AD-A124 984 TERMINAL FORECAST REFERENCE NOTEBOOK FOR RHEIN MAIN AB 1/2
GERMANY(U) WEATHER SQUADRON (31ST) APO NEW YORK 09057
DETACHMENT 25 15 OCT 82

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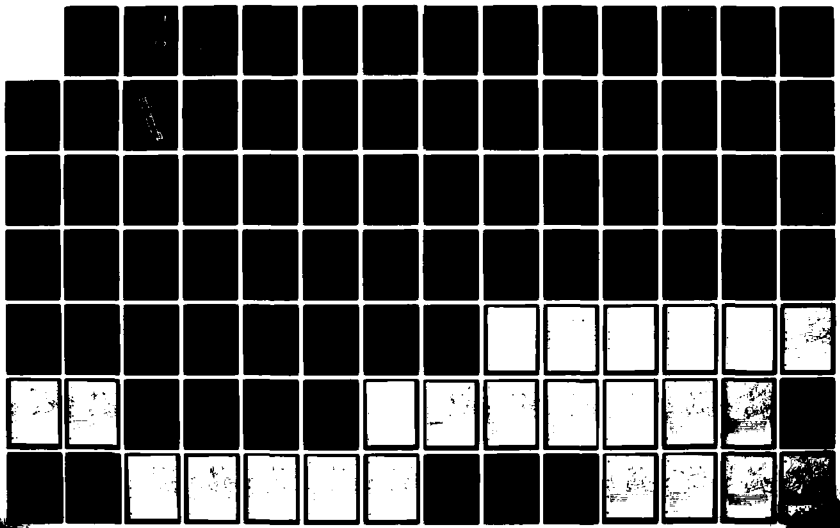

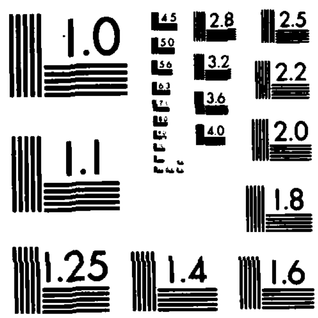

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Terminal Forecast Reference Notebook for Rhein Main AB, Germany

Final, 15 Oct. '82

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TERMINAL FORECAST REFERENCE NOTEBOOK

FOR

RHEIN MAIN AB, FRG

APPROVED FOR PUBLIC RELEASE;
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PUBLISHED BY
DETACHMENT 25
31ST WEATHER SQUADRON
2ND WEATHER WING (MAC)
UNITED STATES AIR FORCE
15 OCTOBER 1982

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Terminal Forecast Reference Notebook

for

Rhein-Main AB, Germany

September 1981

Edited by SSgt Edgar E. Vachino
Detachment 25, 31 Weather Squadron

TERMINAL FORECAST REFERENCE NOTEBOOK

RHEIN-MAIN AB, GERMANY

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Prepared on 28 Aug 81

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STATION LOCATOR CHART

LOCAL WEATHER AND EQUIPMENT

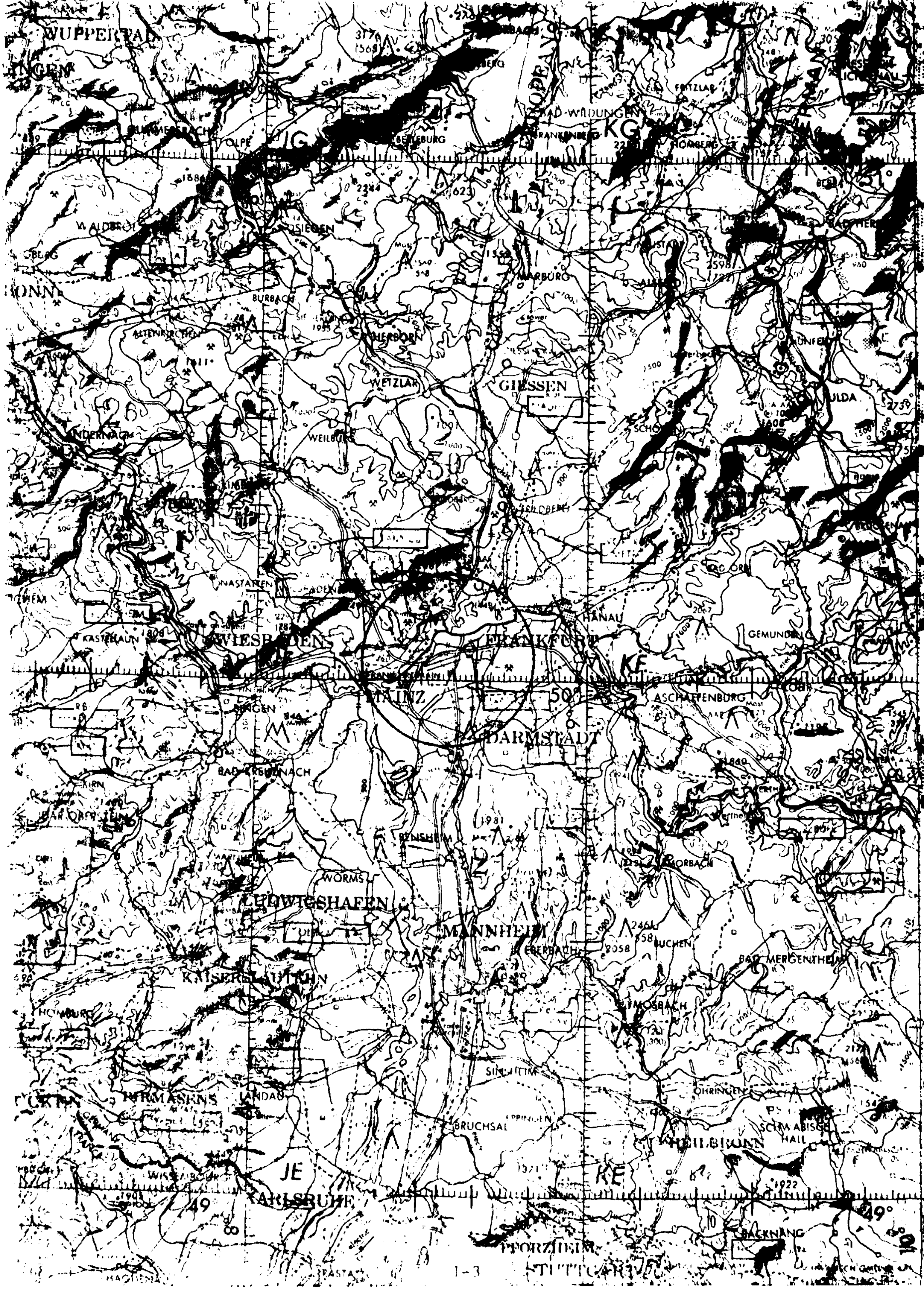
RHEIN MAIN LOCATION AND TERRAIN SUMMARY

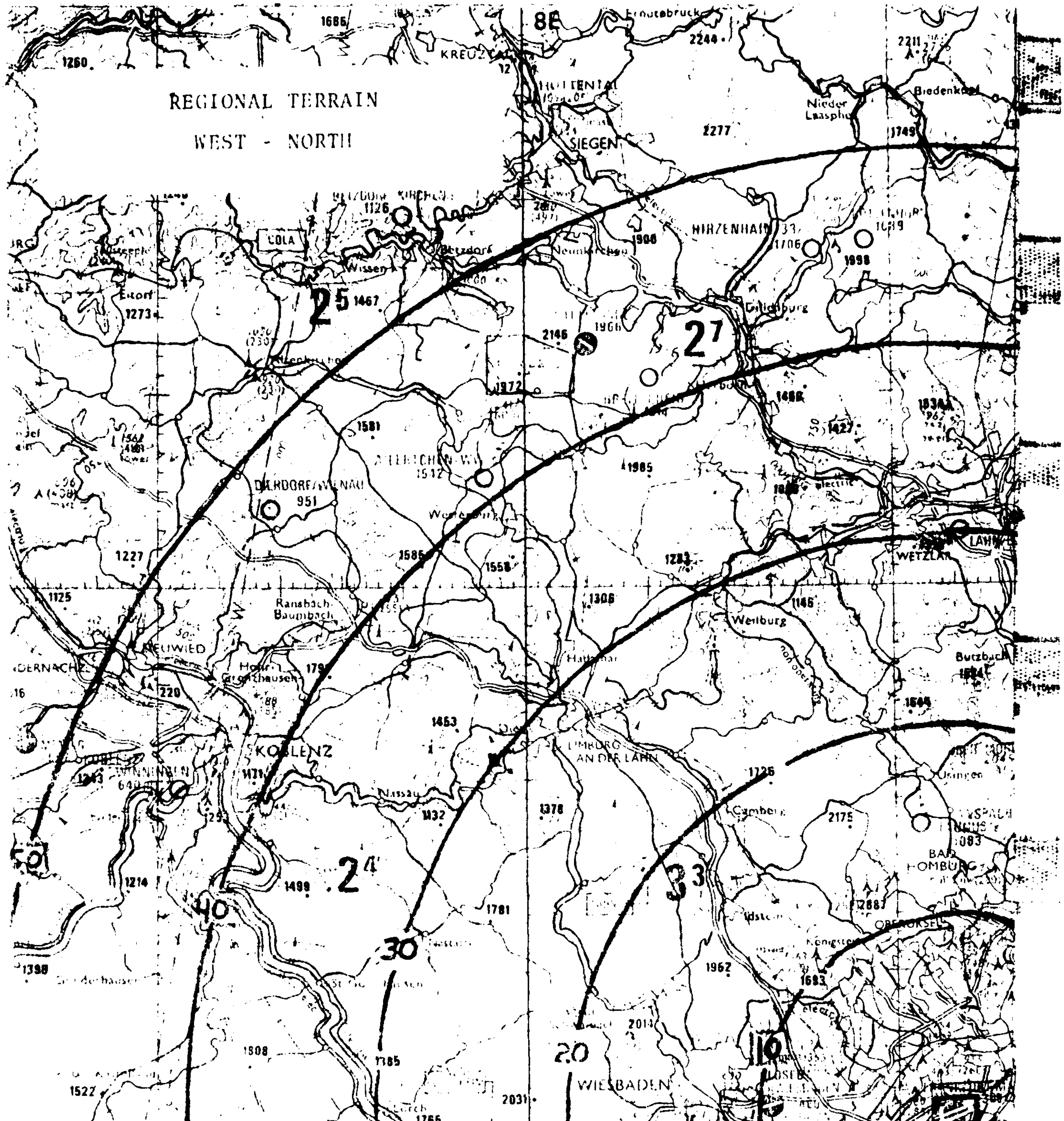
LOCATION

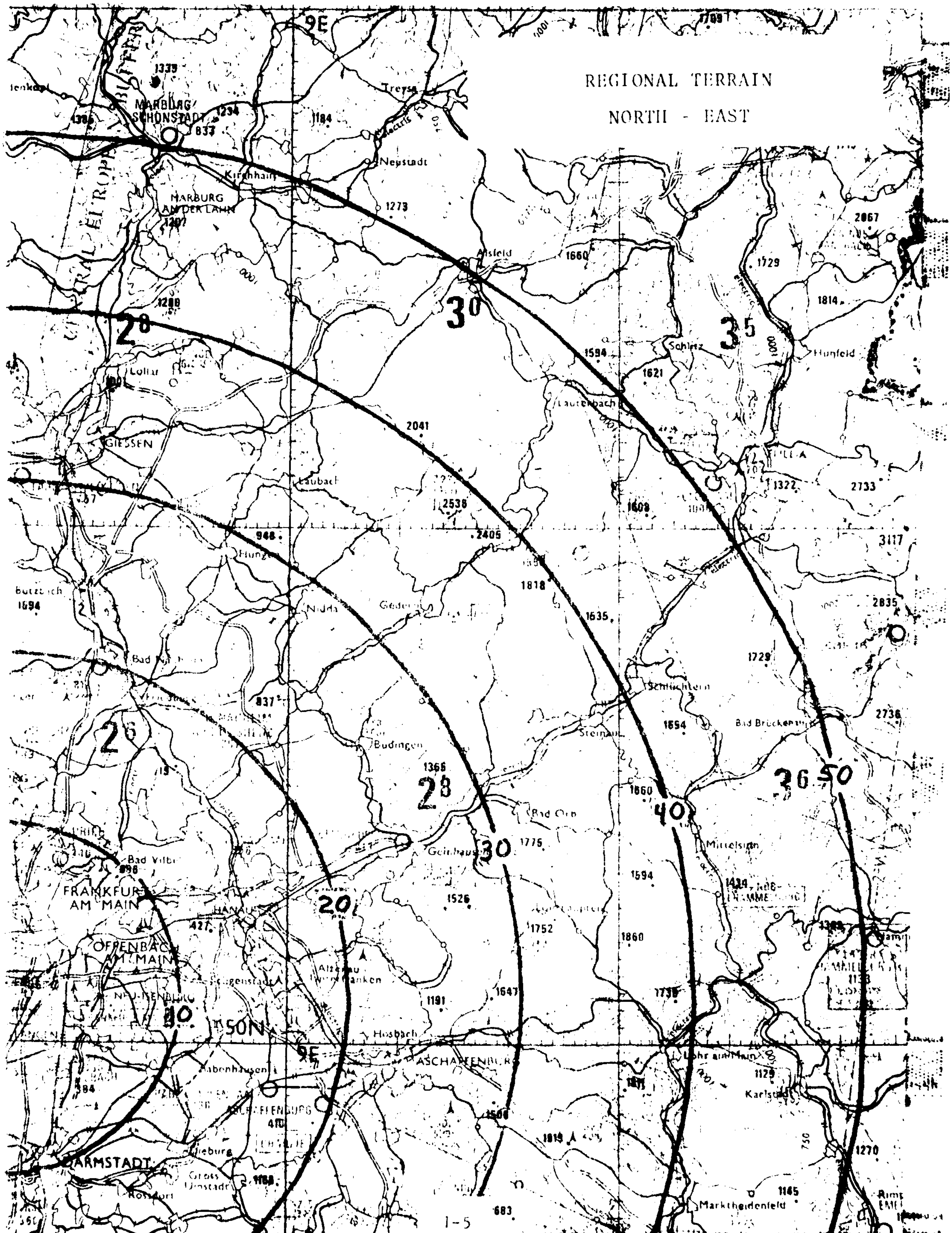
Rhein Main Air Base is located at latitude 50 degrees 02 minutes North and longtitude 08 degrees 34 minutes East. The civilian side of the field has ICAO identifier EDDF and station locator 10637. 10 is the block number for Germany. The military side is ICAO identifier EDAF and has locator number 10636.

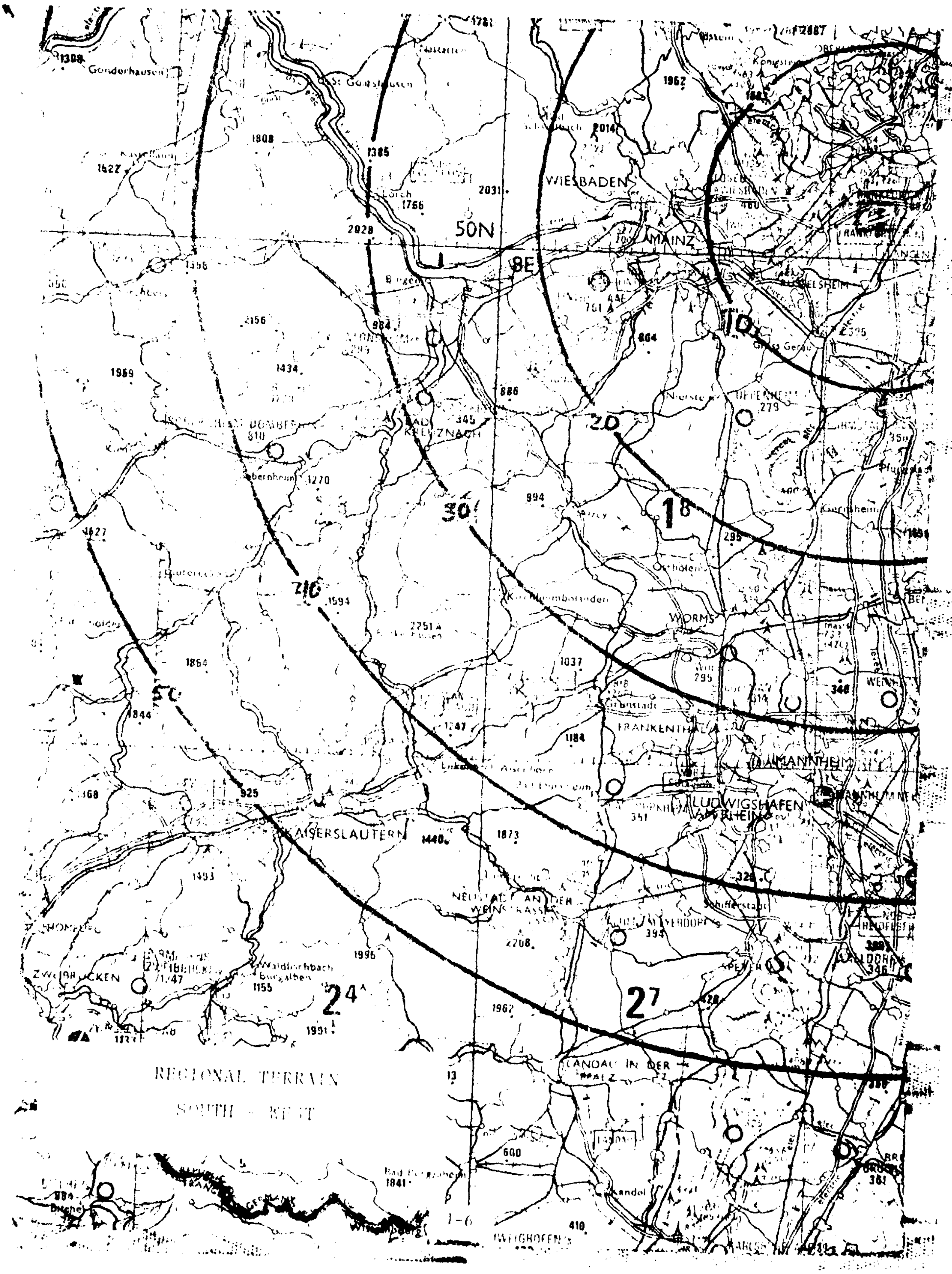
TERRAIN

The field elevation of Rhein Main Air Base is 365 feet. The base is located on a flat rise of terrain from the low ground of the Main River and Rhein River valleys, about six nautical miles east of Wiesbaden. The relatively flat Main River and Rhein River valleys extend twenty to forty miles west-southwest and southwest from the base. Rhein Main Air Base, surrounded on all sides by woods, is located on the left bank of the Main River in the north central edge of these valleys. Seven miles to the northwest of the base the Main River Valley is bounded by the Taunus Mountains which form a barrier oriented southwest to northeast. These mountains rise to elevations over 3000 feet MSL. To the south and southeast of the base the terrain rises slowly to the Odenwald Mountains with elevations from 1500 feet MSL to 2000 feet MSL.

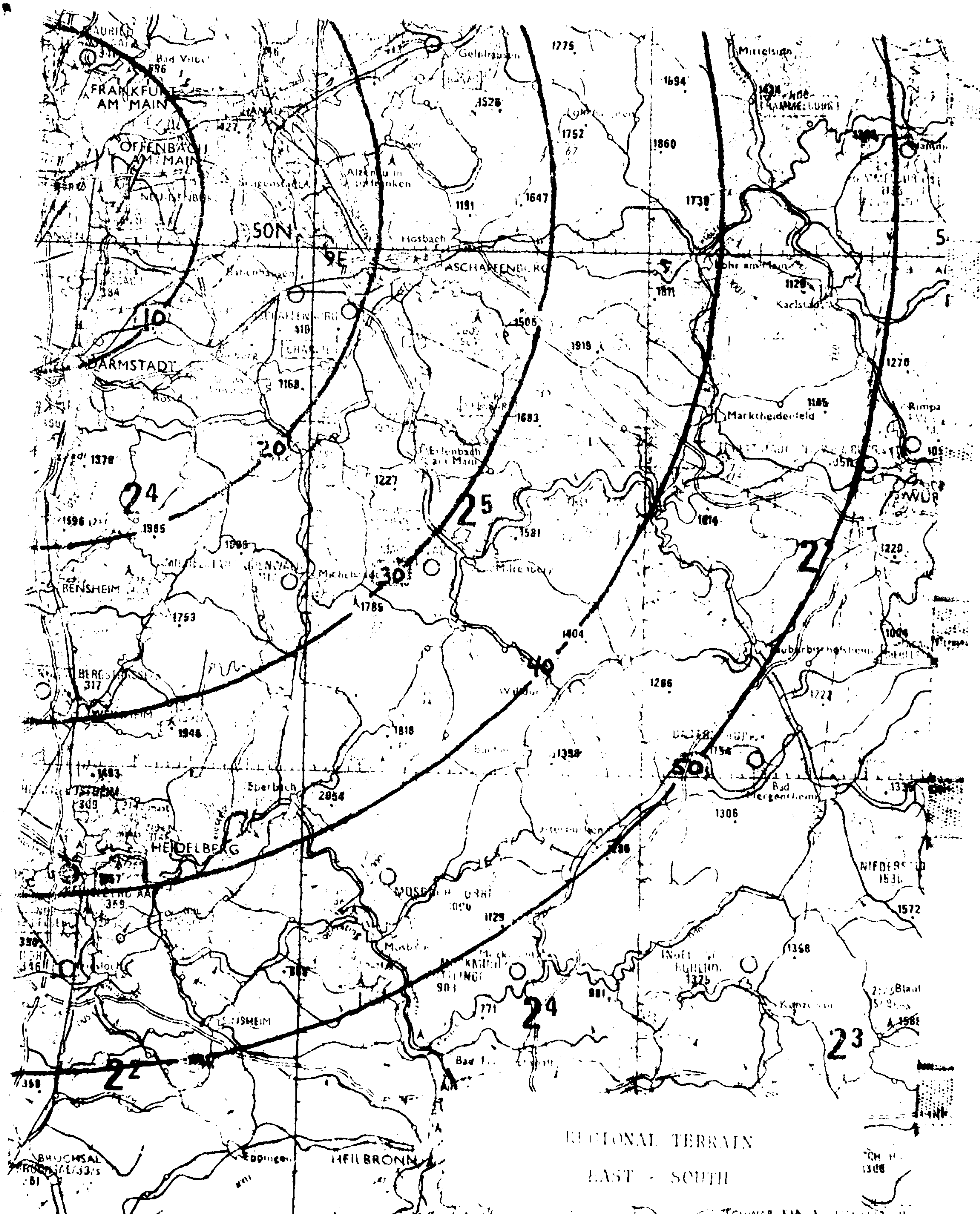

WUPPERTAL
SIEGEN
BURBACH
ALTENKIRCHEN
HERBORN
WETZLAR
WEILBURG
MARBURG
GIESSEN
FRITZLAR
BAD WILDUNGEN
HOMBERG
KASTELLAUN
NASTATTEN
WIESBADEN
FRANKFURT
HANAU
GEMUNDEN
MAINZ
ASCHAFFENBURG
DARMSTADT
BINGEN
BAD KREUZNACH
BENSHEIM
WORMS
AMORBACH
LUDWIGSHAFEN
MANNHEIM
EBERBACH
BUCHEN
BAD MERGENTHEIM
MOSBACH
PIRMASENS
LANDAU
BRUCHSAL
OHRINGEN
HEILBRONN
KARLSRUHE
BACKNANG
PFORZHEIM


REGIONAL TERRAIN
WEST - NORTH
SIEGEN
HIRZENHAIN
Wissen
NEUWIED
KOBLENZ
WETZLAR
Weilburg
LIMBURG AN DER LAHN
Camberg
Usingen
Idstein
WIESBADEN
MAINZ
Nassau
50N
8E
10
20
30
40
50


REGIONAL TERRAIN
NORTH - EAST
MARBURG SCHONSTADT
MARBURG AN DER LAHN
Kirchhain
Neustadt
Treysa
Alsfeld
Schlitz
Hunfeld
Lauterbach
Giessen
Laubach
Hungen
Nidda
Butzbach
Bad Nauheim
Schlüchtern
Steinau
Bad Brückenau
Budingen
Bad Orb
Gelnhausen
Bad Vilbel
FRANKFURT AM MAIN
HANAU
OFFENBACH AM MAIN
NEU-ISENBURG
Hosbach
ASCHAFFENBURG
Lohr am Main
Karlstadt
Marktheidenfeld
DARMSTADT
Dieburg
Gross Umstadt
Rossdorf
Mittelsinn
Alzenau
50N
9E



REGIONAL TERRAIN
SOUTH - WEST

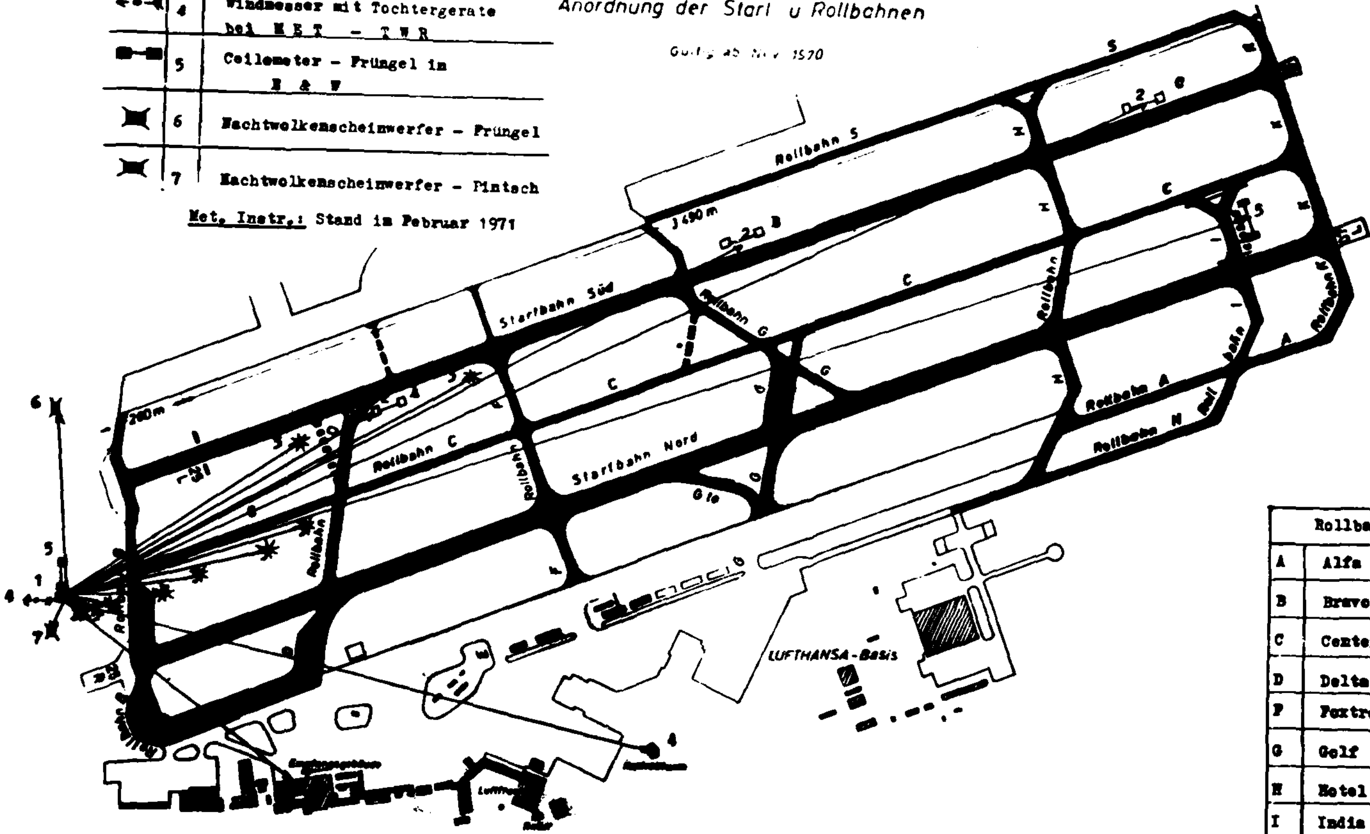

FRANKFURT AM MAIN
OFFENBACH AM MAIN
DARMSTADT
ASCHAFFENBURG
Gelnhausen
Hosbach
50N
9E
Marktheidenfeld
Karlstadt
Rimpar
Erlenbach am Main
Michelstadt
BENSHEIM
Eberbach
HEIDELBERG
Bad Mergentheim
Tauberbischofsheim
BRUCHSAL
Eppingen
HEILBRONN
SCHWAB HALL
10
20
30
40
50
REGIONAL TERRAIN
EAST - SOUTH

Plan 1,2,3,4. *schwarz*

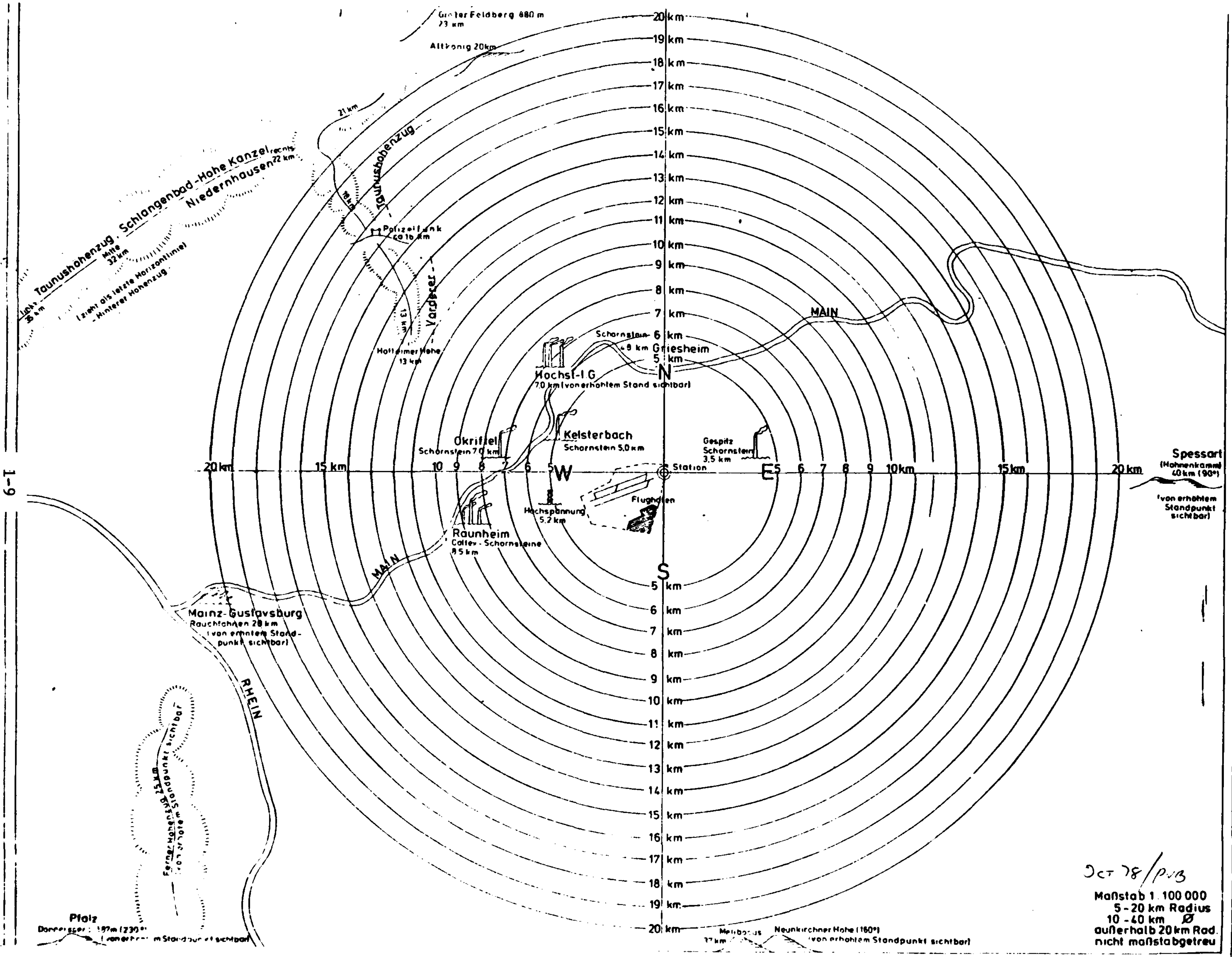
FLUGHAFEN FRANKFURT/Main
Anordnung der Start u Rollbahnen
Gültig ab Nov 1970

