

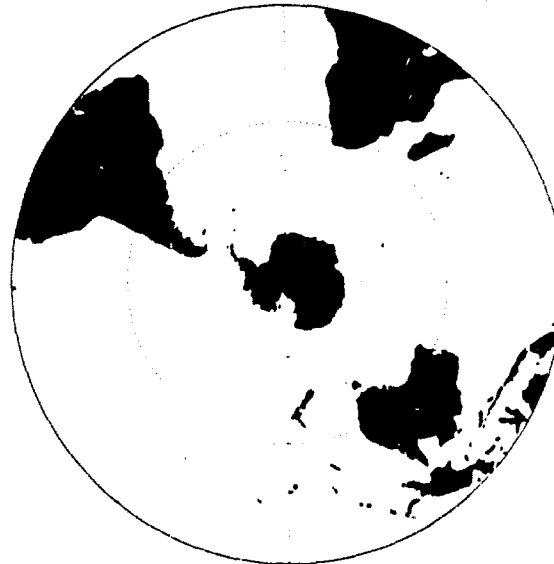


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# JOINT U.S. NAVY/U.S. AIR FORCE CLIMATIC STUDY OF THE UPPER ATMOSPHERE VOLUME 7 - JULY

JULY, 1989

AD-A227 126



PREPARED BY  
NAVAL OCEANOGRAPHY COMMAND DETACHMENT  
ASHEVILLE, N.C.

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OCT 04 1990  
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PREPARED UNDER THE AUTHORITY OF  
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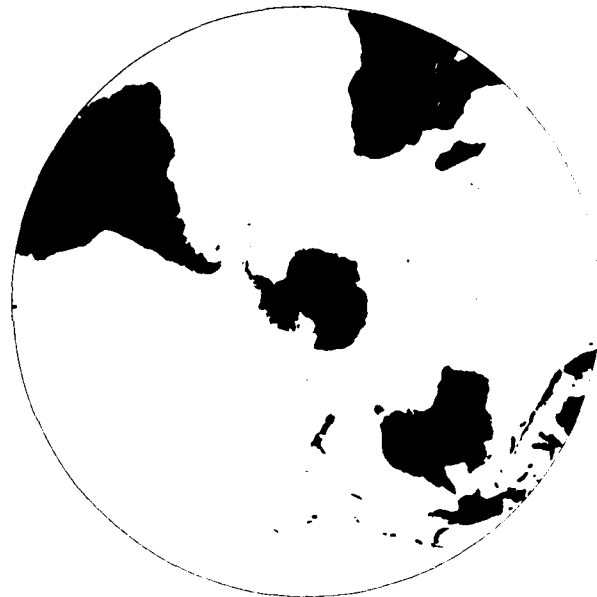




