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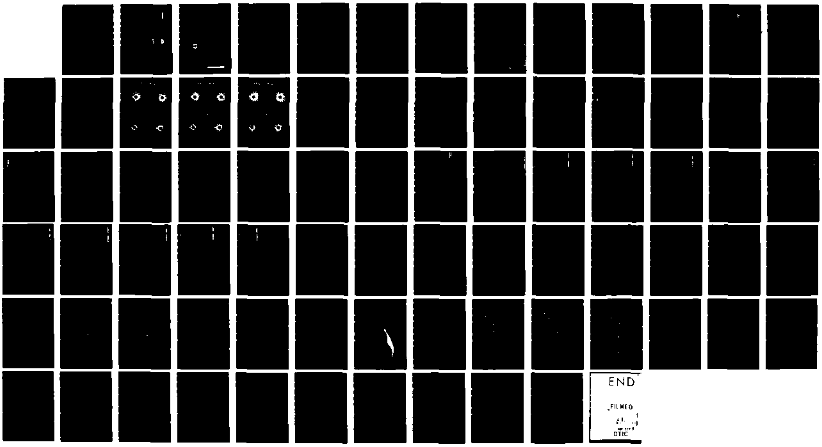

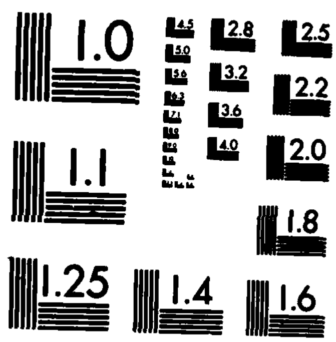

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I

INVENTORY

Terminal Forecast Reference Notebook for Katterbach AAF, Germany

DOCUMENT IDENTIFICATION

3 Jan. 83

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TERMINAL FORECAST REFERENCE NOTEBOOK

FOR

KATTERBACH AAF, GERMANY

APPROVED FOR PUBLIC RELEASE;
DISTRIBUTION UNLIMITED

PUBLISHED BY
DETACHMENT 5
7TH WEATHER SQUADRON
2D WEATHER WING (MAC)
UNITED STATES AIR FORCE
3 JANUARY 1983

[redacted]

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)* Terminal Forecast Reference Notebook for Katterbach AAF, Germany		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Detachment 5, 7th Weather Squadron APO New York 09326		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Headquarters, 2d Weather Wing Aerospace Sciences Division (2WW/DN) APO New York 09012		12. REPORT DATE 3 January 1983
		13. NUMBER OF PAGES 78 (including covers)
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*		15. SECURITY CLASS. *(of this report)* UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for Public Release;
Distribution Unlimited

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

18. SUPPLEMENTARY NOTES

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

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DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

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1. Physical Features. In describing the European weather, we are apt to compare the European continent with the United States. Although there may be no marked differences in the properties of the air masses invading both continents, the weather observed is sometimes notably different than one might expect due to the interaction with the European physical environment. In contrast to the United States, there is no extensive south to north mountain barrier like the western highland upon which is superimposed a series of mountain ranges. Instead the principal mountain systems are arranged in a general west-east direction and are described as follows:

a. The Alps are the highest European mountain chain and form the southern boundary of Germany. They extend from southern France well into southeastern Austria. In the main ridge of the mountains are many peaks higher than 10000 ft.

b. The Pyrenees chain, separating France from Spain, has peaks extending above 9000 feet.

c. The Apennines stretch the entire length of Italy and have peaks which rise to 8500 feet in central Italy.

d. The Scandinavian mountains are orientated in a southwest to northeast direction. The highest peaks rarely exceed 7000 feet.

2. Besides the above mountain barriers, there are numerous smaller mountainous regions in Europe which have their characteristic effects upon invading air masses. In Germany, there are many areas where the elevation raises to 3000 feet above the surrounding valleys causing small scale weather variations. The most important of these local groups of smaller mountains and hills are:

a. The Black Forest in SW Germany with tops of over 4000 feet.

b. The Haardt and Hunsrück mountains covering areas west of the Rhine river.

c. The Schwäbisch Alb between Stuttgart and Ulm.

d. The Odenwald to the east of the Rhine near Heidelberg and Mannheim.

e. The Taunus mountains to the north of Frankfurt.

f. The Eifels and Westerwalds in the Bonn and Koblenz area.

g. The Rothaar mountains to the SW of Kassel.

h. The Harz SE of Hannover.

i. The Vogelsberg between Giessen and Fulda.

j. The Spessarts east of Frankfurt.

k. The Rhön mountains near Fulda.

l. The Thüringerwald to the east of Fulda.

m. The Frankenwald SW of Hof.

n. The Fränkisch Alb S66f Nurnberg.

o. The Bohemian Forest along the Czechoslovakian border.

p. The Bavarian Alps forming the boundary with Austria.

3. Influence of Topography. Because of the absence of the north-south mountain barrier, the relatively warm Atlantic maritime air masses can invade the entire land area. Therefore, there are no abrupt changes in climate across western and central Europe. In general, the mountain barriers extending west-east across southern Europe merely separate the warm southern region from the cooler areas to the north. With the numerous mountains and hills south of 52°N in Germany, winds from virtually any direction will produce upslope effects. The effects of upslope may produce extensive areas of low stratus, fog, and precipitation, or, in many cases, the effects may produce only very localized conditions.

TERMINAL FORECAST REFERENCE NOTEBOOK (TFRN)

SECTION I

LOCATION AND TOPOGRAPHY

DETACHMENT 5, 7th WEATHER SQUADRON

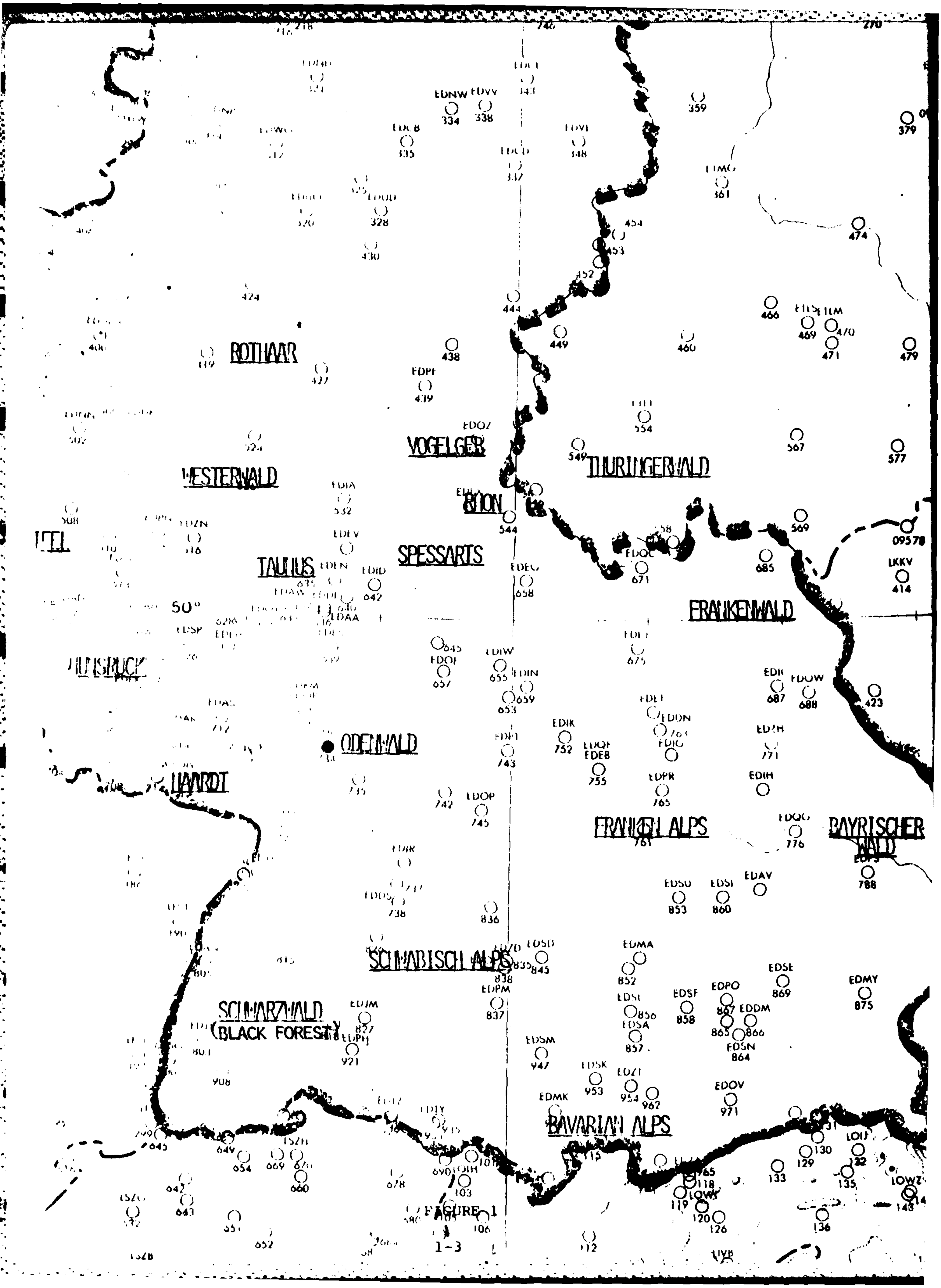

ROTHAAR
VOGELGEB
WESTERWALD
THURINGERWALD
RHON
SPESSARTS
TAUNUS
50°
FRANKENWALD
HUNSRUCK
ODENWALD
HAARDT
FRANKEN ALPS
BAYRISCHER WALD
SCHWABISCH ALPS
SCHWARZWALD
(BLACK FOREST)
BAVARIAN ALPS

FIGURE 1

HELIPORT WEATHER BRIEF

KATTERBACH ARMY HELIPORT, FRG
49 30'N 10 48'E
ELEVATION 1532 feet

TERRAIN SUMMARY: Katterbach AHP is located 25 miles WSW of Nuernberg. It is also 3 miles E of the city of Ansbach.

The airfield is in the Eastern section of the Frankenhöhe. With an elevation of 1532 feet there is a natural upslope motion into the Katterbach area. The Schwabische Alb and the Frankische Alb are other small hills that can effect the airfield area. There are no major rivers which effect Katterbach, however small streams and valleys can often be a contributory factor to local fog problems.

AIRFIELD WEATHER: The predominant type of air mass that effects the local area is Maritime Polar. This air mass produces a typical maritime climate with mild winters and cool summers. The natural upslope motion with westerly winds is a weather producer. The various hills to the south and west do not have a significant effect on the local area.

CLOUDINESS AND VISIBILITY: The typical synoptic situation effecting the local area during autumn and winter is a high pressure cell centered over Western Europe. The air mass is generally moist and stable with wet, cloudy, and foggy weather prevalent. When the high is displaced northward and eastward, the source region of the air flow is continental polar and good flying conditions prevail for two to ten days. Haze and smoke, however, will reduce visibilities after the second day in the shallow cold air unless the high pressure system is centered over northern Germany which results in moderate easterly gradient, good visibility, and occasional gusty winds.

The autumn frontal activity is generally marked by a well-defined wind shift, wide bands of clouds and steady precipitation with little temperature change at the surface. Frontal systems lifted over the dome of colder air takes on the characteristics of warm frontal occlusions eliminating much of the surface phenomena. Frequency of autumn and winter frontal passages averages 4 to 10 per month from October through March.

During the late spring and early summer, the Azores high is displaced northward and becomes stronger. The prevailing circulation over the are is west to northwest. The moist maritime air is warmed as it moves over land masses of Europe and combined with mechanical lift from the terrain features causes a relatively high frequency of convective showers and thunderstorms. The frequency of thunderstorms per month is 1 to 3 during April, May and September; and 6 to 8 during June, July and August. Most summertime fronts are relatively weak, characterixed by narrow cloud and precipitation belts.

Fog and haze are the main causes of low visibilities throughout the year. During the spring and summer months nocturnal cooling will cause fog to form during the early morning hours. This phenomena occurs 5 to 7 days a month from May through August, but seldom persists beyond 0900 to 1000 LST. During the fall and winter, fog occurs more frequently and persists for longer periods of time (averages 7-10 times per month from November through March). Low stratus ceilings are a frequent occurrence during late fall and winter. When wind velocity is sufficient to preclude fog formation, the low ceilings have a tendency to form near sunset and intensify during night hours. They tend to lift and burn off during the late morning and afternoon hours the following day. Stratus ceilings below 1,000 feet have a frequency of 6 to 8 days per month during this period.

PRECIPITATION: Precipitation occurs frequently and quite uniformly through the year. There is minimum precipitation occurrence during the months of January, February, and March. Measureable precipitation occurs on an average of 156 days a year (40%). During the late spring and summer, precipitation occurs most frequently as brief convective showers or thunderstorms. In the fall and winter it occurs as either rain or snow (the frequency of rain is approximately 67% while snow and freezing rain is approximately 33%).

WINDS: Surface winds are seldom a problem to flying at Katterbach AHP. Normally gusty winds are associated with thunderstorm activity or with tight pressure gradients associated with air mass changes in spring and fall. Gusts greater than 35 knots are infrequent.

METEOROLOGICAL INSTRUMENTATION

Ansbach AHP is equipped with the following meteorological instrumentation

a. FPS-77 located in Base Weather station and the RTM is to the west of the Weather Station

b. RO2GMQ-20 Wind Recorder loacted on south side of field. The wind recorder is located in the observing section.

c. TMQ-11 located on south side of field.

d. GMQ-10 indicator located in weather station. Instrument is located on south side of field.

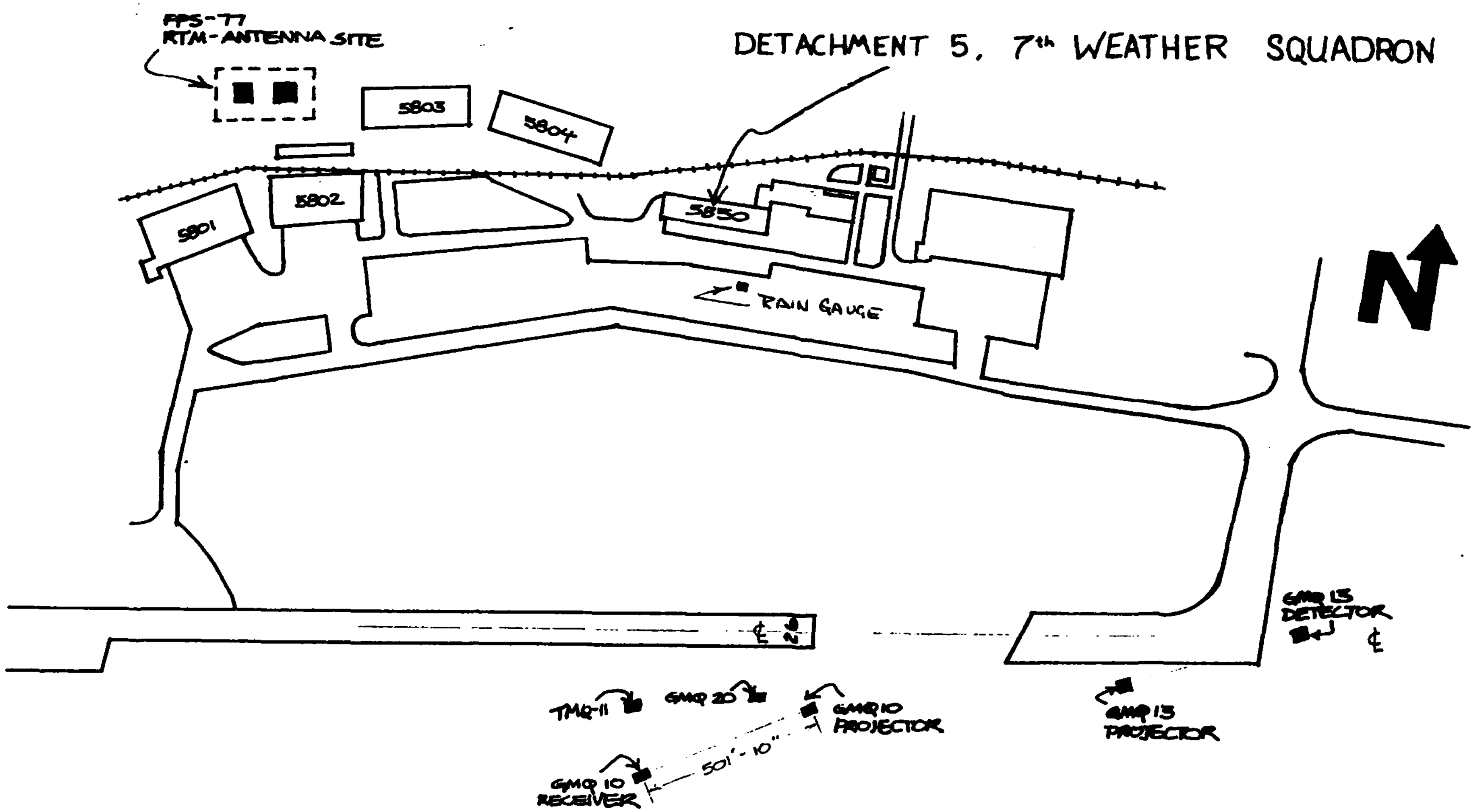
e. GMQ-13 Rotating Beam Ceilometer readout located in weather station. Instrument is located on south side of field.

f. ML-102-E Aneroid Barometer, ML-512 Mercurial Barometer, and ML-75 measuring (rain) stick .

g. Helium located in weather station area.

h. Rain gauge located on grassy area in front of weather station.

INSTRUMENTATION LOCATION - KATTERBACH AHP GERMANY



TERMINAL FORECAST REFERENCE NOTEBOOK (TFRN)

SECTION II

THRESHOLD VALUES AND OPERATIONAL CRITICAL WEATHER ELEMENTS

THRESHOLD VALUES

AH-1, UH-1, and OH-58 aircraft operate from Ansbach AHP. Each aircraft has criteria that can affect that aircraft's operational ability. The principle weather types that can impact upon aircraft are as follows:

a. Clouds less than 1,000 feet, and ceilings less than 500 feet.

b. Visibilities less than 2.7NM.

c. Winds greater than 25 knots with gust spreads of 15 knots or greater. 20 knots is a critical value for Stand-Off Target Aquisition System (SOTAS) aircraft.

d. All types of precipitation.

e. Icing and turbulence of all intensities.

f. Tornadoes

g. Hail 3/4 inch or greater

h. Winds 50 knots or greater

CLIMATOLOGICAL INDEX

1. Surface Winds, pages 2-3 through 2-7

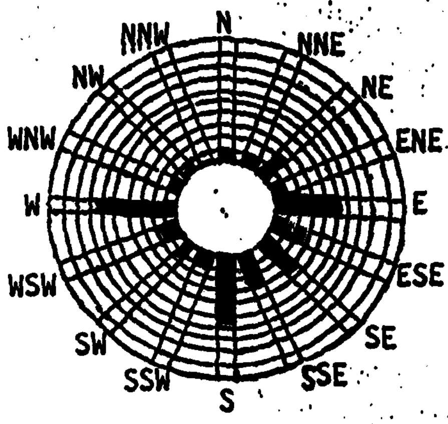
2. Operational Ceilings and Visibilities, pages 2-8 through 2-19

3. Precipitation, page 2-20

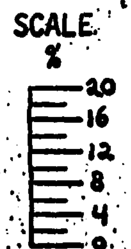
4. Temperature, page 2-21

SURFACE WINDS

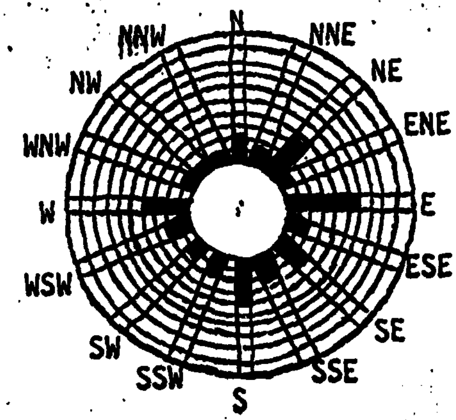
LESS THAN 11kts (75.7%)
GREATER THAN 21kts (.7%)



CALM (7.3%)
MONTH January



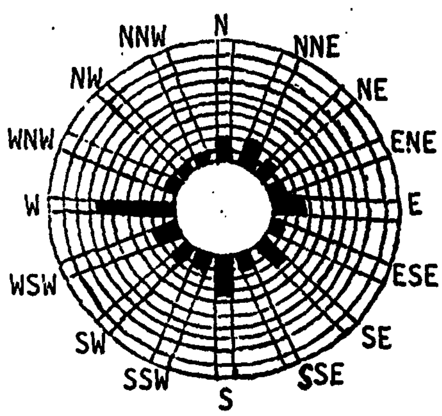
LESS THAN 11kts (74.1%)
GREATER THAN 21kts (1.9%)



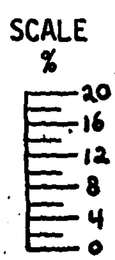
CALM (5.4%)
MONTH February

SURFACE WINDS

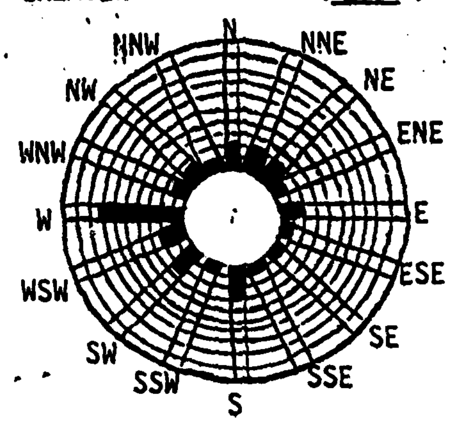
LESS THAN 11kts (59.8%)
GREATER THAN 21kts (2.9%)



CALM (5.6%)
MONTH March



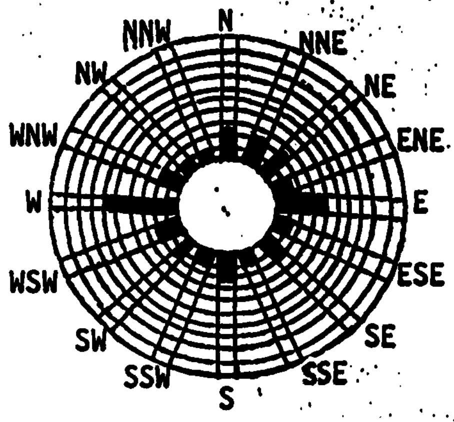
LESS THAN 11kts (63.0%)
GREATER THAN 21kts (2.1%)



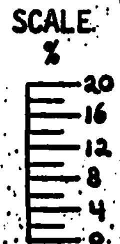
CALM (8.0%)
MONTH April

SURFACE WINDS

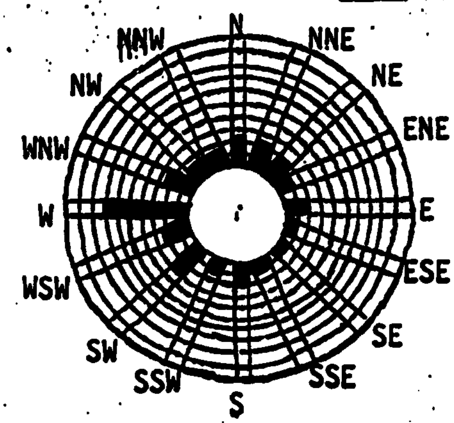
LESS THAN 11kts (71.2%)
GREATER THAN 21kts (.5%)



CALM (9.8 %)
MONTH May



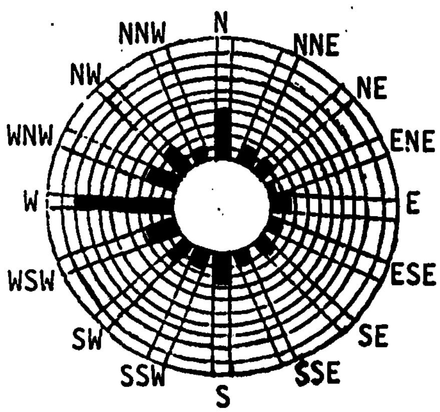
LESS THAN 11kts (92.5%)
GREATER THAN 21kts (.2%)



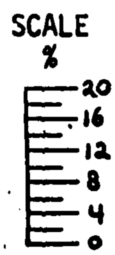
CALM (8.9 %)
MONTH June

SURFACE WINDS

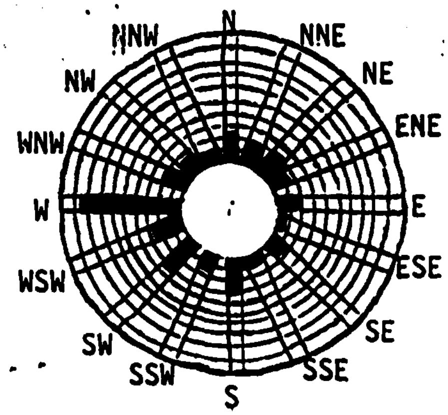
LESS THAN 11kts (76.8%)
GREATER THAN 21kts (.3 %)



CALM (9.6%)
MONTH July



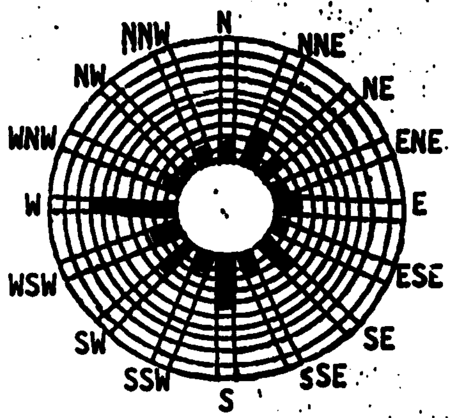
LESS THAN 11kts (79.5%)
GREATER THAN 21kts (.3 %)



CALM (8.5 %)
MONTH August

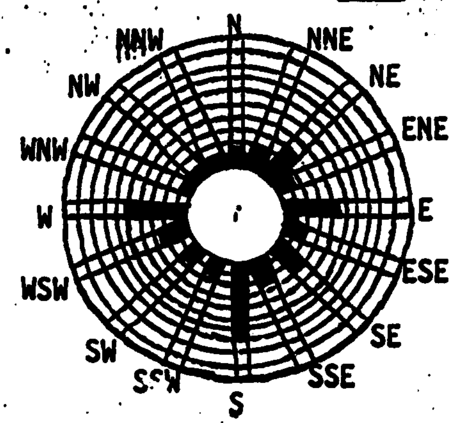
SURFACE WINDS

LESS THAN 11kts (79.3%)
GREATER THAN 21kts (.8%)

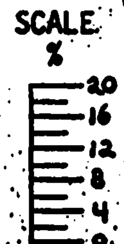


CALM (8.8%)
MONTH September

LESS THAN 11kts (94.4%)
GREATER THAN 21kts (.6%)

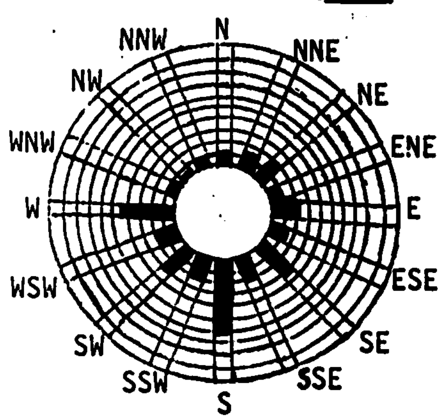


CALM (6.7%)
MONTH October



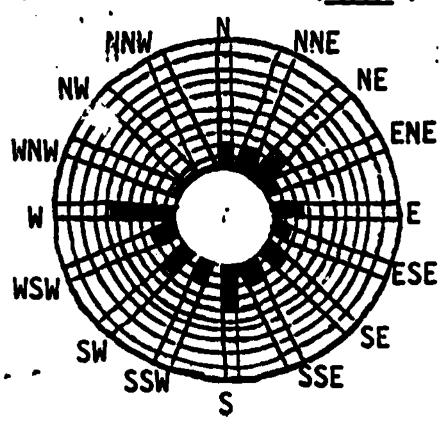
SURFACE WINDS

LESS THAN 11kts (72.7%)
GREATER THAN 21kts (1.6%)

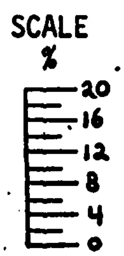


CALM (5.7%)
MONTH November

LESS THAN 11kts (75.6%)
GREATER THAN 21kts (1.2%)



CALM (5.4%)
MONTH December



SURFACE WIND CLIMATOLOGY - ANSBACH   PERIOD OF RECORD 1965-1972

WIND DIR	JAN <11K	JAN >21K	FEB <11K	FEB >21K	MAR <11K	MAR >21K	APR <11K	APR >21K	MAY <11K	MAY >21K	JUN <11K	JUN >21K
N	2.1	X	4.2	.0	3.9	.1	4.4	X	5.2	X	5.5	X
NNE	1.9	X	3.1	X	4.3	.0	4.6	X	4.6	X	5.1	X
NE	4.4	X	7.2	X	3.2	.1	3.7	.0	5.1	X	3.4	X
ENE	1.8	X	2.0	X	2.5	X	2.2	.0	2.7	X	2.5	X
E	10.5	.1	11.5	X	5.3	.0	4.0	.0	8.1	X	3.7	.0
ESE	5.5	.0	3.9	X	1.8	X	1.5	X	2.6	X	1.6	X
SE	7.0	X	5.8	X	4.7	X	2.0	X	4.3	X	2.0	X
SSE	6.1	X	4.6	X	2.6	X	1.8	X	2.7	X	2.3	X
S	11.4	.0	8.4	X	7.6	X	5.9	.1	5.0	X	4.5	X
SSW	2.4	X	3.4	X	2.2	.2	2.2	X	2.3	X	2.8	X
SW	2.9	X	3.0	.1	3.6	.3	4.8	.3	3.5	.1	6.5	X
WSW	3.2	.3	4.2	.4	3.4	.9	4.2	.5	4.5	.2	5.1	.0
W	12.9	.1	6.6	1.3	11.6	1.2	13.5	1.2	11.4	.2	14.5	.1
WNW	1.3	.2	2.2	.1	2.5	.0	2.8	.0	3.9	X	4.7	.1
NW	1.2	X	1.8	X	1.7	X	2.7	X	2.6	X	2.8	X
NNW	.5	X	1.6	X	1.7	X	2.1	X	2.2	X	2.8	X
VRB	.6	X	.6	X	.9	.1	.7	X	.5	X	2.8	X
CALM	7.3	--	5.4	--	5.6	--	8.0	--	9.8	--	8.9	--
TOTAL	83.0	.7	79.5	1.9	66.1	2.9	71.1	2.1	81.0	.5	81.5	.2

X indicates that the value was never observed.
Defining parameters are LESS THAN 11 knots and GREATER THAN 21 knots.
Plotted values are percentages of total observations for the entire month.