▬	1	M E T - Beobachtu[illegible]
□–□	2	Transmissometer - Prüngel A - B - C
✳	3	Sichtmessfeuerreihe in Mtr. 5o - 1oo - 18o - 3oo - 4oo - 6oo - 72o - 92o - 138o Mtr.
←•→	4	Windmesser mit Tochtergerate bei M E T - T W R
■–■	5	Ceilometer - Prüngel in E & W
⧓	6	Nachtwolkenscheinwerfer - Prüngel
⧓	7	Nachtwolkenscheinwerfer - Pintsch

Met. Instr.: Stand im Februar 1971

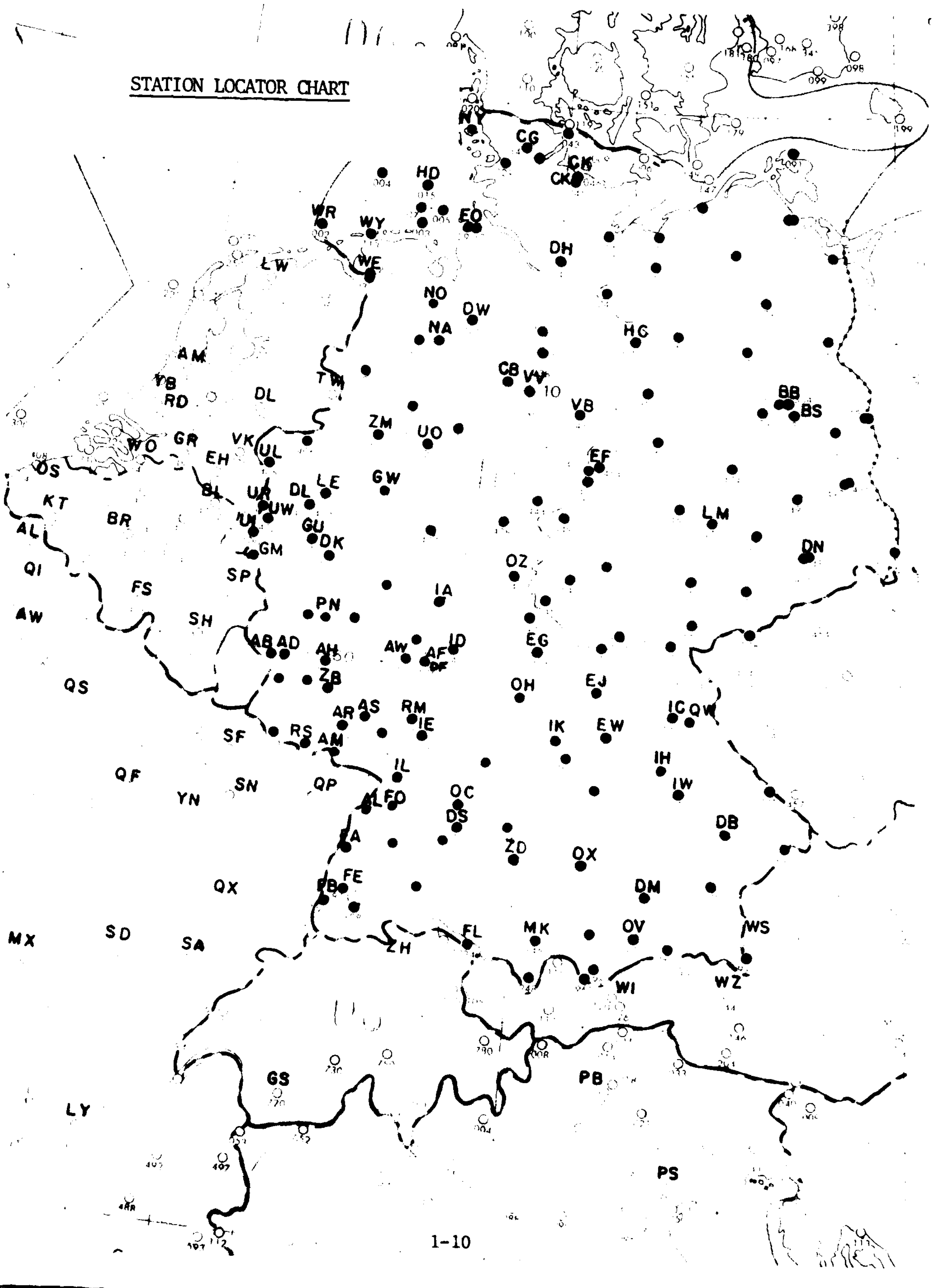


	Rollbahnen
A	Alfa
B	Bravo
C	Center
D	Delta
F	Foxtrot
G	Golf
H	Hotel
I	India
K	Kilo
S	Süd
N	Nord



Großer Feldberg 880 m
23 km
Altkönig 20 km
21 km
links Taunushöhenzug
Schlangenbad-Hohe Kanzel rechts 22 km
Niedernhausen
Mitte 32 km
(zieht als letzte Horizontlinie)
- Hinterer Höhenzug -
Taunushöhenzug
18 km
Polizeifunk ca 16 km
Vorderer
13 km
Hofheimer Höhe 13 km
Schornstein 4,8 km Griesheim
Höchst-I.G
7,0 km (von erhöhtem Stand sichtbar)
Kelsterbach
Schornstein 5,0 km
Okriftel
Schornstein 7,0 km
Gespitz
Schornstein
3,5 km
Station
Flughafen
Hochspannung
5,2 km
Raunheim
Caltex-Schornsteine
8,5 km
MAIN
N
S
E
W
Spessart
(Hahnenkamm)
40 km (90°)
(von erhöhtem Standpunkt sichtbar)
Mainz-Gustavsburg
Rauchfahnen 28 km
(von erhöhtem Standpunkt sichtbar)
RHEIN
Ferner Höhenzug 25 km
(von erhöhtem Standpunkt sichtbar)
Pfalz
Neunkirchner Höhe (160°)
(von erhöhtem Standpunkt sichtbar)
Maßstab 1:100 000
5-20 km Radius
10-40 km Ø
außerhalb 20 km Rad.
nicht maßstabgetreu

STATION LOCATOR CHART



LOCAL WEATHER AND EQUIPMENT

Frankfurt/Rhein-Main Flughafen is situated in an extended basin with forests. It is 4km south of the Main river at Russelsheim and 10km southwest of the city of Frankfurt. The Main and Rhein rivers join 17km west-southwest of the airport. The Rhein-Main plain is surrounded, except on the south, by mountains which shape the prevailing wind flow and affect the weather at the airfield.

GENERAL

Winter weather at the Frankfurt/Rhein-Main airport is characterized by low stratus ceilings, clouds and fog. During summer, the weather improves markedly. In the close vicinity of the field, severe thunderstorms are rare. Thunderstorms normally form and hold over the Taunus Mountains to the north and over the Odenwald to the south. These mountain deflect and focus the prevailing wind flow, but also, during the winter, create a basin of cold air storage. Fog formation in winter is enhanced by air pollution trapped in the valley.

WIND DIRECTION AS AN INFLUENCE ON AIRFIELD WEATHER

Wind from south through west:

Prevailing wind direction at Rhein-Main is from the southwest, due to the configuration of the Rhein-Main valleys and the Taunus mountains. Strong southwest winds flow through the valley in advance of strong frontal activity and then shift to westerly after frontal passage. Crosswinds are not usually a problem since the runway is aligned with the prevailing winds.

Weak winds from the south to the southwest favor the formation of fog, by advecting moisture from the forests, grasslands and the broad Rhein river valley. Persistent fog situation are terminated by the increasing wind velocities associated with the approach of frontal systems. South-westerly winds may also cause cloudiness over the Taunus from orographic lifting.

Wind from the northwest:

Northwesterly winds are rare because of the deflection of the Taunus Mountains. Almost immediately after the passage of a cold front, clouds break up and temperatures increase briefly from insolation. As air fills in behind the front, temperatures then begin to fall. The surface winds under these conditions veer to the west, though at an altitude of a few hundred meters, the flow is from the northwest. Strong northwesterly flow produces turbulence and shear for aircraft on Final Approach, though winds are quite light at the surface. Strong northwesterly flow of unstable air, though rare, brings the normally stationary thunderstorms down off the Taunus and across the airfield.

Wind from the northeast:

The secondary maximum in prevailing winds is from the northeast. These winds are also produced by the Taunus and the Wetterau plain northeast of Rhein-Main. Daytime northeasterly flow is produced by strong high pressures east of Rhein-Main. The gradient flow from the Siberian High, for example, is focused by the Main valley. On clear fall and winter evenings, radiation cooling over the Wetterau plain also produces northeasterly flow, often in contrast to the gradient wind. If this flow accelerates to 5 knots, fog formation will often be prevented, and fog in existence may be dissipated.

At speeds below 5 knots, and especially after precipitation occurs, radiation fog forms during the early night in the Main valley and in the forest clearings north and east of the airfield. This fog is often carried over the airfield.

Wind from the southeast:

Winds from the southeast are deflected by the Odenwald and are therefore rare.

AIRFIELD WEATHER EQUIPMENT

All observations, weather equipment and maintenance are provided by the Deutsche Wetterdienst for the airfield. The USAF has no permanently installed observing equipment at the field.

BAROMETER

Mercurial lla.

TEMPERATURE

The DWD has a direct reading electronic temperature/dewpoint set and in addition Wet/Dry Bulb instrumentation installed in a 2 Meter Instrument Shelter. Measurements are representative. However, a Systematic error of +0.3C occurs with the Wet/Dry Bulb set on cold days with a NE wind carrying body heat into the instrument shelter.

WIND

Two Cup type anemometers are located on 10 Meter wind masts at each end of the runway. The wind direction, speed and 10 minute averages are recorded on drum type electric trace recording equipment in the observer shelter. Only the east wind record is examined for peak winds and gusts for synoptic records, through both traces are kept on file.

VISIBILITY

Since the airfield is surrounded by flat terrain and forest, long range visibility markers are poor to the N, S, and E. The ROS is located at the East end of the filed. There are numerous visibility markers inside the forest perimeter (1km East, 4km West). In addition, there are six transmissometer sets with continuous recording of RVR available for each set.

CLOUD HEIGHT

Cloud height is determined with two fixed beam/rotating detector ceilometers, one at either end of the runway. The equipment is accurate up to two thousand feet.

SECTION 2

CLIMATIC AIDS

OPERATIONALLY CRITICAL WEATHER CRITERIA

CLIMATOLOGICAL SUMMARY

MONTHLY TABLES OF CLIMATOLOGICAL DATA

ANNUAL CLIMATOLOGY GRAPHS

MONTHLY CLIMATOLOGY GRAPHS

AWS CLIMATIC BRIEF

OPERATIONALLY CRITICAL WEATHER CRITERIA

1. Aircraft Operations (Also see AWSP 55-1 & AWS VA 55-2)

a. Winds

(1) Maximum Tailwind 10 Knots - C9

(2) Maximum Crosswind 30 Knots - C9

(3) Maximum Crosswind 35 Knots - C130

(4) Maximum Crosswind 25-25 Knots - C141

(5) Maximum Crosswind 27 Knots - C5 (Varies with instrumentation and weather)

b. Winds for Drop Missions (Most drops must be VFR (020/4.3), some VFR (015/3.0))

(1) HE - Heavy Equipment

Drop Wind ≤ 40 Kts (AF Equipment)
≤ 30 Kts (Army, Most Common Type)

Surface Wind ≤ 17 Kts (With Parachutes)
≤ 13 Kts (Without Parachutes)

(2) CDS - Container Delivery System

Drop Wind ≤ 40 Kts (AF)
≤ 30 Kts (Other)

Surface Winds ≤ 13 Kts

(3) HALO - High Altitude Low Opening (Must be able to see the ground)

Drop Wind - No Restriction

Surface Wind ≤ 13 Kts

(4) TTB - Tactical Training Bundles

Drop Wind ≤ 40 Kts

Surface Wind ≤ 25 Kts

(5) PERS - Personnel

Drop Wind ≤ 30 Kts

Surface Wind ≤ 13 Kts

(6) LAPES - Low Altitude Parachute Extraction System

Crosswind ≤ 35 Kts

(7) IFR Drops

Terminal Minimums OR 300/.4

Formation Terminal Minimums 300/1.0

(8) AWADS - Adverse Weather Aerial Delivery System

Ceiling and Visibility 500/1.0 (Approx.)

2. Local Weather Warning/Met Watch Advisory Criteria

a. Wind

(1) > or equal to 40 Kts - LWW

(2) > or equal to 25 Kts - MWA

(3) Low level wind shear within 5 NM - MWA

(4) Severe turbulence below 10,000 Ft - MWA

b. Ceiling/Visibility

(1) < or equal to 1000/2.0 NM - MWA

(2) < or equal to 300/.4 NM - MWA

(3) < or equal to 200/.4 NM - MWA

c. Precipitation

(1) Hail -> or equal to 1/2 inch - LWW

(2) Heavy snow ≥ 2 inches in 12 hours - LWW

(3) Heavy rain ≥ 2 inches in 12 hours - LWW

(4) Freezing precipitation or ice pellets - LWW

(5) Snow accumulating > trace - MWA

(6) Severe icing below 10,000 Ft - MWA

(7) Heavy frost - MWA

d. Thunderstorms/Lightning

(1) Thunderstorms within 10 NM - MWA

(2) Tornado within 10 NM - LWW

(3) Probability for Lightning Conditions (POLC) greather than or equal to 80% within 25 NM - MWA.

e. Temperatures

(1) Freezing temperatures (01 May - 15 OCT) - LWW

(2) Temperature Drop 20°F in 12 hours or less reaching 32°F

CLIMATOLOGICAL SUMMARY

RHEIN MAIN AIR BASE

RHEIN MAIN CLIMATOLOGICAL SUMMARY

AIR MASSES

Due to the configuration of Europe and its being located in the zone of prevailing westerlies, the most predominant air mass affecting Rhein-Main during all seasons is maritime in its origin. Maritime polar air masses are prevalent from fall through spring. Continental air masses are in the minority with continental polar occurring during the winter when low to negative zonal flow is caused by a well developed Siberian high or during the summer when a high pressure cell breaks off the Azores high and becomes stationary over central Europe.

CLOUDINESS AND VISIBILITY

The maritime influence is quite evident when sky cover statistics are examined. Annually, cloudy skies (greater than 6/10 coverage) occur 71% of the time with a maxima in winter and partly cloudy to clear skies (5/10 coverage or less) occur 18% of the time with the maxima in summer. Air mass stability and southwesterly flow through the Rhein Valley with its moisture and pollution sources cause October to have the poorest flying weather during the morning hours (0600-0800). Ceilings of less than 200 feet and visibilities of less than 0.4NM occur 15% of the time (five days). However, alternate minimums are met 50% of the time and this figure rises above 80% during the afternoon. Conversely, the best flying weather occurs April through July with above minimum conditions existing 97% of the time.

TEMPERATURE

A graphical portrait of the temperatures at Rhein-Main shows a standard climatological curve. Extremes above 100 degrees F and below 0 degrees F are rare. Freezing temperatures usually are recorded from November through May.

PRECIPITATION, THUNDERSTORMS AND SNOWFALL

Precipitation amount is fairly uniform throughout the year with a maxima during the summer and a minima during the winter. On the average, a trace of precipitation is reported every second day. During the summer, greater amounts of precipitation fall due to thunderstorms and convective showers. However, during the winter, total accumulation decreases and frequency of occurance increases. A trace of snowfall or greater has been recorded from November through May, but the greatest frequency of occurrence and accumulation is December through February.

WINDS

Frontal-pre and post, and strong zonal flow result in a prevailing wind direction of southwest. Non-frontal, pre-frontal and weak zonal flow result in a wind direction from the northeast due to the configuration of the mountains extending from the north through the east and the down slope motion into the Rhein Valley. Wind speeds greater than 40 knots occur with thunderstorms, instability lines, frontal and post frontal weather.

(The following climatology tables were extracted from the RUSSWO, period of record Sep 46 - Dec 76).

January

Median Conditions / **% Chance**

Time (Z)	CIG	VIS	TT	TD	ALSTG	PREV WIND	8THS SKY COVER	PCPN	OBST
00-02	040	5+	34/1	31/0	3005	SSW8	6	19	16
03-05	035	4.3	33/1	30/-1	3005	SSW8	6	20	19
06-08	030	4.0	33/1	30/-1	3004	SSW8	6	20	21
09-11	035	2.7	35/2	32/0	3006	SSW8	6	21	22
12-14	035	4.0	37/3	33/1	3005	SSW8	6	20	17
15-17	035	4.0	38/4	33/1	3003	SSW8	6	18	15
18-20	035	4.3	36/2	32/0	3005	SSW8	6	18	15
21-23	035	4.3	35/2	32/0	3005	SSW8	6	18	15

% Chance of Operationally Significant Weather

Time (Z)		WIND ≥ 25 KTS	TSTM	FZRA FZDL	SNOW ≥ TRACE	< 200/ .4NM	< 300/ .4NM	< 1000/ 0.2NM	< 2000/ 4.3NM
00-02		1		.8	6.0	04	05	27	58
03-05		1		1.2	7.2	04	05	32	62
06-08		1		1.2	6.7	08	09	40	68
09-11		1		.6	7.0	06	07	41	71
12-14		1		.8	6.7	03	04	32	64
15-17		1		.3	6.4	03	04	31	62
19-20		1	.1	.3	5.7	03	04	24	56
21-23		1		1.0	5.3	03	04	26	58

PK WND E/W	MAX 24 PCPN	MAX MO PCPN	MAX SNOW DEPTH	MAX TEMP	MIN TEMP
42/48	.74	3.86	9	60	-4

NOTE: ONLY TWO OCCURRENCES OF WIND ≥ 40 KTS.
HAIL REPORTED ONE TIME BETWEEN 18-20Z.

February									
	Median Conditions							% Chance	
Time (Z)	CIG	VIS	TT	TD	ALSTG	PREV WIND	8THS SKY COVER	PCPN	OBST
00-02	050	5.0	34/1	31/0	3000	NE 5	5	15	15
03-05	050	5.0	34/1	30/-1	2999	NE 4	5	15	15
06-08	045	4.0	33/1	30/-1	2999	NE 5	6	17	19
09-11	045	4.0	37/3	31/0	3001	SSW9	6	18	13
12-14	050	5+	40/5	32/0	3001	NNE8	6	15	5
15-17	060	5+	41/5	32/0	2998	NNE8	6	15	5
18-20	060	5+	37/3	31/0	2999	NNE7	6	15	7
21-23	070	5+	36/2	31/0	3000	NE 5	5	13	11

% Chance of Operationally Significant Weather

Time (Z)		WIND ≥ 25 KT	TSTM	FZRA FZDZ	SNOW ≥ TRACE	< 200/ .4NM	< 300/ .4NM	< 1000/ 2.0NM	< 2000/ 4.3NM
00-02		1			4.7	03	04	19	51
03-05		1		.2	5.3	03	04	22	51
06-08		1		.4	6.7	04	04	33	62
09-11		1		.1	7.4	03	03	28	62
12-14		2		.6	4.3	02	02	18	46
15-17		1		.2	5.0	02	02	21	44
18-20		1		.2	3.1	02	03	13	43
21-23		1			3.2	03	04	14	46

		PK WND E/W	MAX 24 PCPN	MAX MO PCPN	MAX SNOW DEPTH	MAX TEMP	MIN TEMP		
		33/40	1.29	4.68	8	64	-4		

NOTE: ONE OCCURRENCE OF WND ≥ 40 KTS.

March

Median Conditions / **% Chance**

Time (Z)	CIG	VIS	TT	TD	ALSTG	PREV WIND	8THS SKY COVER	PCPN	OBST
00-02	100	5+	37/3	32/0	3000	NE 5	5	13	11
03-05	090	5+	36/3	32/0	3000	NE 5	5	17	10
06-08	100	4.0	36/3	32/0	3000	NE 5	6	16	15
09-11	100	4.3	42/6	33/1	3002	SSW9	6	14	8
12-14	100	5+	47/8	33/1	3000	WSW12	6	13	4
15-17	140	5+	48/9	33/1	2997	SW11	6	11	3
18-20	140	5+	43/6	33/1	2998	NNE8	5	12	5
21-23	100	5+	40/5	33/1	2999	NE 6	5	12	6

% Chance of Operationally Significant Weather

Time (Z)		WIND ≥ 25 KT	TSTM	FZRA FZDZ	SNOW ≥ TRACE	< 200/ .4NM	< 300/ .4NM	< 1000/ 2.0NM	< 2000/ 4.3NM
00-02		1			2.3	01	01	07	35
03-05		0			4.8	01	01	01	44
06-08		1			5.0	02	02	23	61
09-11		2			2.7	01	01	13	47
12-14		2			1.6	00	00	06	27
15-17		1	.3		1.1	00	00	04	21
18-20		1			1.0	00	01	05	25
21-23		0			1.4	00	01	05	29

PK WND E/W	MAX 24 PCPN	MAX MO PCPN	MAX SNOW DEPTH	MAX TEMP	MIN TEMP
44/46	.89	4.3	4	74	9

NOTE: ONE OCCURRENCE OF WND ≥ 40 KTS.

April

Median Conditions								% Chance	
Time (Z)	CIG	VIS	TT	TD	ALSTG	PREV WIND	8THS SKY COVER	PCPN	OBST
00-02	NO	5+	42/6	36/2	2997	NE 6	4	12	5
03-05	200	5+	41/5	36/2	2996	NE 5	5	14	9
06-08	200	5+	43/6	37/3	2997	NE 6	5	15	9
09-11	200	5+	50/10	37/3	2997	NNE9	5	14	3
12-14	200	5+	55/13	37/3	2995	NNE10	5	12	2
15-17	200	5+	55/13	37/3	2992	NNE10	5	14	1
18-20	200	5+	51/11	37/3	2992	NE 7	5	14	1
21-23	NO	5+	46/8	37/3	2995	NE 6	4	13	2

% Chance of Operationally Significant Weather

Time (Z)		WND ≥ 25 KT	TSTM	FZRA FZDZ	SNOW ≥ TRACE	< 200/ .4NM	< 300/ .4NM	< 1000/ 2.0NM	< 2000/ 4.3NM
00-02		1			.4	01	01	05	18
03-05		1			.2	02	02	09	31
06-08		1			.8	01	01	14	41
09-11		1			.5	00	00	06	24
12-14		1			.3	00	00	02	10
15-17		1	.8		.6	00	00	02	09
18-20		1			.1	01	01	02	11
21-23		0			.1	01	01	02	11

PK WND E/W	MAX 24 PCPN	MAX 40 PCPN	MAX SNOW DEPTH	MAX TEMP	MIN TEMP
43/48	1.22	4.10	2	87	20

NOTE: ONLY ONE OCCURRENCE OF WND ≥ 40 KTS.

-

May

Time (Z)	Median Conditions CIG	VIS	TT	TD	ALSTG	PREV WIND	8THS SKY COVER	% Chance PCPN	OBST
00-02	200	5+	50.10	45/7	2996	NE 4	4	12	8
03-05	120	5+	49/9	45/7	2996	NE 4	5	13	14
06-08	120	5+	53/12	46/8	2997	NE 6	5	13	11
09-11	200	5+	60/15	46/8	2997	SW 9	6	10	3
12-14	200	5+	63/17	45/7	2995	SW10	6	12	.3
15-17	200	5+	64/18	45/7	2993	WSW10	6	15	1
18-20	200	5+	60/15	46/8	2992	E 3	6	13	2
21-23	200	5+	54/12	46/8	2995	NE 4	4	13	4

% Chance of Operationally Significant Weather

Time (Z)		WIND ≥ 25 KT	TSTM	MAY-OCT FZ TEMP	SNOW ≥ TRACE	< 200/ .4NM	< 300/ .4NM	< 1000/ 2.0NM	< 2000/ 4.3NM
00-02		1	.3			01	02	07	22
03-05		0	.5			03	03	13	39
06-08		1	.3			01	01	10	40
09-11		1	.2		.1	00	00	03	17
12-14		1	.5			00	00	02	06
15-17		1	2.3			00	00	02	06
18-20		1	1.0			00	00	03	10
21-23		1	.6			00	01	03	11
		PK WND E/W	MAX 24 PCPN	MAX MO PCPN	MAX SNOW DEPTH	MAX TEMP	MIN TEMP		
		35/45	1.81	6.21	T	89	26		

NOTE: ONE OCCURRENCE OF WIND ≥ 40 KTS.
HAIL REPORTED TWICE BETWEEN 00-02Z and 12-14Z.

June

Time (Z)	Median Conditions CIG	VIS	TT	TD	ALSTG	PREV WIND	8THS SKY COVER	% Chance PCPN	OBST
00-02	NO	5+	56/14	50/10	3002	NE 4	4	9	8
03-05	200	5+	54/12	50.10	3002	NE 4	4	9	12
06-08	200	5+	59/15	51/11	3003	NE 6	4	7	11
09-11	200	5+	65/19	51/11	3003	NNE9	5	9	3
12-14	200	5+	69/21	51/11	3001	WSW10	5	11	.4
15-17	200	5+	69/21	51/11	2999	W 9	5	17	.2
18-20	200	5+	66/19	51/11	2998	N 6	5	12	.3
21-23	200	5+	60/16	51/11	3001	NNE6	4	10	2

% Chance of Operationally Significant Weather

Time (Z)		WIND ≥ 25 KT	TSTM	FZRA FZDZ	MAY-OCT FZ TEMPS	< 200/ .4NM	< 300/ .4NM	< 1000/ 2.0NM	< 2000/ 4.3NM
00-02		0	.5			00	00	03	17
03-05		0	.4			01	01	12	36
06-08		0	.1			01	01	08	34
09-11		0	.3			00	00	03	15
12-14		0	1.1			00	00	02	08
15-17		1	3.5			00	00	02	06
18-20		0	1.3			00	00	02	10
21-23		0	.7			00	00	02	09
		PK WND E/W	MAX 24 PCPN	MAX MO PCPN	MAX SNOW DEPTH	MAX TEMP	MIN TEMP		
		33/36	2.14	5.33	0	97	32		

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July									
	Median Conditions							% Chance	
Time (Z)	CIG	VIS	TT	TD	ALSTG	PREV WIND	8THS SKY COVER	PCPN	OBST
00-02	NO	5+	60/16	54/12	3003	NE 4	3	7	7
03-05	NO	5+	58/15	54/12	3004	NE 4	4	7	16
06-08	200	5+	62/17	55/13	3004	NE 6	4	7	13
09-11	200	5+	69/21	55/13	3004	SW 9	5	8	4
12-14	200	5+	73/23	54/12	3003	W 8	5	8	2
15-17	200	5+	74/24	54/12	3000	WSW11	5	9	2
18-20	NO	5+	71/22	55/13	2999	W 9	4	7	1
21-23	NO	5+	64/18	55/13	3002	NE 4	3	6	3

% Chance of Operationally Significant Weather									
Time (Z)		WIND ≥ 25 KT	TSTM	FZRA FZDZ	MAY-OCT FZ TEMPS	< 200/ .4NM	< 300/ .4NM	<1000/ 2.0NM	< 2000/ 4.3NM
00-02		0	1.0			01	01	03	17
03-05		0	1.3			02	02	12	37
06-08		0				01	01	08	36
09-11		1	.2			00	00	03	19
12-14		1	.7			00	00	01	07
15-17		1	1.6			00	00	02	06
18-20		1	1.9			00	00	03	07
21-23		1	1.5			00	00	02	10
		PK WND E/W	MAX 24 PCPN	MAX MO PCPN	MAX SNOW DEPTH	MAX TEMP	MIN TEMP		
		38/42	2.53	5.66	0	100	38		
	NOTE:	ONE OCCURRENCE OF WIND ≥ 40 KTS.							

August

Median Conditions								% Chance	
Time (Z)	CIG	VIS	TT	TD	ALSTG	PREV WIND	8THS SKY COVER	PCPN	OBST
00-02	NO	5+	60/16	54/12	3002	NE 4	4	9	10
03-05	NO	5+	58/15	54/12	3001	NE 4	4	8	19
06-08	200	4.3	61/16	55/13	3003	NE 5	5	9	20
09-11	200	5+	69/21	56/14	3003	SW 8	5	7	8
12-14	200	5+	73/23	54/12	3001	SW10	5	9	3
15-17	200	5+	74/24	54/12	2999	WSW10	5	11	2
18-20	200	5+	69/21	55/13	2998	NNE6	5	12	2
21-23	NO	5+	63/17	55/13	3001	NNE4	4	12	5

% Chance of Operationally Significant Weather

Time (Z)		WIND ≥ 25 KT	TSTM	FZRA FZDZ	MAY-OCT FZ TEMP	< 200/ .4NM	< 300/ .4NM	< 1000/ 2.0NM	< 2000/ 4.3NM
00-02		0	10			01	01	06	14
03-05		0	.5			02	02	13	41
06-08		0				02	02	15	46
09-11		0	.3			01	01	06	25
12-14		1	1.7			00	00	02	09
15-17		0	2.7			00	00	02	08
18-20		0	2.3			00	00	03	12
21-23		0	1.2			00	00	03	15

PK WND E/W	MAX 24 PCPN	MAX MO PCPN	MAX SNOW DEPTH	MAX TEMP	MIN TEMP
32/35	3.12	5.81	0	96	37

September

Time (Z)	CIG	VIS	TT	TD	ALSTG	PREV WIND	8THS SKY COVER	% Chance PCPN	% Chance OBST
	Median Conditions								
00-02	NO	5+	53/12	50/10	3004	NE 4	3	8	22
03-05	200	4.3	51/11	49/9	3004	NE 4	4	7	32
06-08	200	4.0	53/12	50/10	3004	NE 5	5	8	32
09-11	200	5+	60/16	52/11	3005	SW 9	5	10	16
12-14	200	5+	65/19	51/11	3003	SSW8	5	6	5
15/17	200	5+	66/19	51/11	3000	S 6	5	10	3
18-20	200	5+	60/16	51/11	3001	S 6	4	11	7
21-23	NO	5+	56/14	51/11	3003	SSW7	4	9	14

% Chance of Operationally Significant Weather

Time (Z)		WIND ≥ 25 KT	TSTM	FZRA FZDZ	MAY-OCT FZ TEMP	< 200/ .4NM	< 300/ .4NM	< 1000/ 2.0NM	< 2000/ 4.3NM
00-02		0	.5			01	02	13	38
03-05		0	.2	.1	.1	05	06	24	54
06-08		1				06	07	32	62
09-11		1	.1			01	02	14	40
12-14		0	.1			00	00	03	18
15-17		0	.6			00	00	03	12
18-20		1	.8			00	00	03	18
21-23		0	.4			01	01	05	27

PK WND E/W	MAX 24 PCPN	MAX MO PCPN	MAX SNOW DEPTH	MAX TEMP	MIN TEMP
38/38	1.39	5.37	0	93	32

October

	Median Conditions							% Chance	
Time (Z)	CIG	VIS	TT	TD	ALSTG	PREV WIND	8THS SKY COVER	PCPN	OBST
00-02	070	4.3	45/7	43/6	3008	SSW7	5	12	28
03-05	045	4.0	44/6	42/6	3008	SSW7	6	15	30
06-08	045	2.7	44/6	42/6	3008	SSW8	6	15	36
09-11	050	4.3	50/10	44/6	3009	SW 8	6	12	25
12-14	090	5+	54/12	44/6	3008	SW10	6	11	14
15-17	120	5+	54/12	44/6	3005	SW 8	6	13	15
18-20	120	5+	49/10	44/6	3007	SSW6	5	11	19
21-23	090	5+	46/8	43/6	3008	SSW6	5	11	24

% Chance of Operationally Significant Weather

Time (Z)	WIND ≥ 25 KT	TSTM	FZRA FZDZ	MAY-OCT FZ TEMPS	< 200/ .4NM	< 300/ .4NM	< 1000/ 2.0NM	< 2000/ 4.3NM
00-02	0				10	11	27	54
03-05	0			.2	13	14	31	60
06-08	0			.1	15	15	39	69
09-11	1				06	07	25	54
12-14	1				01	02	16	37
15-17	1	.1			02	03	17	35
18-20	0				05	05	17	37
21-23	0	.1			06	07	22	45

PK WND E/W	MAX 24 PCPN	MAX MO PCPN	MAX SNOW DEPTH	MAX TEMP	MIN TEMP
40/43	1.61	5.32	T	80	21

NOTE: ONLY ONE OCCURENCE OF WIND ≥ 40 KTS.

