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13. ABSTRACT

This reference file discusses factors affecting the Weather at Chanute AFB, IL. Included are location and topography, weather controls, climatic aids, and local forecast studies.

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Climatic Data						
Chanute AFB, IL						
Local Forecast Studies						

TERMINAL FORECAST REFERENCE FILE

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DETACHMENT 8

24TH WEATHER SQUADRON

CHANUTE AFB, ILLINOIS

5 APRIL 1971

16

TERMINAL FORECAST REFERENCE FILE

INDEX

Section I- Location and Topography

Section II - Weather Controls

Section III - Climatic Aids

Section IV - Local Forecast Studies

SECTION I: LOCATION AND TOPOGRAPHY

This section contains:

a. A general discussion of the topography of the station and significant geographic factors which influence local weather.

b. A discussion of air pollution sources and their effects on local weather.

c. Maps and charts illustrating the written descriptions of section I.

(1) Chanute AFB is located at 40° 18'N Latitude, 88° 09' W Longitude. The base is adjacent to and south of the Village of Rantoul, Illinois; and 95 miles south-southwest of Lake Michigan

(2) Chanute AFB is surrounded by flat cultivated farm land. The elevation varies from 999' 25 miles northwest of the base to 600' 25 miles southeast. The field elevation is 737'. There are no large rivers, bodies of water, or forests in the local area. Fig 1 is a topographic map of the Chanute AFB area.

(3) Surface water drainage on the base and in the surrounding area is extremely poor. In general, surface water from Rantoul and the base drains eastward; eventually into the Wabash River. Numerous potholes and marshy areas provide for a considerable volume of surface water retention. Lack of efficient surface water drainage is evident from the flood damage sustained during periods of heavy precipitation and melting snow.

(4) The base central heating plant, located just northwest of the runways is the main source of smoke polution. The incinerator and dumps located on the southern edge of the base are another smoke source. Also, the fire fighters practice petroleum fire fighting which produces a dense black smoke that has caused a visibility problem for aircraft on final approach on mornings when low level inversions trap the smoke.

(5) The meteorological instruments indicators are located in the representative observation site. The observing section occupies the second floor of a small two story building, P-1885, situated 7/10 of a mile east of the base weather station. (see Fig.2.).

AN/GMQ-11 Wind measuring set 500'S of ROS
AN/TMQ-11 Temperature-Humidity Set - 2200' E. of ROS.
AN/GMQ-10 Transmissometer 1000' N. of the approach end of runway 27 (Primary Instrument runway)
AN/GMQ-13 Rotating Beam Ceilometer - 3400' E. of approach end of runway 27.

NOT REPRODUCIBLE

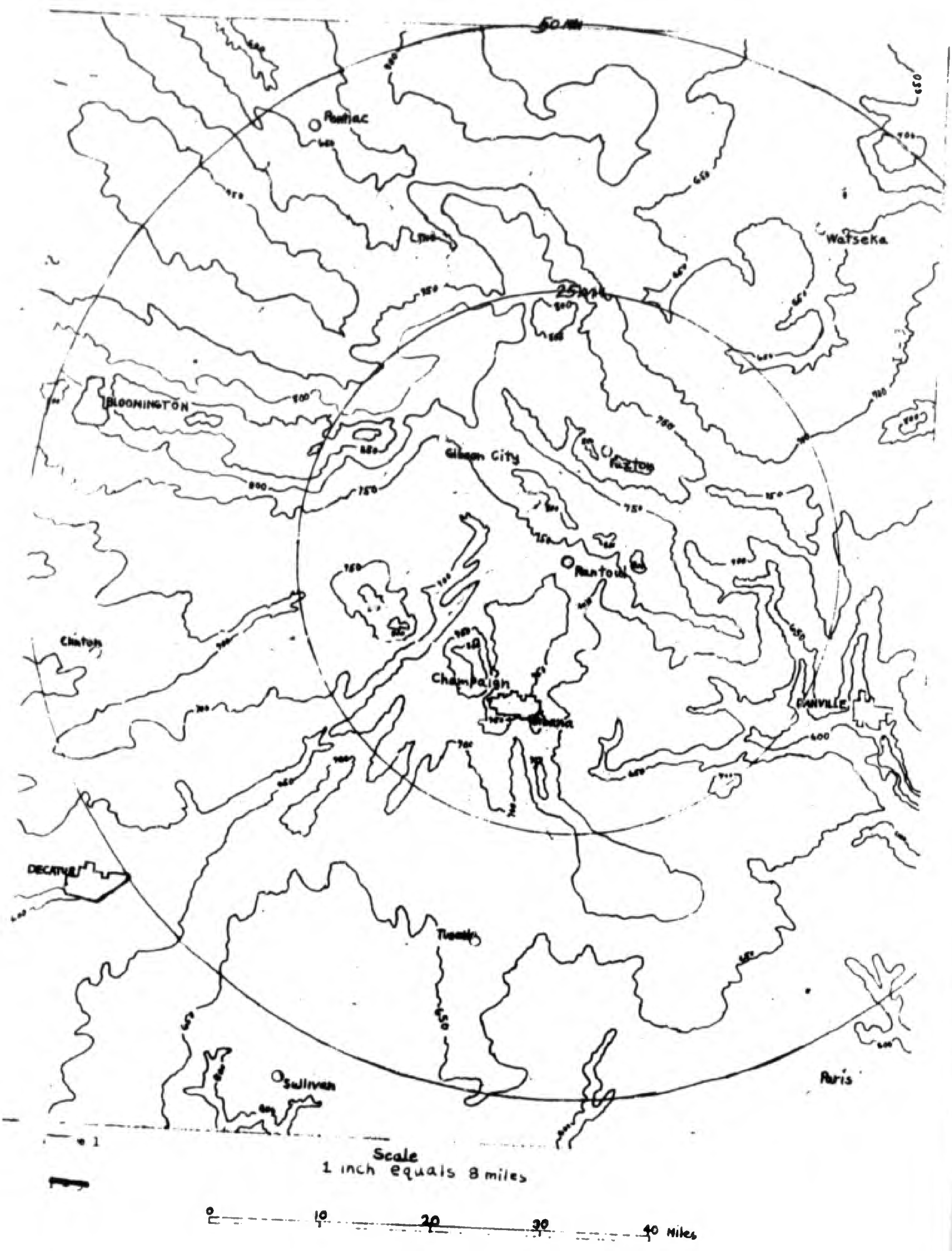
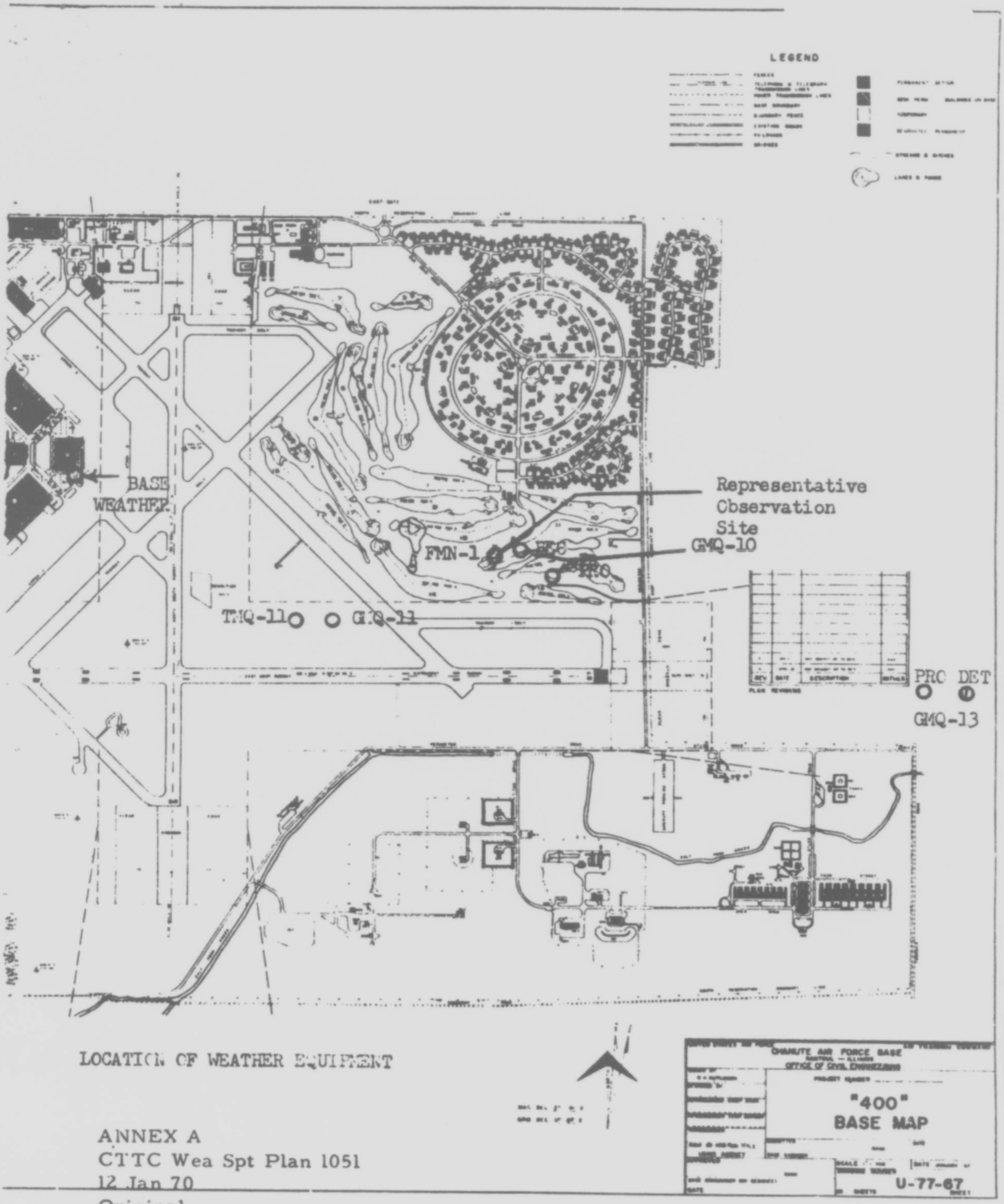

50 Mi
25 Mi
Pontiac
Watseka
Bloomington
Gibson City
Paxton
Rantoul
Clinton
Champaign
Urbana
Danville
Decatur
Tuscola
Sullivan
Paris
650
700
750
800
Scale
1 inch equals 8 miles
0
10
20
30
40 Miles

Figure 1



LOCATION OF WEATHER EQUIPMENT

Figure 2

SECTION II - WEATHER CONTROLS

1. A description of synoptic features for the four seasons of the year follows. Major weather systems are discussed in general terms. More detailed analysis of certain seasonal controls can be found in section IV.

A. Winter Weather.

The winter season begins near the end of November and continues until middle or late March. The dominant air mass during this period is continental polar from Canada. January is the coldest month with an average daily high of 34 degrees and low of 19 degrees. December and February are both slightly warmer with a rather marked increase in temperature by late in March. Snowfall averages about 20 inches for the winter with a fairly even distribution throughout the four month period. Snowfall occurs as the result of two main storm tracks, the first the Texas wave or Colorado low with the second occurring with the weaker Alberta low.

The Texas wave occurs when the polar front is located within 400 miles to the south of Chanute and the upper level flow is southwesterly. Storms will develop in the lee of the Rockies and move into the area of the Texas panhandle. As they develop and move northeast, Chanute will experience widespread bad weather. Flying conditions will be IFR for extended periods with possible below minimum conditions for a period of days if the low level winds are from the Gulf of Mexico over the cold surface. Heavy snow can result if the wave deepens into a major storm. This will generally result if a fresh supply of Canadian air is available to the system. Freezing rain can result from this same type of system if temperatures below 700mb are above freezing.

The Alberta type low moves from the northwest at speeds ranging from 25 to 40 knots. Little moisture is generally available to these systems so resulting precipitation is not likely to be heavy. Since the storms are fast moving, the bad weather normally lasts for a period of 12 hours or less. If the storm is intense, snowfalls of 2-4" are not unlikely over a six hour period. These storms are often followed by a very strong polar outbreak. If the pressure gradient is very tight, near blizzard conditions may exist for several hours due to the very strong winds and blowing or drifting snow. Following this period, skies will clear quite rapidly, and temperatures may fall to zero or lower within 12 to 24 hours.

On occasions following a polar outbreak where the flow below 5000' is from the north or northeast, Chanute may experience low clouds and snow showers due to the effect of Lake Michigan. These conditions will usually be intermittant in nature and do not produce heavy snows here. To the north and east of Chanute, such conditions are much more common and produce heavy snows within one hundred miles of the lakes.

The new forecaster will have a tendency to underestimate the amount of cloudiness especially stratus variety in the winter. Even after the passage of a storm center to the east, low clouds may persist from 24 to 48 hours. This is true unless a strong high pressure system moves across the midwest from Canada.

When high pressure systems pass the midwest and become stationary along the East coast, bad weather is also likely. Temperatures will be mild with little diurnal change, but low cloudiness and occasional light precipitation will result. Freezing drizzle may result if the moisture moves north before surface temperatures have had a chance to modify. This type of weather may precede the formation of the Texas wave as described previously.

B. Spring Weather.

The spring season begins toward the latter part of March and continues into early June. The continental polar air mass is dominant in early spring; but as the polar front moves north, maritime polar and tropical air masses become more common. Late in March the average high is 50 degrees with an average low of 32 degrees. By late in May the average high is 75 degrees and the average low 55 degrees.

Through much of this period the polar regions are still very cold. At the same time, the rapidly increasing solar heating across the southern U.S. brings daytime temperatures to near summer levels. This tremendous thermal contrast makes spring the stormiest and thus windiest time of the year in the Midwest. Through mid-April the storm track will often still be south of Chanute. This is mainly due to the strong high pressure systems that persist over the cold waters of Hudson Bay or the Great Lakes during the spring season. The polar front is pushed south, and heavy rains or even snow will result in this area. These highs may persist as late as June and are the cause of the "back door cold fronts" in this area as spring progresses.

Even more common after early April are the intense lows that form in the western Plains and move toward Minnesota or Wisconsin. Strong southerly winds ahead of these lows will bring a sharp rise in temperatures and dew points to Chanute. As the lows continue to the northeast, the cold fronts will pass Chanute and bring much colder weather, especially in the early spring. Surface winds of 40 knots are not uncommon both before and after these frontal passages. This is especially true in late March and all of April and is not rare even in May. After frontal passage, cloudiness will be widespread for a day or two especially during the daylight hours. Very cold air aloft will trigger snow flurries in early spring and showers or thundershowers in late spring.

Most thunderstorm activity occurs ahead of the cold fronts during this season. This activity reaches a peak in central Illinois in May and early June. Air mass thundershowers are rare before summer except with the cold air aloft situations just described. When squall lines form in advance of the cold front, radar must be monitored closely for possible severe thunderstorms or even tornadoes. In the spring nearly all severe weather approaches from the southwest in line with the upper air flow.

Generally, ceilings and visibilities will be much improved over the previous winter season. The solar heating is much stronger and will normally dissipate radiation fog by mid-morning. The major exception to this occurs in early spring when the polar front is to the south and winter type Texas waves may still develop. By late spring, most daytime cloudiness is of the cumulous variety with fair conditions often resulting by sunset.

C. Summer Weather.

The summer season begins in early June and continues until the second week in September. The maritime tropical airmass dominates with occasional frontal passages bringing in strongly modified maritime polar air from the Pacific. July is the warmest month of the year with an average high of 86 degrees and low of 65 degrees. June and August are only slightly cooler. When the tropical air mass dominates, highs will reach the 90's with lows near 70. After the weak frontal passages, temperatures will range from the low 80's to near 60 at night.

Summer weather is controlled strongly by diurnal effect, as opposed to the well developed synoptic features of the other seasons. Morning ground fog is quite common due to high dew points and light winds. This will almost always disappear an hour or two after sunrise. Cumulus activity will normally appear by late morning. If the air is moist up to 700 mb, this activity will lead to airmass thundershowers by mid-afternoon. Otherwise, it will not usually develop to any great extent.

Although frontal passages do not produce great temperature changes as in spring, they are still the cause of much of the thunderstorm activity in this area. While severe thunderstorms are not as widespread as in spring, they can and do occur through the entire summer. With a weak storm track across southern Canada generally occurring through this period, the upper flow will be light westerly or even northwesterly. Nocturnal thunderstorms often result with the passage of a weak trough in this flow that was not apparent on the previous 500mb or 700mb map. Afternoon thundershowers over Iowa, Nebraska or even South Dakota are often a good indicator of this activity occurring here during the night. These storms are normally not the severe type.

The greatest likelihood of precipitation in the summer occurs after a cold front becomes stationary over southern Illinois and through Missouri and Kansas. The Bermuda high will bring overrunning moisture across this front. Weak surface waves will move east along the front and produce extensive thunderstorm activity. If the lifting mechanism is strong enough, squall lines will develop perpendicular to the upper flow. Severe weather may result with this type of system. It is most common in June and early July. By August the upper flow over the Midwest is so weak that little frontal activity of any kind exists.

This final period of summer is characterized by a strong ridge aloft producing a very strong low level inversion at night. Late summer is therefore often accompanied by periods of haze which persist through the day. Early morning visibilities will be very low, possibly below minimum for flying. By mid-morning surface visibilities will rise to 3-5 miles with little improvement the rest of the day. During these periods thunderstorm activity is very unlikely and temperatures will remain high.

D. Fall Weather.

The fall season begins around the second week in September and continues into late November. During the early fall maritime tropical and maritime polar air masses are dominant with an occasional continental polar intrusion. By late fall continental polar air dominates with maritime polar air prevalent the remainder of the time. September is quite mild with an average high of 78 degrees and a low of 55 degrees. October's averages range from 67 degrees to 45 degrees. The range drops sharply in November with a high of 49 degrees and a low of 31 degrees.

Fall weather is quite different from spring in many respects. Solar heating is weaker across the South while polar outbreaks are not too severe until November. For these reasons, storminess is not as widespread or severe as in the spring. Winds in September and October are much more moderate than in April and May. Thunderstorm activity drops off sharply in October with the drop in occurrence of maritime tropical air. By November, thunderstorms are very rare.

The first real sign of fall occurs when a rather deep upper trough develops over the Rockies with the first snows of the season at higher elevations. This trough is usually well developed enough to bring southerly flow and widespread shower activity to the midwest after the dry weather of late summer. These rains will often hit the area north and west of Chanute first but will move across the Midwest with a series of maritime polar fronts. The blocking effect of the Bermuda High, which is still fairly intense, keeps the trough aloft to the west which in turn keeps out any really cold weather.

By October, the westerlies are generally found at about this latitude. Late in the month, polar air will on occasion cover the entire midwest bringing freezing temperatures to all of Illinois. Most of the time the storms still move north of Chanute which brings about periods of mild, hazy weather known as "Indian Summer." These periods are also quite dry with good flying weather.

By November, the Bermuda high is very weak, and the prevailing winds aloft are from the northwest. Polar outbreaks will be quite pronounced. Cyclonic activity is increasing, especially over the relatively warm waters of the Great Lakes. With these storms comes extensive low cloudiness in the cold, moist air. Late in the month the polar front becomes well established to the south of Chanute with the first measurable snowfalls of the season likely.

SECTION III - CLIMATIC AIDS

Most of the charts and graphs in this section are from the Revised Uniform Summaries of Surface Weather Observations for the years 1936-1967. The cloud type chart is from the Illinois Water Survey Department. The tornado charts are from ESSA.

CEILING AND VISIBILITY CHARTS

1. The first four pages of charts give the percentage frequency of ceiling and/or visibility values being below various criteria. The variables involved are month of the year and time of day. The greater likelihood of poor flying conditions in the winter months is evident in all four charts.

2. The next chart shows the likelihood of selected flying conditions by month only. Here the graphs are drawn to show the percentage equal to or greater than the criteria involved.

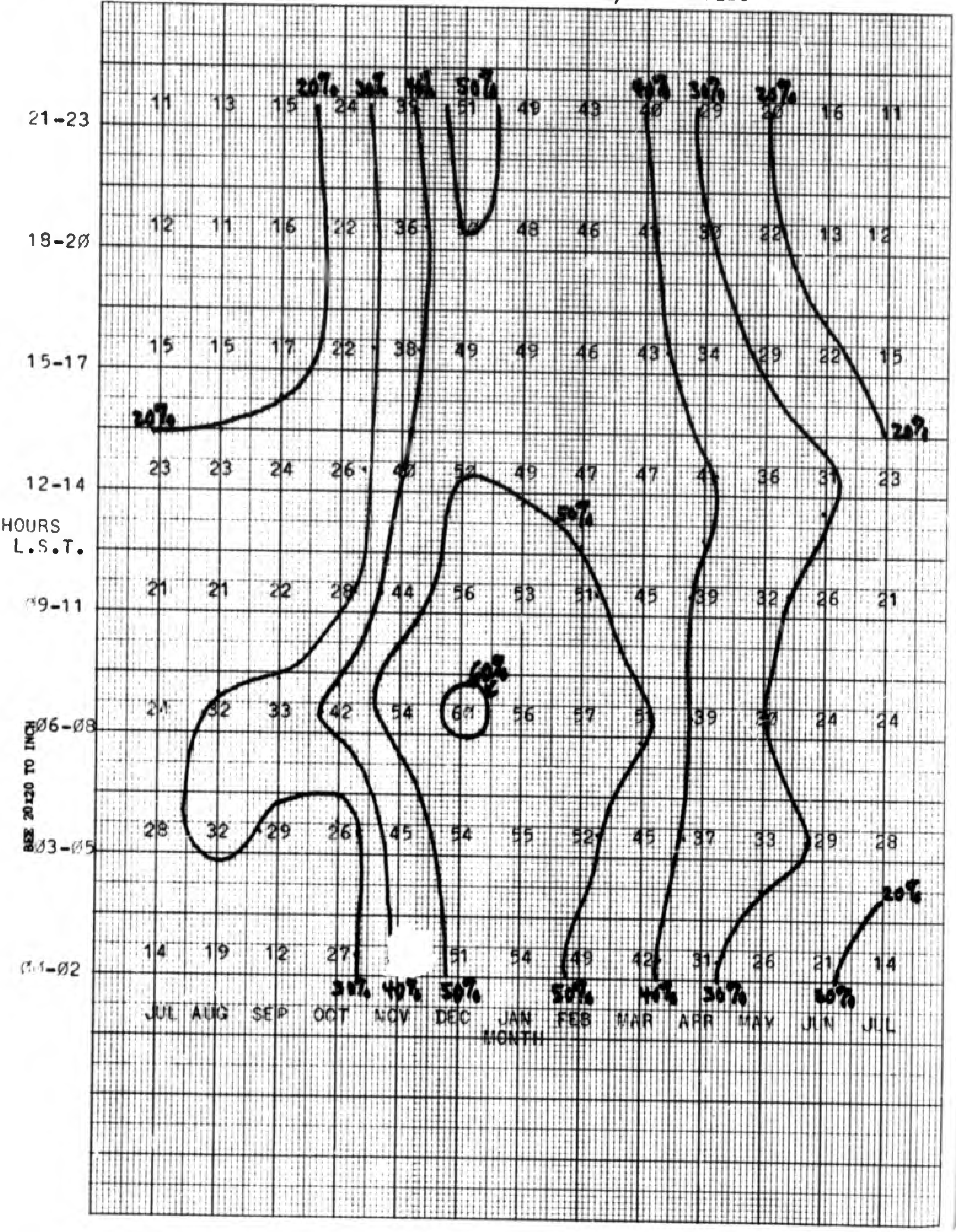
3. The next four pages have two charts breaking up ceiling and visibility criteria into four different values. Following this are charts of total sky cover and a breakup of sky cover into four categories.

4. The final chart in this section gives the number of occurrences for various cloud types at Chanute over a seven year period.

5. The following visibility limitations should be noted. An insufficient number of markers will cause groupings at various distances. One good four mile marker will cause a grouping at that value. Under four miles there are a number of good check points in all directions except beyond the buildings to the west. Night visibility points to the east are mainly small farm houses and are not too reliable.