SURFACE WIND CLIMATOLOGY - ANSBACH CONTINUED

WIND DIR	JUL <11K	JUL >21K	AUG <11K	AUG >21K	SEP <11K	SEP >21K	OCT <11K	OCT >21K	NOV <11K	NOV >21K	DEC <11K	DEC >21K
N	8.3	X	4.8	X	3.6	X	3.0	X	2.6	X	4.4	X
NNE	3.1	X	3.6	X	6.1	X	3.6	X	3.0	X	4.4	X
NE	3.2	X	4.7	X	3.6	X	5.9	X	4.1	X	5.5	X
ENE	1.1	X	3.0	X	2.6	X	3.2	X	2.0	X	2.0	X
E	3.3	X	4.1	X	3.8	X	8.6	X	4.7	.0	4.4	X
ESE	2.2	X	1.7	X	2.2	X	3.8	X	3.2	X	2.9	X
SE	2.7	X	3.3	X	5.9	X	6.2	X	7.0	X	4.3	X
SSE	2.3	X	2.4	X	3.8	X	5.0	X	4.4	X	4.3	X
S	5.5	X	6.7	X	8.9	X	13.9	.0	12.6	X	8.2	.0
SSW	2.8	X	3.3	X	3.3	X	3.1	X	4.7	.1	4.1	X
SW	4.6	.1	6.8	X	6.9	X	3.6	X	6.3	.2	5.4	.2
WSW	5.4	.1	5.5	.1	5.1	.1	5.0	.4	4.0	.7	4.5	.3
W	16.1	.1	17.0	.1	13.0	.7	10.4	.1	8.4	.6	10.3	.5
WNW	5.6	X	4.4	X	3.1	X	2.2	X	1.9	.0	1.5	X
NW	4.8	.0	3.5	.0	1.9	X	2.2	.1	1.0	.0	1.2	.0
NNW	2.5	X	2.4	X	2.9	X	1.4	.0	.8	X	.6	X
VRB	3.3	X	1.3	.1	2.6	X	1.3	X	.7	.0	.7	.0
CALM	9.6	--	8.5	--	8.8	--	6.7	--	5.7	--	5.4	--
TOTAL	86.4	.3	87.0	.3	88.1	.8	81.1	.6	78.4	1.6	81.0	1.2

X indicates that the value was never observed.
Defining parameters are LESS THAN 11 knots and GREATER THAN 21 knots.
Plotted values are percentages of total observations for the entire month.

SURFACE WIND CLIMATOLOGY - CONTINUED

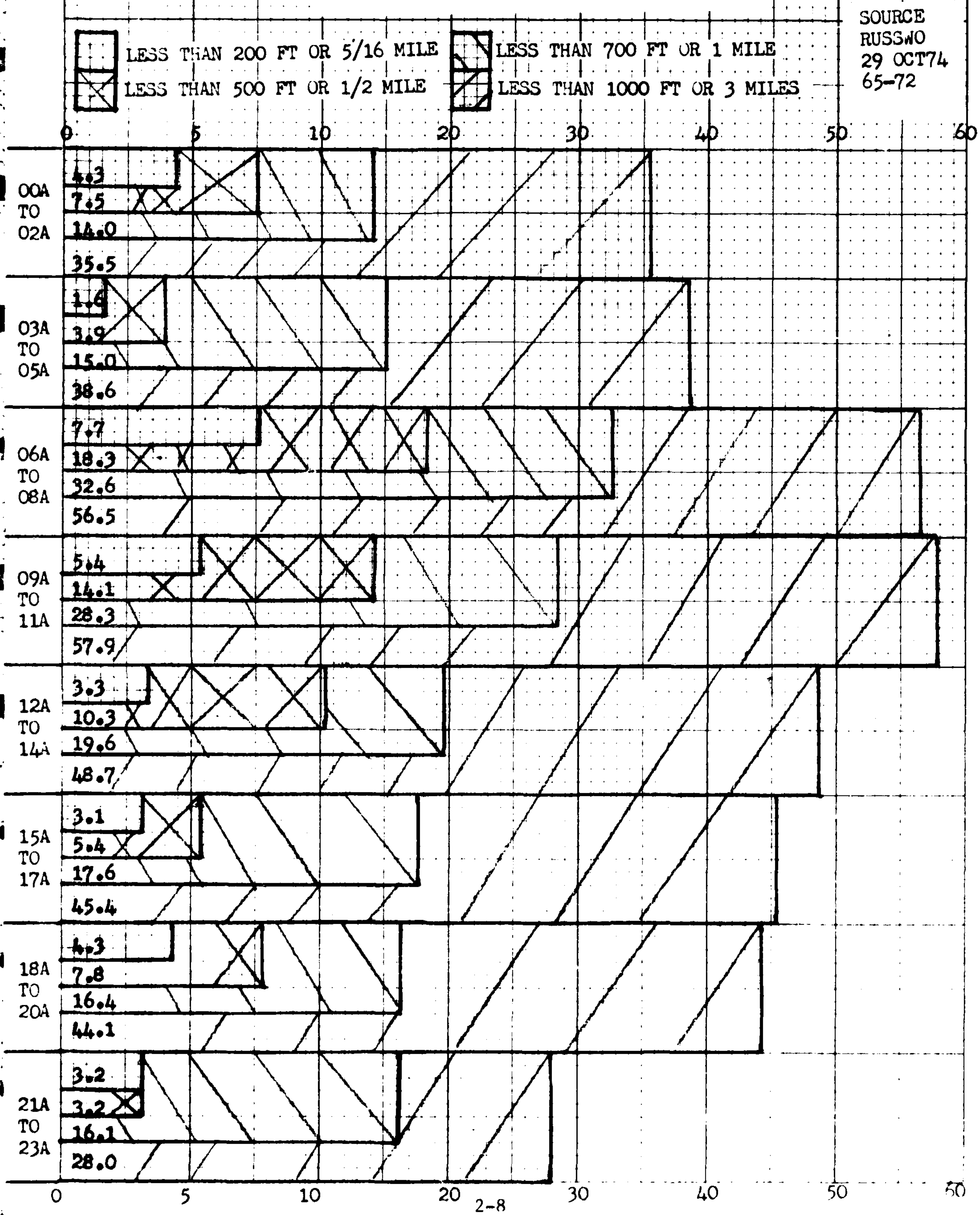
WIND DIR	ANNUAL <11K	ANNUAL >21K
N	4.3	.0
NNE	3.9	.0
NE	4.5	.0
ENE	2.3	.0
E	5.0	.0
ESE	2.8	.0
SE	4.7	X
SSE	3.5	.0
S	8.2	.0
SSW	3.0	.0
SW	4.8	.1
WSW	4.5	.3
W	12.1	.4
WNW	3.0	.0
NW	2.3	.0
NNW	1.7	.0
VRB	1.2	.0
CALM	7.5	--
TOTAL	79.3	.8

X indicates that the value was never observed.
Defining parameters are LESS THAN 11knots and GREATER THAN 21 knots.
Plotted values are percentages of total observations for the entire month.

JANUARY

OPERATIONAL CEILING/VISIBILITY CLIMATOLOGY

JANUARY



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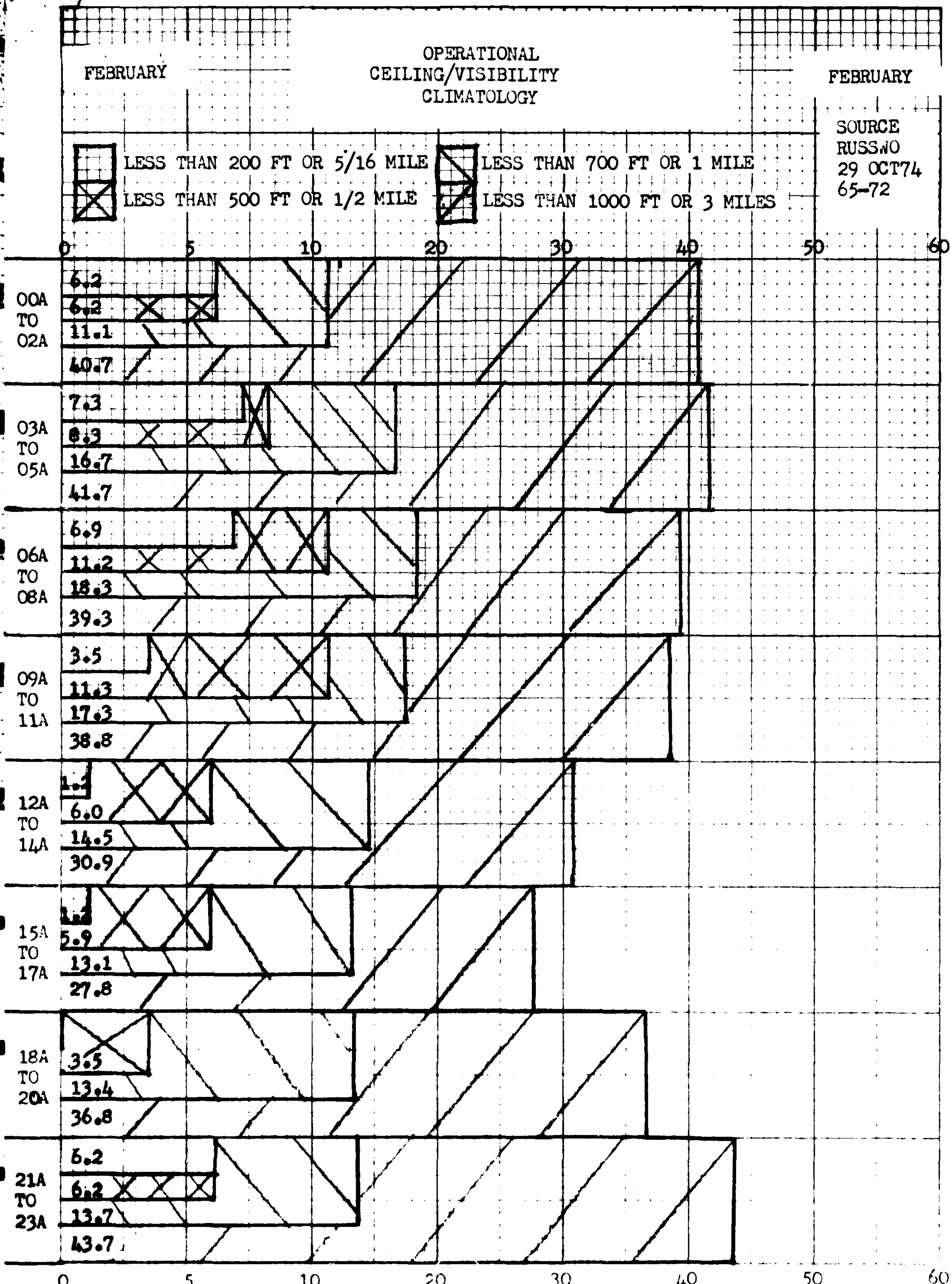
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OPERATIONAL
CEILING/VISIBILITY
CLIMATOLOGY
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65-72
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LESS THAN 500 FT OR 1/2 MILE
LESS THAN 700 FT OR 1 MILE
LESS THAN 1000 FT OR 3 MILES
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00A TO 02A
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41.7
06A TO 08A
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15A TO 17A
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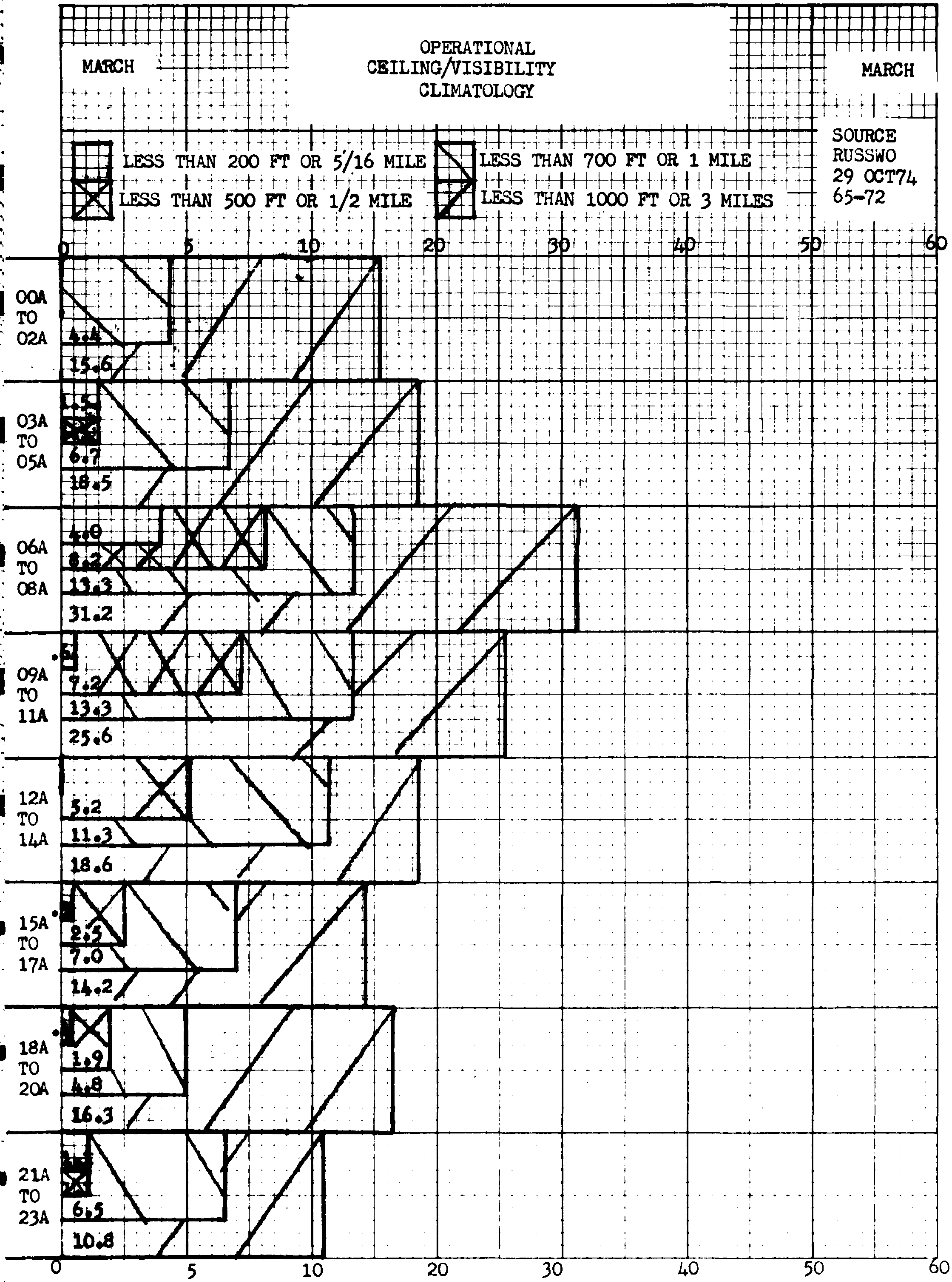
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CEILING/VISIBILITY
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LESS THAN 700 FT OR 1 MILE
LESS THAN 1000 FT OR 3 MILES
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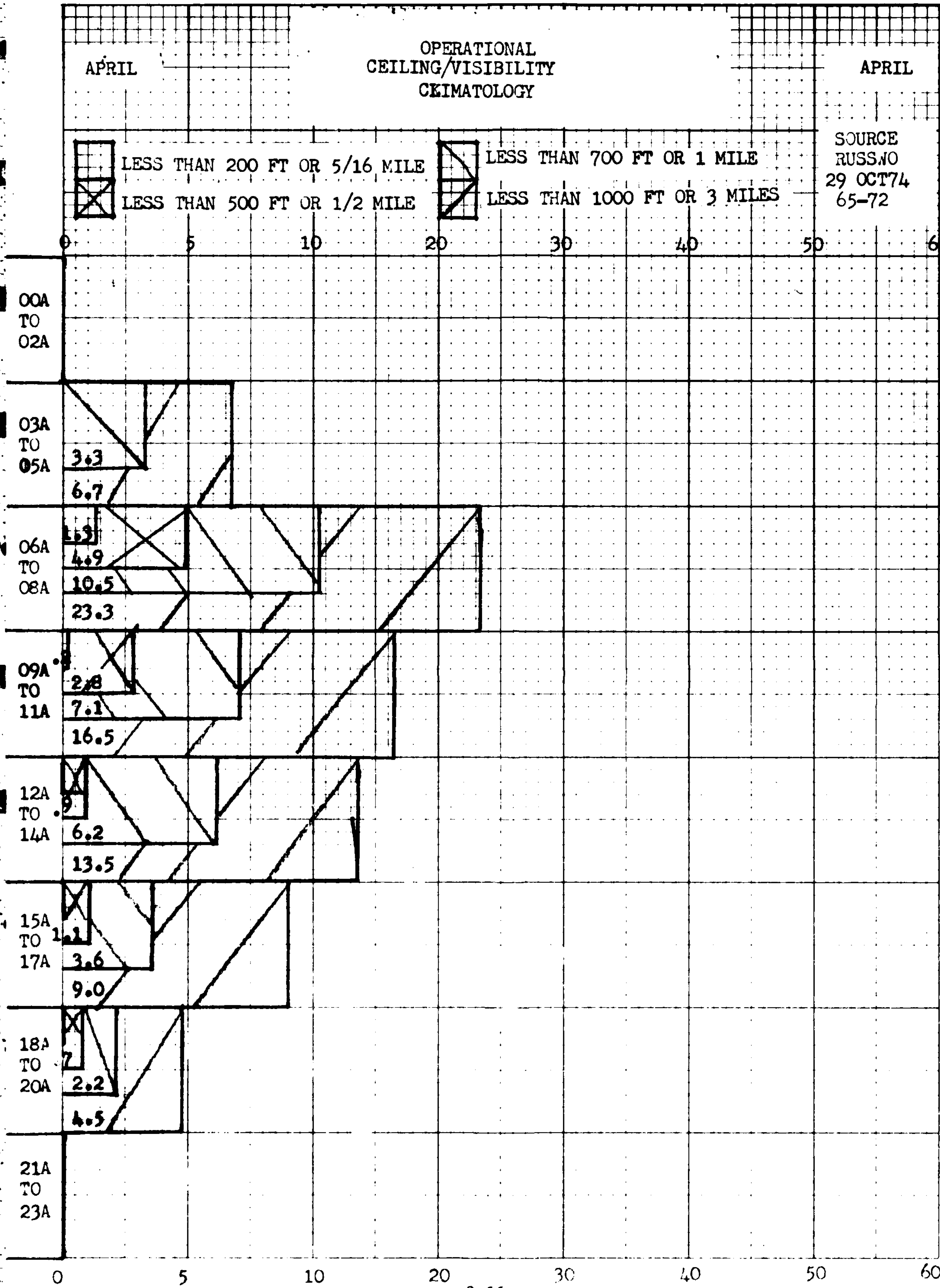
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CEILING/VISIBILITY
CLIMATOLOGY
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SOURCE
RUSSWO
29 OCT74
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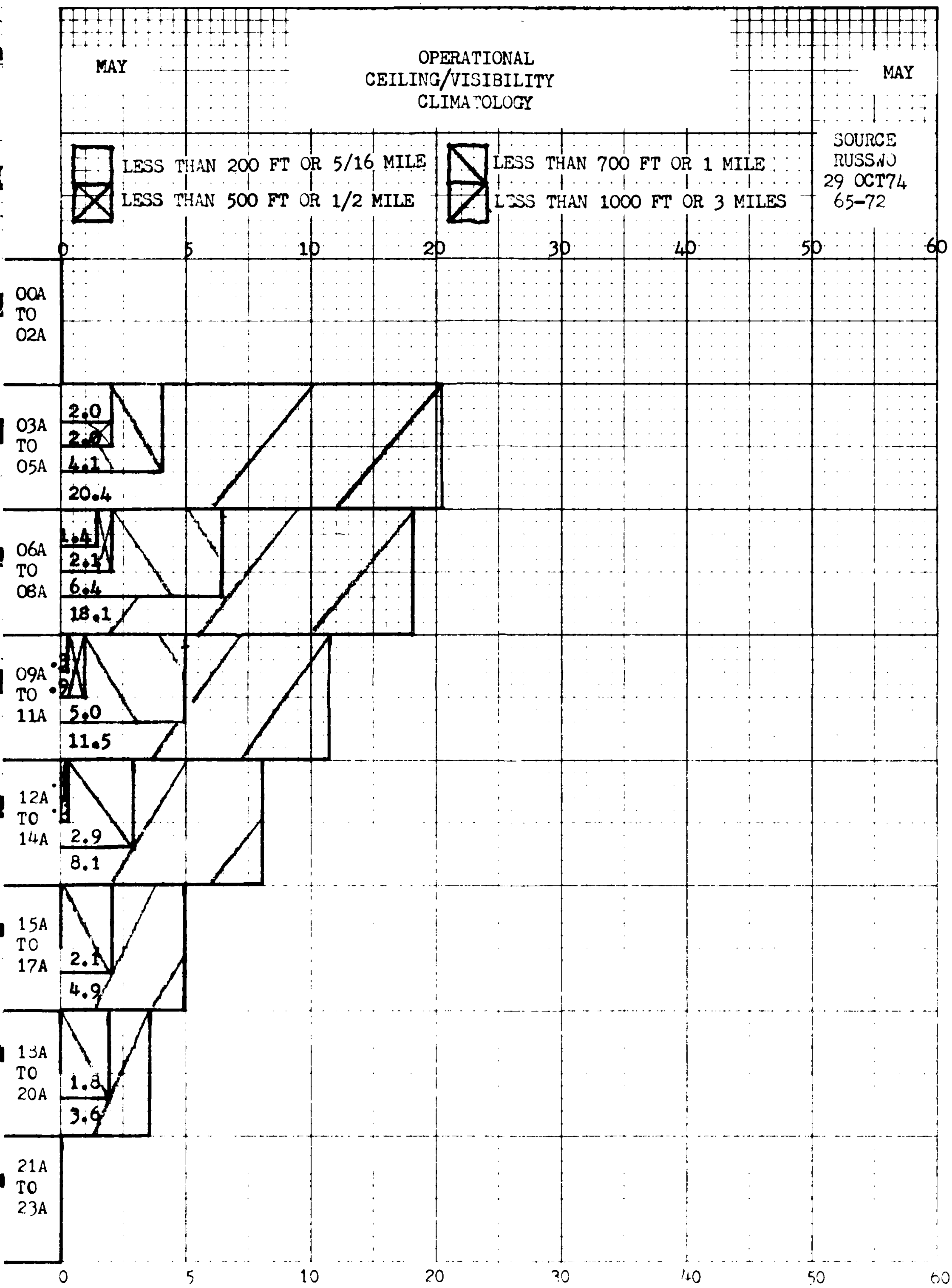

