AD 676072

TERMINAL FORECAST REFERENCE FILE

VOLUME I

DETACHMENT 19

8TH WEATHER SQUADRON

WHITEMAN AFB

SEPTEMBER 1968

72

TABLE OF CONTENTS

REVISIONS

Number	Date	Part and Section Changed

PART 1

SECTION A

TOPOGRAPHY

TOPOGRAPHY

Whiteman AFB, Missouri is located at 38°44' North, 93°34' West in the rolling hills of western Missouri. Field elevation is 869' MSL, while the elevation within a 75-mile radius varies from 700 to 1400 feet.

The base is situated in a slight depression with higher terrain to the south and west. The Boston and Ozark mountains to the south reach heights to 2800 feet. Weather conditions, on the average, are slightly improved as they encounter the down-slope effect, when moving into the Whiteman area from the higher terrain to the south and west.

Since there are no major east-west mountain chains in the central United States, the Whiteman AFB area is subject to rapid invasion of air masses from both Canada and the Gulf of Mexico. As a result, a wide range of rapidly changing weather is experienced.

The Gulf of Mexico represents the only major moisture source that affects weather conditions in the Whiteman area. With the establishment of a predominant southerly flow, stratus and precipitation are advected from the Texas Gulf coast northward into Missouri. Other nearby moisture sources include the Missouri river, some 40 miles north of the base, and the Lake of the Ozarks, some 40 miles southeast of the base; neither of these sources is believed to significantly influence Whiteman AFB weather.

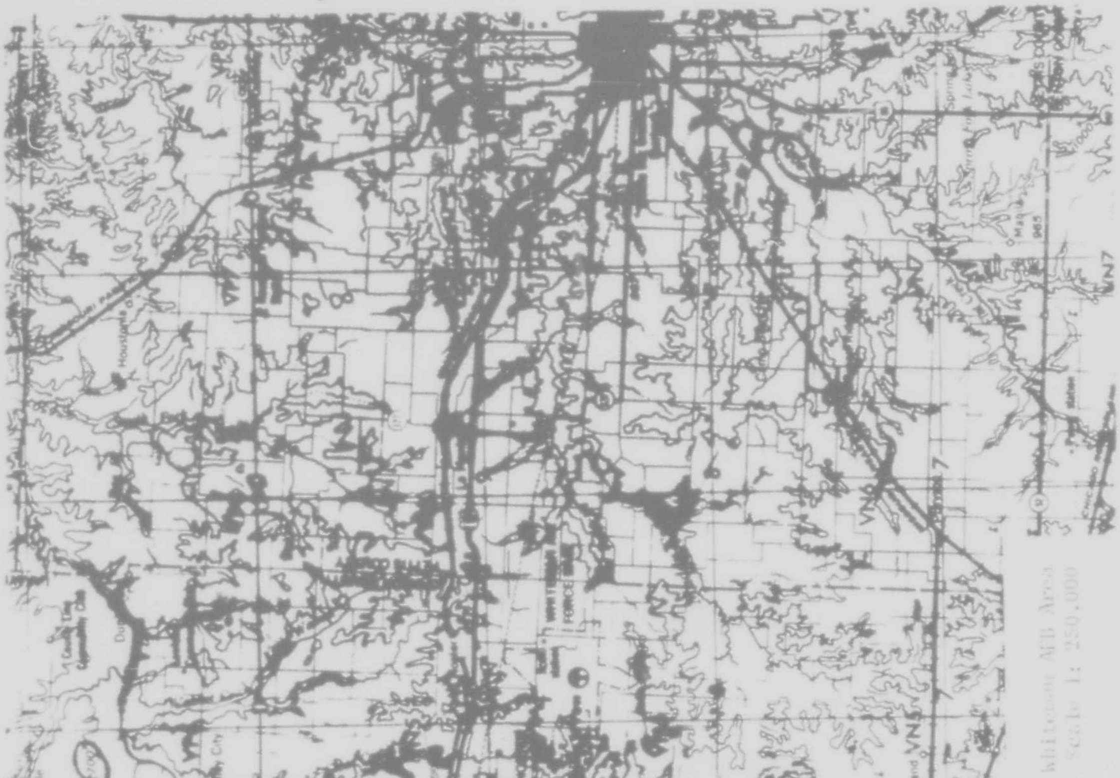

Fig 1 - A - 1

GRAPHIC NOT REPRODUCIBLE

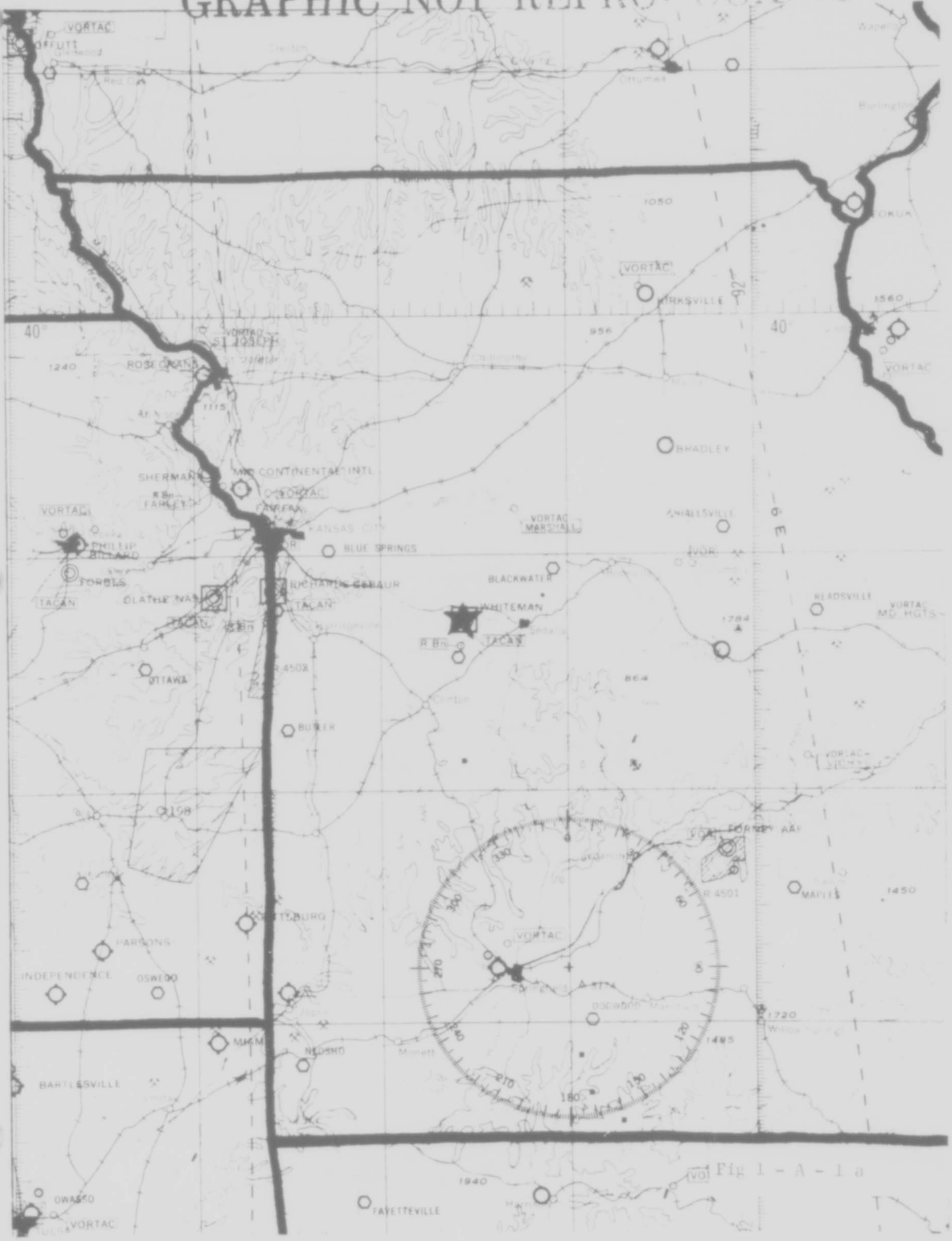

Fig 1 - A - 1 a

SECTION B

ATMOSPHERIC POLLUTION SOURCES

ATMOSPHERIC POLLUTION SOURCES

Whiteman AFB is not sufficiently close to a large population center for industrial pollution to be considered a significant factor for operations or forecasting. Kansas City, Missouri, located 65 miles to the northwest, is the only large industrial complex that provides a source of pollution for the Whiteman area. This pollution, in the form of industrial smoke, is advected into Whiteman when the low level wind flow is from 290° to 300° and there is a strong low level inversion present. It is extremely rare that this smoke restricts visibility below five miles at Whiteman.

Local smoke at Whiteman AFB is the result of trash incineration at a large dump located three miles northwest of the base. With very light winds, from no specific direction, and a strong low level inversion, smoke from this dump will spread over the local area. Rarely will this smoke restrict visibility below seven miles, but it is visible within the local area.

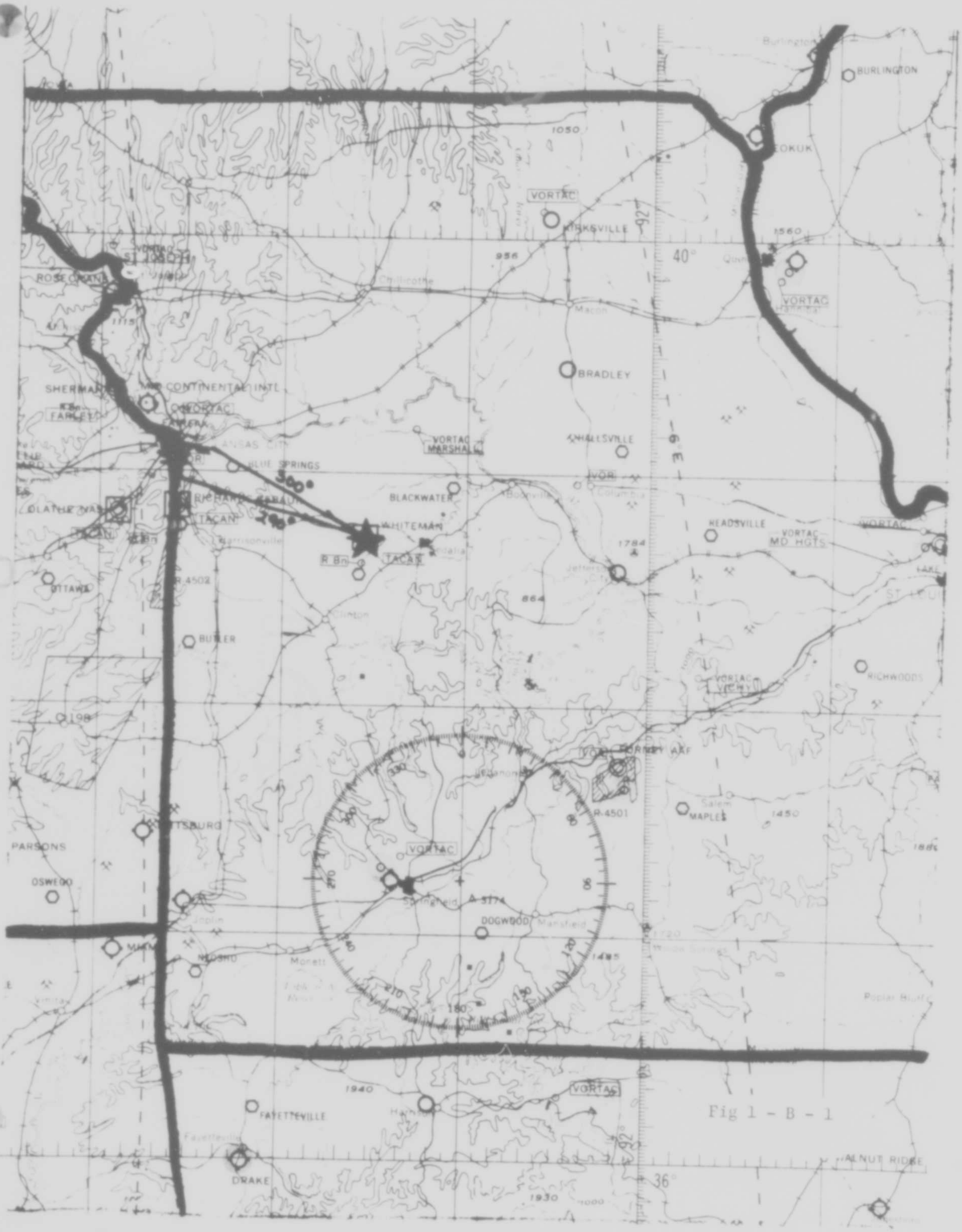
BURLINGTON
VORTAC
KIRKSVILLE
40°
BRADLEY
SHERMAN
BLUE SPRINGS
BLACKWATER
WHITEMAN
TACAN
READSVILLE
OTTAWA
BUTLER
RICHWOODS
R-4501
PARSONS
OSWEGO
MAPLES
DOGWOOD
FAYETTEVILLE
DRAKE
36°
1050
956
1560
1784
864
1450
1940
1930

Fig 1 - B - 1

SECTION C

INSTRUMENTATION

Exposure of Observing Instruments

The weather station is located east of the main base complex in the Base Operations building. It has been there since the Base Operations was built.

The Representative Observation Site (ROS), located 1280 feet west of center line and 6600 feet from the south end of the runway, became operational in 1960 or 1961. It is elevated 28 feet above the terrain. The view of the horizon is obstructed from 280° to 290° and from 300° to 310° by two hangars located one-half mile away.

Weather equipment is located as follows and unless otherwise noted is considered representative.

1. AN/CPS-9, Weather Radar: Located 1100 feet north of the weather station, with the antenna height of 107 feet. The only obstruction is a 140 foot water tower at 260°. Since it is a very narrow block there is virtually no loss of returns caused by it. This radar was installed 3 May 1961.

2. AN/TMQ-11, Temperature-Humidity Measuring Set: Located 1050 feet west of center line and 7350 feet north of the south end of the runway, with the indicator located in the ROS. The TPQ-11 became operational 21 November 1963.

3. AN/GMQ-10, Transmissometer: Projector number 1 is located 1140 feet east of center line and 1650 feet north of the south

end of the runway. The receiver is 502 feet south of it, 1184 feet east of center line. It was installed 16 October 1961.

The second projector is located 1091 feet east of center line, 1300 feet south of the north end of the runway. The second receiver is 1143 feet east of center line, 502 feet north of the projector. The second set was installed 4 March 1963 and is located near a slightly marshy area. On very rare occasions, it is engulfed in ground fog which does not affect the runway.