RU SWO
936-1967

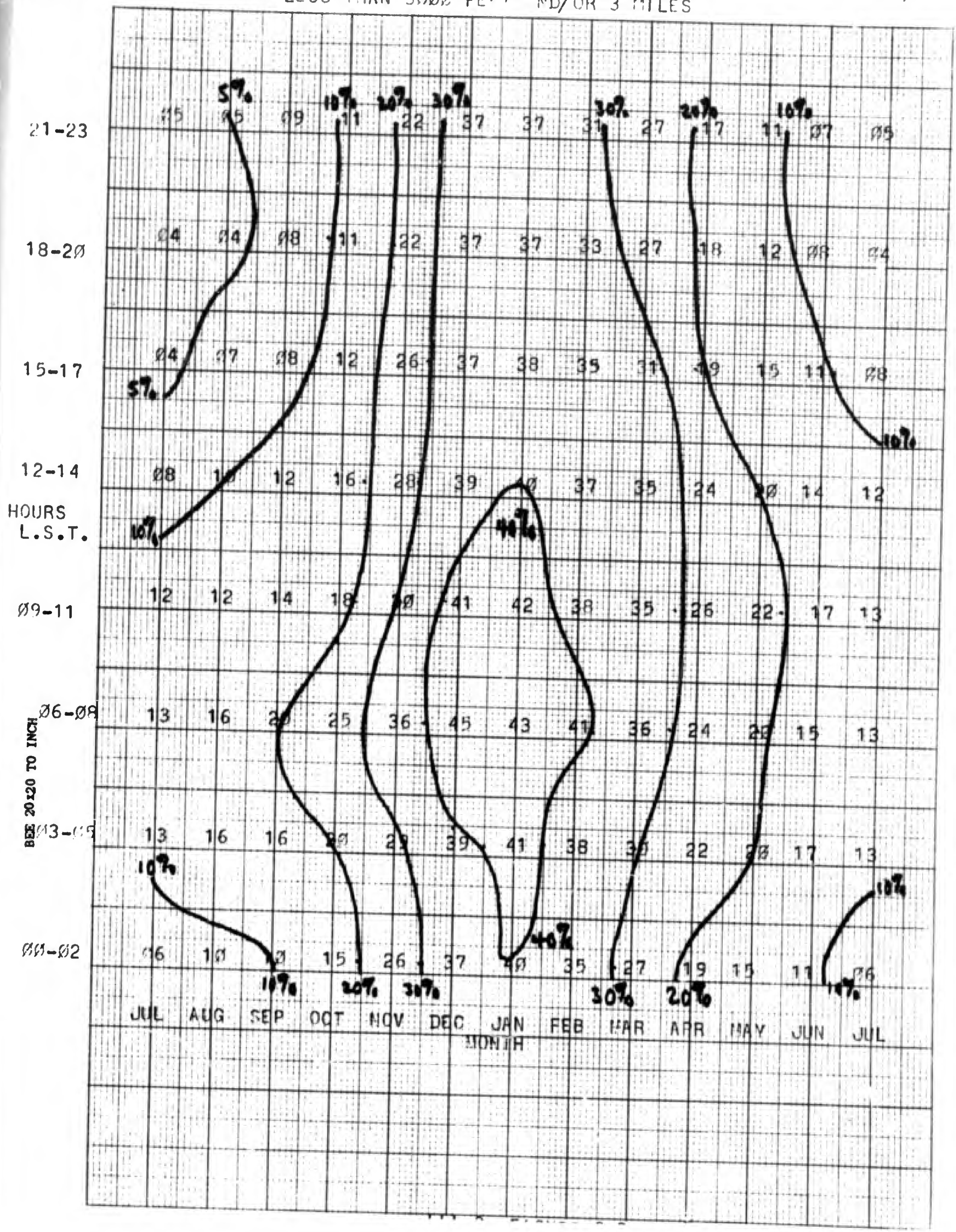
PERCENT FREQUENCY OF OCCURRENCE (CEILING AND VISIBILITY) LESS THAN 5000 FEET AND/OR 5 MILES



HOURS L.S.T.	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
21-23	11	13	15	24	39	51	49	43	40	29	20	16	11
18-20	12	11	16	22	36	[illegible]	48	46	41	30	22	13	12
15-17	15	15	17	22	38	49	49	46	43	34	29	22	15
12-14	23	23	24	26	40	52	49	47	47	41	36	31	23
09-11	21	21	22	28	44	56	53	51	45	39	32	26	21
06-08	24	32	33	42	54	61	56	57	[illegible]	39	27	24	24
03-05	28	32	29	26	45	54	55	52	45	37	33	29	28
00-02	14	19	12	27	[illegible]	51	54	49	42	31	26	21	14

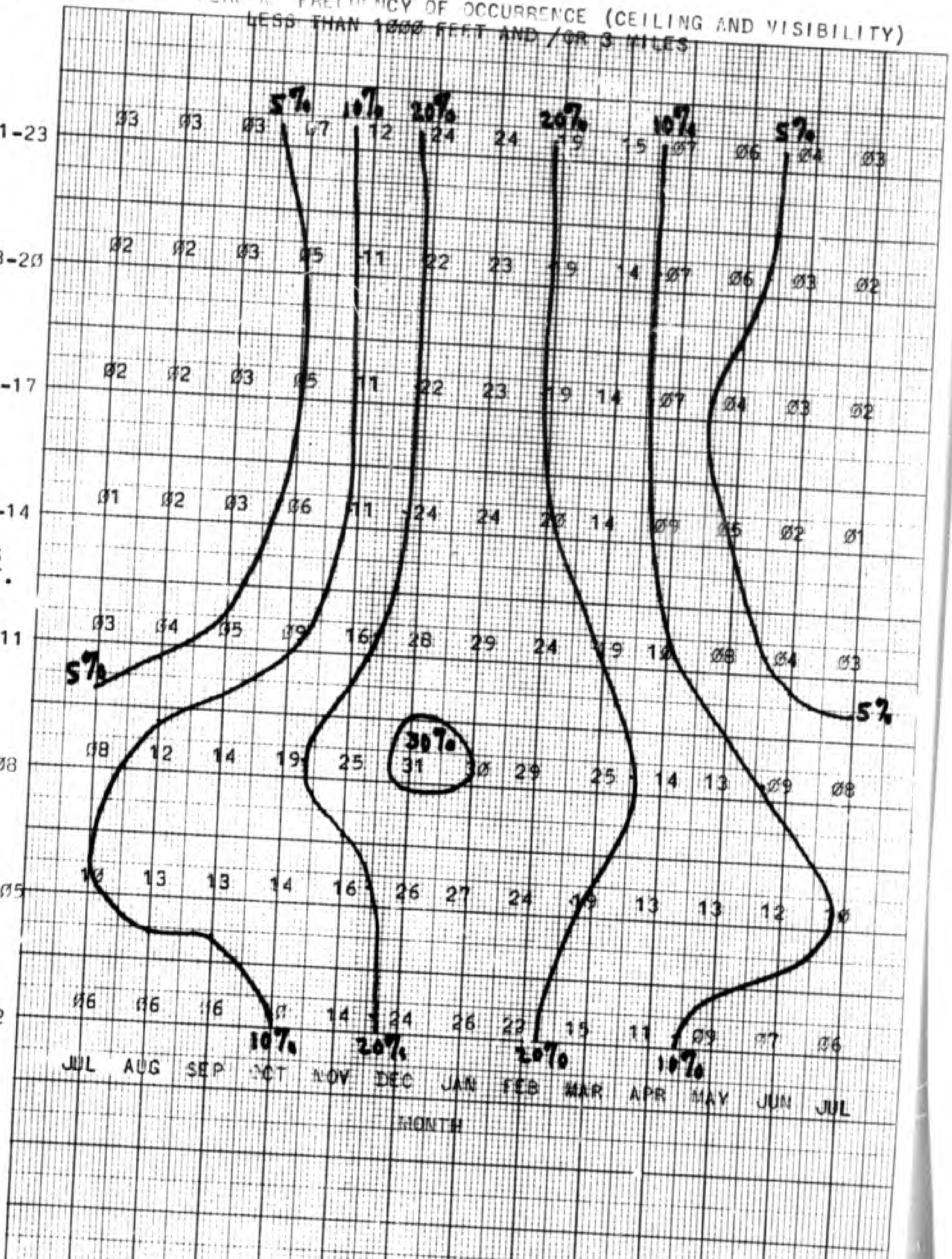
BOS WO
1936-1967

PERCENT FREQUENCY OF OCCURRENCE (CEILING AND VISIBILITY)
LESS THAN 3000 FEET AND/OR 3 MILES



RUSSWO
1936-1967

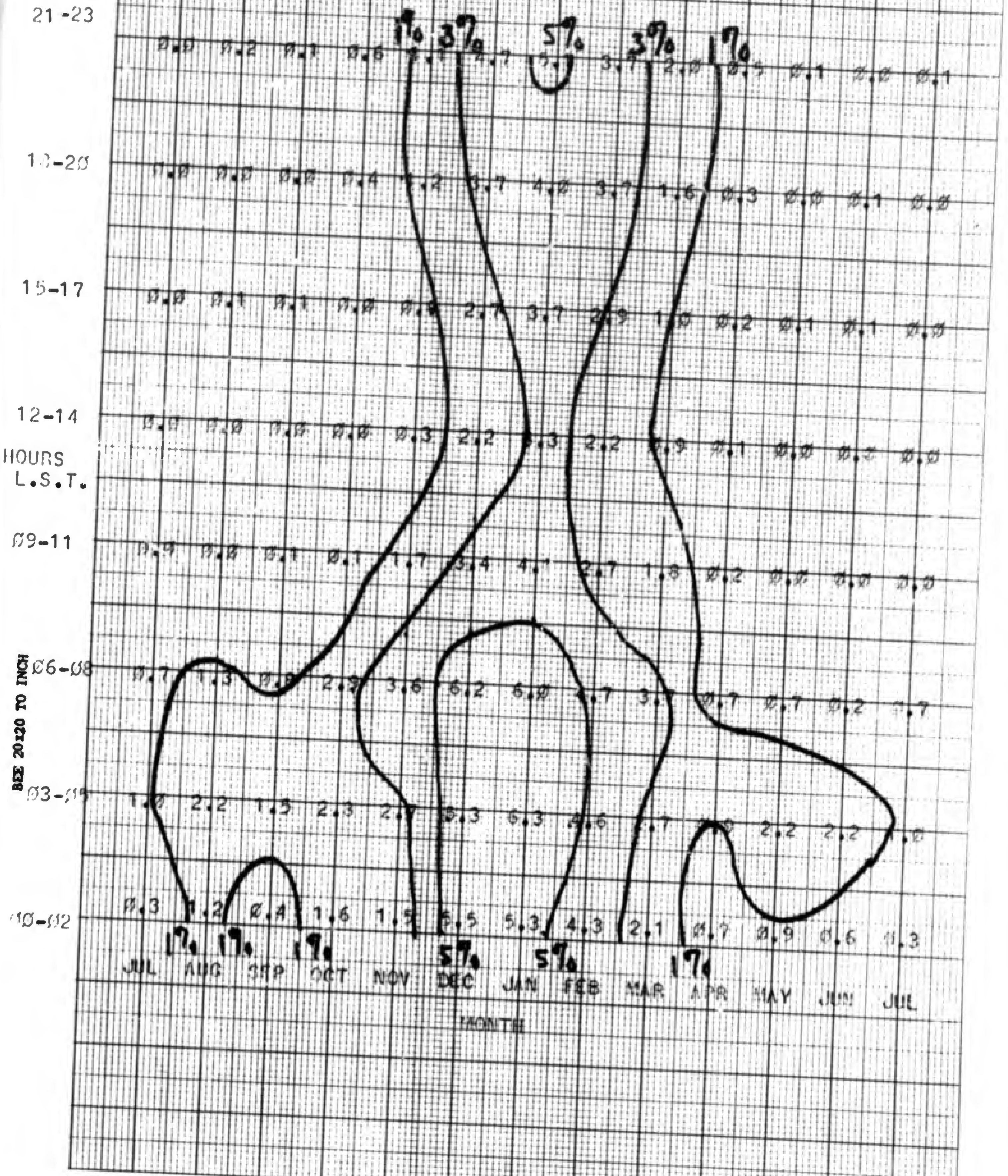
PERCENT FREQUENCY OF OCCURRENCE (CEILING AND VISIBILITY) LESS THAN 1000 FEET AND/OR 3 MILES



HOURS L.S.T.	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL
21-23	03	03	03	07	12	24	24	19	15	07	06	04	03
18-20	02	02	03	05	11	22	23	19	14	07	06	03	02
15-17	02	02	03	05	11	22	23	19	14	07	04	03	02
12-14	01	02	03	06	11	24	24	20	14	09	05	02	01
09-11	03	04	05	09	16	28	29	24	19	10	08	04	03
06-08	08	12	14	19	25	31	30	29	25	14	13	09	08
03-05	10	13	13	14	16	26	27	24	19	13	13	12	10
00-02	06	06	06	10	14	24	26	22	15	11	09	07	06

[illegible]
1936-1967

PERCENT FREQUENCY OF OCCURRENCE (CEILING AND VISIBILITY)
LESS THAN 200 FEET AND/OR 1/2 MILE



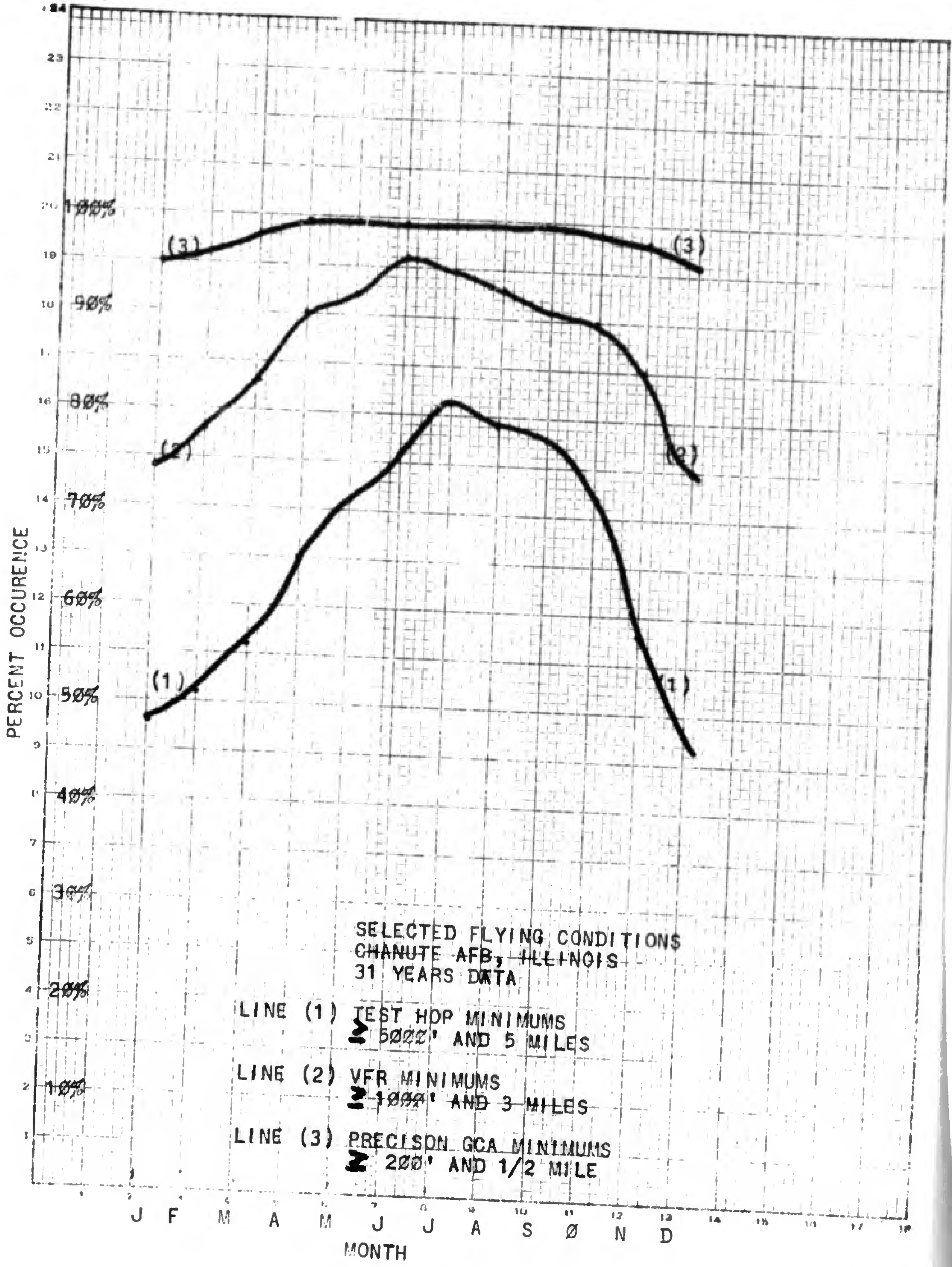
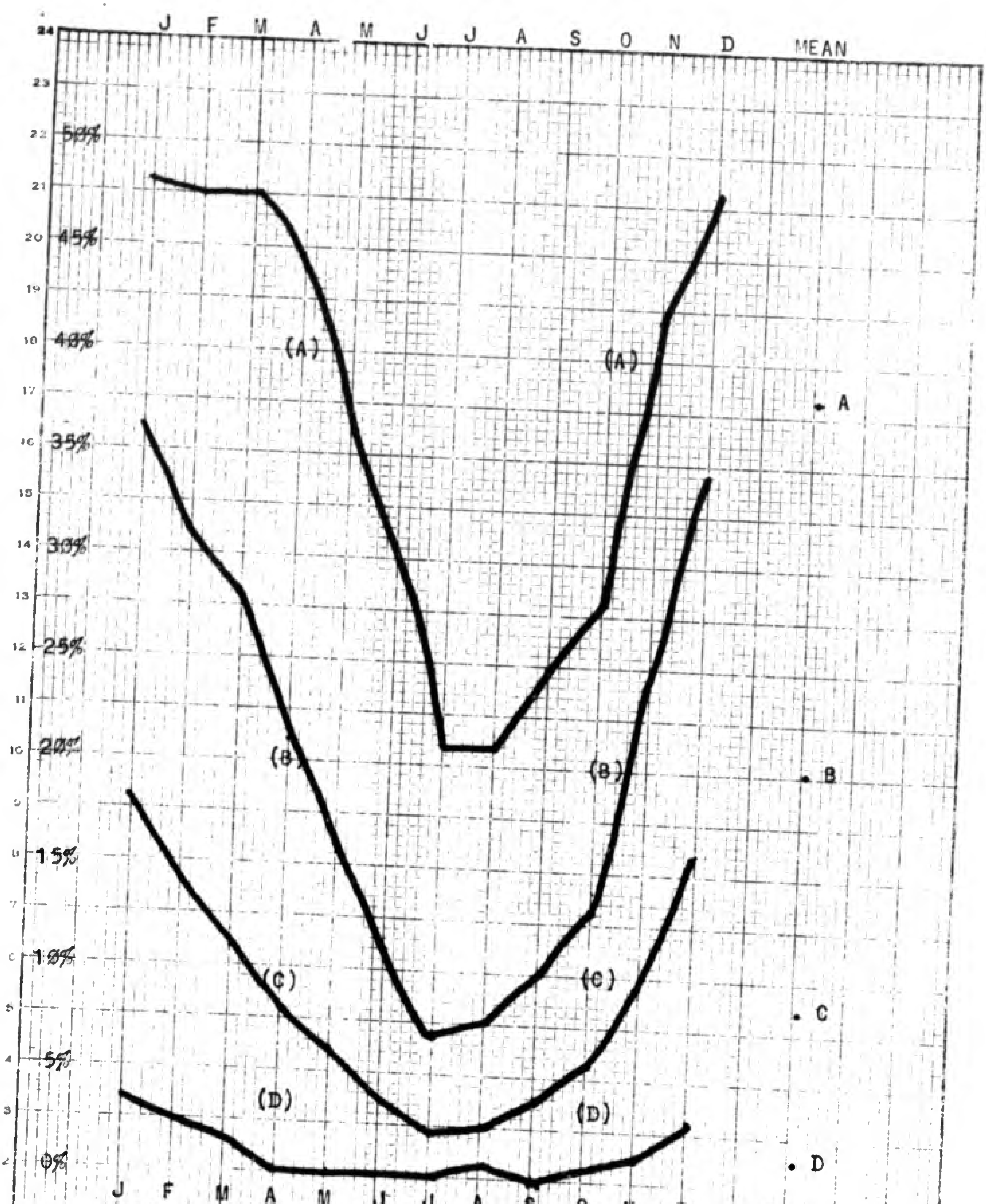

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
PERCENT OCCURENCE
(1)
(2)
(3)
J F M A M J J A S O N D
MONTH
SELECTED FLYING CONDITIONS
~~CHANUTE AFB, ILLINOIS~~
31 YEARS DATA
LINE (1) TEST HOP MINIMUMS
≥ 5000' AND 5 MILES
LINE (2) VFR MINIMUMS
≥ ~~1000' AND 3 MILES~~
LINE (3) PRECISON GCA MINIMUMS
≥ 200' AND 1/2 MILE

FIGURE 4



PERCENTAGE FREQUENCY OF OBSERVATIONS BY THEMONTH
WITH CEILINGS LESS THAN THE FOLLOWING:
A=10,000' B=3,000' C=1,000' D=200'

III-7 FIGURE 5-A

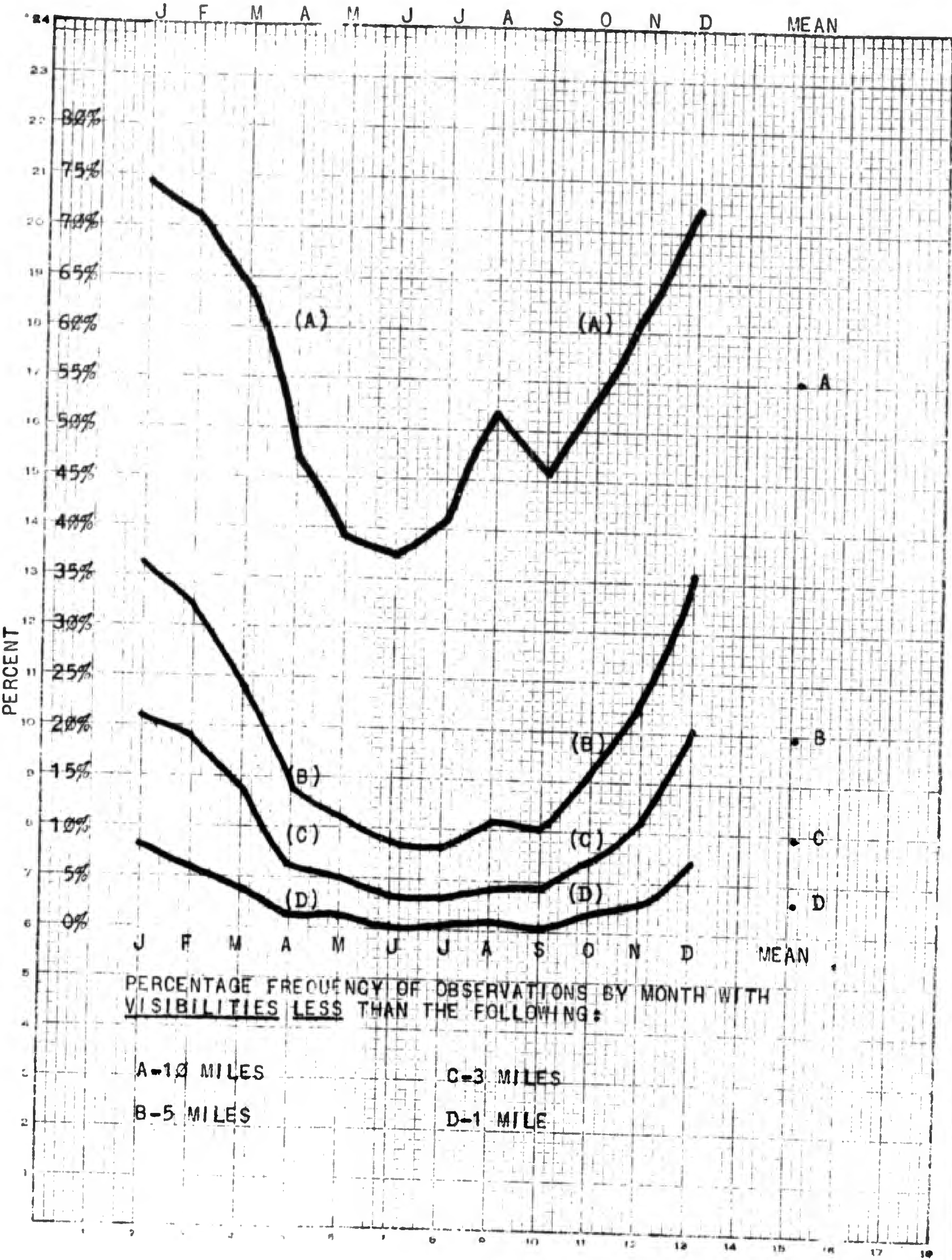
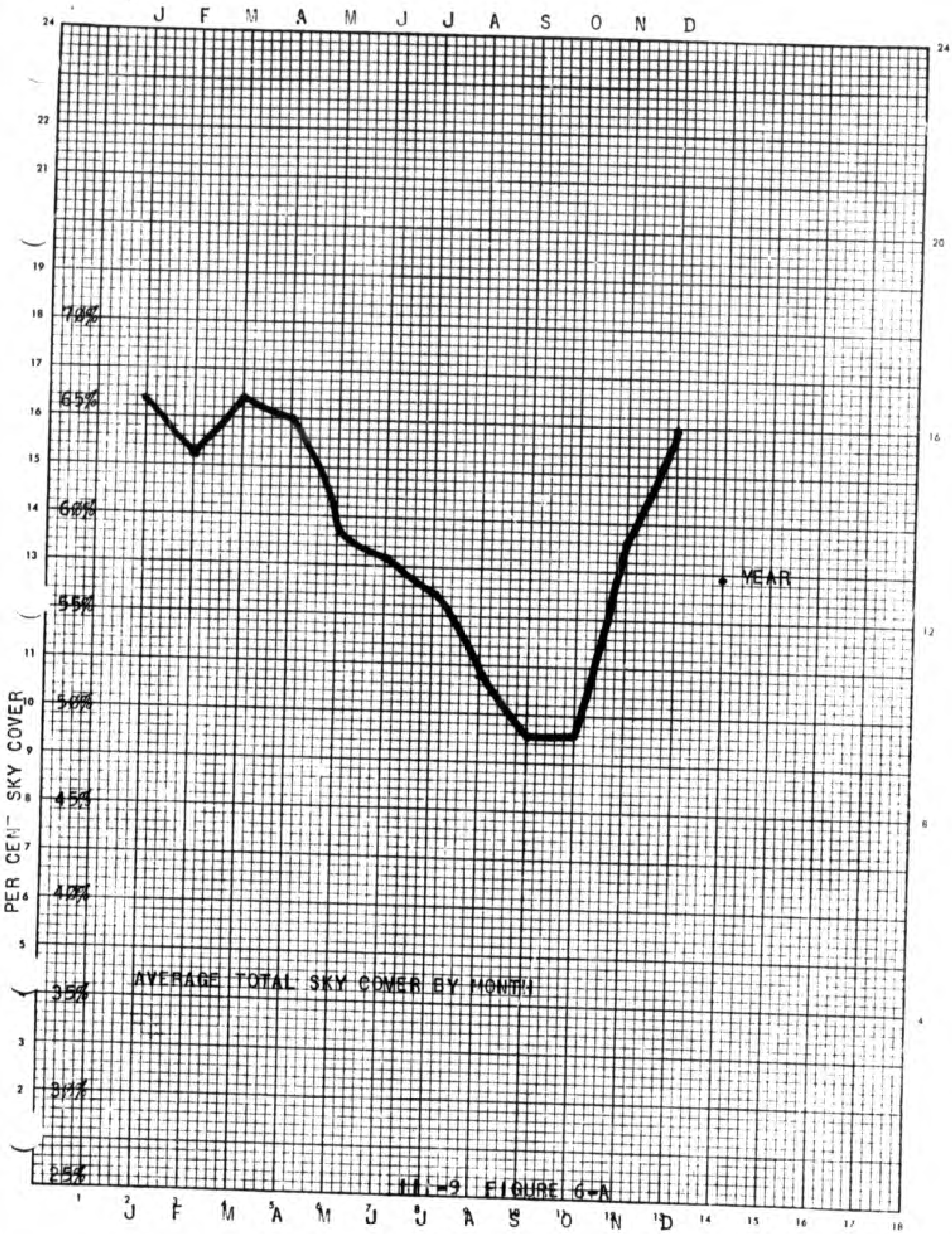

J F M A M J J A S O N D MEAN
80%
75%
70%
65%
60%
55%
50%
45%
40%
35%
30%
25%
20%
15%
10%
5%
0%
PERCENT
(A)
(A)
(B)
(B)
(C)
(C)
(D)
(D)
A
B
C
D
J F M A M J J A S O N D MEAN
PERCENTAGE FREQUENCY OF OBSERVATIONS BY MONTH WITH VISIBILITIES LESS THAN THE FOLLOWING:
A-10 MILES
B-5 MILES
C-3 MILES
D-1 MILE