MAY
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CEILING/VISIBILITY
CLIMATOLOGY
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LESS THAN 1000 FT OR 3 MILES
SOURCE
RUSSWO
29 OCT74
65-72
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00A TO 02A
03A TO 05A
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06A TO 08A
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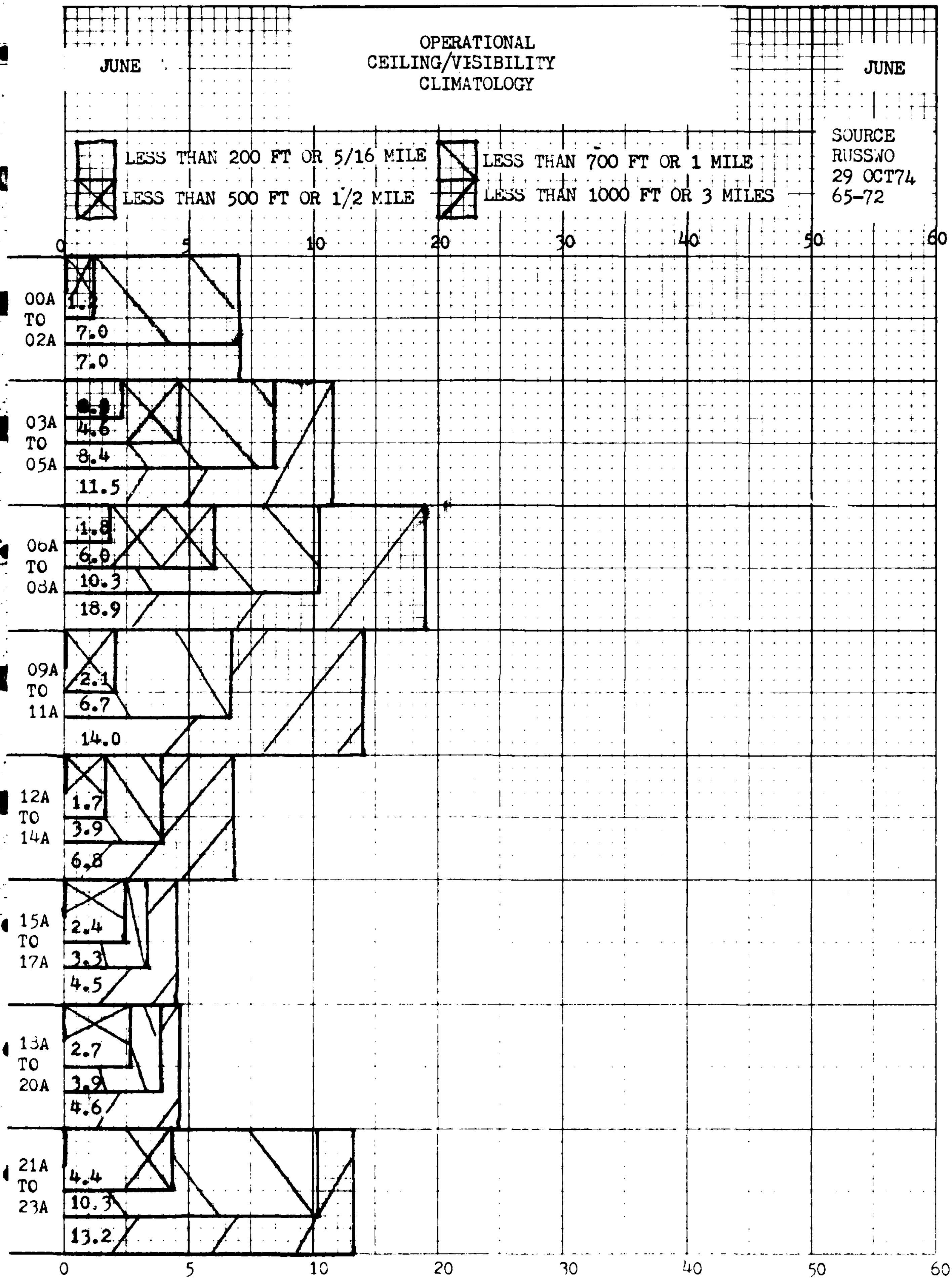
21A TO 23A



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CLIMATOLOGY
JUNE
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21A TO 23A
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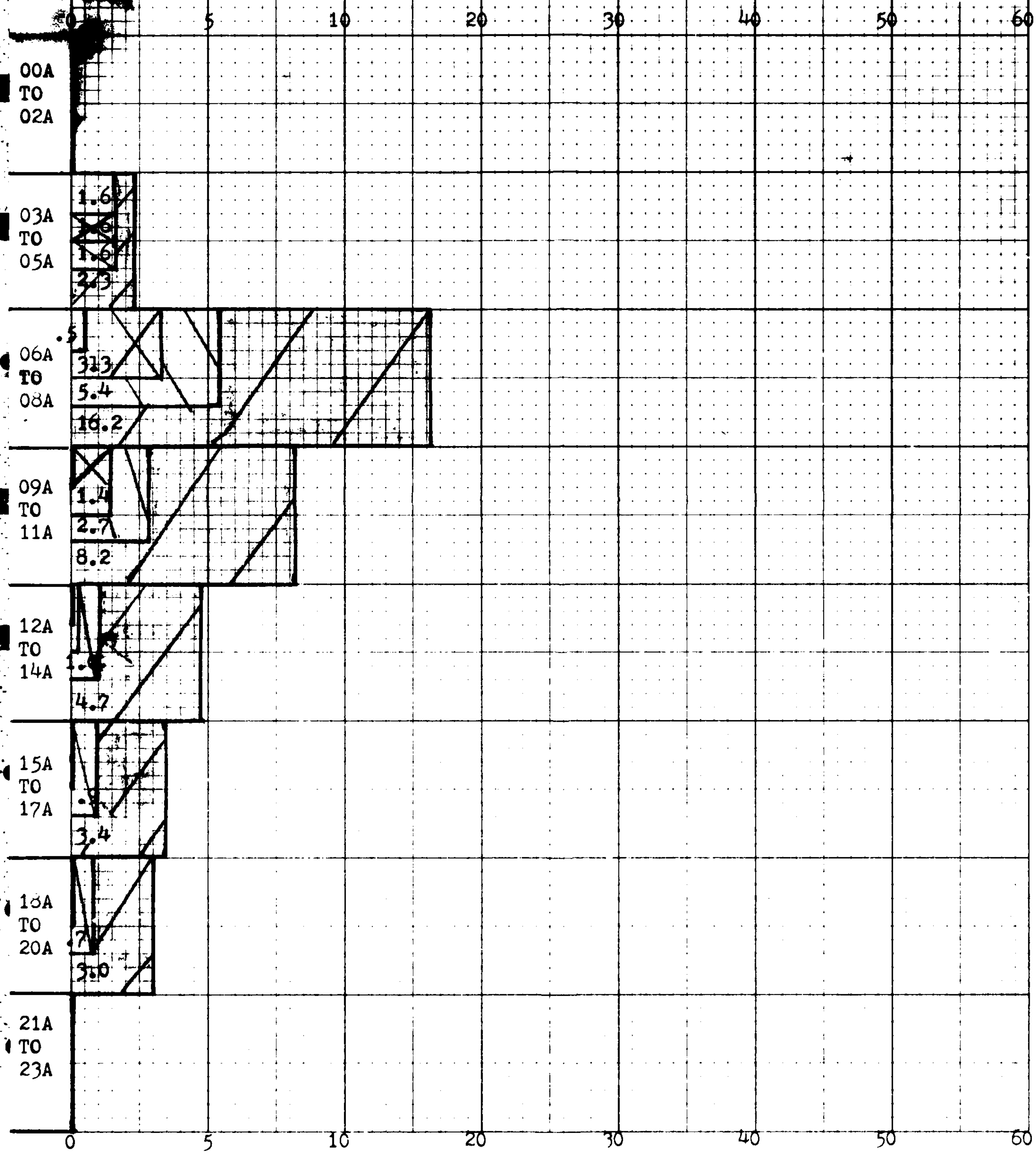
JULY

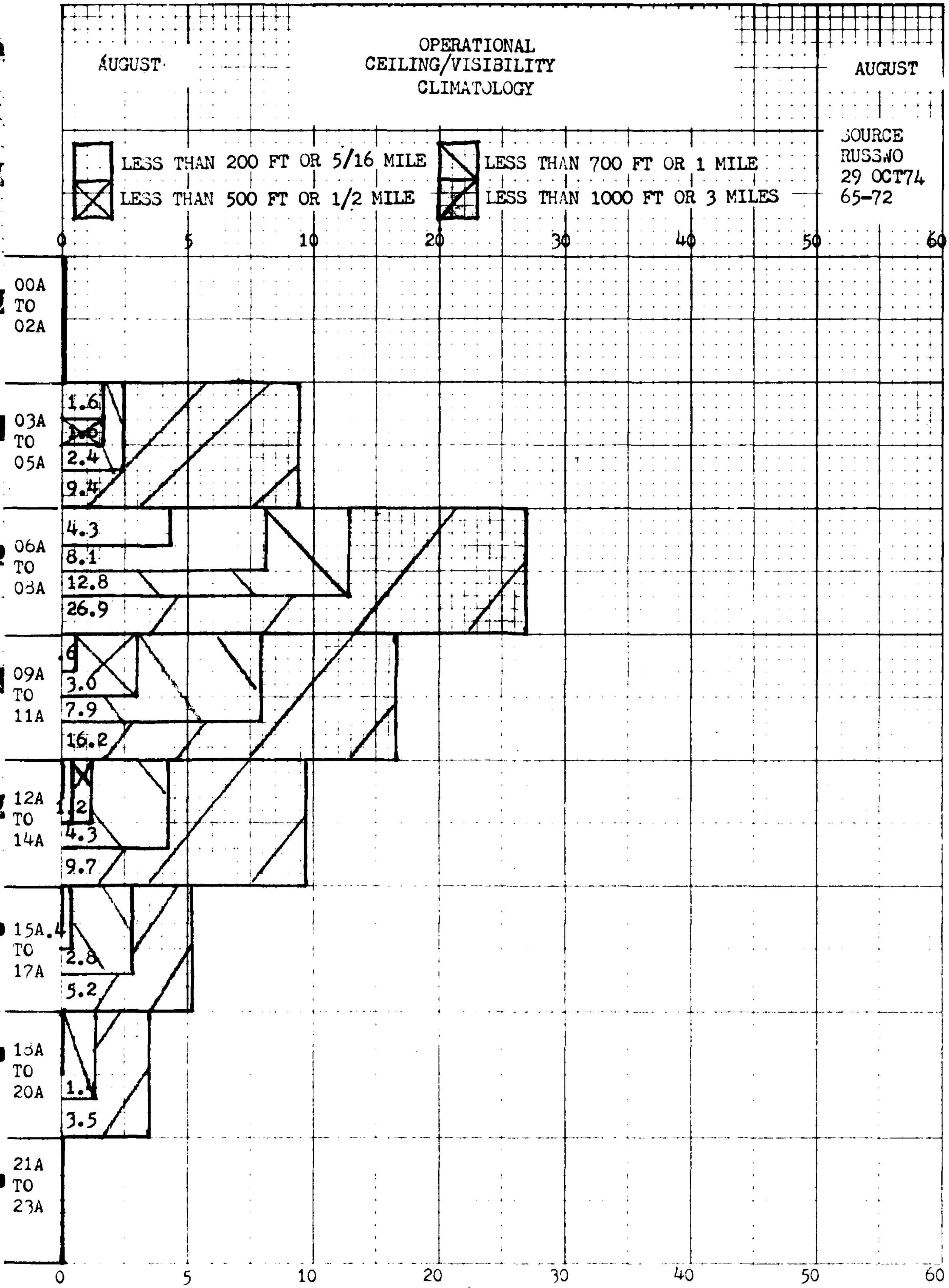
OPERATIONAL
CEILING/VISIBILITY
CLIMATOLOGY

JULY

LESS THAN 200 FT OR 5/16 MILE
LESS THAN 500 FT OR 1/2 MILE
LESS THAN 700 FT OR 1 MILE
LESS THAN 1000 FT OR 3 MILES

SOURCE
RUSSWO
29 OCT74
65-72

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SOURCE
RUSSWO
29 OCT74
65-72
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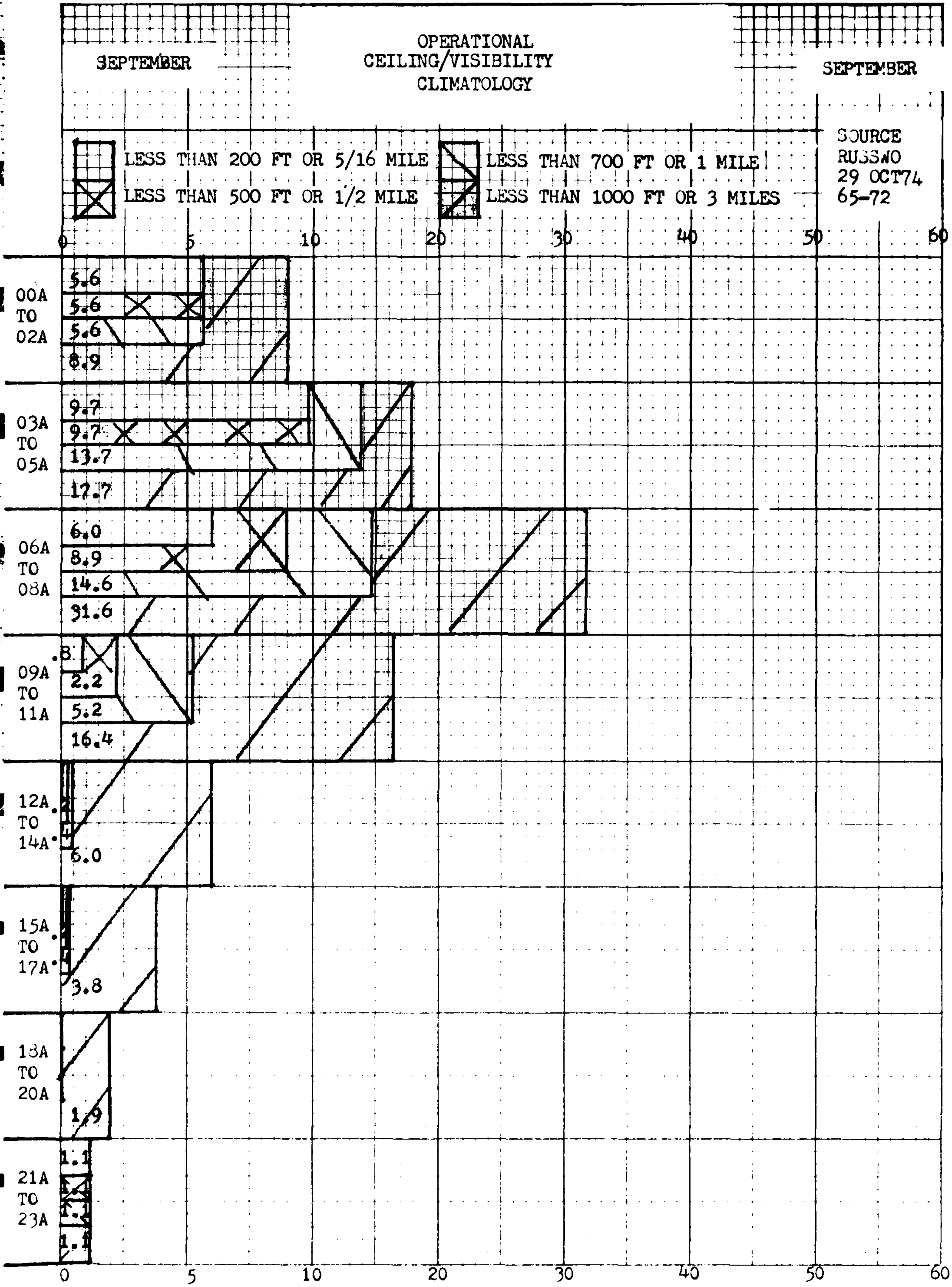
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SOURCE
RUSSWO
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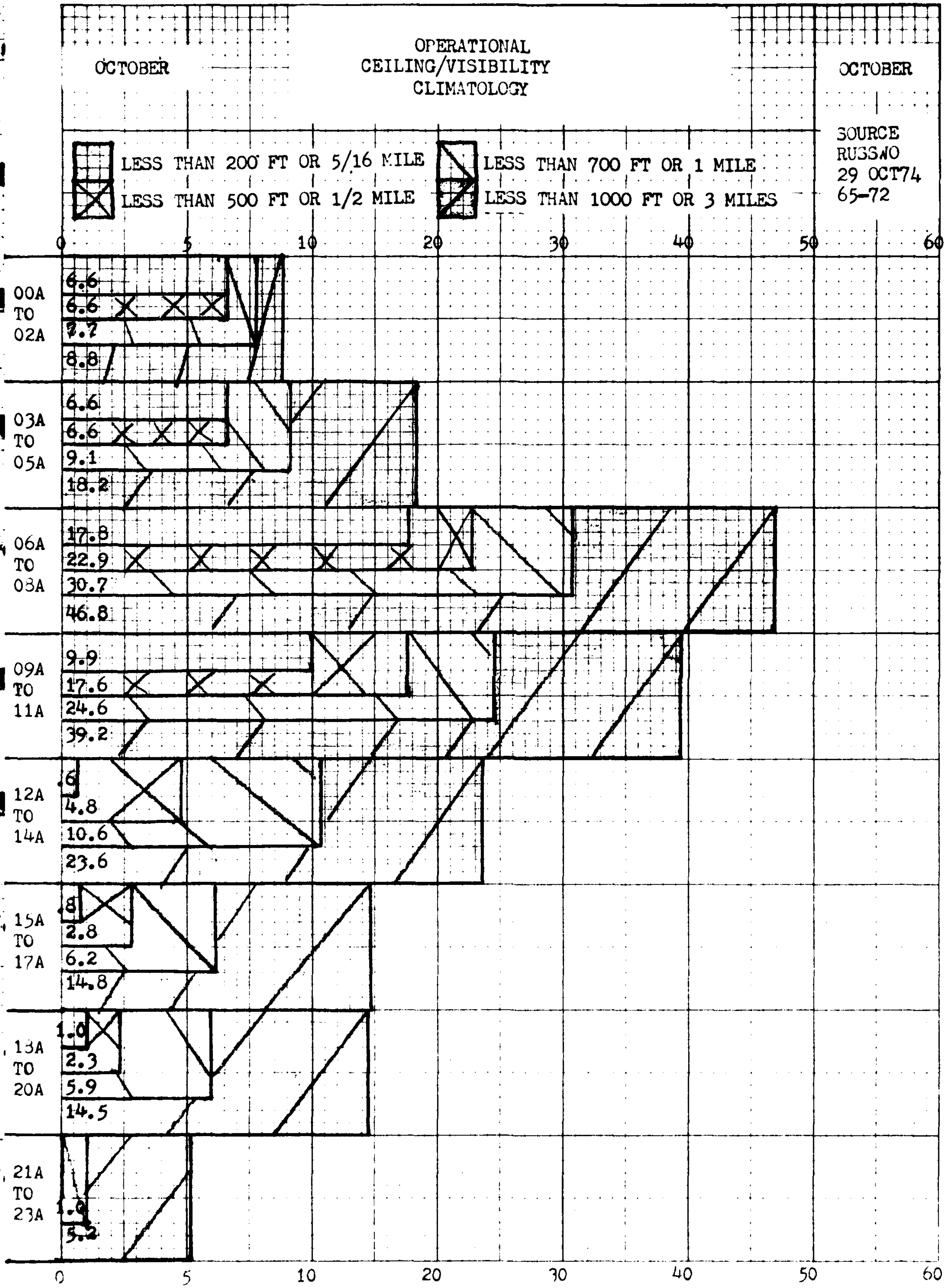

OCTOBER
OPERATIONAL CEILING/VISIBILITY CLIMATOLOGY
OCTOBER
SOURCE RUSSWO 29 OCT74 65-72
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LESS THAN 700 FT OR 1 MILE
LESS THAN 1000 FT OR 3 MILES
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03A TO 05A
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9.1
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24.6
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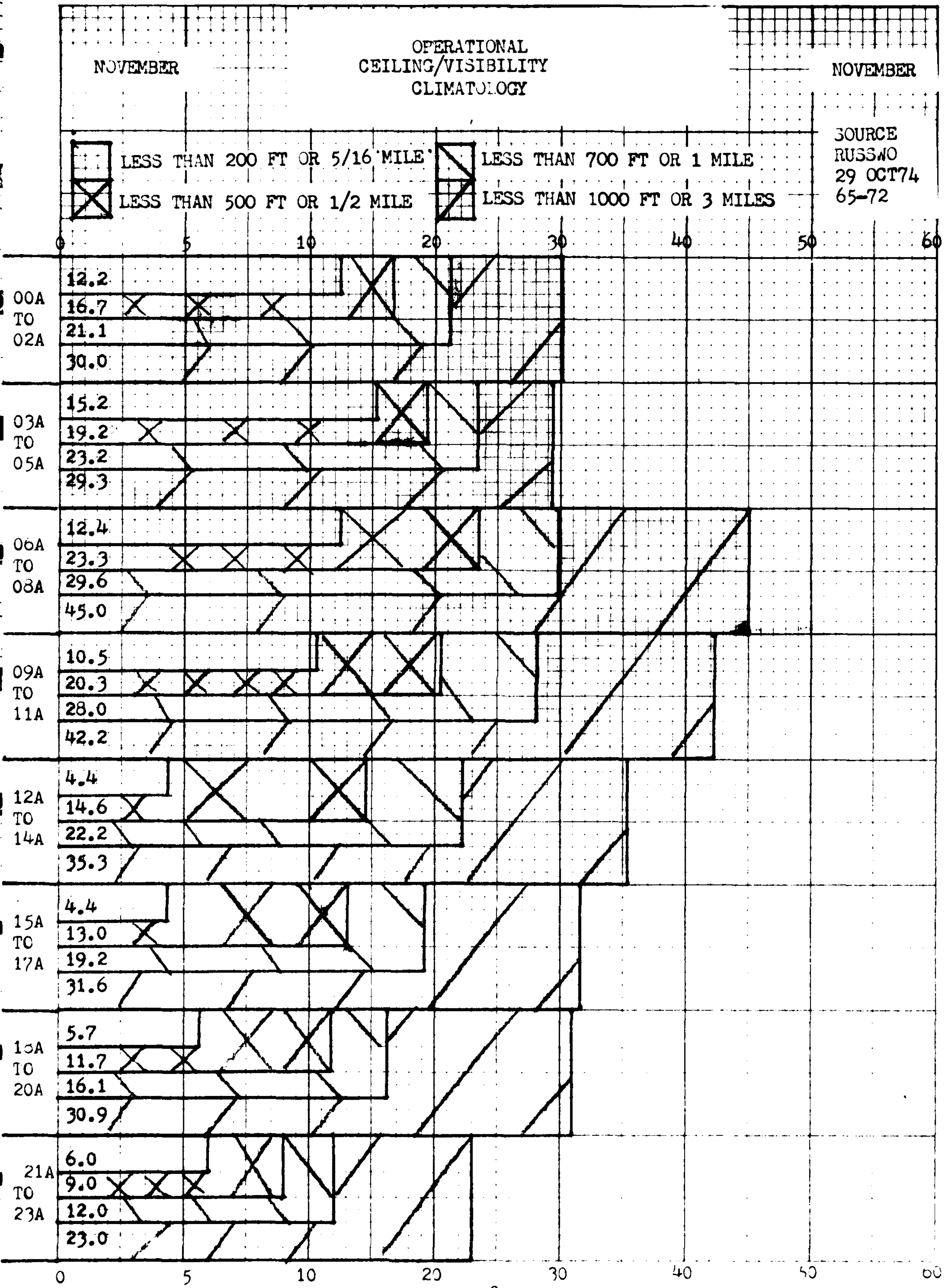
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CEILING/VISIBILITY
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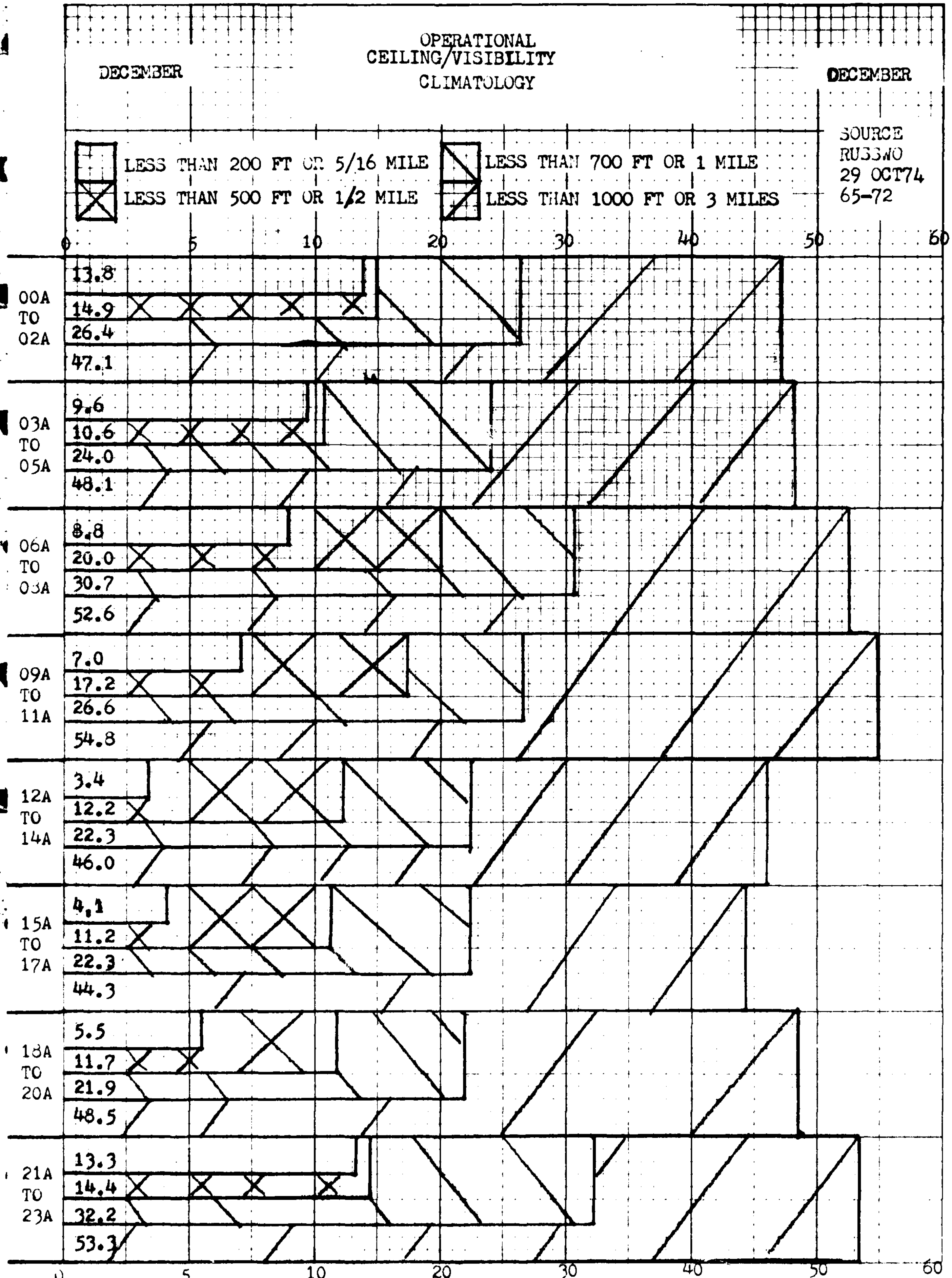

