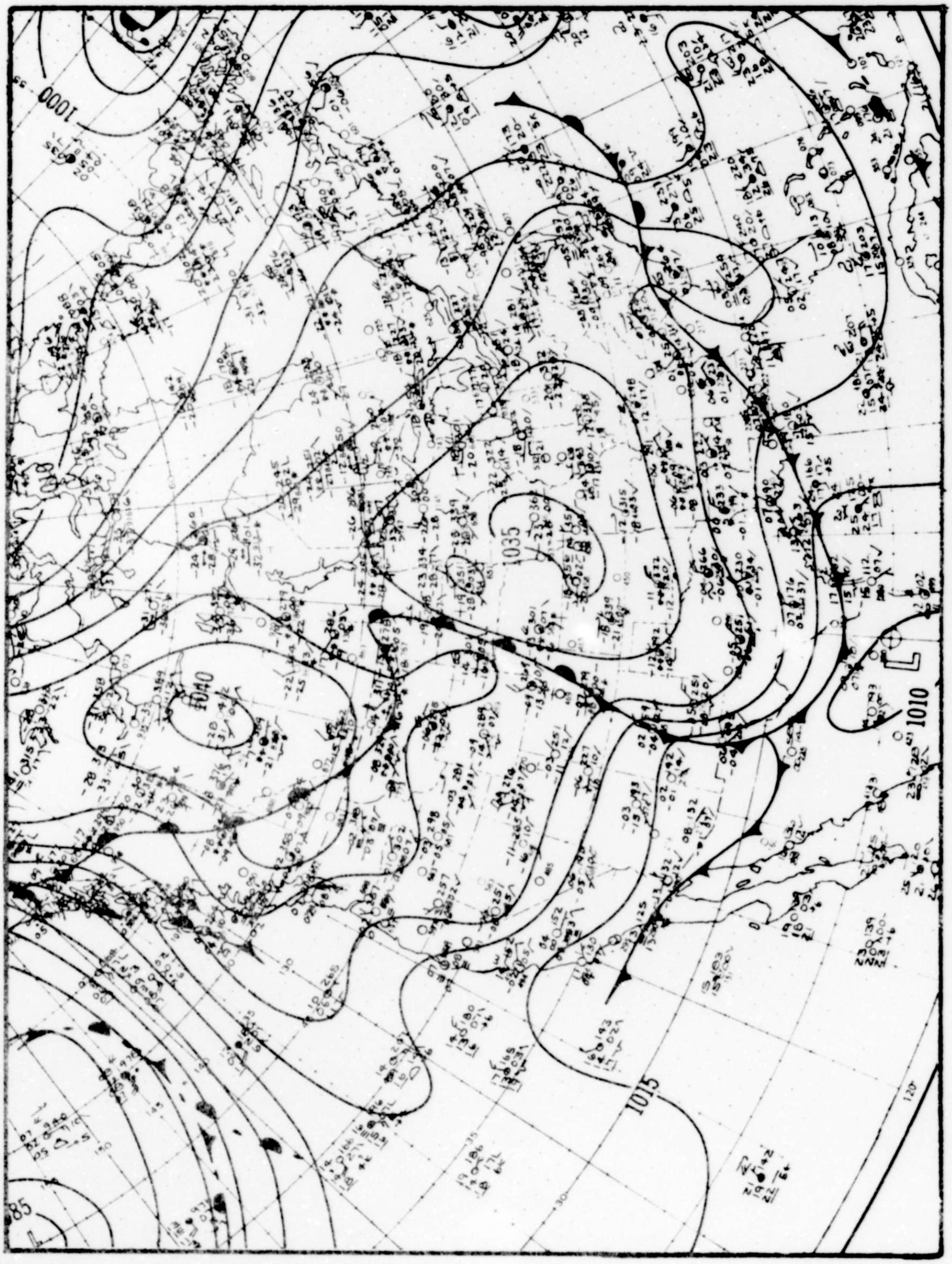


FIGURE 31. - 1200Z 13 DECEMBER 1958 SURFACE ANALYSIS

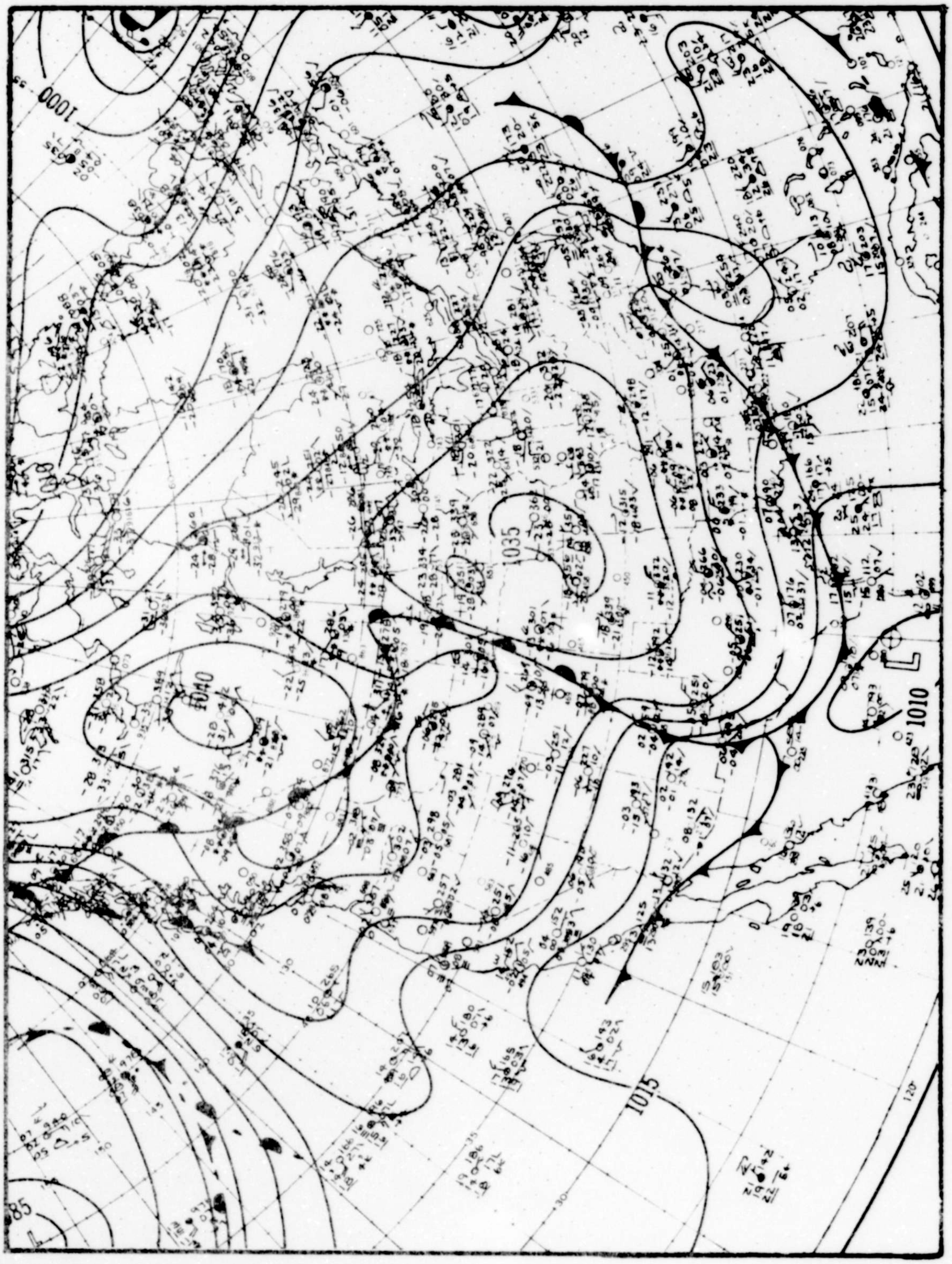


FIGURE 31. - 1200Z 13 DECEMBER 1958 SURFACE ANALYSIS

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY *(Corporate author)* Det 15, 24th Weather Squadron Vance AFB, OK 73701	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP N/A

3. REPORT TITLE

TERMINAL FORECAST REFERENCE FILE, VANCE AFB, OK

4. DESCRIPTIVE NOTES *(Type of report and inclusive dates)*
FINAL

5. AUTHOR(S) *(First name, middle initial, last name)*
N/A

6. REPORT DATE 15 JULY 1970	7a. TOTAL NO. OF PAGES 81	7b. NO. OF REFS NONE

8a. CONTRACT OR GRANT NO. N/A	9a. ORIGINATOR'S REPORT NUMBER(S)
b. PROJECT NO. N/A	N/A
c. N/A	9b. OTHER REPORT NO(S) *(Any other numbers that may be assigned this report)* N/A
d. N/A	

10. DISTRIBUTION STATEMENT

This document has been approved for public release and sale; its distribution is unlimited.

11. SUPPLEMENTARY NOTES N/A	12. SPONSORING MILITARY ACTIVITY Hq 7th Weather Wing Scott AFB, IL 62225

13. ABSTRACT

The

This reference file discusses factors affecting the weather at Vance AFB, OK. Included are location and topography, weather controls, climatic aids, and a special synoptic study.

DD FORM 1 NOV 65 1473

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14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Meteorology						
Climatic Data						
Topography						
Weather Controls						
Special Synoptic Study						

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