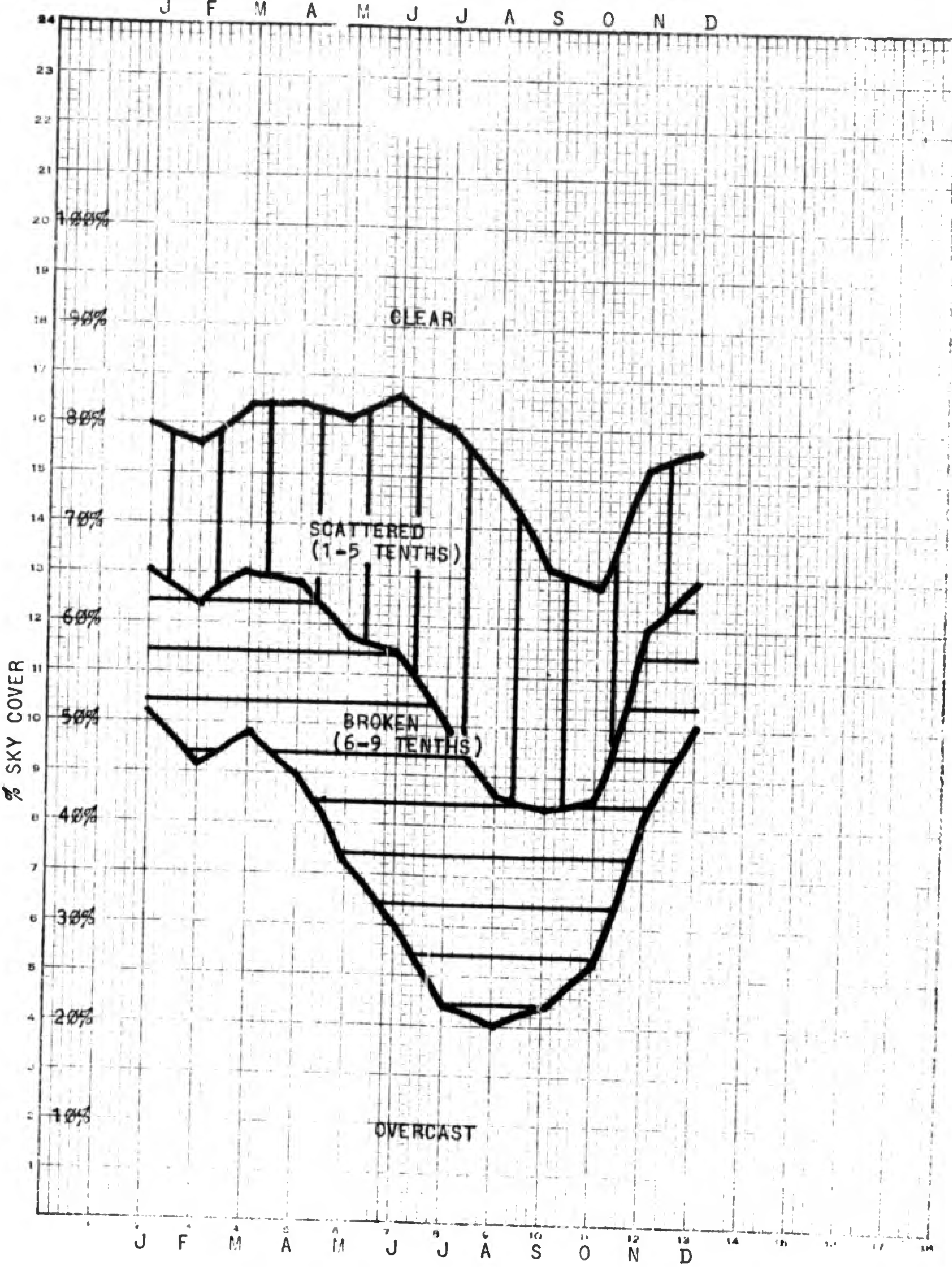
FIGURE 5-B



AVERAGE TOTAL SKY COVER BY MONTH

FIGURE 6-A

PERCENT OF DAYS EACH MONTH WITH INDICATED SKY COVER



III-10 FIGURE 6-B

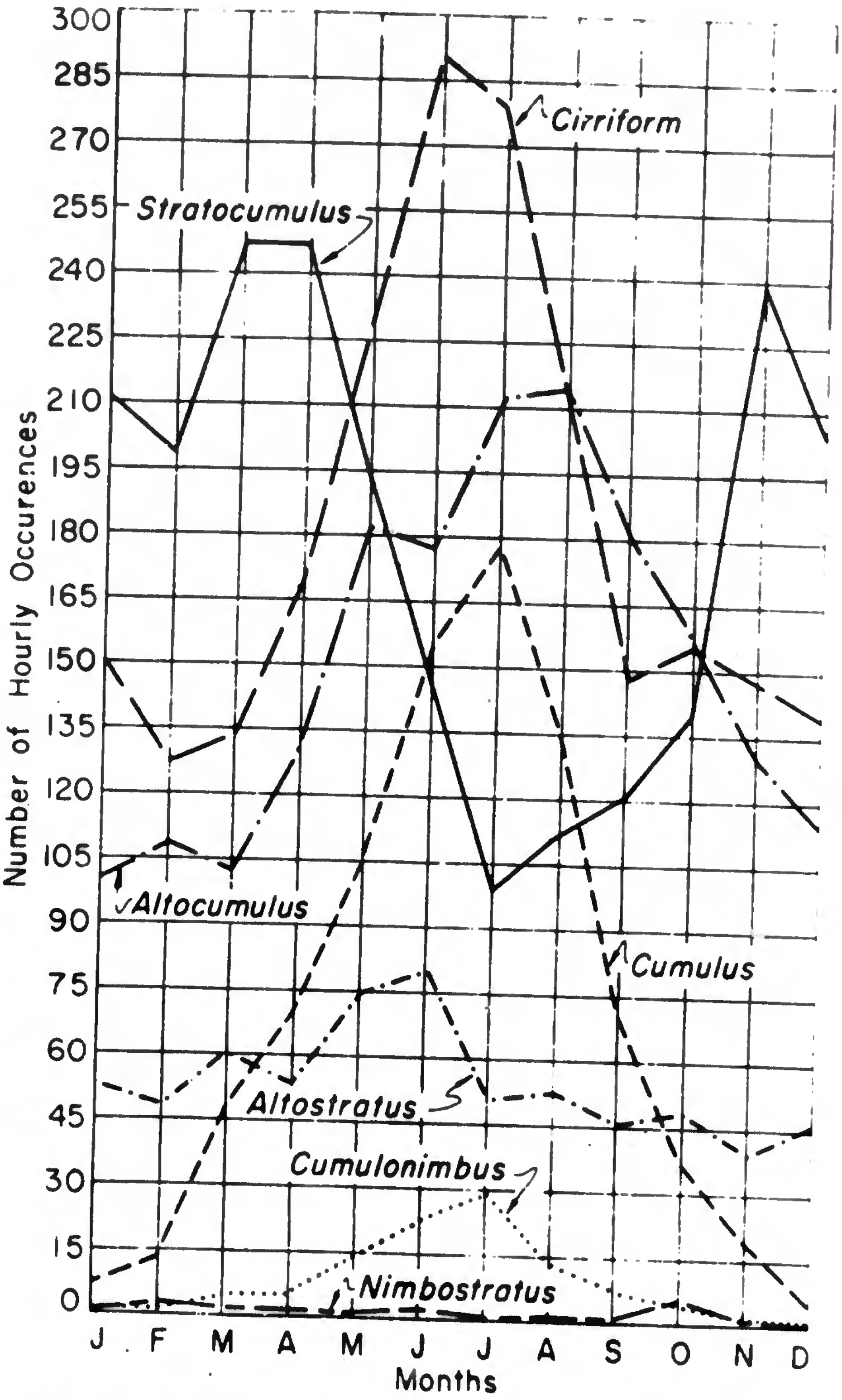


FIG. 54 AVERAGE MONTHLY NUMBER OF CLOUD OCCURENCES AT RANTOUL, 1949-1955
PREPARED BY, ILLINOIS WATER SURVEY DEPARTMENT

ANNUAL TEMEPRATURE CHARTS

Description:

Annual temperature variation by months for Chanute, based on 20 years data. All temperatures are shown in degrees fahrenheit. The mean maximum, average and mean minimum temperature are represented by smooth curves. These curves suggest a gradual change from day to day for the entire year.

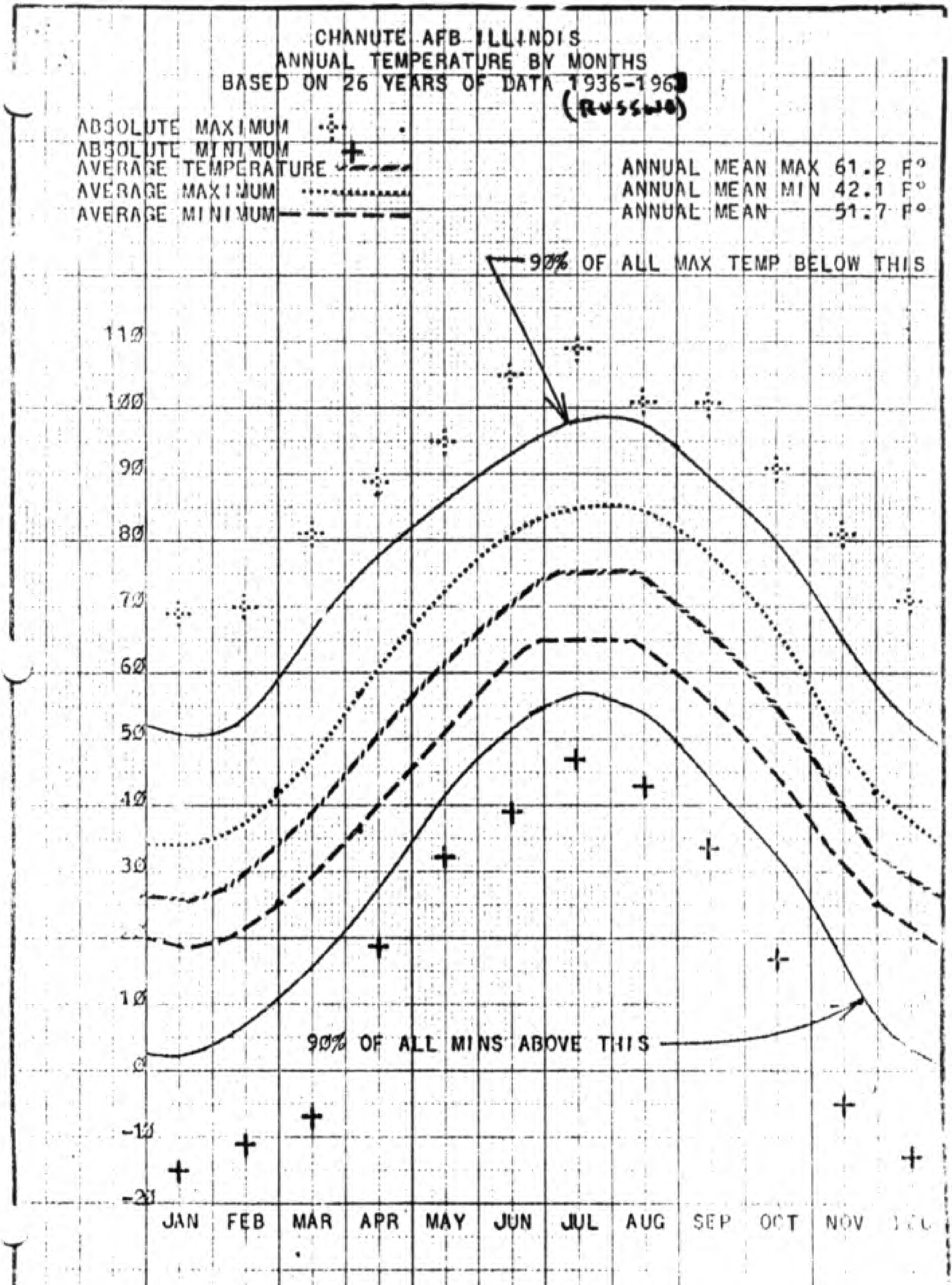
Limitations:

This gradual change is not the true picture when we consider the variability of the extremes and the method of computation of the maximum, minimum, and average temperature.

There are in every month, with possibly the exception of the summer months, a large number of overlapping of maximum and minimum temperatures. The computation of the mean maximum and mean minimum lead to conservative changes from month to month and there fore produce a smooth curve. Examination of the tabular data show a tendency to group near the middle of the range of variation and the frequency of occurrence becomes progressively less towards the extreme range of variations.

Use:

The temperature charts displayed while subject to the above condition, fortunately becomes a useful tool. Keep in mind the extremes are rare occurrence and the bulk of data is concentrated around their respective mean. The 90% above for minimum and 90% below for maximum temperatures will assist the forecaster when dealing with extreme values.



CHANUTE AFB ILLINOIS
ANNUAL TEMPERATURE BY MONTHS
BASED ON 26 YEARS OF DATA 1936-196
(RUSSWO)

III-13 Figure 8

PRECIPITATION CHARTS:

1. The first chart gives precipitation figures for the twelve months. Each month has.three values plotted, the greatest monthly precipitation, the average monthly precipitation and the least monthly precipitation for the period given. The highest averages are in late spring and early summer. The lowest are in late fall and most of winter.

2. The second chart gives snowfalldata for the twelve months. The data is plotted in the exact same way with three bar graphs for each month. Little variation in average snowfall is shown through the winter months.

MONTHLY PRECIPITATION (1938-1964)

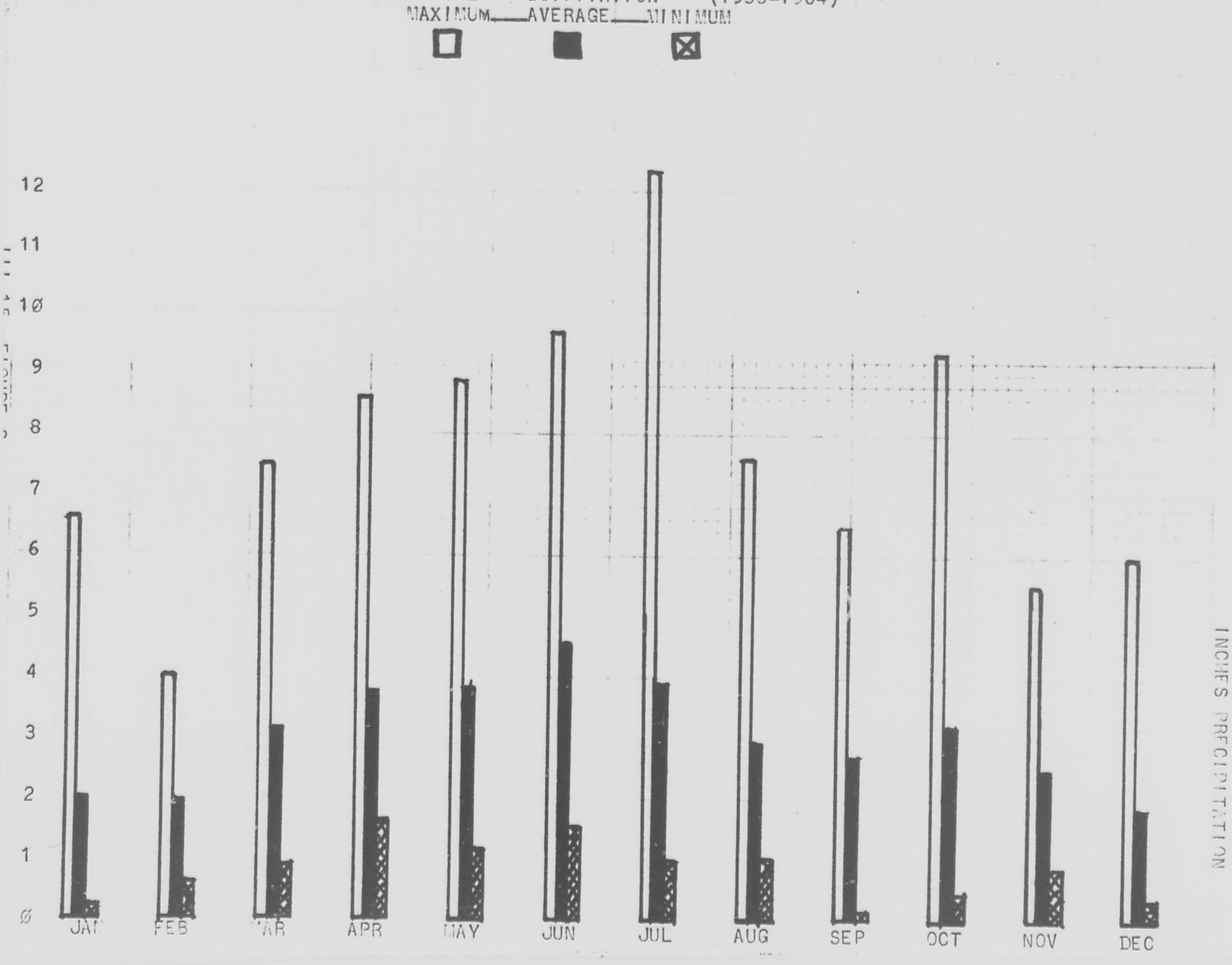
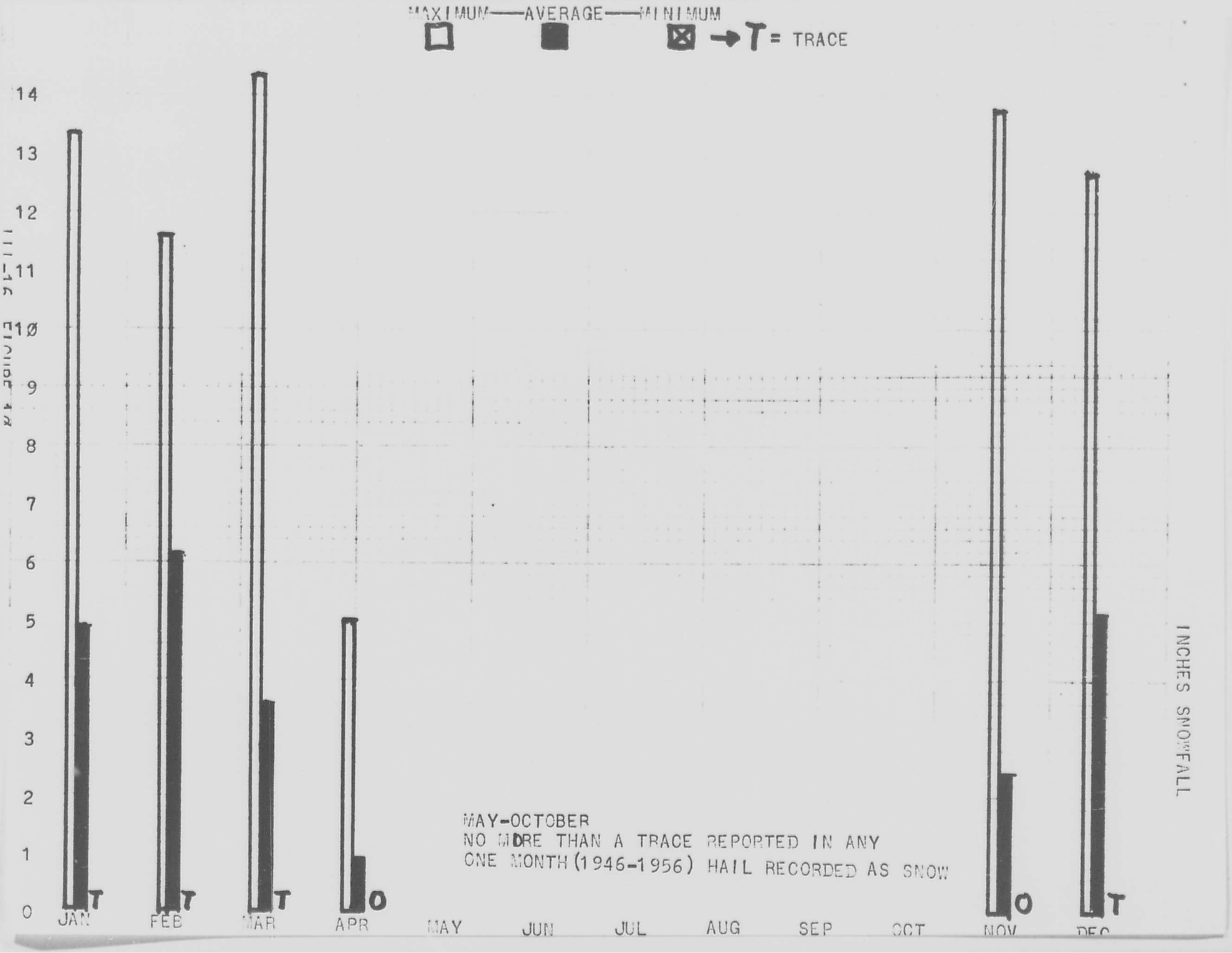


FIGURE 10

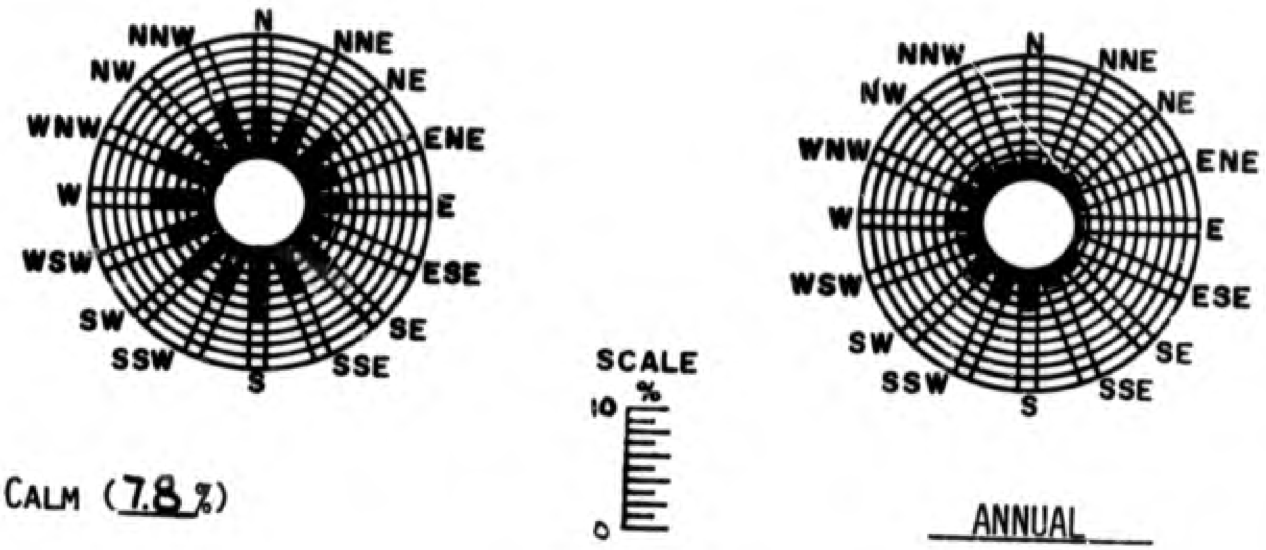


MAY-OCTOBER
NO MORE THAN A TRACE REPORTED IN ANY
ONE MONTH (1946-1956) HAIL RECORDED AS SNOW

SURFACE WIND ROSES:

1. Wind roses are plotted for the twelve months and for the total year. Data was accumulated over 31 years and was taken from the RUSSWO. There are two roses plotted for each month, one for winds ten knots or less and the other for winds eleven knots or greater. The percentage of calm winds is also given. Each division on the radial represents one percent of the total winds for that month. This means that the total of the radials on both wind roses plus the total of calm winds will add up to one-hundred percent. Thus the likelihood of winds greater than ten knots is also shown in addition to the directional percentages.