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SOURCE
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29 OCT74
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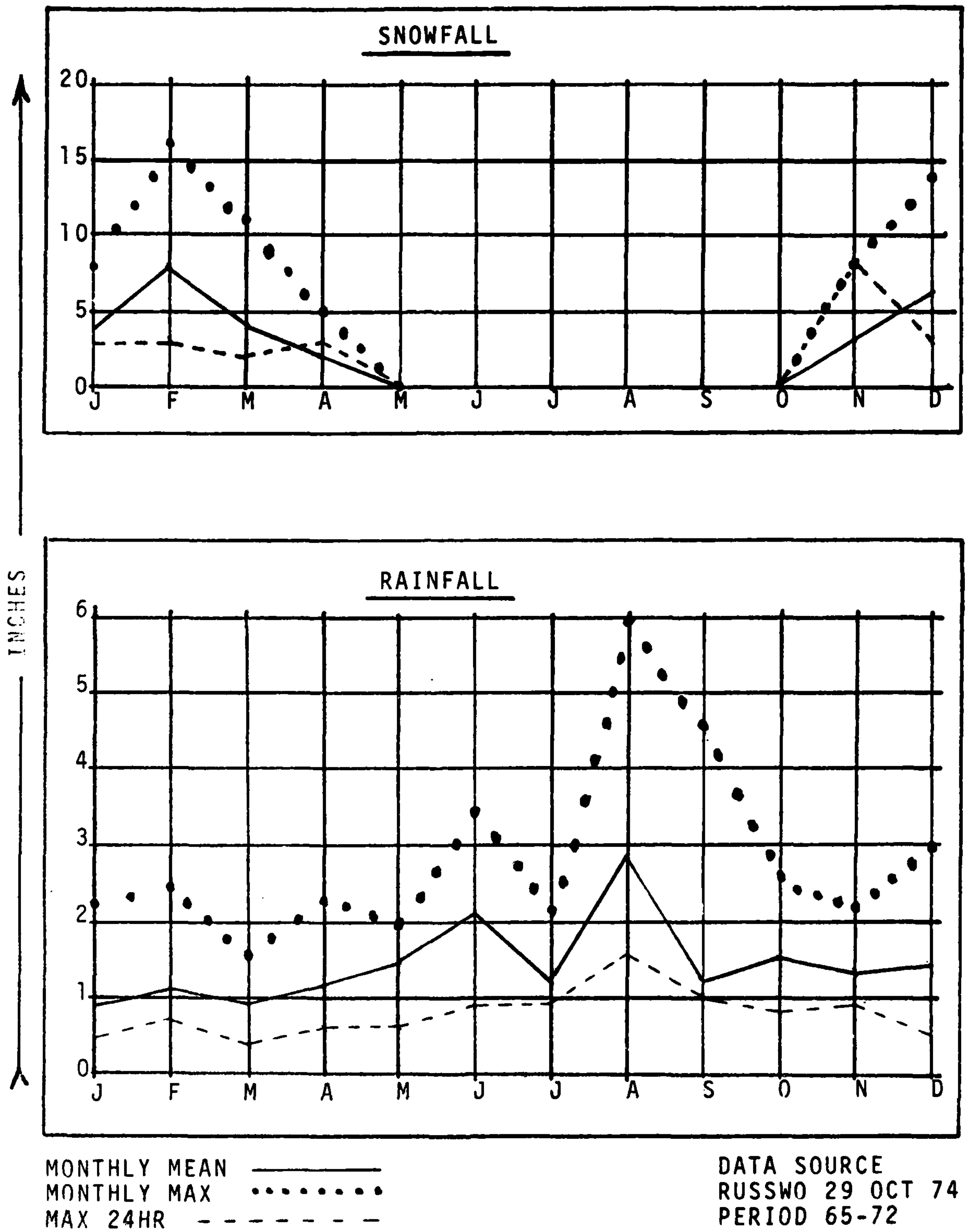
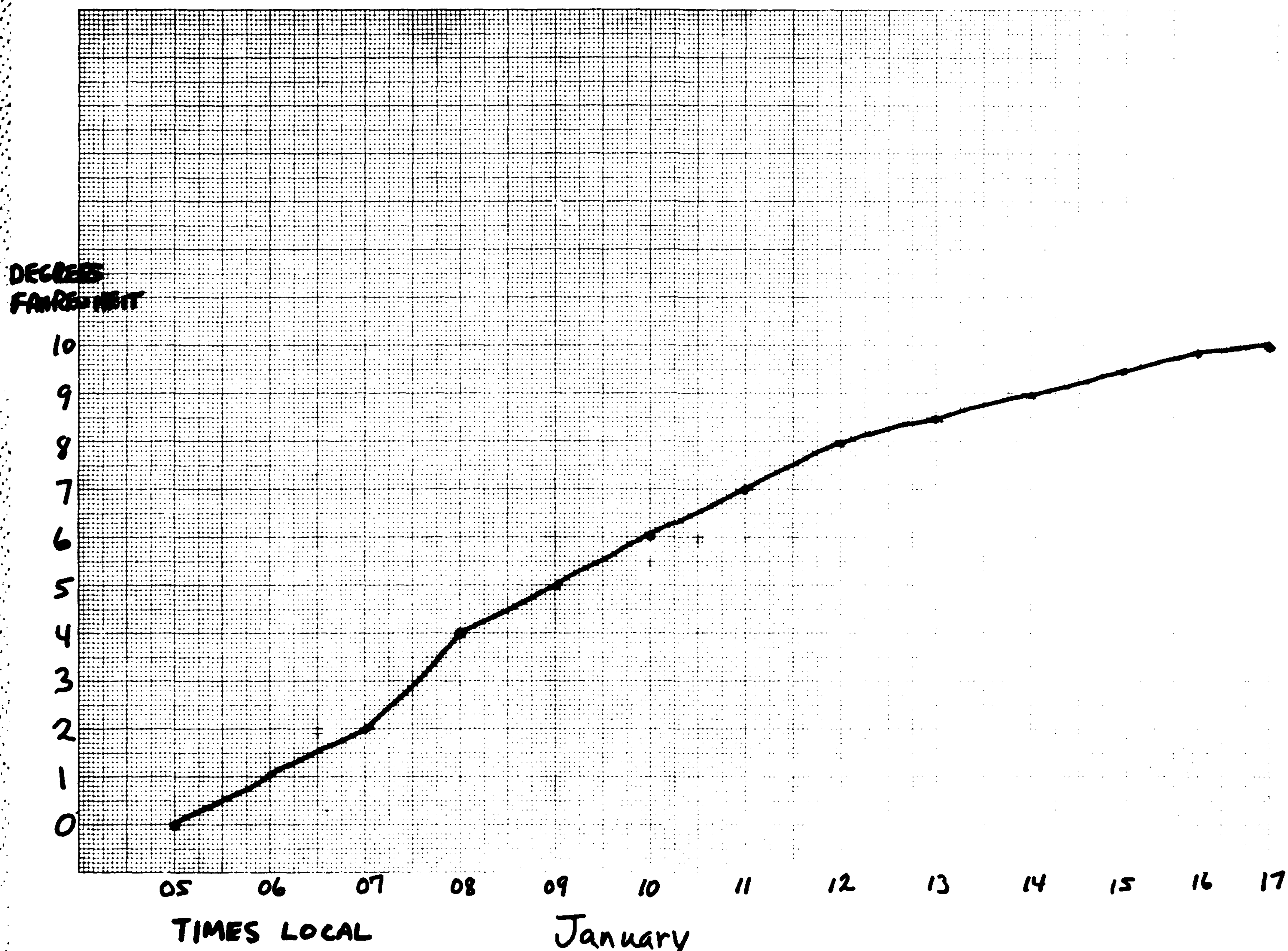
PRECIPITATION



ANSBACH AHP, Ge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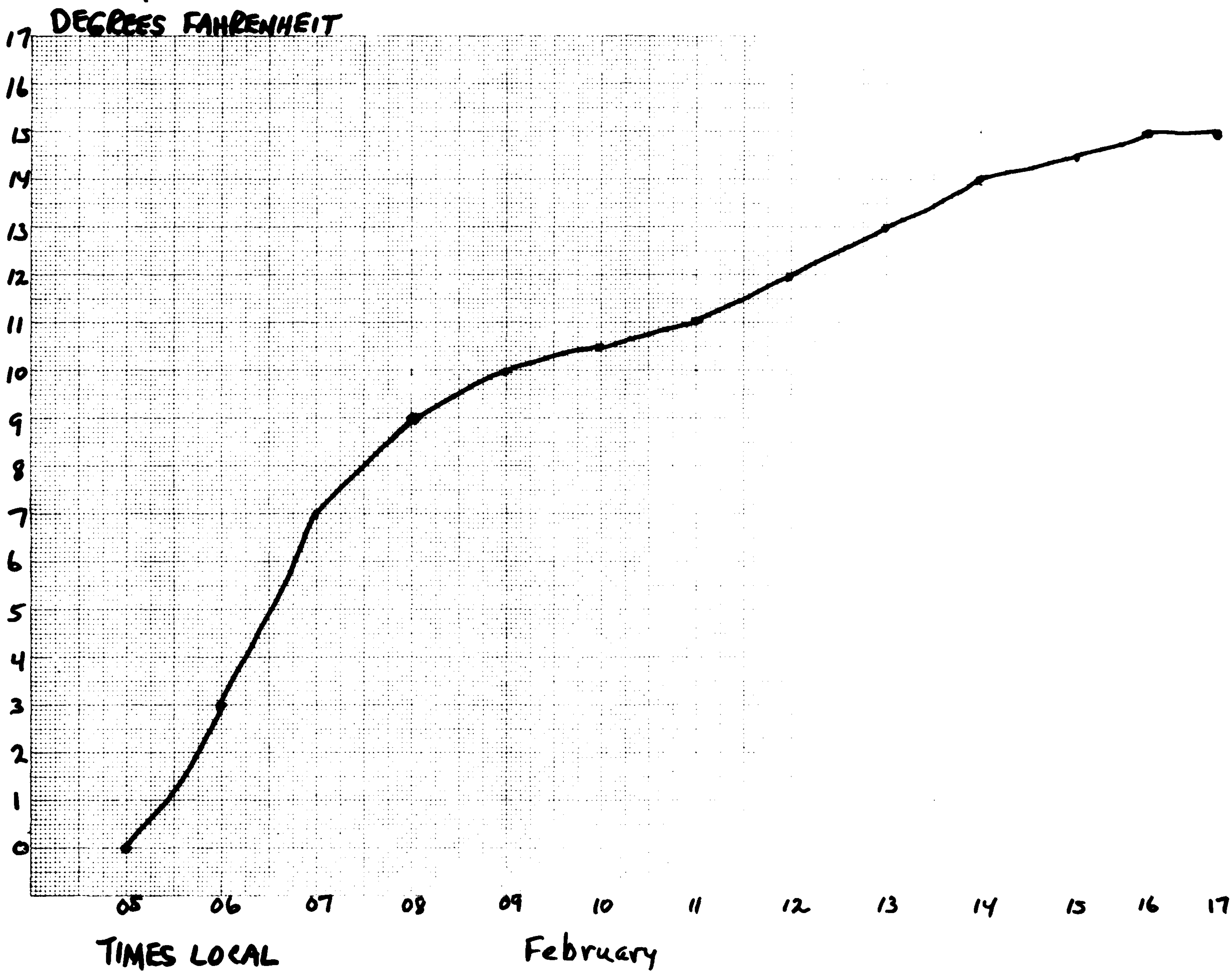
TIMES LOCAL
January



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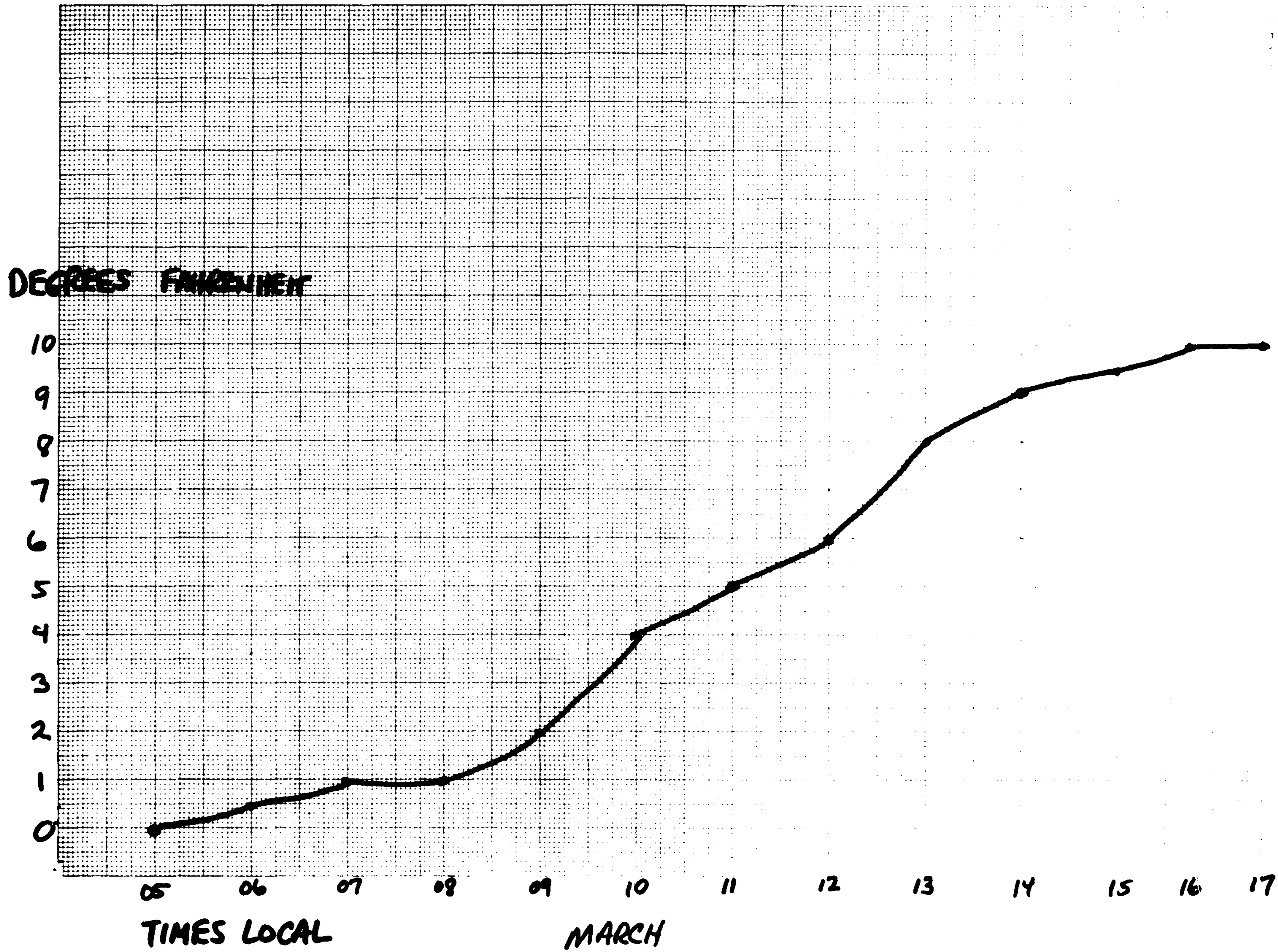
TIMES LOCAL
February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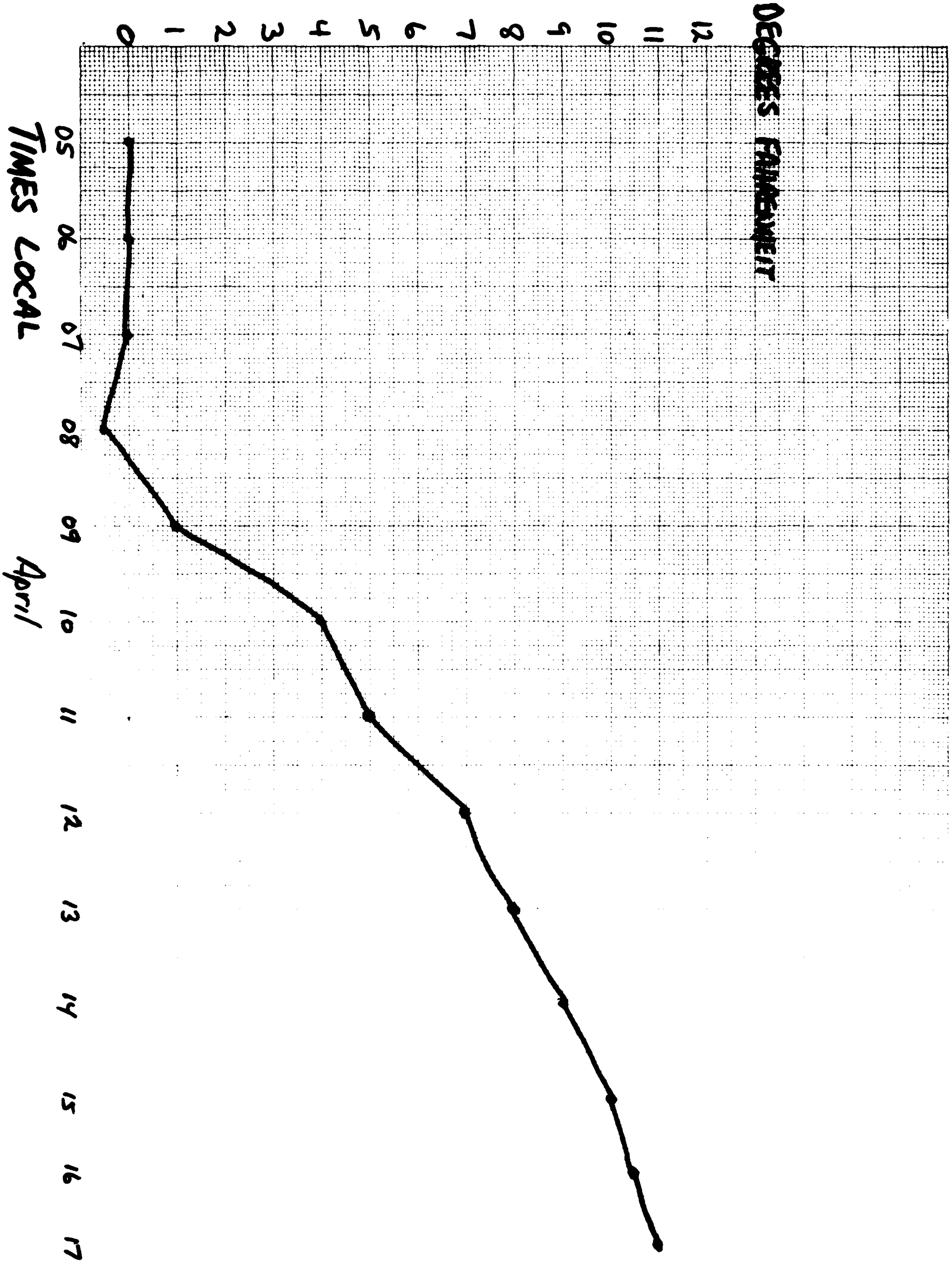
TIMES LOCAL
MARCH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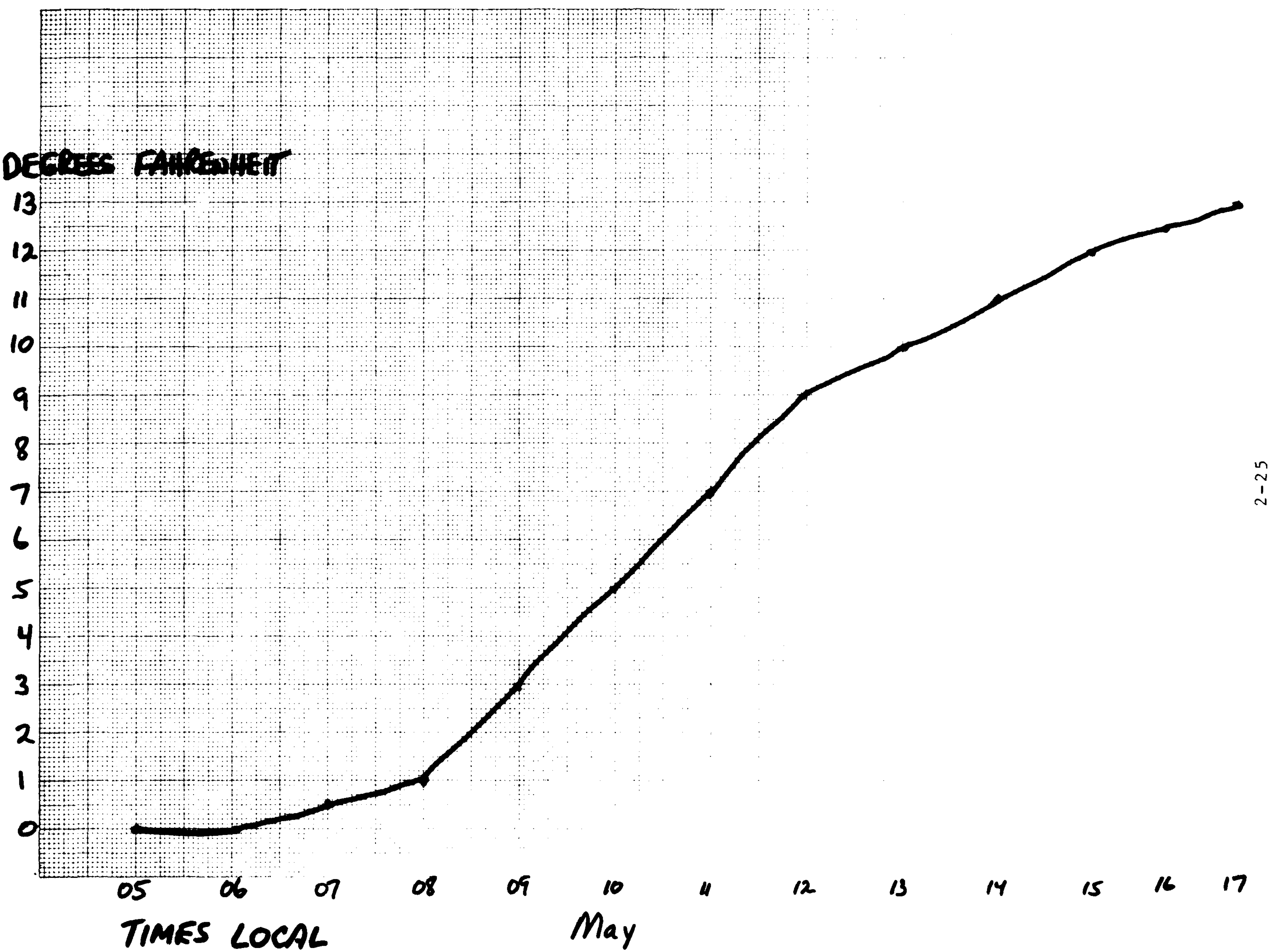
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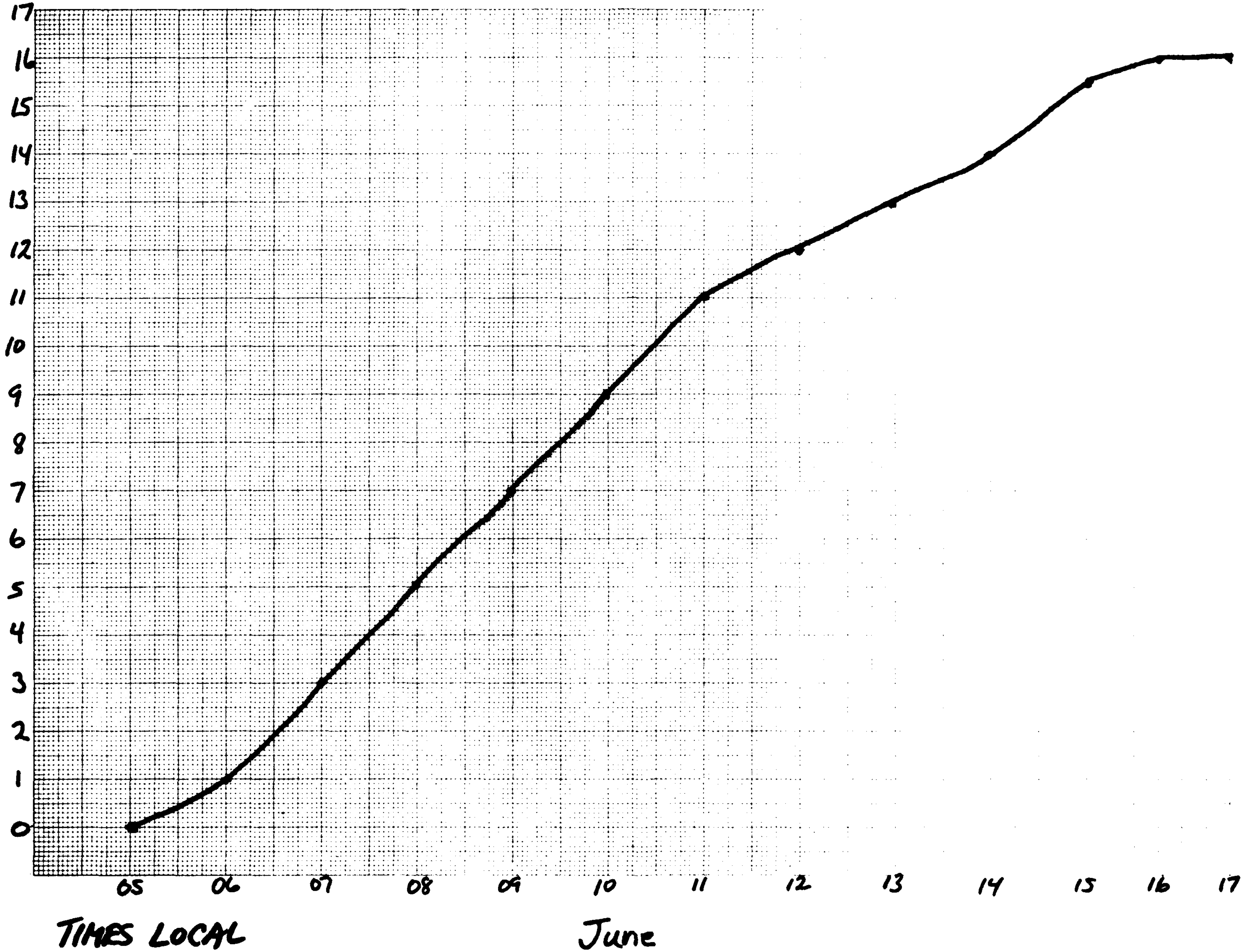
TIMES LOCAL
May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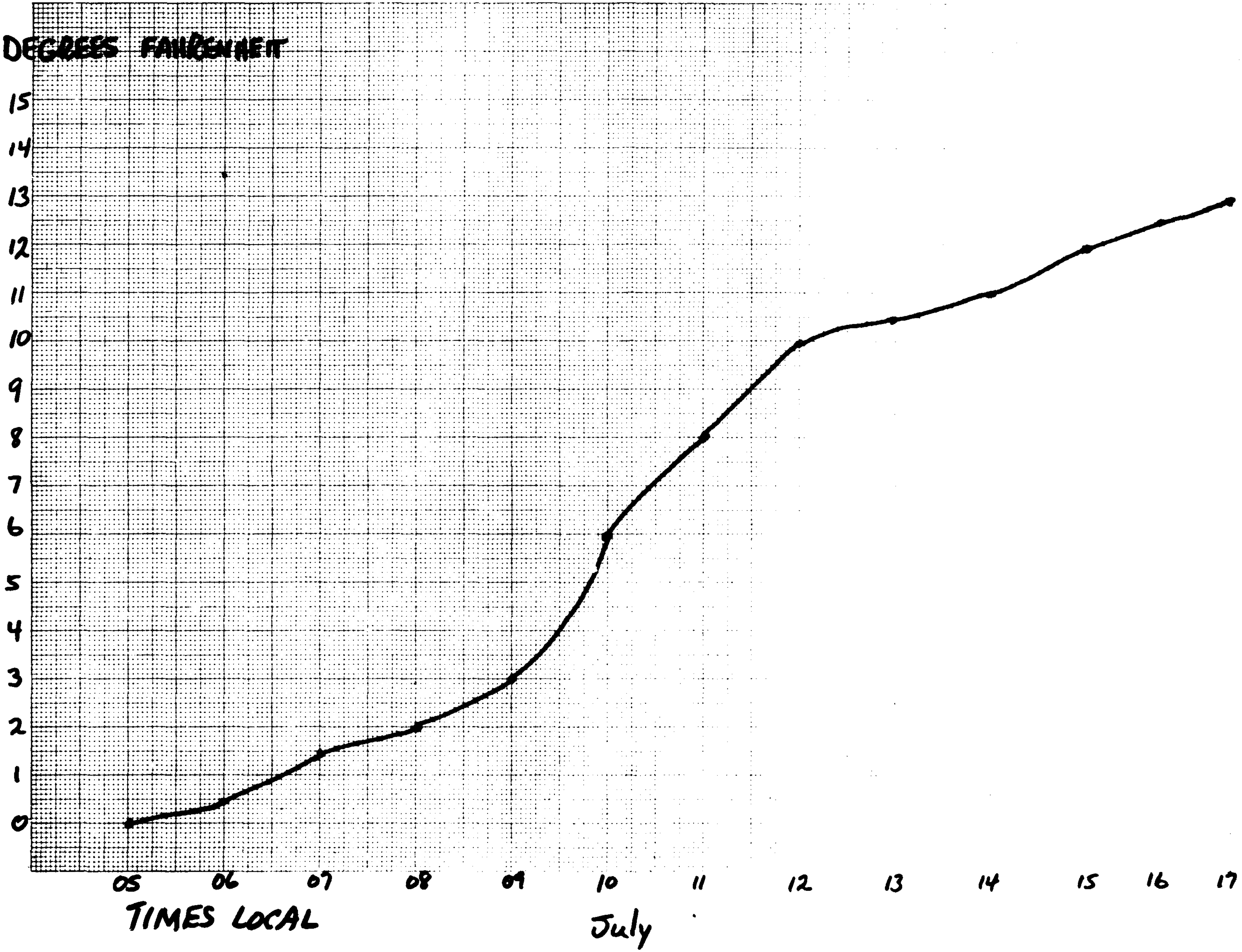
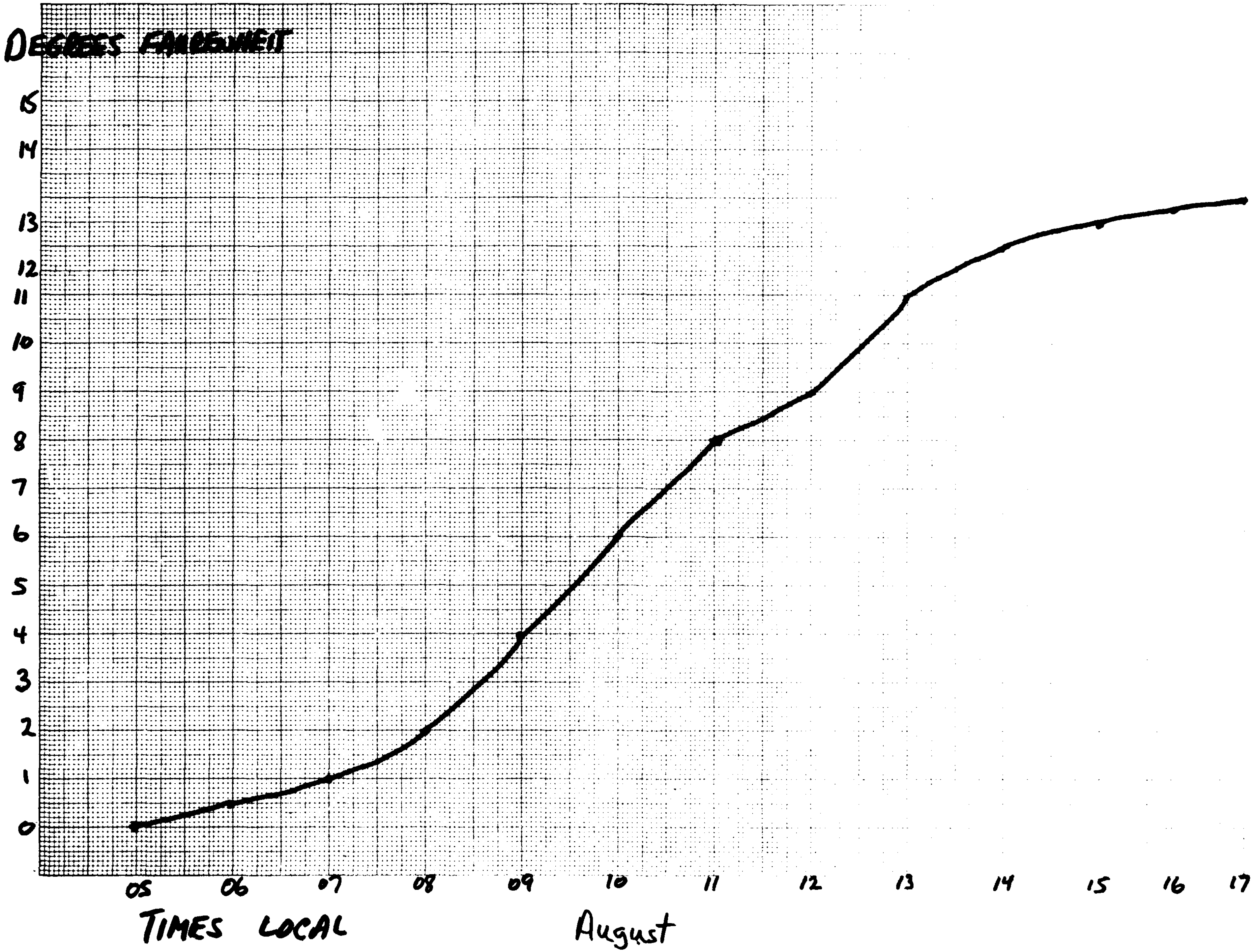
TIMES LOCAL
June