4. AN/GMQ-11, Wind Measuring Set. The first set was installed 21 March 1961, 500 feet east of center line and 1525 feet north of the south end of the runway. It is 21 feet above ground.

The wind set on the north end of the runway was installed 4 March 1963. It is 500 feet east of center line and 1000 feet south of the end of the runway. It is 13 feet above ground.

5. AN/GMQ-13, Cloud Height Measuring Equipment. The first set was installed 16 October 1961. The detector is located 25 feet west of center line and 2650 feet south of the runway. The projector is 400 feet west.

The north end set was installed 4 March 1963. The detector is located 50 feet east of center line, 1800 feet north of the end of the runway. The projector is 400 feet east.

6. ML-17, Rain Gauge, is located 100 feet north northwest of the ROS.

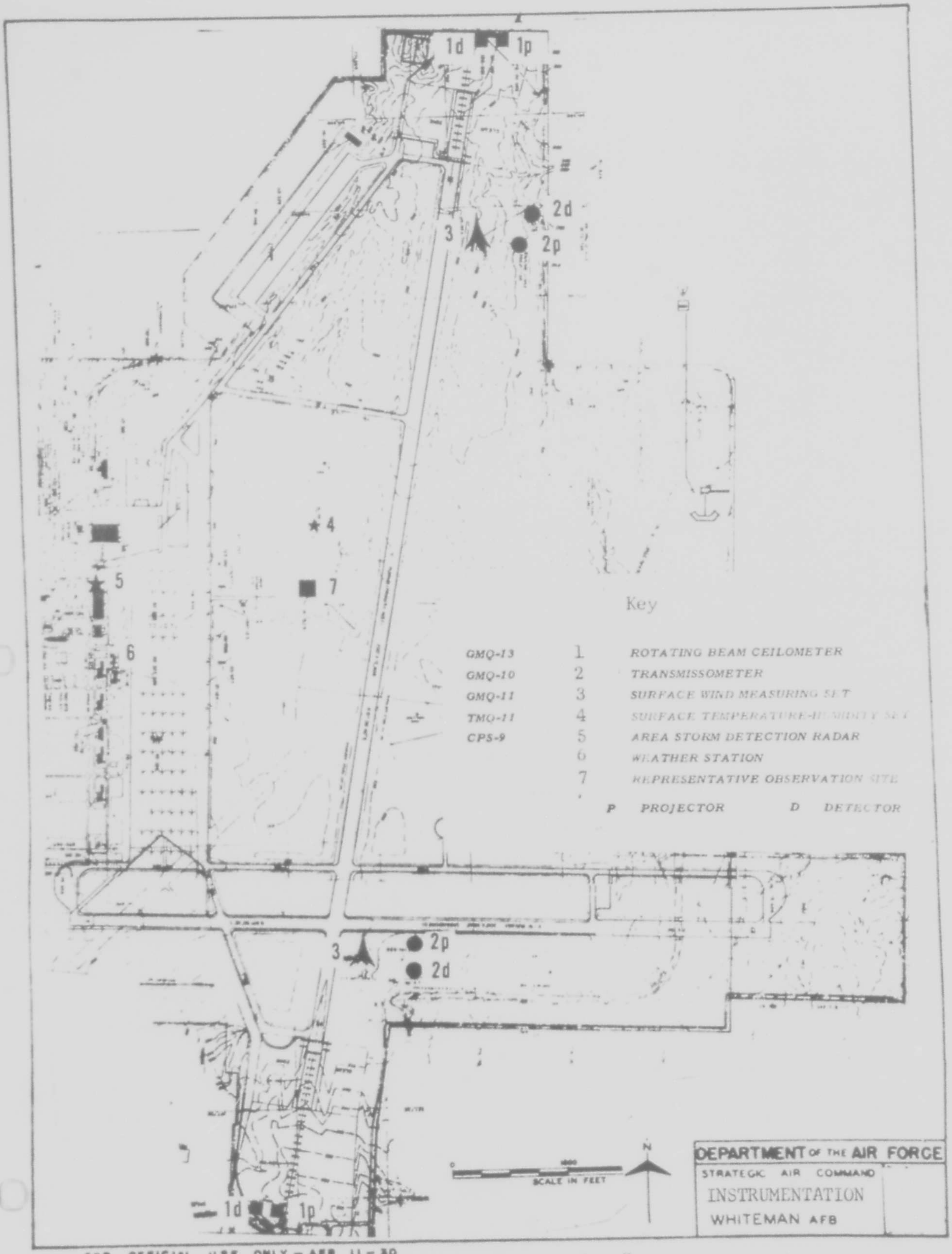

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Fig 1 - C - 2

7. ML-2, Mercurial Barometer, is located in the weather station. The ML-3 Barograph and the ML-102 Aneroid Barometer are located in the ROS.

History of Past Observing Site and Instrument Location

Sedalia AAF was activated in 1942. Weather observations were taken from December 1942 to September 1946. The field was inactivated in 1947. It was reactivated in 1951 as Sedalia AFB. Weather observations were begun 1 June 1954 and have continued since that time. However, there are no records available indicating any equipment was, in the past, at any other location.

PART 2

WHITEMAN AFB, MISSOURI ELEV 869 FT 38 44N 93 34W PREPARED -- APR 65

PERIOD OF RECORD -- APR 43-SEP 46, JUN 54-NOV 60

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TEMPERATURE (DEG. F)												
EXTREME MAX	71	73	87	91	95	103	107	105	101	91	81	69
MEAN DAILY MAX	39	43	53	66	75	83	85	88	81	69	54	41
MEAN DAILY MIN	22	26	34	46	56	65	68	68	59	48	35	25
EXTREME MIN	-11	-5	-5	22	33	40	54	50	40	26	4	-7
MEAN NO DAYS												
MAX 90F OR MORE	0	0	0	*	*	7	15	15	5	*	0	0
MIN 32F OR LESS	26	21	14	2	0	0	0	0	0	1	13	23
MIN 00F OR LESS	1	1	*	0	0	0	0	0	0	0	0	*
PRECIPITATION												
MEAN NO DAYS												
PRECIP	7	7	10	10	13	10	8	8	8	7	5	7
SNOWFALL	4	3	3	*	0	0	0	0	0	0	*	2
SNOWFALL 1.5 IN	1	1	2	*	0	0	0	0	0	0	*	1
MEAN AMOUNT (IN)												
PRECIP	2	2	3	4	5	4	3	4	3	3	1	2
SNOWFALL	6	5	6	1	0	0	0	0	0	0	1	5

WHITEMAN AFB, MISSOURI

FLYING WEATHER

PERCENTAGE FREQUENCY CEILING BELOW 1500 FT AND/OR VISIBILITY BELOW 3.00 MI.

HOUR(LST)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
01 - 03	22.1	20.4	[illegible]	11.8	8.4	4.7	2.2	2.7	3.9	6.9	7.1	20.5
04 - 06	25.2	23.7	16.4	14.8	12.4	7.5	4.7	3.9	8.3	9.1	9.1	24.5
07 - 09	26.8	25.6	13.3	17.6	13.1	7.0	6.0	5.0	8.9	9.9	11.6	27.0
10 - 12	25.2	23.1	[illegible]	14.6	11.8	7.1	4.1	4.8	7.3	10.9	10.3	25.2
13 - 15	22.3	20.9	15.5	9.6	7.8	4.9	2.1	2.9	5.0	6.6	8.1	20.5
16 - 18	19.4	20.5	14.1	9.3	6.6	2.0	1.1	1.7	4.2	6.2	5.7	18.0
19 - 21	19.5	19.2	14.6	10.6	7.1	2.0	1.5	1.1	3.6	6.3	6.5	17.3
22 - 24	19.6	17.0	15.8	8.9	5.9	2.1	0.6	1.3	4.2	6.1	5.9	17.9
ALL	22.5	21.3	16.0	12.1	9.1	4.7	2.8	2.9	5.7	7.8	8.0	21.4

PERCENTAGE FREQUENCY CEILING BELOW 300 FT AND/OR VISIBILITY BELOW 1.00 MI.

HOUR(LST)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
01 - 03	6.0	6.0	2.5	1.1	0.9	0.7	0.3	0.3	0.4	1.2	1.3	6.6
04 - 06	6.3	6.1	3.0	3.1	2.7	1.8	1.1	0.5	1.8	3.1	0.9	7.6
07 - 09	8.7	7.2	3.5	2.1	1.0	0.5	0.8	1.0	1.6	3.0	0.6	9.3
10 - 12	5.6	5.4	0.1	0.	0.2	0.4	0.1	0.1	0.2	0.9	0.2	6.7
13 - 15	3.9	4.8	2.3	0.	0.	0.	0.	0.3	0.1	0.1	0.8	3.7
16 - 18	4.3	5.2	2.2	0.2	0.6	0.3	0.1	0.	0.2	0.3	0.6	3.6
19 - 21	4.5	6.3	3.1	0.6	0.6	0.2	0.2	0.1	0.3	0.3	0.8	4.4
22 - 24	4.7	5.9	2.5	0.9	1.2	0.3	0.	0.1	0.3	0.6	0.8	6.0
ALL	5.5	6.0	2.4	1.0	0.9	0.5	0.3	0.3	0.6	1.2	0.7	6.0

PART 3

SECTION A

INTRODUCTION

INTRODUCTION

Whiteman is located in a typical continental climatic regime (moderate, winter dry - Cw - by Koeppen). Summers are quite warm - July absolute maximum temperature is 107°F. Winters are cold - January absolute minimum is -11°F. The Gulf of Mexico provides a source of moist, warm air. This maritime tropical (mT) air is the energy source for both the air mass and frontal thunderstorms that can occur any month of the year. Most treacherous are the pre-frontal squall lines with their intense phenomena (tornadoes, etc.). Squall lines can occur any month of the year, but are most frequent in the spring. Low ceilings and visibilities are major forecast problem only with winter systems and with those spring and fall fronts that become stationary in central and south Missouri and north Arkansas.

SECTION B

GENERAL CIRCULATION

GENERAL CIRCULATION

Air Masses. The Missouri area can be affected by all types of air. They are listed in their frequency of occurrence:

Maritime Tropical (mT) is the prevalent summer air mass and also occurs in the winter season with some regularity. Fall through spring, mT air is brought into the region by a polar high moving eastward or by the development of a Colorado low. This is the air mass of summer thunderstorms and of over-running weather phenomena.

Modified Maritime Polar (mP) air is found throughout the year. It is brought into the region by Pacific occlusions which move across the northwestern mountain states. This is the type air mass most commonly associated with fast moving cold fronts.

Continental Polar (cP) air moves over the area throughout the year, with greatest frequency in the winter. The cP air mass is often brought in behind a secondary cold front as a low system moves across the Midwest. Except in the summer, cP air is significantly colder than mP air.

Continental Arctic (cA) air brings the most bitter winter weather to this region. When the upper air pattern adjusts so that a series of highs move southward out of Canada, the latter ones of the sequence bring cA into the Whiteman area.

Superior (S) air occasionally moves into the Whiteman area from the late spring to the early fall. Southwesterly winds in some depth are required from this type of advection. This air is typified by increasing temperatures, decreasing moisture content, and decreasing thunderstorm potential.

As with air masses, all types of fronts can occur in the Missouri area. Cold fronts are the most frequent and usually the most well defined fronts. They are best defined when preceding a strong polar (or arctic) high which has a large southward component of movement. When cold fronts have originated as a Pacific front and have moved across the Rocky Mountains, they are offten diffuse. In the spring, formation of squall lines makes analyses of these diffuse fronts particularly difficult. Cold fronts are subject to frequent frontolysis in this area. Cold frontogenesis rarely occurs closer than southern Canada.

Stationary fronts present a great forecast problem. Often they are diffuse, with little weather; however, when well defined and located just to the south of Whiteman, accompanying over-running weather can be a great hazard. Thunderstorms are frequent in such cases during the spring and fall. In the winter, freezing precipitation, as well as an occasional thunderstorm, can occur. Frontogenesis of stationary fronts is almost always associated with cyclogenesis. A developing low will bring mT air into a zone of contrast with modified mP or cP. Frontolysis usually occurs after a cold front has become stationary.

Warm fronts are, with rare exceptions, associated with cyclogenesis in the Texas Panhandle, in Oklahoma or in Kansas and originate in the same manner as new stationary fronts. Occasionally cold fronts that become stationary move north again as warm fronts. In this case, over-running phenomena will usually continue to occur.

Occlusions will occasionally pass through this area. They are normally recently formed by cyclogenesis in Kansas or Oklahoma. The low center must necessarily track just to the north of the Whiteman-Kansas City area. Pacific occlusions that survive passage across the Rockies move well to the north of the area.

SECTION C

SEASONAL WEATHER REGIMES

SEASONAL WEATHER REGIMES

Winter weather regimes occur late November through mid-March. Transition from fall is generally gradual; frequency of cyclonic disturbances increase and polar air masses become colder. Transition into spring is noted by increasing temperatures, more frequent intrusions of mT air masses, and by an increase in thunderstorm frequency and intensity. Spring regimes predominate during March, April and May, but spring severe weather types can occur through mid-June. Summer regimes predominate by mid-June; cold fronts often lose their thermal contrast in crossing the sun-heated plains. The westerly mid-level jetstream is well north of Missouri, usually into Canada. Cyclone frequency is at a minimum. This summer regime continues to be dominant until September and may persist until early October. Fall is noted by the beginning of the annual increase in cyclonic activity; polar air masses are more frequent and are noticeably colder. The cold fronts which precede these polar air masses maintain a strong thermal contrast and their passage brings a noticeable change in air mass.

Winter Weather Regimes.

1. Regime I. During the winter months, continental Polar (cP) outbreaks can occur twice weekly through Missouri. Clues are available, both aloft and on the surface, to follow these outbreaks.

a. Aloft:

(1) Emergence of a long wave trough off the Pacific Coast and movement eastward across the plains states.

(2) Strong height falls in the anticyclonic flow ahead of the trough.

(3) Strong cold air advection to the rear of the 500MB trough.

(4) Southward migration of the polar jet stream.

b. Surface:

(1) Strong pressure rises in Alberta and Saskatchewan of 3mb per 6 hours or higher. Outbreaks of the cold air across the border can follow within a 12-hour period.

(2) Extremely strong surface gradient on the back side of a high from the Canadian border northward.

(3) Speed of movement of the front can be approximately 50% of the gradient wind.