SURFACE WINDS



LESS THAN 11 KTS (63.6 %)

EQUAL TO/GREATER THAN 11 KTS (28.4%)

CALM (7.8 %)

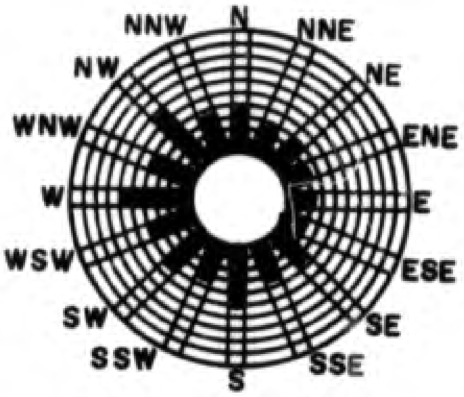
ANNUAL

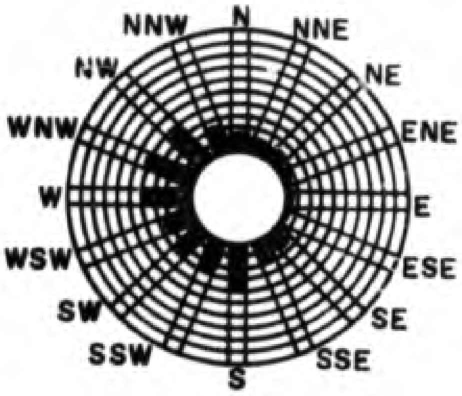
FIGURE 11

SURFACE WINDS

LESS THAN 11 KTS (58.5%)

EQUAL TO/GREATER THAN 11 KTS (36.2%)





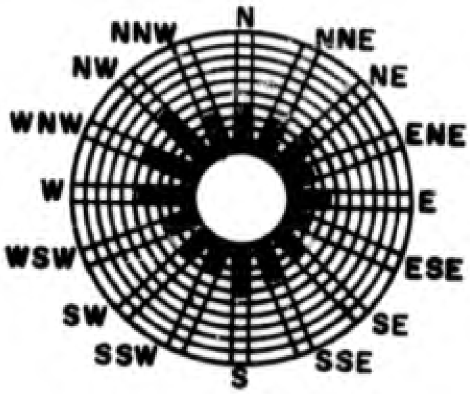
CALM (5.3%)

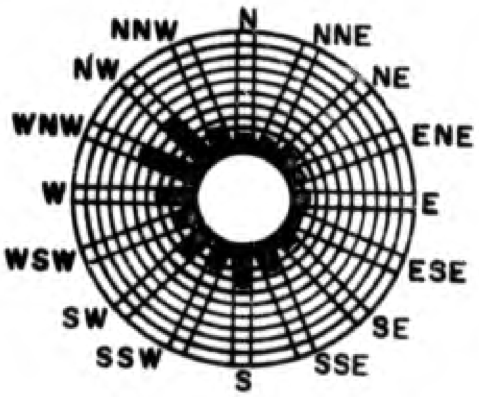
MONTH: JAN

SURFACE WINDS

LESS THAN 11 KTS (56.3%)

EQUAL TO/GREATER THAN 11 KTS (38.3%)





CALM (5.4%)

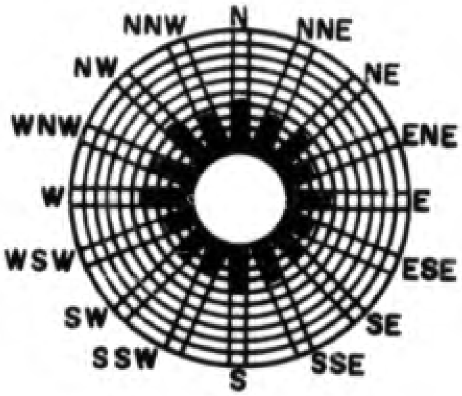
MONTH: FEB

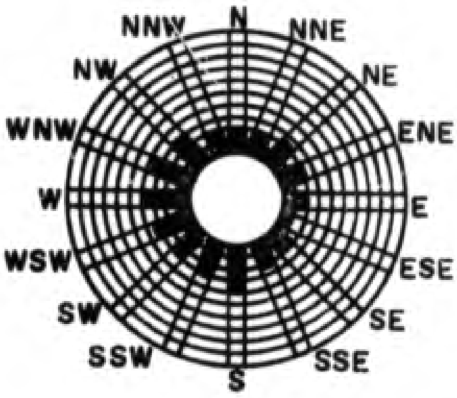
FIGURE 12

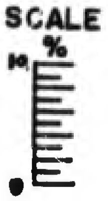
SURFACE WINDS

LESS THAN 11 KTS (54.0%)

EQUAL TO/GREATER THAN 11 KTS (41.5%)







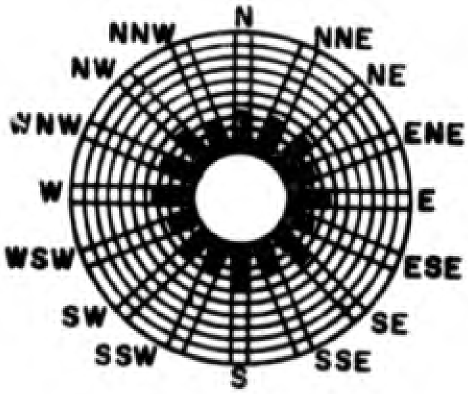
CALM (4.5%)

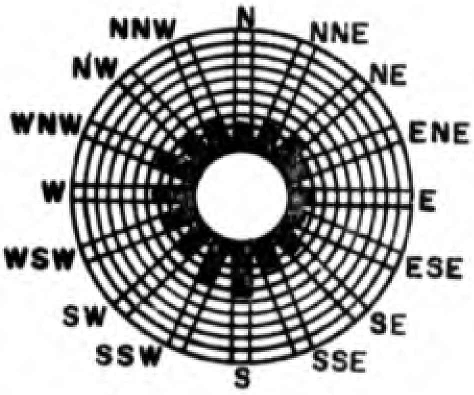
MONTH: MAR

SURFACE WINDS

LESS THAN 11 KTS (50.7%)

EQUAL TO/GREATER THAN 11 KTS (45.2%)





CALM (4.1%)

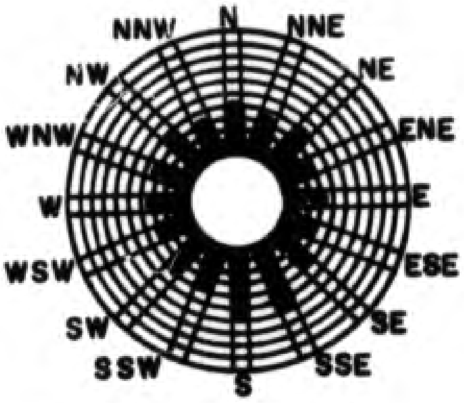
MONTH: APR

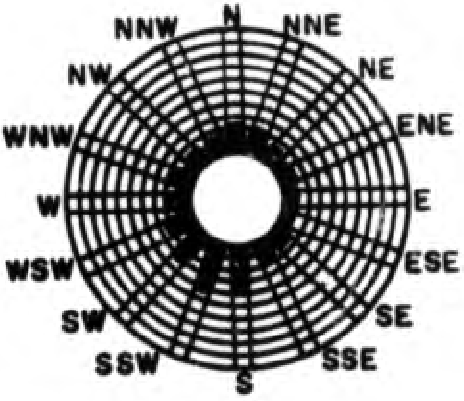
FIGURE 13

SURFACE WINDS

LESS THAN 11 KTS (60.2%)

EQUAL TO/GREATER THAN 11 KTS (33.9%)





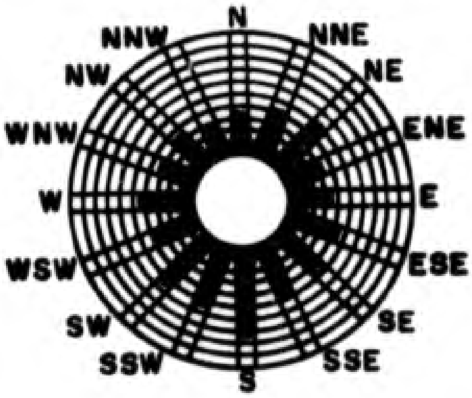
CALM (5.9%)

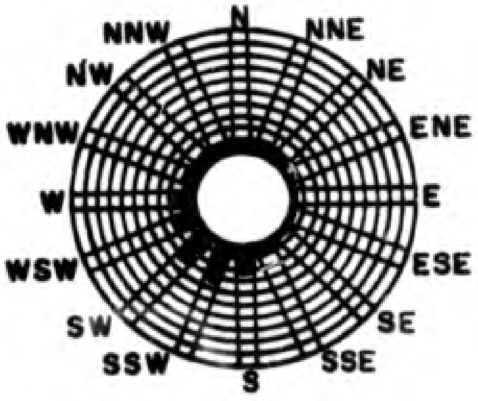
MONTH: MAY

SURFACE WINDS

LESS THAN 11 KTS (68.8%)

EQUAL TO/GREATER THAN 11 KTS (22.3%)





CALM (8.8%)

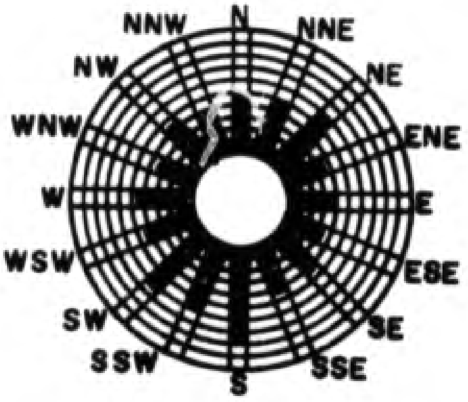
MONTH: JUN

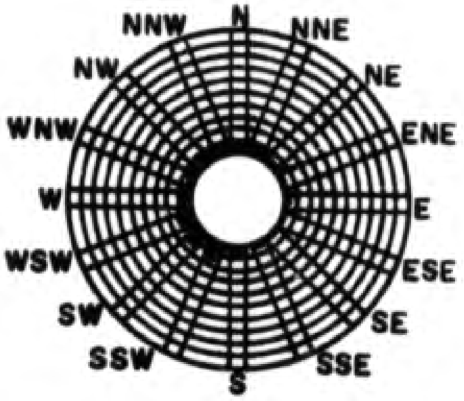
FIGURE 14

SURFACE WINDS

LESS THAN 11 KTS (75.9%)

EQUAL TO/GREATER THAN 11 KTS (11.9%)





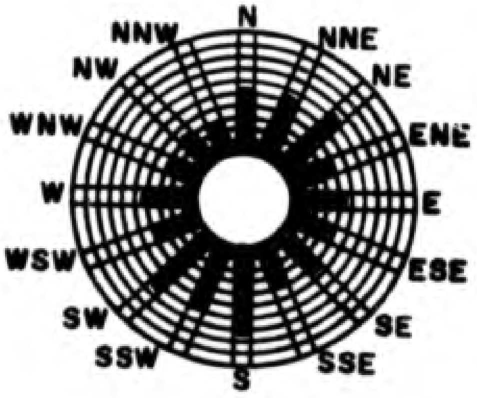
CALM (12.2%)

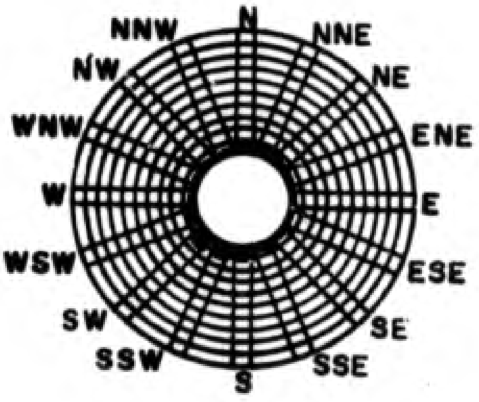
MONTH: JUL

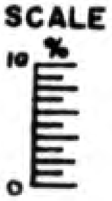
SURFACE WINDS

LESS THAN 11 KTS (74.5%)

EQUAL TO/GREATER THAN 11 KTS (11.0%)







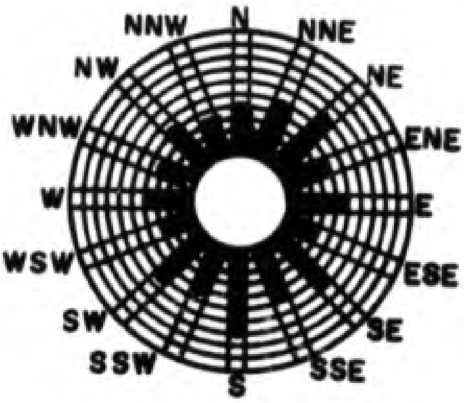
CALM (14.4%)

MONTH: AUG

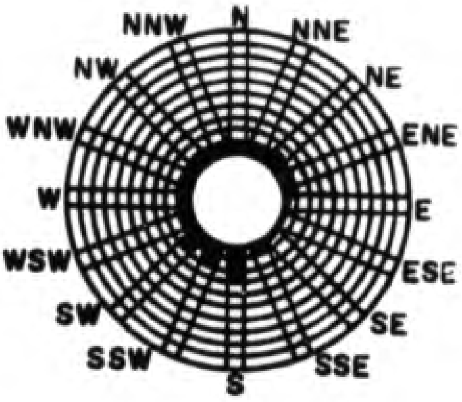
FIGURE 15

SURFACE WINDS

LESS THAN 11 KTS (71.9%)



EQUAL TO/GREATER THAN 11 KTS (17.1%)

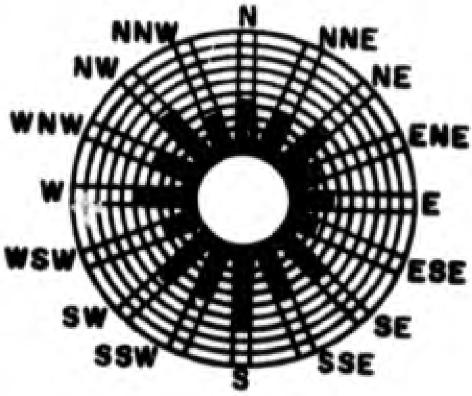


CALM (11.0%)

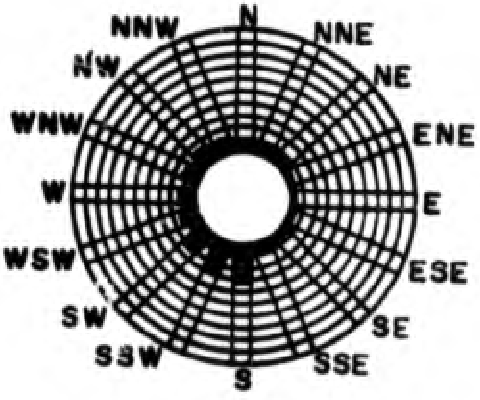
MONTH: SEP

SURFACE WINDS

LESS THAN 11 KTS (68.4%)



EQUAL TO/GREATER THAN 11 KTS (21.7%)



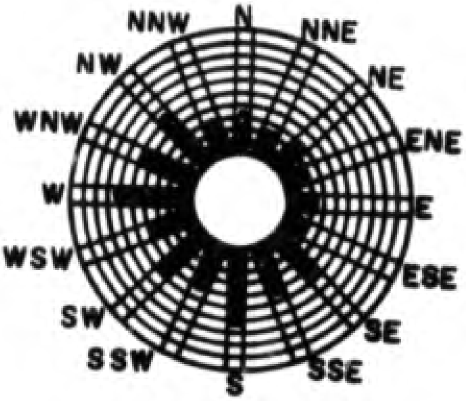
CALM (9.8%)

MONTH: OCT

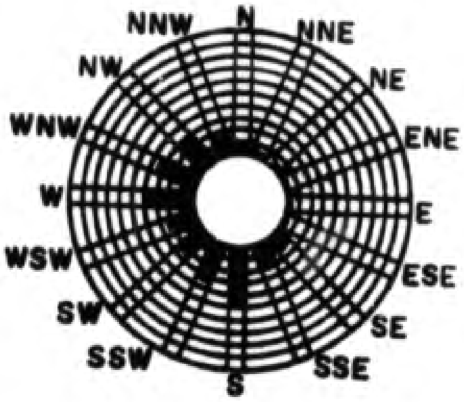
FIGURE 16

SURFACE WINDS

LESS THAN 11 KTS (61.5 %)



EQUAL TO/GREATER THAN 11 KTS (31.8 %)

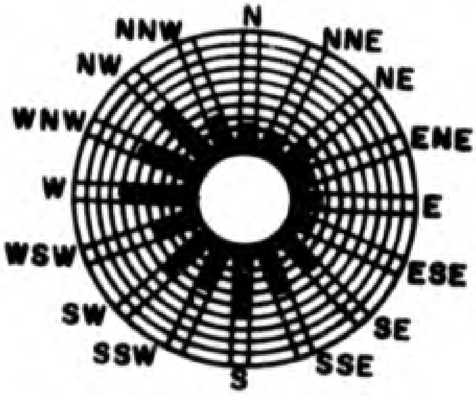


CALM (6.1 %)

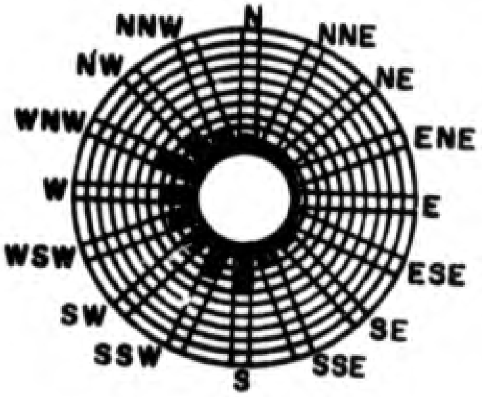
MONTH: Nov

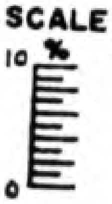
SURFACE WINDS

LESS THAN 11 KTS (62.5 %)



EQUAL TO/GREATER THAN 11 KTS (31.8 %)





CALM (5.6 %)

MONTH: DEC

FIGURE 17

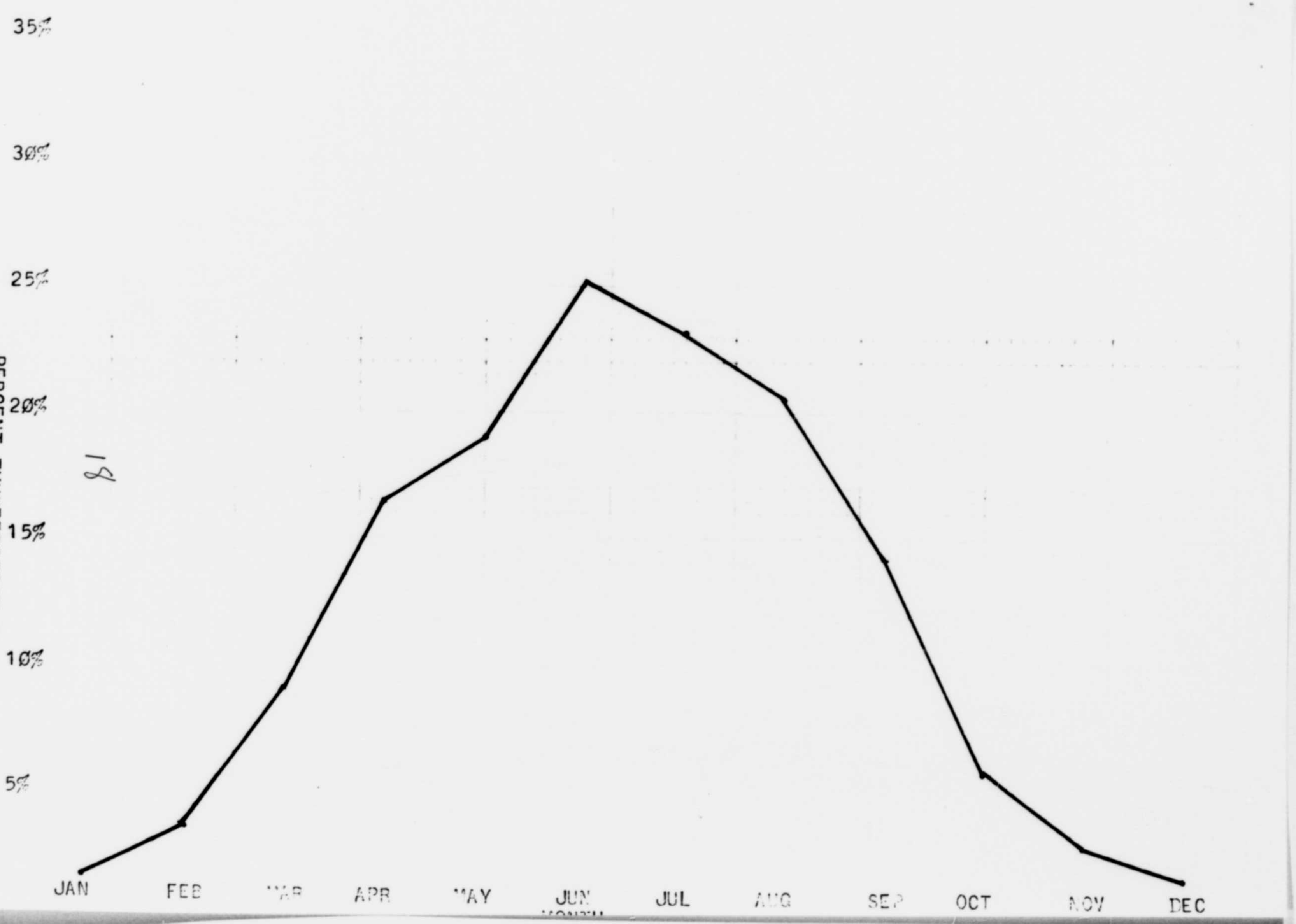
THUNDERSTORM AND TORNADO CHARTS:

1. The first two charts give percentages of thunderstorm occurrence. The first one gives the percent of thunderstorm days for each month. The second one gives percent of thunderstorm occurrence by both month of the year and time of day.

2. The final four charts are related to tornado occurrence and are from ESSA. Each is adequately described. Obviously, Chanute is in an area of high tornado likelihood.

1936-1967

PERCENT DAYS WITH THUNDERSTORMS



18

III-26 FIGURE 18

PERCENT FREQUENCY OF THUNDERSTORM OCCURRENCE
BY MONTH AND HOUR OF DAY

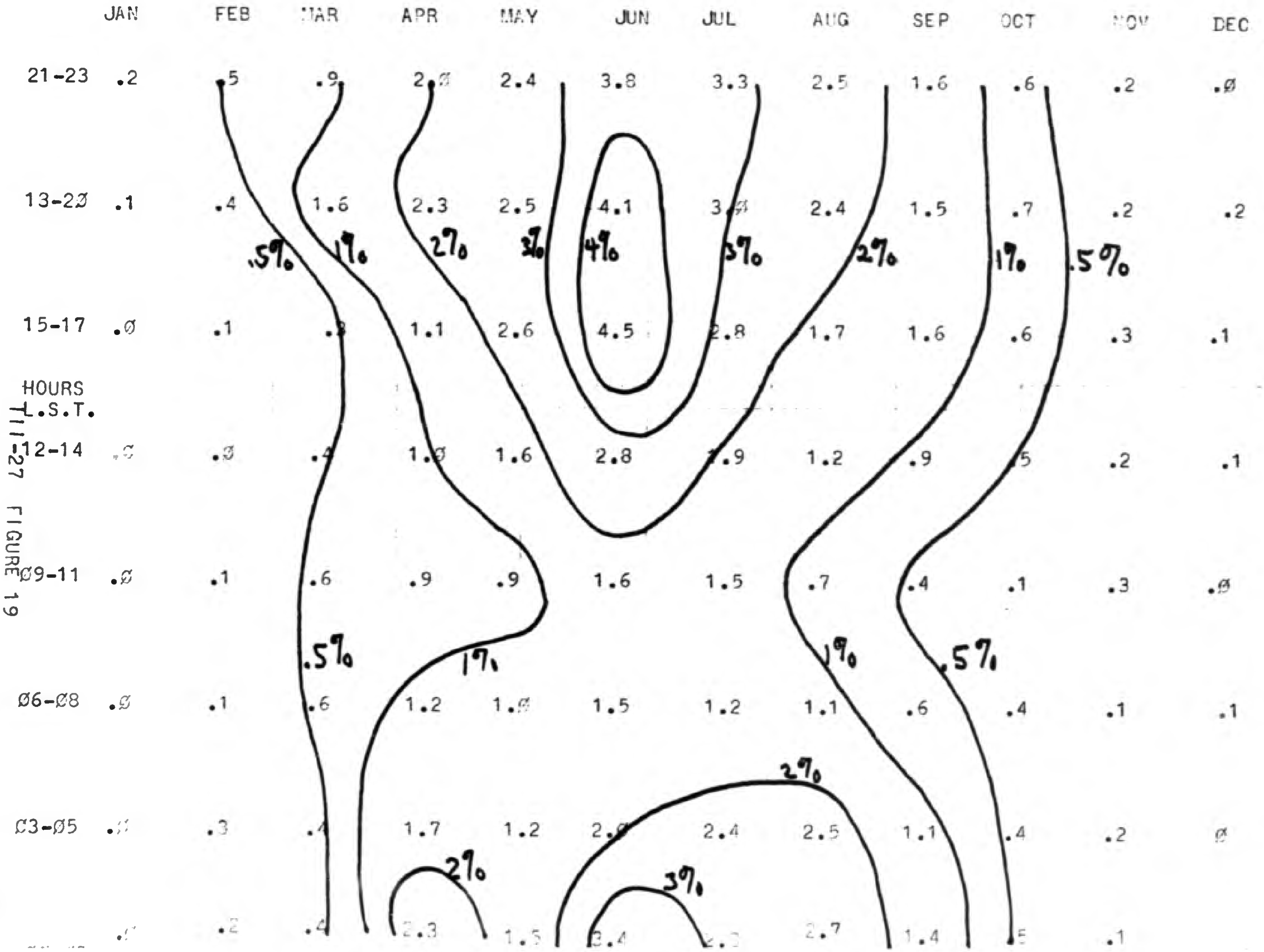
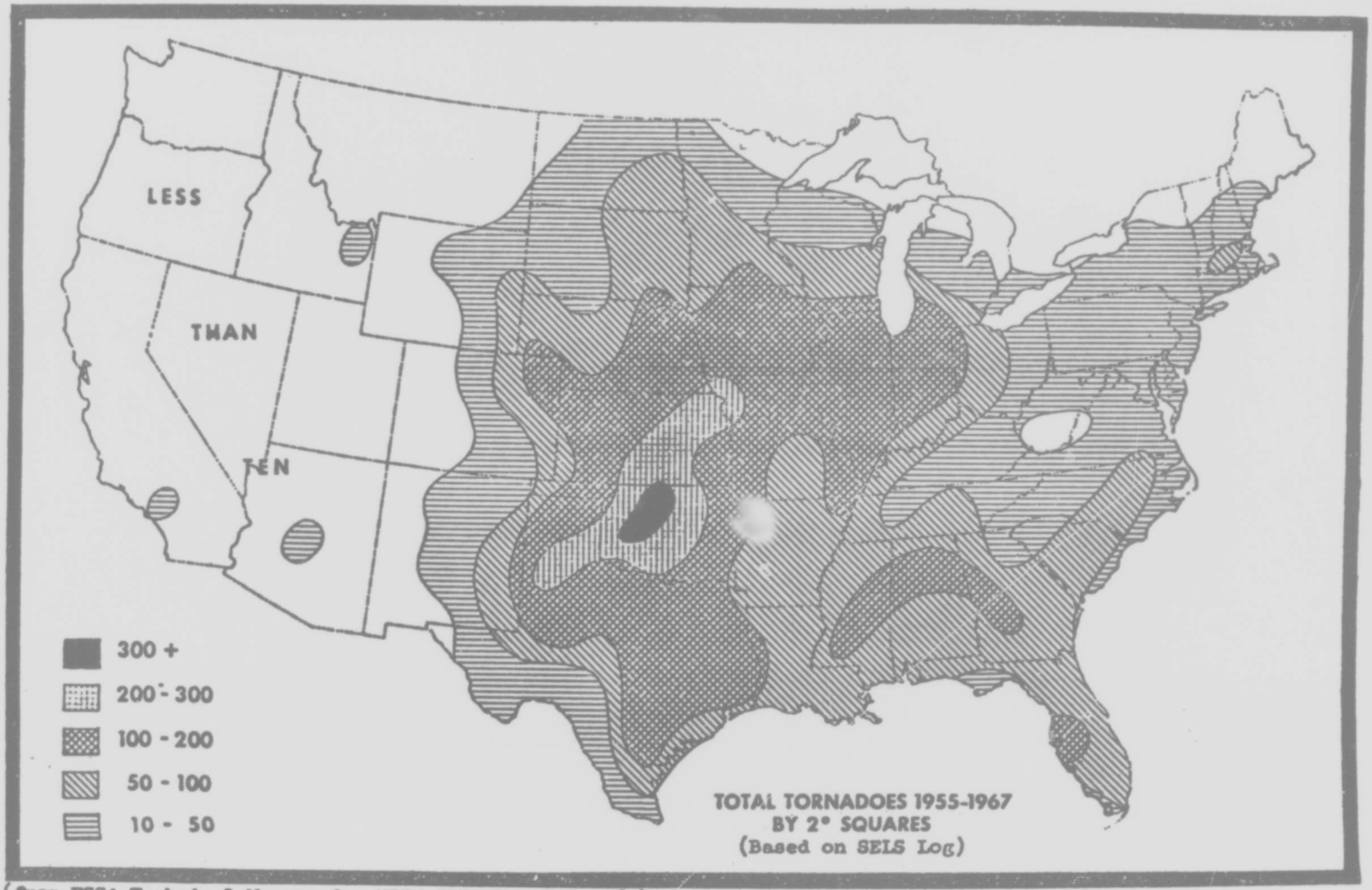