Temperature curves continued




DEGREES FAHRENHEIT
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05 06 07 08 09 10 11 12 13 14 15 16 17
TIMES LOCAL
August


DEGREES FAHRENHEIT
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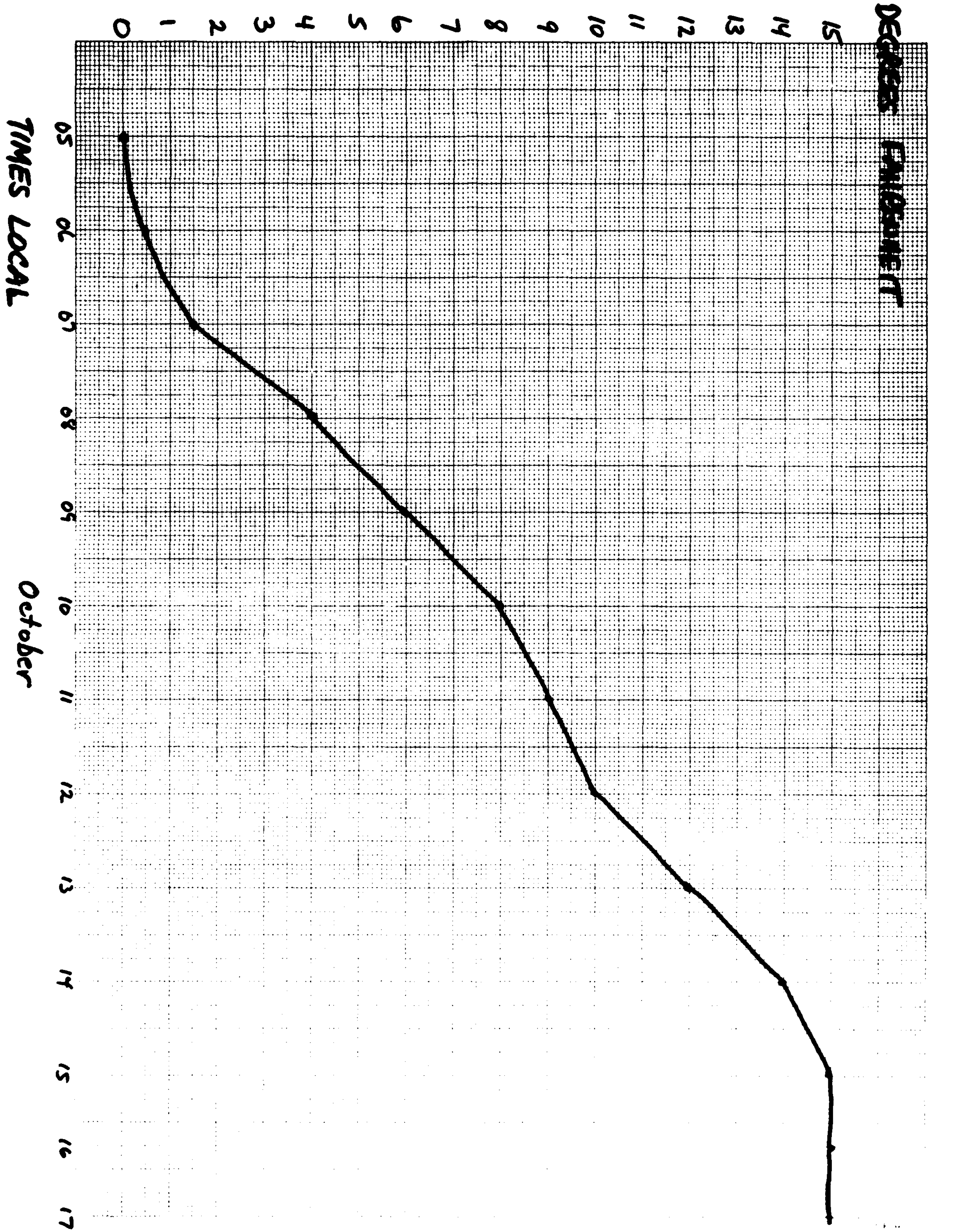
05 06 07 08 09 10 11 12 13 14 15 16 17
TIMES LOCAL
September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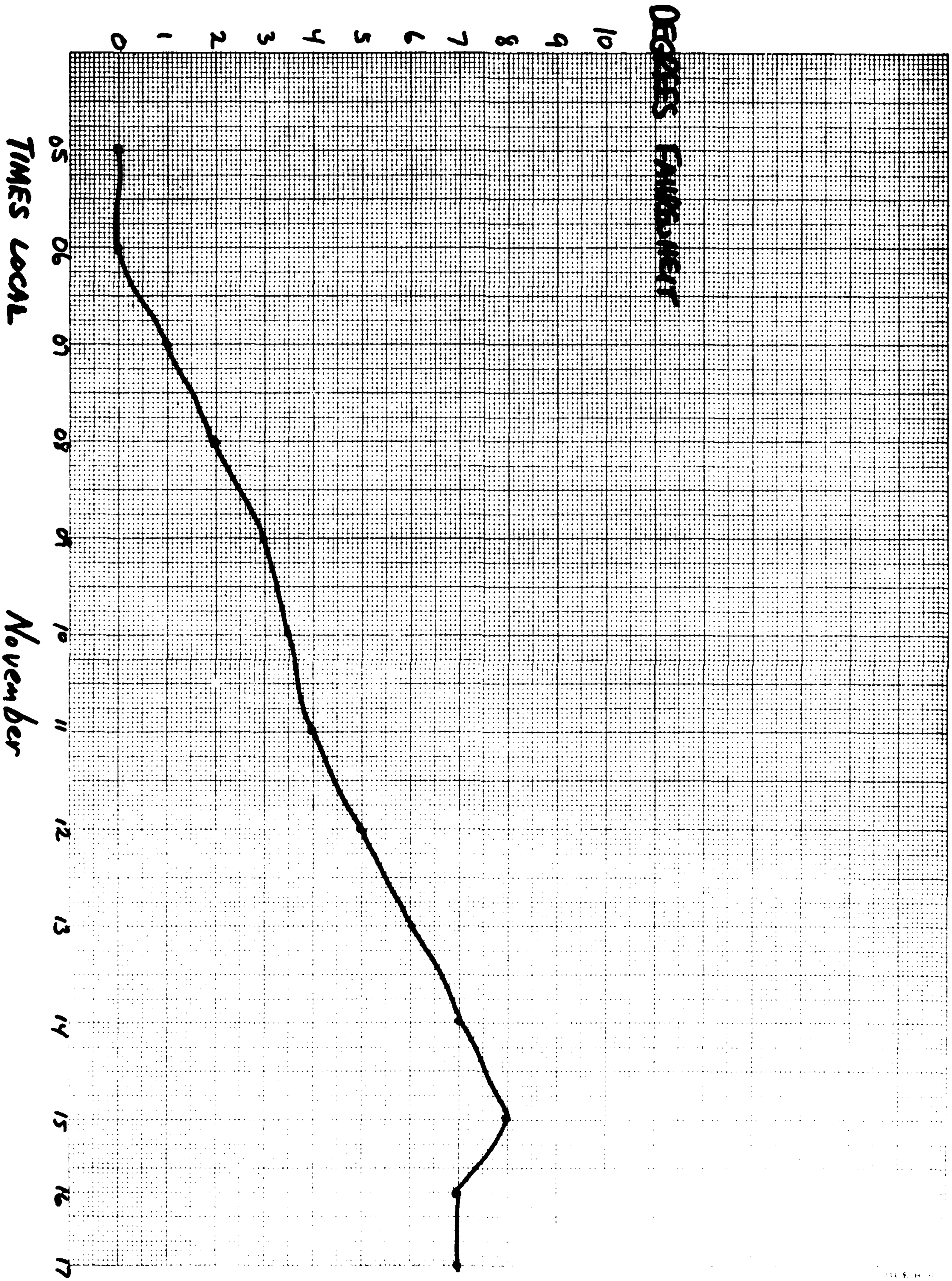
TIMES LOCAL
October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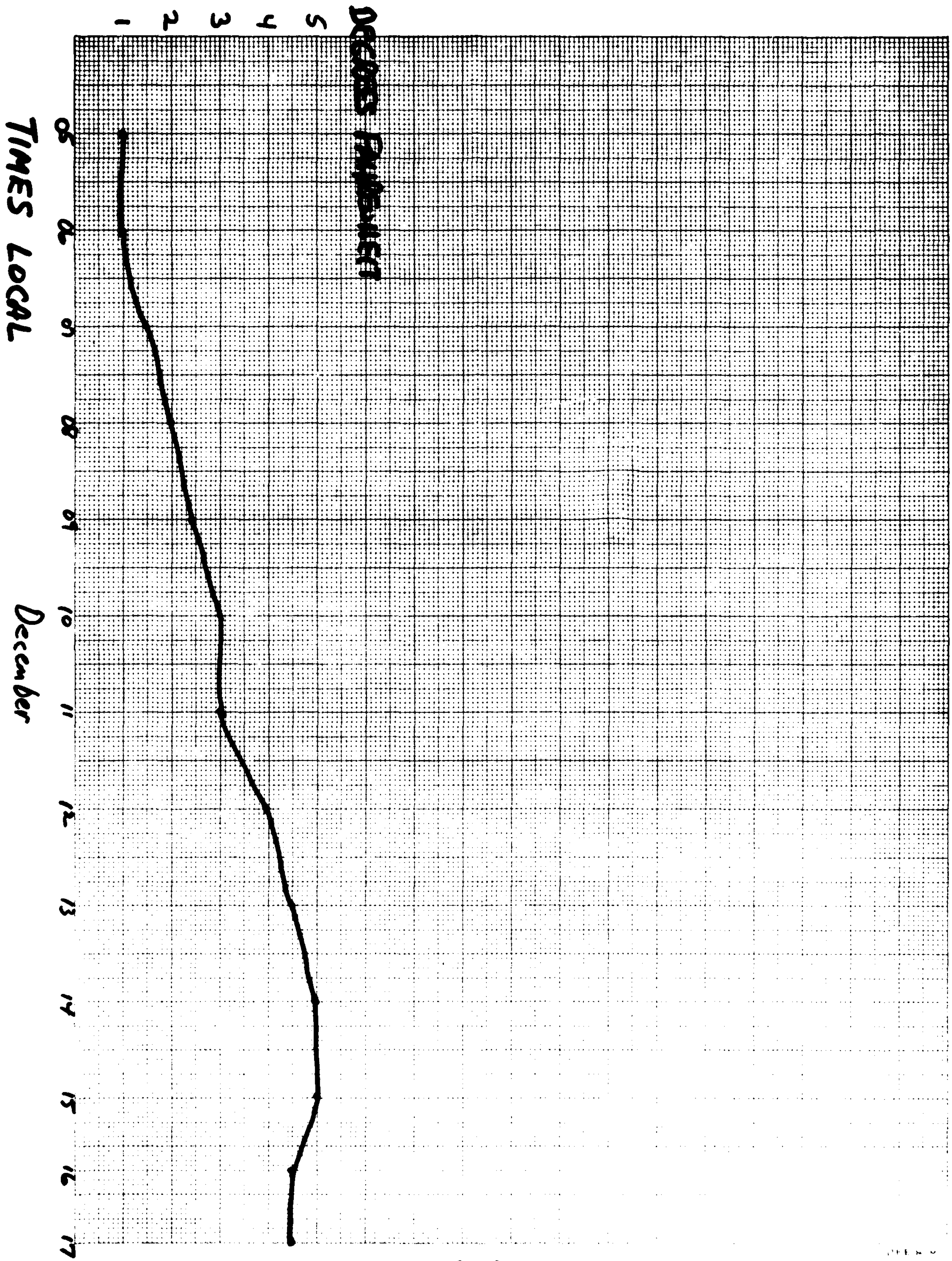
November


DEGREES FAHRENHEIT
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TIMES LOCAL
December

TERMINAL FORECAST REFERENCE NOTEBOOK (TFRN)

SECTION III

APPROVED LOCAL FORECAST STUDIES, RULES OF THUMB AND FORECASTER HINTS

THIS UNIT HAS NO APPROVED FORECAST STUDIES

THIS UNIT HAS NO APPROVED RULES OF THUMB

THIS UNIT HAS NO APPROVED FORECASTER HINTS

TERMINAL FORECAST REFERENCE NOTEBOOK (TFRN)

SECTION IV

WEATHER CONTROLS

PART I: SEASONAL DISCUSSIONS

SPRING AND SUMMER WEATHER

1. Pressure Systems: The summer circulation is characterized by the intensification and northward displacement of the Azores anticyclone together with the weakening of the Icelandic Low.

2. Air Masses: The principal European air masses are either polar or tropical, and they can have a maritime or continental source region and/or trajectory. Original characteristics obtained in the source region may be more or less transformed depending on the trajectory the air will follow. A detailed description of European air masses can be found in 2WWP 105-12, Chapter 3, Section E.

3. Fronts: During the summer, all frontal zones become somewhat indistinct because of the weaker temperature gradients and less favorable wind fields. The Atlantic polar front is located farther north than during the winter. It separates maritime tropical air masses from modified polar air massess and the mean position extends from Iceland to northern Scandinavia.

4. Temperatures: Rapid warming begins in March and continues until August. In summer, mean daily maximums are in the 70's, with overnight lows in the 50's. Hot weather occurs occasionally with easterly flow. In September, a distinct cooling trend begins.

5. Winds: The low level flow over central and southern Germany is predominantly northwesterly during the summer; however, many localized deviations are created by terrain. Due to cooling at night, drainage winds from the hills may cause local changes in the mean daytime wind direction and speed. Windspeeds generally are highest in the afternoon, in association with maximum solar heating, and lowest around sunrise. In summer, strong winds are uncommon but they can occur with thunderstorm activity.

6. Precipitation: Summertime precipitation over Europe is principally air mass type convective activity. Weak fronts or troughs and the associated lifting will often produce widespread shower activity. VFR usually cannot be maintained in summer rainshowers.

7. Thunderstorms: Summertime heating results in frequent shower activity over the interior region during May through late September. Thunderstorms, however, are generally associated with troughs or weak frontal systems. Although nonfrontal thunderstorms are uncommon, afternoon cumulus may develop rapidly over ridge lines due to orographic lifting and cause shower activity with reduced ceilings. Although German thunderstorms do not build as high as the storms over the southern U.S., they are no less severe. During the transitional springtime, although the Icelandic Low is weakening and giving way to the Azores High, major polar outbreaks are not uncommon and can produce Heidelberg's most severe thunderstorms due to large air mass temperature contrasts.

8. Fog and Haze: Poor visibility is common in all seasons in southern Germany, although during May through August, visibility is greatly improved over the winter trends. The restriction to visibility is likely to be a thin layer of morning fog or haze that "burns off" rapidly by midmorning and lifts the visibility above VFR minimums.

9. Icing: In summer, icing in the low levels is generally not a problem, because of relatively high freezing levels. Summertime icing is principally associated with convective activity and is usually above the 5000 ft level.

10. Turbulence: Turbulent conditions exist about 30% of the time for aircraft flying below 5000 ft. Terrain influences are one of the prime considerations when trying to avoid turbulence. The leeside of ridge lines normal to the wind direction will be the likely place for turbulent air when the wind speed is 25 knots or greater.

AUTUMN AND WINTER WEATHER

1. Pressure System: In winter, the Azores high pressure cell is much less intense, while the high pressure system over Asia sometimes extends as far westward as France and Spain. The Icelandic low pressure system is quite deep and extensive.

2. Air Masses: Air masses, like those during the spring and summer, continue to have polar and tropical source regions. The polar air massess are of particular importance and some characteristics are illustrated in the following examples.

a. Maritime polar is the most common air mass found over Europe. The air mass properties will depend upon the over water trajectory; however, all maritime polar invasions are characterized by their relatively warm temperatures and high relative humidities. Since the air is usually warmer than the continent, stable conditions generally prevail. Status-type clouds, light rain or drizzle, and moderate to poor visibilities with fog and haze characterize the associated weather.

b. Continental polar air invades Germany during periods of easterly flow around an intense Russian or Scandinavian high pressure cell. Since continental polar air is cold and dry, one can expect clear skies and good visibilities during the first stages. As the anticyclonic circulation becomes more intense, temperature inversions will develop, and visibilities will be reduced in the stable air due to smoke and haze. If cyclonic activity is taking place in the Mediterranean, warm maritime air may overrun the cold polar air causing heavy snowfall over Germany.

3. Fronts: During the winter, most cold fronts which invade Europe originate over the North Atlantic and have a long over water trajectory. The cold air behind cold fronts is modified by the relatively warm Atlantic Ocean to such an extent that in most cases continuity is very difficult to maintain on surface analyses. Upon reaching the relative cold European continent, the air which travels behind the cold front is usually warmer than the air over Europe. The cold front loses its charateristics and can be analysed as a trough. Poorest frontal weather conditions are associated with pre warm frontal situations. Ceilings less than 500 feet and a visibility less than 1 mile are common in such situations. Stationary cold fronts associated with a weak westerly flow may also produce low ceilings and visibilities.

4. Temperatures: During autumn and winter, differences between the mean

temperatures of the warmest and coldest month is about 20°F. A distinct cooling trend begins in September and by late October daily maximums are generally in the mid 50's with overnight lows in the mid 40's. During winter, the central core of Europe is cold while the north and western part is warm due to the warm oceans currents. The predominant westerly air flow produces relatively mild temperatures. Western Europe is occasionally affected by cold outbreaks from the large cold air mass source region to the east. During winter the daily maximum temperatures generally range from the mid 30's to the mid 40's and the minimums range from the high 20's to the mid 30's.

5. Winds: The low level flow over central and southern Germany is predominantly southwesterly in winter, however, local deviations are created by terrain. Valleys oriented within 20 degrees of the major axis of the air flow tend to channel the wind and may increase its speed to well above 35 knots. Infrequent occurrences of gale force winds are normally associated with winter time cold frontal passages. At elevations above 1500 feet, gale force winds occur on an average of two or three days a month. Diurnal variation in wind speed is less pronounced in winter at low levels. Wind speeds are generally highest in the afternoon, in association with maximum solar heating, and lowest around sunrise.

6. Precipitation: Winter precipitation is usually more widespread and persistent, but generally less intense than in summer. Precipitation, unless very light, will always lower the effective ceiling and reduce the horizontal and slant range visibility. Freezing rain, although not frequent, may occur a few times each year and has to be considered as a principal hazard to aircraft operations.

7. Thunderstorms. During the winter, thunderstorms do occur on rare occasions but are mainly confined to the months May through September.

8. Fog and Haze. Winter and autumn are the seasons having the most days with fog. During the period of October through March, frequent haze occurs on an average of 15 to 25 days per month, reducing the visibility to less than 5 miles. In winter the restriction to visibility is likely to be thick fog or dense haze coupled with extensive cloud cover. Due to the low sun angle, short days, and the heavy cloud/fog cover, little "burning off" of the fog or haze occurs during the day. It is not ususual for the poor visibility to persist over the entire area for several days during the winter season.

9. Icing: The high frequency of low cloudiness and freezing levels near the surface result in conditions favorable for icing on 15 to 20 days per winter month. About 3/4 of the icing is in the form of "rime" ice while the remainder is normally of the "mixed" variety.

10. Turbulence: The main causes of turbulence are the thermal discontinuities associated with fronts and tight pressure gradients and their interaction with the surrounding terrain. While the factors causing turbulence vary in intensity by season the overall frequency remains about the same throughout the year. Terrain influences are one of the prime considerations when trying to avoid low level turbulence.

11. Cloudiness: Due to the rugged terrain over central Europe, the amount of cloudiness and ceilings have a wide variation. The average amount of cloudiness

is 70% or greater during the entire year. The elevation of the stations and the protection from the prevailing air flow effects the distribution of cloudiness and ceilings. The windward slopes have a greater amount of cloudiness and lower ceilings than the leesides, and lower ceilings are, of course, observed at stations with higher elevations. Maximum cloudiness and lowest ceilings occur in winter. During the morning cloudiness is greater than during the afternoon in winter. Over northern Germany there is a tendency for low clouds to persist into the afternoon. Stratocumulus associated with high pressure cells are quite persistent in the Ruhr Valley and other northern German industrial areas. Low ceilings and visibilities are often observed with the approach of a secondary trough. Ceilings below 1000 feet are frequently observed under such conditions. Low clouds are also observed with slow moving cold fronts approaching northern Germany and the lowlands from a northerly direction. When these fronts stagnate over this region, low ceilings will persist for days. Very low clouds with continuous precipitation are usually associated with an outbreak of cold moist air from a northerly direction, especially in the region between Brussels and Cologne. Southern Germany has more than 15 days per month with overcast skies during the winter. The mean cloud amounts are greatest in the morning. Low clouds are predominately stratiform or thick stratocumulus. At the majority of stations in southern Germany the ceiling is below 2000 feet on more than half of the winter mornings.