(4) If a high develops a central pressure of 1040mb or higher, the cold wave usually moves directly down the east slope of the Rockies to Texas, then eastward across the Gulf of Mexico to the Atlantic. If the central pressure is as high as 1043mb, this movement is always noted.

c. Associated Weather:

(1) Snow or rain 3 to 6 hours after frontal passage. Snow accumulation usually 1 to 3 inches.

(2) Strong northwest winds to the rear of the front up to 12 hours after frontal passage.

(3) Ceiling gradually lowering from 2 to 3 thousand feet to 4 to 6 hundred feet during frontal passage and persisting from 8 to 12 hours.

(4) Coldest temperature usually occurs on the second day after cP frontal passage.

(5) Fair skies occur for several days following the outbreak.

2. Regime II. Maritime Polar air masses (mP) move across the Rockies into the central plains. Most of the moisture is lost coming across the mountains. From November through February, southerly flow ahead of an incoming front of this nature will advect gulf stratus and light precipitation northward into the Kansas - Missouri area from the south coast of Texas. This condition of low ceilings and visibilities will give way to fair skies and mild temperatures as the front passes.

3. Regime III. Maritime Tropical (mT) air is, under certain conditions of southerly flow, advected into the Whiteman area from the Gulf of Mexico. Generally the southerly flow is caused by an mP or cP air mass being positioned on the east coast of the United States. There are commonly no important fronts present to hinder this mT advection, but the condition of the surface gradient gives rise to two distinct patterns as follows:

a. Weak Surface Gradient

(1) Surface and Low Level Features:

(a) Stagnation of pressure systems giving weak gradient.

(b) No low level jet through the mid-west.

(c) Insignificant surface pressure changes.

(2) Associated Weather:

(a) Widespread low stratus (1,000 ft), drizzle and/or fog will advect northward into the upper Midwest.

(b) If the surface is moist or covered with wet, melting snow dense fog will develop.

b. Strong Surface Gradient

(1) Surface and Low Level Features:

(a) Normal movement of pressure systems across the United States giving a moderate or strong surface gradient through the Midwest.

(b) A low level jet of 40 knots or greater through the Midwest.

(c) Significant pressure changes in advance of an approaching mP or cP cold front.

(d) Occurs frequently during the winter.

(2) Associated Weather:

(a) Rapid northward advection of stratus.

(b) Precipitation developing as mT air settles in firmly and a cold front (mP or cP) approaches from the west.

4. Regime IV. Maritime Tropical (mT) air interacting with continental Polar (cP) air usually results in the most intense wintertime weather systems. When a northeast-southwest cold front becomes stationary through Texas or Oklahoma, a wave may develop on the front in the Texas panhandle area. This cyclogenesis takes about 24 hours from the time the front becomes stationary and is likely to occur only if a closed low aloft is located through Colorado and/or New Mexico. Cirrus and altocumulus clouds range from 50 to 200 miles ahead of the front. Stratocumulus ceilings (of 1500 to 2000 ft) occur in the frontal zone and an overcast stratus ceiling (of 500 to 1000 ft) occurs behind the front. Because of the extreme discontinuity of these two air masses, the area of expected cyclogenesis will probably have an overcase of low clouds. Thick cirrostratus and altostratus layers west and southwest of Whiteman are very good indications of cyclogenesis along the front. As the low moves out of the southwest, towards the northeast, freezing precipitation and heavy snow will generally accompany it. Close meteorological watch of hourly sequences and of gradient flow is advised after onset of the cyclogenesis. This situation gives Whiteman its heaviest snowfall. The low center must track south of Whiteman, but north of Louisiana, for heavy snow to be experienced at Whiteman.

a. Aloft:

(1) Low level winds from the east through southeast over Kansas and Oklahoma.

(2) Flat, weak (low index) gradient over the Rockies with the westerly polar jet advancing near Grand Junction, Colorado.

(3) Strong height falls near Dodge City and Topeka, Kansas.

b. Surface Features:

(1) Rapid surface falls on the lee side of the Rockies, generally appearing in the afternoon (diurnal fall).

(2) Inverted trough develops in the frontal zone southwest of Whiteman.

Spring Weather Regimes.

1. Regime I. The continental Polar (cP) air mass is brought into the central plains by low systems which track progressively further north as the season proceeds. Weather is generally good in this air mass. However, pre-frontal stratus can be advected in from the Gulf of Mexico and post-frontal stratus will occur at times. The favorable conditions for post-frontal stratus are:

a. Moisture deposited in eastern Nebraska, Kansas and western Missouri.

b. Low center passage to the northeast such that low level convergence is in evidence.

c. Frontal orientation is such that low level winds have an easterly component

SECTION D

SPECIAL PHENOMENA AND REFERENCES

SPECIAL PHENOMENA AND REFERENCE

Special Phenomenon. When, in late summer or fall, a tropical cyclone moves inland in Texas, the central Missouri area will occasionally experience some weather effects. The cyclone takes on extra-tropical features as its center moves this far north. However, heavy rains and high winds (not of hurricane strength) can occur in the Whiteman area. Additionally, squall lines with tornadoes can form from the tropical convergence lines and could feasibly affect the area as far north as the central plains.

Reference:

1. The diurnal temperature variation at Whiteman differs with each weather regime type discussed in Section C. This variation is, in some cases, unusually large and it is extremely advantageous to utilize the heating graphs (referenced in Part 4) in forecasting maximum temperatures.

2. Wintertime minimum temperature forecasting is complicated by the wide range of air mass temperatures that are experienced in this inland area. The Minimum Temperature Study (Part 4 of this file) is a particularly valuable tool for forecasting minimum daily temperatures from the mid-fall through the mid-spring.

3. Gulf stratus (which was frequently mentioned in Section C) is a forecast problem. Because this pre-frontal stratus can be advected into the Whiteman area under a number of situations, the Gulf stratus forecast study (see Part 4) developed by E. M. Weber is a particularly valuable forecast tool.

PART 4

SECTION A

RULES OF THUMB

RULES-OF-THUMB

1. Do not forecast visibility below seven miles due to haze and/or smoke restriction.

This rule verifies nearly 100% of the time; pollution from the Kansas City area (wind 290° - 300°) can restrict visibility, but it is extremely rare that the resultant visibility is six miles or less.

2. Do not forecast a post cold frontal cloud clearing line to reach the Whiteman terminal from the west or north if the post frontal surface winds are expected to assume a directional component which is east of north.

This rule verifies at least 75% of the time; post frontal cloud clearing lines characteristically move steadily eastward to eastern Kansas, but do not continue through western (and/or northern) Missouri if surface winds in the Whiteman area shift from the west of north to the east of north.

3. Do not forecast surface winds (except associated with thunderstorm) to exceed 30 knots unless one of the following conditions is noted:

a. A strong cold front is moving into the area from the northwest.

b. A strong southerly flow has developed in Oklahoma and western Kansas.

This rule verifies at least 90% of the time. The cold frontal situation typically involves a strong polar or arctic outbreak and is accompanied by a strong surface pressure gradient and strong gradient wind flow. The strong southerly flow may or may not manifest a low level jet, but it will invariably cause gusty surface winds (30 knots or more) over a very large area in the central United States. A typical strong southerly flow situation involves the return flow from a strong high pressure area that has moved east or southeast of Whiteman.

4. Do not forecast surface winds (except associated with thunderstorm) to exceed 34 knots unless stations in eastern Kansas or northern Missouri are experiencing surface winds of 38 knots or more.

This rule verifies 80% to 90% of the time; the terrain of central Missouri is somewhat rougher (i.e., more frictional dampening) than the terrain to the west and north of Whiteman. Also, with a strong southerly flow, the Ozark Plateau (to the south of Whiteman) channels the strongest flow into Oklahoma and Kansas: thus, eastern Kansas experiences southerly gusts earlier and strong than does Whiteman.

5. Forecast an afternoon maximum temperature by referencing the applicable heating graph (computer readouts located in the forecast section) and adding this expected temperature rise value to the morning minimum temperature.

This rule is accurate within a three degree tolerance about 75% of the time. It is, of course, least accurate when a strong advective situation develops or when cloud cover is highly variable.

SECTION B

WINTER MINIMUM TEMPERATURE STUDY

WINTER MINIMUM TEMPERATURE STUDY

Preface. This study has been in evolution since 1960.

The first draft was written about 1962 by Captain Giron, Chief Forecaster.

The first revision, dated 1964, was done by Captain Stumpff (Reserve Officer from Warrensburg, Missouri) who added sample weather charts.

The forecast study was further expanded by Captain Stumpff in 1965, to include updated verification and a sample checklist and data sheet.

The forecast verification data was updated by 1Lt Goddard to include verification statistics through 1967.

WINTER MINIMUM TEMPERATURE STUDY

The problem of forecasting winter (November 1 thru March 31) minimum temperatures at Whiteman AFB, Missouri, has been under study since 1960. Captain Giron, chief forecaster at Whiteman AFB until 1963, prepared a study providing a correction factor which when applied to the wet bulb temperature computed at the time of afternoon maximum temperature produced a forecast minimum temperature. This correction factor was given for cold air advection, warm air advection, very cold air advection, and very warm air advection. Usage has determined the desirability of another correction factor called "neutral advection" and determined by averaging cold and warm advection factors. In a few unusual conditions (explained later in this paper) an additional 5°F correction is added for extremely warm air advection.

The procedure for forecasting the minimum temperature for the following morning is outlined as follows:

1. Determine Tw (wet bulb temperature) at maximum temperature.

2. Determine the type of advection influencing temperatures at Whiteman thru 0600C on the following morning.

3. Enter correction table with Tw and read minimum temperature forecast under type of advection determined.

The table of expected minimum temperatures for each Tw at maximum temperature is given on the following page.

WINTER MINIMUM TEMPERATURE FORECAST

Tw	Advection VC	C	N	W	VW
60	35	40	47	54	60
59	34	39	46	53	59
58	33	38	45	52	58
57	32	37	44	51	57
56	31	36	43	50	56
55	30	35	42	49	55
54	29	34	41	48	54
53	28	33	40	47	53
52	27	32	39	46	52
51	26	31	38	45	51
50	25	30	37	44	50
49	24	30	36	43	49
48	23	30	36	42	48
47	22	29	35	42	47
46	21	29	35	41	46
45	20	28	34	40	45
44	19	28	34	39	44
43	18	28	33	38	43
42	17	27	32	38	42
41	16	27	32	37	41
40	15	27	32	36	40
39	14	26	31	35	39
38	13	25	30	34	38
37	12	25	29	33	37
36	11	24	28	32	36
35	10	23	27	31	35
34	9	22	26	30	34
33	8	21	25	29	33
32	7	20	24	28	32
31	6	19	23	27	31
30	5	18	22	26	30
29	4	17	21	25	29
28	3	16	20	24	28
27	2	15	19	23	27
26	1	14	18	22	26

Tw	Advection VC	C	N	W	VW
25	0	13	17	21	25
24	-1	12	16	20	24
23	-2	11	15	19	23
22	-3	10	14	18	22
21	-4	9	13	17	21
20	-5	8	12	16	20
19	-6	7	11	15	19
18	-7	6	10	14	18
17	-8	5	9	13	17
16	-9	4	8	12	16
15	-10	3	7	11	15
14	-11	2	6	10	14
13	-12	1	5	9	13
12	-13	0	4	8	12
11	-14	-1	3	7	11
10	-15	-2	2	6	10
9	-16	-3	1	5	9
8	-17	-4	0	4	8
7	-18	-5	-1	3	7
6	-19	-6	-2	2	6
5	-20	-7	-3	1	5
4	-21	-8	-4	0	4
3	-22	-9	-5	-1	3
2	-23	-10	-6	-2	2
1	-24	-11	-7	-3	1
0	-25	-12	-8	-4	0
-1	-26	-13	-9	-5	-1
-2	-27	-14	-10	-6	-2
-3	-28	-15	-11	-7	-3
-4	-29	-16	-12	-8	-4
-5	-30	-17	-13	-9	-5
-6	-31	-18	-14	-10	-6
-7	-32	-19	-15	-11	-7
-8	-33	-20	-16	-12	-8
-9	-34	-21	-17	-13	-9

-11°F is record SZL Min Temp

VVC - Subtract 30°F from Tw
VVW - Add 5°F to Tw

Minimum temperatures were divided into seven categories for each Tw. These categories and their abbreviations are:

- VVC - extremely cold
- VC - very cold
- C - cold
- N - neutral
- W - warm
- VW - very warm
- VVW - extremely warm

REVISED 1964

This method of forecasting minimum temperatures was analyzed for accuracy from data obtained for the winter months from November through March for the years 1962-63 and 1963-64. Forecast and actual observed minimum temperatures were both divided into the above mentioned categories. A few (less than 5%) observations fell at five degrees below "a very cold advection" forecast. These were labeled VVC and called extremely cold. A few (less than 5%) observations fell at five degrees above "a very warm advection" forecast which were labeled VVW and called extremely warm advection. With these categories and by arbitrarily using a range of 3°F criteria for verification of a temperature forecast, only a few observations (less than 2%) did not fall in any of the above catefories --- these were not included in the analysis. The following table indicates a summary of results.

	1962-63 131 cases	1963-64 139 cases
Percent of forecasts which verified (±3°F)	48%	53%
Percent of forecasts which missed by one category. (Error from 4°F to 10°F.)	43%	38%
Percent of forecasts which missed by two or more categories. (Error in excess of 10°F.)	9%	9%
Skill score (Method: For rating Quantative forecasts - ASM 105-40 Rev. pp 43.)	.55	.48

Most errors made in forecasting winter minimum temperatures appear to stem from the difficulties encountered in accurately identifying the type of advection forecasted to influence temperatures at Whiteman AFB. This study was further aimed toward finding criteria to aid in this identification of advection type. The data was scanned and analyzed using WABN data, check list information, and surface charts as found in "Weatherwise". Features of each type of advection were found by using a strictly emperical method.

The first problem involved is to determine whether Whiteman is to be dominated by a cold or a warm air advection. Generally, near the ground (where temperatures are read), all types of fronts are preceded by warm air advection. A cold front moving past and away from the station is attended by cold air advection and usually indicates a deepening dome of cold air. Cold air advection continues until the center of this dome passes --- then warm air advection begins.

The following criteria seem to have value in establishing the type of advection to be considered in making a forecast minimum temperature. Sample surface weather charts illustrate a few of these types.

Cold Advection (C)

Minimum temperature forecasts based on cold air advection most often are valid when one or more of the following conditions exist.

1. A northerly flow of air (10 to 15 knots) in the lower 2000 foot level over Whiteman for 8-10 hours prior to usual minimum temperature time.