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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE				
1a REPORT SECURITY CLASSIFICATION Unclassified		1b. RESTRICTIVE MARKINGS		
2a SECURITY CLASSIFICATION AUTHORITY		3 DISTRIBUTION/AVAILABILITY OF REPORT Public Release/Distribution Unlimited		
2b DECLASSIFICATION/DOWNGRADING SCHEDULE				
4 PERFORMING ORGANIZATION REPORT NUMBER(S)		5 MONITORING ORGANIZATION REPORT NUMBER(S) NAVAIR 50-1C-7 S/N 0850-LP-015-8000, AWS/TR-89/007		
6a NAME OF PERFORMING ORGANIZATION National Climatic Data Center Global Analysis Branch	6b OFFICE SYMBOL (If applicable) E/CC22	7a NAME OF MONITORING ORGANIZATION Naval Oceanography Command Detachment Asheville		
6c ADDRESS (City, State, and ZIP Code) Federal Building Asheville, NC 28801-2696		7b ADDRESS (City, State, and ZIP Code) Federal Building Asheville, NC 28801-2696		
8a NAME OF FUNDING/SPONSORING ORGANIZATION Commander, Naval Oceanography Command Headquarters, Air Weather Service		9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8c ADDRESS (City, State, and ZIP Code) Stennis Space Center, MS 39529-5000 Scott AFB, IL 62225-5008		10 SOURCE OF FUNDING NUMBERS		
		PROGRAM ELEMENT NO	PROJECT NO	TASK NO
				WORK UNIT ACCESSION NO
11 TITLE (Include Security Classification) Joint U.S. Navy/U.S. Air Force Climatic Study of the Upper Atmosphere Volume 7-July				
12 PERSONAL AUTHOR(S) NCDC - Michael J. Changery, Claude N. Williams NAVOCEANCOMDET - Michael L. Dickenson, Brian L. Wallace				
13a TYPE OF REPORT Final	13b TIME COVERED FROM TO	14 DATE OF REPORT (Year, Month, Day) July 1989	15 PAGE COUNT 236	
16 SUPPLEMENTARY NOTATION				
17 COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	SUB-GROUP		
19 ABSTRACT (Continue on reverse if necessary and identify by block number)  This study of the upper atmosphere is based on 1980-85 twice daily gridded analysis produced by the European Centre for Medium Range Weather Forecasts. Included are global analyses of (1) Mean Temperature/Standard Deviation, (2) Mean Geopotential Height/Standard Deviation, (3) Mean Density/Standard Deviation, (4) Height and Vector Standard Deviation. All for 13 pressure levels - 1000, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, 50, 30 mb. In addition, analyses of (5) Mean Dew Point/Standard Deviation - levels 1000 through 300 mb, (6) jet stream (mean scalar speed) - levels 500 through 30 mb. Also included are global 5 degree grid point wind roses for the 13 pressure levels.				
20 DISTRIBUTION/AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS		21 ABSTRACT SECURITY CLASSIFICATION Unclassified		
22a NAME OF RESPONSIBLE INDIVIDUAL Brian L. Wallace		22b TELEPHONE (Include Area Code) (704) 252-7865	22c OFFICE SYMBOL	

DD FORM 1473, 84 MAR

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SECURITY CLASSIFICATION OF THIS PAGE  
UNCLASSIFIED

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The Joint U.S. Navy/U.S. Air Force Climatic Study of the Upper Atmosphere was prepared by the Officer in Charge, Naval Oceanography Command Detachment, Asheville, North Carolina under the authority of Commander, Naval Oceanography Command. Additional funding was provided by the Air Weather Service as a result of Tri-Services Climatology initiatives. The work was performed at the National Climatic Data Center (NCDC). Specific acknowledgement of the NCDC staff is made to Mr. M.J. Changery, project leader; Mr. C.N. Williams, Jr. for data processing and software development; and Messrs. M.G. Burgin and D.A. McKittrick for drafting skills. Special acknowledgement is made to the European Centre for Medium-range Weather Forecasts for providing the basic gridded analyses.

## INTRODUCTION

During the past decade, improvements in the collection and assimilation of data required for more accurate representations of the atmosphere have resulted in data sets useful for developing a more definitive climatology of the global atmosphere. Such a climatology has uses in aircraft operations and planning, indirect assessments of atmospheric transport as well as a standard state from which atmospheric anomalies can be analyzed.

Prior climatologies, U.S. Navy (1959), U.S. Navy (1966), Naval Weather Service Command (1969), and Naval Weather Service Command (1970), were produced from individual station data with varying periods of record, and the resulting summarized data were analyzed. A serious deficiency was the lack of reporting locations in the major ocean basins. Analyses over the oceans were derived by extrapolating from known analyses over coastal regions as well as the few island or ocean vessels available. An additional complication was the manually intensive effort required to ensure horizontal and vertical consistency of the data.

With the advent, in the 1970s, of more powerful computers and data collection and assimilation systems, the initial analyses used for input into forecast models had a three-fold advantage over the station analyses utilized in the prior climatologies. First, the data assimilation system utilized a greater variety of information for production of an analysis. The normal array of land-based upper air reporting stations was supplemented by ship-based reporting stations, cloud reports, pilot reports and, most importantly, satellite-derived temperature, moisture and wind data. Consequent analyses more accurately represented the state of the atmosphere at a given observation time. Second, the assimilation system quality-controlled all incoming data and ensured the horizontal and vertical consistency of the resulting analyses. Finally, through the computer-based system, global data were available and archived in grid-point form.