PART II: GENERAL WEATHER PHENOMENA

1. The seasonal cyclone tracks and seasonal anticyclone tracks are presented in Figures 1 and 2, respectively, pertinent tracks are referred to when they relate to operationally significant forecast problems Forecast problems are categorized by month in Table 2. Discussion is topic oriented based upon forecast problems. A standard analysis package evolves from the problem discussion. Theory is not presented. Prior to going to Table 2 problems, a definition of the short wave trough is presented.

2. The Short Wave Trough: The short wave trough dominates the European weather forecasting problem. The short wave trough is defined via the following example: Consider the typical winter situation with the quasi-stationary Icelandic Low (a planetary scale feature) northwest of England. Frequently a synoptic scale low breaks out of the Icelandic Low moving along one of the cyclone tracks in Figure 1. This low is associated with a traveling, synoptic scale wave in the westerlies. This wave is not the short wave, since it can be easily tracked in upper air analysis and machine progs. However, there are short waves associated with the traveling low. These scales of motion are depicted in Figure 3. Most of the short waves will be surface features, but some waves will have increased amplitude detectable at gradient and 850MB levels as a wind shift or possibly a small-scale velocity maximum. This is a vertically deep short wave trough. To identify short waves, analyse surface isobaric patterns at 1 to 2 MB intervals and then analyze gradient and 850MB level flow lines to find which troughs are vertically deep. The short wave troughs give a spider web character to the traveling synoptic scale surface low. These short wave troughs have a wave length varying from a few to several hundred kilometers and the frequency of passage (at a point) varies anywhere from 90 minutes to 9 to 12 hours. The shorter the wave, the more rapidly it travels and the less the impact upon the weather. For example, the 90 minute waves may merely increase cloudiness and produce drizzle/rain while 9 to 12 hour waves may bring significant showers (Total-Totals values must be considered). On the 90 minute end of the scale, every 3rd or 4th wave may be detectable at the gradient level, while at the 9 to 12 hour end, they are all likely to be detectable at gradient level. The waves detectable at gradient and 850MB levels are important to identify and prog because the associated weather response is much more significant than that with the intervening shallow surface waves. This point will be stressed repeatedly as problem areas listed in Table 2 are systematically addressed.

3. The Siberian High: The Siberian High expands westward into Europe several times during the average winter. The associated cold front usually pushes through Germany to become stationary in central France. This nearly always occurs in conjunction with off shore blocking (Omega High) at 500MB and a deep cold core low at 500MB over Russia. The situation persists until the block breaks down (usually 7 to 10 days). Surface isotherms pack at the frontal boundary, but the leading edge of the front (area of Germany) is too shallow to analyze at 850MB. You can find the frontal inversion on a SKEW-T (usually between 500 to 1,200 feet AGL). The front comes into the central West Germany as a persistent cold easterly wind (8-12 knots). The 2nd day after frontal passage, daytime heating produces persistent stratus under the frontal inversion. In Bavaria, the front wedges up the mountains giving upslope fog/stratus below the frontal inversion and clear skies above. (See Figure 4). When the long wave pattern begins to shift, the Siberian High will recede eastward as a warm front. There will normally not be freezing precip associated with this withdrawal.

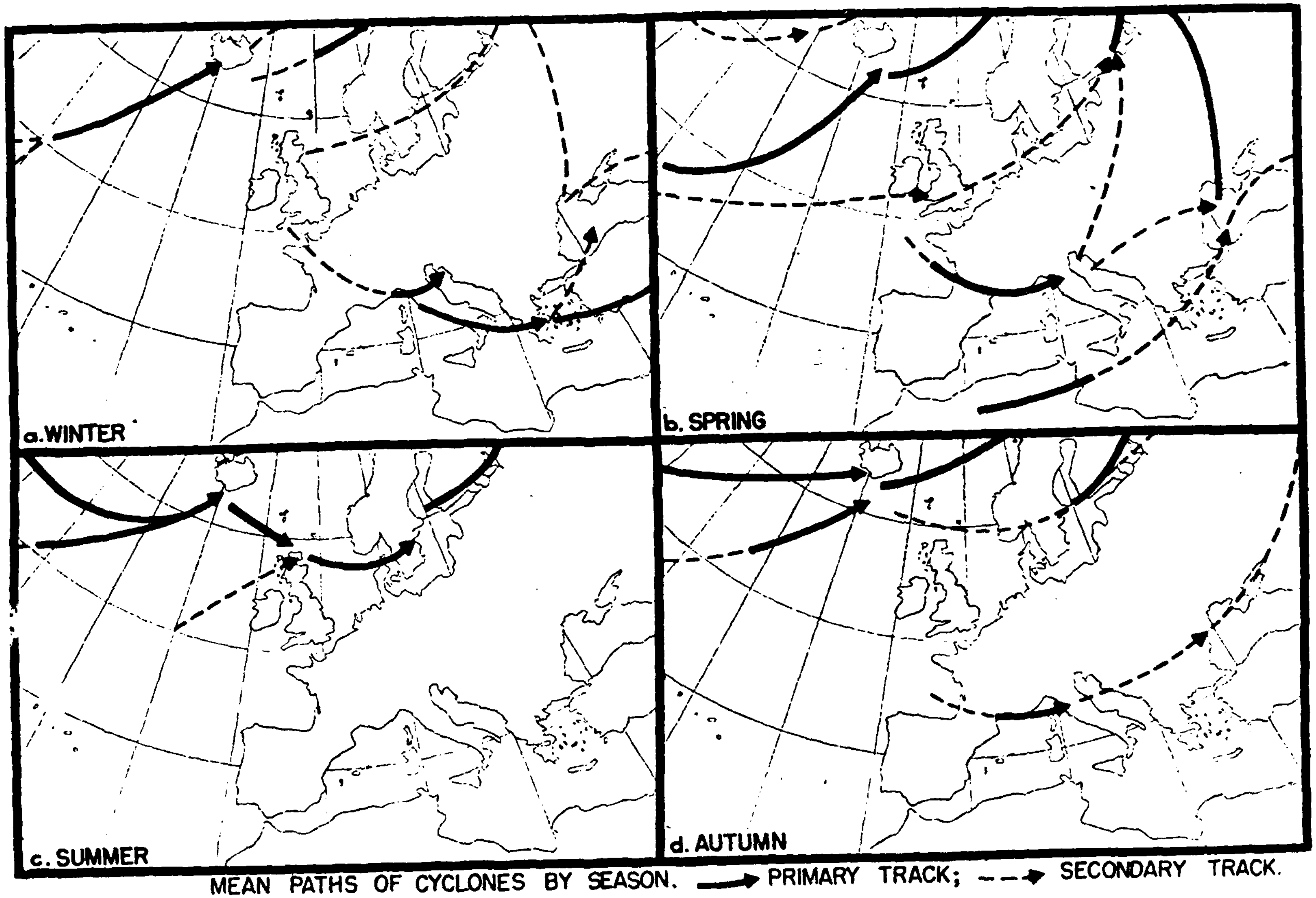
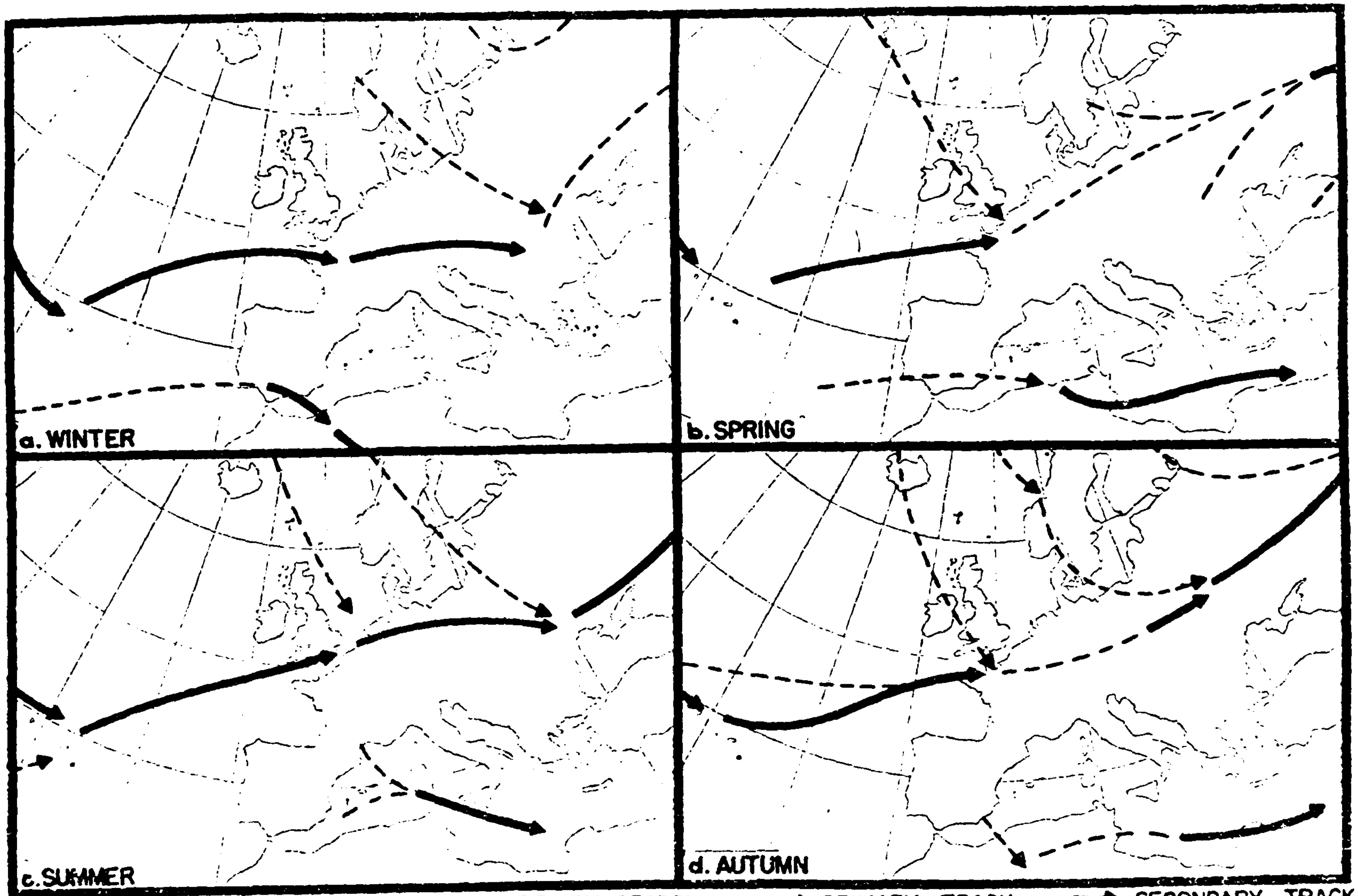

a. WINTER
b. SPRING
c. SUMMER
d. AUTUMN
MEAN PATHS OF CYCLONES BY SEASON. ⟶ PRIMARY TRACK; - - -▶ SECONDARY TRACK.

FIGURE 1



MEAN PATHS OF ANTICYCLONES BY SEASON. ⟶ PRIMARY TRACK; - - → SECONDARY TRACK.

FIGURE 2

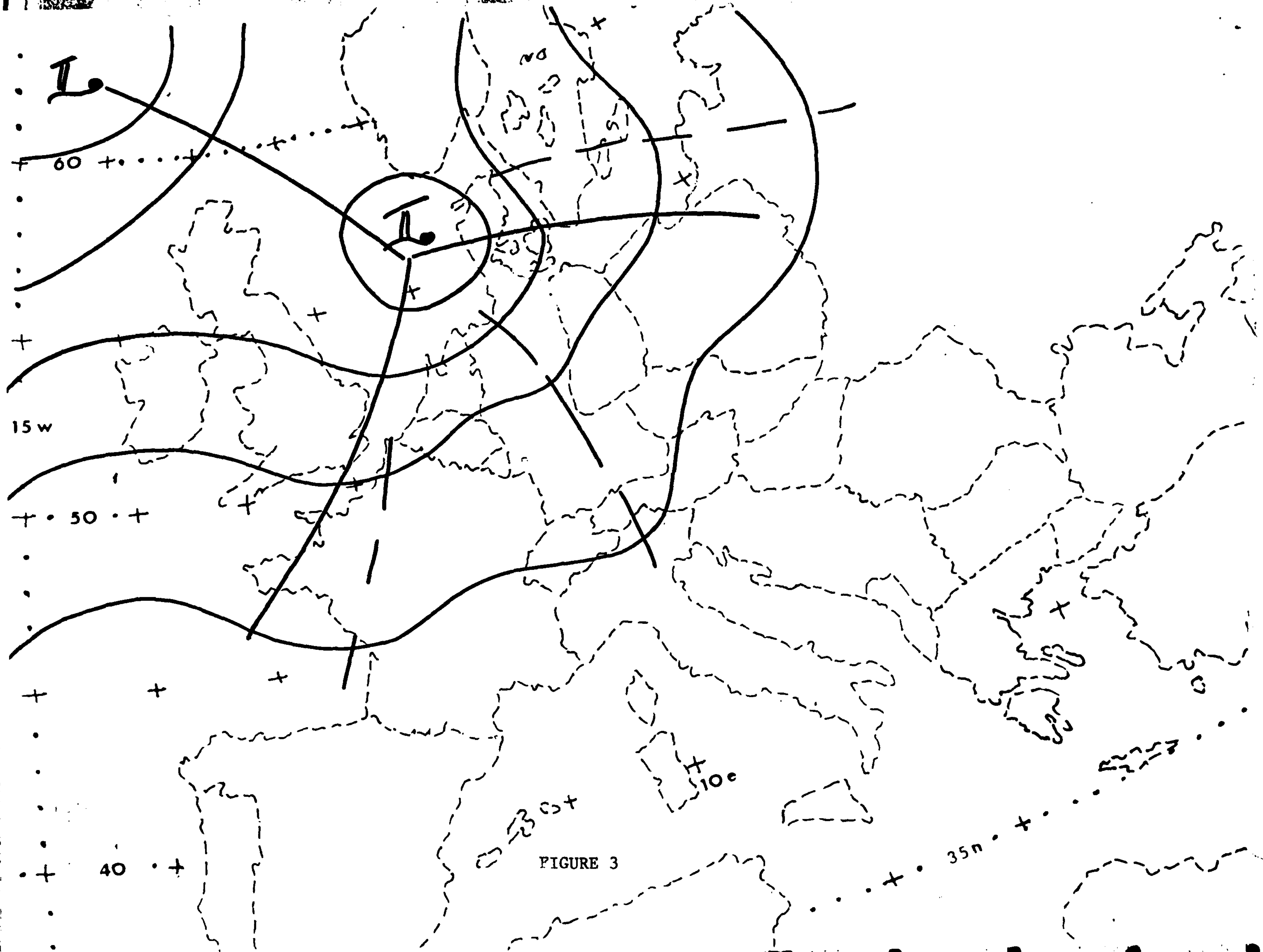
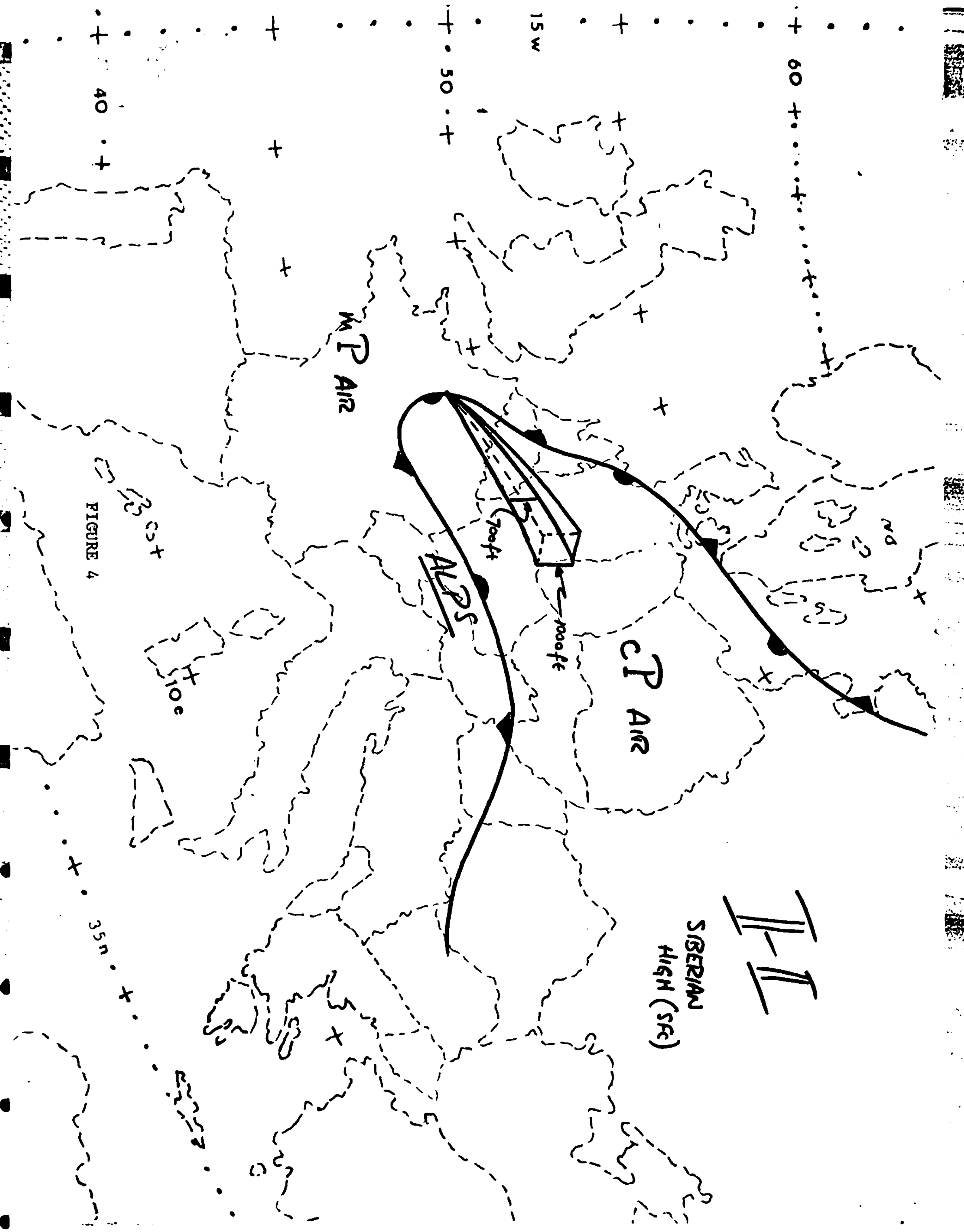


FIGURE 3



mP AIR
cP AIR
ALPS
700ft
1000ft
II-II
SIBERIAN HIGH (SFC)
60
50
40
15w
10e
35n

FIGURE 4

4. Persistent Stratus: Persistent stratus occurs with four synoptic situations. The stratus forms and breaks with passage of short wave troughs. The four situations are:

a. The Siberian High, discussed above.

b. In advance of a warm front (the stratus breaks are "sucker holes").

c. Upslope Conditions: Stratus breaks occur when the wind direction changes with short wave trough passage. Following trough passage, stratus reforms if synoptic scale gradient level winds return to upslope direction.

d. Post Cold Front Stratus (NW flow): Gradient level winds above 20 knots produce 3,000 to 4,000 foot ceilings overnight (often going scattered in late morning), and gradient winds below 20 knots produce 2,000 to 2,500 foot ceilings. Conditions are lower if a short wave trough passes. The dynamic mechanism is a combination of solar and turbulent mixing.

5. Fog (Radiation Versus Upslope): A general problem in central Germany is determination of the fog formation mechanism, radiation versus upslope. Upslope fog/stratus requires a surface inversion several hundred feet deep, moist air within this layer, and the proper wind direction. Use GMGO Upslope and Lee Effects Maps to infer proper wind direction, Upslope fog/stratus will not break with heating. Consider the following classic example in Figure 5. This model affects the Finthen AAF Terminal, but is of interest to all units which clear aircraft. A stationary trough sets up over the English Channel (through 500MB). This produces persistent SW flow. Given a stable air mass and ample moisture at low levels (a result of SW flow), you have potential upslope conditions (use a SKEW-T to evaluate stability, moisture content of the air, and depth of the surface inversion). The fog is in the ridge east of the channel trough. There is no front in the trough even though air mass characteristics vary substantially over a broad zone. The first fog day is frequently radiation fog. Radiation fog will break at 0900 to 1100L, but often visibility will not go above four to five miles. Temperatures are above 0°C (often four to five °C). Use SKEW-T (depth of moisture, etc. IAW AWS/TR-79/006) to forecast the breakout time. Winds at gradient level must be 10 knots or below for radiation fog onset, e.g., a short wave may come through and break the fog out of cycle. When the moisture reaches amount/depth needed for upslope fog (a surface inversion with air near saturation through 500 feet or more), the fog will not break following sunrise. It won't break until the wind direction or air mass changes. A typical upslope pattern is, Day 1: Ceiling 500/1 all day; Day 2: Ceiling 200/1/2 all day and moist column deepens; Day 3: Cooler temperatures with drizzle and continued 200/1/2 stratus/fog. Considering forecast specification categories (AWSR 105-27), upslope conditions are often above 200/1/2 but below 1000/1 before sunrise, but fall below 200/1/2 after sunrise, and then return to the below 1000/1 interval after sunset. Now consider the short wave trough as defined earlier. As a short wave moves through, wind direction and speed change and stability lessens. Fog reverts to radiation mechanism and the area normally breaks wide open. Trough timing is critical. When the trough arrives, the fog breaks. After the short wave passes, the synoptic scale flow reverts to the upslope pattern. Without an air mass change upslope fog will recur. Superficially, the day-to-day sequence of events appears to be a series of chaotic unforecastable variations wherein one-day fog/stratus conditions

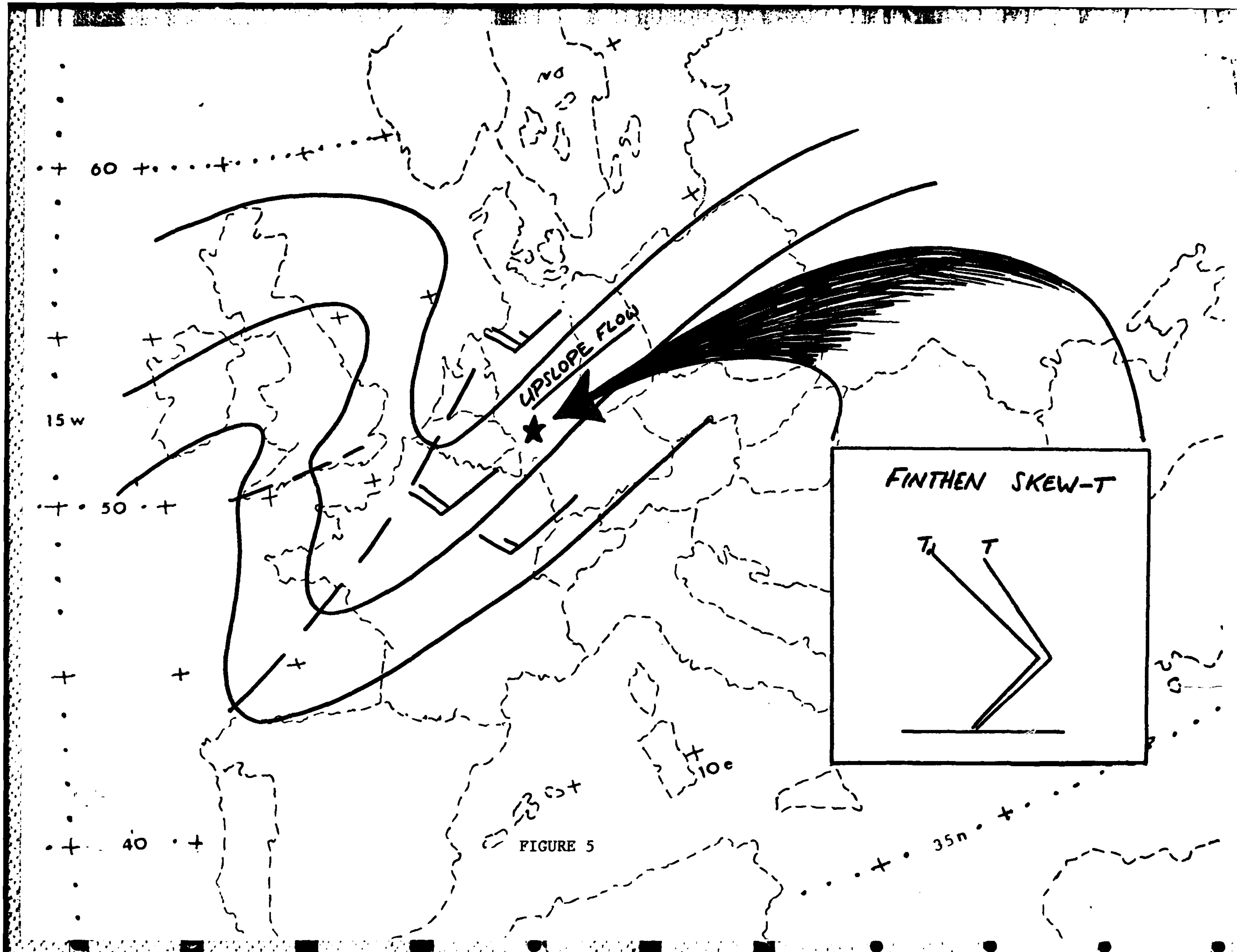


FIGURE 5

break after sunrise and the next day they worsen after sunrise. However the sequences can be forecast. To do this, analyze/prog the short waves, and determine during each hour of the forecast whether the driving force is upslope or radiation. Note that the ends of the upslope season are not clear-cut; it depends on the synoptic pattern. See Table 2.

6. Freezing Precipitation: The primary seasons are late fall and early spring, but given the right synoptic situation, freezing precipitation can occur throughout the winter. Mixed precipitation (rain/snow/etc) tends to be associated with the retreat of the Siberian High. This precipitation is mixed or snow, dependent upon temperatures within the advancing air mass. Freezing precipitation usually comes ahead of the warm front associated with a cyclone on the southern track. The surface must be frozen (preferably for several days). Otherwise, the heat capacity of the soil will prevent freezing precipitation. There are two variations: widespread and spotty freezing precipitation.

a. Widespread Freezing Precipitation: If the 0°C isotherm at 850MB is trailing (behind) the warm front, snow will occur ahead of the warm front (or rain dependent on position of 0°C isotherm at the surface), and freezing precipitation will not occur (See Figure 6). Figure 7 is the model for freezing precipitation. The key is the position of the 850MB 0°C isotherm in relation to the warm front. As the warm front passes, freezing precipitation will continue if the surface air is close to or below freezing in the warm sector. The ice may be covered by snow as the cold front passes. Alternately, heavy rain in the warm sector will usually melt existing ice. When predicting freezing precipitation, start time is the arrival of the 0°C 850MB isotherm and stop time is the arrival of the warm front (except as noted above).

b. Spotty Freezing Precipitation: (See Figure 8). Here the 0°C isotherm only goes north of the warm front in the cold pockets associated with the mesoscale lows. There are two components of motion to predict. The short wave (meso-low) component (toward the northwest) and the warm frontal component. The vector resultant is usually toward the northeast. The areas of freezing precipitation are small. They may track continuously or they may jump in response to orographic and other effects. In this situation, you can make good area forecasts, but point forecasting is very difficult.