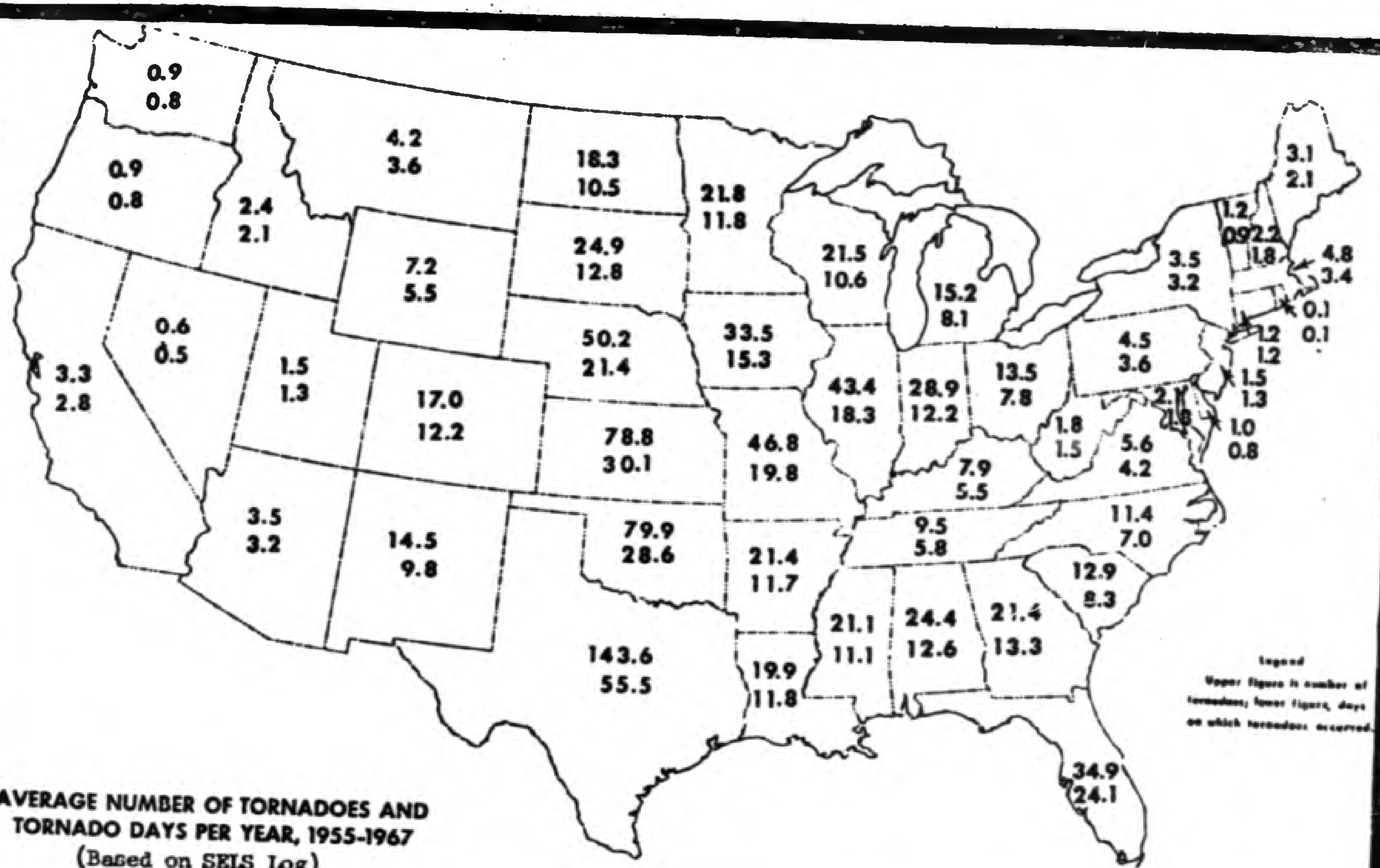
FIGURE 19



TOTAL TORNADOES 1955-1967
BY 2° SQUARES
(Based on SELS Log)

(from ESSA Technical Memorandum WBTM FCST 12, Sep 1969)

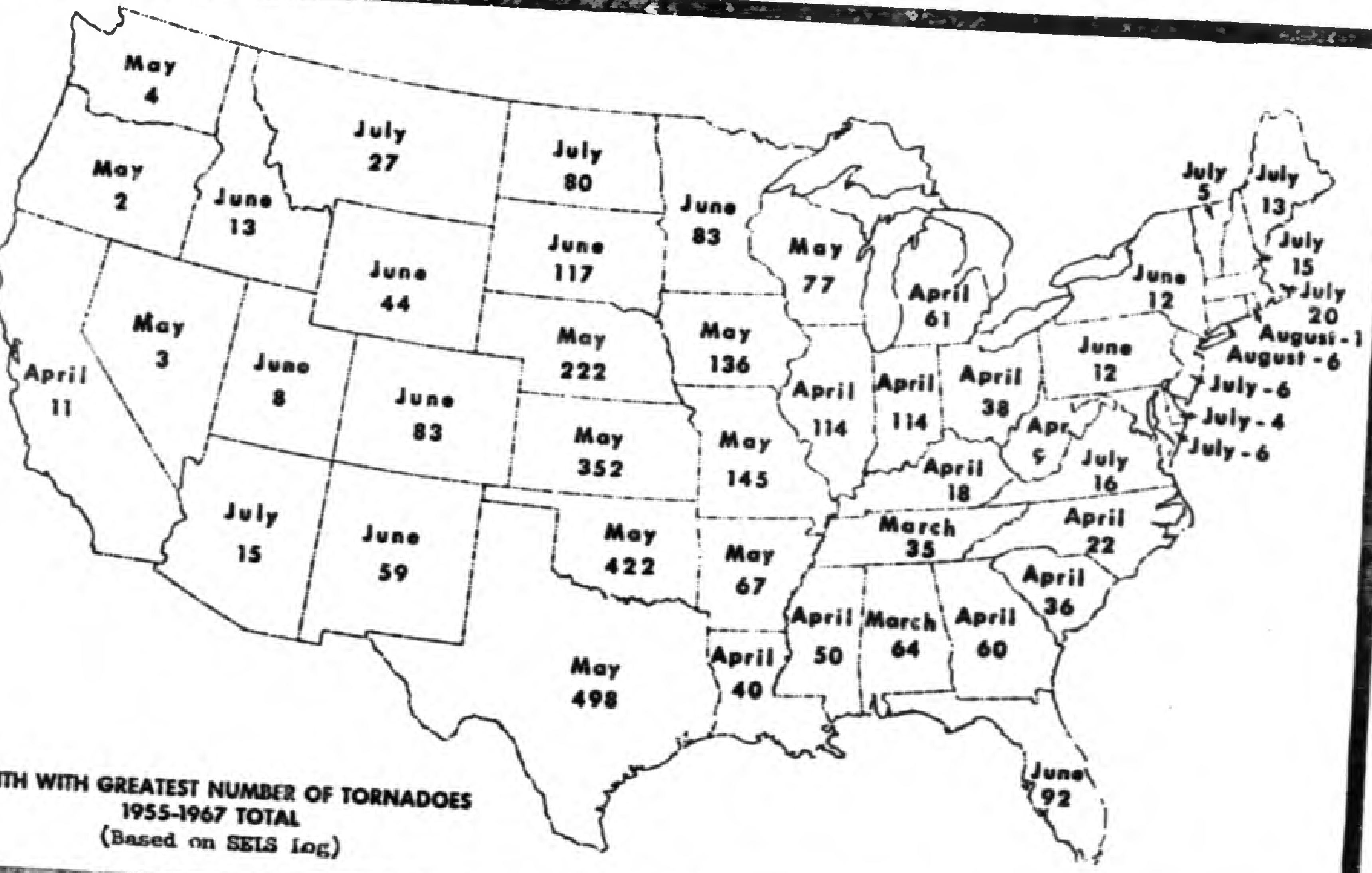
FIGURE 20



AVERAGE NUMBER OF TORNADOES AND TORNADO DAYS PER YEAR, 1955-1967
(Based on SELS Log)

(from ESSA Technical Memorandum WBTM FCST 12, Sep 1969)

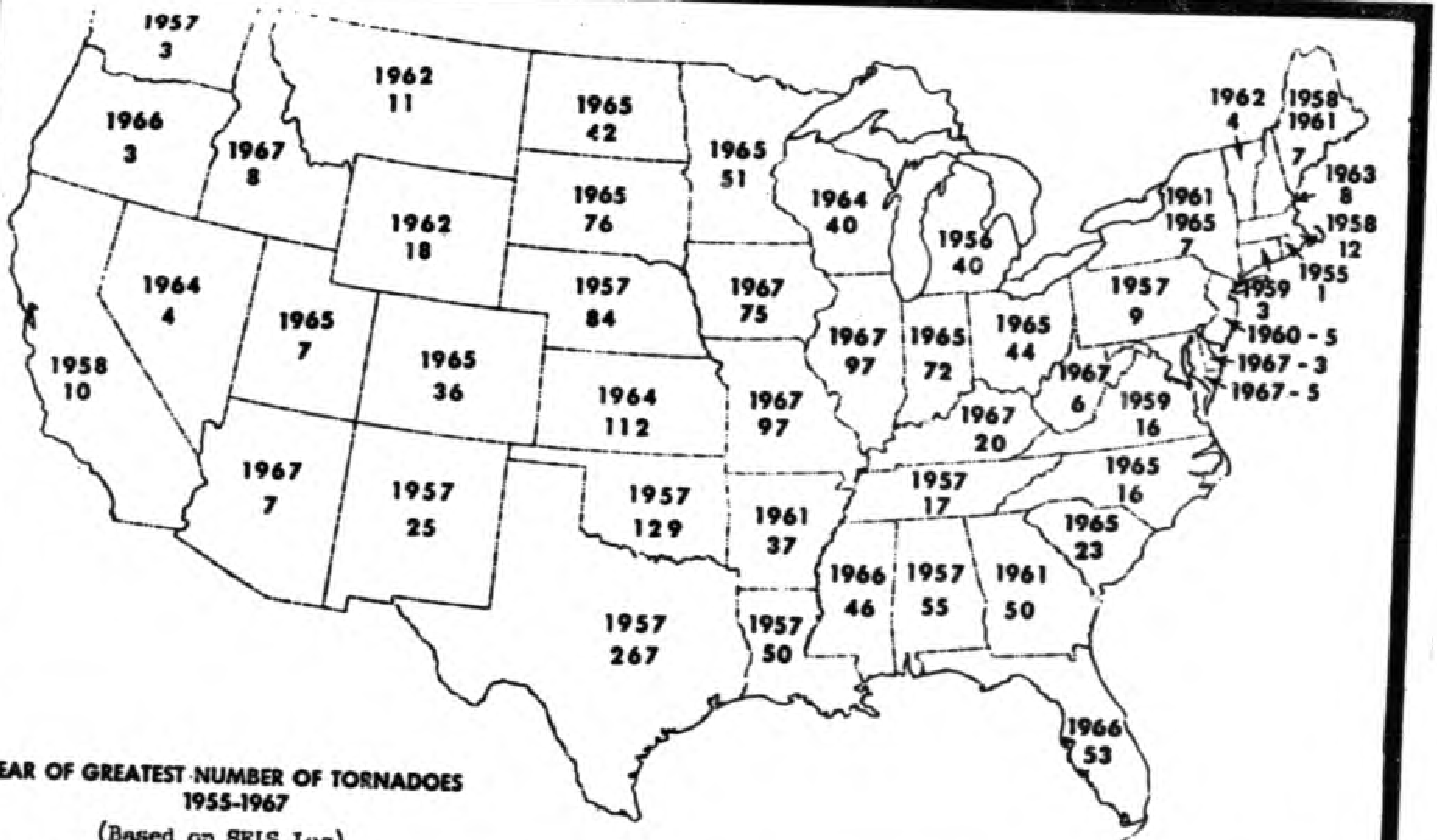
FIGURE 21



MONTH WITH GREATEST NUMBER OF TORNADOES
1955-1967 TOTAL
(Based on SELS Log)

(from ESSA Technical Memorandum WBTM FCST 12, Sep 1969)

FIGURE 22



YEAR OF GREATEST NUMBER OF TORNADOES
1955-1967
(Based on SEIS Log)

(from ESSA Technical Memorandum WBTM FCST 12, Sep 1969)

FIGURE 23

SECTION IV - LOCAL FORECAST STUDIES

1. Operational Requirements for Chanute Air Force Base
   - a. VFR - Equal to or greater than 1000' and 3 miles.
   - b. IFR - Less than 1000' and/or 3 miles but equal to or greater than 200' and 1/2 mile.
   - c. GCA - Precision minimums for runway 27; 200' and 1/2 mile
   - d. VOR - 500' and 1 mile.
   - e. ASR - 300' and 1 mile - Runway 27
     400' and 1 mile - Runway 09
   - f. Controlled VFR- 1000' and 1 mile (traffic pattern only)

2. Critical Terminal Forecast Problems
   - a. Thunderstorms with or without hail.
   - b. Damaging wind storms and tornadoes.
   - c. Heavy rain or snow (2 inches or more in 12 hours.)
   - d. Freezing precipitation or sleet.
   - e. Low stratus and fog.

An Objective Method for Forecasting Thunderstorm Intensity at Chanute AFB.

by Col Paul Frenzen AFRes

A major portion of the forecast problem during spring and summer months at Chanute concerns the probability of occurrences and the expected intensity of thunderstorms. This study correlates convective activity observed in the general area of Chanute during the afternoon and evening with a single stability parameter derived from the 1200Z radiosonde ascent taken that morning at Peoria, some 80 miles west. Deep southwesterly flow characterizes the great majority of thunderstorm outbreaks in this area; therefore the Peoria data furnishes an adequate stability measure for the air mass expected over Chanute during the critical afternoon hours of active convective situations, several hours later. By the same token, characteristics of that air mass will also determine cumulus activity over a much wider area than that of the air base alone. Forecasts obtained by this method are therefore considered appropriate to the entire local flying area, and verification criteria are defined accordingly (Table 2).

The stability parameter used, a form of the "total-total index", is obtained as an algebraic sum of terms depending solely upon temperature and dew point data for 850 and 500 mb; no thermodynamic calculations or skew-T diagrams are involved. Though obviously a gross simplification, limited accuracy obtainable with tabular, objective forecast procedures of this kind scarcely justifies complicating the matter further. Moreover, such straight forward determination of the stability indices both facilitates processing large amounts of historical data during the development stages of the procedure and makes possible routine operational calculation of the daily index long before the raob has been plotted. In fact when data are available, the index can be derived from the "Selected level RAOB data" (SLAMS) as early as one hour after observation time. Finally, the simple, Algebraic index also lends itself to the interpretation of trajectory forecast data produced by the AFGWC Multi-level Cloud Forecasting Model (see Tests discussion, below). As employed for example by the AWS Central Forecast Facility, the "total-total" or TT index is defined as the sum of a static stability measure known as the "vertical total" or VT, and an approximate measure of convective instability termed the "cross total" or CT. These components are defined:

$$VT = (850\text{ mb temp}) - (500\text{ mb temp}) = (T_{850} - T_{500}),\text{ and}$$

$$CT = (850\text{mb dew pt}) - (500\text{ mb temp}). = (T_{d_{850}} - T_{500}).$$

Standard applications of this index are described in Supplement No. 2, Tech. Note No. 3, Seventh Weather Wing, Scott AFB; March 1966. Note that since the temperature at 500 mb is invariably less than zero, the total-total index can be written (and more easily computed) in terms of an absolute value.

$$TT = T_{850} + T_{d_{850}} + 2\ /T500/.$$

In addition, the present procedure incorporates several empirical adjustments to the foregoing, "raw" TT index. These have been included in order to maximize the correlation observed on scatter diagrams between the index magnitude and convective activity subsequently observed.

The first correction, one for static-stability, corresponds to earlier findings that a minimum critical value of VT must be attained, whatever the VT + CT total may indicate, before significant convective activity will occur. This feature is included in the algebraic determination of the index by defining a sliding adjustment based upon the observed vertical total: When VT is less than 27, a correction numerically equal to (27 - VT), but not more than 5, is subtracted from the TT sum. This procedure corresponds to Suppl. No. 2's observation that VT = 26 is "a reasonable threshold value for thunderstorm occurrence without regard to moisture." In the present procedure, VT's greater than 26 fully contribute to the final magnitude of the index, but effects of smaller VT's are systematically attenuated in proportion to the amount they fall short of the critical value.

Two more numerical adjustments reduce the final index whenever the 500 mb temperature is either too warm ($T500 > -12.5$) or too cold $T_{500} < -22.5$). Again, the warm aloft-procedure has a counterpart in Suppl. # 2 where consideration is given to significant isotherms at 500 mb, " based on what experience has shown are critical threshold values of temperatures at that level for moderate to severe thunderstorm activity during certain seasons of the year." Rather than using seasonally dependent critical values, the present method adopts $T_{500} = -12.5$ as the basis of a further, sliding adjustment to the index sum. In terms of twice the absolute value of the 500 mb temperature, the index is reduced by the amount ($25 - 2 /T_{500}/$), but again by not more than 5, whenever the doubled absolute value, $2/T_{500}/$, is less than 25.

A cold-aloft correction handled in similar fashion as a sliding, algebraic adjustment has no counterpart in earlier accounts of TT, index forecast applications. It is introduced in the present instance because systematic over-forecast errors were found to occur in excessively cold-aloft conditions. Evidently these errors are caused by excessive weighting of the cross-total in such circumstances. When temperatures at 500 mb fall much below -20, the saturation mixing ratio changes only very slowly with temperature, since its value is down to 1 gm / kg or less; thus the approximation $CT = T_{d850} - T_{500}$) never a very good measure of the moisture distribution, increasingly over-estimates the vertical moisture gradient as $T500$ decreases and becomes a very bad estimate when T_{500} falls as low as -25, At any rate correlations on scatter diagrams off TT index vs observed convective activity were improved by reducing the algebraic index sum by the amount ($2/T500/ - 45$,), but no more than 5 whenever the doubled absolute value $2/T500/$ was more than 45. Fortunately this somewhat arbitrary adjustment is seldom required except at the very beginning and end of April thru Sept period considered suitable for this forecast procedure. These seemingly complicated instructions for the sample data sheet of Table 1.

Table 1.

CONVECTIVE CLASS FORECAST STUDY WORK SHEET
Chanute AFB, Illinois

COL:	1	2	3	4	5	6	7	8	9	10	11
DATE	/T500/ Record	T850 Tenths	T_{d850} Keep	2/T500/ 2/(1)/ signs	VT (1+2) Round	TT (2+3+4) Off	(4)<25 >45 Adjust,	(5)<27 <5,	TT* (6+7+8) (–)	FCST CLASS	OBSVD CLASS
15 Apr	18.2	+6.1	+1.8	36	24	44	0	-3	41	B	B
21 Apr	24.7	-4.0	-8.0	49	22	37	-4	-5	28	A	B
22 May	13.5	+15.8	+8.8	27	29	52	0	0	52	B	B

Month, Year

Instructions: a) Enter data in columns 1, 2, and 3; use absolute value in 1, retain signs in 2 and 3.

b) Double Col. 1; enter result in 4.

c) Add col's 1 and 2, and enter result in Col 5.

d) Add col's 2,3, and 4; enter result in Col 6.

e) If entry in Col 4 is less than 25 (or more than 45), but not more than 5, in Col. 7.

f) If entry in col 5 is less than 27, enter the amount 27-col 5, but not more than 5, in Col. 8.

g) Add col's 6,7, and 8; enter result as TT* in Col.9.

h) Select forecast class from Table 2 and enter letter designator in Col. 10.

Classes of Convective Activity

Categories of cumulus activity and the means by which their occurrence and relative intensity are to be verified are summarized in Table 2. These classifications have been subject to considerable revision during the development of this study. For example, early attempts to differentiate between thundershower activity actually reported at the station and that observed in the general flying area were abandoned when these classes were found to be statistically indistinguishable. The more or less arbitrary inclusion of a severe convective C+ category in the final classification of Table 2 is not supported by an associated, welldefined range of index values. Although this is due in part to an insufficient number of observations of these relatively rare events, it can also be attributed to the fact that such phenomena can be triggered over a fairly wide range of moderate to high instabilities, provided only that a sufficiently strong dynamic mechanism is present. In this regard, efforts were made to include a second criterion for mechanical lifting in the study, but to date these attempts have not been successful. Inclusion of such a lifting index would be the next step in improving a pruely thermodynamic forecast procedure of this kind.

Table 2. Convective Classes and TT^* Index Values

Convective Class	Description	TT^* Range
A	Little or no convective activity; psbl few sctd TCU, but no CB or RW; no significant radar echoes.	< 37
B	Light convective activity; TCU in svrl quads, CB tops or RW in sight; psbl T or TRW- recorded at station; DSNT LTG, LTGCC: sctd radar echoes, psbly in weak lines.	37-54
C	Moderate convective activity; prbl TRW or TRW+ recorded at station; psbl 35k gusts; LTG ALQUDS, LTGCC; well developed radar echoes, prbly organized in lines.	> 54
C+	Severe convective activity; TRW+ with gusts >35k; psbl HAIL, psbl TORNADO.	> 60

Determination of TT* Criteria

The range of adjusted total-total index or TT* values shown in the right hand column of Table 2 were determined by tabulating six years of observations (1965-70, mid Apr thru Sept.) and classifying the convective activity observed during the afternoon and evening according to the descriptions given. Since even when perfectly anticipated by a TT* index derived from the early morning PIA raob, atmospheric stability is not the sole factor controlling afternoon convection, each convective category was observed to occur over a wide range of TT* values (see Table 3). However, the total data sample of nearly one thousand days includes a sufficiently large number of cases in each category for the observed TT* distributions to be distributed in nearly Gaussian, or "normal" manner.

Table 3 lists the observed TT* distributions (first two rows for each class) along with the corresponding coordinates of Gaussian curves (third and fourth rows) fitted to the observed data by plotting the distributions on normal frequency distribution graph paper. Since this method of presentation converts Gaussian curves to straight lines, true normal distributions are easily fitted to nearly normal data. The quality of the fit obtained in the present instance can be judged by comparing the second and third rows appearing in Table 3 for each class, that is by comparing the Observed "% of total" with the "Fitted normal %". Significant discrepancies will be seen to occur only at the outer ends of the distributions where very few cases are involved. The individual distributions for the three classes of convection exhibit considerable overlap; for example, the TT* interval 35-40 is well represented in all three categories. However the class distributions do have distinctly separated modal values; the class A curve peaks at TT*= 28.0, class B at 36.5, and class C at 42.8.

The fitted normal distributions are used to construct sets of "Normal No. of obs. as listed in the fourth row for each class in Table 2. These are totaled, across the classes, for each TT* interval, to obtain a set of "Total normalized obs". From these figures, the individual Normal no. of obs" for each class can be converted to a percentage of the total number of observations in each TT* interval. From these we can construct Table # 4, the Normalized per cent relative probability" for the occurence of each class within each TT* interval. The entries of this table are plotted in Figure 1 in the form of a largely, self-explanatory forecast nomograph.

Comparison of Figure 1 with the right hand column of Table 1 will show that the critical TT* values separating nominally expected convective classes correspond to points on the curves where adjacent classes are equally probable. Thus, at TT* = 37 there is very nearly a 50:50 chance for either class A or class B convection (and a small chance of class C as well). Similarly, at TT* > 54 (i.e.; = 55), there is a 50% chance of class B convection and 50% chance of something else. Here, by discounting as much as 20% possibility for class A to occur with TT* > 54, errors in this region of three choices are relegated to the category of more acceptable, overforecasts rather than underforecasts.

TABLE 3. Observed and Fitted TT* Distributions (1965-70).

Conv. Class		Range of TT* values observed								Totals
		22	23-28	29-34	35-40	41-46	47-52	53-58	58	
A	No. of obs.	101	102	151	112	59	20	2	0	547
	% of total	18.5	18.6	27.6	20.5	10.8	3.7	0.4	0	100.1
	Fitted norm. %	17.0	22.0	26.0	20.5	10.5	3.2	0.7	0.1	100.0
	Normal no. obs.	93.0	120.0	142.0	112.0	57.5	17.5	4.0	0.5	546.5
B	No of obs.	6	18	55	118	102	44	11	0	354
	% of total	1.7	5.1	15.5	33.3	28.8	12.4	3.1	0	99.9
	Fitted norm. %	0.6	4.9	17.5	32.0	29.0	13.0	2.7	0.3	100.0
	Normal no. obs.	2.0	17.0	62.0	116.5	102.0	46.0	9.5	10	356.0
C	No of obs.	0	1	1	8	13	13	7	1	44
	% of Total	0	2.3	2.3	18.2	29.6	29.6	15.9	2.3	100.2
	Fitted norm. %	0.1	0.7	5.1	17.1	31.0	28.5	13.5	3.5	99.5
	Normal no. obs.	0	0.5	2.0	7.5	13.5	12.5	6.0	1.5	43.5
Total normalized obs.		95.0	137.5	206.0	236.0	173.0	76.0	19.5	3.0	946/

Notes:

a) Fitted normal values read from coordinates of straight lines fitted to plots of observed distributions ("% of total") on normal frequency distribution graph paper.
b) (Normal no. obs.) = (Fitted normal %) x (Total normalized obs), in each class.

Table 4 Normalized Percent Relative Probability of each Convective Class for Given TT^*.

CLASS	RANGE OF TT^* VALUES									
	22	23-28	29-34	35-40	41-46	47-52	53-58	58		
A	97.9	87.4	69.0	47.4	33.2	23.0	20.5	16.7		
B	2.1	12.3	30.0	49.4	59.0	60.0	48.7	33.3		
C	0	0.3	1.0	3.2	7.8	16.4	30.8	50.0		

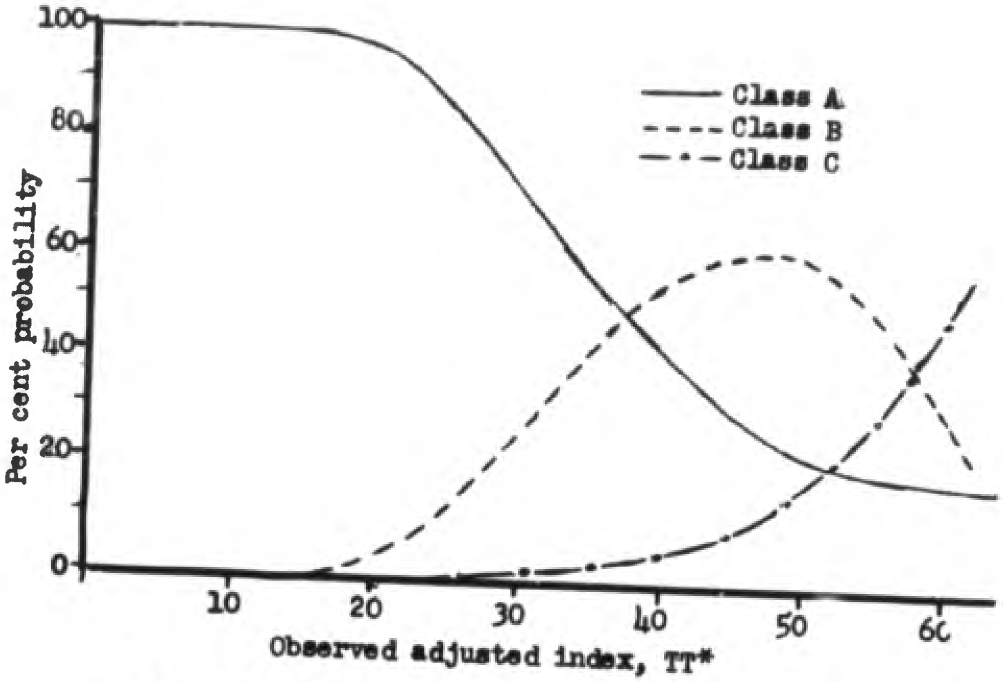


Figure 1. Relative per cent probability for the occurrence of three classes of convective activity at Chanute AFB as a function of an adjusted stability index, TT*.

Tests

An independant set of data for 1963, a year not involved in the selection of the forecast criteria, was extracted from historical records in order to carry out a statistically independent test of the convective-class forecast method. Results obtained are summarised in the following contingency table.