November

Time (Z)	Median Conditions CIG	VIS	TT	TD	ALSTG	PREV WIND	8THS SKY COVER	% Chance PCPN	OBST
00-02	045	4.3	39/4	36/2	3001	SSW7	6	16	22
03-05	040	4.0	38/4	36/2	3001	SSW9	6	20	26
06-08	035	4.0	38/4	36/2	3000	SSW9	6	19	28
09-11	035	4.0	41/5	37/3	3002	SSW9	6	21	21
12-14	035	5+	44/6	37/3	3001	SSW9	6	17	17
15-17	050	5+	43/6	37/3	2999	SSW9	6	15	17
18-20	050	5+	41/5	37/3	3001	SSW9	5	18	16
21-23	050	5+	40/5	37/3	3001	SSW9	5	19	19

% Chance of Operationally Significant Weather

Time (Z)	WIND ≥ 25 KT	TSTM	FZRA FZDZ	SNOW ≥ TRACE	< 200/ .4NM	< 300/ .4NM	< 1000/ 2.0NM	< 2000/ 4.3NM
00-02	1			1.7	07	09	25	52
03-05	1		.5	2.7	08	12	27	56
06-08	1		.3	3.1	09	12	38	65
09-11	2			3.6	06	07	32	61
12-14	2		.2	2.4	04	05	24	48
15-17	1			1.6	04	05	24	43
18-20	1			2.4	05	06	23	44
21-23	1			2.1	06	07	23	47

PK WND E/W	MAX 24 PCPN	MAX MO PCPN	MAX SNOW DEPTH	MAX TEMP	MIN TEMP
33/52	1.74	5.20	4	63	11

NOTE: ONLY ONE OCCURENCE OF WND ≥ 40 KTS.

December

Median Conditions / % Chance

Time (Z)	CIG	VIS	TT	TD	ALSTG	PREV WIND	8THS SKY COVER	PCPN	OBST
00-02	035	4.3	34/1	31/0	3009	SSW8	6	18	23
03-05	035	4.0	34/1	31/0	3009	SSW8	6	18	23
06-08	030	4.0	34/1	31/0	3009	SSW8	6	19	26
09-11	035	2.7	35/2	32/0	3011	SSW9	6	19	26
12-14	035	4.0	37/3	32/0	3010	SSW8	6	17	24
15-17	035	4.0	37/3	32/0	3008	SSW9	6	19	24
18-20	035	4.0	35/2	31/0	3009	SSW8	6	18	22
21-23	035	4.0	35/2	31/0	3009	SSW8	6	17	23

% Chance of Operationally Significant Weather

Time (Z)	WIND ≥ 25 KT	TSTM	FZRA FZDZ	SNOW ≥ TRACE	< 200/ .4NM	< 300/ .4NM	< 1000/ 2.0NM	< 2000/ 4.3NM
00-02	1		1.3	5.1	03	05	27	59
03-05	1		1.2	6.2	04	05	28	60
06-08	1		.9	8.2	05	06	35	67
09-11	1		.3	7.7	04	05	39	70
12-14	1		.1	5.9	04	04	31	63
15-17	1	.1	.1	6.5	03	04	30	60
18-20	1		.8	6.8	03	04	24	59
21-23	0		.8	5.7	03	04	24	60

PK WND E/W	MAX 24 PCPN	MAX MO PCPN	MAX SNOW DEPTH	MAX TEMP	MIN TEMP
43/48	1.35	5.11	10	60	1

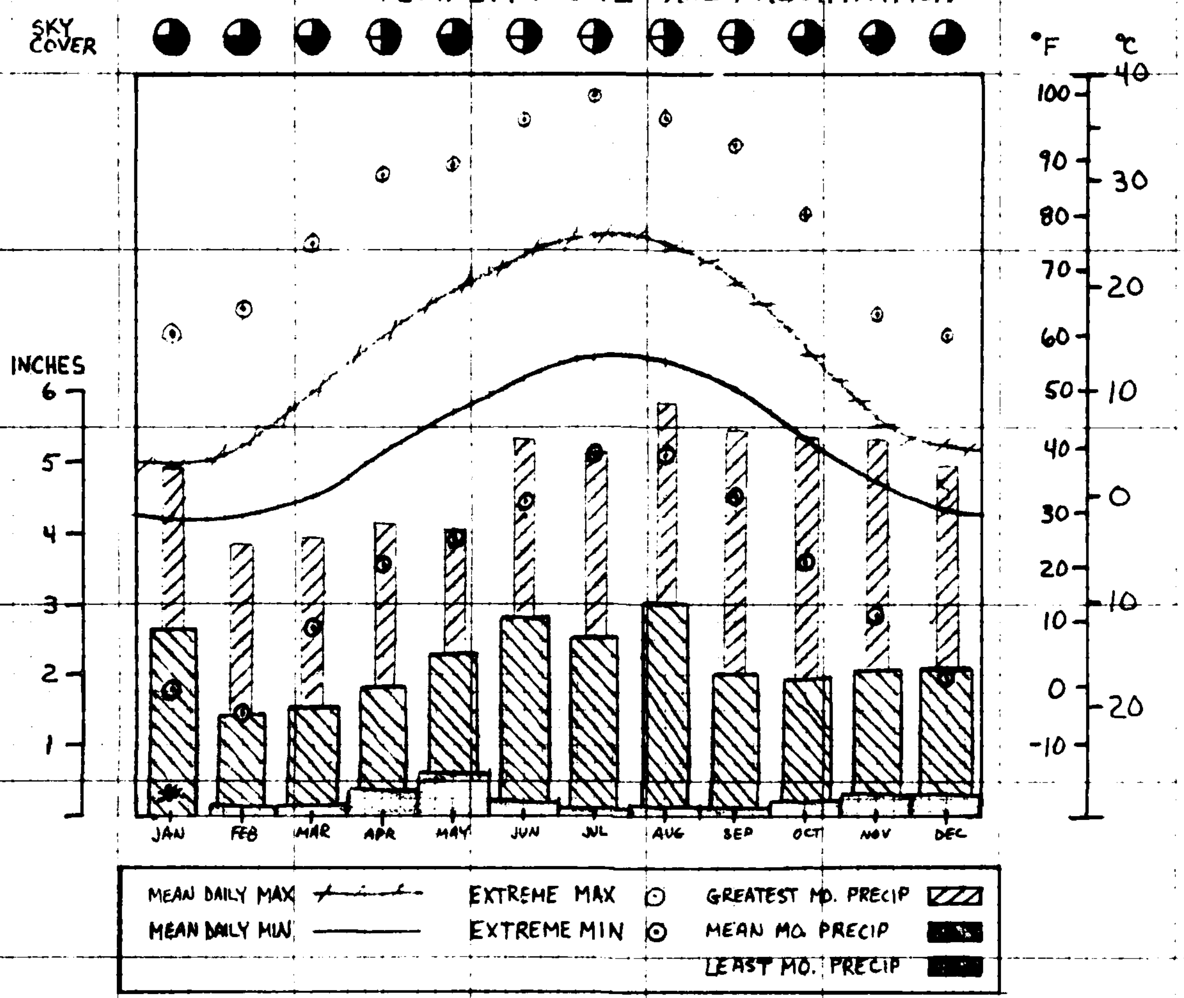
NOTE: ONLY TWO OCCURENCES OF WND ≥ 40 KTS.

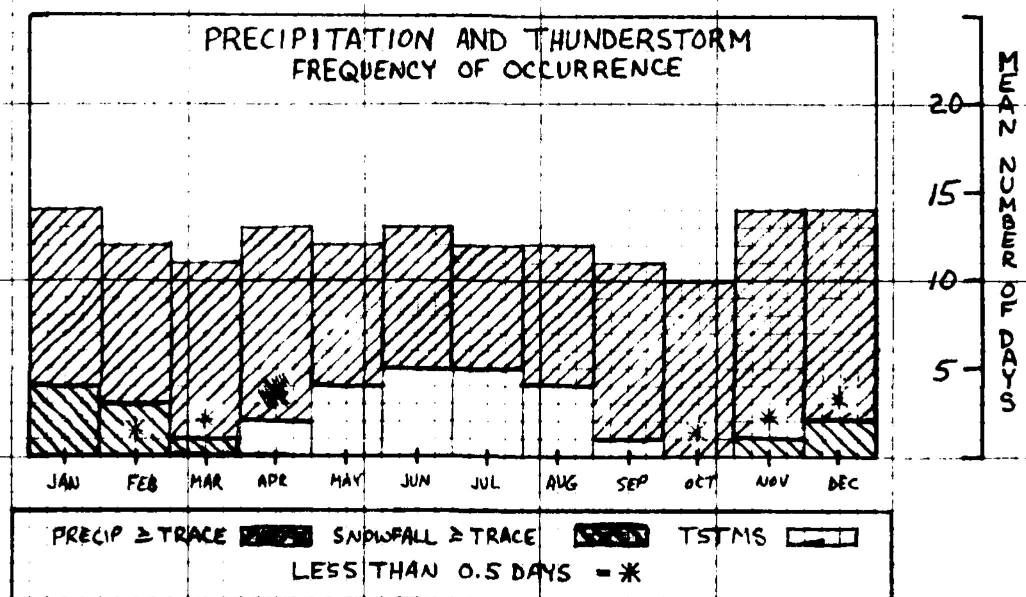
ANNUAL CLIMATOLOGY GRAPHS

RHEIN MAIN AIR BASE

ANNUAL CLIMATOLOGY-RHEIN MAIN AB

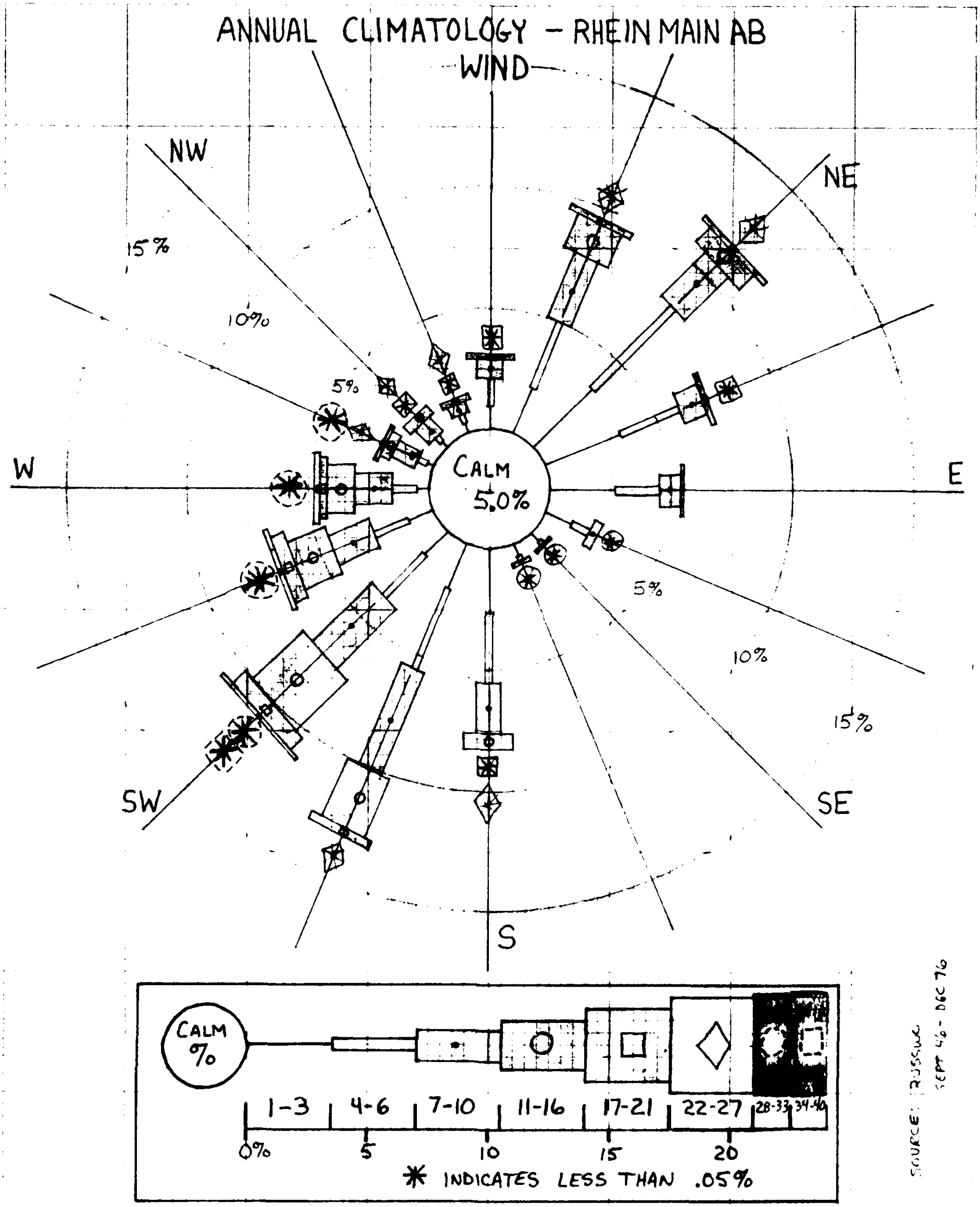
TEMPERATURE AND PRECIPITATION





SOURCE: RUSSWO SEPT 46 - DEC 76

BEE 10x10

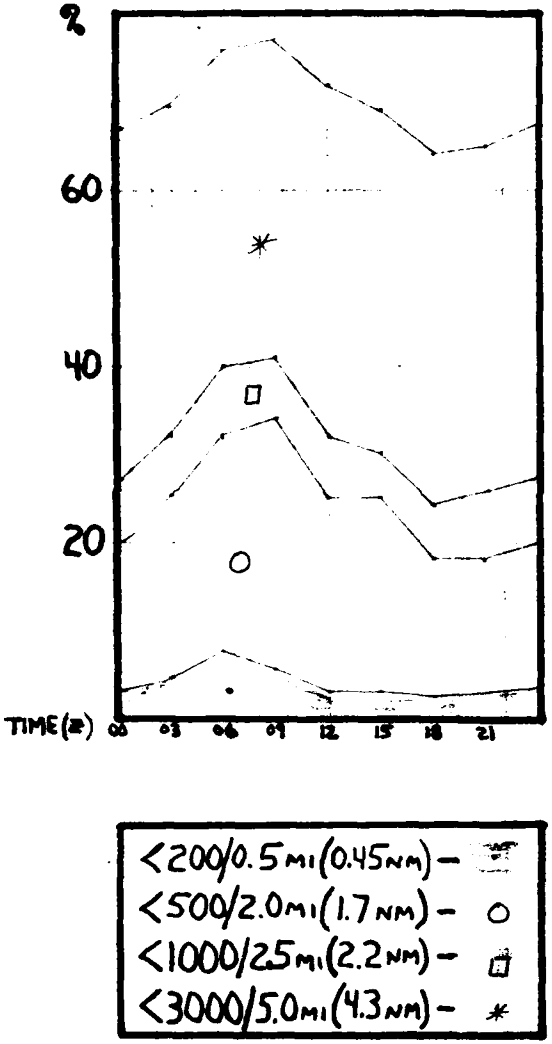

ANNUAL CLIMATOLOGY - RHEIN MAIN AB
WIND
NW
NE
W
E
SW
SE
S
CALM 5.0%
5%
10%
15%
CALM %
1-3
4-6
7-10
11-16
17-21
22-27
28-33
34-40
0%
5
10
15
20
✱ INDICATES LESS THAN .05%
SOURCE: RUSSWC SEPT 46 - DEC 76

MONTHLY CLIMATOLOGY GRAPHS

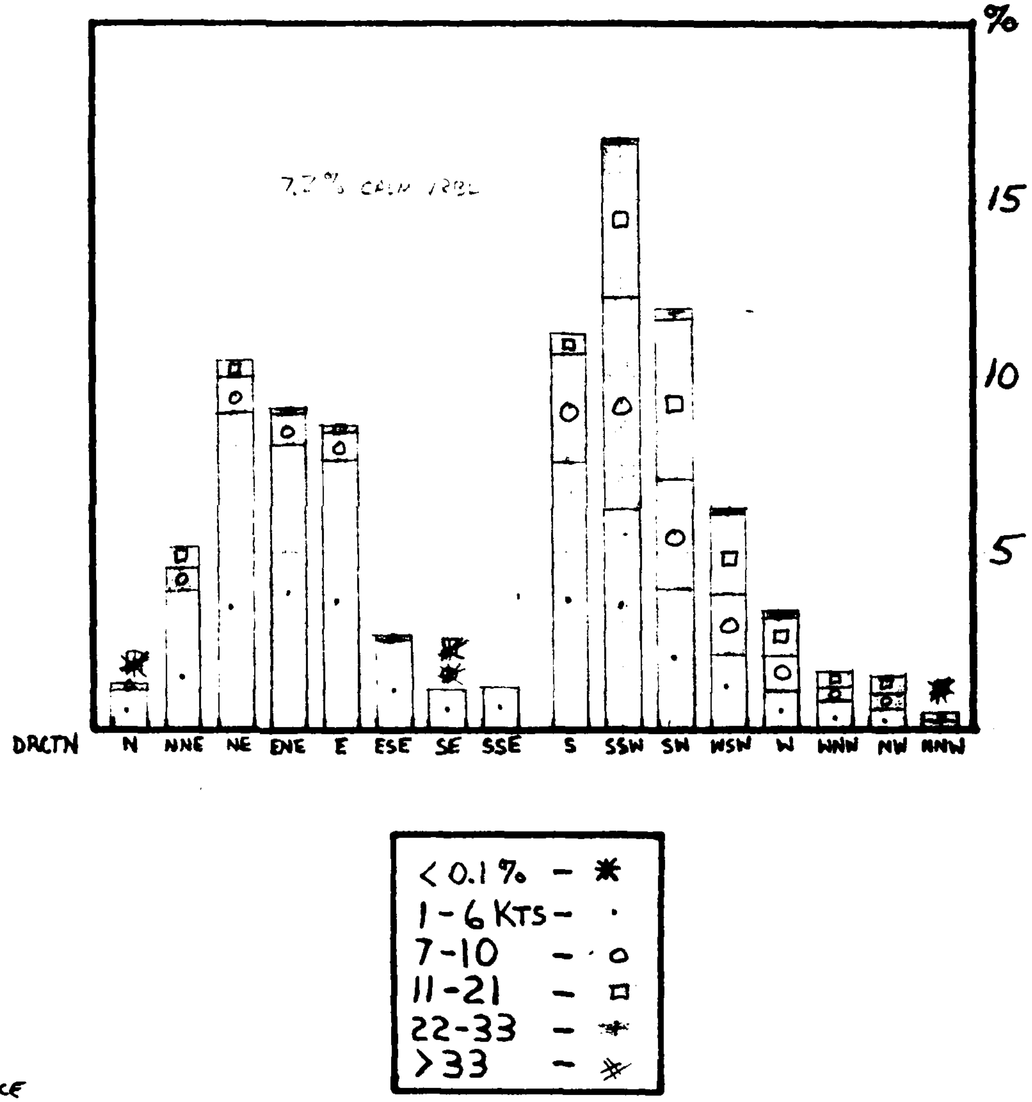
RHEIN MAIN AIR BASE

JANUARY
CLIMATOLOGY

CEILING/VISIBILITY



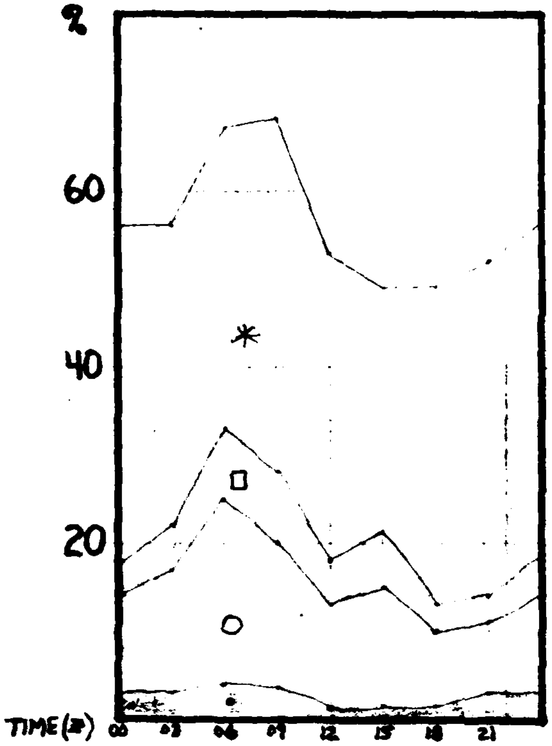
WIND



SOURCE: REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS JAN67-DEC76

FEBRUARY CLIMATOLOGY

CEILING/VISIBILITY



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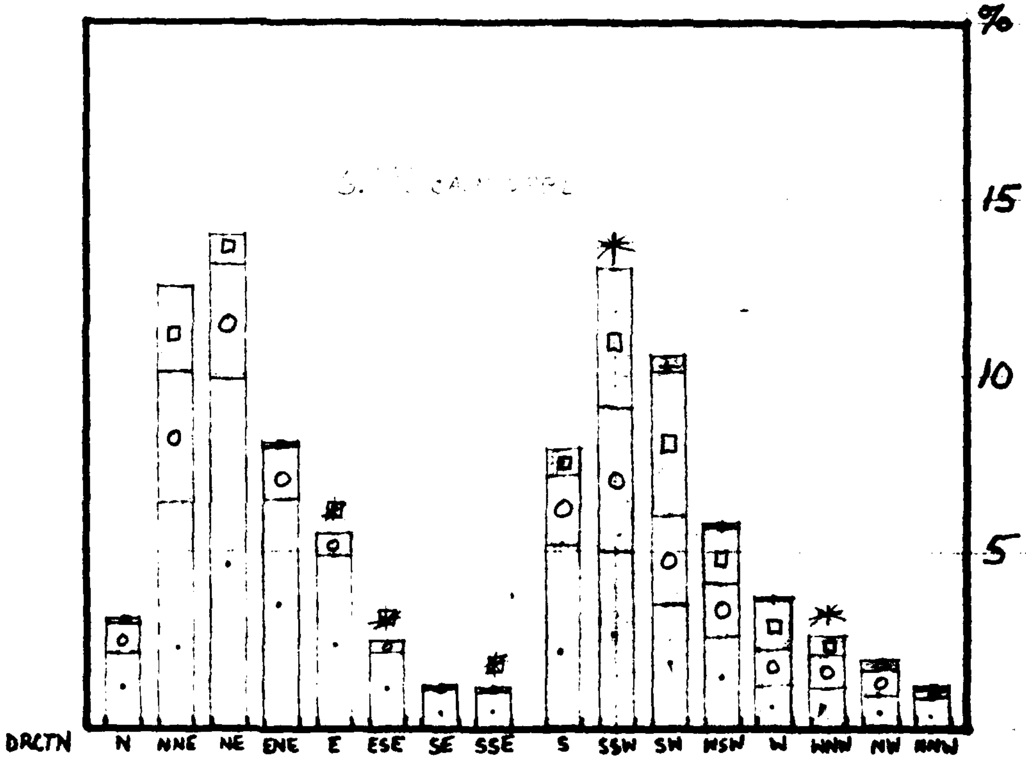
<500/2.0MI(1.7NM) – ○
<1000/2.5MI(2.2NM) – □
<3000/5.0MI(4.3NM) – *

SOURCE: REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS JAN67 – DEC76

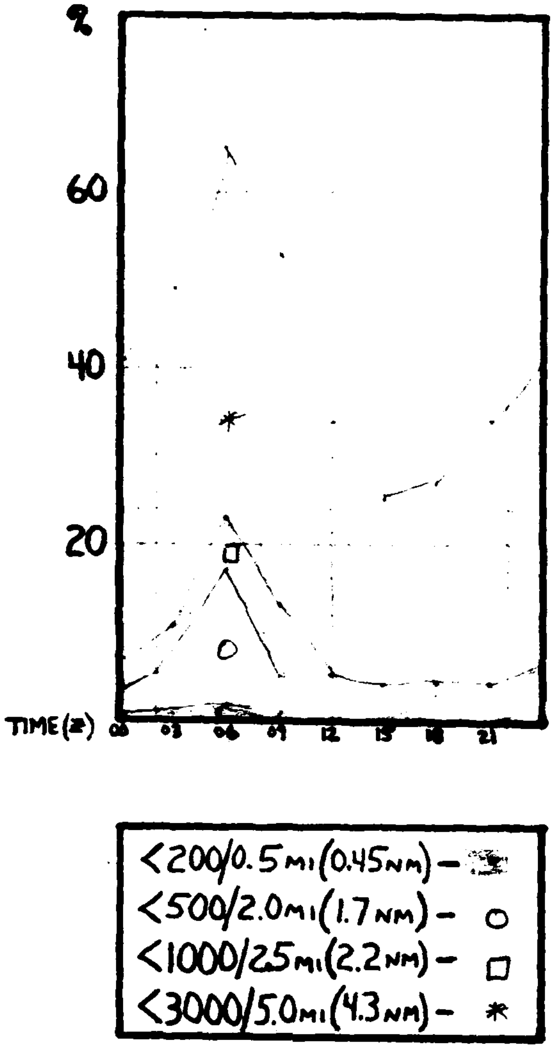
WIND



<0.1% – *
1-6 KTS – ·
7-10 – ○
11-21 – □
22-33 – +
>33 – *

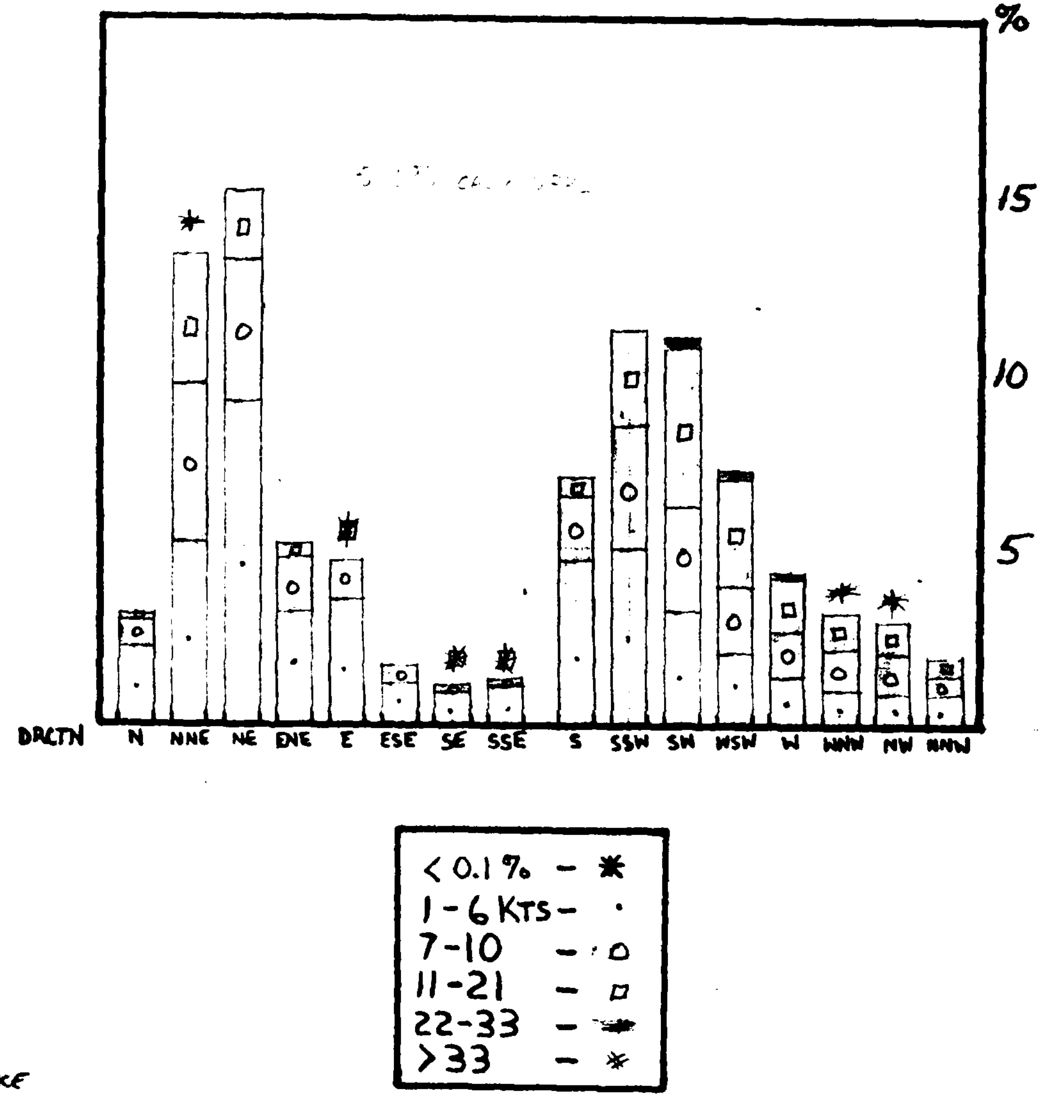
MARCH CLIMATOLOGY

CEILING/VISIBILITY



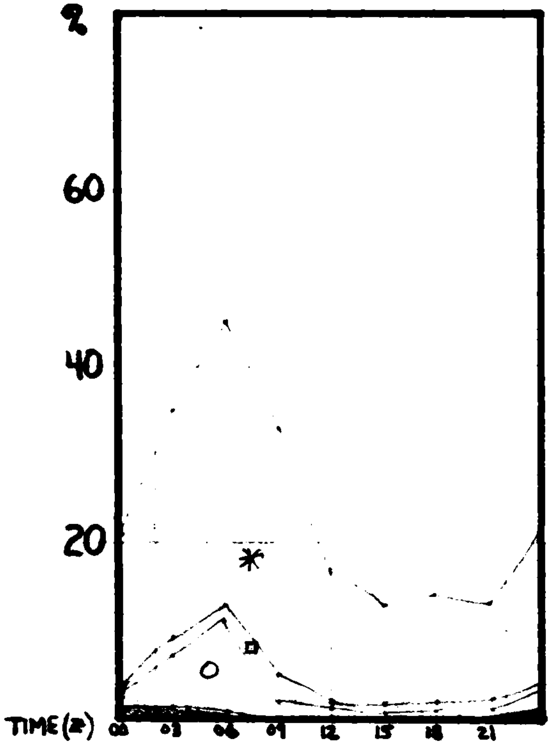
SOURCE: REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS JAN67–DEC76

WIND



APRIL CLIMATOLOGY

CEILING/VISIBILITY



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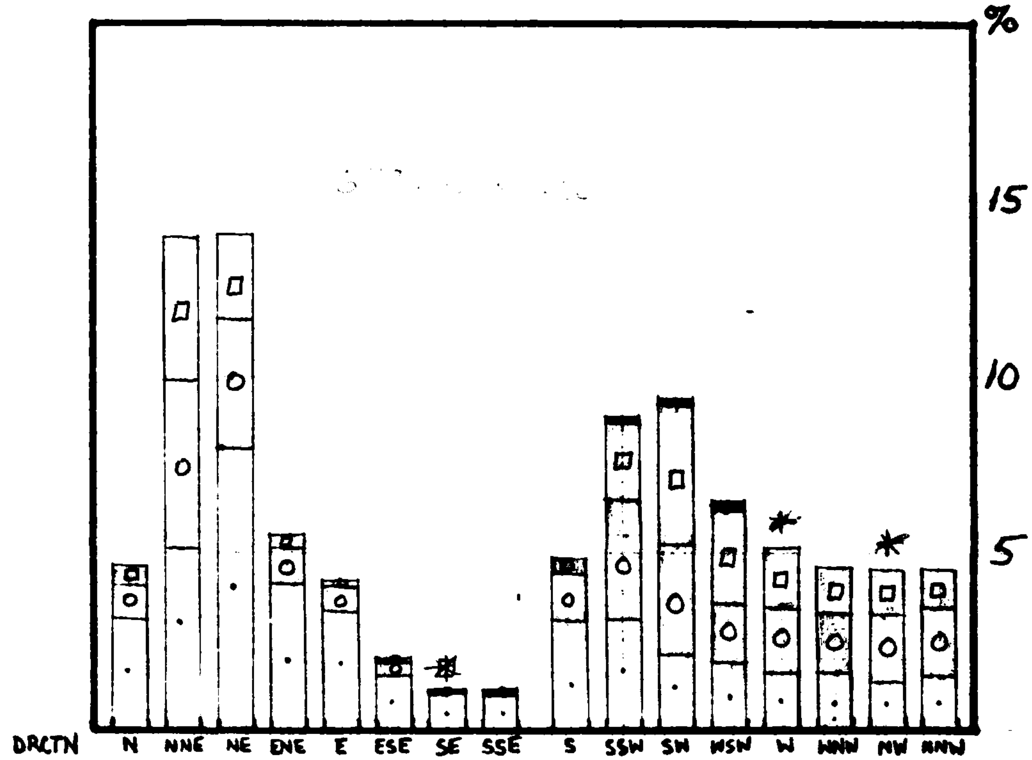
<500/2.0mi(1.7nm) – o
<1000/2.5mi(2.2nm) – □
<3000/5.0mi(4.3nm) – *