A number of analysis sets produced by various national and international meteorological services were investigated. It is recognized that improvements to the data assimilation and analysis systems occurred within any analysis set produced, and that current analyses more accurately reflect the atmosphere's state than do the earlier analyses. It is also recognized that specific parameter or geographic-based deficiencies exist in all analysis sets. However, the intent of this upper-air climatology effort is the production of analyses to serve the needs of the operational meteorologist. A climatology derived from global analyses achieves this goal. Based on known capabilities and technical reviews of the various systems, as well as recommendations from the professional numerical modeling community, the analyses produced by the European Centre for Medium-range Forecasts were selected for processing.

## ECMWF DATA

The European Centre for Medium-range Weather Forecasts (ECMWF) is an international organization established in 1973 and supported by 17 member states. It is responsible for providing global forecasts to the European community. Their data assimilation system consists of multivariate optimal interpolation analysis allowing the incorporation of a variety of observations with differing error characteristics and spatial distributions. A relatively comprehensive coverage of global data is ensured through the data collection schedule. A unique feature of the ECMWF system is the method of grid point analysis. Rather than analyzing individual grid points, varying sized boxes (depending on data density) are created containing groups of grid points. Grid point analysis uses data from within the box as well as adjacent boxes, thereby assuring a consistent analysis between all the grid points.

The system also includes internal quality control which examines the climatological reasonability of incoming data as well as the internal consistency of the data.

In addition, the system utilizes a model initialization process which ensures that harmful gravity waves, caused by imbalances in the analysis, with the potential to create problems in subsequent forecast fields, are suppressed. Through the initialization process, the atmosphere's mass and wind fields are adjusted so that only a portion of the gravity wave balanced by dynamic and physical processes is retained. Further information on the ECMWF system is available in Lorenc (1981), Shaw, et al. (1984), Lonnberg, et al. (1986), and ECMWF (1988).

The resulting initialized analyses are vertically interpolated to these 13 standard pressure levels: 1000, 850, 700, 500, 400, 300, 250, 200, 150, 100, 70, 50, and 30 mb, and include the geopotential height, temperature, and wind for all levels with moisture included for the 1000 through 300 mb levels.

Six years (1980-1985) of individual analysis were obtained from ECMWF on a 2.5° global grid. Although the analyses were permanently archived as spherical harmonic coefficients, ECMWF reconstituted the analyses for use in the data processing. Synoptic analyses at six-hour intervals were received for the six-year period, but only the 00 and 12Z analyses were re-sorted into a grid point sort. Given the quality control performed by ECMWF on collected data and the requirements for horizontal and vertical data consistency imposed by the assimilation system, minimal quality control was performed prior to summarization. Primary quality control was limited to comparison of level data against known/estimated climatological extremes.

The summarized grid point data were objectively analyzed, machine-contoured by parameter and level on polar stereographic (0°-90°N and S) and cylindrical equidistant (0°-60°N and S) projections with resulting contours machine-labeled. In addition, individual wind observations were consolidated into eight 45° segments centered on directions north, northeast, .... through northwest for display as wind roses on a series of cylindrical equidistant projections.

Since the ECMWF analyses were archived as spectral harmonic coefficients, the grid point reconstitution process provides data for all global 2.5° grid points. This naturally includes (for the 1000 through 700 mb levels) selected grid points at which the land elevations exceed the height of the pressure surface. For these grid points, a blanking program was used to eliminate both contours and grid point wind roses.

## ANALYSES

### 1. Pressure-Height

Grid point geopotential height values (in dekameters) are summarized by month for 13 levels from 1000 mb to 30 mb with solid and dashed contours of mean values presented on pressure height charts. Standard deviation of height is calculated from the individual daily values with contours presented on a separate chart series including the standard deviation of vector mean wind. Local points of highest and lowest pressure are designated with H's and L's on the analyzed charts. Not all pressure centers are enclosed by closed contours. Vector mean wind in 5-knot increments are calculated for selected grid points considered adequate to depict flow for the hemisphere with wind shaft orientation related to specific latitude/longitude lines. Vector mean winds less than 2.5 knots are depicted as a shaft with no barbs. Contours of mean geopotential height and vector mean wind barbs are presented for the northern/southern hemispheres on polar stereographic projection and for 0° to 60° north and south on cylindrical equidistant projections with blanking for appropriate high elevation land areas on the 1000 through 700 mb charts.