7. Air Mass Thunderstorms: The key ingredients are warm air advection, a deep layer of low-level moisture, and solar heating. These factors produce the instability. A typical pattern is a stationary, modifying air mass. After a few days, a few thunderstorms occur in late afternoon. The next day thunderstorms are widespread. The overturning resulting from the thunderstorms stabilizes the air mass, and the following day there are fewer storms again. The cycle repeats until the air mass changes. On any given day, analyze the TT and prog the maxima. Use Table 3 to make the forecast. Anywhere in the day to day sequence discussed above, the arrival of a short wave trough will trigger locally numerous thunderstorms day or night. Concurrent arrival of a vertically deep short wave trough (detectable at gradient or 850MB) and a TT maximum will occasionally trigger severe weather. However, the TT max and the short wave must be independently progged as they move at different rates, and the short wave will tend to outrun the instability maximum. Thunderstorms, of course, are always related to orography based on the extra lift from flow over a ridge or suppressive lee effects.

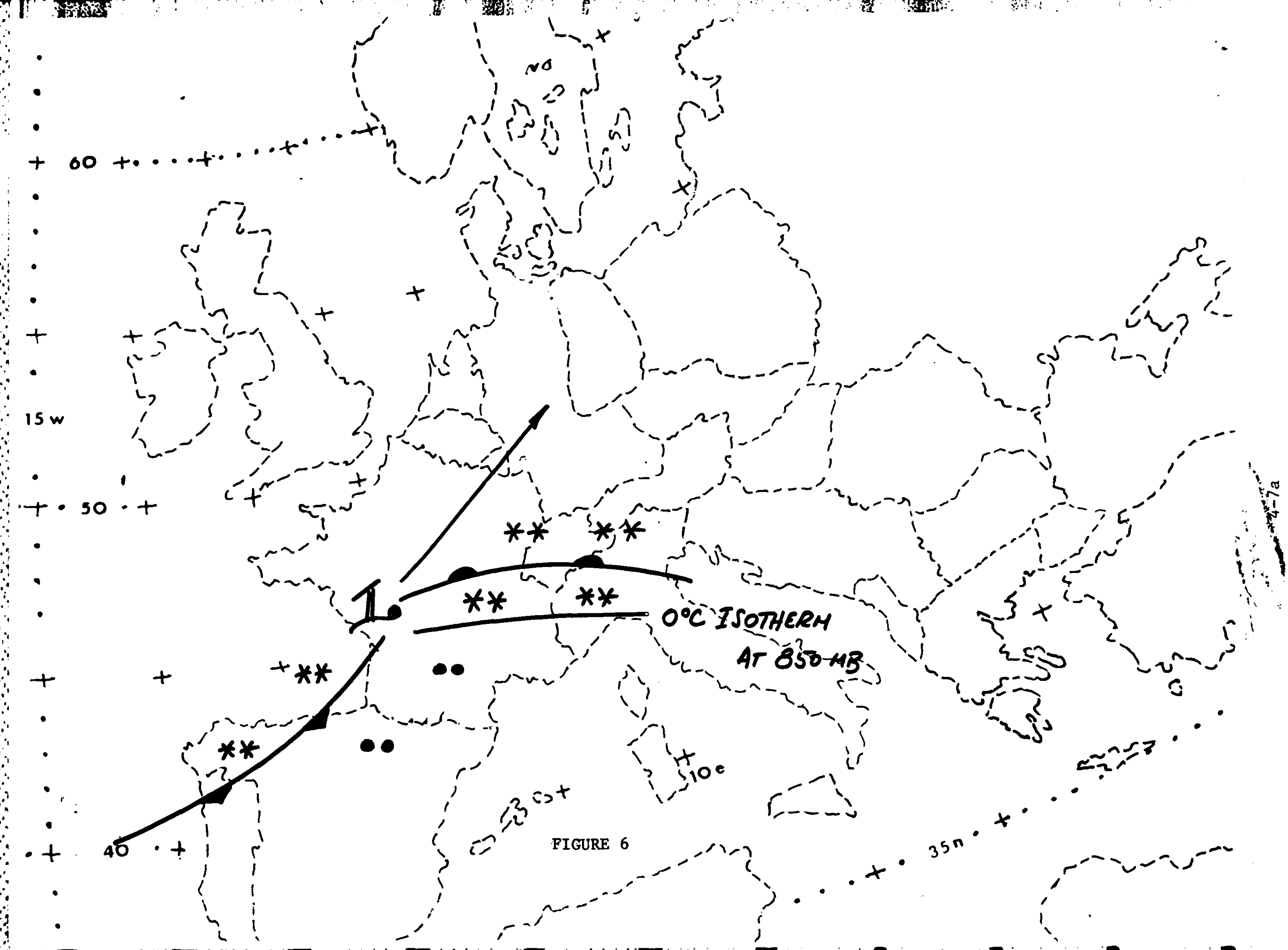


FIGURE 6

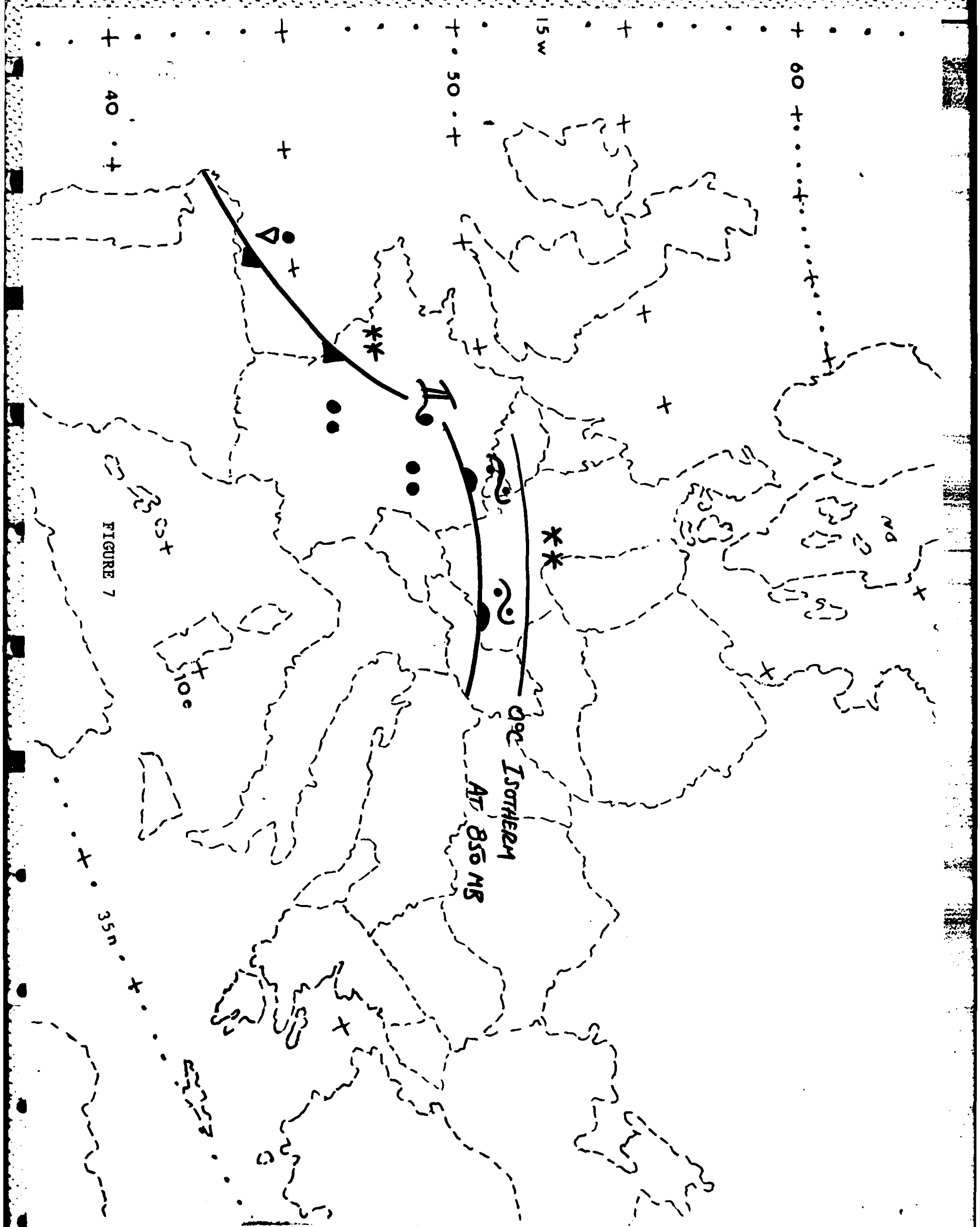


FIGURE 7

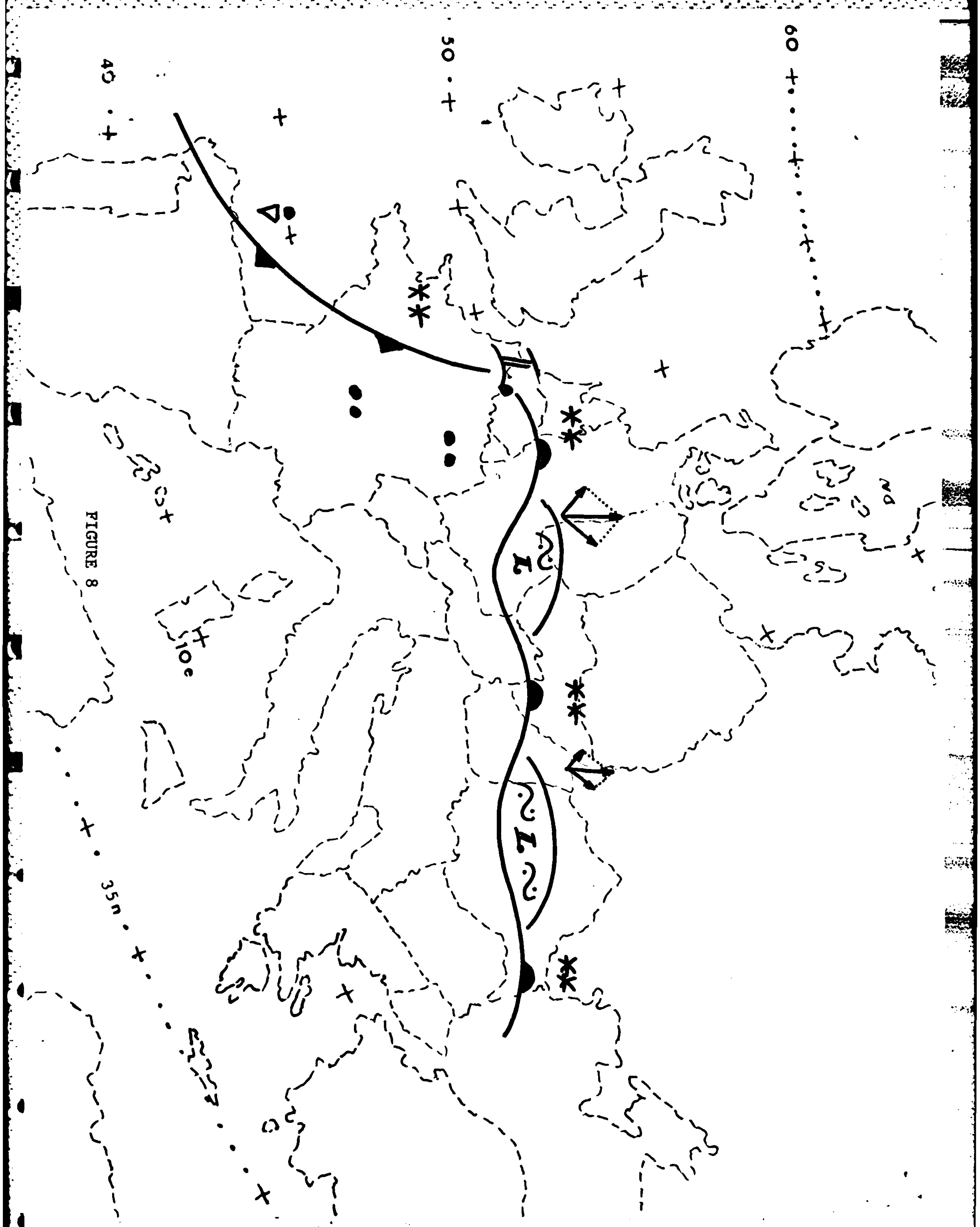


FIGURE 8

8. Thundershowers, Rainshowers, and Snowshowers: There are two models, the short wave trough and the closed (synoptic-scale) low.

a. Short Wave Trough: The short-wave problem is identical to that discussed with air mass thunderstorms. The only difference is the spotty showers, associated with air mass instability alone, are not present. Showers (rain or snow, dependent upon temperature) will be generated by the trough and move with it. Shower intensity depends on the TT values arriving at the time the trough arrives. The vertically deep trough will produce heavy showers (wintertime thunder/snow showers are even possible if TT are high enough). See Figure 9.

b. Closed Low: The closed surface low may or may not be associated with a frontal system. See Figures 10 and 11. The low usually follows the northern track. Analyze the 850MB isotherms to determine whether or not there are fronts. and for frontal placement. When analyzing occlusions, sometimes the 700MB level is better than the 850MB level (the occlusion may be above 850MB). It is nearly impossible to identify a European front from surface data alone. Trough associated cloudiness can mask solar heating to give the appearance of a front when none exists. When fronts are not present, showers will be less widespread and will closely correlate to the passage of short wave troughs. Frontal lows will also be overtaken by short wave troughs, but the trough will merely intensify the showers on a background of rain. Use isallobaric analysis to predict the track and rate of movement of the low, extrapolate observed frontal movements, and pay special attention to the vertically deep short wave trough. Overlay a progged TT analysis on the progged pressure system analysis to determine event intensity.

9. Continuous Rain or Snow: These events are associated with the closed low (with and without fronts) just discussed. Continuous precipitation is a background condition related to the synoptic scale vertical motion pattern which the heavy showers come with passage of short wave troughs. Heavy snow is always associated with a warm or occluded warm front in winter. The retreat of the Siberian High will produce heavy snow in the southern and eastern areas of West Germany as it moves out as a warm front.

10. Trough Associated Winds: There are two models, those accompanying frontal systems and those not associated with frontal systems.

a. The frontal model is seen in Figure 12. This is the winter windstorm model. Once more you prog the low with isallabaric analysis and extrapolate the fronts. The key is to recognize that the strong winds are not associated with frontal pressure gradients, but with a vertically deep short wave trough passing through the system. The wind max will outrun the low and be dissipated in the ridge ahead of the low. Do an isotach analysis at gradient level and use extrapolation tools.

b. The channel trough discussed with upslope conditions is the fall and spring windstorm model. See the sequence in Figure 13. Note that there are no fronts and the wind does not change direction (at any one point) as the max moves through the major trough (the wind max is a compression wave). In the fall you tend to have more stable air (low TT) and showers are less likely to accompany the windstorm. The spring season can go either way but often when a TT max is associated, thunderstorms develop in the compression wave. The keys are: Identify the wave while it is still on the back side of the major trough, and