SOURCE: REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS JAN67–DEC76

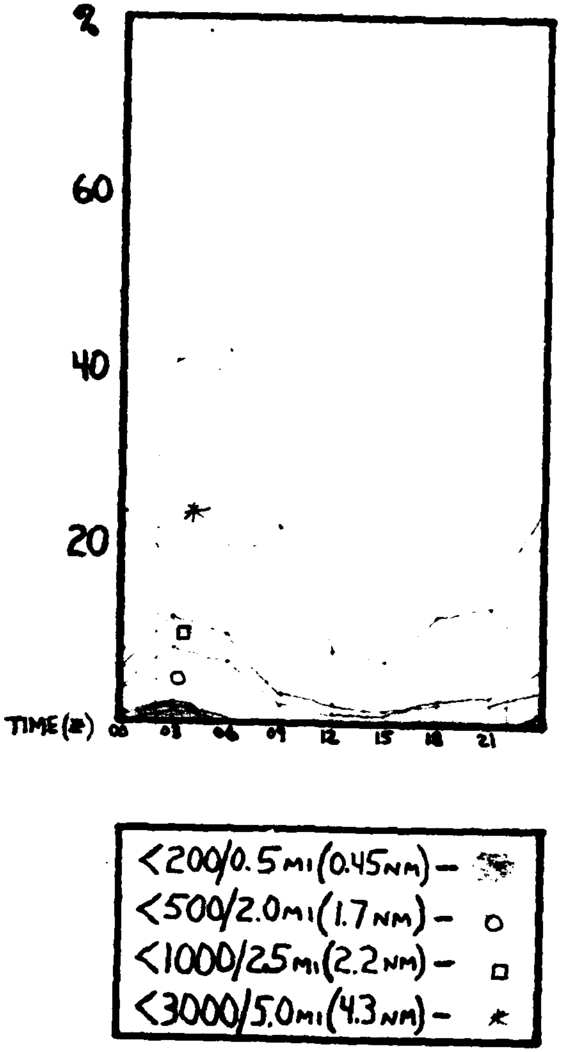
WIND



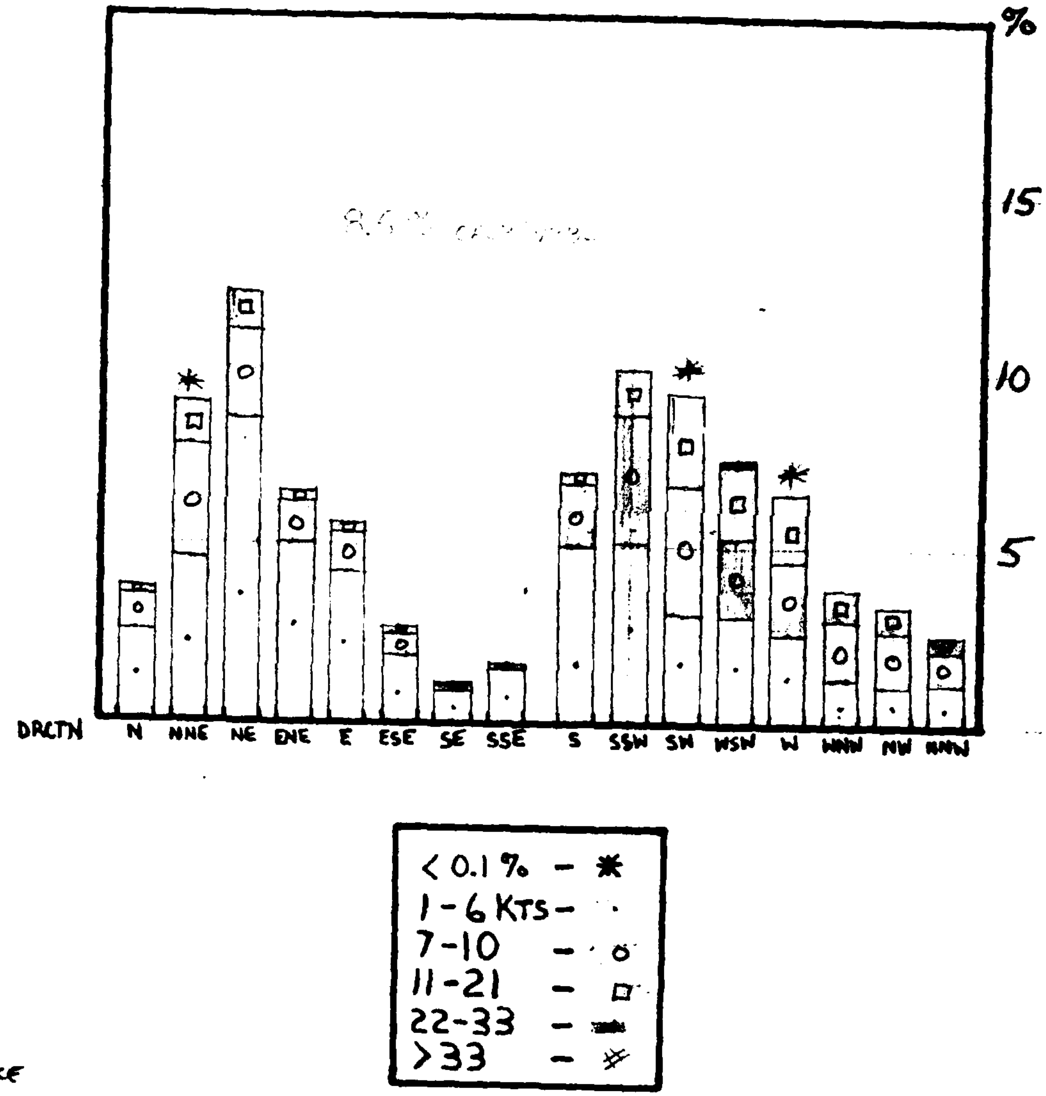
<0.1% – *
1–6 KTS – ·
7–10 – o
11–21 – □
22–33 – ▬
>33 – ⋇

MAY CLIMATOLOGY

CEILING/VISIBILITY



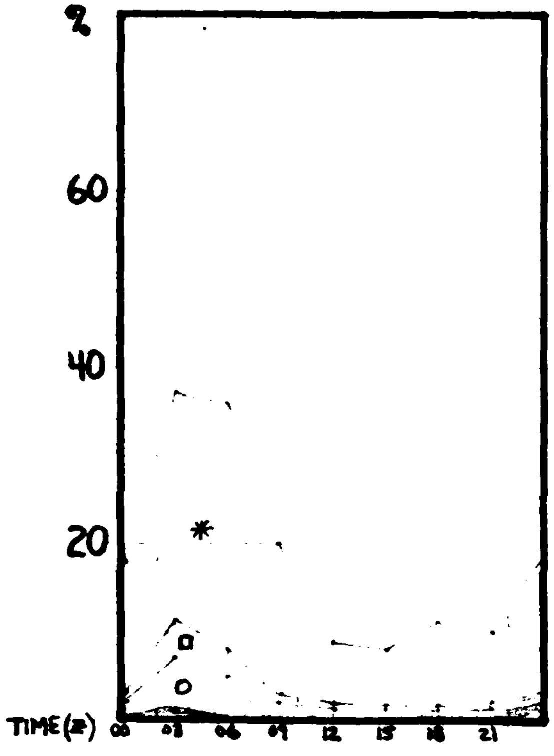
WIND



SOURCE: REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS JAN67–DEC76

JUNE CLIMATOLOGY

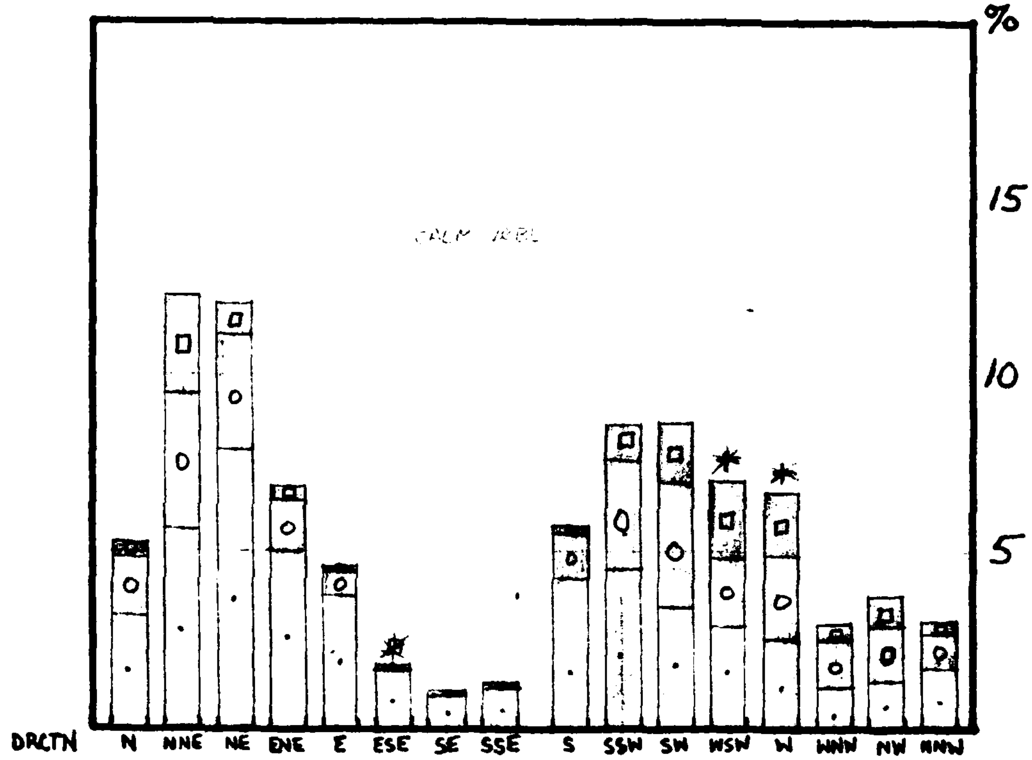
CEILING/VISIBILITY



<200/0.5mi(0.45nm) –
<500/2.0mi(1.7nm) – o
<1000/2.5mi(2.2nm) – □
<3000/5.0mi(4.3nm) – *

SOURCE: REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS JAN67 – DEC76

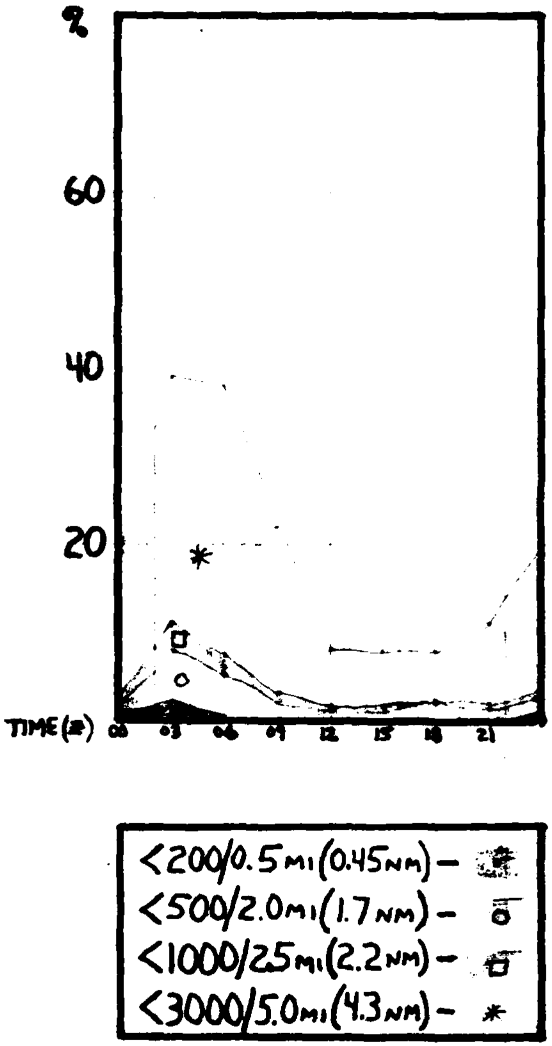
WIND



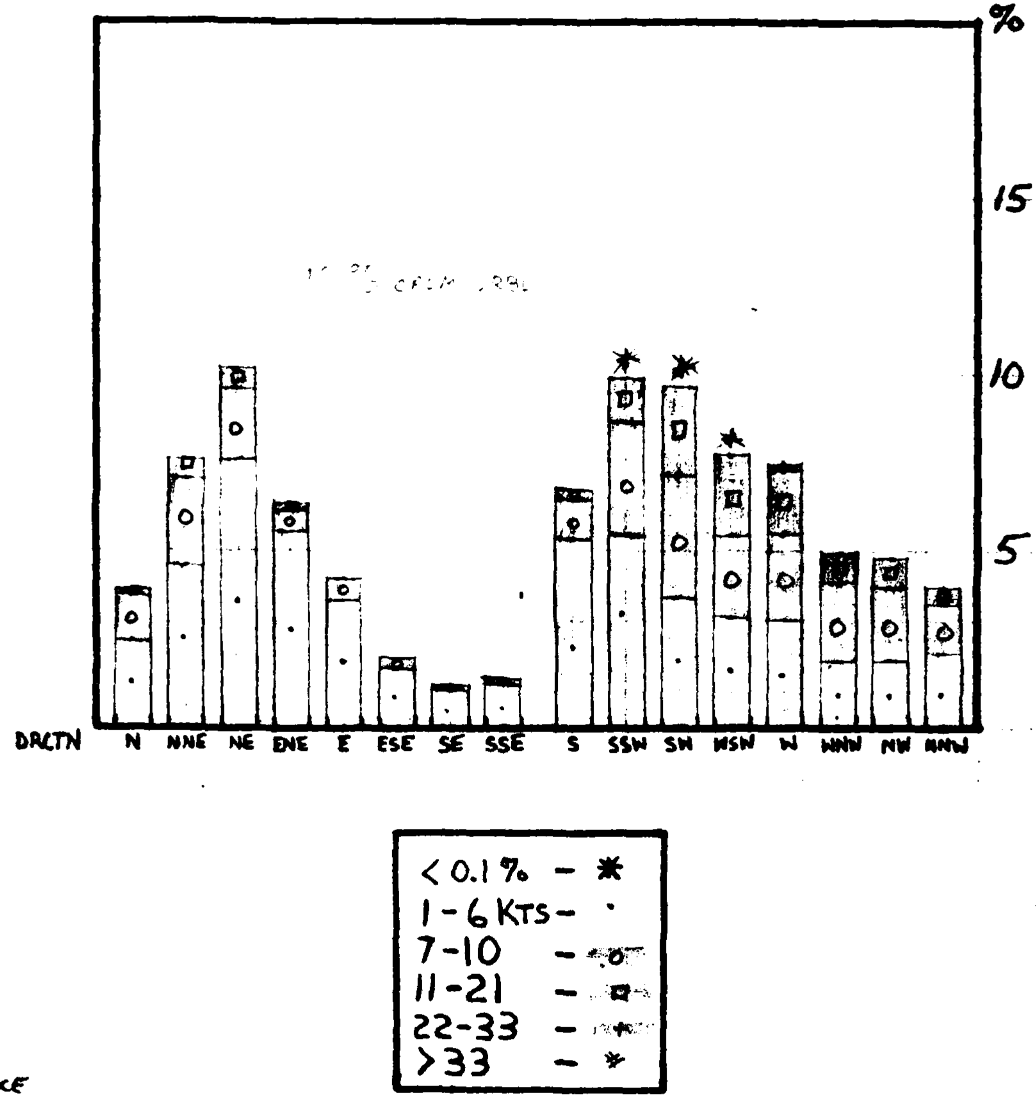
< 0.1% – *
1 - 6 KTS –
7-10 – o
11-21 – □
22-33 –
>33 – ✳

JULY CLIMATOLOGY

CEILING/VISIBILITY



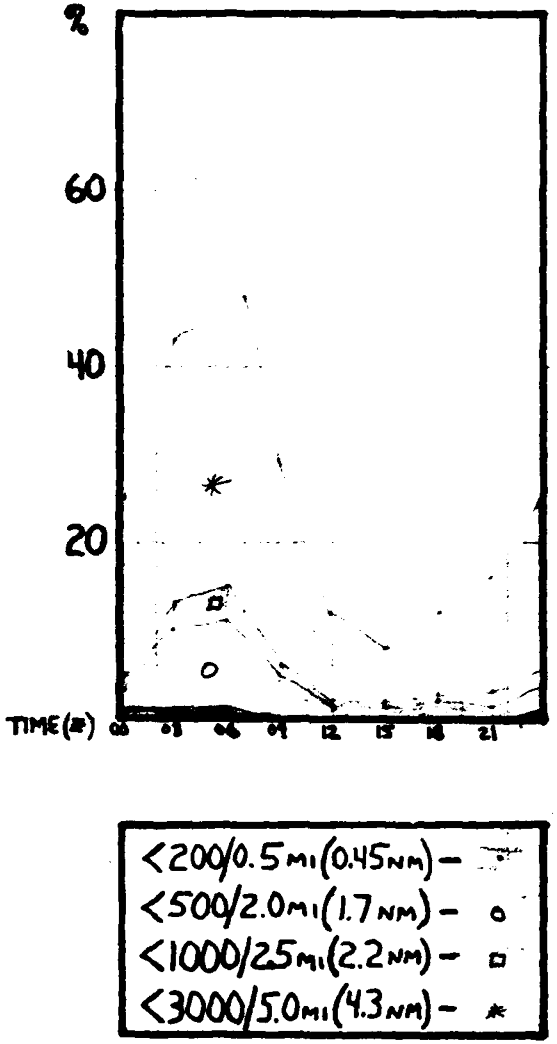
WIND



SOURCE: REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS JAN67-DEC76

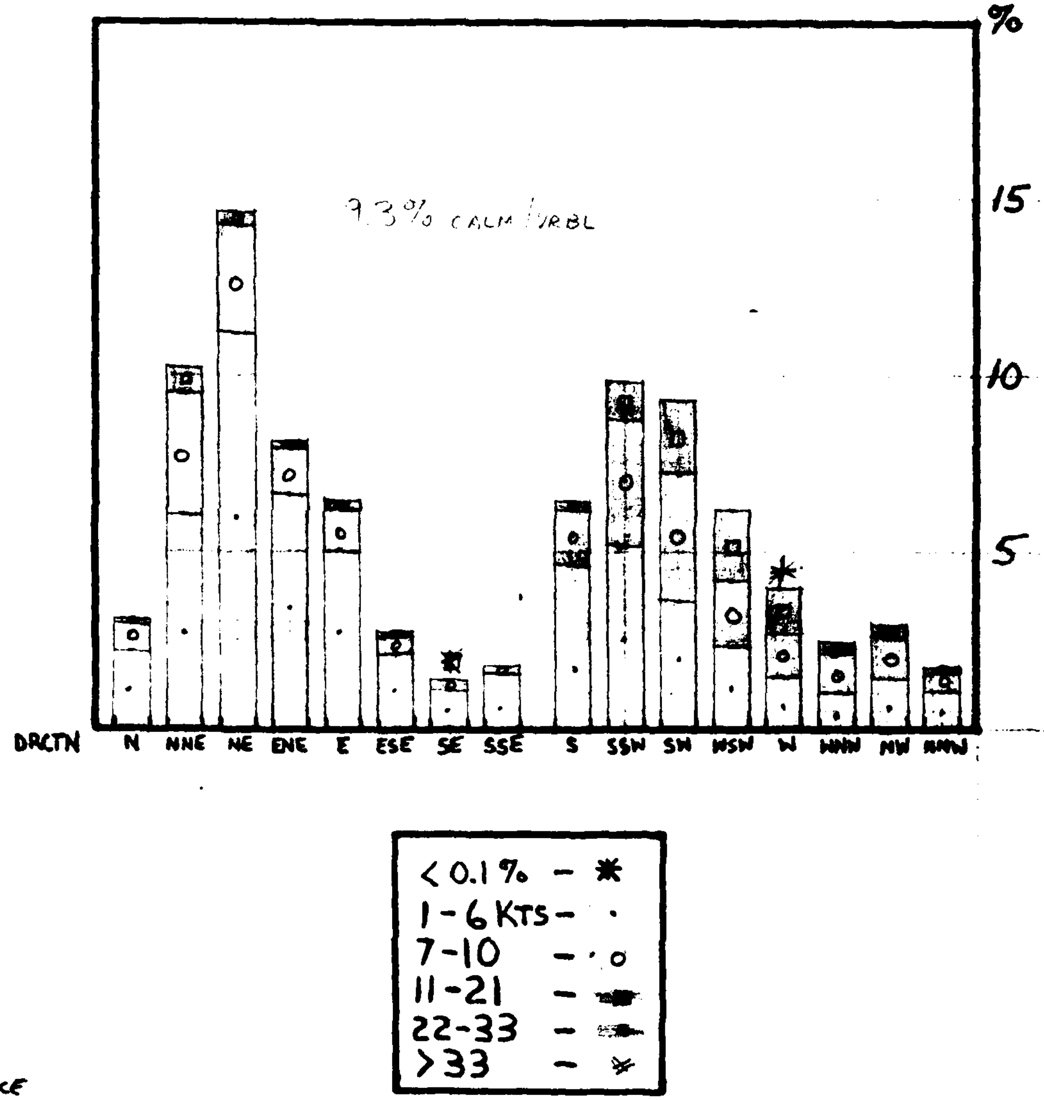
AUGUST CLIMATOLOGY

CEILING/VISIBILITY



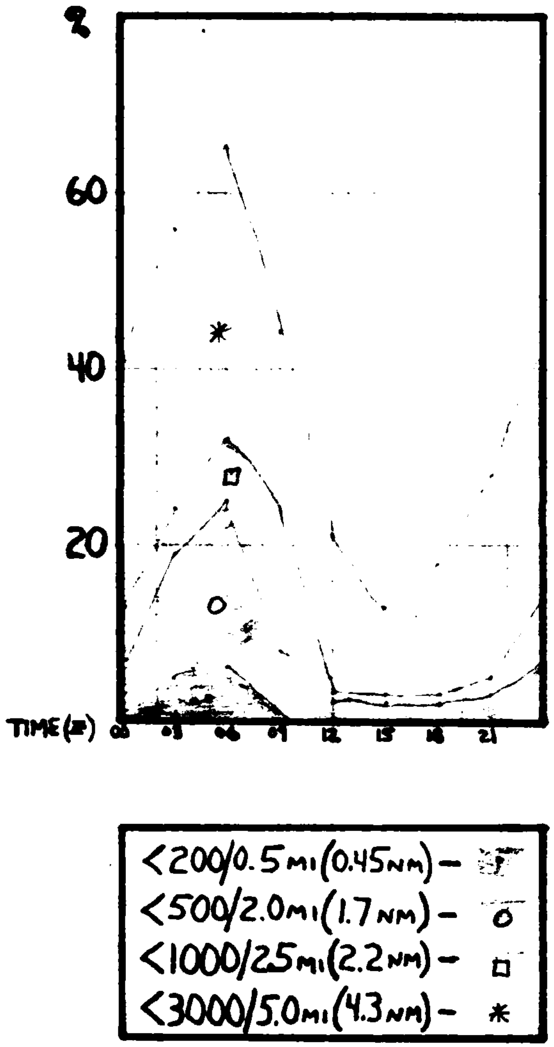
SOURCE: REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS JAN67–DEC76

WIND

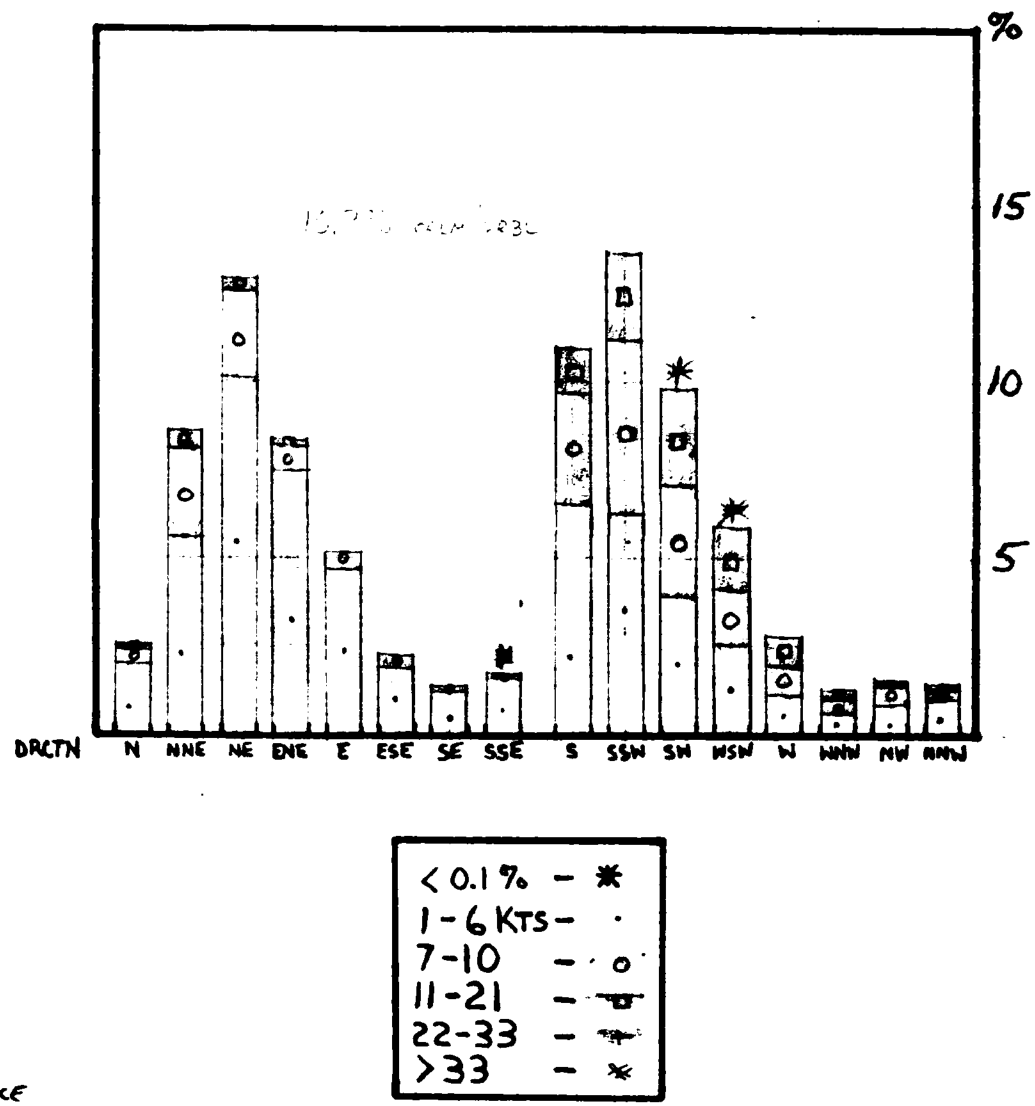


SEPTEMBER CLIMATOLOGY

CEILING/VISIBILITY



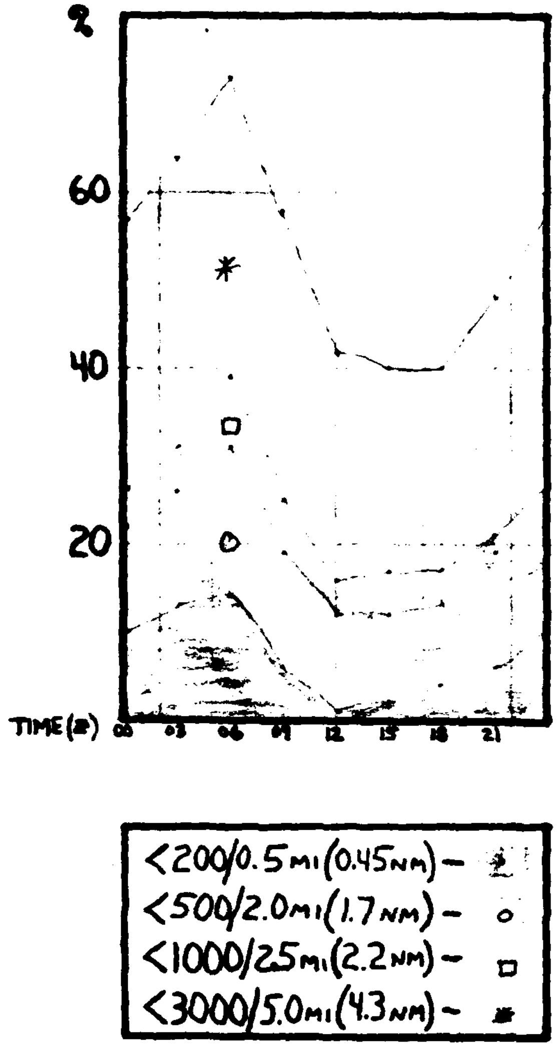
WIND



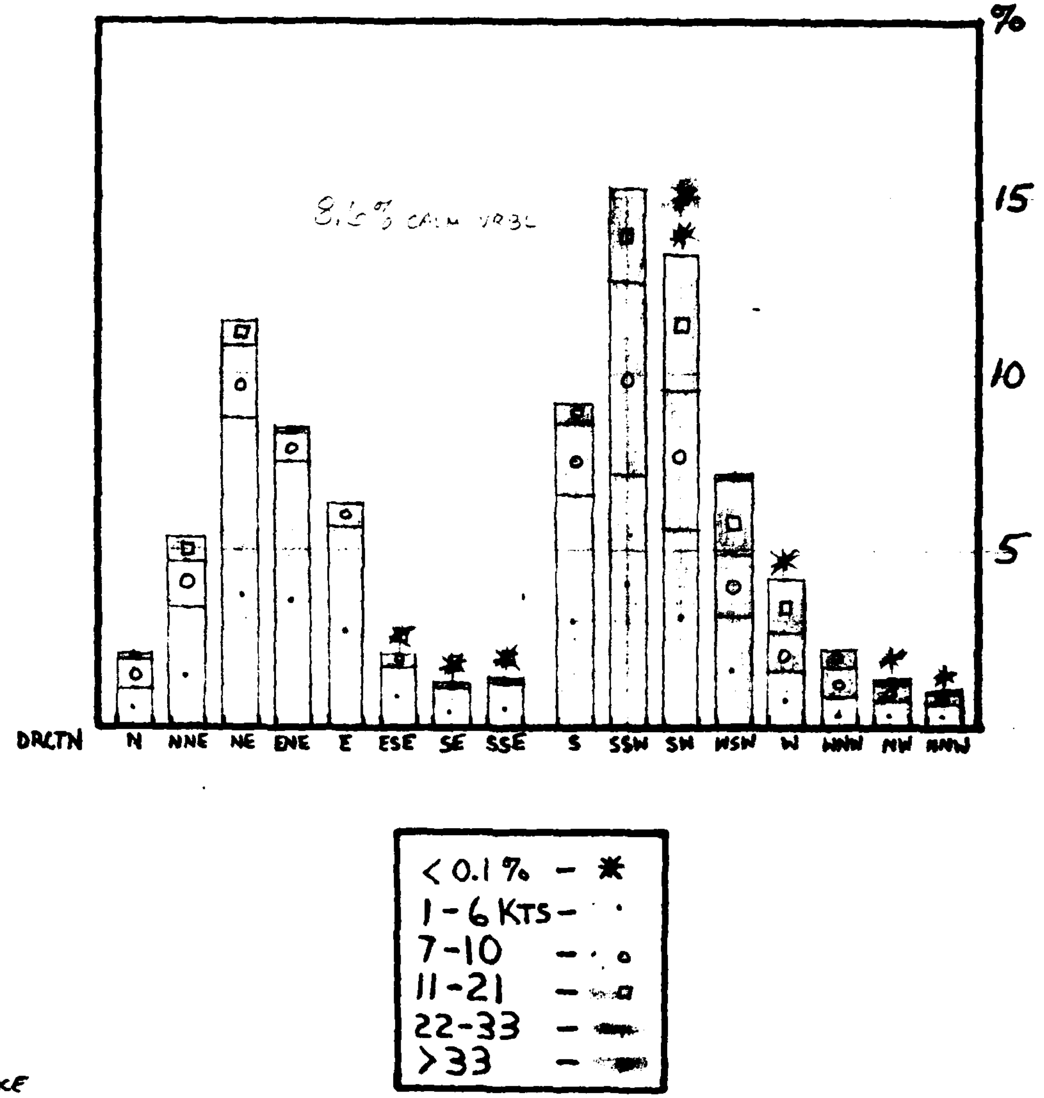
SOURCE: REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS JAN67-DEC76