Fig 4 - B - 5

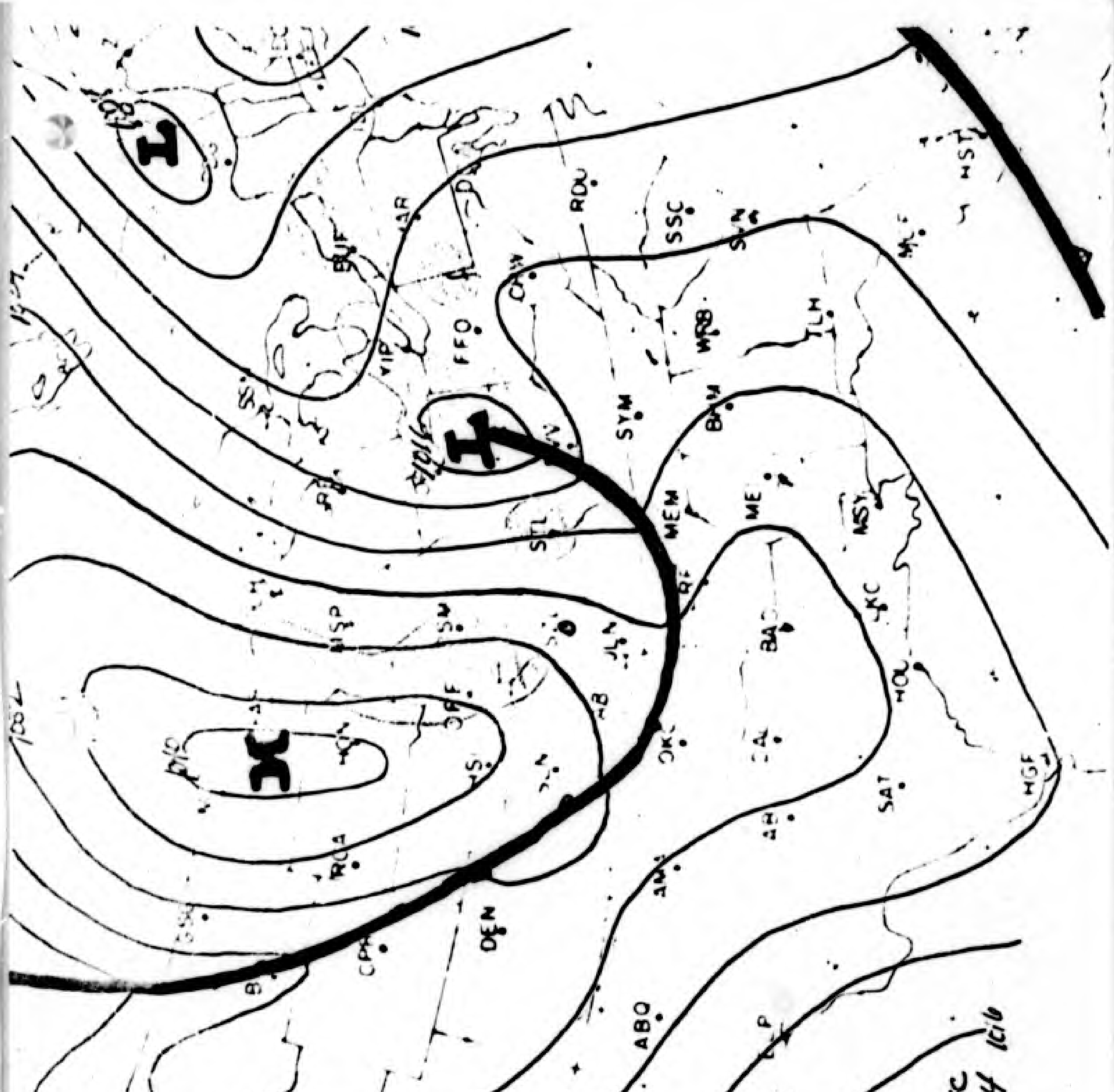


Fig 4 - B - 5a

2. Northerly surface winds and increasing sea level pressure from 1200C to 2400C.

3. Northerly surface winds from 10 to 15 knots (even with negligible increase of sea level pressure) for 6-8 hours prior to usual minimum temperature time.

4. Surface winds northerly of 10 to 20 knots after 2400C thru minimum temperature time.

Very Cold Advection (VC)

In addition to conditions necessary to forecast a minimum temperature using cold air advection, when one or more of the following conditions also occur, a forecast minimum temperature based on very cold advection most often verifies.

1. A moving and well defined cold front with a NE-SW orientation passing Whiteman by 1800C. The front should be followed by a well-defined high pressure system moving steadily southeastward and attended by northerly surface winds of 10-20 kts.

2. Increasing sea level pressure in excess of 5 mb from 1200C thru 2400C together with northerly surface winds of 15 to 20 kts for 6 to 8 hours during the afternoon or evening prior to the minimum temperature time.

3. Northerly surface winds throughout the night of 15 to 20 knots --- even with cloud cover and precipitation.

4. Strong northerly surface winds with clearing by 2400C. Winds continuing northerly of 5 to 10 knots after 2400C.

Extremely Cold Advection (VVC)

In addition to having satisfied criteria for very cold air advection one or more of the following seem to produce conditions where a minimum temperature forecast using extremely cold advection will verify.