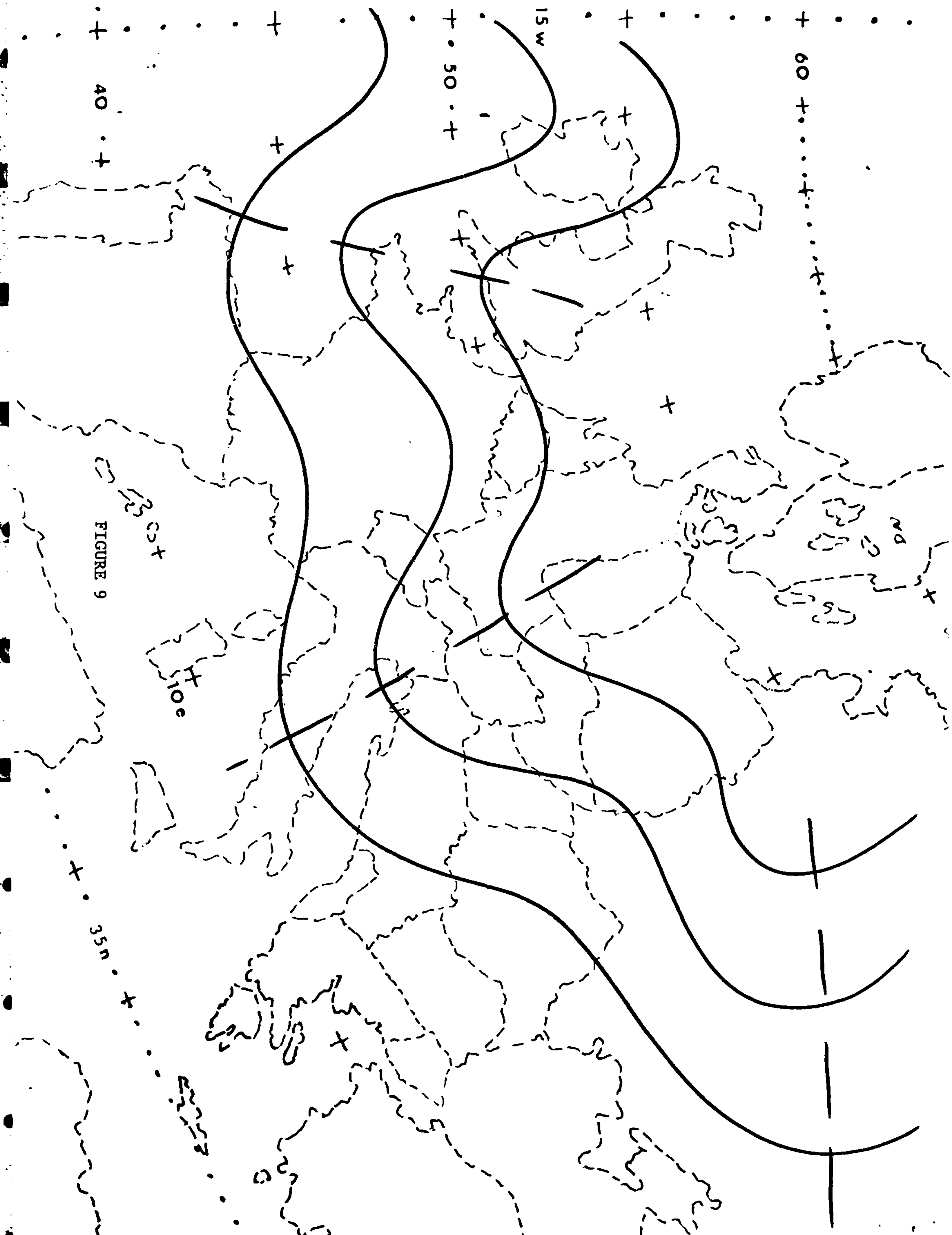


FIGURE 9

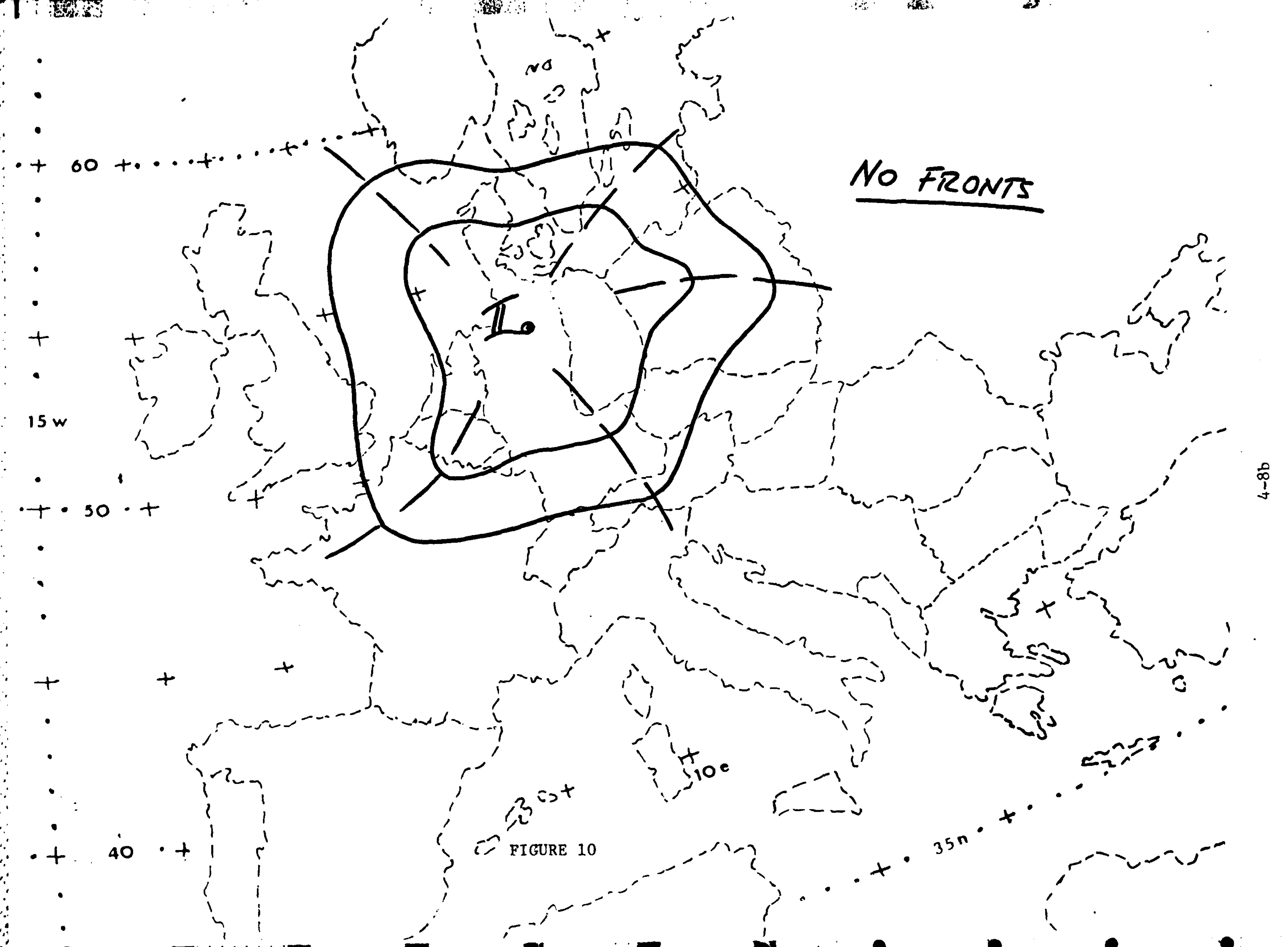


FIGURE 10

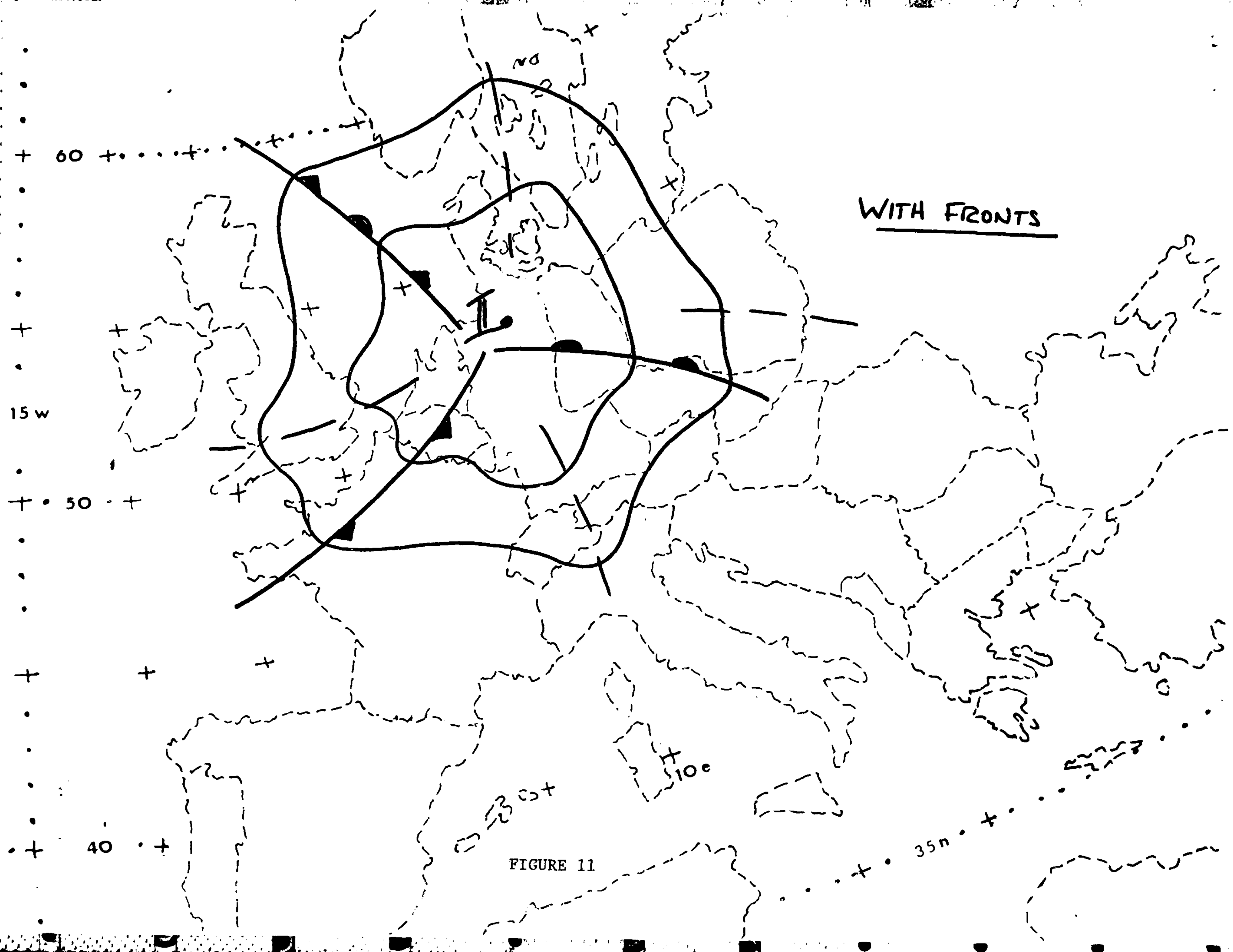


FIGURE 11

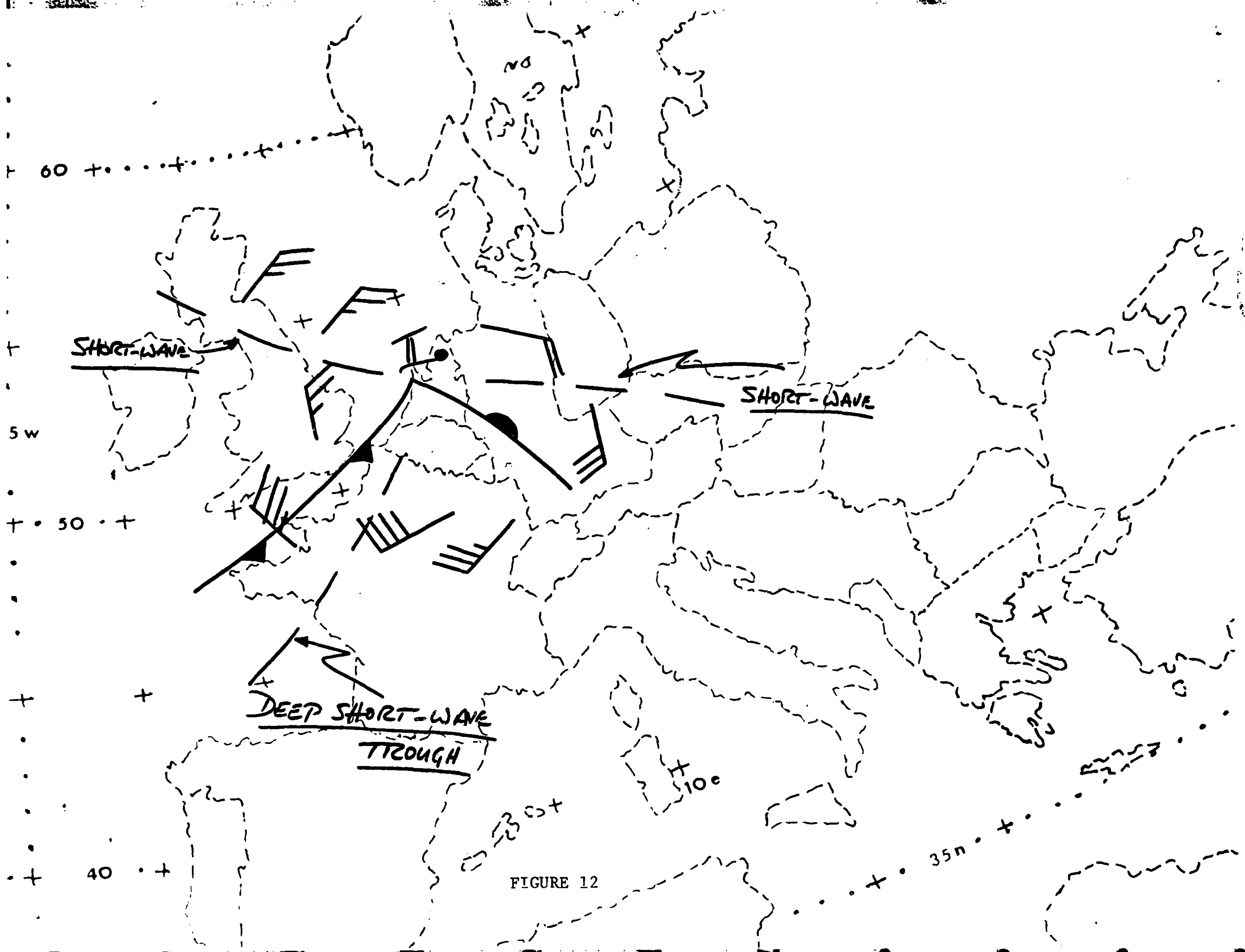

60
5 w
50
40
35n
10e
no
SHORT-WAVE
SHORT-WAVE
DEEP SHORT-WAVE
TROUGH

FIGURE 12

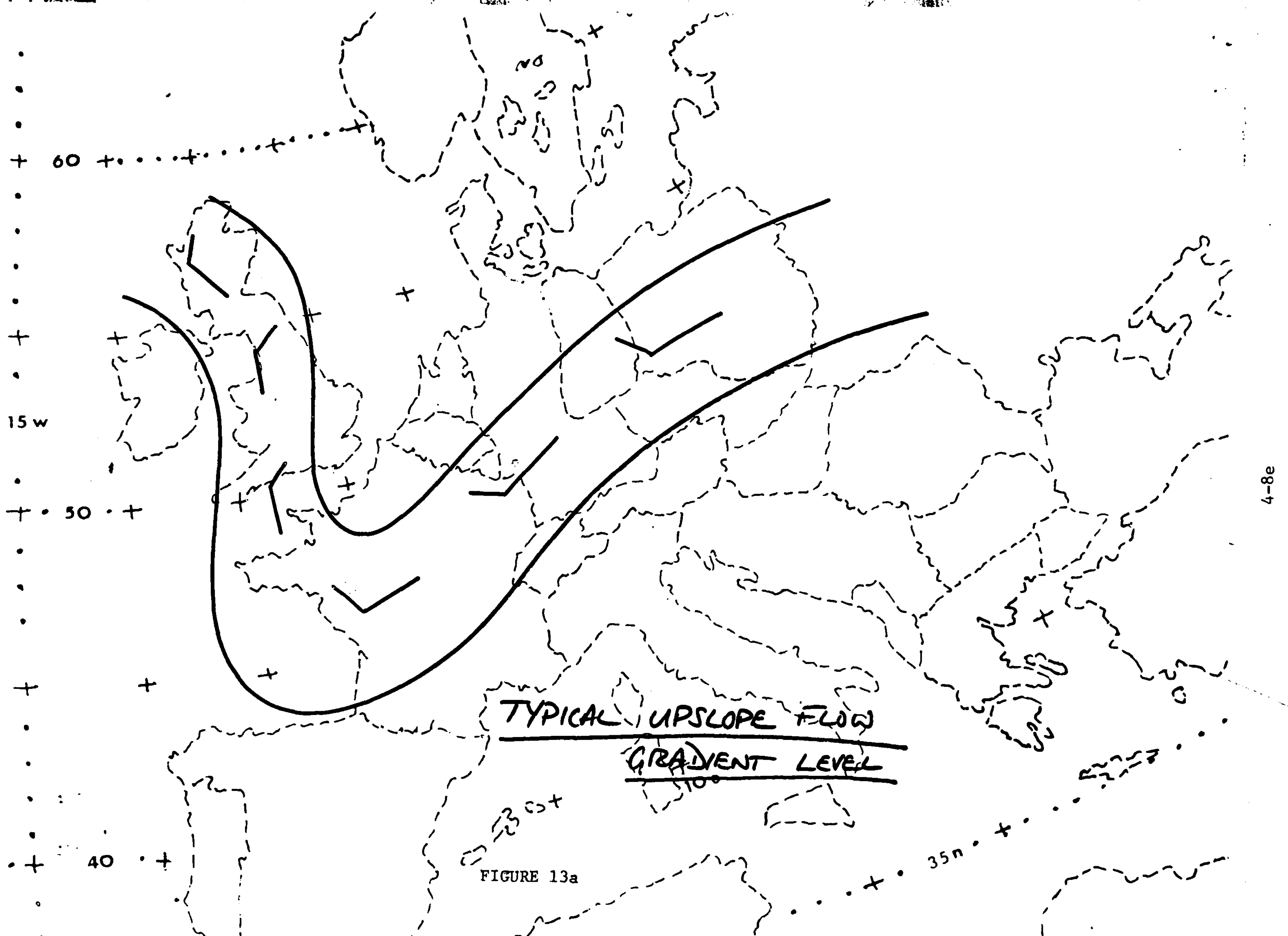


FIGURE 13a

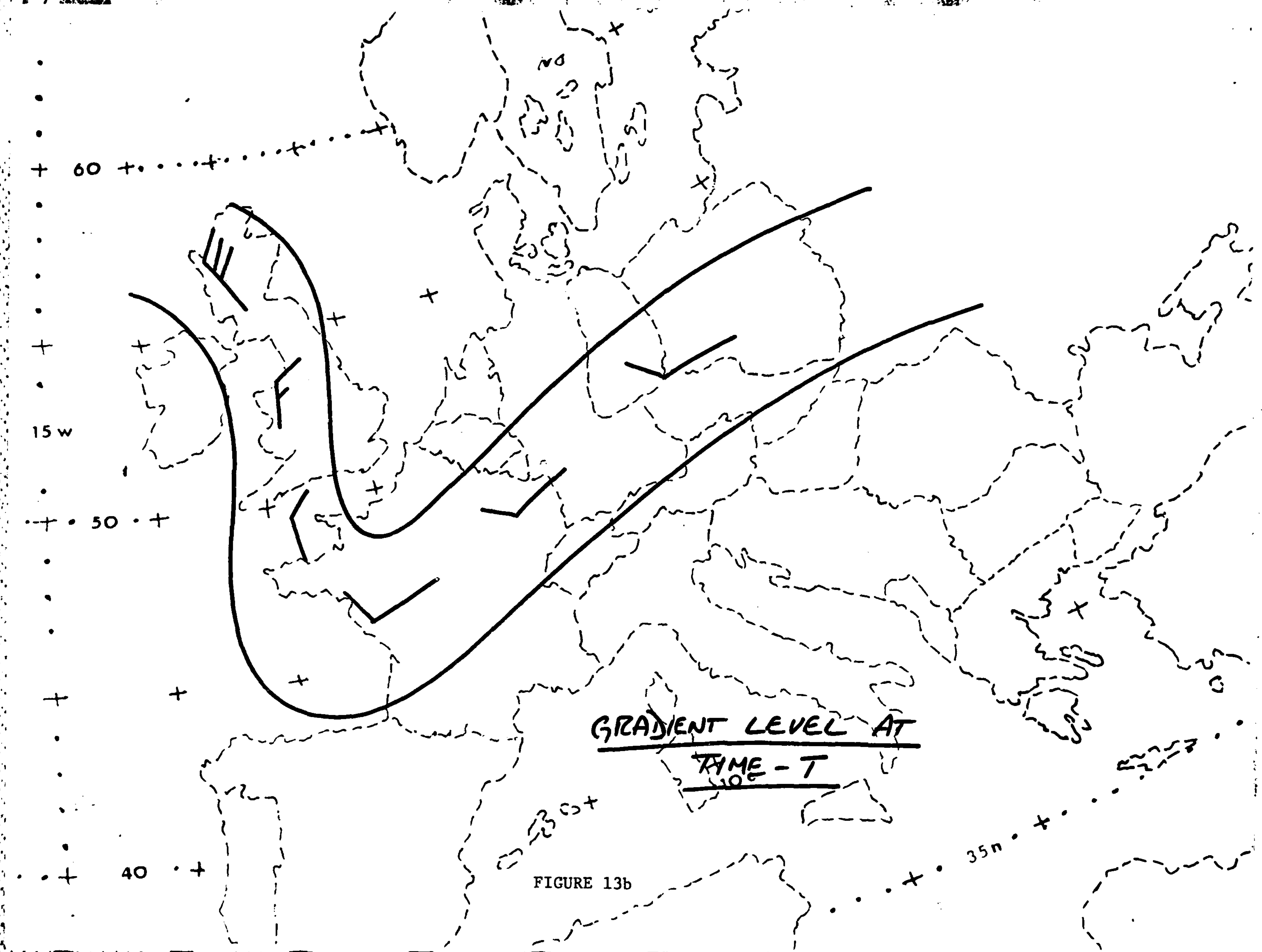


FIGURE 13b

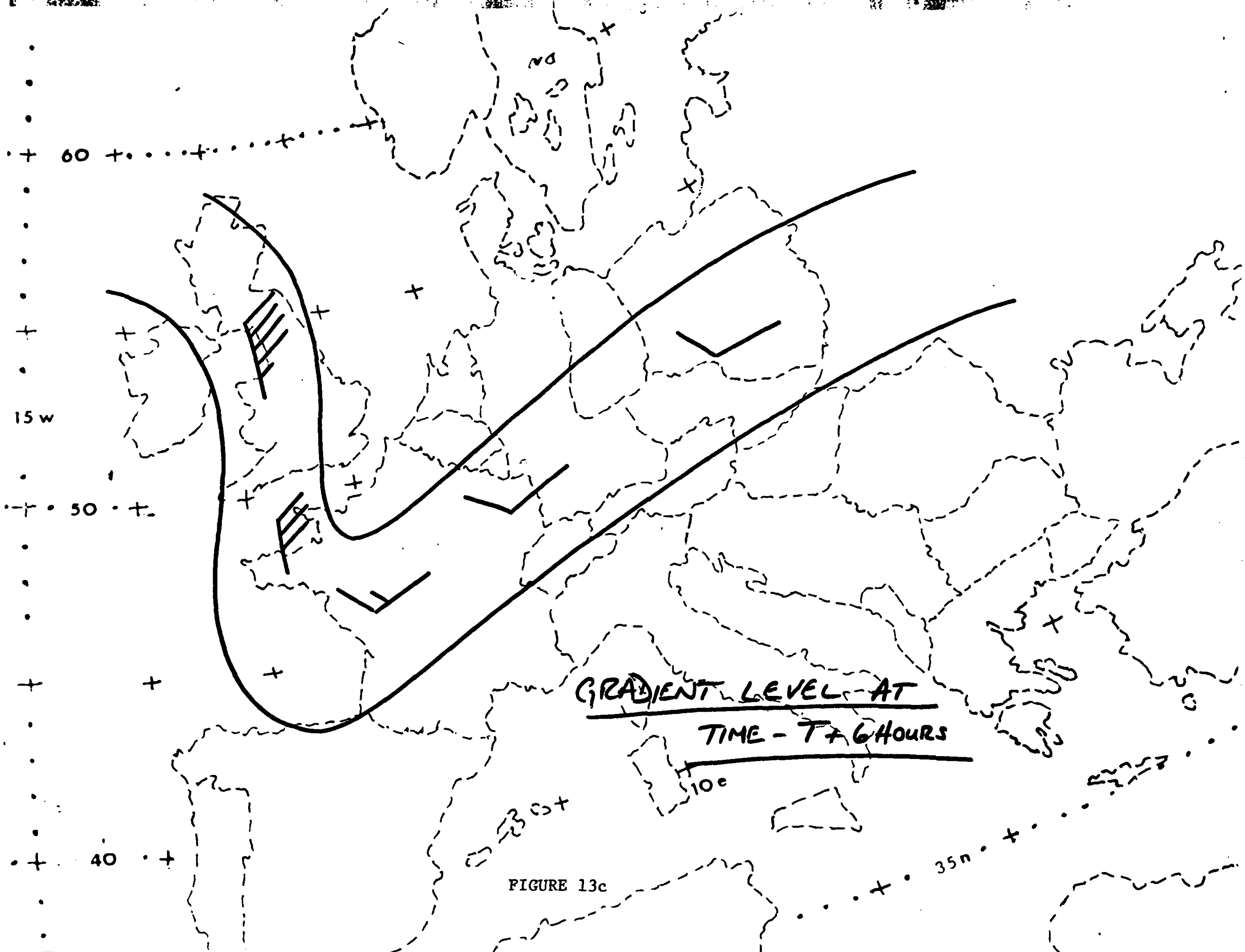


FIGURE 13c

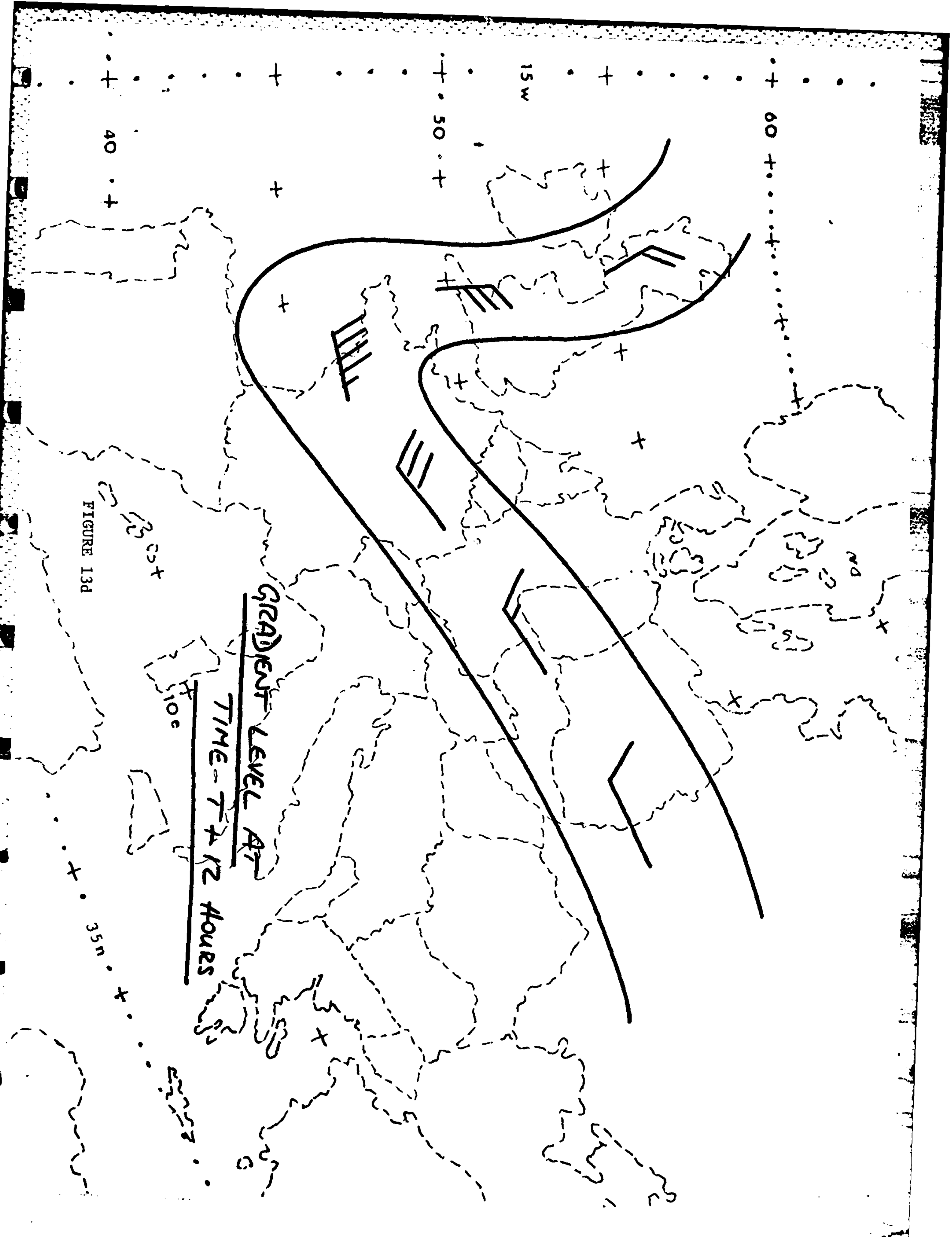


FIGURE 13d

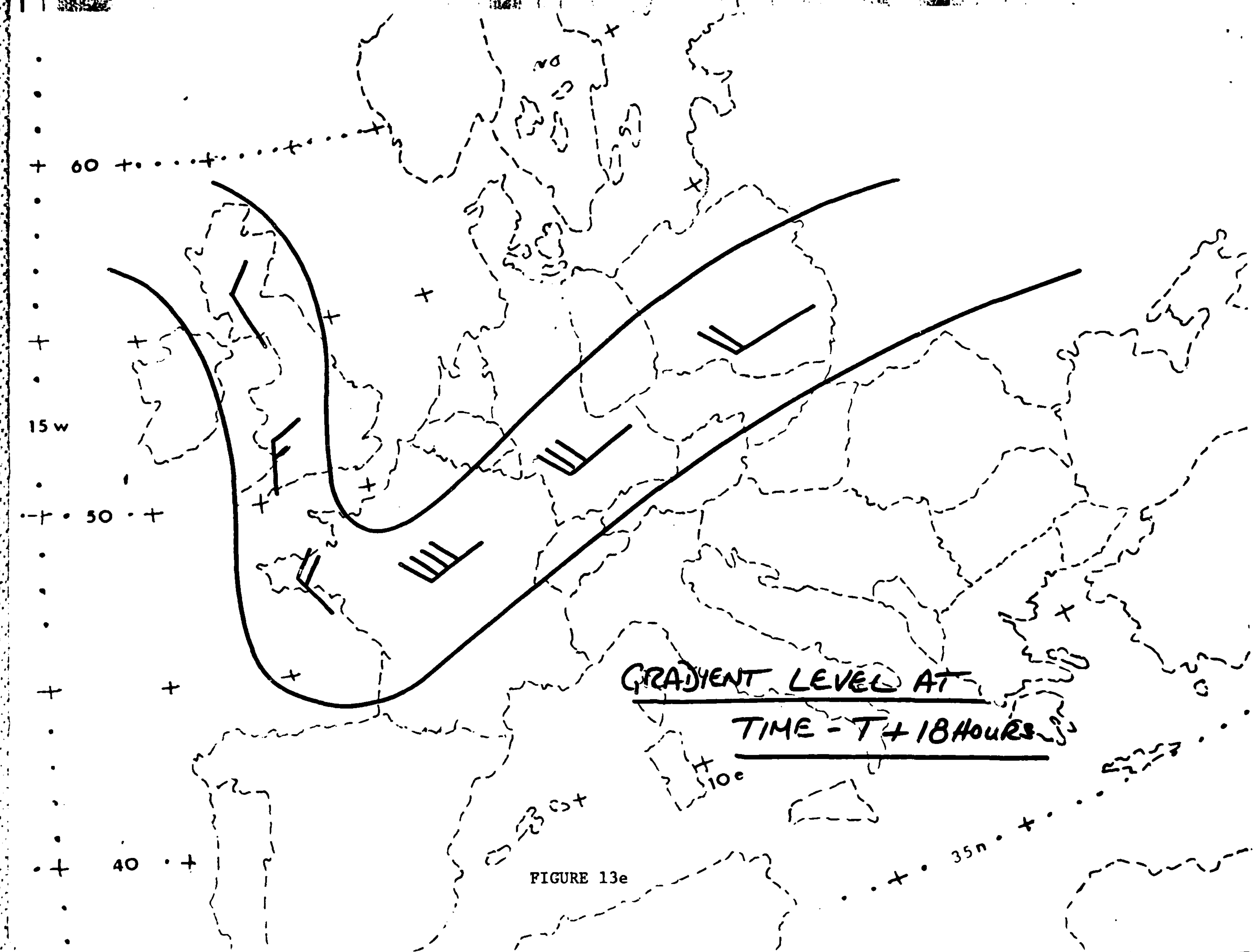


FIGURE 13e

prog the wind isotach maximum using extrapolation.

11. Summary: From the foregoing, it is evident that local analysis is the key. It takes study, practice, and frequent forecast reviews/re-analysis to become a skilled European forecaster, but this is achievable in three to six months. The emphasis must be on:

a. Surface analysis (one to two MB analysis in key quadrants to identify short waves and analysis of closed isallobars).

b. Gradient level analysis (identify short waves, windstorm indicators, and upslope fog conditions).

c. 850MB to 700MB isothermal analysis (locate fronts and identify deep short waves).

d. Analysis and progging of the Total-Totals fields.

12. An important issue is whether or not a trough has a front (a boundary between two air masses) associated with it. Unfortunately, centralized products do not provide reliable guidance on frontal type or presence. Furthermore, centralized progs do not retain small scale synoptic features like the short wave trough and the compression wave wind maximum. Read the analysis models in the ECI 2570 course frequently, and view caramate follow-on-training products regularly. Finally, when long range forecasts are needed, the Baur Type catalog can be a useful source. Whenever a classic Baur pattern is observed, the situation will persist at least as long as the longer indicated time mode. The shorter time models are apparently the result of classifying mixed Baur Types (rather than discarding them).

PRIMARY FORECASTING PROBLEMS BY MONTH

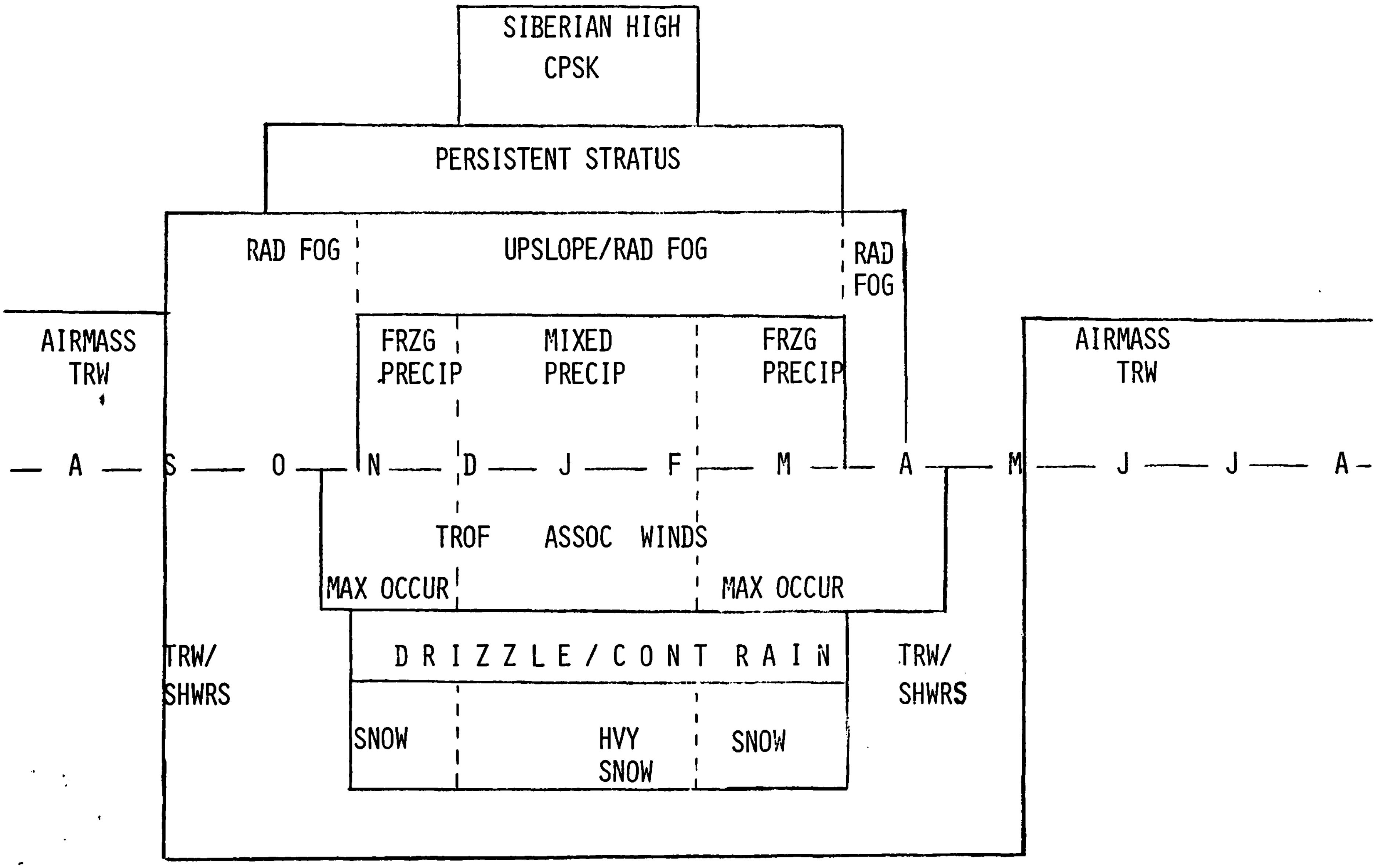


TABLE 2

TOTAL-TOTALS INDEX VALUES GUIDE FOR FORECASTING THUNDERSTORMS

IN CENTRAL GERMANY

(MAY NEED ADJUSTING FOR SPECIFIC LOCATIONS IN GERMANY)

FORECAST	VT	CT	TT
ISOLATED	26	20 - 23	46 - 49
FEW	$\geq$ 28	20 - 24	50 - 52
SCATTERED	$\geq$ 28	22 - 26	53 - 55
NUMEROUS	$\geq$ 28	$\geq$ 26	$\geq$ 55

TABLE 3

4 -

DT