OCTOBER CLIMATOLOGY

CEILING/VISIBILITY



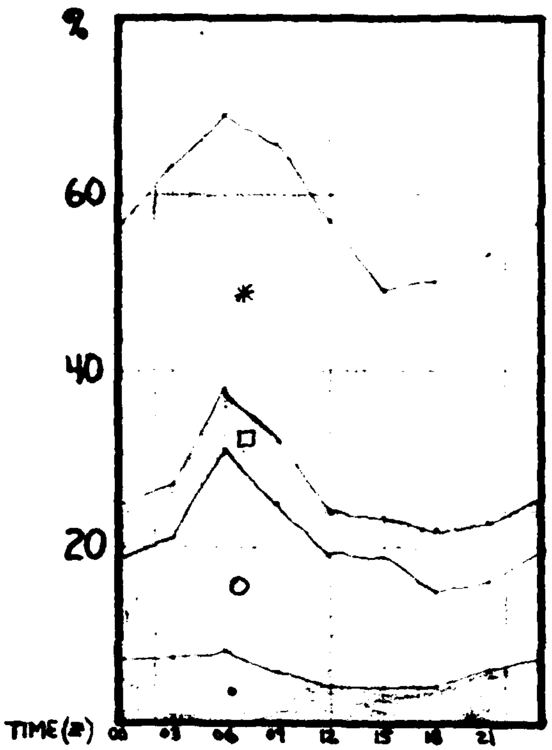
WIND



SOURCE: REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS JAN67-DEC76

NOVEMBER CLIMATOLOGY

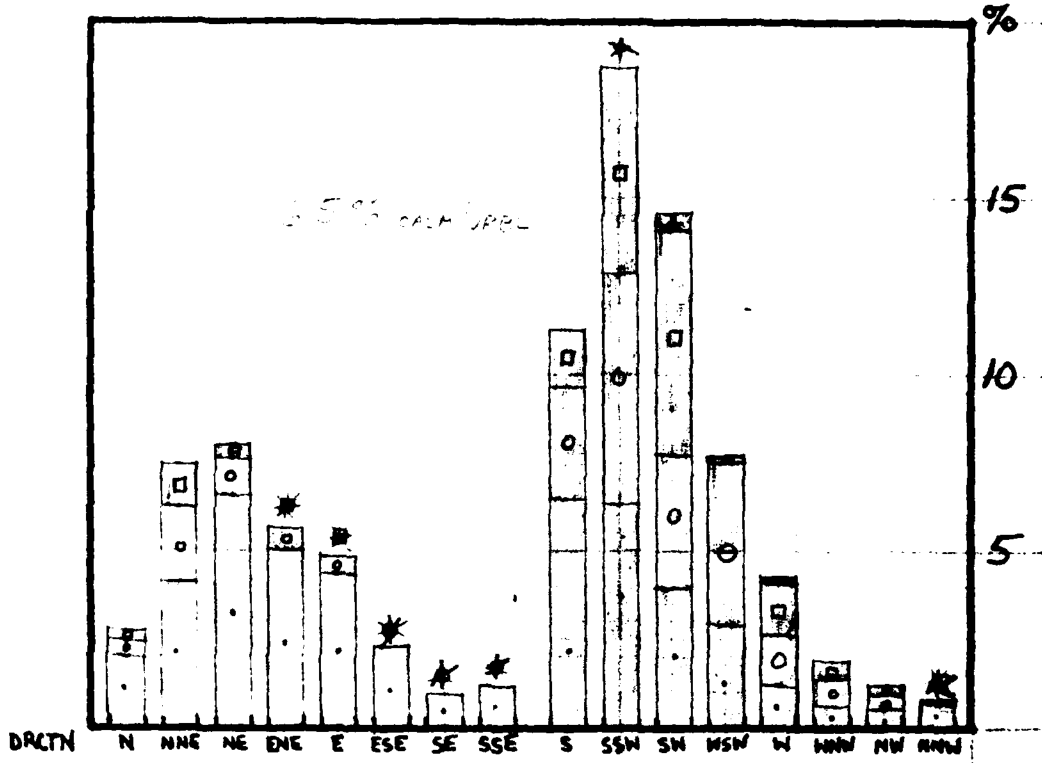
CEILING/VISIBILITY



<200/0.5 MI (0.45 NM) – •
<500/2.0 MI (1.7 NM) – o
<1000/2.5 MI (2.2 NM) – □
<3000/5.0 MI (4.3 NM) – *

SOURCE: REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS JAN67 – DEC76

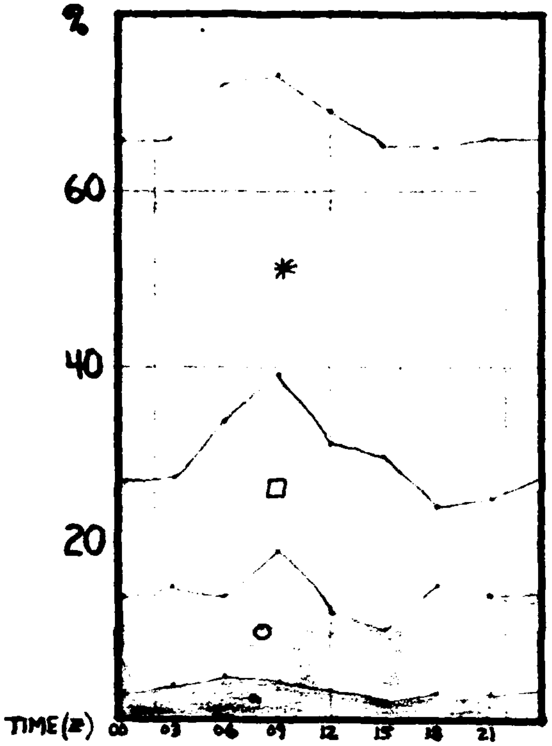
WIND



< 0.1 % – *
1 – 6 KTS – ·
7 – 10 – o
11 – 21 – ▬
22 – 33 – ▬
> 33 – *

DECEMBER CLIMATOLOGY

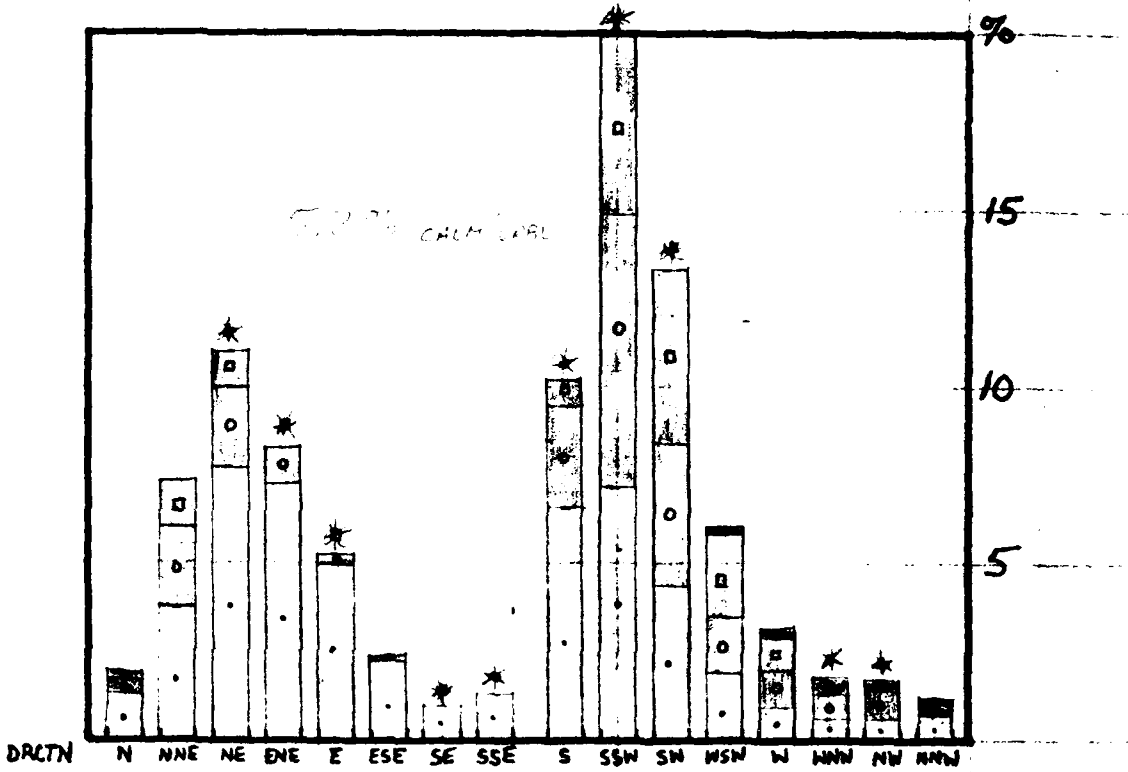
CEILING/VISIBILITY



<200/0.5MI(0.45NM) – •
<500/2.0MI(1.7NM) – o
<1000/2.5MI(2.2NM) – □
<3000/5.0MI(4.3NM) – *

SOURCE: REVISED UNIFORM SUMMARY OF SURFACE WEATHER OBSERVATIONS JAN67–DEC76

WIND



< 0.1% – *
1–6 KTS – •
7–10 –
11–21 –
22–33 –
>33 –

AWS CLIMATIC BRIEF

FRANKFURT MAIN/RHEIN MAIN APT, GERMANY

CL DATED JUN 70 OBSOLETE

PREPARED BY USAFETAC NOVEMBER 1977

STATION NAME / LOCATION: RHEIN-MAIN APT GERMANY(FRANKFURT) N50 02 E008 34

PERIOD: SEP 46-DEC 76 B — ELEV: 368

STN LTRS: EDDF — WBAN NO: 35032 — WMO NO: 10637

AWS CLIMATIC BRIEF

MONTH	Temp (°F) Mean Daily Max	Mean Daily Min	Mean Monthly	Extreme Max	Extreme Min	Precip (in) Monthly Mean	Monthly Max	Monthly Min	Max 24 Hrs	Snowfall (in) Monthly Mean	Monthly Max	Max 24 Hrs	Mean RH (%) LST 04	LST 13	Vapor Pressure (in Hg)	Dew Pt (°F)	Pressure Altitude (ft)	Surface Wind Prevailing Direction	Mean Speed (kt)	Max Speed (kt)	Cloud Cover	Precip ≥ .01	Precip ≥ .5	Snowfall ≥ .1	Snowfall ≥ 1.5	Thunderstorms	Fog Vsby < 7/8 mi	Max ≥ 90	Max ≥ 80	Min ≤ 32	Min ≤ 00
JAN	37	28	33	60	-1	1.6	3.9	*	.7	4	11	9	90	87	.18	[illegible]	1000	SSW	6	[illegible]	8	14	6	4	1	0	20	0	0	20	*
FEB	40	28	34	64	-4	1.4	3.8	.1	1.3	4	17	8	88	77	.17	31	[illegible]	NE	6	[illegible]	7	12	*	3	1	*	19	0	0	18	*
MAR	50	33	42	74	9	1.5	3.9	.1	.9	1	4	4	86	61	.19	33	[illegible]	NE	7	[illegible]	7	11	*	1	*	*	18	0	0	19	0
APR	59	40	50	87	20	1.8	4.1	.3	1.0	*	2	2	86	56	.22	37	[illegible]	NE	7	[illegible]	6	13	1	*	*	2	13	0	*	4	0
MAY	67	46	57	89	26	2.3	4.0	.6	1.8	*	*	*	87	54	.31	46	[illegible]	NE	6	[illegible]	7	12	1	0	0	4	14	0	3	1	0
JUN	73	52	63	97	32	2.8	5.3	.2	2.1	0	0	0	86	55	.38	51	[illegible]	NNE	6	[illegible]	6	13	1	0	0	5	15	1	6	*	0
JUL	78	56	66	100	38	2.5	5.1	.1	2.0	0	0	0	87	54	.44	55	700	NE	6	[illegible]	6	12	1	0	0	5	14	2	10	0	0
AUG	74	54	65	96	38	3.0	5.8	.1	3.1	0	0	0	88	54	.44	55	[illegible]	NE	6	[illegible]	6	12	1	0	0	4	17	1	7	0	0
SEP	69	50	60	93	32	2.[illegible]	5.4	.1	1.4	0	0	0	93	62	.38	51	[illegible]	SSW	5	[illegible]	6	11	1	0	0	1	21	*	3	*	0
OCT	58	42	50	80	21	1.9	5.3	.2	1.6	*	*	*	93	71	.28	43	[illegible]	SSW	6	[illegible]	7	10	1	0	0	*	24	0	*	4	0
NOV	45	36	41	63	11	2.1	5.2	.3	1.7	1	7	4	91	80	.22	37	[illegible]	SSW	7	[illegible]	8	14	1	1	*	*	24	0	0	10	0
DEC	39	30	35	60	1	2.1	4.9	.3	1.1	3	19	10	89	82	.17	31	[illegible]	SSW	7	[illegible]	8	14	1	2	*	*	24	0	0	18	0
ANN	57	41	49	100	-4	25.0	5.8	*	3.1	13	19	10	89	65	.27	42	[illegible]	SSW	6	[illegible]	7	148	9	11	2	[illegible]	[illegible]	4	29	90	*
POR	21	21	21	21	21	21	21	21	21	21	21	21	10	10	10	10	6	10	10	[illegible]	4	21	21	21	21	21	21	21	21	21	21

REMARKS RUSSWO POR:
HOURLY OBS: JAN [illegible]7-DEC 7[illegible]

DAILY OBS: SEP 46-DEC 67

NOTE: * DATA NOT AVAILABLE — # = AMTS < UNITS SHOWN IN HEADING — ** MAX HRLY WND SP CLASS INT — S = CALM GRTR N PLVG DRCTN — BASED ON [illegible] FULL MONTHS

CAV FREQ (%)	HRS LST	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN	POR
CEILING LESS THAN 3000 FT AND/OR VISIBILITY LESS THAN 3 MI	00-02	56	38	23	11	13	8	7	22	21	43	46	53	27	
	03-05	60	39	31	21	22	20	18	23	34	51	50	53	35	
	06-08	66	53	41	26	19	16	16	24	42	56	59	60	40	
	09-11	64	50	31	21	14	13	10	16	25	43	54	61	34	
	12-14	59	38	22	14	6	6	4	6	10	32	46	54	29	
	15-17	58	36	15	10	4	5	5	4	6	30	41	54	22	
	18-20	50	34	15	9	6	6	5	6	7	28	39	51	21	
	21-23	52	35	18	9	8	6	5	7	11	33	40	51	23	
	ALL HRS	58	40	25	15	12	10	9	12	20	40	47	55	29	10
CEILING LESS THAN 1500 FT AND/OR VISIBILITY LESS THAN 3 MI	00-02	35	25	12	5	8	5	4	9	16	32	32	35	18	
	03-05	41	28	18	12	17	16	15	17	29	39	34	37	25	
	06-08	49	39	30	18	14	11	13	19	37	46	45	46	31	
	09-11	51	36	17	8	5	5	5	8	19	32	42	50	23	
	12-14	43	23	9	3	2	3	2	2	5	19	30	41	15	
	15-17	40	25	7	3	2	2	2	2	4	21	30	40	15	
	18-20	31	20	7	3	3	3	3	4	5	20	28	33	13	
	21-23	35	21	8	3	4	3	3	4	[illegible]	25	29	33	15	
	ALL HRS	41	27	14	7	7	6	6	8	15	29	34	39	19	10
CEILING LESS THAN 1000 FT AND/OR VISIBILITY LESS THAN 2 MI	00-02	24	16	5	4	6	2	2	4	8	23	23	22	12	
	03-05	29	20	7	8	10	7	8	10	20	28	25	23	16	
	06-08	36	28	19	11	8	4	5	11	26	34	34	31	21	
	09-11	36	22	9	4	3	1	2	5	10	21	28	33	15	
	12-14	27	14	4	2	1	1	1	1	2	13	20	27	9	
	15-17	27	16	3	1	1	1	1	1	2	13	20	24	9	
	18-20	21	10	3	1	2	1	2	2	2	14	19	21	8	
	21-23	22	12	3	2	2	2	1	2	3	20	20	21	9	
	ALL HRS	28	17	7	4	4	2	3	5	9	21	24	25	12	10
CEILING LESS THAN 200 FT AND/OR VISIBILITY LESS THAN 1/2 MI	00-02	3	3	1	1	1	0	1	*	1	10	7	3	3	
	03-05	4	3	1	1	2	1	2	1	5	12	7	3	4	
	06-08	8	4	1	*	*	*	*	1	6	14	8	5	4	
	09-11	6	3	*	0	0	0	0	*	1	5	6	4	2	
	12-14	3	1	0	0	0	0	0	0	0	1	4	3	1	
	15-17	3	2	0	0	0	0	0	0	0	2	4	2	1	
	18-20	3	2	0	*	0	0	0	0	0	4	4	2	1	
	21-23	3	2	0	*	0	0	0	0	*	4	5	3	[illegible]	
	ALL HRS	4	3	*	*	*	*	*	*	2	7	6	3	2	10

AWS FORM NOV 76 62 — PREVIOUS EDITION MAY BE USED

SECTION 3

APPROVED LOCAL FORECAST STUDIES

LOCAL STUDIES

RULES OF THUMB

APPROVED FORECAST STUDIES

There are no approved local forecast studies available for Rhein-Main. An objective method for forecasting fog has been retired to the local forecast techniques file.

RULES OF THUMB

There are currently no rules of thumb which have been thoroughly tested with a minimum of two years of dependent data and three years of independent data.

SECTION 4

WEATHER CONTROLS

SYNOPTIC PATTERNS

- WINTER
- SPRING
- SUMMER
- FALL

SYNOPTIC PATTERNS

WINTER

WINTER

AIR MASSES

It may be pointed out that due to Europe's location with respect to land and water masses, it is predominantly exposed to maritime air masses from the Atlantic since we are in the zone of westerlies. Contrary to conditions in the United States, there is no source of cold arctic air directly to the north of Europe that is easily pulled down over the continent behind each cold front.

Since the average flow over Europe and Germany is westerly, or a small variation thereof for the most of the winter, Germany and Rhein Main experience maritime polar air masses much of the time and less severe winters than the United States. To continue from this observation we may say that Maritime Polar air is the most prevalent air mass over Germany;and its two north-south relatives, maritime tropical and maritime arctic air,invade Germany on occasions when the circulation is distorted far enough to bring that respective air mass in. Maritime arctic air usually invades after a long trajectory from the north or northwest off the Greenland ice cap. Such a flow must traverse the warm Gulf Stream causing some warming before reaching Germany.

The other two air masses experienced in Germany are continental polar and continental arctic. For conditions to allow either of these two air masses to prevail it is clear that the circulation cannot have a long over water trajectory; therefore, we may say that the normal westerly flow must be shut off. Continental polar and continental arctic air masses invade Germany *under extremely low index* conditions, usually so low as to be negative in this region with easterly circulation. These two air masses originate over the extremely cold Siberian ice cap and are brought down into Germany with an easterly or north easterly flow around an intense Siberian or Scandinavian warm cell, which is very often a result of a connection with a north-eastern extension of the Azores High that has become independent of its parent high.

The weather phenomena associated with the above air masses at Rhein Main are as follows: During the presence of maritime air masses (whether tropical, polar. or arctic), generally stable conditions prevail except during conditions of convergence such as frontal passages. These air masses are relatively warmer than the continent during the winter and are cooled from beneath during their passage from their warmer source. Stratified clouds, drizzle or rain, and moderate to poor visibilites with haze and fog prevail. During the presence of continental air masses, generally good flying conditions prevail. Due to the lack of moisture in its first stages, clear skies and the coldest weather are observed. After the invasion of these two air masses (continental polar and arctic) is complete, low temperatures continue but a strong subsidence inversion appears due to the anti-cyclonic circulation accompanying the air masses. Broken to overcast skies prevail during the daytime, often clearing at night during peak radiation effects. An important phenomenon during the presence of the continental air masses, is the occurence of long lasting snowfalls or moderate to heavy snow showers. The criterion for the latter effect is a strong cyclonic activity in the Mediterranean and over-running of warm, moist air aloft. Snow is often the result of warm frontal activity over the Black Sea area. A trough forms in the easterly flow and moves westward into Germany, creating snow showers in the convergence of the trough of moist air.

FRONTS

Associated weather is common to all European fronts with few local effects. As with air masses, it is most interesting to compare frontal passage at Rhein Main to frontal passages in the United States. Again, the location of air masses as given previously is of prime interest. In Germany, the outbreaks of cold air are associated with anti-cyclonic circulation and with very little convergence preceding or accompanying the outbreak, just as in the US. Cold highs moving southward in the U.S. from Canada are sharply contrasted to the warm moist southern U.S air masses from the Gulf of Mexico. The discontinuity is great enough to cause many strong fronts and much cumulus and thunderstorm activity. The opposite is true in Germany. The discontinuity between air masses is small and the fronts are weaker. Invasions of the coldest air here, are a part of a large warm stable sprawling high with accompanying subsidence inversions and easterly flow seldom preceded by fronts. Nearly all cold fronts affecting Rhein Main have a history that brought them off the eastern coast of North America and across the Atlantic Ocean. Modification of the cold air mass behind the front , due to its long trajectory over the relatively warm Atlantic, is in many cases so great that continuity is difficult to maintain. Upon reaching the cold European continent the air that has traveled behind the cold front across the ocean is warmer than the air over Germany, and the cold front loses its characteristics; yet it does not take up those characteristics of a warm front or an occlusion and must be analyzed simply as a trough. As a result of the above circumstances, it is true that cold fronts at Rhein Main and in northern Europe as a whole, are much different from those in the U.S. Less cumuloform clouds are assosiated with fronts here than in the States, and average tops of the cumulus during the winter is about 8 to 10 thousand feet.

Poorest frontal weather conditions at Rhein Main are associated with pre-warm frontal situations. Ceilings less than 500 feet and visibilities less than 1 mile are not uncommon. Stationary cold fronts associated with weak westerly flow are equally as bad. Both are accompanied by low stratus, rain, and fog. It is believed that with weak westerly or southwesterly flow accompanied by frontal zone lying in the Rhein Main area, low stratus and fog are clogged into the Main River Valley and trapped by the surrounding mountains.

Temperature forecasts have no particularly unusual considerations and the causes of warm and cold weather has been discussed under the section on Air Masses.

Thunderstorms are most rare during all winter months which correlates well with the relatively little cumulus activity associated with European fronts and also the normal expectancy throughout the winter.

Tornadoes have never been observed at Rhein Main during the winter.

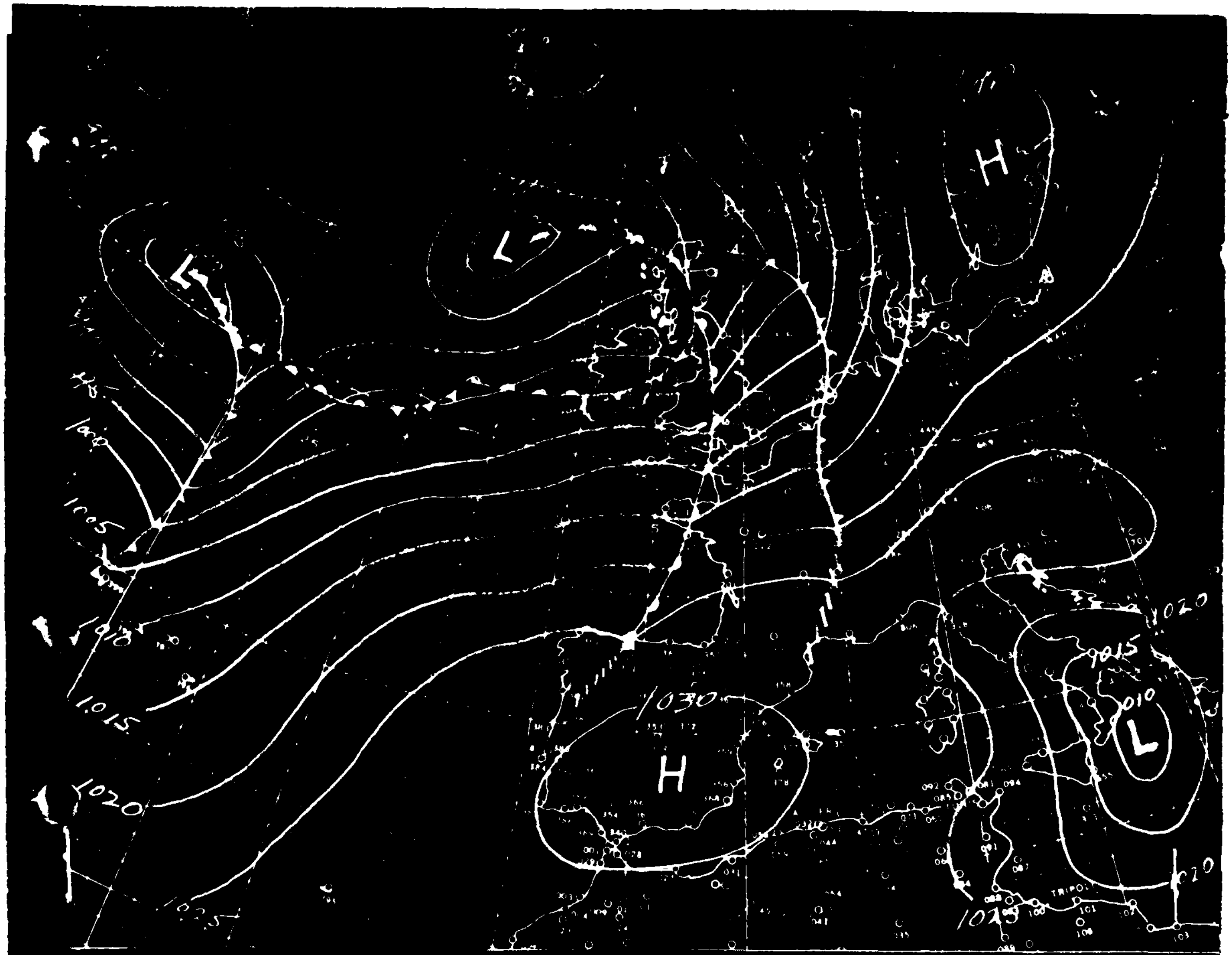


FIG.1-1 [illegible] LY TYPE WITH AN OCCLUSION [illegible] WARM FRONT. On the 1200Z, [illegible] Jan. 1948, [illegible] ridge of high pressure extends from the sub-tropical high over [illegible] into the Alps. [illegible] trough of low pressure extends from the central North Atlantic to Scotland. An occlusion has moved in from the Atlantic to the North Sea, the Lowlands, and [illegible] France and [illegible] following warm front has reached western Scotland, [illegible], Brittany, and northwestern [illegible]. This weather type brings [illegible] unfavorable flying weather conditions with low ceilings and poor visibility. [illegible] precipitation [illegible] snow becoming rain with rising temperature. [illegible] movement due to [illegible] ridge mentioned [illegible] which [illegible] this pronounced [illegible].