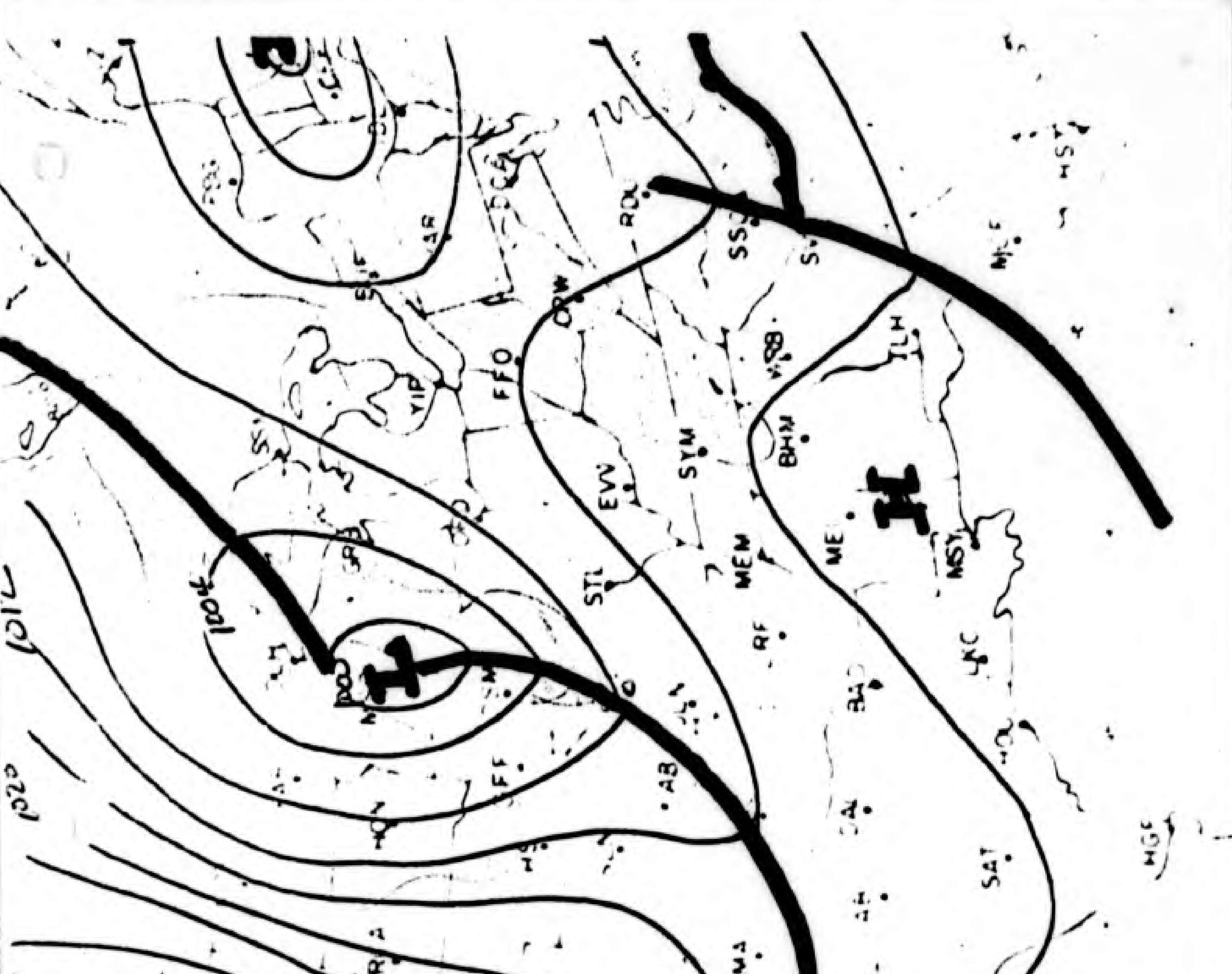

1020
1012
1004
DCA
FFO
STL
EVV
SYM
MEM
BHM
ILM
AMA
DEN
CPR
GSG
ABQ
LSV
SAT
SFC

Fig 4 - B - 6

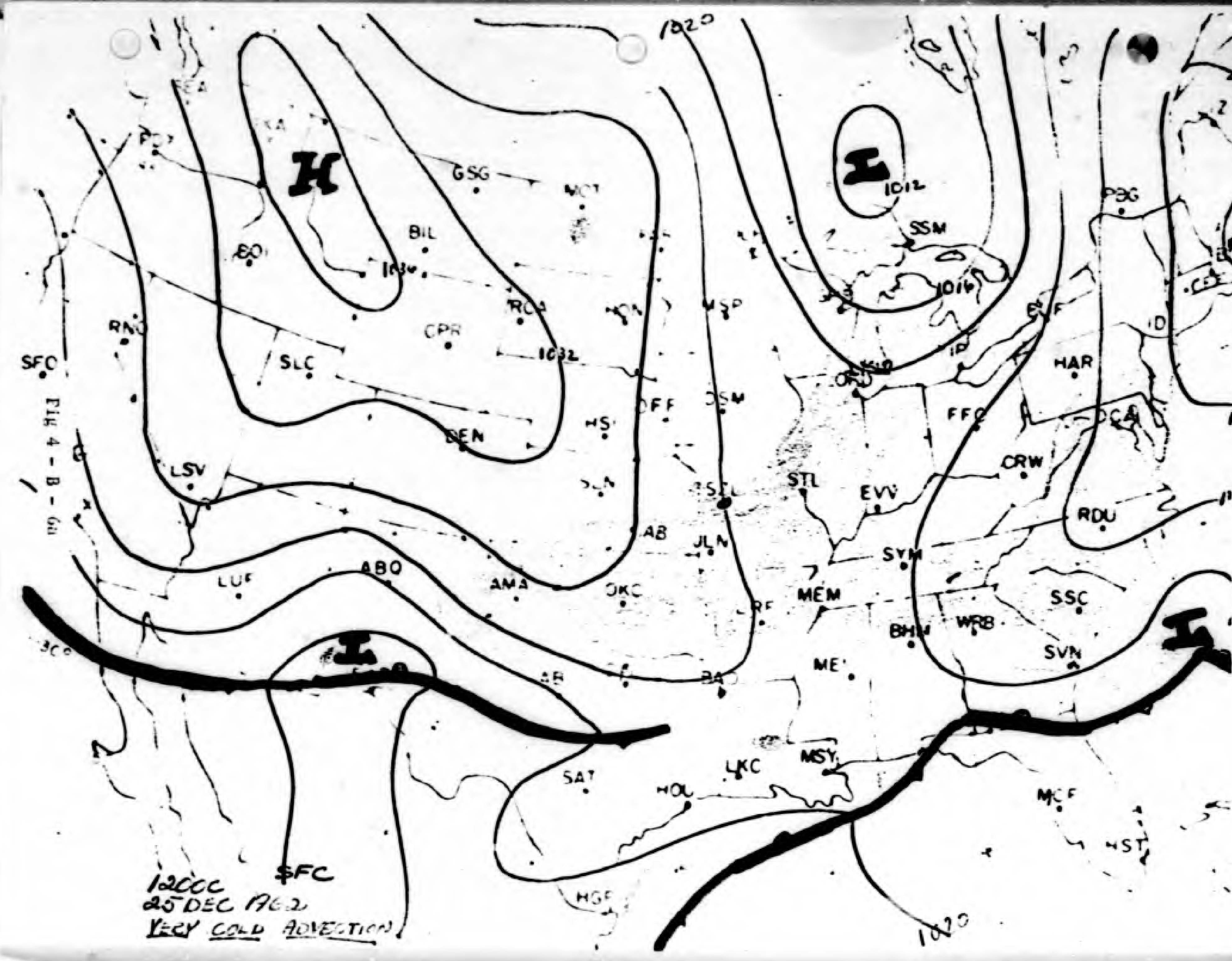
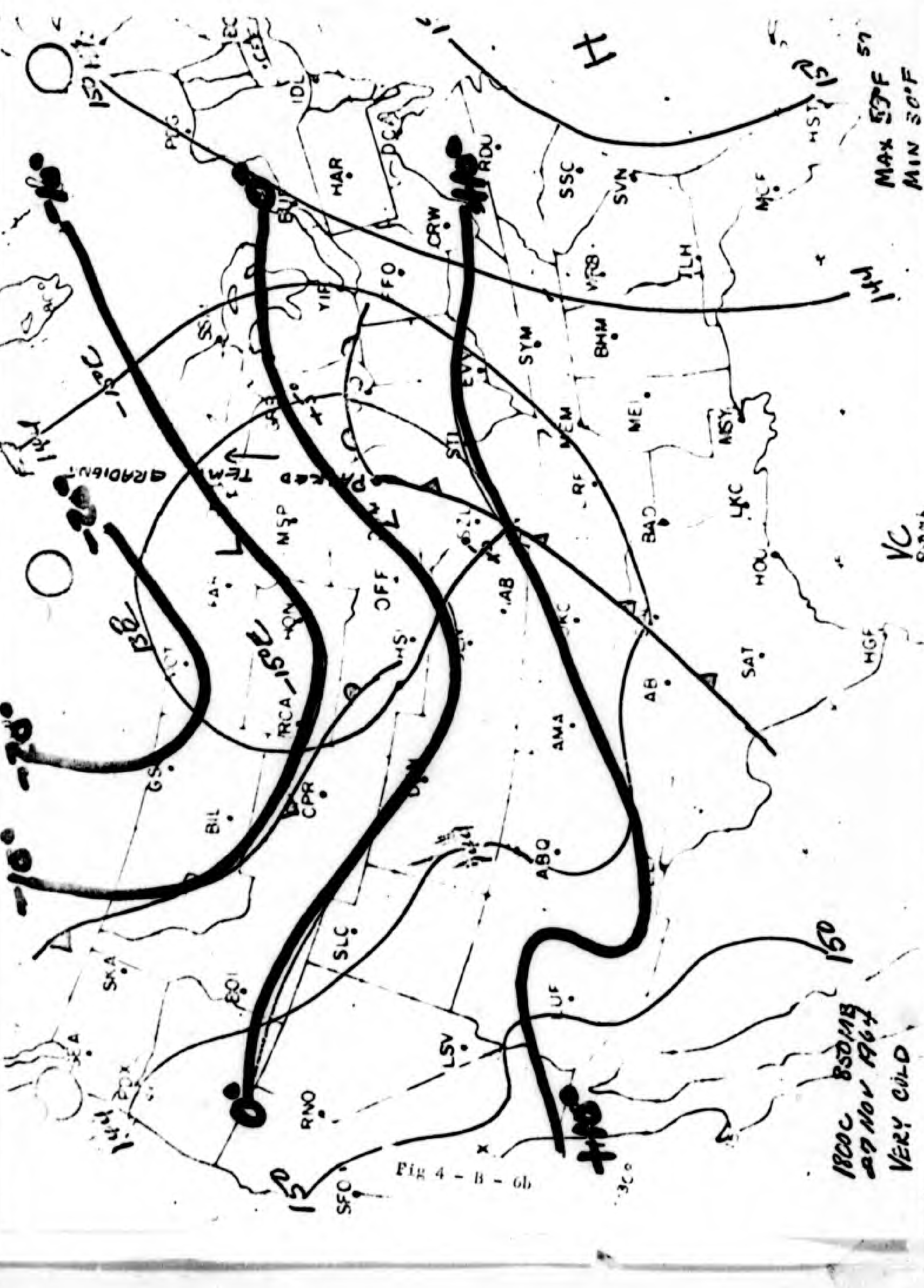
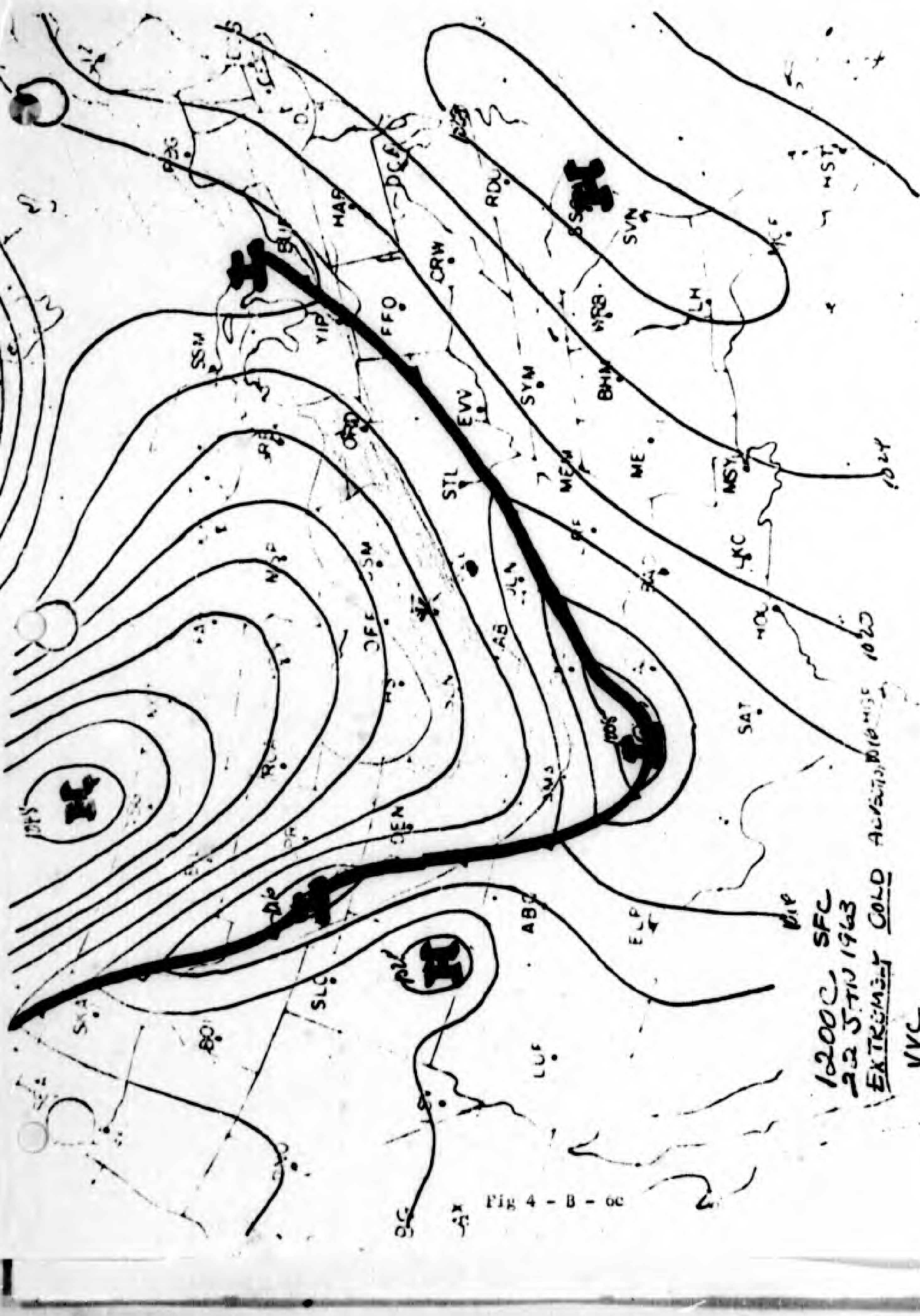

H
L
1012
1016
1020
1032
GSG
BIL
SSM
PSG
RNO
SFO
SLC
CPR
RCA
MSP
HAR
DCA
FFC
DEN
LSV
STL
EVV
CRW
RDU
JLN
SYM
ABO
AMA
OKC
MEM
SSC
BHM
WRB
SVN
SAT
HOU
LKC
MSY
MCF
SFC
1200C
25 DEC 1962
VERY COLD ADVECTION

Fig 4 - B - 6a



1800C 850MB
27 NOV 1964
VERY COLD
MAX 57°F
MIN 30°F
TEMP GRADIENT
H
VC
SFO
RNO
LSV
SLC
BOI
SEA
BIL
CPR
ABQ
AMA
SAT
HOU
LKC
MSY
MEI
BHM
MEM
SSC
SVN
TLH
HAR
RDU
CRW
IDL
MSP
OFF

Fig 4 - B - 6b



1200Z SFC
22 JAN 1963
EXTREMELY COLD
VVC
1020
1024
SKA
BOI
SLC
DEN
ABQ
ELP
LUF
SAT
HOU
MSY
ME
MEM
BHM
SYM
STL
EVV
CRW
RDU
FFO
YIP
ORD
SSM
HAR
DCA
SVN
LH

Fig 4 - B - 6c

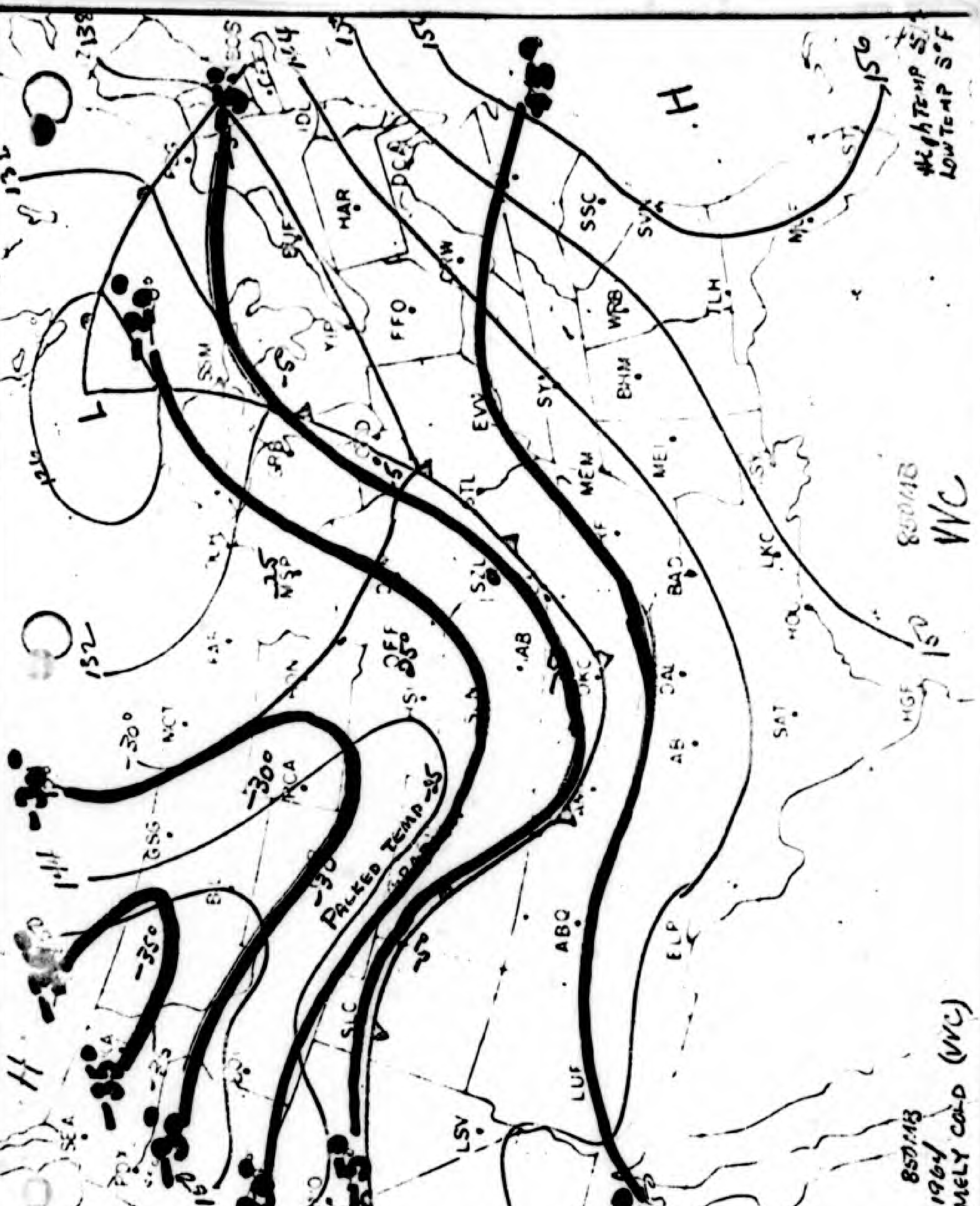


Fig 4 - B - 6d

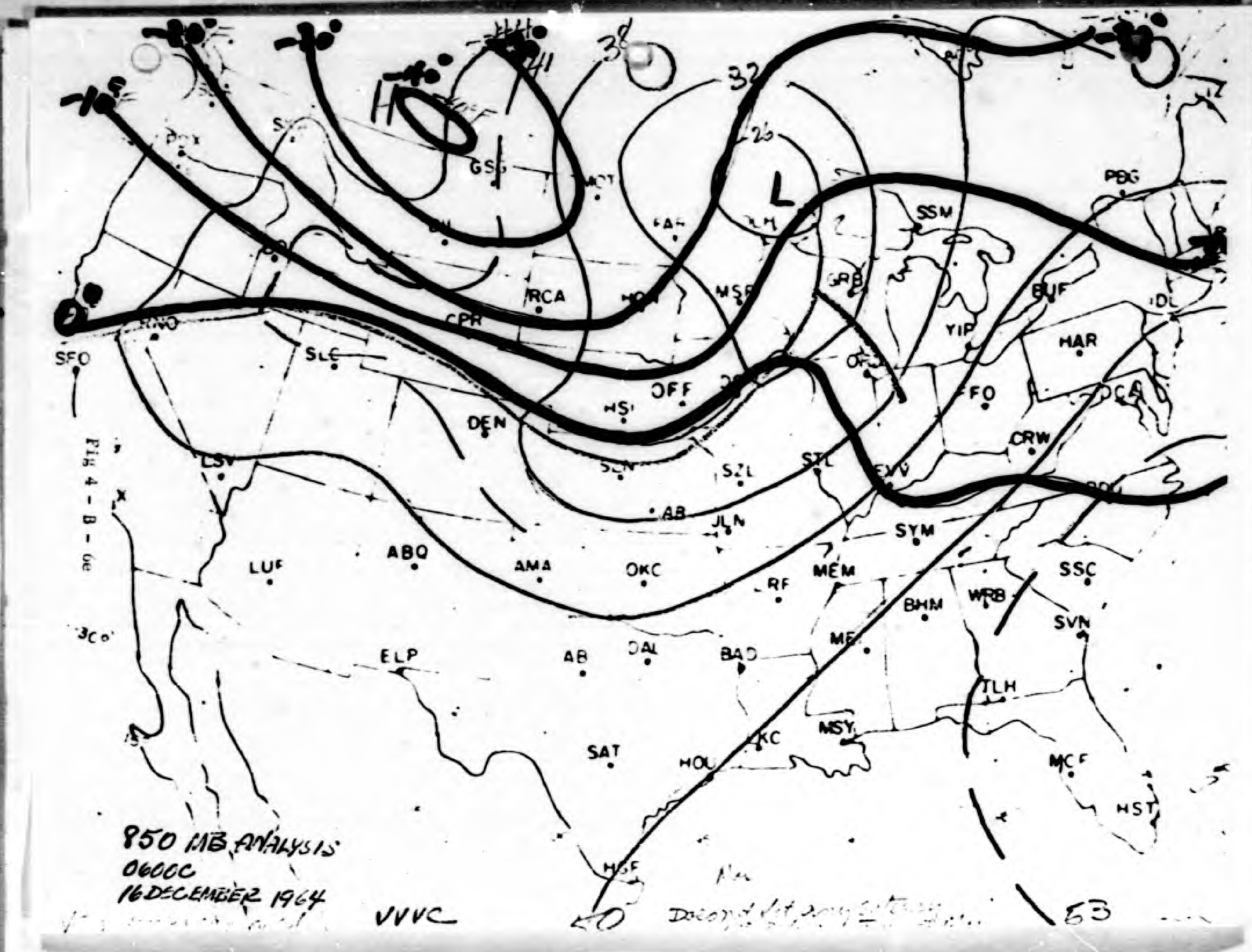

850 MB ANALYSIS
0600C
16 DECEMBER 1964
VVVC
SFO
RNO
SLC
LSV
LUF
ABQ
ELP
DEN
CPR
RCA
GSG
AMA
OKC
DAL
SAT
HOU
OFF
JLN
STL
MEM
SYM
BHM
WRB
SSC
SVN
TLH
MCF
HST
MSY
CRW
FFO
HAR
BUF
YIP
SSM
GRB
MSP
PBG
DCA
IDL
32
L

Fig 4 - B - 6e

1. A well-defined cold front passing Whiteman by 1800C orientated from NE to SW attended by a dome of cold air in a high pressure system (excess of 1030mb) centered in northwestern US and moving toward Missouri. Also northerly surface winds 15 to 25 knots for 6 to 8 hours after frontal passage.