Forecast Class

		A	B	C	TOTAL
	A	72	21	1	94
	B	16	22	1	39
OBSVD	C	0	5	0	5
	TOTAL	88	48	2	138

FORECAST CLASS

Forecasts issued: 138
Percent correct by class = 94/138 = 68%
Heidke Skill Score = .31

On a yes-no basis, the table reduces to:

Forecast Class

		YES	NO	TOTAL
OBSVD CLASS	YES	28	16	44
	NO	22	72	94
	TOTAL	50	88	138

This breaks down as follows:
Forecasts issued: 138
Percent correct: 100/138 = 72.5%
Heidke Skill Score = 0.39
The result is considered operationally useful.

Of considerable potential value is the fact that the convective-class forecast procedure shows promise as a means of interpreting the trajectory forecasts generated by the AFGWC Multi Level Cloud Forecast Model (See AWS Tech Report No. 210)

Since these bulletins give 24 hour forecast values for the input parameters of the TT* index (i.e. T_{500}, T_{850}, and T_{d850}), a profile convective intensity forecast for as much as 36 hours in advance can be obtained.

Tests of this kind were initiated shortly after trajectory forecasts for Chanute become available on the teletype circuits during the summer of 1970. Results are summarized in the following table:

Forecast Class

		A	B	C	TOTAL
OBSVD	A	42	21	0	63
CLASS	B	6	25	2	33
	C	2	3	0	5
	TOTAL	50	49	2	101

Forecasts issued: 101
Percent correct by class: 67/101 = 66.3%
Heidke Skill Score: .37

On a yes-no basis this table becomes:

Forecast Class

	YES	NO	TOTAL
YES	30	8	38
NO	21	42	63
TOTAL	51	50	101

Forecasts issued: 101
Percent correct: 72/101 = 71.3%
Heidke Skill Score: 0.43

Note: Figure numbers in remaining studies begin with number 9 and continue consecutively.

AN AID FOR USE IN FORECASTING THUNDERSTORMS

Based on a Report by L. L. Means, U.S. Weather Bureau

The primary tool used by Mr. Means in his work was the 850 mb chart. The charts were categorized into different types of patterns depending upon the position of the trough and ridge at 850 mb east of the Rockies and their relationship to the isotherm patterns. An elongated slow-moving or stationary ridge effectively blocks the movement of the pre-trough thunderstorms even though the areas of activity may be only a short distance away.

This thunderstorm study was made with specific reference to Chicago, but the general classification of thunderstorm types and no-thunderstorm types as described by Mr. Means would apply equally well for other stations in the Illinois area. Therefore, in the types that follow, the relative position of Chicago is used to determine the occurrence or non-occurrence of thunderstorms in a subsequent 24 hour period. Consequently, in order to use the types discussed, one only has to place his station in a position analogous to that of Chicago in order to determine the type of classification.

NO THUNDERSTORM TYPES

TYPE I (No thunderstorms in 33 cases) (Figures 9 and 10)

This type is characterized by post-trough cold advection usually associated with a north-south ridge over the central states. This type may indicate marked cold advection to the rear of the trough as in Figure 9, or neutral or weak advection as indicated in Figure 10.

TYPE II (No thunderstorms in 7 cases) (Figure 11)

In this type a closed anticyclone dominates the Great Lakes region. No frontal waves are present immediately to the south or west.

TYPE III (1 thunderstorm in 27 cases) (Figure 12)

The elongated ridge in this type is usually warm and slow moving.

This is a no-thunderstorm type along the ridge lines and east of it. As soon as the ridge indicates movement, thunderstorms would most likely move into the no-thunderstorm area from the west or southwest.

TYPE IV (No thunderstorms in 15 cases) (Figure 13)

A warm tongue east of the trough line is moving constantly to the east with an area of cold advection to the rear. The area of thunderstorms, if any, would occur near the beginning of the period before the warm air is replaced by an area of cold advection.

TYPE V (1 thunderstorm in 23 cases) (Figure 14)

This type is characterized by a pronounced warm tongue with little eastward motion indicated. Thunderstorms would be of little consequence to the east of this area of the warm tongue.

THUNDERSTORM TYPES

TYPE I (3 thunderstorms in 5 cases) (Figure 15)

The predominant feature of this type is westerly flow with neutral advection which is frequently susceptible to wave development.

TYPE II (27 thunderstorms in 74 cases) (Figure 16)

More thunderstorms occur with this pattern than any other type, but this type is also the most frequent summer pattern. The predominant pre-trough warm air advection is the striking feature. Thunderstorms are more likely the second or third day of this pattern rather than the first day. With marked warm air advection (cross pattern) ahead of a trough and a surface cold front approaching from the west, the area east of the trough becomes highly susceptible to squall line development, especially if the flow is westerly at levels above the 850 mb level. These squall lines may develop very rapidly and move eastward at excessive rates of speed often times approaching 50-60 miles per hour.

TYPE III (10 thunderstorms in 30 cases) (Figure 17)

Another type that accounts for numerous thunderstorms is the pre-trough stagnant warm-tongue type. The warm tongue is described as stagnant because no important current is oriented normal to the axis of the warm tongue to rapidly displace the warm tongue.

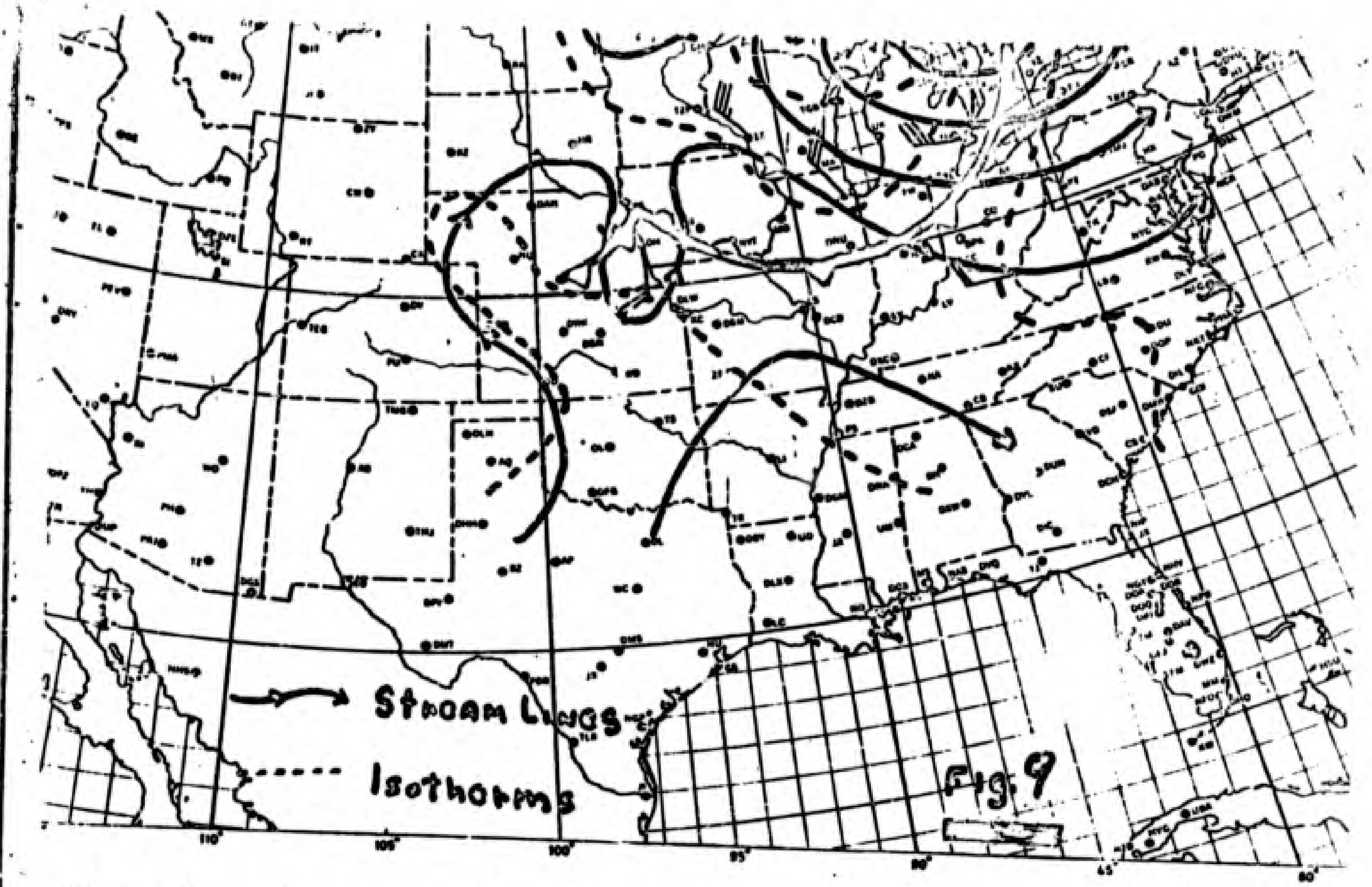

Stream Lines
Isotherms
110°
105°
100°
95°
90°
85°
80°

Fig 9

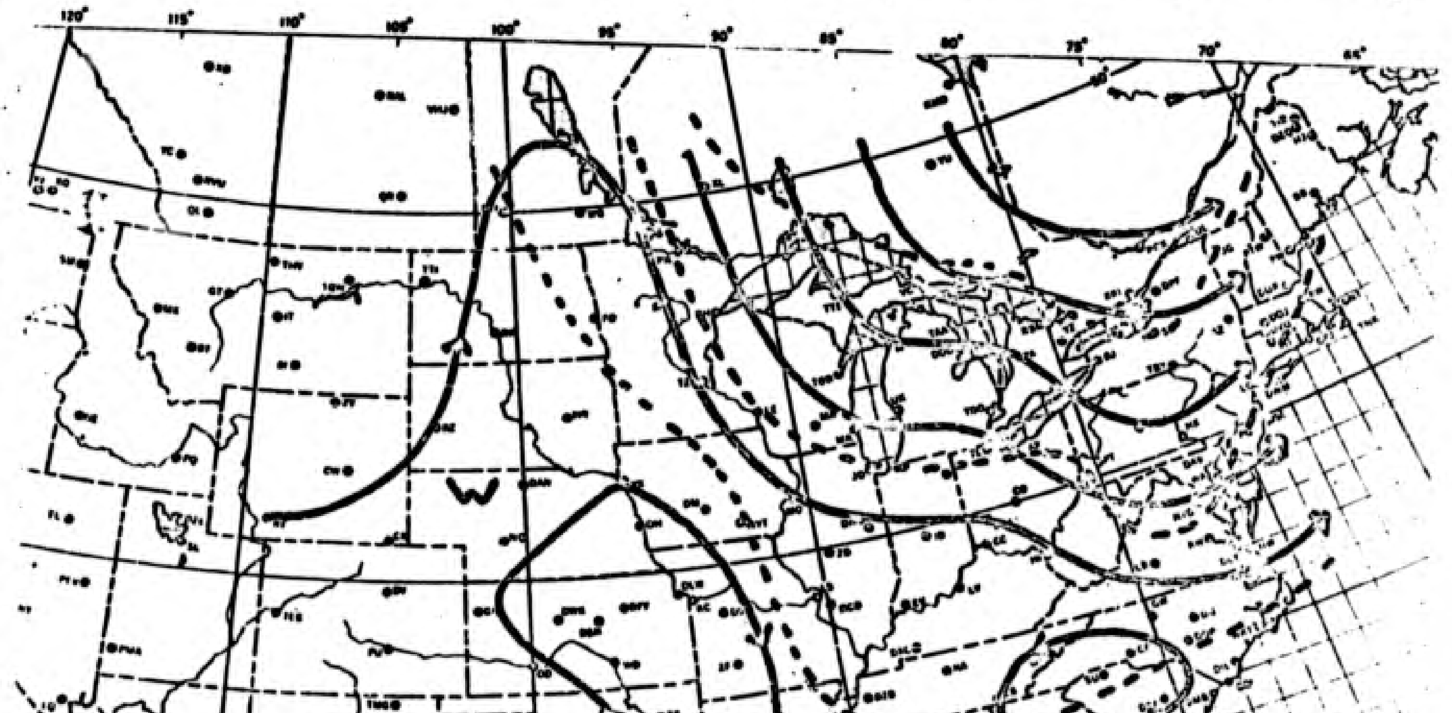

120°
115°
110°
105°
100°
95°
90°
85°
80°
75°
70°
65°
W

Fig. 1(

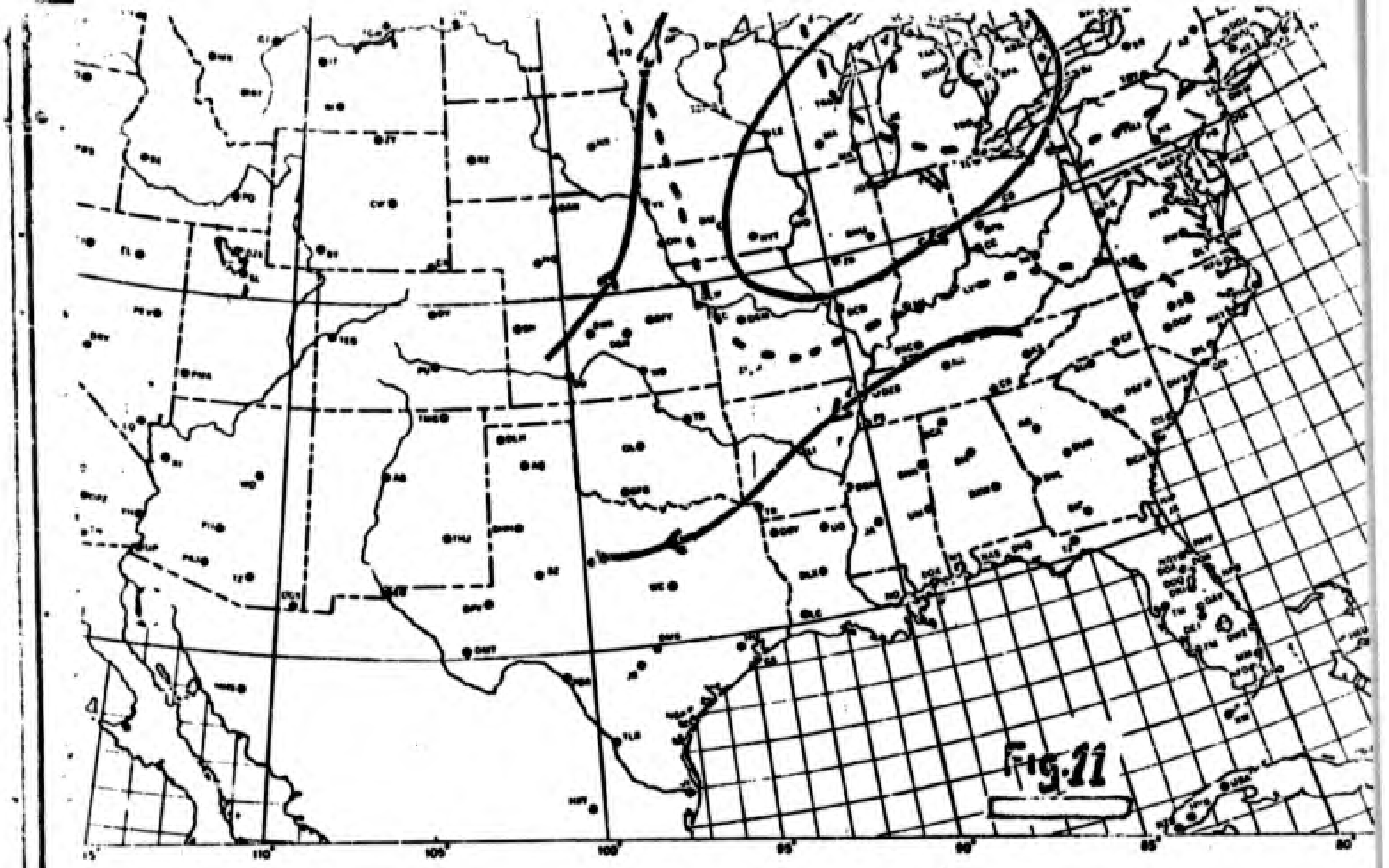
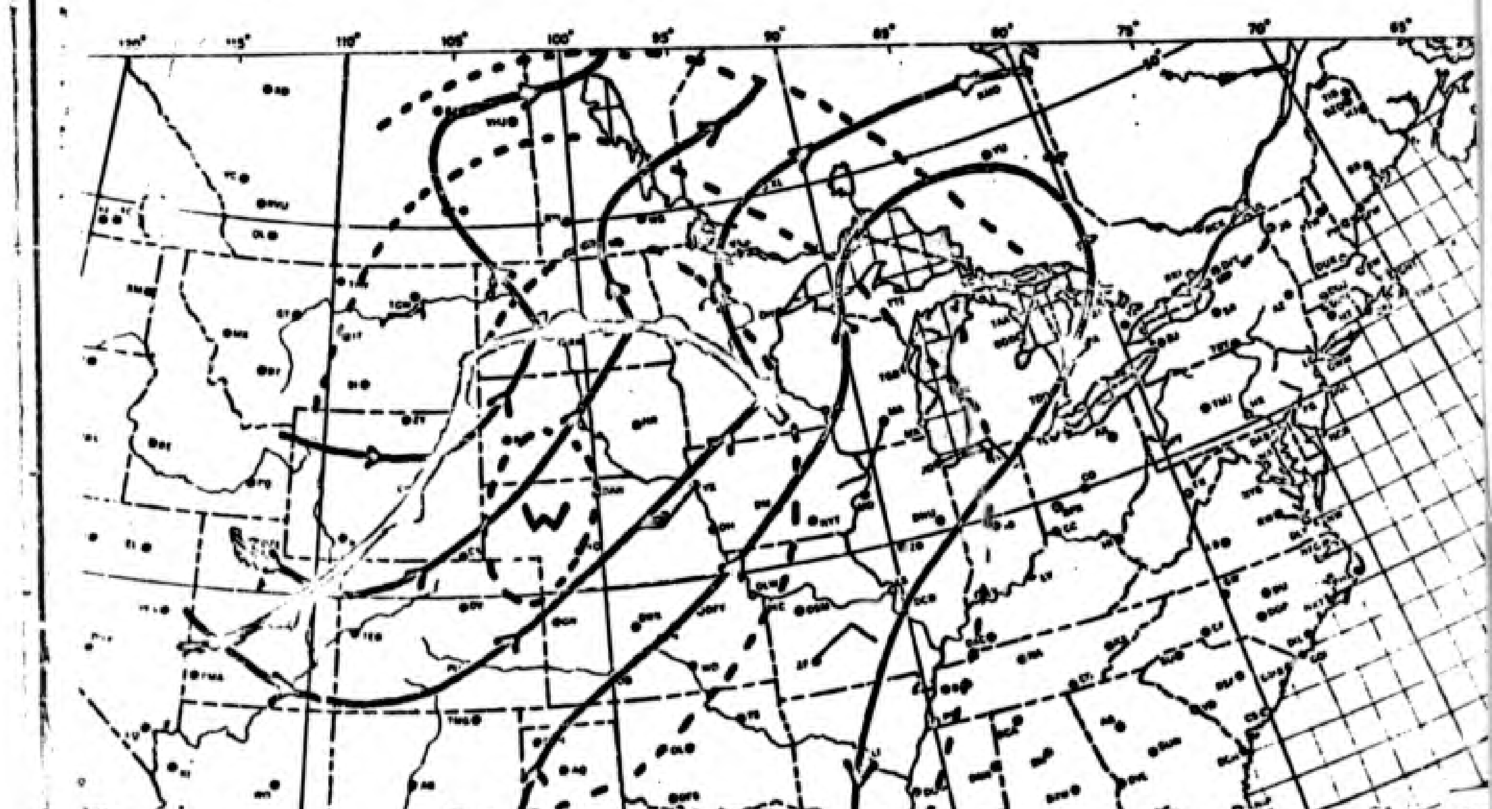


Fig. 11



23

Fig. 1

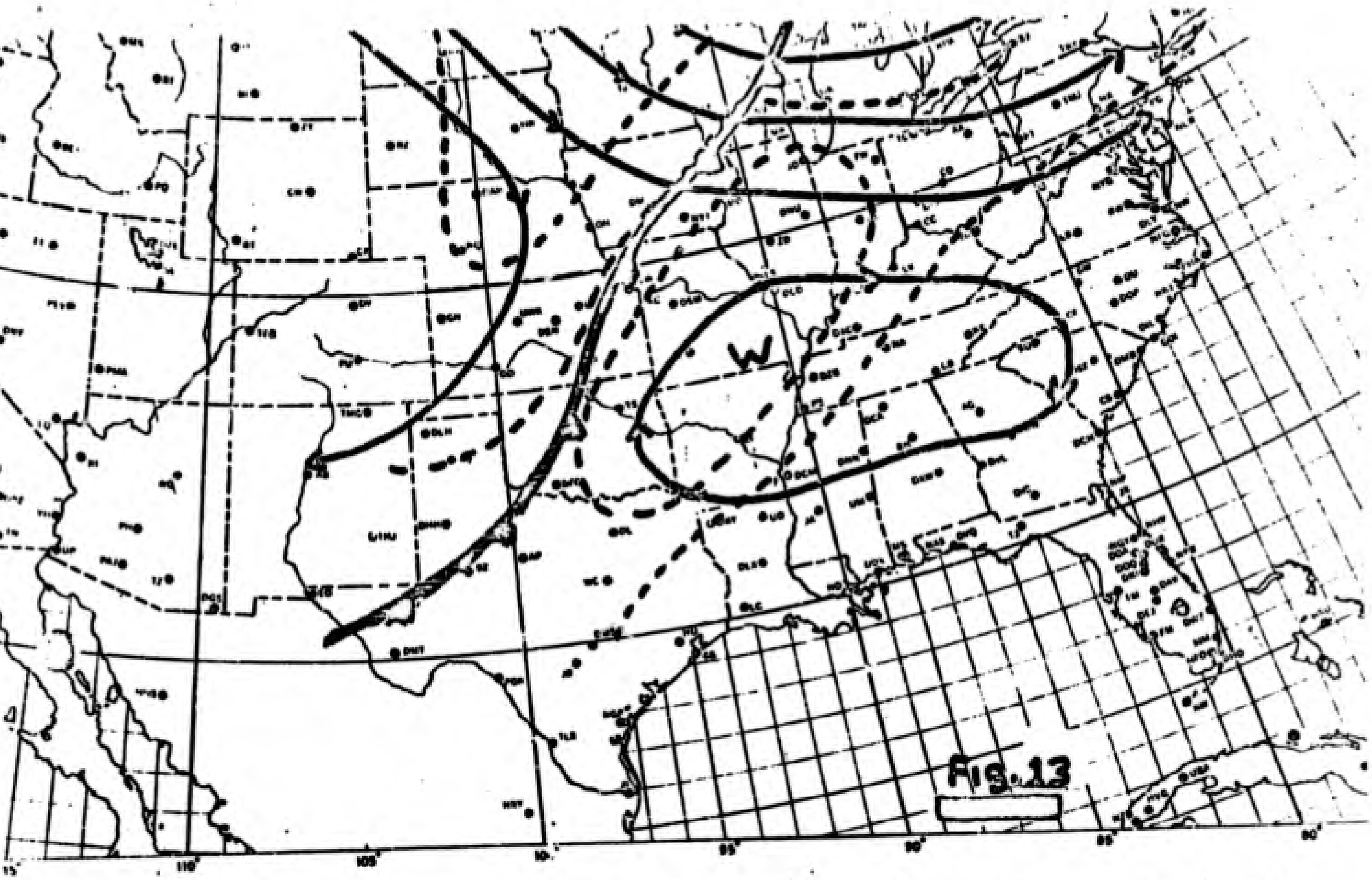
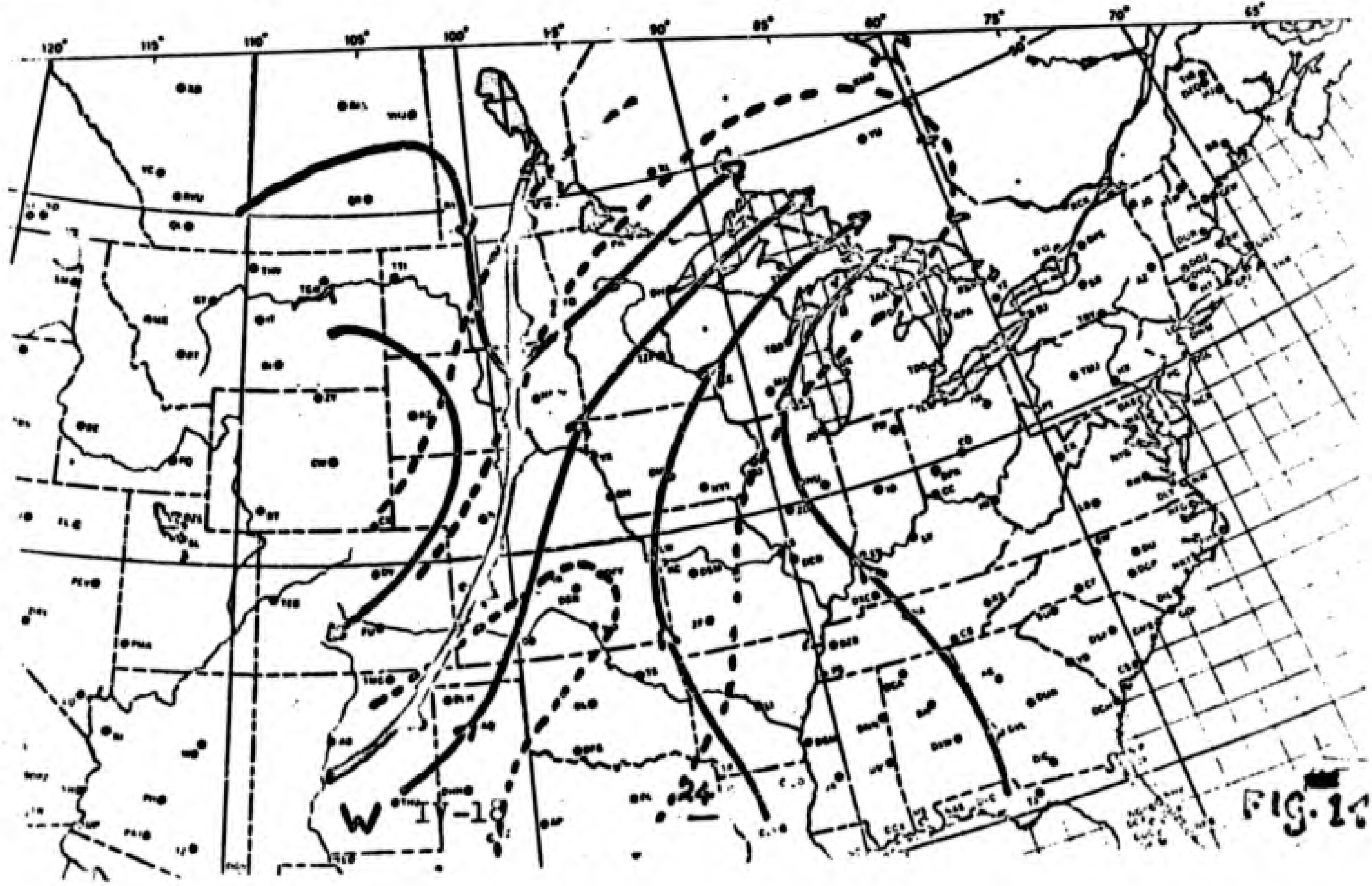