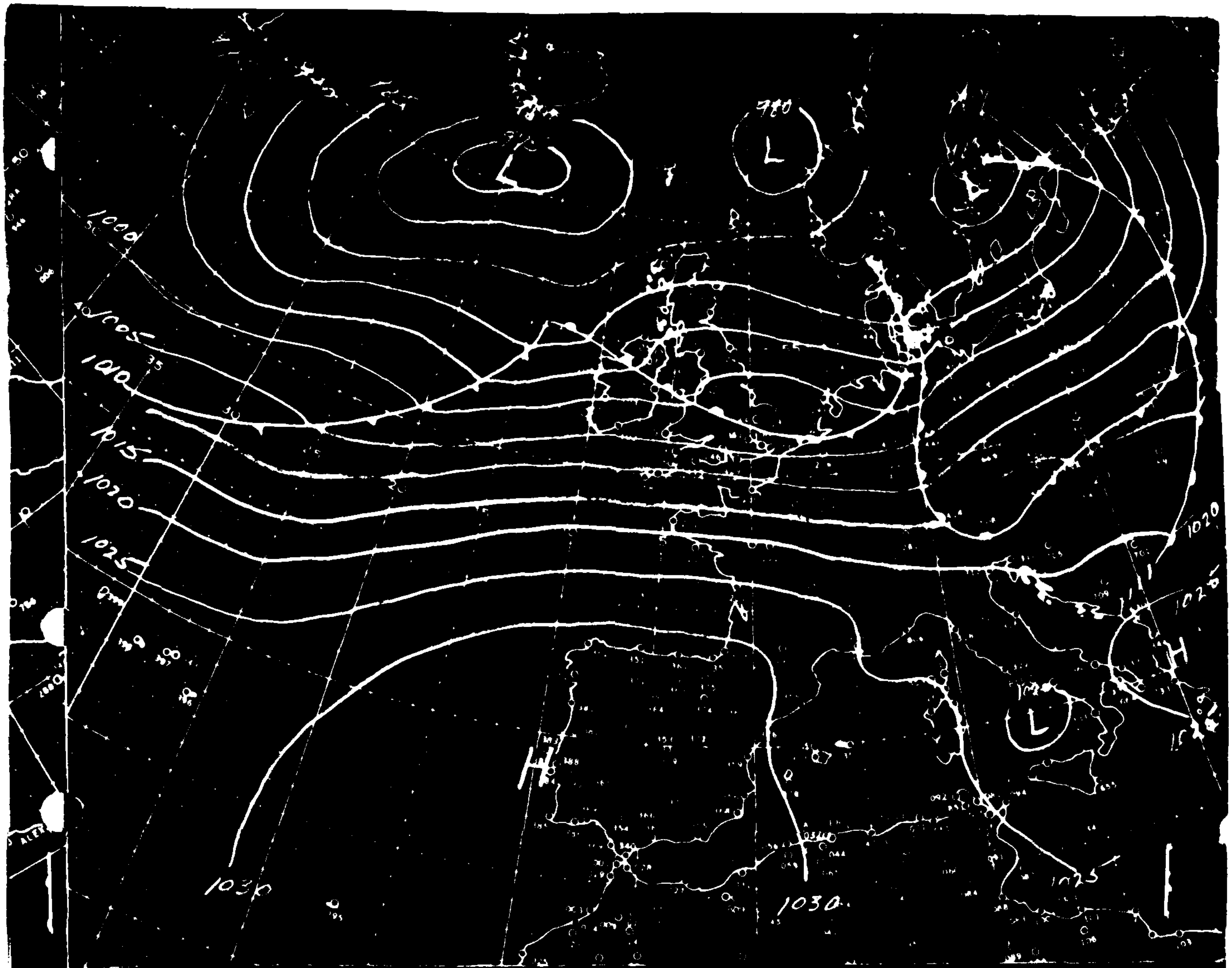
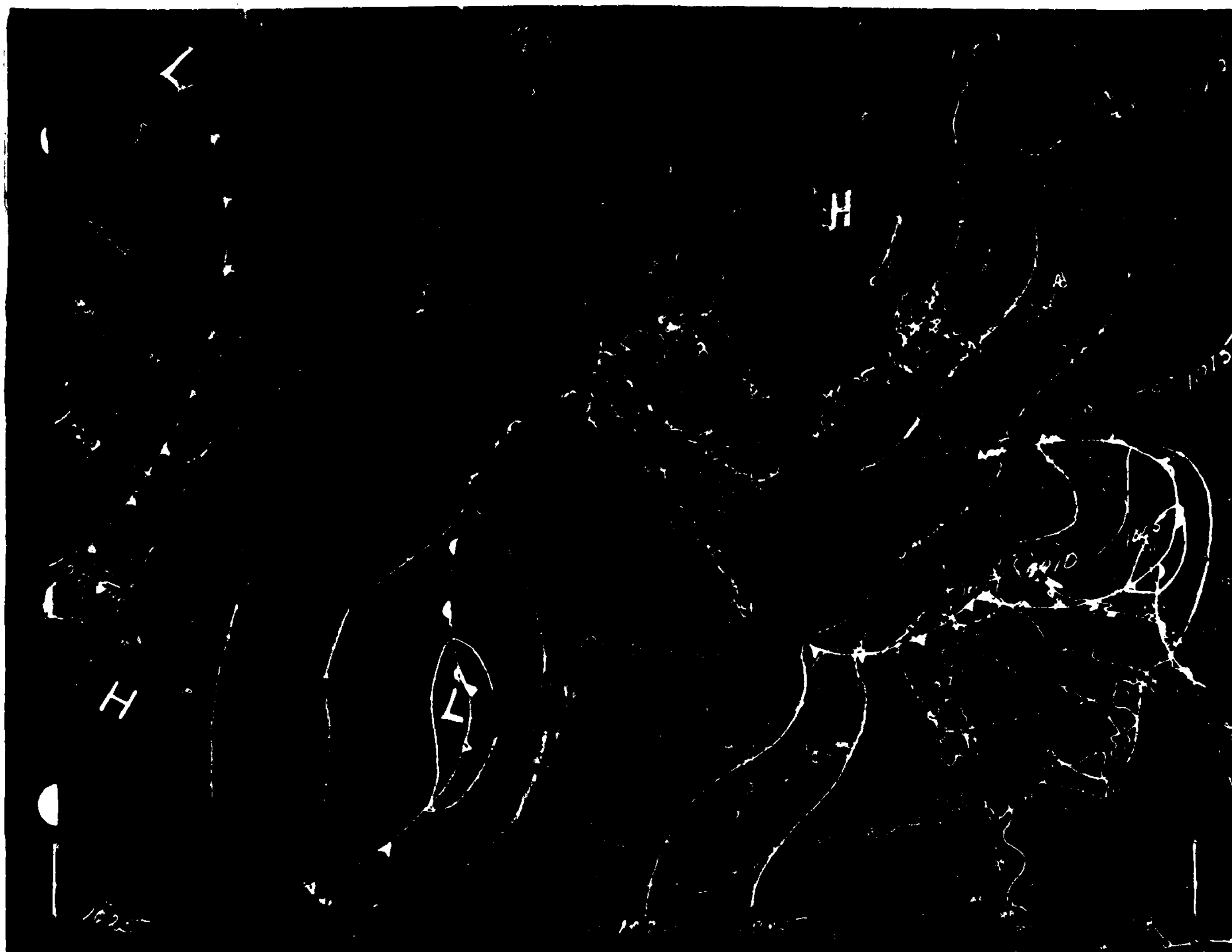


FIG. 1-2 THE WESTERLY TYPE: On the 0600Z, 13 J n. 1948, the subtro ic l high extends from the Azores to Spain with a steep ressure gradient tow r s the British Isles in the subtropical air flow. A low is cent red south of Ic l nd with trough extending to the e st tow rds southern S ndin vi . n occluded fr nt l system s alre dy passed Rhein M in nd lies over western Russi . The w rm front of the second system assed Rhein M in t bout 0 . Ceilings wer gen lly 5 - feet, lowering to 1 0 feet in re- rm front l r in. Win ver ge 5-3 knot .

[illegible] FROM [illegible] [illegible]. [illegible] n the [illegible], 14 [illegible] n. 1 48, the [illegible]ure distribution [illegible], [illegible] n. 194[illegible], [illegible] 1-[illegible], exce[illegible] the low [illegible] t into north [illegible]. The [illegible]ure [illegible] on the co[illegible] front of the [illegible] on the [illegible], [illegible] to [illegible]. [illegible] influen[illegible] the [illegible] from the [illegible]

[illegible] of 1977 [illegible] centered south [illegible] Ireland, [illegible] extending over France to south Germany. [illegible] from the [illegible] side of [illegible] [illegible] warm front [illegible]


L
H
1015
1010
H
L
1020

[illegible]

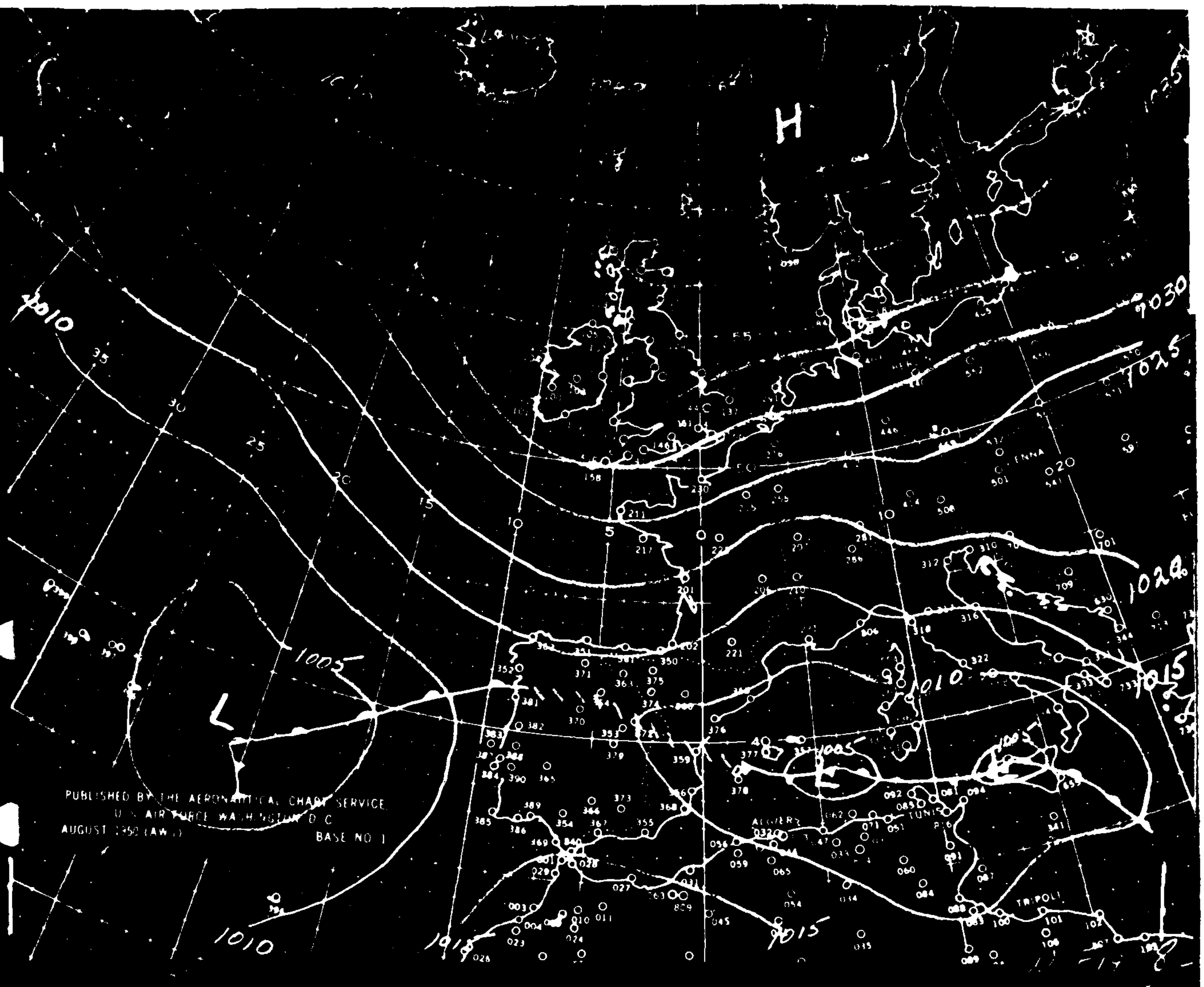


FIG. 1-6 THE EASTERLY TYPE. On the 1200Z, 19 Feb.1948, a strong high pressure system is centered over Scandinavia and Finland. There is low pressure over the Mediterranean and the Black Sea. A broad easterly flow of continental air moves from Russia over Germany, France, and Great Britain with temperatures between about 17 and 28°F over Germany at [illegible]. Generally, there are winds between east and northeast. After 15/[illegible] there is an invasion of colder air masses with snow showers and gust to 30 miles per hour and [illegible] snowfall afterwards. The visibility is predominantly above 7 miles. [illegible] it [illegible] to [illegible] miles. The ceiling is generally 3000 feet and [illegible] during [illegible] feet during [illegible] snowfall. This weather type generally brings [illegible] good flying conditions, [illegible] ceilings and good visibility. Occasionally [illegible] showers [illegible] intervals [illegible] with lower ceilings [illegible] visibility.

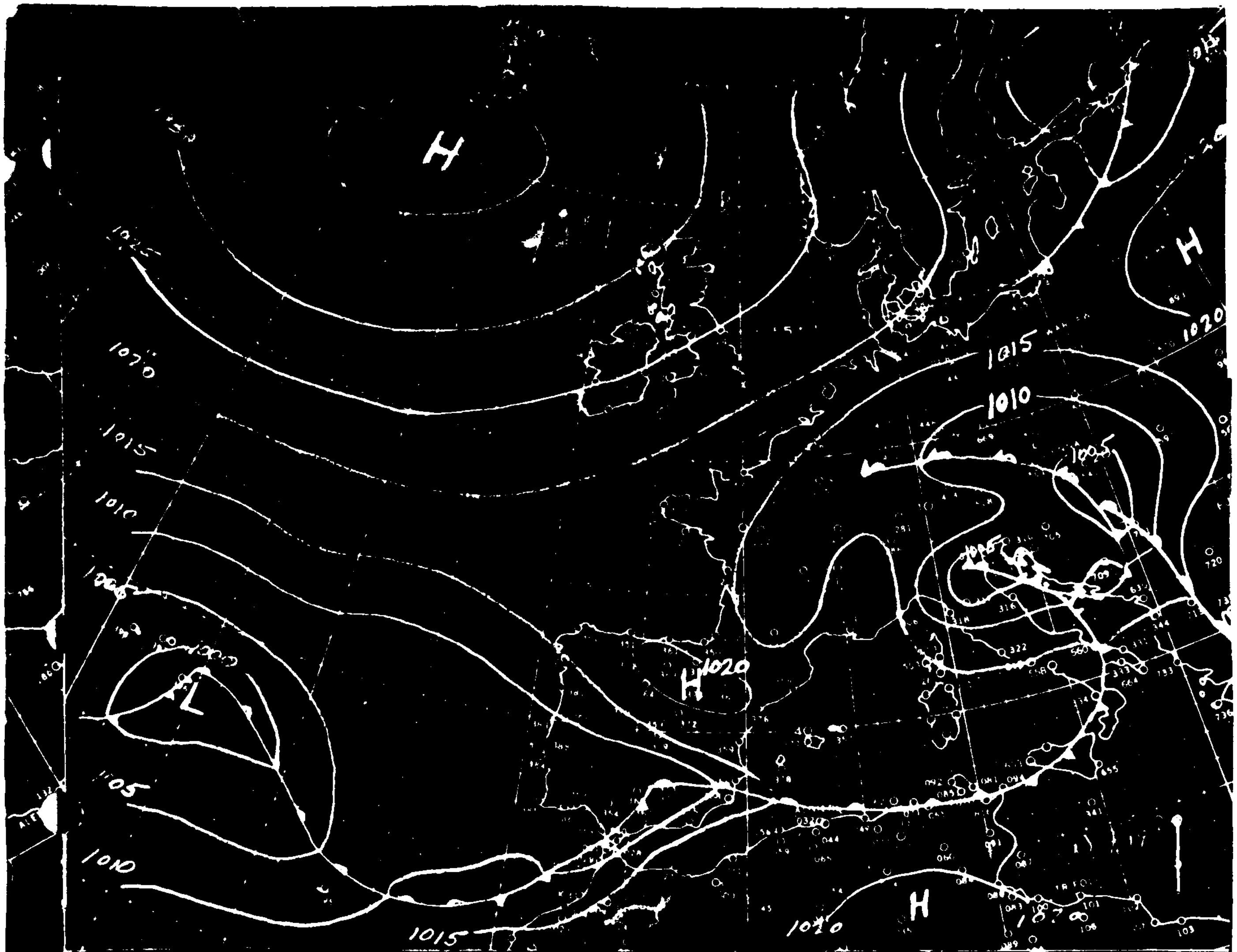


FIG. 1-7 THE SOUTHEASTERLY TYPE. On the 1600Z 23 Feb.1948 there are anticyclonic centers over the North Atlantic and south Russia connected by a weak ridge over south Sweden and the Baltic. Weak low pressure areas are situated over the Alps and eastern Czechoslovakia. An occlusion extends from Hungary to Czechoslovakia and then westward along 50°N over Germany. There is continental cool air at the surface with warmer air from the Mediterranean gliding up aloft. Therefore there is a very extensive area of moderate to heavy snowfall across Germany to northeastern France. The snowfall lasted from about 0400Z 23 Feb.1948 until 1900Z. The ceiling lowered during the snowfall from about [illegible] feet to [illegible] from 0835Z to 1000Z and then rose to [illegible]00 feet at 1[illegible] and [illegible] to 1[illegible] feet. The visibility was at first 3 miles and decreased to [illegible] during the heaviest snowfall. There [illegible] ily variation of temperature. [illegible] type brings Rhein-Main airfield long-lasting bad flying weather conditions with heavy precipitation.

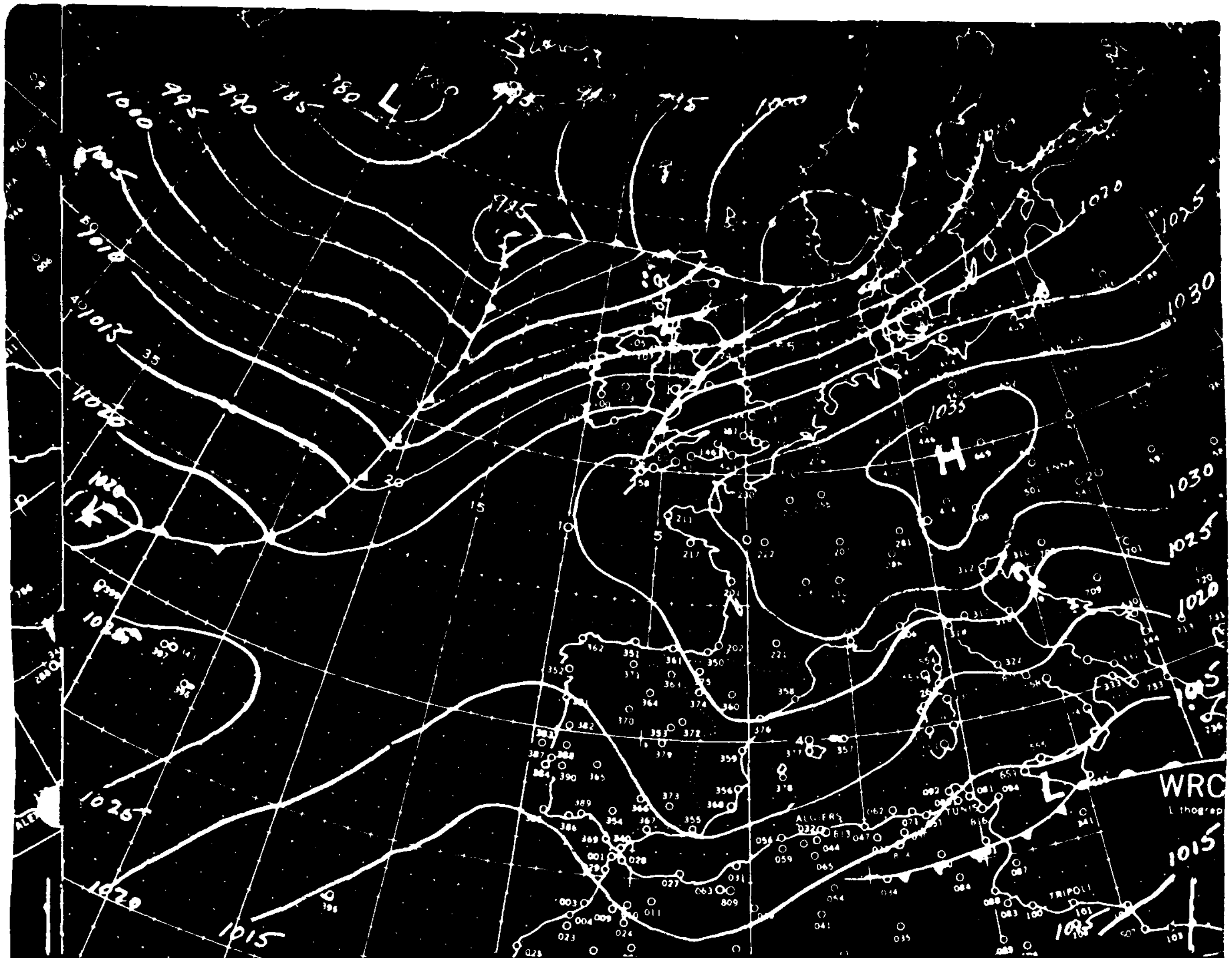


FIG. 1-8 THE ANTICYCLONIC TYPE: This weather type seldom occurs over the Frankfurt area, but if once established it usually lasts for a long period. On the 1200Z, 4 Jan. 1946, a wide anticyclonic area extended over the greater part of Germany, France, Austria, Czechoslovakia, Hungary, and Rumania with two centers, one over western Czechoslovakia, the other over northern Rumania. Frankfurt lies in the northwestern part of the westerly high pressure cell. There are slight easterly winds, only high or middle clouds and good visibilities, generally about 3 to 6 miles. There is no precipitation. This situation is often associated with morning fog with visibilities less than 1 mile.

SYNOPTIC PATTERNS

SPRING

SPRING

AIR MASSES

As mentioned in the section on WINTER weather, Europe is geographically a large penensula, and therefore since we are in the zone of general westerly circulation it is predominantly under the influence of maritime air masses.

Under normal conditions of the general circulation, the maritime polar air mass is the most frequently observed air mass over Germany during the spring season. Other maritime air masses observed less frequently in the Rhein Main area are maritime tropical and maritime arctic. As mentioned earlier in the privious section, maritime arctic air masses may invade the Rhein Main area when the normally westerly flow is distorted to northerly, and the air mass flows southward over the shortest possible route into Germany. An ideal situation for this occurs when the Azores high ridges sharply northward over Iceland, causing northerly flow from the Norwegian Sea across southern Norway and into the North Sea. A salient feature of this ideal situation is the formation of a low in the North Sea Area around Denmark, or a movement of a low into this area. The maritime arctic air with this situation moves southward from the source region into the NorthSea and then southeastward into the Rhein Main area.

For an invasion of maritime air (tropical) into the Rhein Main area during these months, there must be a well developed and persistent flow from the southwest. As can be seen, the synoptic situation ideal for the intrusion of maritime tropical air may be marked by a general trough in the mid-Atlantic causing southwesterly flow from the region of the Azores into the Rhein Main area. During the spring months, the persistence and frequency of the maritime tropical air mass is relatively low. As can be expected, the frequency and persistence of this air mass increases as the season progresses.

The other two air masses which may be observed in this area are continental polar and continental arctic. The frequency and persistence of these air masses shows a decided decrease during spring when compared with winter. As the source regions for these air masses is Siberia and northern Russia, an extremely low index situation must exist for an intrusion of these air masses into the Rhein Main area. In an idealized situation, the Azores high ridges northeast, joining the Scandinavian high. With this situation, a long northeasterly or easterly flow prevails from the source region to the Rhein Main area.

In concluding the discussion of air masses, a short discussion on weather phenomena associated with the above air masses follows:

The fresh outbreak of maritime polar and maritime arctic air masses into the Rhein Main area during the months of March through May is usually accompanied by convective shower activity within the air mass rather than stratiform clouds and drizzle as is usually the case during the winter. This change in the character of weather phenomena is due to the fact that in the spring, the temperature difference between sea and land gradually diminishes and is finally reversed. This reversal may take place rapidly in many cases. In March, the continent is usually under the influence of a high pressure area with clear skies which allow maximum insolation during daylight hours. As a result of this reversal of temperature difference between land and sea areas, the air masses are gradually changing from mPw and mAw to mPk and mAk during the spring months.

Weather within a maritime tropical air mass is usually characterized by stratocumulus and fair weather cumulus. Showers rarely occur within this air mass during the spring season, but are observed along a frontal boundary between maritime polar and maritime tropical air masses.

Within a deep continental polar or continental arctic air mass, weather is usually characterized by clear skies, good visibilities during the first days of the outbreak and large diurnal variations in temperature. If the continental polar or continental arctic air mass persists three to four days, the visibility shows a gradual deterioration as a result of (1) increased stabilization due to subsidence within the air mass, and (2) if the flow is northeast, smoke is advected from the industrial areas of Frankfurt to Rhein Main. If the air mass is shallow in the vicinity of Rhein Main, the over-running of warm air from the Mediterranean area will result in overcast nimbostratus and precipitation in our area.

FRONTS

During the spring, the character of the frontal systems is gradually changing. In the winter months, the strongest frontal systems are warm type occlusions with cold fronts being weak and diffuse. As a result of the reversal of temperature difference between land and sea in this period, the warm fronts tend to become more diffuse as they move over the continent and the cold fronts become more sharply defined. The cold fronts are accompanied by increasing activity throughout the season. Also, in the northwesterly flow behind a cold front, a series of closely spaced minor troughs develop within the fresh maritime polar or maritime arctic air mass. These trough lines are characterized during this season by swelling cumulus and general shower activity along the trough line. During the first eighteen to twenty-four hours after fresh maritime polar outbreaks, the trough lines pass the Rhein Main area with fairly regular time intervals between them. The maximum activity is normally experienced during daylight hours due to added convection. Because of the relatively strong flow during this season, cumulus activity associated with fronts and troughs usually extends no higher than 10,000 feet with thunderstorm activity being a rare phenomenon.

The poorest frontal weather is normally associated with cold frontal passages at Rhein Main and subsequent trough passages in a fresh maritime polar or maritime arctic air mass. Hazards associated with this weather type are: (1) turbulence in swelling cumulus along fronts and trough lines, (2) low ceilings in showers, 800 to 1200 feet for periods usually not exceeding thirty minutes, (3) visibility below 3 miles in showers for periods usually not exceeding thirty minutes, and (4) gusty surface winds within the range of 20 to 35 knots associated with the frontal and trough passages.

LOCAL WEATHER CHARACTERISTICS

Strong winds: In this season, as in winter, strong winds are observed with westerly situations wherein a frontal zone extends east-west through the English channel and the North Sea area with unstable waves moving along the front and deepening. Also strong winds occur with northwesterly situations wherein a modified maritime arctic air mass invades the Rhein Main area. Gusty winds of relatively short duration accompany the passage of the minor troughs in this situation.

Visibility restrictions: A light southwesterly flow into the Rhein Main area with a long west-southwesterly trajectory continues to be the situation most favorable to formation of fog in this area. This is due to the slight rise in terrain from the Rhine Valley to the Rhein Main area, causing the moist air to move slowly upslope. It might be well to mention that the terrain continues to rise slowly to the east to the vicinity of Offenbach so that when a low stratus and fog condition exists at Rhein Main, ceilings and visibilities are generally lower in the vicinity of Offenbach than those reported at Rhein Main. As has been mentioned before, a light northeasterly wind (020 to 040 degrees) at the surface associated with a stable lapse rate near the survace is favorable to the advection of smoke or "smog" from the Frankfurt area into Rhein Main.

FIG 2-1 [illegible] OCCLUSION AND COLD FRONT. [illegible], 3[illegible] March 1948. On 3[illegible] March [illegible] well developed ridge extends from Italy to the Baltic States with [illegible] secondary center of the Icelandic low situated in North Scotland. [illegible] well developed occlusion extends along the [illegible] coast of the British Isles and [illegible] small warm sector lies over northern France. The front [illegible] by [illegible] well defined wind shift at the surface and [illegible] trough [illegible] the 7[illegible] level. Due to strong subsidence in the ridge, [illegible] in [illegible] by [illegible] to broken [illegible] the cumulus [illegible]. The cold front [illegible] during the evening [illegible] March [illegible] [illegible]ry front. In the [illegible] behind the front [illegible] increase in [illegible] [illegible] [illegible] fe[illegible]. [illegible] [illegible]

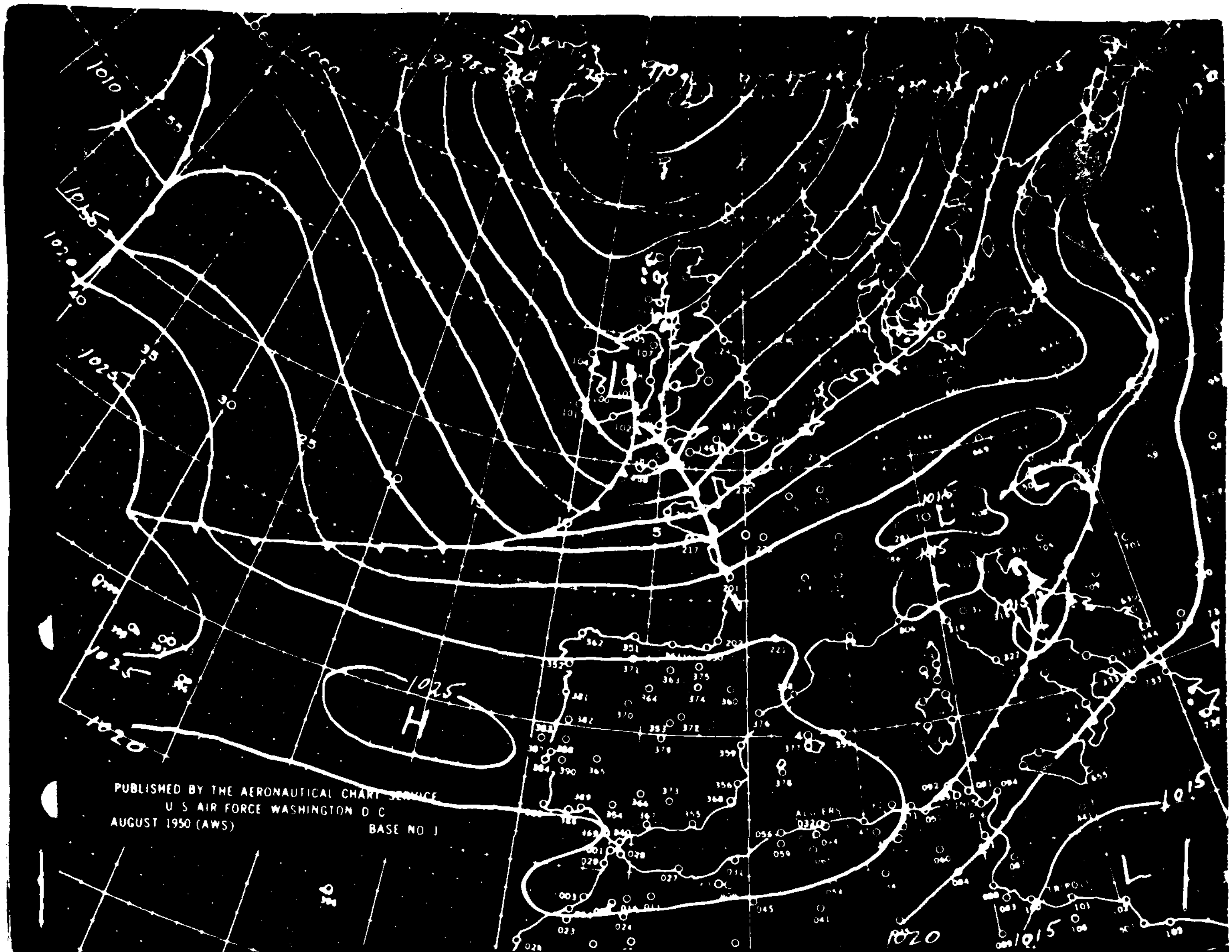


FIG. 2-2 SOUTHWESTERLY FLOW ACCOMPANIED BY INVASION OF MODIFIED mA AIR (KNOWN LOCALLY AS APRIL WEATHER SITUATION: 1200Z, 2 April 1948. On 2 April 1948 at 1200Z, a cold front between cP and mP air masses extends from Lake Ladoga southwest through east Poland, the Balkans and into southern Sardinia with a series of waves moving northeast along the front. To the west along a line from Copenhagen to Friedrichshaven lies a weak boundary between mP air and modified mA air. The boundary is marked by widespread cumulus and shower activity within the modified mA air mass to the west and stratiform clouds in the mP air to the east. The invasion of the modified mA air mass into the Rhein Main area was marked by a drop in temperature and by shower activity. Principal cloud type with this situation is stratocumulus associated with swelling cumulus. An occasional cumulonimbus developed over the mountains to west and north of Rhein Main. Ceilings were generally [illegible]-3[illegible] feet with this situation lowering temporarily to [illegible]00-12[illegible]0 feet in showers. Visibility with this situation was excellent, generally 30-50 miles lowering temporarily to less than [illegible] miles [illegible]. Average wind velocity with this situation [illegible] with gusts [illegible] knots.