2. Increasing sea level pressure of excess of 10mb from 1200C to 2400C with northerly surface winds of 10 to 20 knots during afternoon and night --- even with cloud cover and precipitation.

3. Clearing by 220C with strong high pressure system centering over the local area. Northerly surface winds becoming calm. Fresh snow cover on ground. Sea level pressure increasing throughout period.

Warm Advection (W)

Warm advection for the purposes of forecasting minimum temperatures is attended by one or more of the following conditions. Some of the conditions are definitely not describing advection, however the correction appears to have value in obtaining a minimum temperature forecast.

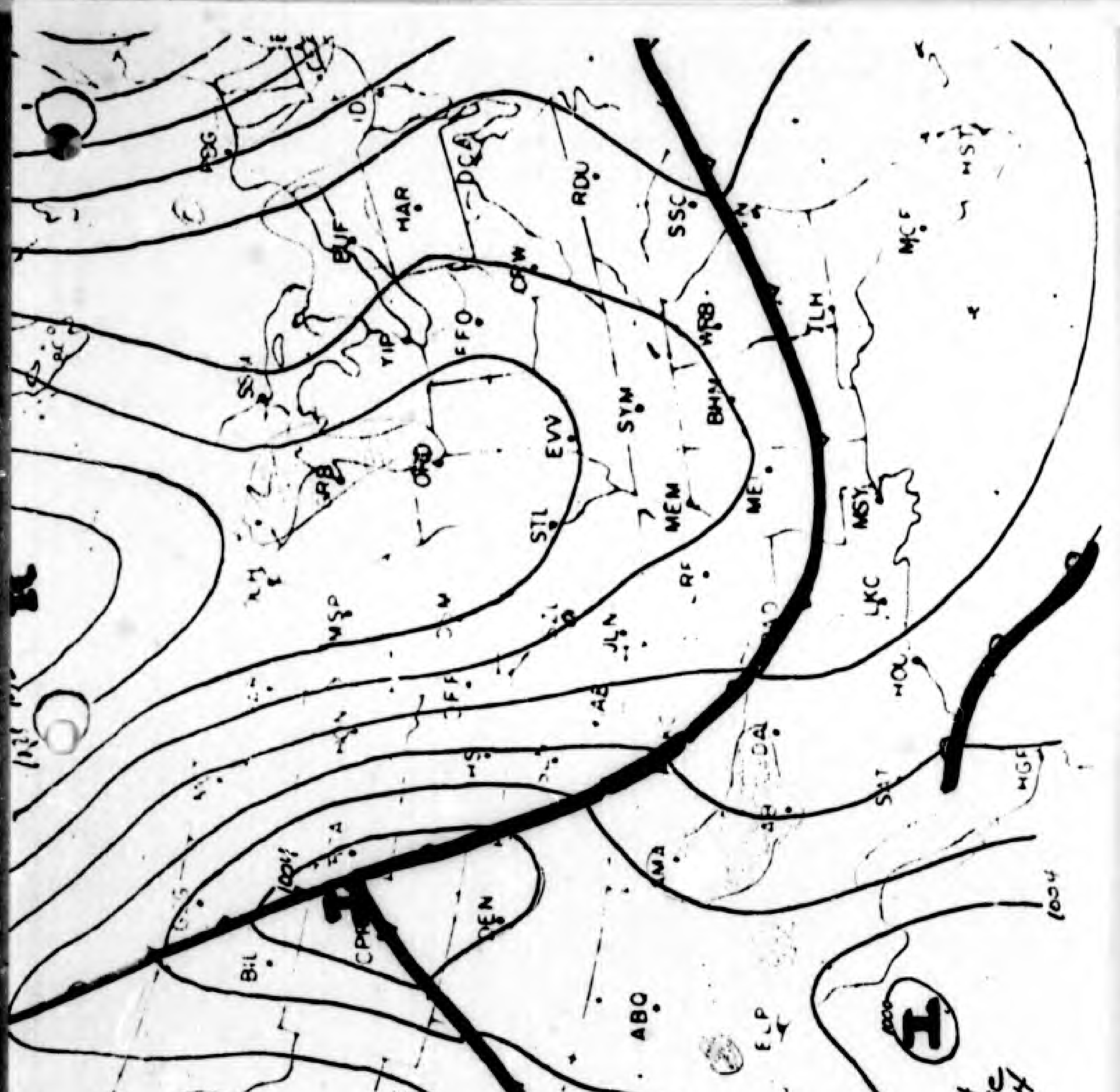
1. Southerly surface winds of 5 to 10 knots and decreasing sea level pressure from 1200C to 2400C.

2. Southerly surface winds of 10-15 knots with little pressure change. High thin clouds may be present.

3. Light surface winds, little pressure change, and ceilings below 8000 feet moving in by 2400C. Light precipitation may occur.

Very Warm Advection (VW)

In addition to satisfying conditions for warm air advection if one or more of the following hold, it appears that a very warm advection correction yields a valid minimum forecast.



PSG
HAR
DCA
RDU
SSC
BUF
CRW
FFO
YIP
ORD
EVV
SYM
BHM
MEM
STL
MSP
JLN
LKC
MSY
DAL
DEN
BIL
ABQ
SLC
LSV
RNO
1004
1200C SFC
18 MAR 1964

Fig 4 - B - 7

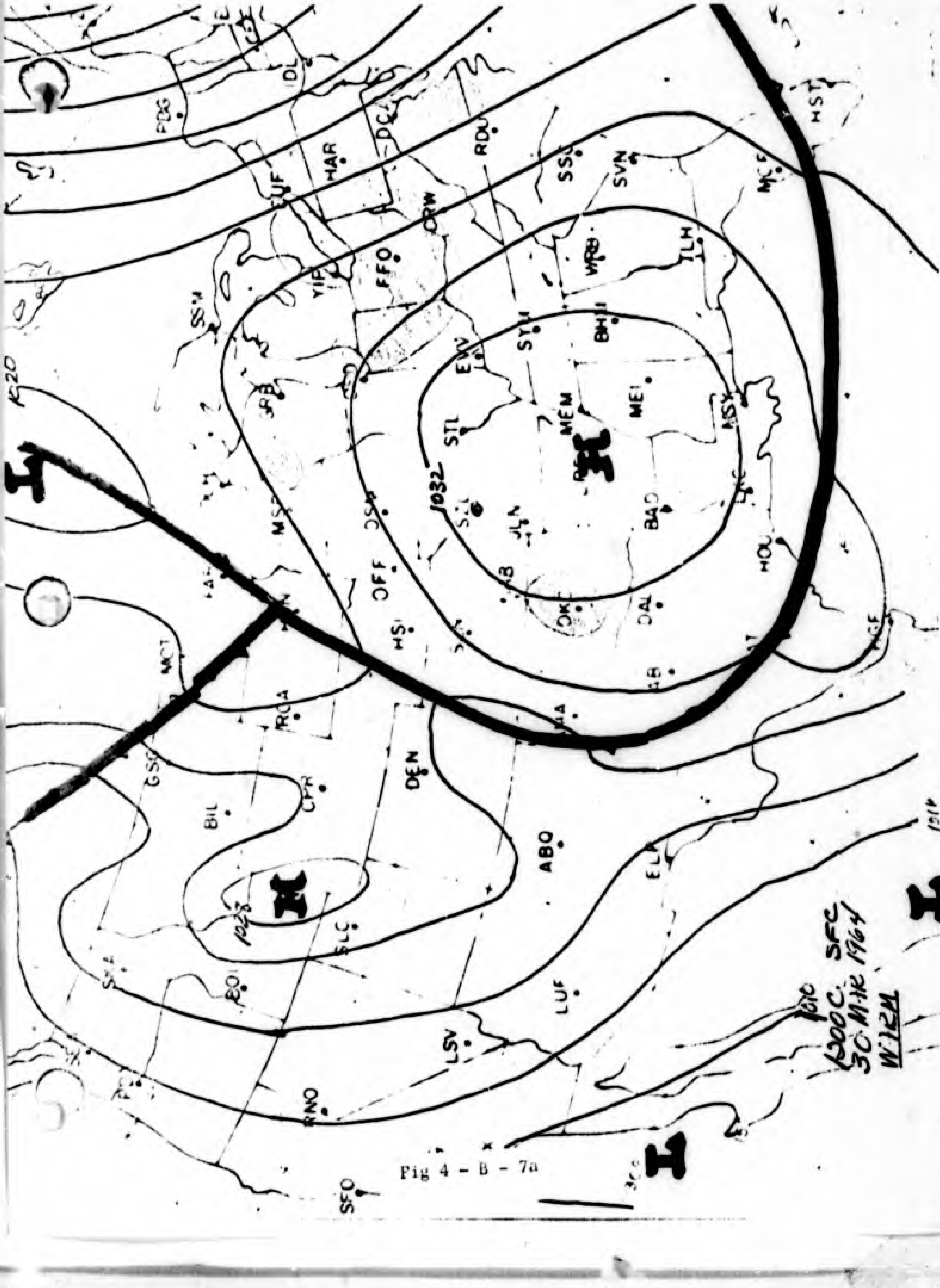

1300C SFC
30 MAR 1964
W12M
1032
1028
1020
H
L
DEN
ABQ
SLC
STL
MEM
RDU
HAR
DCA
CRW
FFO
SSM
GSO
CPR
BIL
BOI
RNO
LSV
LUF
ELP
DAL
HOU
SFO

Fig 4 - B - 7a

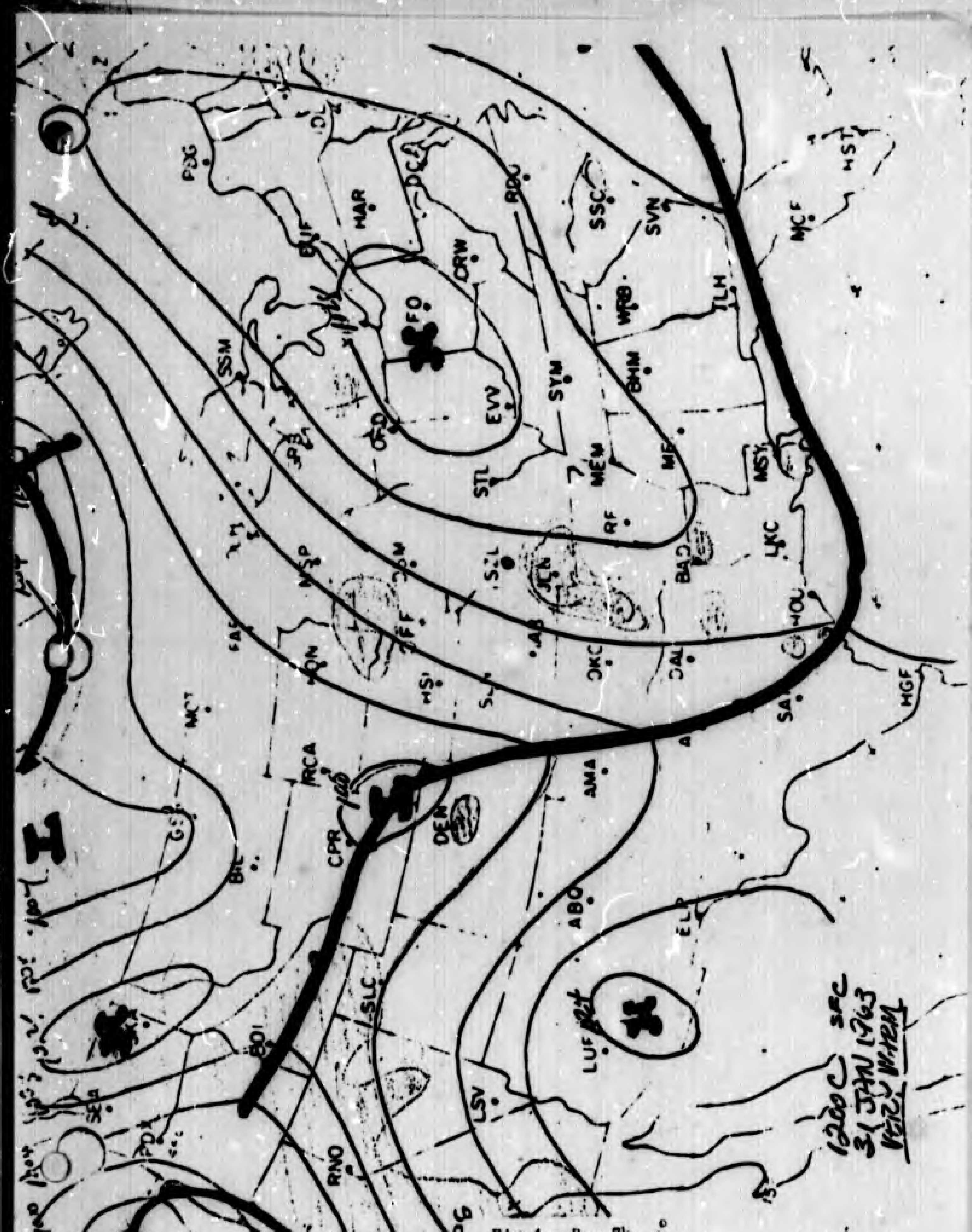
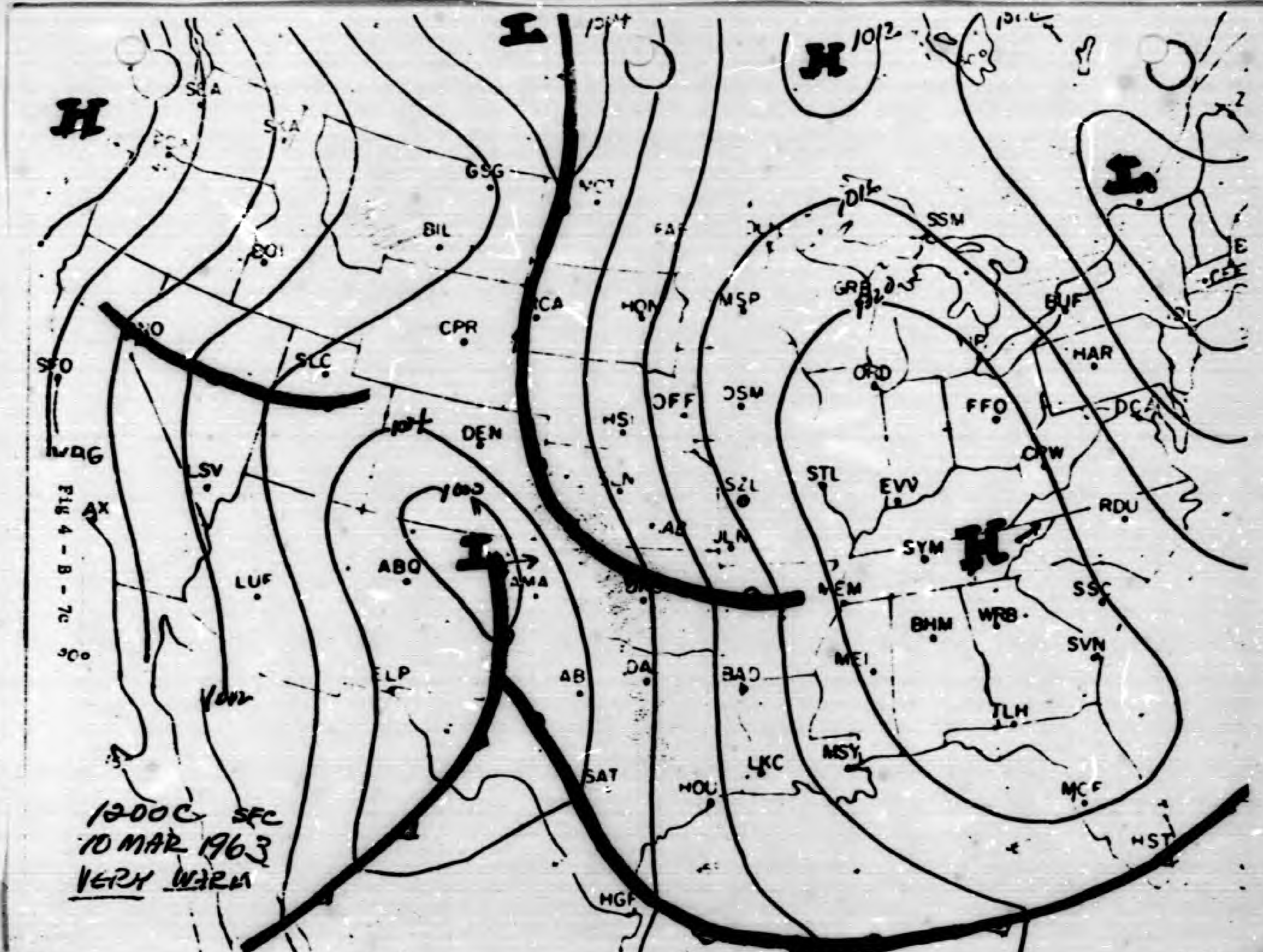