FIG. 13



24

FIG. 1

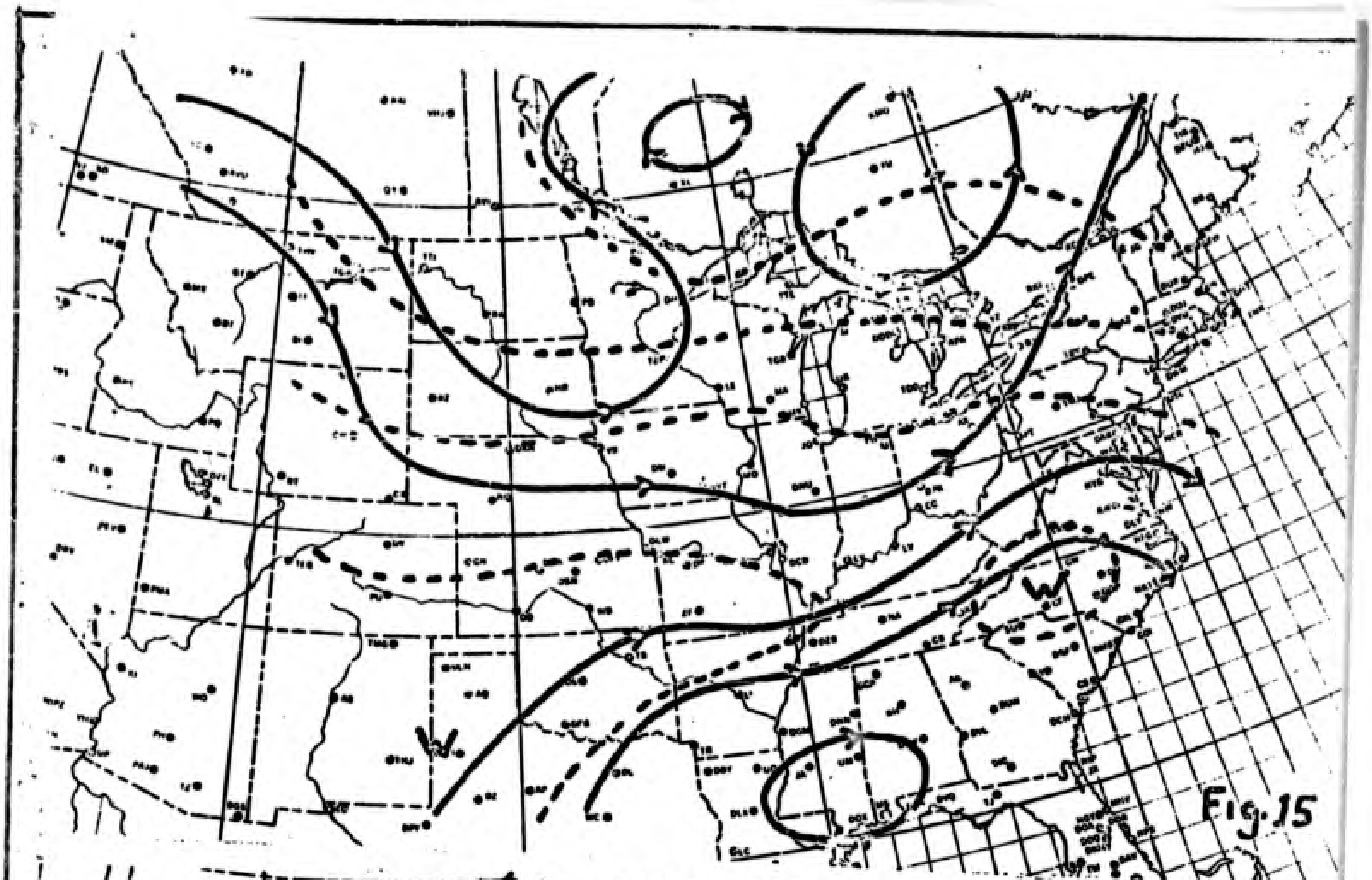


Fig. 15

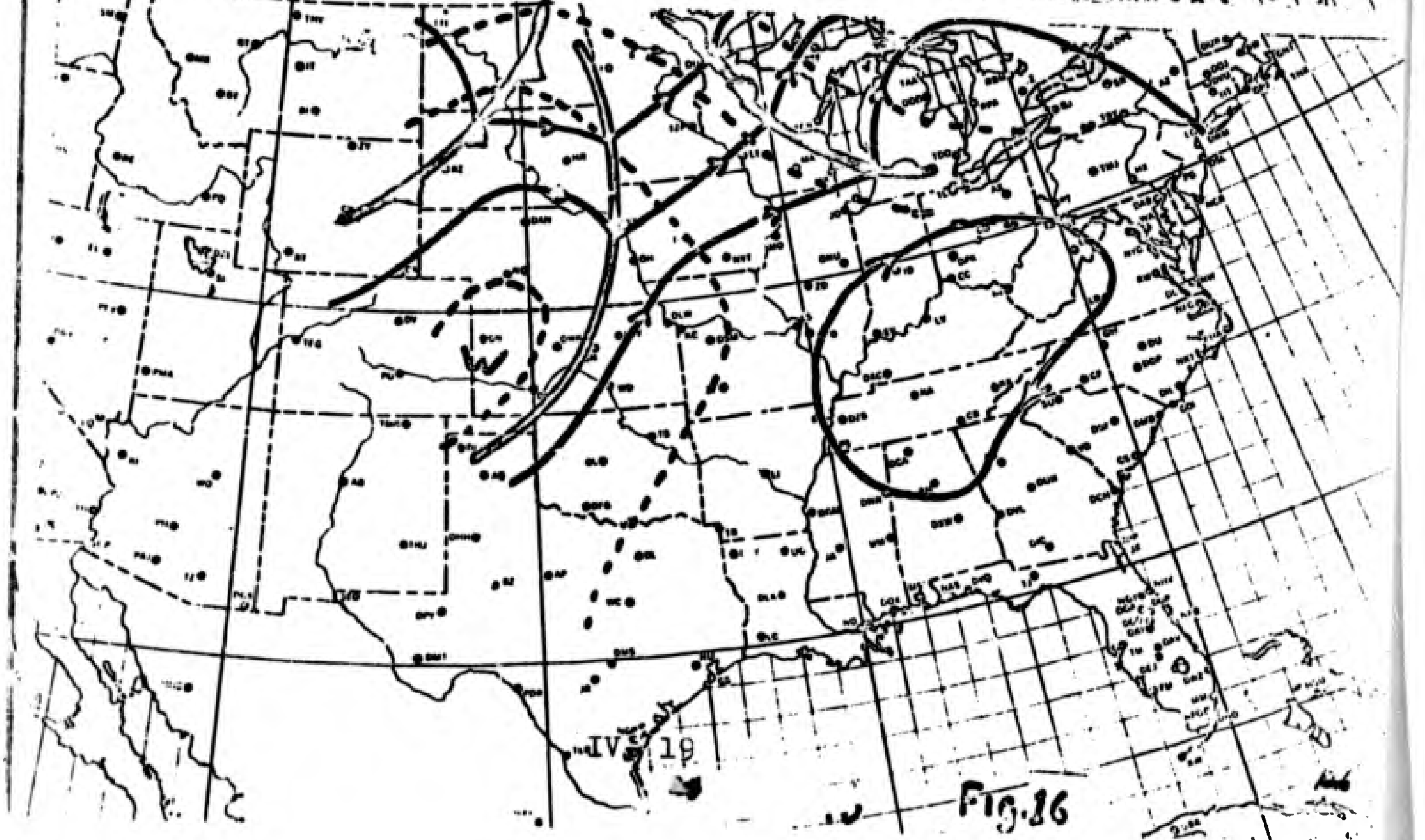


Fig. 16

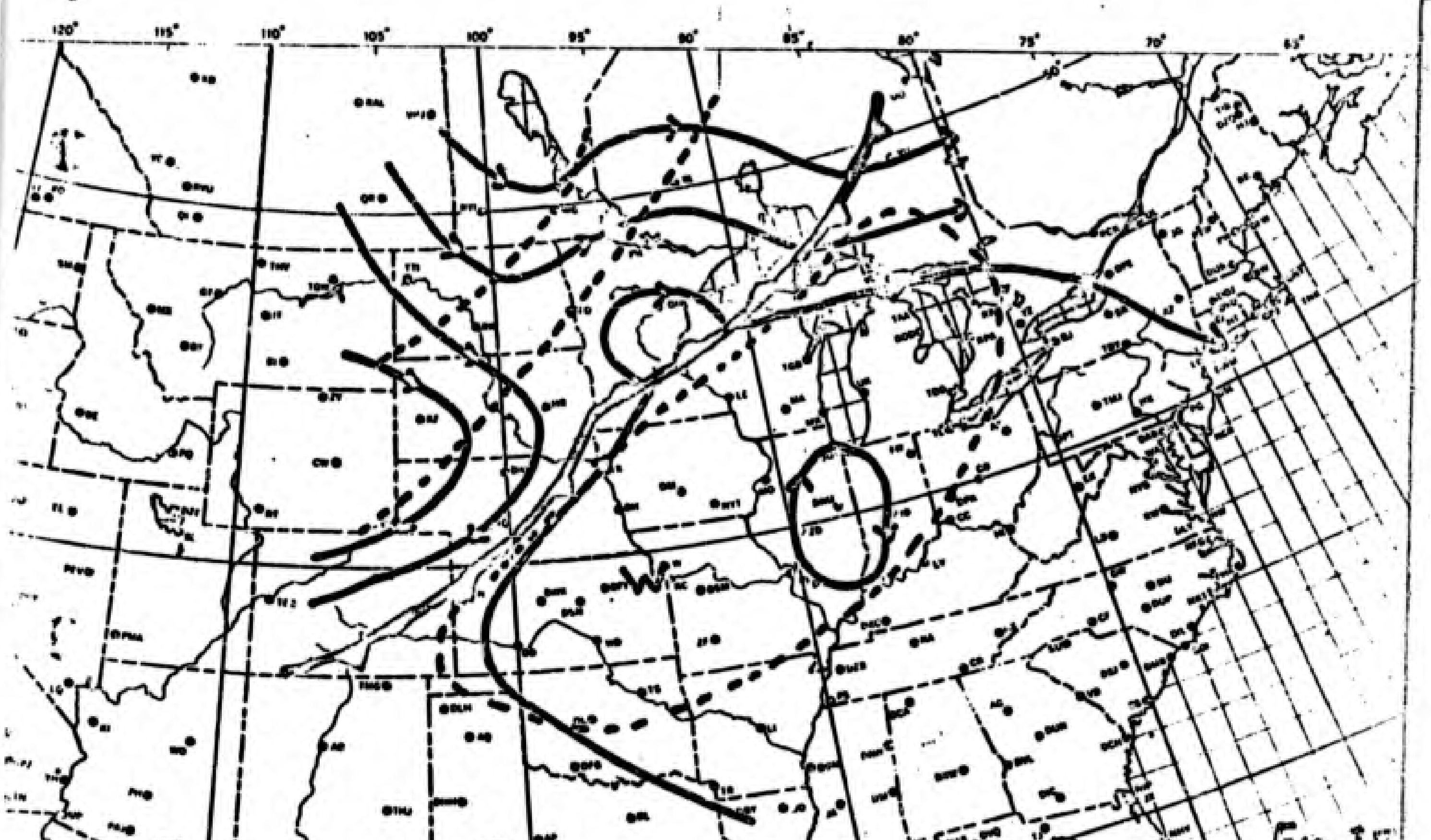


Fig. 17

SPECIAL SYNOPTIC STUDIES

1. Major Synoptic Features: Characteristic weather patterns of this area will now be presented along with accompanying maps and tables. Effects of the Texas Wave, maritime polar fronts and continental polar fronts are discussed below.

Texas Wave

This frontal system has the greatest effect on the Chanute area. It causes longer periods of precipitation, low ceilings, and low visibilities than any other system that passes this station. The conditions that are most favorable for its formation are a stationary continental polar front situated northeast-southwest through the southern states and west through Texas, or a polar front that has become stationary through Illinois, Missouri, Oklahoma and then into Texas. With the intrusion of a new continental polar high moving south out of Canada along the Rockies, or a strong maritime polar high moving southeast across Utah and New Mexico, and a strong southerly flow of warm, moist maritime tropical air from the Gulf of Mexico up through the Gulf States into the Arkansas-Tennessee area, this wave will form. See Figure 3 for a typical Texas Wave. Usually the starting point of the low pressure cell is in the Texas panhandle area or the southwestern Texas and eastern New Mexico area. Figures 4 and 5 show the tracks expected for the frontal systems explained above. When the low center is forecast to move into a square as shown on Figure 4, a minimum of 18 hours of precipitation can be expected at this station.

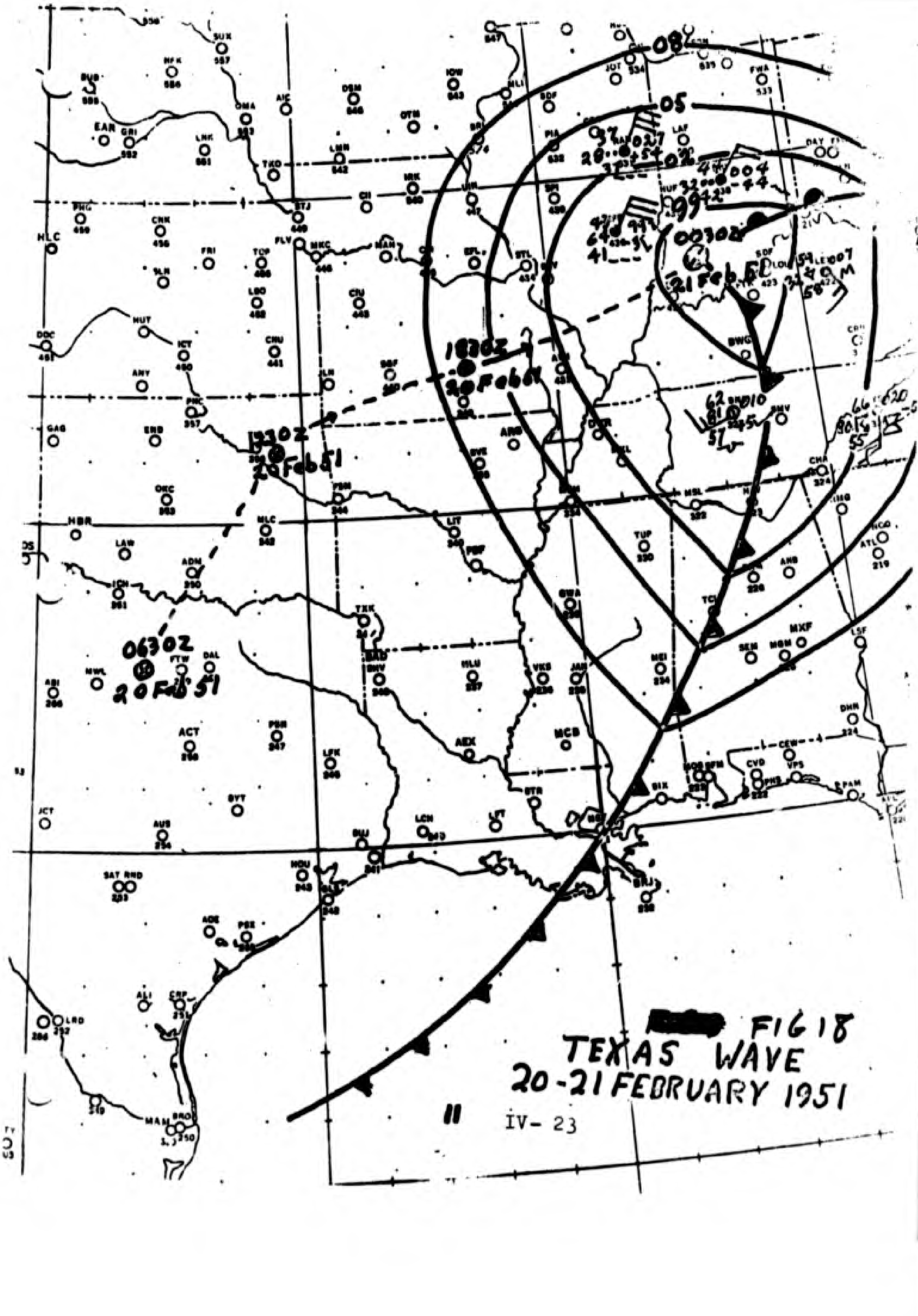
When the wave is still to the southwest of the station, Chanute experiences overrunning conditions dependent on the distance of the warm front to the south of the station. Usually broken to overcast cirrus with increasing altostratus prevails. The altostratus deck continues to lower and a low again is dependent on the nearness of the warm front to Chanute, and can be forecast easily if a close check is kept on the stations to the south and southwest of this station. With the low still 18 hours away, or usually in northwest Arkansas, northeast Oklahoma, or southern Missouri area, conditions at this station rapidly become worse. Ceilings are generally one thousand feet above the ground or less. Visibilities are less than 2 miles in fog. Rain, drizzle, snow, freezing rain or freezing drizzle can occur, depending on the temperature of the layer of cold air on the surface at this station. These conditions will continue until the low has passed well into eastern Ohio or southern Ontario. Winds will be 360 degrees to 030 degrees at this station during the entire track of the wave.

The movement of the wave can be forecasted easily with the flow at 700 millibars until the low passes into Ohio or Pennsylvania, and its velocity is very uniform. Occasionally, the wave will move north of Chanute while still west of the station. When this occurs the warm front will pass north of Chanute, and ceilings, visibilities, and weather conditions improve immediately. Scattered to broken altocumulus and scattered staratocumulus prevail with visibilities greater than 5 miles observed. Within 8 to 12 hours after the warm frontal passage, the cold front will pass this station, putting Chanute once again in the cold air with the same weather conditions as described above. Due to the rarity of this type, little can be said in detail concerning it. The movement north and west of the station can be forecasted if a close check is kept on the trough movement at 850 and 700 millibars and the strengthening of the ridge along the east coast.

Table 1

Hourly Sequence Reports for Chanute Air Force Base

TIME CST	CIG	SKY	VSBY	WX	TEMP	DEW PT	WIND DIR	WIND VEL	ADDITIONAL DATA
19 FEB'51									
0630C	2	X	1/8	F	41	41	↗	16	320 //// 41
1230C	4	X	5/8	F	44	43	→	10	310 //// 39
1830C	1	X	0	F	42	42		C	310 //// 45
20 FEB'51									
0030C	0	X	0	F	39	39	←↙	8	61400 //// 46
0630C	3	X	1/8	F	36	36	↙	12	912 //// 36
1230C	4	X	3/4	R-F	38	38	↓↙	20	82706 //// 38
1830C	3	⦶7⊕	3/4	RW-F	39	39	↓↙	30	93087 7//9 40
21 FEB'51									
0330C	4	●	2	R-	36	35	↓↘	32	11429 6//9 40
0630C	6	●	3	F	35	33	↘	28	33415 6//9 34 PRESRR



[redacted] FIG 18
TEXAS WAVE
20-21 FEBRUARY 1951

TEXAS WAVE
FIG 4 19

TEXAS WAVE
FIG 3 20

Maritime Polar Front

With the Maritime Polar Front 500 miles west of the station, the observed cloudiness will be scattered to broken altocumulus and scattered cirrus. As the front approaches within 300 miles of the station, a lower deck of stratocumulus will be observed, usually overcast, but with occasional broken conditions during the night time hours. Ceilings in this stratocumulus deck will be 4500 to 5500 feet while the front is more than 300 miles away from the station, and will gradually lower to 1000 feet or less for the 8 to 12 hour period preceding frontal passage. With the frontal passage, the lower deck of stratocumulus will move eastward and an upper deck of altocumulus and altostratus will prevail, usually scattered or broken at 7000 to 10000 feet.

Visibilities will be 7 miles or more until within 8 hours of frontal passage, then lower to as low as 1 mile in fog or drizzle. Immediately following frontal passage, visibilities will improve rapidly to 7 miles or more.

Light showers can be expected as far as 300 miles ahead of the front. This ban of showers will prevail from the western border of Iowa until the passage of the front into the Atlantic ocean.

lustrate a typical maritime polar front.

TABLE 2

MARITIME POLAR COLD FRONT SERIES

HOURLY SEQUENCE REPORTS FOR CHANUTE AIR FORCE BASE

TIME CST	CIG	SKY	VSBY	WX	TEMP	DEW PT	WIND DIR	WIND VEL	ADDITIONAL DATA
1230	7	⊕	2	TRW	58	56	↑	25	51500/ 9//4 47
1330	7	⊕	3/4	L-F	56	56	↑↖	23	
1430	4	⊕	3/4	L-F	56	56	↑	22	
1530	5	⊕	2	F	57	55	↑	26	622 5//4
1630	5	⦶12⊕	4	F	57	55	↑	26	
1730	5	⦶10⊕	5	F	58	56	↑	22	
1830	10	⊕	4	RW-F	58	56	↑	23	91220 5//4 58
1930	20	⦶40⊕	3	RW-F	55	53	↗	23	
2030	70	⊕	8		51	49	↑↗	11	
2130	75	●	7		53	49	→↗	10	005 07/5
2230	85	⊕	7		52	44	→	12	
2330	90	⊕	7		49	43	↠	15	
4TH 0030	80	⦶	8		47	43	↠	7	50504 0107 58
0130	80	⦶	7		45	42	↠	9	
0230	100	⦶	4	GF	44	40	→	5	
0330	120	⦶	3	GF	44	40	→	7	102 0107
0430	120	⦶	3	H	44	38	→	7	
0530	120	⦶	3	H	42	37	↗	7	
0630	120	⦶	4	GF	37	35	↗	10	408 0207 37
0730	120	⦶	4	GF	39	35	↗	10	
0830		○	6	H	41	37	↑↗	10	

1230C 3 Dec 1951 TO 4 Dec 1951

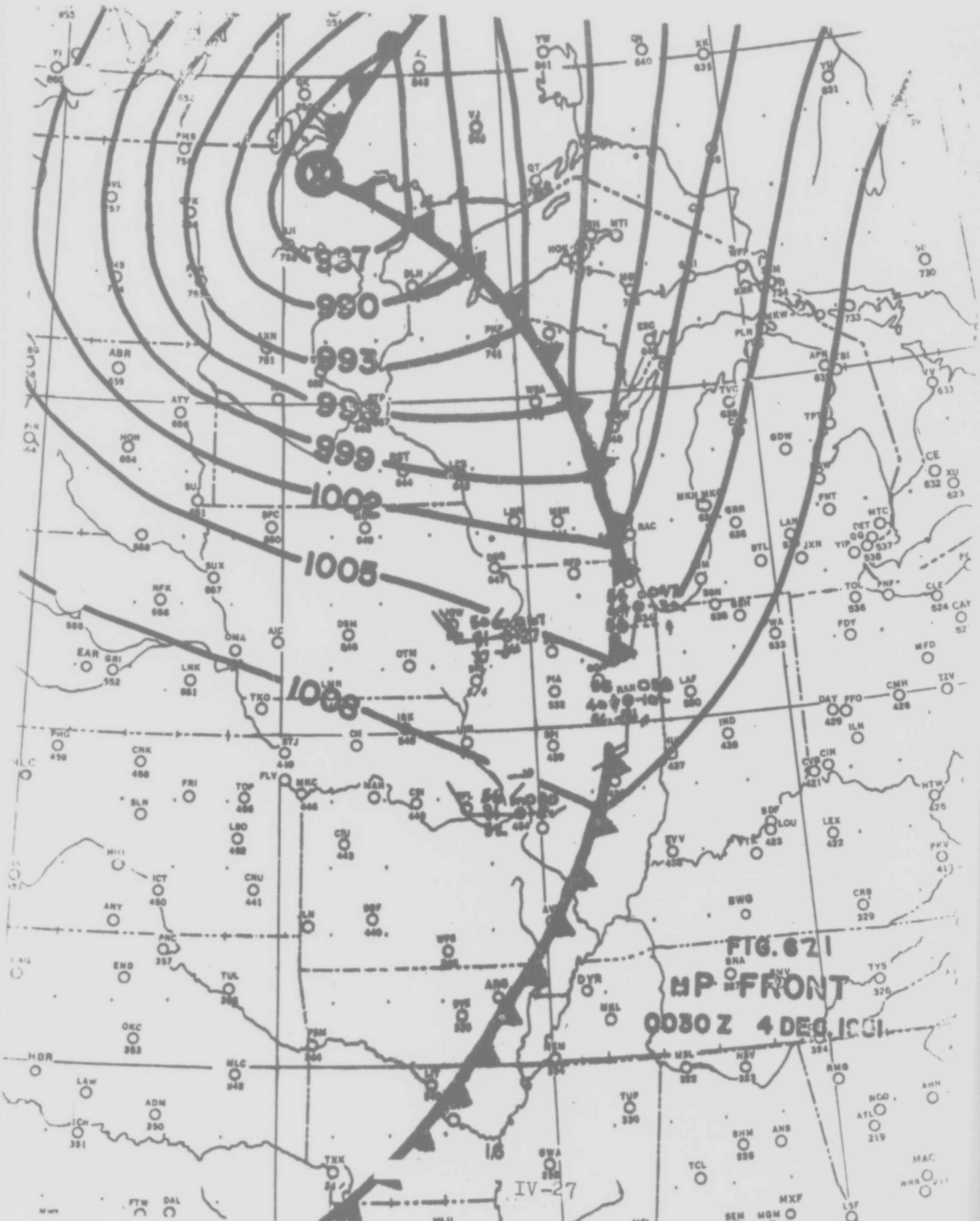


FIG. 621
MP FRONT
0030 Z 4 DEC. 1961

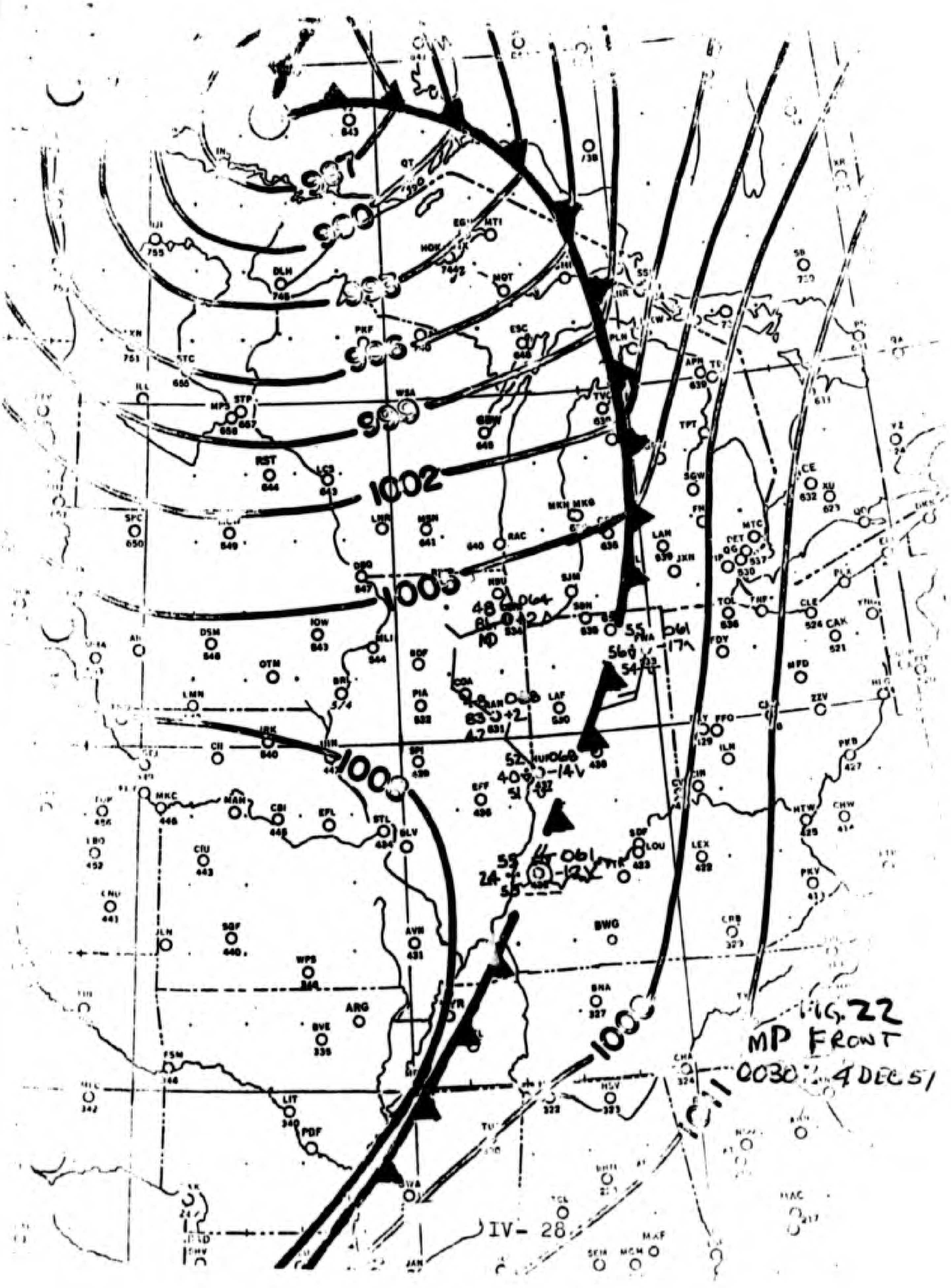


FIG. 22
MP FRONT
0030Z 4 DEC 51

Continental Polar Front

With the Continental Polar front 250 miles away from the station, generally fair weather conditions exists at this station. Occasionally, with strong, unstable air over the station preceding frontal passage, there will be some cumulus activity with showers and possible thunderstorms (thunderstorm predominantly March through September).