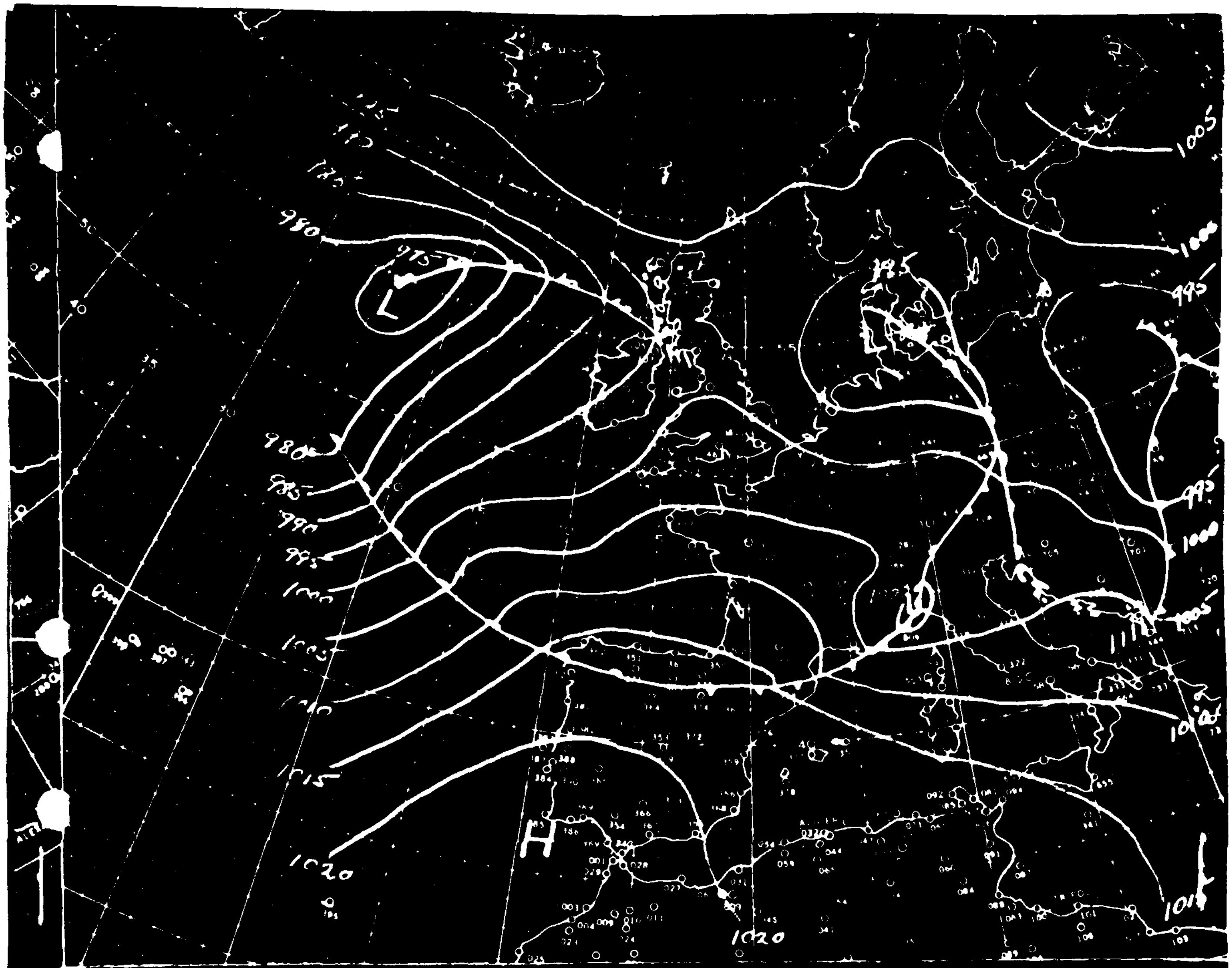


FIG. 2-3 WESTERLY SITUATION WITH GENERAL TROUGH ALONG 55 DEGREES NORTH: 1200Z, 20 March 1947. General trough extends from mid-Atlantic across Scotland continuing to area northwest of Black Sea. In the area south of the trough the flow at surface and aloft is west-northwest resulting in advection of mP air over the continent. A weak occlusion extends from low over Schleswig to east of Berlin and Prague with cold front from Prague extending southwestward into secondary low center in Gulf of Genoa. With this situation there exists a general stratocumulus layer over Europe. In the Rhein Main area general broken to overcast stratocumulus conditions prevail with some swelling cumulus developing over mountains to north during afternoon. Visibility during night was generally 7 miles but lowered to [illegible] miles at dawn in light fog and rain. At dawn the ceiling lowered to [illegible] feet. By [illegible], the ceiling has risen to 2000-3000 feet and continues to improve to 4000 feet during the evening. Visibility improves to 7-20 miles. This westerly situation just described is very similar in its effect on flying conditions to the winter westerly type.

FIG. 2-4 WESTERLY TYPE WITH GENERAL TROUGH BETWEEN 6[illegible] AND 65 DEGREES NORTH: [illegible], 21 March 1948. General trough extends from well developed low to northeast of Iceland across Scandinavia into a secondary low in the vicinity of Lake Ladoga. A strong west to east flow exists at surface and aloft resulting in the advection of an mP air mass over the continent. A weak front line between mP air masses lies through central Britain, northern Denmark, and into the [illegible] with series of stable waves moving along the front. With this situation ceilings remained above 1000 feet and visibility over 10 miles at Rhein Main. This westerly situation is more nearly typical of summer westerly situation.

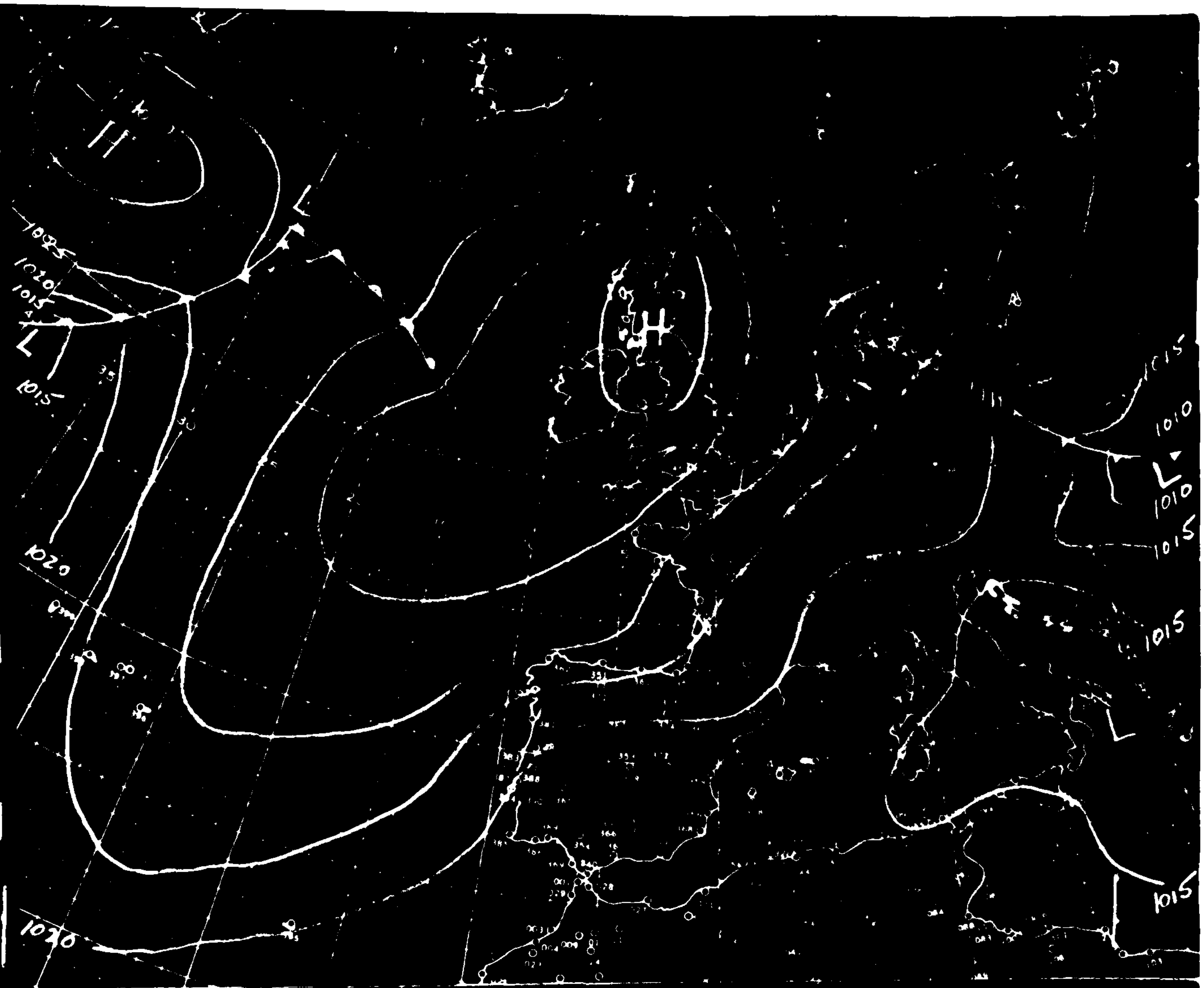


FIG. 2-5 NORTHEAST SITUATION: 1200Z, 25 April 1948. [illegible] dee[illegible] low exists [illegible] the southern tip of Greenland with [illegible] ridge of the Azores high extending northeastward into [illegible]. Continued warm air advection strengthens the ridge and causes [illegible] further extention to the east. The flow pattern thus established is from the northeast. The trajectory of the air reaching Rhein Main is over land which, coupled with subsidence in the ridge, brings cool, relatively dry and stable air into this area. Cloud types with this situation, as would be expected, are stratiform. Ceilings at Rhein Main with this situation were generally [illegible] feet with visibility reaching [illegible] minimum of [illegible] at sunrise and a maximum during the afternoon of [illegible] miles. [illegible] winds were observed with maximum velocities reaching [illegible] in the afternoon. [illegible] ground visibility in the vicinity of Rhein Main is restricted [illegible] from Frankfurt [illegible].

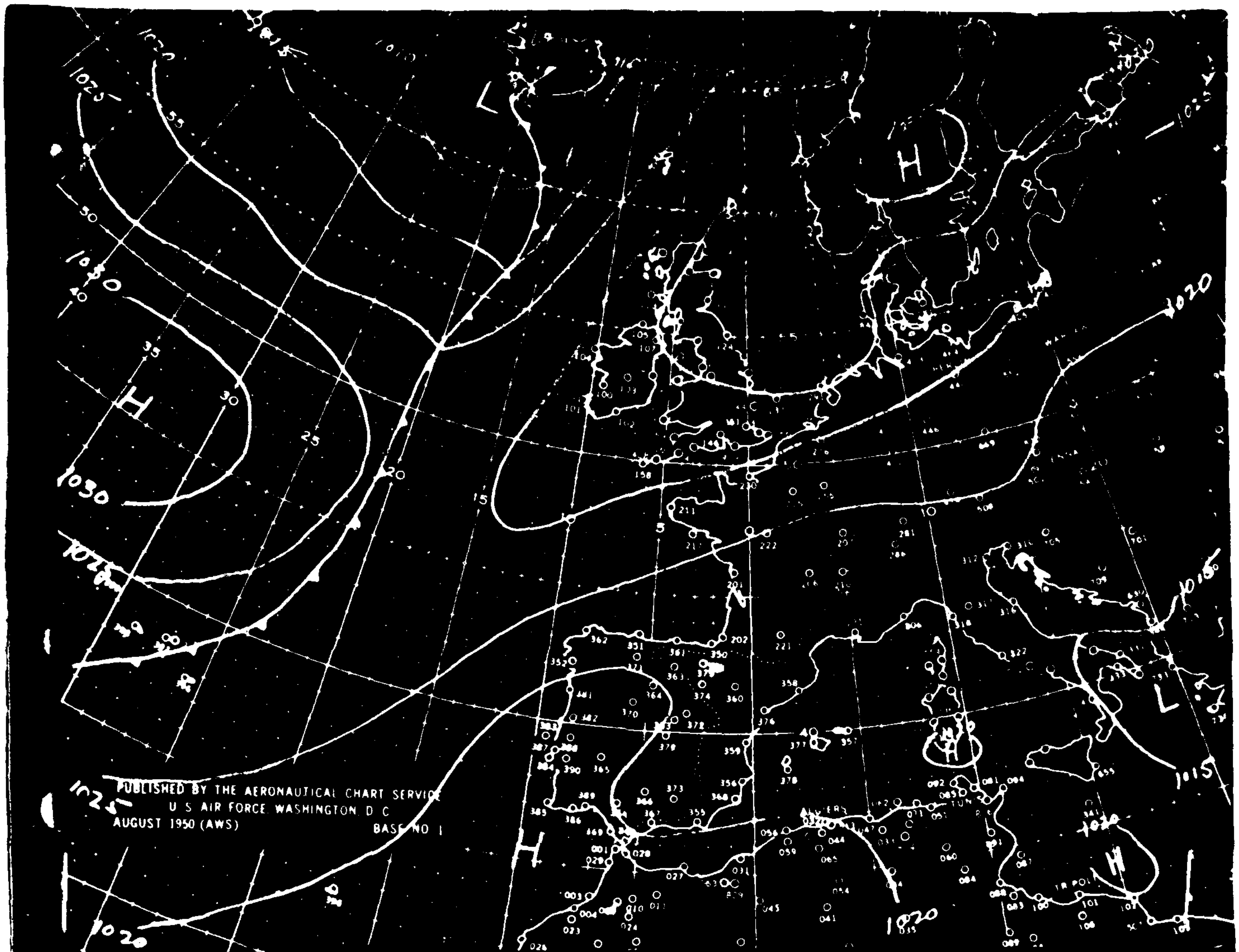


FIG. 2-6 EASTERLY TYPE: 1200Z, 8 May 1948. High pressure area is centered over the North Sea and south Scandinavia with a low in Caucasus region. Moderate east to west flow exists with moderate subsidence occurring into northern Germany. The subsidence gradually diminishes in southern Germany. With this flow, moisture is advected from the Black Sea area over southern Germany. Cloud types observed with this situation ranges from stratocumulus in northern Germany to swelling cumulus in southern Germany. At Rhein Main scattered to broken cumulus were observed with ceilings ranging from 3500-4000 feet. Occasional swelling cumulus were observed over hills in the vicnity of Rhein Main. Visibility remained 1-[illegible] miles during day. Surface winds were east-northeast to east at [illegible] knots.

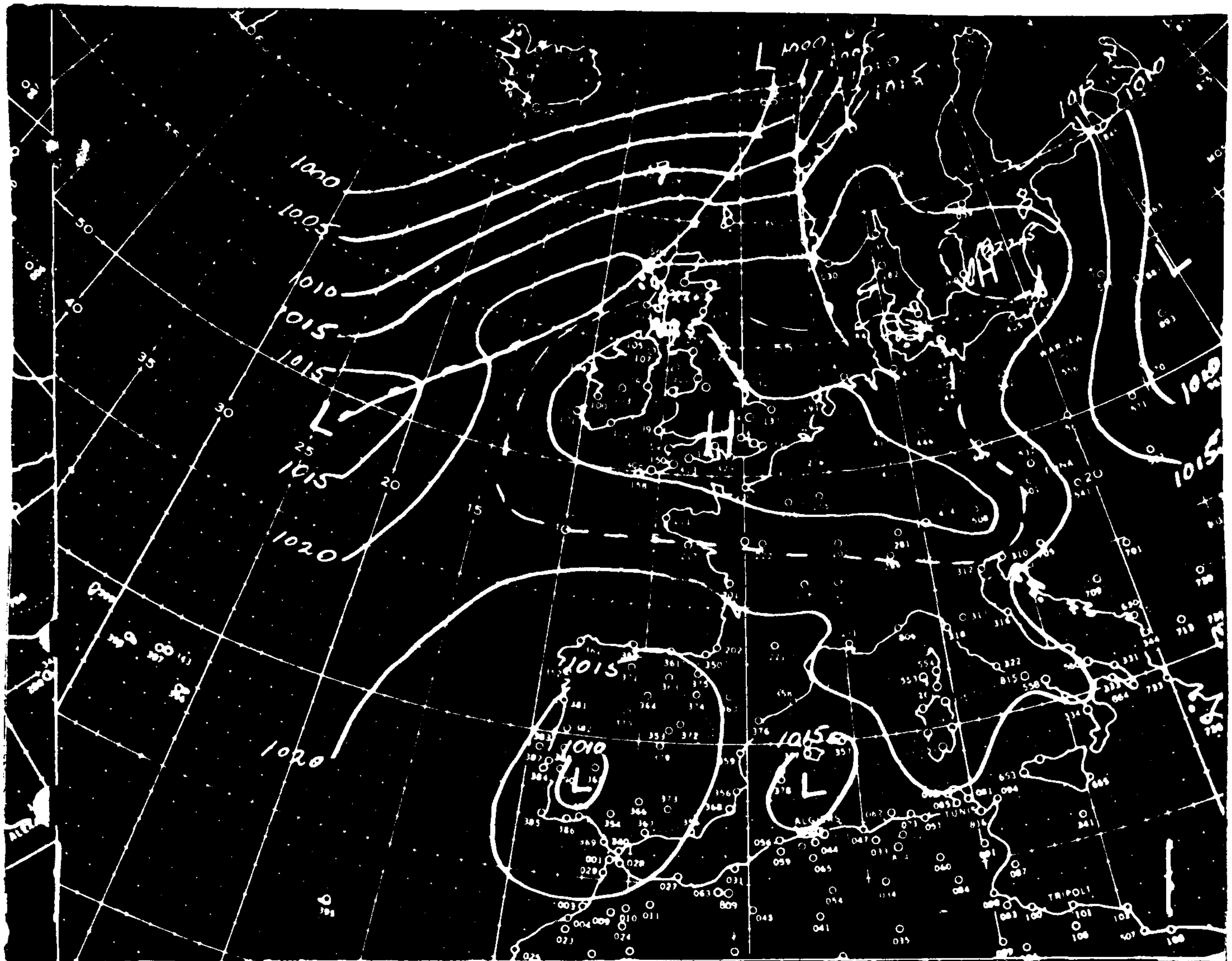


FIG. 2-7 HIGH PRESSURE TYPE: 1200Z, 26 March 1946. On 26 March a stagnant high is centered over the Channel in the vicinity of Calais and Dover with the major axis oriented west-northwest to east-southeast. In northern Germany general fog and stratus conditions were observed with fog dissipating by 1200Z. At Rhein Main ceilings were unlimited with thin broken to overcast altostratus. Visibility was restricted at sunrise in haze and improved to 6-8 miles during the day. Light surface winds prevailed during the entire period. A large diurnal variation in temperature was observed with this situation.

SYNOPTIC PATTERNS

SUMMER

SUMMER

AIR MASSES

As was true in the winter and spring seasons, the predominant air mass over the continent during summer is of mP origin. Because of strong insolation during the summer months, the continent is heated rapidly with the temperature difference between land and sea areas reaching a maximum during this season. Because of the strong heating, a general low pressure condition exists over the continent resulting in a monsoon-like circulation from sea to land. This type of circulation is predominant throughout most of the summer, occasionally interrupted by a transitory high pressure influence. In these high pressure situations, the air masses tend to warm rapidly and assume continental characteristics.

During summer, the cool maritime air masses experience a rapid modification as they move over the relatively warm continent. The air mass is heated in the lower layers resulting in the development of strong convective activity which may extend well above 20,000 feet and result in air mass rain showers and thunderstorms. As may be determined from this, the principal cloud types within an mP air mass during the summer are cumuliform, especially during daylight hours and just after sunset. In fact, under a southwesterly flow condition, thunderstorm activity may start after sundown in the northern Rhone Valley in France, and move into the Rhein Main area during the night. This is not an unusual occurrence.

During some years in the summer season, a secondary high cell will break away from the main Azores high and become stationary over central Europe, occasionally joining with the Russian high. This situation causes an influx of cT air from the vicinity of the Ukraine and the Balkans. Another situation resulting in the invasion of continental tropic air develops with southwestward displacement of the Russian high and usually accompanied by a separate cell in the Balkans and a northward displacement of the Levant high. This synoptic picture results in a long southerly flow from Africa, over the Alps, and into Germany. This situation was observed in the late summer of 1946 and 1947, occurring once each season.

With the flow of cT air from the Ukraine and Balkans, scattered stratocumulus clouds may form at Rhein Main during the day below the subsidence inversion. When the sources of cT air is Africa, clear skies usually prevail in the Rhein Main area because of strong subsidence and a trajectory of the air mass over the alps. The two cases of the latter situation were associated with Scirocco, and the strong southerly flow carried dust particles aloft from the region of Africa through central Germany.

Arctic air masses have not been observed in the Rhein Main area during the summer months.

FRONTS

In summer, as in spring, cold fronts are the most frequent and as a rule the most sharply defined in the Rhein Main area. Cold fronts in our area are usually accompanied by stratocumulus, moderate to heavy rain showers and occasional showers of soft hail. Occasionally thunderstorms develop on the frontal surface accompanied by heavy rain and occasional hail. Hazardous flight and terminal conditions with this situation are:

(1) danger of icing, (2) turbulence, severe in cumulonimbus, (3) gusty surface winds in the fronts, and (4) ceilings below 1000 feet and visibility less than three miles in rain showers and/or thunderstorms.

Most fronts which affect the Rhein Main area are those moving from the west. Another type of system which occasionally affects the Rhein Main area is known as the 5-B situation. This situation is characterized by a sharp trough aloft extending north to south through central Europe, a stationary front in the vicinity of the upper air trough, and a low in the central Mediterranean area. The low formed in the Mediterranean remains stationary for a period of one to several days with stable waves moving along the stationary front. Finally, the main low center moves slowly north-northeast along the stationary front accompanied by a large area of precipitation. The precipitation may last in a given locality from 24 to 48 hours. In a summer 5-B when unstable air masses are involved, widespread shower and thunderstorm activity accompany the type.

LOCAL CHARACTERISTICS

Restriction to visibility in the other seasons of the year, as noted, are enhanced with southwesterly flow. This is true in summer also. A light southwesterly flow with a long southwest trajectory, or if of short southwest trajectory, one over moist ground is the situation most favorable to formation of light fog during the summer months. A light flow from 030° is favorable for smoke pollution at Rhein Main. Again, this restriction is not so persistent as in winter or spring because of the relative instability of the air masses.

Surface winds: Prevailing wind at Rhein Main is southwest. Unless a strong northwest flow is established, a southerly through west northwesterly gradient flow will result in a southwest surface wind. This is partially due to the deflective action of the Taunus Mountains. This effect of the terrain on surface winds frequently obscures the wind shift accompanying cold frontal passage in a westerly flow. Surface winds at Rhein Main will veer immediately at the frontal passage but will back again to southwest, usually within less than an hour after the frontal passage.

Thunderstorms: Thunderstorms occurring at Rhein Main are usually associated with a cold front or with a trough passage with the greatest concentration of air mass thunderstorm activity being in the vicinity of the Taunus and Vogelsberg Mountains to the north and east, and to the Odenwald to the southeast. Nocturnal thunderstorm activity is for the most part confined to the river valleys and occasionally move into the immediate vicinity of the air field.

FIG.3-1 [illegible], [illegible] Aug. 1948. An extensive low is situated over the Scandinavian countries causing strong westerly flow over northern Europe with the flow decreasing southward. [illegible] second low is centered in the [illegible] Atlantic with [illegible] well defined warm front extending from the center of the low to the Brest peninsula. Here the frontal zone becomes diffuse and extends eastward through northern France and central Germany marking [illegible] weak boundary between mP and mT air masses. The front [illegible] in [illegible] vicinity of Rhein [illegible] in during the morning and afternoon [illegible] low ceilings of stratocumulus and low visibility in fog and rain. During [illegible] hour [illegible], transient ridge moves through [illegible] in [illegible] visibility.

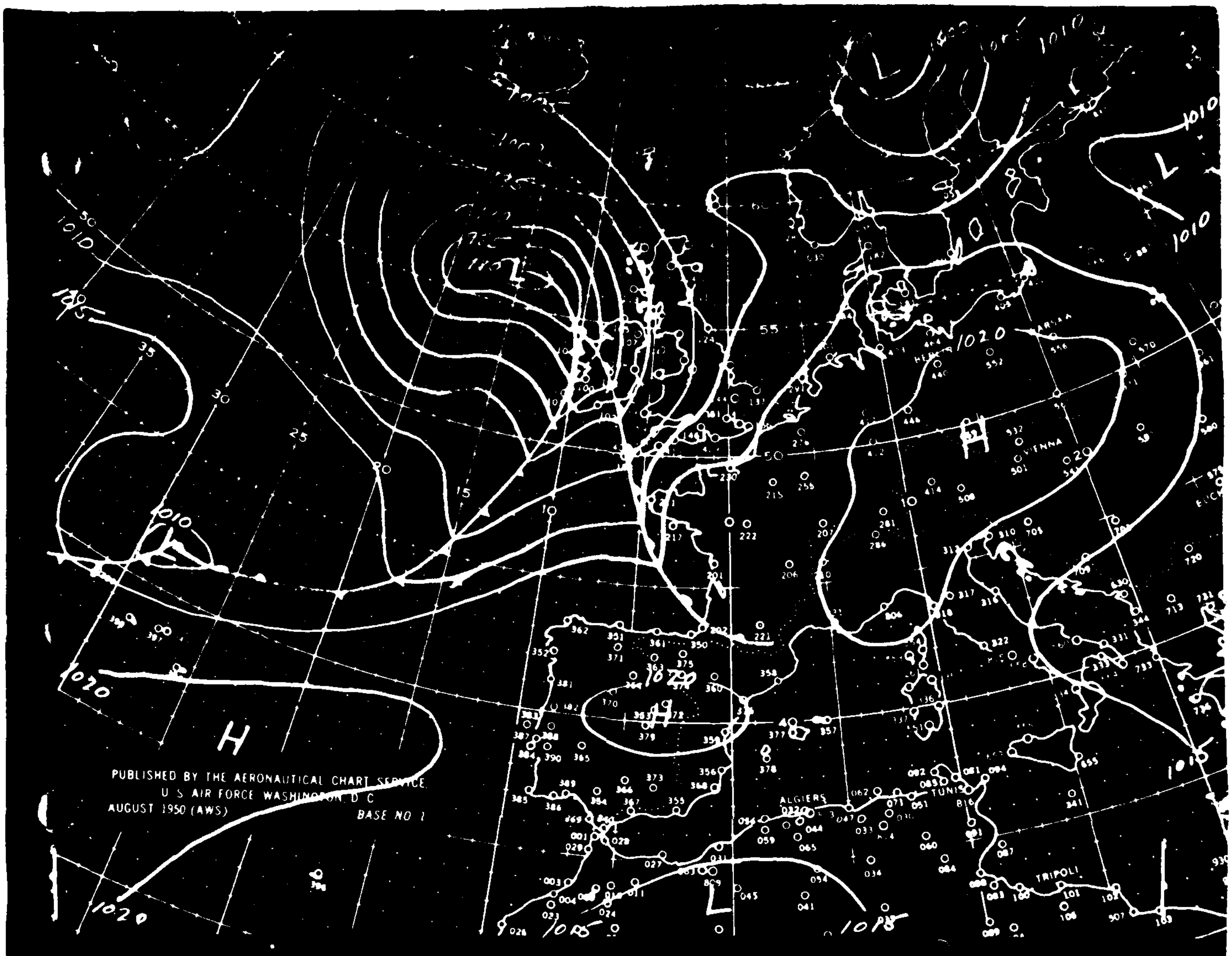


FIG.3-2 SOUTHWESTERLY FLOW: 1200Z, 21 Aug. 1948. A well developed low is centered to northwest of Ireland with a well defined occluded system extending to northern Ireland. The cold front extends along the west coast of Ireland thence southwest into the Atlantic. The warm front extends from point of occlusion into the Bay of Biscay. A high cell is centered over the northern Balkans with the major axis oriented southwest to northeast. A modified m ir mass prevails over the continent. Clouds observed during early morning were scattered cirrus. Cumulus cloud developed over the hills in the vicinity of Rhein Main and during late afternoon scattered to broken altocumulus was observed. The significant feature of this and other southwesterly situations is that it is the most ideal situation for fog formation at Rhein Main. Visibility reached a minimum of near 1 mile in light ground fog at sunrise.

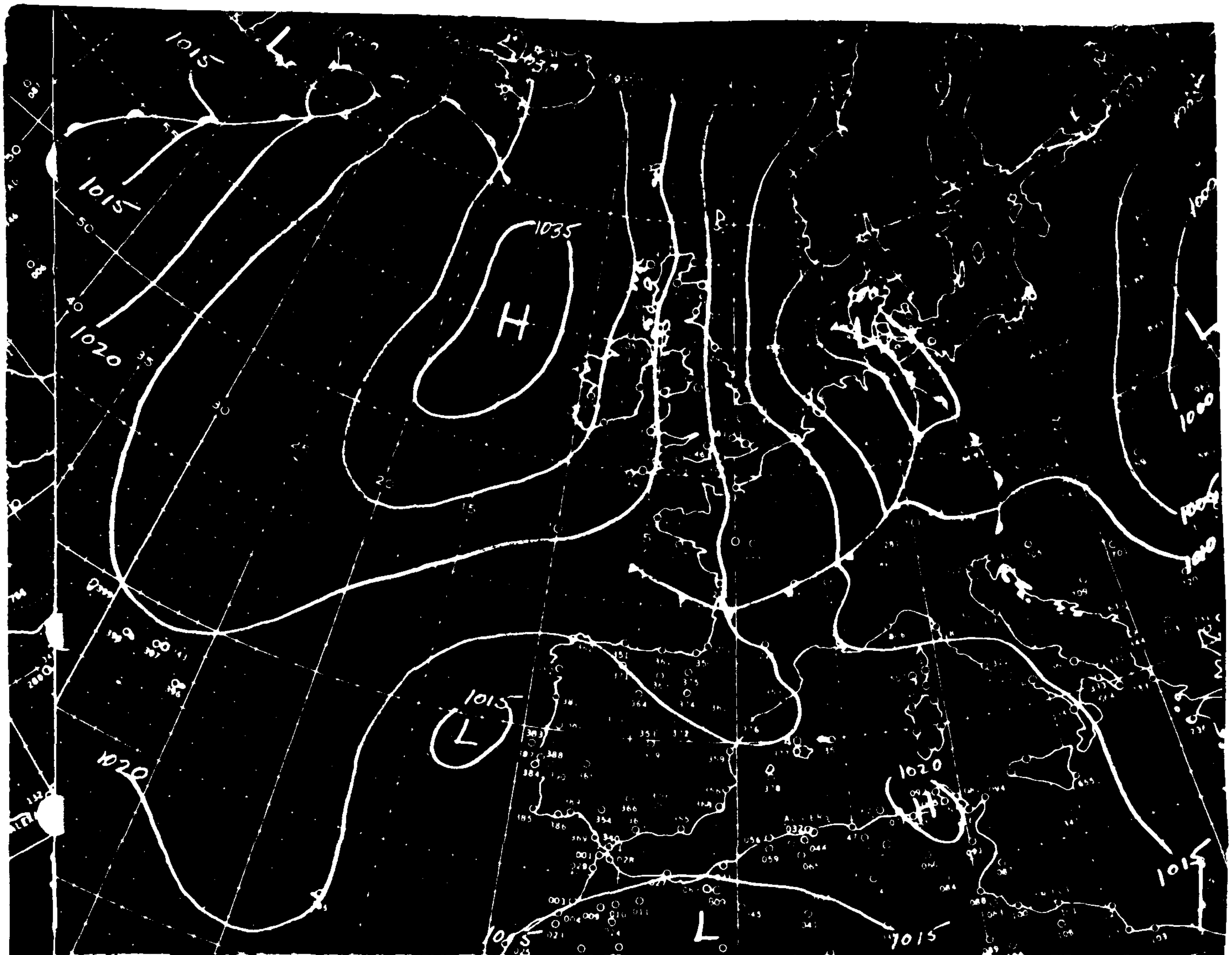


FIG.3-3 NORTHW[illegible]TERLY FLOW ([illegible]ONSO[illegible] TYPE): 12[illegible], 8 July 1948. [illegible] gene[illegible]l low pressure [illegible]re[illegible] exists over the continent with [illegible] gener[illegible]l high [illegible]res[illegible]ure syste[illegible] over the Atl[illegible]ntic re[illegible]ultin[illegible] in the monso[illegible]-like flow from northw[illegible]st over the [illegible]. An occluded front e[illegible]tends from [illegible] in Denm[illegible]rk with the [illegible] of occlusi[illegible]n ne[illegible]r Berlin. [illegible] cold fro[illegible]t e[illegible]tends fro[illegible] oin[illegible] of [illegible]c[illegible]lusion [illegible], [illegible]ijon [illegible]nd Borde[illegible]ux, wit[illegible] [illegible] fro[illegible] thro[illegible] [illegible] and into centr[illegible]l [illegible]. [illegible] front [illegible]ed the Rheim[illegible] in [illegible] b[illegible] 04[illegible] n[illegible] 50[illegible] nd the [illegible] 0900[illegible] nd 1000[illegible]. Ceilin[illegible] [illegible]ered [illegible] feet to [illegible] fe[illegible] ap[illegible]ro[illegible]ch of the [illegible] front [illegible] to 6 [illegible]. Visibili[illegible]y [illegible] from 1[illegible] to [illegible] mile. [illegible]eilin[illegible] [illegible] feet [illegible] [illegible] [illegible]

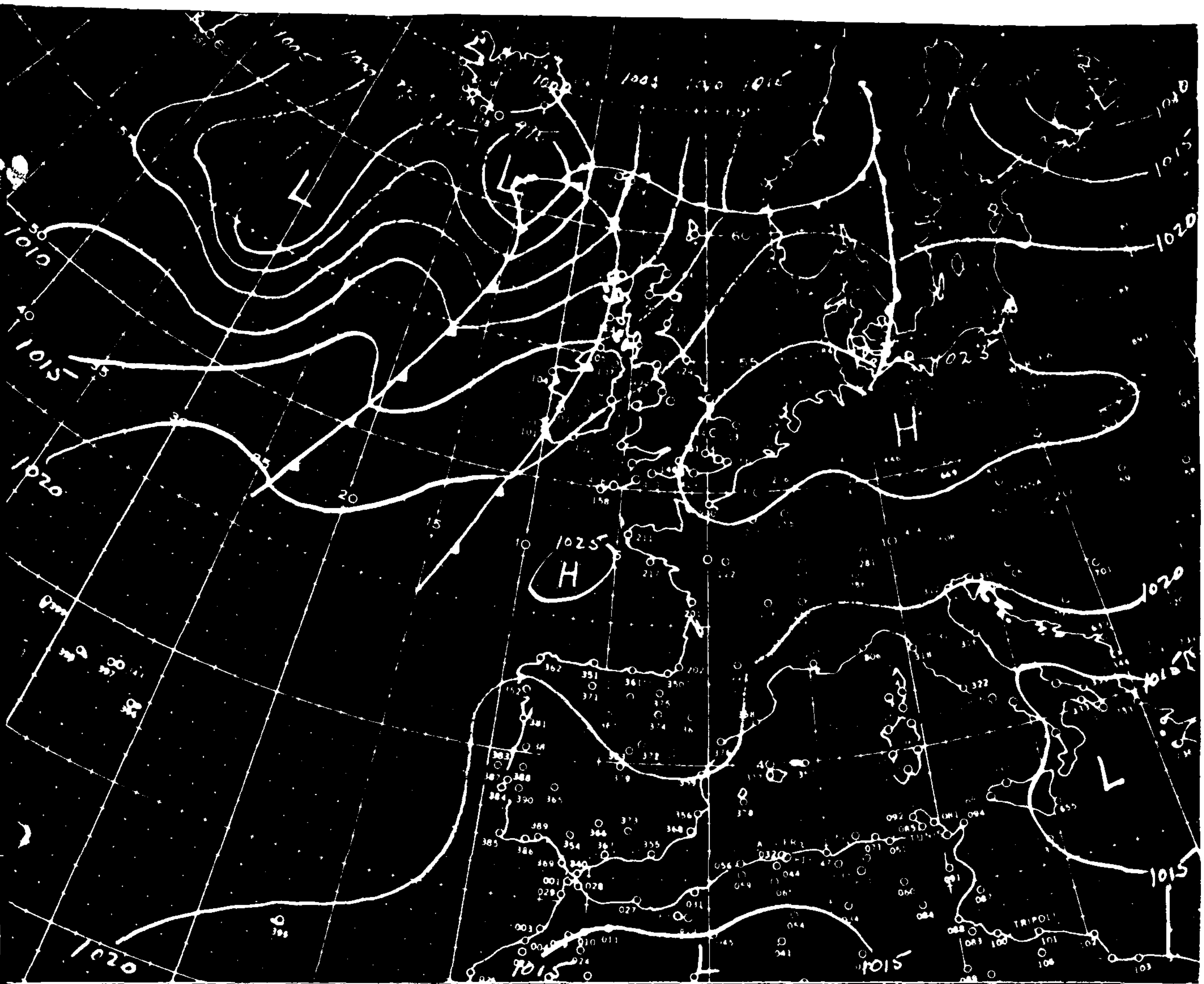


FIG. 3-4 HIGH INFLUENCE WITH EASTERLY FLOW:1200Z, 30 August 194[illegible]. A well developed low is centered to the south of Iceland with general trough over the Atlantic. A cold front extends southward along the west coast of Scotland, through central Ireland and continues southwestward towards the Azores. A dynamic high is centered in east Germany with major axis oriented east-west. The flow at all levels into the Rhein Main area is east-southeast resulting in the advection of dry air mass into suthern and central Germany. Clear to high scattered conditions existed at Rhein Main with less than 1/8 cumulus forming during the afternoon.