PDX
SEA
BOI
RNO
SLC
LSV
CPR
RCA
DEN
AMA
ABQ
OKC
DAL
HOU
SAT
MSP
STL
EVV
MEM
SYM
CRW
HAR
DCA
SSM
SSC
SVN
MCF
HST
MGF

Fig 4 - B - 7b



1200Z SFC
10 MAR 1963
VERY WARM
H
L
SFO
SLC
DEN
CPR
BIL
GSG
ABQ
ELP
LUF
LSV
AMA
SAT
HOU
HGF
LKC
MSY
MEM
STL
EVV
ORD
MSP
DSM
OFF
SZL
GRB
SSM
BUF
HAR
DCA
FFO
CRW
RDU
SYM
BHM
WRB
SSC
SVN
TLH
MCF
MEI
BAD
DAL
1012
1004

Fig 4 - B - 7c

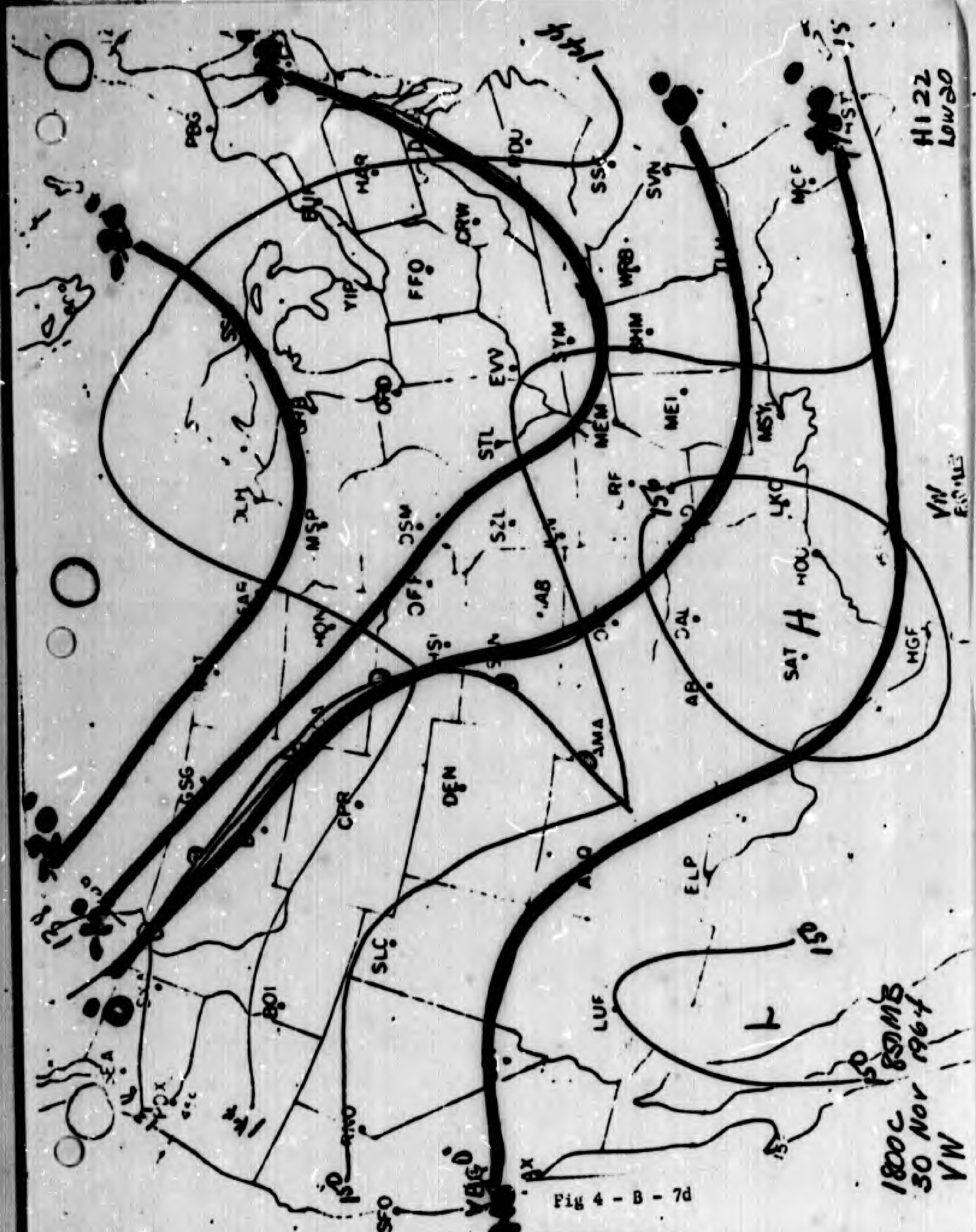


Fig 4 - B - 7d

1. Sea level pressure decrease of 10 mb or more from 1200C to 2400C and southerly surface winds of 15 knots during afternoon and night.

2. Warm frontal passage by 1800C with southerly surface winds of 15 to 25 knots through evening and night. Sea level pressure decrease of 5 mb or more from 1200C to 2400C.

3. Precipitation and or fog (visibility from 3 to 5 miles) and clouds between 1500 feet and 5000 feet by 2000C and continuing throughout night.

Extremely Warm Advection (VVW)

If very warm advection is forecast and if one or more of the following conditions exist, add 5°F to Tw at maximum temperature to produce a minimum temperature forecast.

1. Sea level pressure decrease of 12 mb or more from 1200C to 2400C and strong southerly flow of 15 to 25 knots from a warm air mass located south of the station.

2. Strong southerly surface winds of 15 to 25 knots with ceilings below 1500 feet and possible light precipitation throughout night.

3. Light southerly surface winds with precipitation (2-5 miles visibility), ceilings below 1000 feet, and non-increasing sea level pressure throughout period from 1200C thru 0600C.

4. Very low clouds (Below 500 feet) and low visibility (below 1½ miles) throughout the night. Little change in sea level pressure.

"Neutral Advection" (N)

"Neutral advection" is not literally advection as such; however the minimum temperature is often forecast (and observed) using this defined "neutral advection". One or more of the following seem to be necessary in using this category to forecast a minimum temperature based on neutral advection.

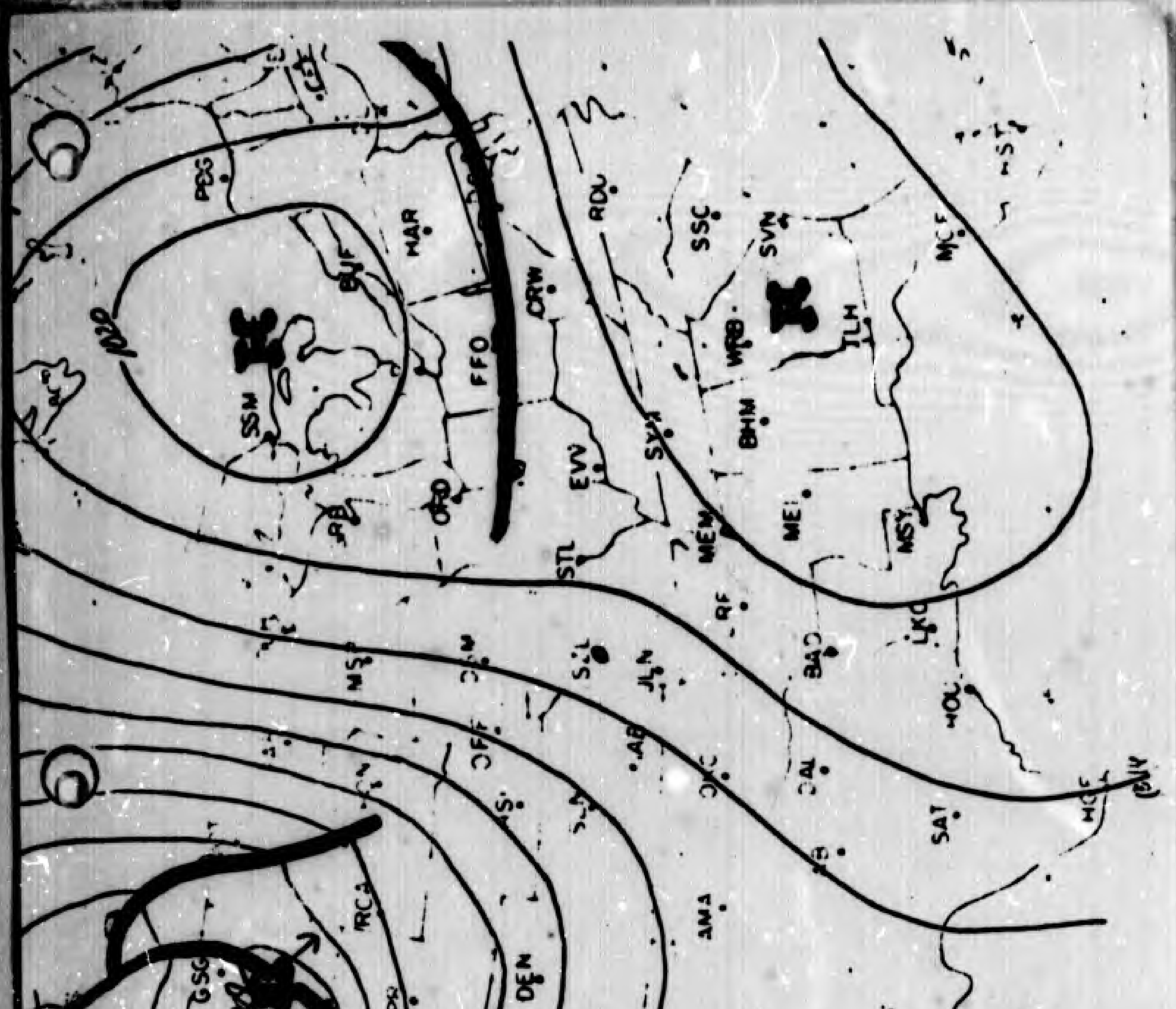
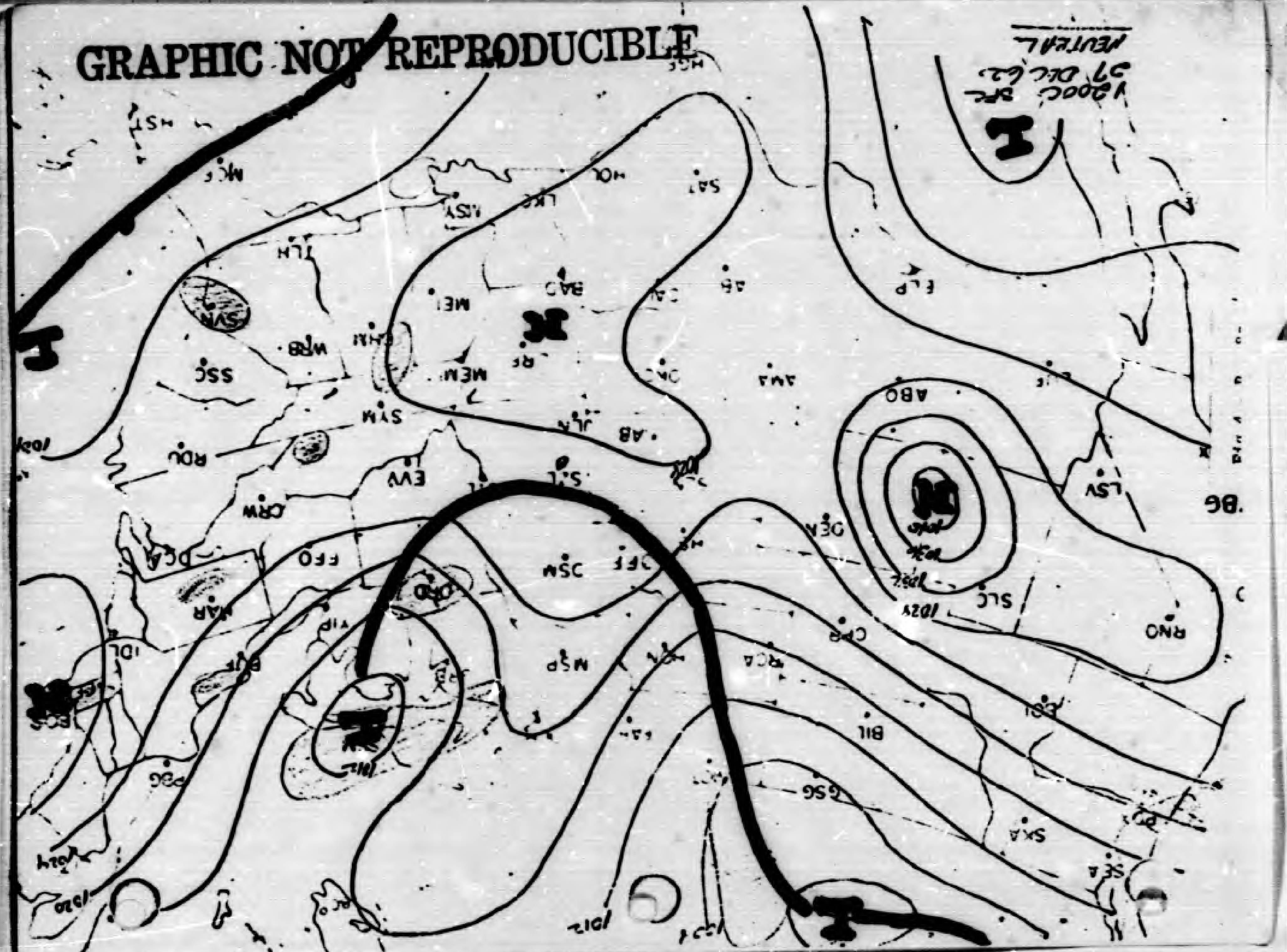