Visibilities are excellent and average 7 miles or more. As the front approaches to within 100 miles of the station, aband of altocumulus, usually spreading 80-100 miles ahead of the front, will be observed. This deck will remain broken to overcast up to the frontal passage at heights of 8000 to 12000 feet.

As the front approaches to within 80 miles of the station, a deck of stratocumulus broken to overcast will dominate with ceilings 5000 to 7000 feet gradually lowering to 1000 feet or less at frontal passage.

If the continental polar air mass is moist, the stratocumulus deck will persist with ceilings 1500 to 5000 feet remaining over the station 12 to 24 hours after frontal passage.

Showers generally form as far as 50 miles in front of both active or snow as far as 150 miles behind the front.

Visibilities are generally 5 miles or less from 8 hours before and up to frontal passage, then generally 2 miles or less for 3 to 5 hours after the frontal passage.

Figure 8 illustrates a typical continental polar front.

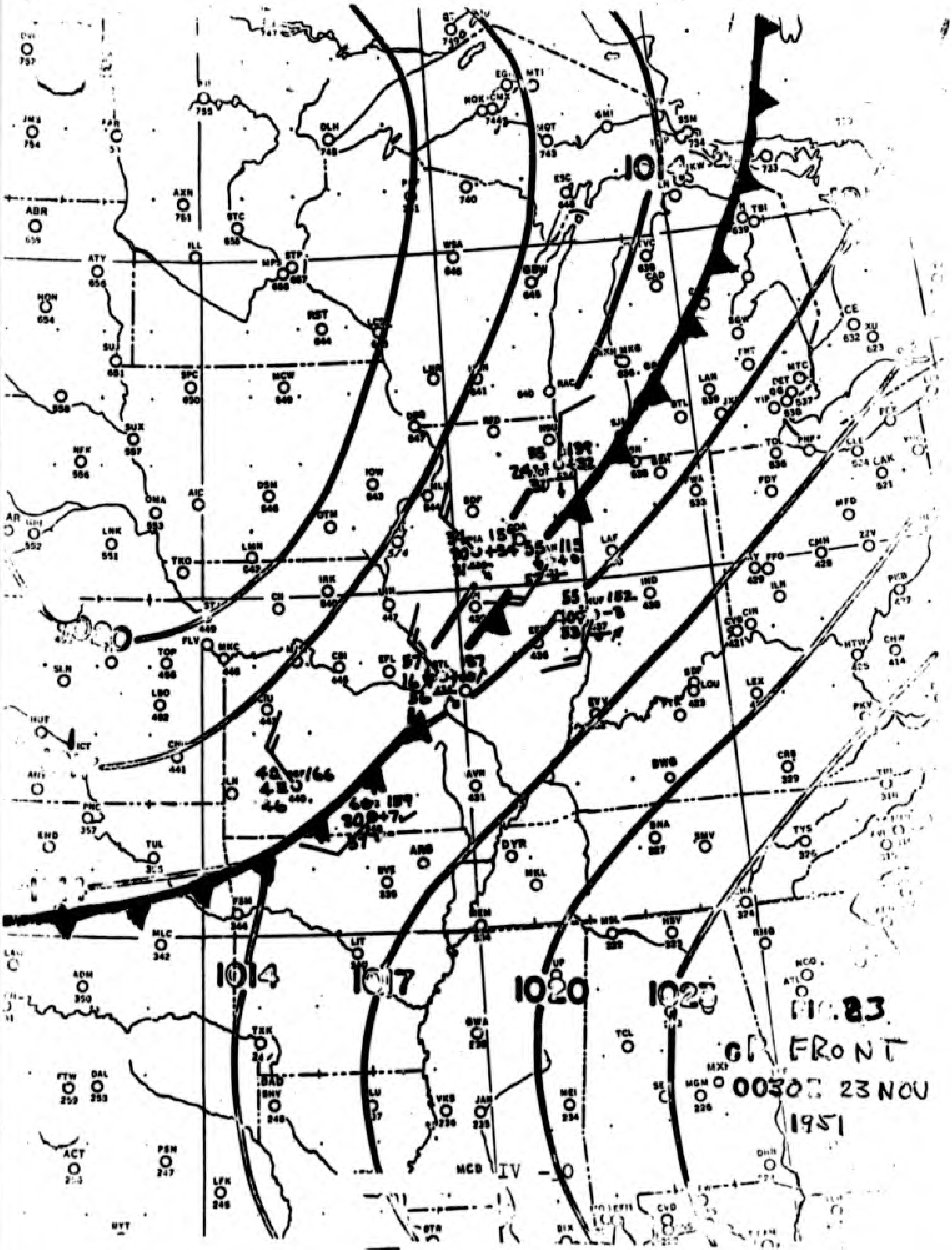


FIG. 83
C[illegible] FRONT
0030Z 23 NOV
1951

FORECASTING MOVEMENTS OF LOWS IN SW FLOW

1. According to J. J. George, a low will tend to move in the direction of greatest apparent warm air advection as determined from the cross pattern at 850 mbs. The speed of the low will be roughly equal to the maximum speed of the wind above the center of apparent warm air advection. The center of warm air advection is determined by drawing lines bisecting the rectangular areas of maximum warm air advection east of the trough line so that there are about the same number of solenoids in each of the four quadrants (if the temperature and isoheight lines are equally spaced); otherwise the rectangular area should be divided into four equal areas. The rectangular area for this type of determination is obtained by the use of two height lines to form two opposite sides of the rectangle and two isotherm lines to form the other two sides as shown in Figure 19.

2. A low will tend to move in the direction of the most rapid advance of the precipitation shield and the speed of the low should be proportional to the distance of the three-hour pressure falls extending outward ahead of the low center; the farther the pressure falls extend ahead of the low, the faster the low will move.

3. Shallow lows with only a slight trough aloft associated with them will tend to move along the flow from 700 mbs or below. Deep cold lows will move with the flow at 500 mbs or higher. The steering level for cold lows should be picked at a height that is above the level at which a closed circulation exists around the low. The speed will be approximately 50-60% of the speed at the steering level.

4. When a cold core of air has been cut off at 700 mbs or 500 mbs in a slow stagnant low pressure trough, there will be a tendency for the surface low to the southeast and the cold core to rotate cyclonically about each other. In other words, as the cold core moves from west of the low center on the

surface to southwest and eventually south of the low center, the surface center will tend to move more northerly than easterly. This must be carefully watched when the cold trough at 500 mbs becomes very slow moving along the eastern coast and a wave has developed along the southeast coast moving momentarily northeastward. In this type of pattern, as the cold core continues southward into the trough, the east coast low will continue to deepen and may actually move slightly west of north during the subsequent 24 hours. This type is rare but does occur occasionally and will bring snow or rain into Kentucky, Ohio, Lower Michigan, Illinois and Indiana through its back door, so to speak. Figure 20 shows the paths of these lows.

5. Any continuous and slowly spreading precipitation areas that develop in central or eastern Texas with a semi-stationary front in the Gulf of Mexico should be watched carefully for the possibility of precipitation spreading into the Rantoul area. Such persistent and spreading precipitation, even though it may not be possible to discern a wave in the Gulf, is a very good indication of wave action in the western Gulf of Mexico. Such areas require special consideration in an effort to try to determine when the wave will actually start moving northeastward and where such a system will enter the southern states. Points enumerated heretofore may serve as some indication as to when major wave action may begin and its possible direction of movement.

MISCELLANEOUS RULES

1. When there is a low pressure trough along the east coast at 700 or 500 mbs with moderate northwest-southeast flow from the eastern Rockies to the trough line and a stationary front is located through the central or western plains states, one should be especially alert for any precipitation patterns that may break out along the front in the Dakotas and eastern Montana. Such precipitation, once it begins, will spread southeastward at excessive rates of speed. If the wave action is only slight, such conditions may dump as much as

three or four inches of snow along its trajectory. Twelve hour pressure falls that begin to appear in western Montana in the vicinity of the stationary front are excellent indications of such wave action on the front. Careful watching of the stretching of the precipitation pattern from northwest to southeast, even though the wave may be overlooked momentarily, will give the forecaster from 6 to 12 hours warning in the Chanute area.

2. When a cut-off low is present at upper levels in the southwestern U.S., the low will remain in its position until 12 or 24 hour pressure height falls (Henry Rule) appear 1200 miles northwest of the upper low position. This is an indication that the closed low will begin to move out toward the north or northeast within the subsequent 24 hours.

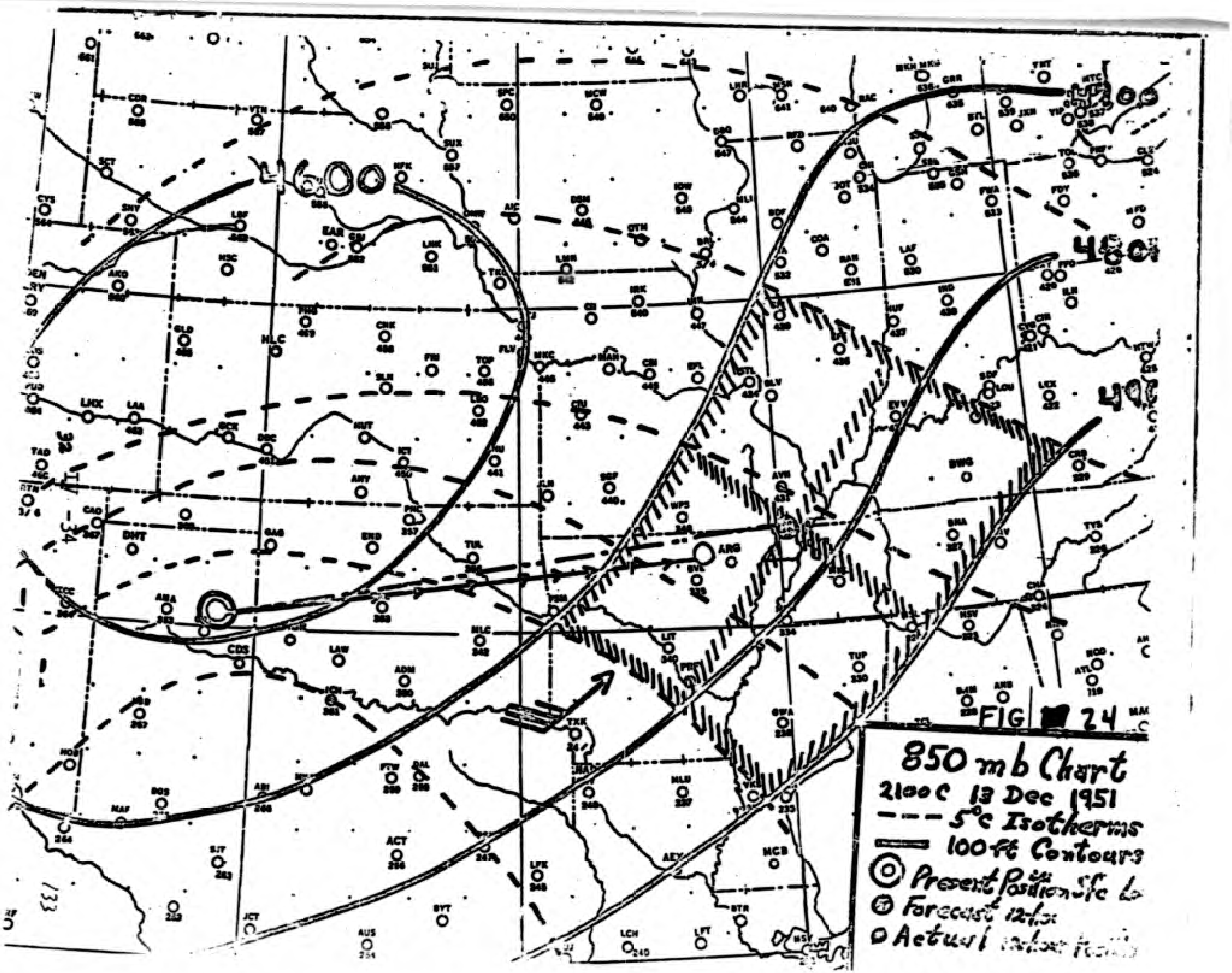


FIG 24

850 mb Chart
2100C 13 Dec 1951

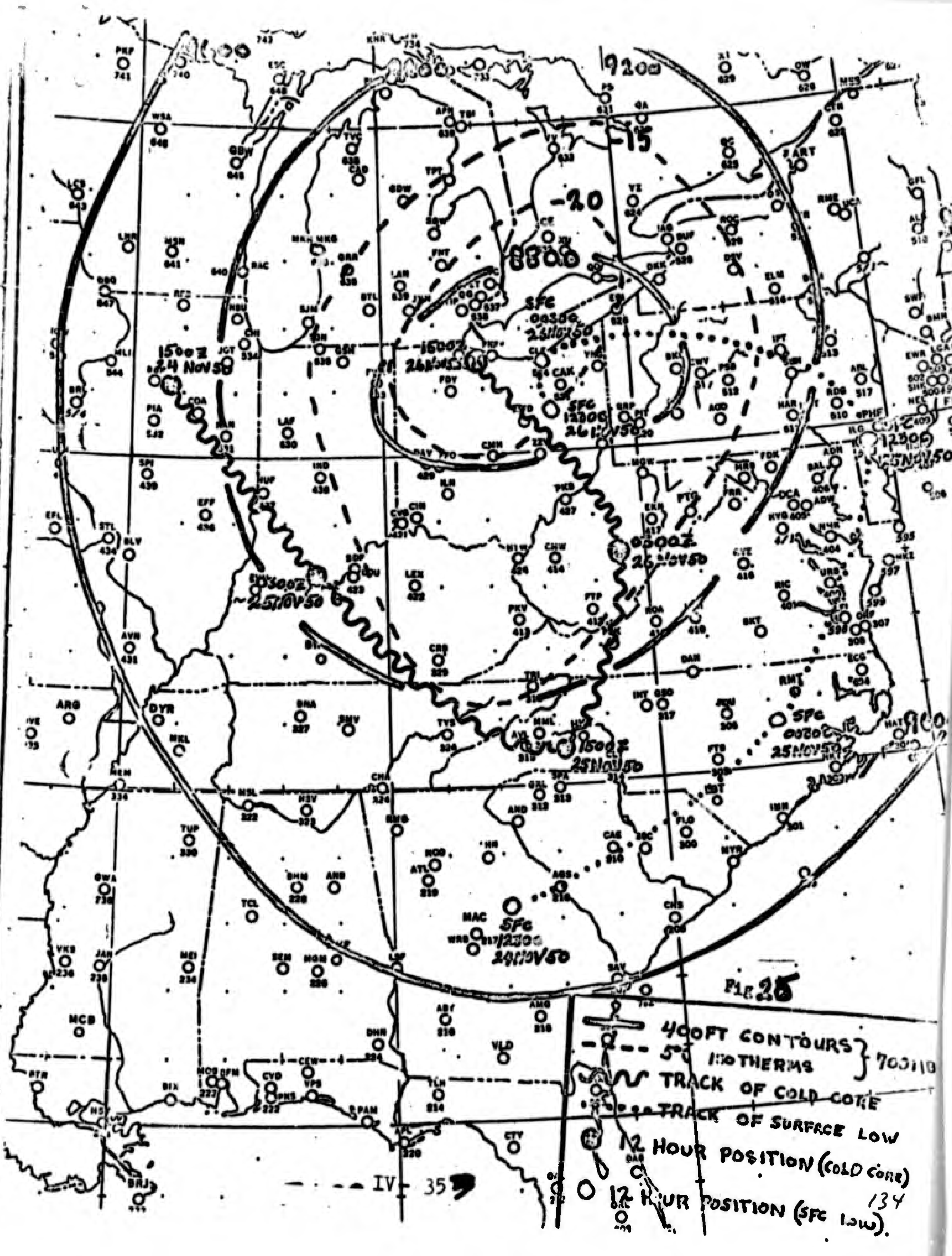

9200
8800
-15
-20
1500Z 24 NOV 50
0300Z 25NOV50
1500Z 24NOV50
SFC 0030Z 25NOV50
SFC 1200Z 26NOV50
0300Z 25NOV50
1500Z 25NOV50
SFC 0030Z 25NOV50
SFC 1230Z 25NOV50
MAC SFC 1230Z 24NOV50
400FT CONTOURS
5°C ISOTHERMS
700MB
TRACK OF COLD CORE
TRACK OF SURFACE LOW
12 HOUR POSITION (COLD CORE)
12 HOUR POSITION (SFC LOW)

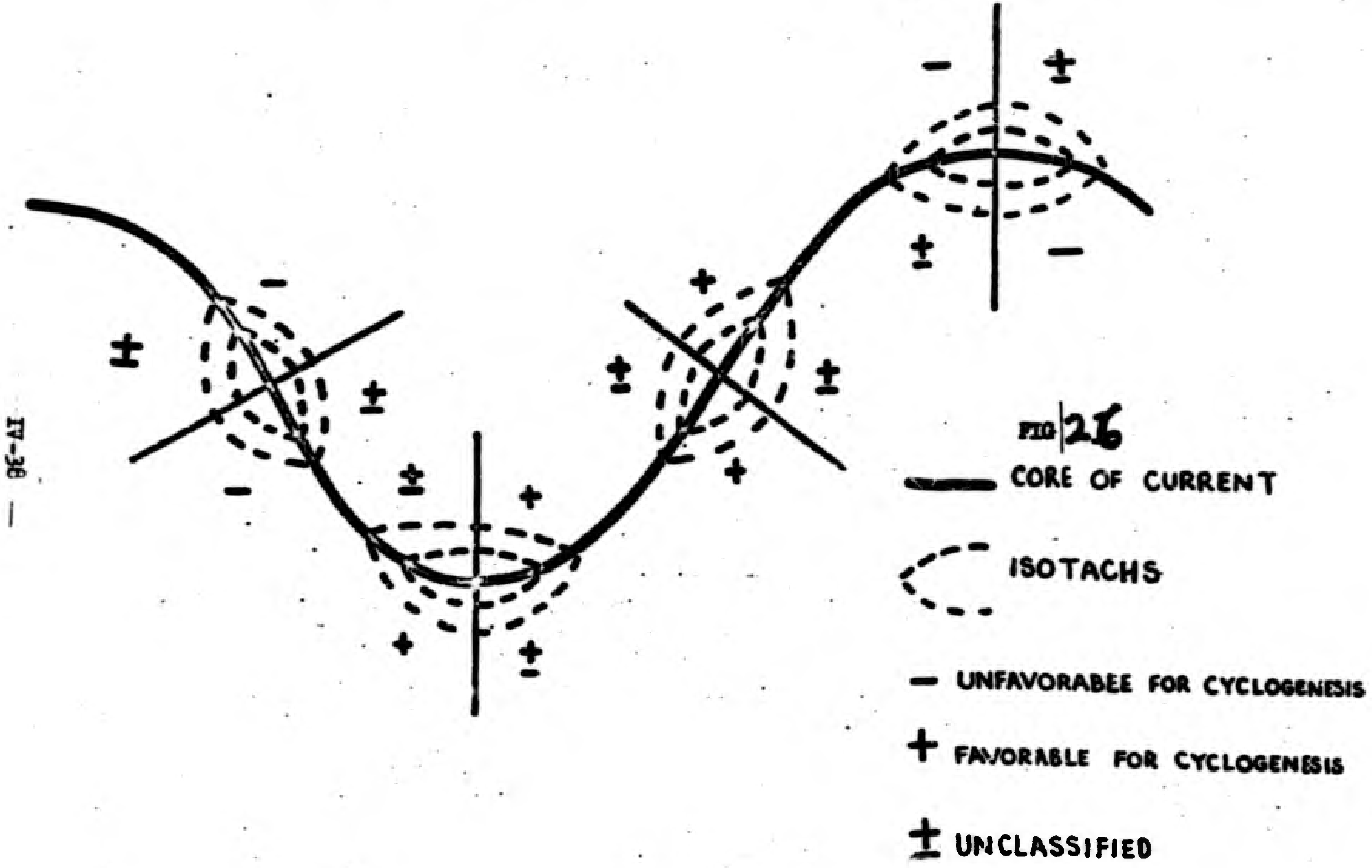
Fig. 25

DETERMINATION OF AREAS OF POSSIBLE CYCLOGENESIS FROM JET STREAM MAXIMUM CONSIDERATIONS

The velocity field from 500 mbs to 200 mbs is a very helpful tool in forecasting cyclogenesis. The considerations here are based on vorticity considerations along the area of maximum wind flow. Vorticity is a combination of both the wind shear and curvature of the streamlines. When both of these factors work together, then they contribute to major cyclogenesis. In using the jet stream, one should find an area of wind speed maximum along the core of the current. This maximum, in order to be effective, must be a well defined maximum over which the wind velocities decrease rapidly in all directions from the center of the maximum. After locating the maximum, the area should be divided into four quadrants through the center of wind maximum. The vorticity relationships in each of these quadrants will determine which areas would be favorable for cyclogenesis. Figure 21 indicates the quadrants that would be favorable and unfavorable for cyclogenesis depending upon the position of the wind speed maximum along the core of the current. For example, if the maximum passes through the trough and starts a path to the northeast, two areas become favorable for cyclogenesis - the northwest and southeast quadrants. If a surface low or a stationary front is located in a favorable position along the core of this current, a new wave or the deepening of an already-existing cyclone will occur as the area of maximum wind passes around the trough toward the inflection point between the trough and the ridge. Similar considerations could be given in regard to the other positions of the maximums. It should be noted that a maximum moving southeastward does not ordinarily possess any definite well-defined quadrants that would be favorable for cyclogenesis. The two indeterminate quadrants may or may not produce cyclogenesis depending upon which of the vorticity relationships - the shear or the curvature - is the most important or whether one consideration counter-balances the other. In other words, when the maximum is in this position, the shear contributes in one direction and the curvature counteracts the shear contribution. The relative importance of each of the contributions therefore would determine whether one should expect favorable cyclogenesis or not. In summary, we might say that an area becomes favorable for cyclogenesis when, looking downstream* from the maximum area, the cyclonic vorticity indicates a decrease. This is true because an area of decreasing vorticity downstream from an instantaneous position of the maximum would become, with the passage of time, an area of increased cyclonic vorticity as the maximum moves downstream into the area under consideration.

* Downstream, by definition, is determined by standing with one's back to the wind and looking in the direction of flow. Upstream would be in the opposite direction.

FIG 26


CORE OF CURRENT
ISOTACHS
— UNFAVORABEE FOR CYCLOGENESIS
+ FAVORABLE FOR CYCLOGENESIS
± UNCLASSIFIED
±
−
+
±
−

GENERAL SYNOPTIC REMINDERS

1. Low pressure centers moving ENE from Texas Panhandle Region into Ohio River Valley will generally cause heavy snow in winter and heavy rain in summer.

2. When low pressure centers moving eastward during the winter from Colorado or Nebraska pass north of Chanute, light snow will fall at Chanute for several hours from middle level altostratus clouds.

3. In the winter, when a deep low pressure has become stationary over lower Michigan, Chanute will be under a strong cyclonic circulation and will have low ceilings with intermittent snow flurries as long as the cyclonic flow persists.

4. In the spring and summer, squall lines frequently form between the Mississippi and Illinois Rivers during the evening and will move eastward, reaching the Chanute area during the early morning hours. These storms are not normally the severe type.

5. When the polar front becomes stationary through Southern Illinois and warm moist air from the Gulf of Mexico over-runs the cold air, Chanute will have a few hours of freezing precipitation, generally turning into snow.

6. When low pressure or open waves move through Central Illinois and Chanute has been under a strong flow of moist and warm air from the Gulf of Mexico, thunderstorms will form mostly at night and last for several hours. On occasion, these are of the severe type.

7. Thinking of the low center in the form of quadrants, if Chanute ever gets in the northeast or northwest quadrants, the fall of snow will likely be heavy.

8. In the summertime, when close inspection of the isotherm pattern reveals a cold pocket of air at the 500 mb level to the west of Chanute, the local area will quite likely have nocturnal thunderstorms.