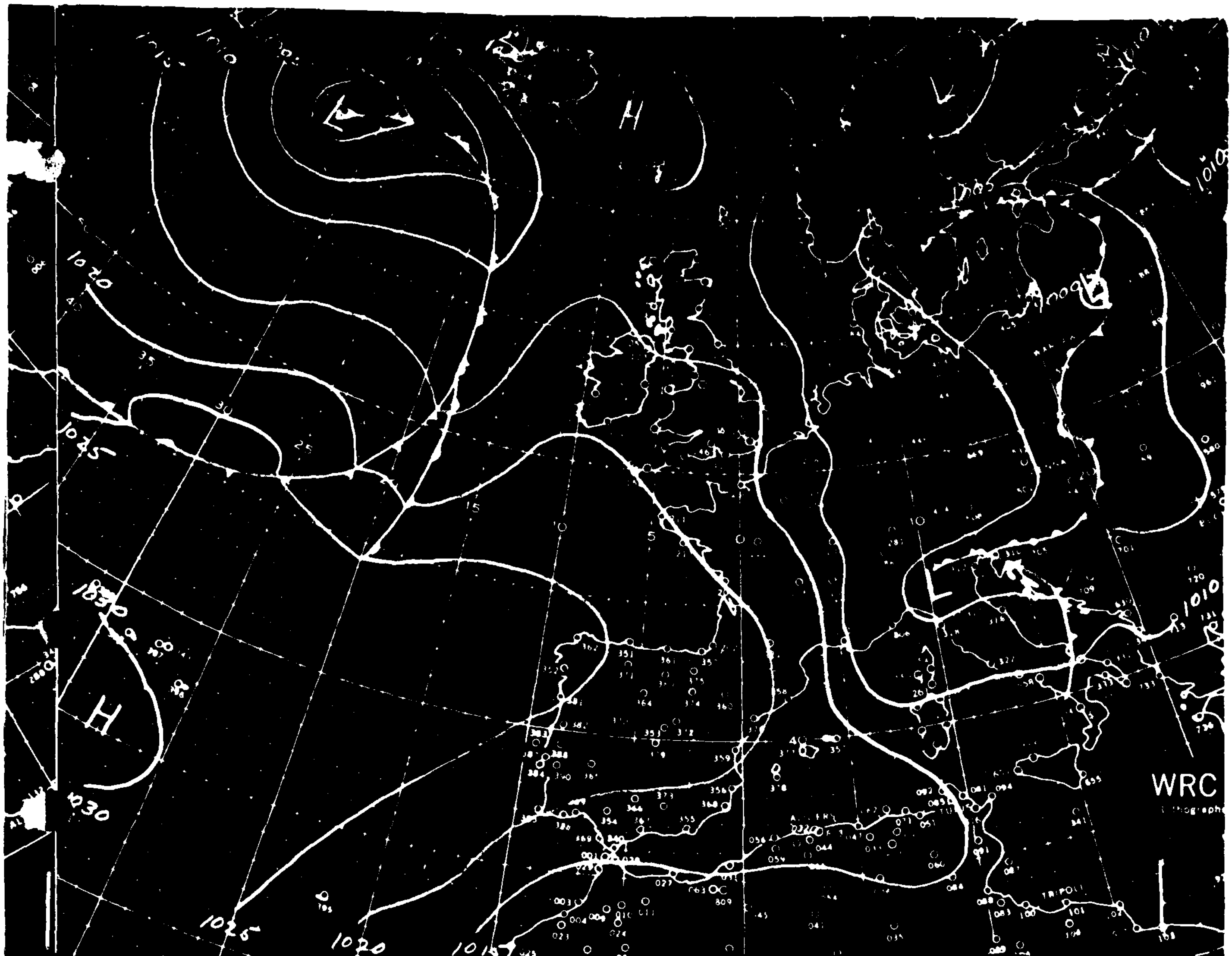


FIG. 3-5 NORTHWESTERLY FLOW ASSOCIATED WITH 5-B SITUATION: [illegible], [illegible] June 194[illegible].

A ridge extends from Azores over southwestern England. A sharp trough exists aloft over eastern Europe with a complex low [illegible] at the surface. Cold air advection into the Mediterranean has caused the development of a low in the Po Valley and quasi-stationary front through the Balkans and Poland. Waves have formed on the frontal surface and, as is characteristic of the 5-B situation, have moved north-northeastward along the front. A large area is affected by the warm air mass flowing over the Alps from the Mediterranean and overrunning the [illegible] air mass which prevails at the surface over Europe. Evidence of the overrunning may be seen as far west as Rhein Main by observing the cloud types, which were predominantly altocumulus and altostratus. The overrunning was strong enough to cause light intermittent rain during the early morning at Rhein Main. [illegible] formed in the northwesterly flow in the Rhein Main [illegible] in the [illegible] during the afternoon.

SYNOPTIC PATTERNS

FALL

FALL

AIR MASSES

During the fall season, the predominant air mass observed over the continent is of maritime polar origin. There are, however, periods when the continent is under the influence of a well defined high pressure area which is associated with a relatively high persistency of cP air in the Rhein Main area. This situation, known as Indian Summer in the U.S., is locally known as Old Woman Summer.

During the fall, the continent is gradually becoming cooler because of the increase of radiation over insolation. Therefore, during this season, the mP air masses will tend to be stabilized as they move over the cooler continent so that the predominant cloud types will be stratiform. Also, because of the gradual change in temperature difference between land and sea area, the high pressure areas are more frequently accompanied by clear skies during the fall than in other seasons. Inasmuch as the fall season is a transition period between summer and winter, weather phenomena more peculiar to summer may be observed during the early fall while late in the fall, phenomena more peculiar to winter becomes predominant.

Gradual stabilization of the air masses as they move over the cooler continent is marked by an increase in the incidence of ground fog and radiation fog in the Rhein Main area during early morning and late evening. It is also observed that haze and light fog become more persistent in lower layers even during the daylight hours. The gradual cooling of the continent is further marked by low stratus, air mass fogs, and drizzle within an invading mT air mass.

Turbidity in continental air masses is greater than in fresh maritime polar air masses, so that in general, visibility is better in the mP air masses than in the cP air mass.

FRONTS

As has been previously stated, the temperature difference between land and ocean areas gradually diminishes during this season, and finally becomes reversed by the end of the season with the land areas becoming relatively cold. Therefore, during this season cold fronts become weak and gradually more diffuse while warm fronts tend to become stronger and more pronounced. Cloud types accompanying frontal passages during this season tend to become more stratiform as the season progresses and when cumuliform clouds do occur, the tops are generally lower than during the summer months. Normally these tops do not exceed 10000 feet.

The temperature difference between polar and tropic regions is gradually increasing during this season, and correspondingly, the cyclogenetic activity is gradually becoming more intense. As may be expected, the most active frontal zones are between mT and mP air masses.

LOCAL WEATHER CHARACTERISTICS

Extremely high winds (those in excess of 50 kts) are seldom observed at Rhein Main, but may occur during any season. A discussion of high winds at Rhein Main is contained in the Severe Weather section of this book.

During this season, as has been mentioned previously, visibility is generally lower within a continental air mass than during the summer and the frequency of radiation fog shows a remarkable increase. Air mass fog may also occur during this season with the intrusion of mT air. As in other seasons, fog is more prevelent with a weak southwest flow with a trajectory from the Rhein valley plain. Toward the end of the season, dense persistent fog may occur during the periods of high pressure influence, and it had been known to last all day or for a period of days.

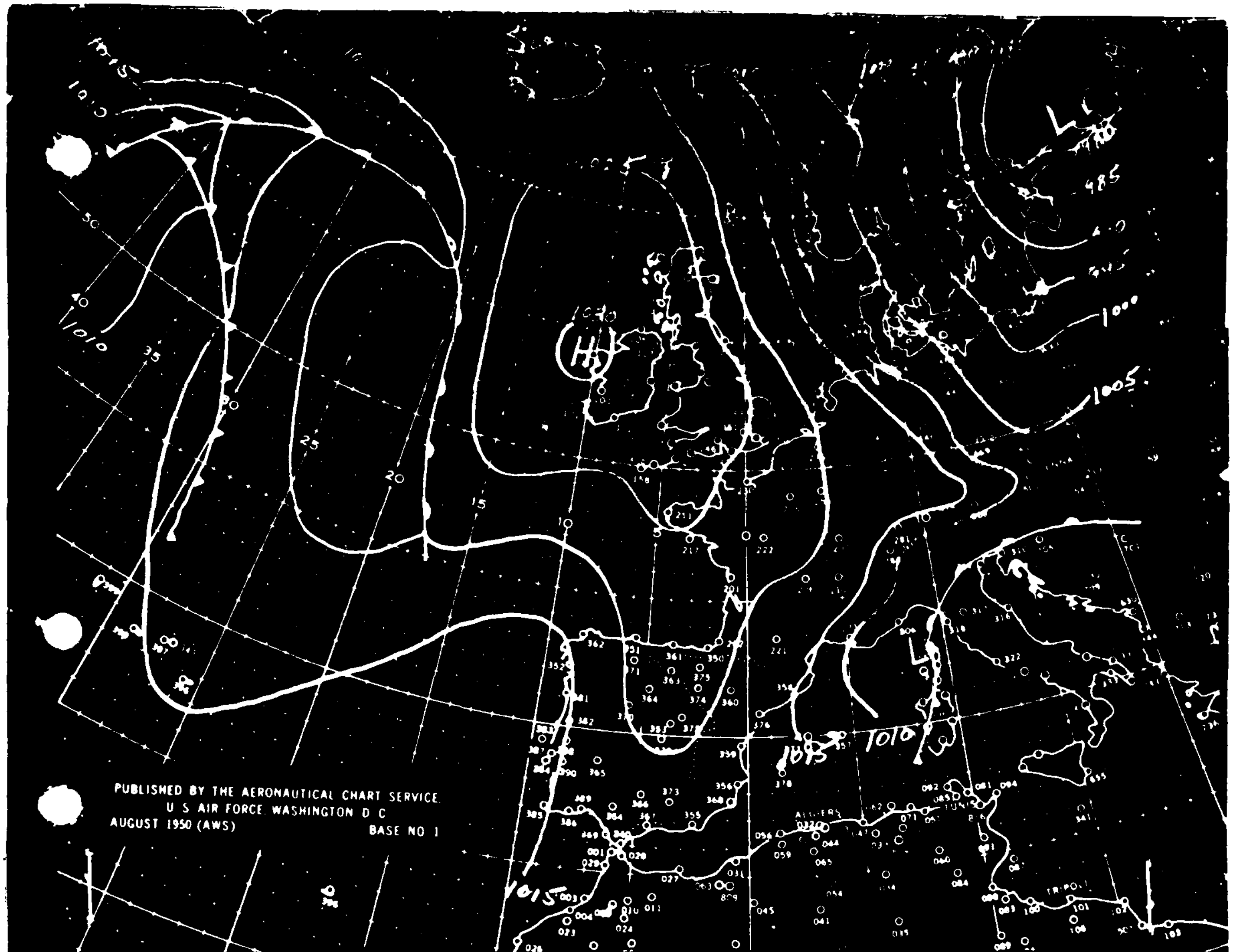


FIG. 4-1 NORTHWESTERLY FLOW: 1200Z, 21 Sept. 1948. A deep low is situated over southeast Finland with a high centered over the British Isles. This pressure pattern resulted in strong northwesterly flow of mA air over the low countries and Germany. Weather at Rhein Main is characterized by broken swelling cumulus and stratocumulus during morning and afternoon with occasional rain showers. Ceilings remained 3000-4000 feet with visibility generally over 10 miles.

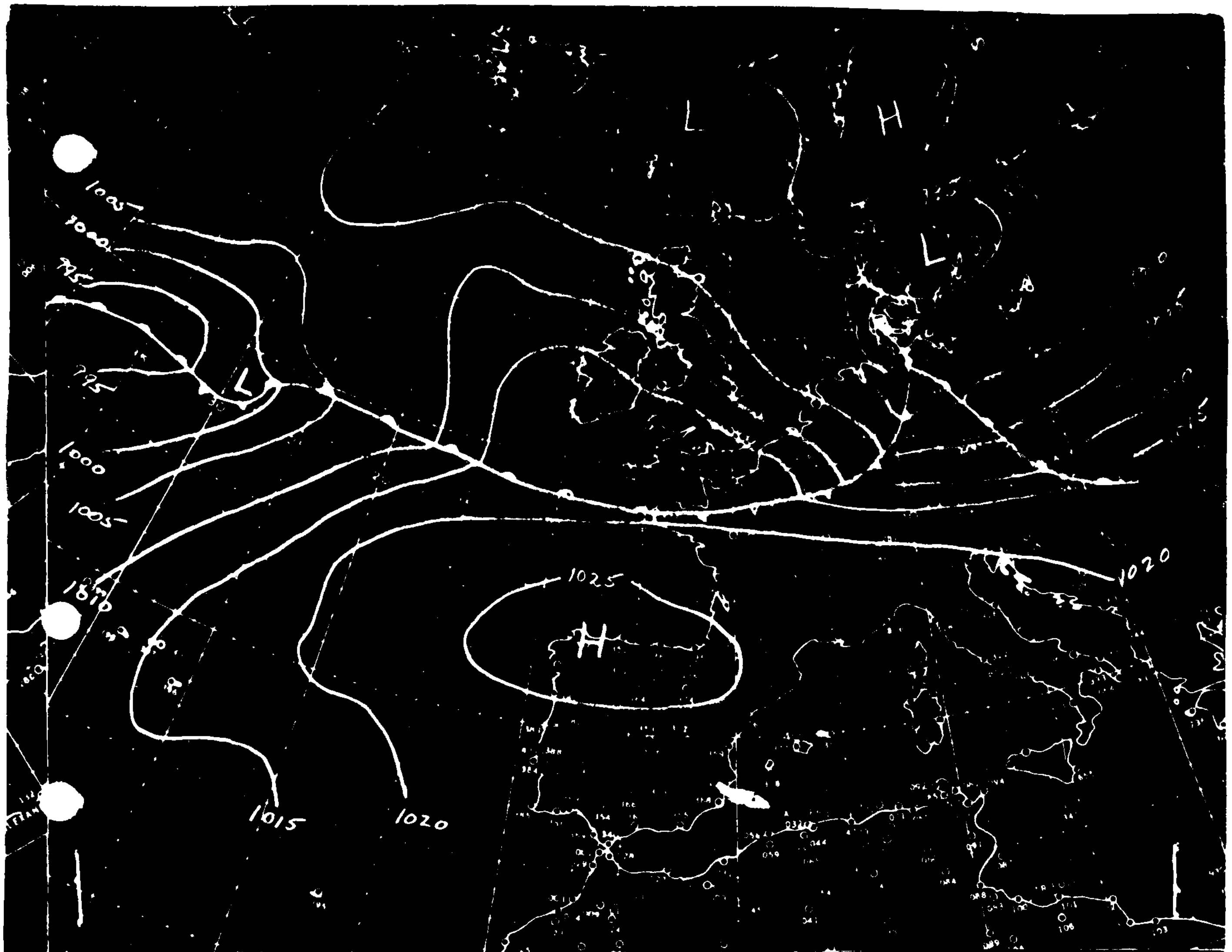


FIG.4-2 WESTERLY FLOW WITH OCCLUDING WAVE: 1200Z, 10 Nov. 1948. Complex low area covers the Scandinavian countries and northeast Germany. A warm front extends from a low in the Atlantic across the Brest peninsula. An occlusion extends from a low in southern Denmark with point of occlusion in northeastern Germany. Cold front extends from point of occlusion southwestward, joining warm front over Brest and warm front from point of occlusion extending into southern Poland. At Rhein Main pre-warm front weather was characterized by low ceilings, low visibilities, rain and fog. The warm front passed Rhein Main at 0700Z with low ceilings and rain persisting in the warm sector, but with visibility improving. Cold front passed Rhein Main at 1130Z-1200Z. Ceilings and visibility improved rapidly after cold front passage. This general situation with a warm front moving from the Biscay area instead of the Brest peninsula with a long southwesterly flow usually results in more hazardous terminal conditions than the above example. [illegible] the surface front position and ceilings have been observed [illegible] 100 feet to less than 500 feet several hours ahead of the front [illegible] below 500 feet in the [illegible].

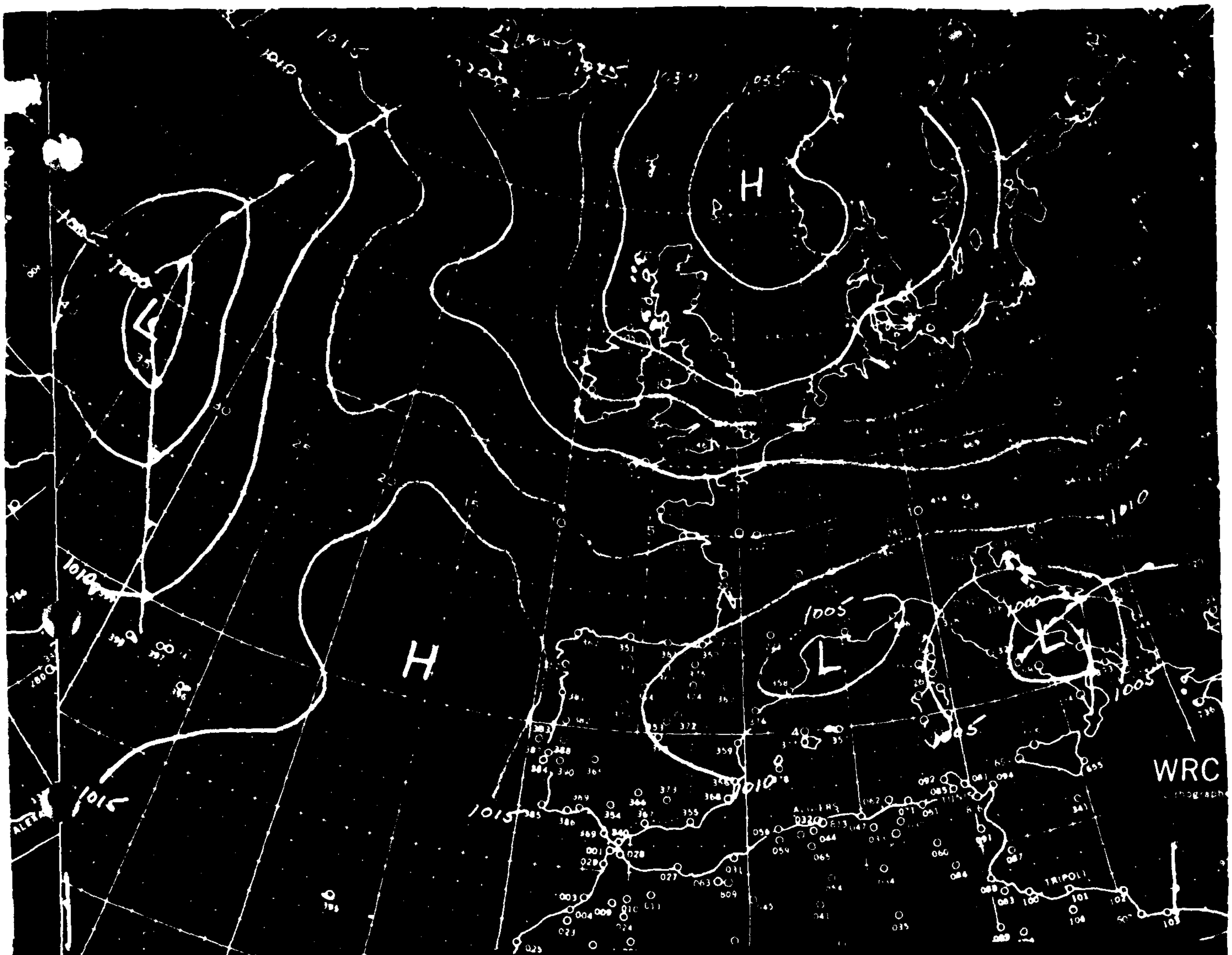


FIG. 4-3 EASTERLY FLOW: 1200Z, 26 Oct. 1947. A strong high is situated over the the northern North Sea with northeast circulation over the Baltic Sea into northeastern Germany. A complex low is centered over Balkans and southern Germany. During the beginning of the 24 hour period, clear skies were observed at Rhein Main. During the afternoon variable amounts of middle and low clouds were observed with the low cloud dissipating by sunset. Minimum visibility was 4 miles during early morning reaching a maximum of 20 miles during the afternoon.

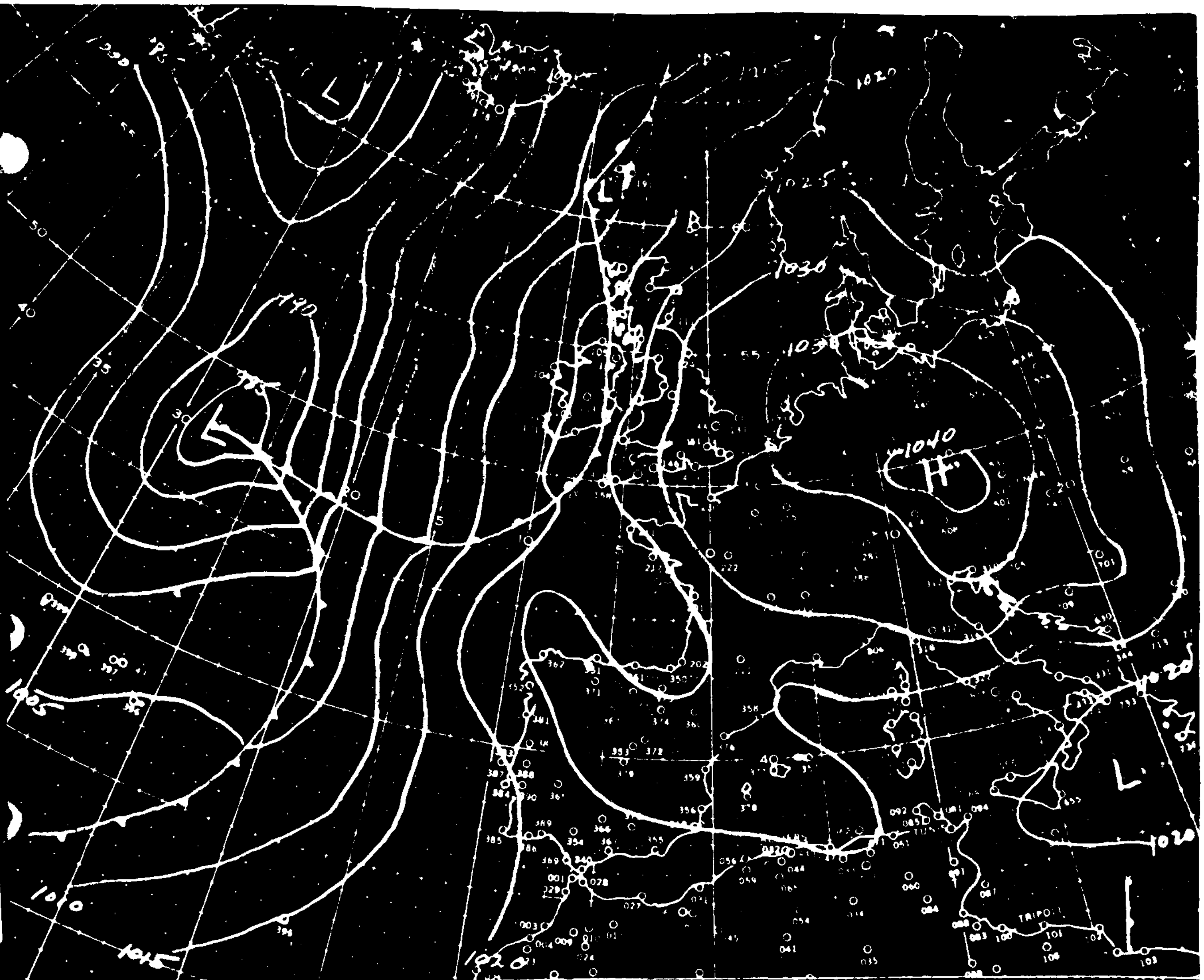


FIG. 4-4 HIGH INFLUENCE: 12 OZ, 25 Nov. 1948. A strong mP high is centered at the surface over east Germany with a warm ridge aloft extending into a high over France. Circulation in the Rhein Main area is light being east to northeast at 1-2 Beaufort during most of the period but becoming calm after sundown. Skies during the entire period were clear to high scattered while visibility varied from a minimum of 1½ miles at sunrise to a maximum of 15 miles during mid-day. As would be expected, relatively large diurnal variation in temperature was experienced.

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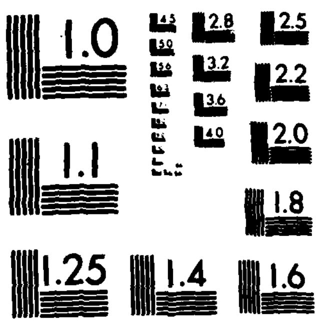

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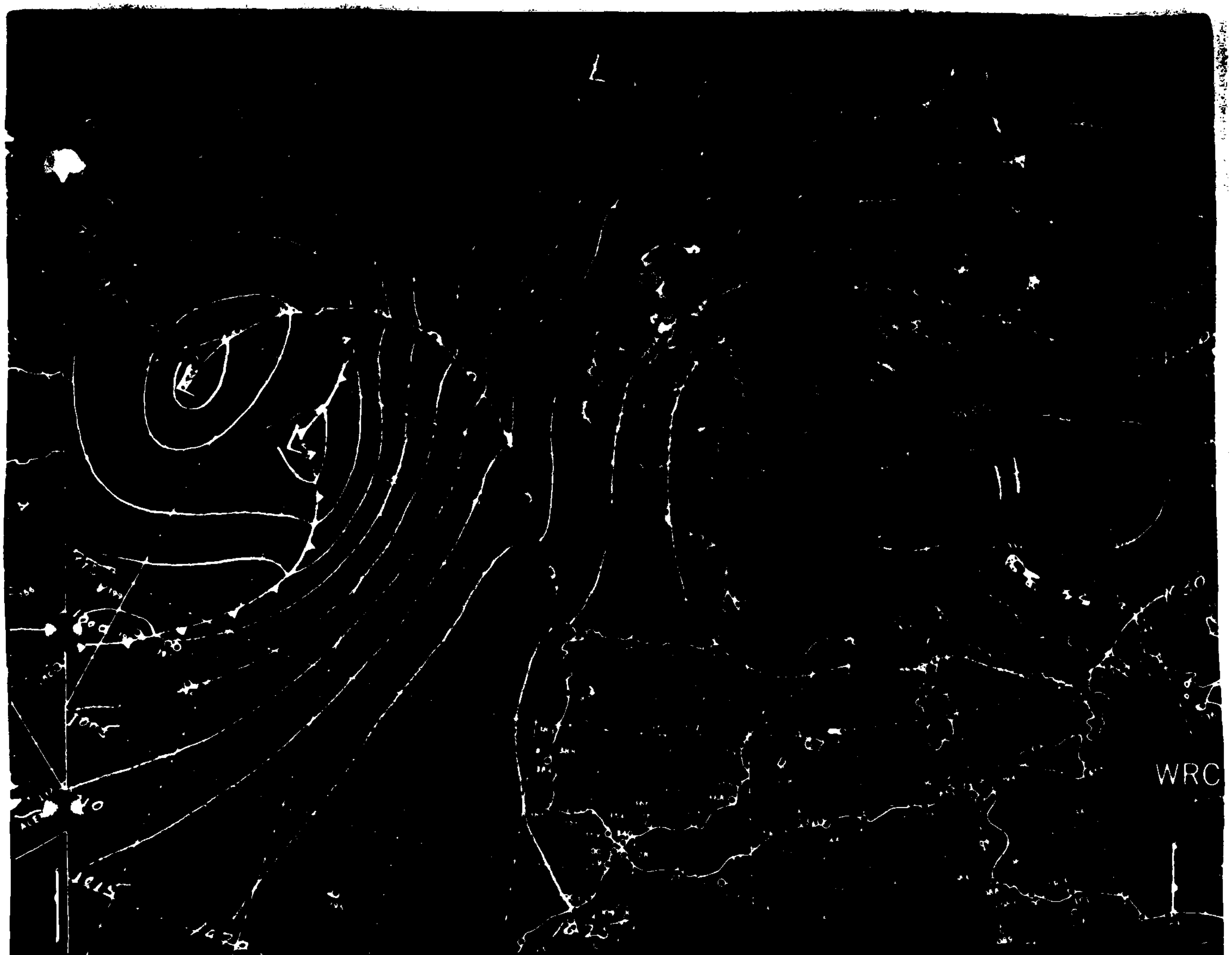

FIG. 4-5 [illegible] NOV. [illegible] had moved to its present position from [illegible] in Fig. 4-4 [illegible] from the [illegible] to move [illegible] seen in Fig. 4-4, [illegible] strength [illegible] by [illegible]

FIG.4-6 [illegible]

[illegible]

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L
L

FIG.4- [illegible]

[illegible] 4-