PBG
MAR
BUF
SSM
FFO
CRW
RDU
SSC
SVN
MCF
WRB
BHM
EVV
STL
MEM
MSY
ORD
ABQ
AMA
DEN
CPR
BIL
RCA
SKA
BOI
RNO
SFO
SAT

Fig 4 - B - 8


GRAPHIC NOT REPRODUCIBLE
1200Z SFC
27 DEC 62,
NEUTRAL

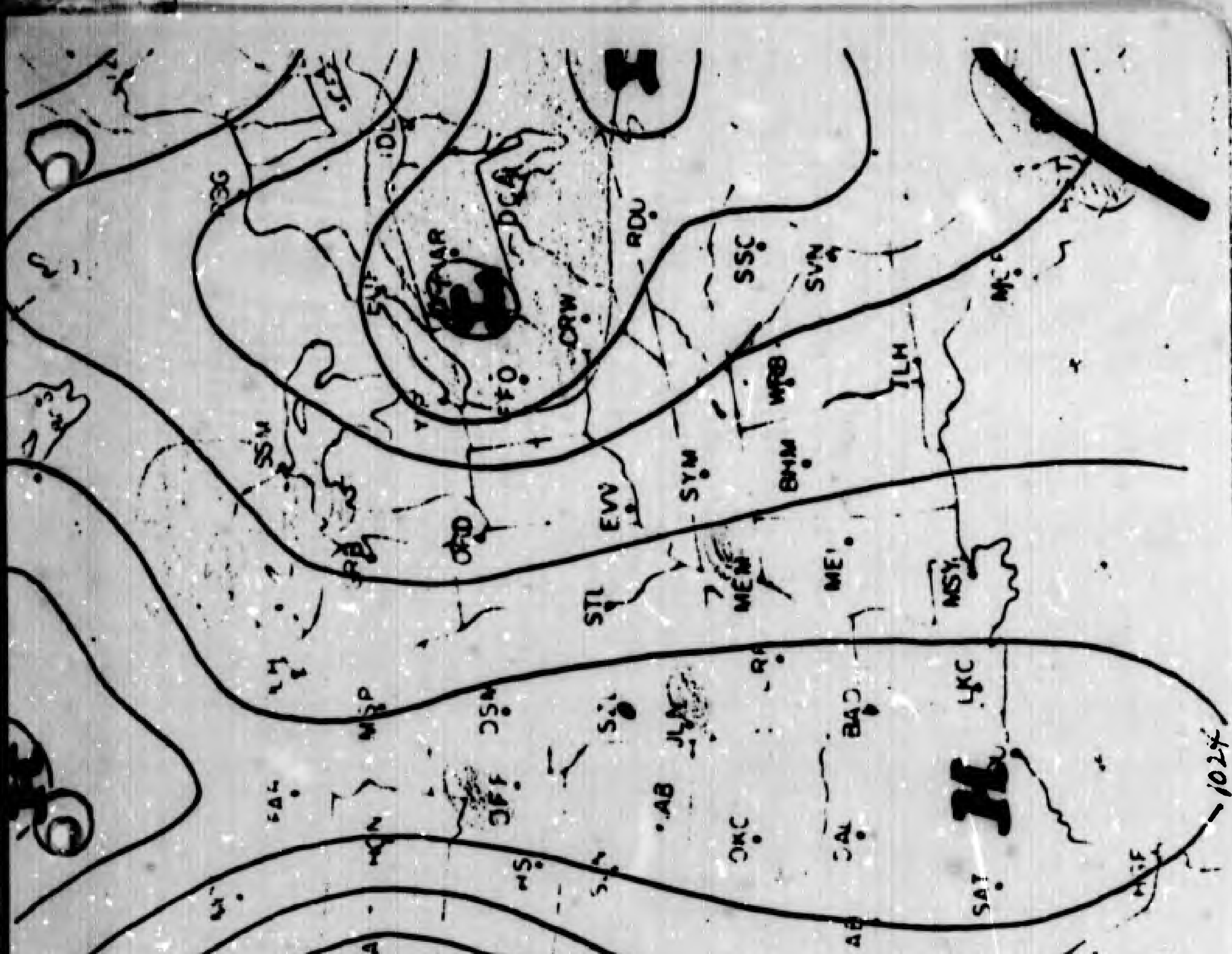

1200Z SFC
21MAR1964
NEUTRAL
1024
SEA
SKA
BOI
RNO
SFO
VBG
SLC
ABQ
ELP
LUF
OKC
SAT
LKC
STL
EVV
MEM
BHM
SYM
WRB
NSY
TLH
ORD
CRW
DCA
RDU
SSC
SVN
MSP
DSM
GSW
RCA

Fig 4 - B - 8b

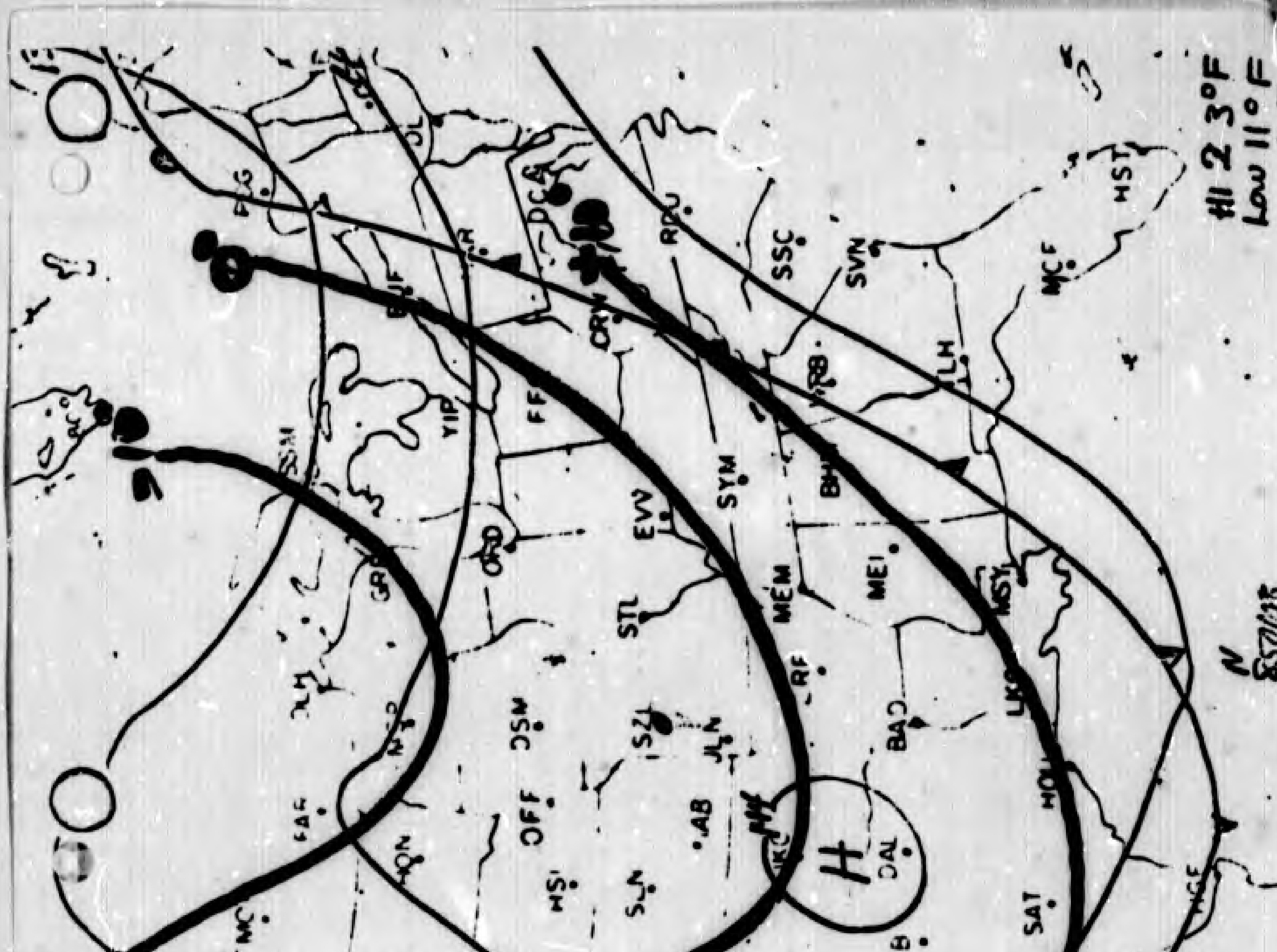

H
DCA
STL
MEM
DAL
ABQ
SLC
DEN
AMA
SAT
ELP
YBG
HI 23°F
Low 11°F
1000C
26 DEC
850MB
NEUTRAL (N)

Fig 4 - B - 8c

1. Very diffuse pressure pattern and light and variable winds in the local area.

2. Whitemnn located at bottom of high centered in the northern US resulting in a change from weak cold to weak warm advection during the night.

3. Light northerly flow over local area with little pressure change, ceilings below 2000 feet and 3 to 5 miles visibility in fog or light precipitation.

4. Light southerly flow with slight increasing sea level pressure and near-zero temperature for 200 miles upstream.

It should be re-emphasized that these aids in identification are strictly emperical and have not been verified. There are surely many exceptions --- only two winters were used in arriving at these observations. One pitfall occurs with a northerly flow over the station, but the air upstream is <u>not</u> colder than the air in the local area. Here a neutral forecast is better than the cold one is tempted to use. (29 Nov 1963 gives an example of such a case.) If past minimum temperatures are out of line with the forecast minimum temperature, some adjustment of the forecast minimum is definitely in order --- few objective methods are without exceptions.

The study fails most often when an extreme cold front passes after the maximum temperature occurs. Perhaps one should use other methods for forecasting the minimum temperature when very cold air is forecast to move in after reading a very warm Tw. at maximum temperature time.

One well taken suggestion from the forecast section is to look at the temperature changes up stream due to a frontal passage -- using this as a check and as a "reasonableness test" of the forecast based on the methods presented in this study. This "reasonableness test" could be applied in all advective cases and would probably save some forecasts.

Forecasters should adjust the forecast given in the study whenever the weather situation and pattern warrants such a change. The intent of the study was to provide objective guides in preparing minimum temperatures and should not be taken as the final word in making up a forecast minimum temperature.

SECTION C

8TH WEATHER SQUADRON

TECHNICAL NOTE 10-7

ADVECTION OF GULF STRATUS INTO THE MIDWEST AND
ITS RELATIONSHIP TO THE LOW LEVEL JET

SECTION Z

FRUITLESS FILE

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)
Hq 8 Weather Squadron
Westover AFB, Ma 01022

2a. REPORT SECURITY CLASSIFICATION
Unclassified

2b. GROUP
N/A

3. REPORT TITLE
Terminal Forecast Reference File - Whiteman AFB, Mo

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
N/A

5. AUTHOR(S) (Last name, first name, initial)
N/A

6. REPORT DATE
September 1968

7a. TOTAL NO. OF PAGES
72

7b. NO. OF REFS
none

8a. CONTRACT OR GRANT NO.
N/A

b. PROJECT NO.

c.

d.

9a. ORIGINATOR'S REPORT NUMBER(S)
N/A

9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
N/A

10. AVAILABILITY/LIMITATION NOTICES
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11. SUPPLEMENTARY NOTES
N/A

12. SPONSORING MILITARY ACTIVITY
Hq Air Weather Service (MAC)
Scott AFB, Illinois 62225

13. ABSTRACT
A reference file for detachment forecasters containing a description of area, climatology, discussion of weather regimes, rules of thumb and forecast studies.

DD FORM 1 JAN 64 1473

UNCLASSIFIED
Security Classification

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

1. ORIGINATING ACTIVITY (Corporate author) Hq 8 Weather Squadron Westover AFB, Ma 01022	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP N/A

3. REPORT TITLE

Terminal Forecast Reference File - Whiteman AFB, Mo

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

N/A

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N/A

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
September 1968	72	none

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