### 2. Wind Roses

Wind roses for 10° grid points from 5° to 85° north and south are presented by month for all levels from 1000 mb to 30 mb. Each hemisphere is divided into three longitudinal zones: 60°W to 60°E, 60°E to 180°E, and 180°W to 60°W. Each rose presents:

- a) Scalar mean speed
- b) Percent frequency of occurrence from each of 8 cardinal point wind directions proportional to shaft length with dots on the shafts representing 5 percentile intervals.
- c) Mean speed for each of the 8 cardinal wind directions rounded to the nearest 5 knots.

Roses for grid points on the 1000 mb through 700 mb level charts are blanked whenever the land elevation exceeds the mean geopotential height of the specified level.

### 3. Temperature

Grid point temperature data (in °C) are summarized by month for 13 levels from 1000 mb to 30 mb with solid and dashed contours of mean values presented on pressure height charts. Temperature standard deviation derived from the individual observations are shown on the same charts with dotted contours. Contours are presented for both the northern and southern hemispheres on a polar stereographic projection and for the zone from 0° to 60° north and south on cylindrical equidistant projections with blanking for appropriate high elevation land areas on the 1000 through 700 mb charts.

### 4. Dew Point

Grid point moisture data were received as mixing ratios for the period through April 19, 1982 and as relative humidity thereafter for the 1000 through 300 mb levels. All moisture data were converted to dew point values. These are summarized by month with solid and dashed contours of mean values presented on pressure height charts. Dew point standard deviation derived from the individual observations are shown on the same charts with dotted contours. Contours are presented for both the northern and southern hemispheres on a polar stereographic projection and for the zone from 0° to 60° north and south on cylindrical equidistant projections with blanking for appropriate high elevation land areas on the 1000 through 700 mb charts.

## 5. Density

Grid point density data were computed from the daily values of temperature and pressure from the equation of state in the form

$$\rho = \frac{P}{RT}$$

where  $\rho$  is the density,  $P$  is the pressure,  $T$  is the temperature, and  $R$  is the gas constant. Density was computed for moist air through 300 mb and for dry air from 250 mb to 30 mb. Density data (in  $\text{Kg/m}^3$ ) are summarized by month for all 13 levels with solid and dashed contours of mean values presented on pressure height charts. Density standard deviation derived from individual observations are shown on the same charts with dotted contours. Contours are presented for both the northern and southern hemispheres on a polar stereographic projection and for the zone from  $0^\circ$  to  $60^\circ$  north and south on cylindrical equidistant projections with blanking for appropriate high elevation land areas on the 1000 through 700 mb charts.

## 6. Standard Deviation of Height and Vector Mean Wind

Standard deviation of the height and vector mean wind data presented on the pressure height charts are presented on monthly charts for the 1000 through 30 mb levels. Height standard deviations (in dekameters) are presented as solid contours and vector wind standard deviations (in knots) as dashed contours. Contours are presented for both the northern and southern hemispheres on a polar stereographic projection and for the zone from  $0^\circ$  to  $60^\circ$  north and south on cylindrical equidistant projections with blanking for appropriate high elevation land areas on the 1000 through 700 mb charts.

## 7. Jet Stream

Grid point scalar mean wind speed (in knots), as presented by the value in the center of the wind rose octagons, are summarized by month and analyzed for 500 through 30 mb. All speeds exceeding 50 knots are shaded with shading intensity increasing by 25-knot increments. Contours are presented for both the northern and southern hemispheres on a polar stereographic projection and for the zone from  $0^\circ$  to  $60^\circ$  north and south on cylindrical equidistant projections.

## DATA AVAILABILITY

Monthly summarized grid point data for the period of record for all levels from 1000 through 30 mb have been retained on magnetic tape. Data available, per level, include:

- Number of observations
- Mean zonal wind component and standard deviation
- Mean meridional wind component and standard deviation
- Vector mean wind and standard deviation
- Mean temperature and standard deviation
- Mean dew point (through 300 mb) and standard deviation
- Mean geopotential height and standard deviation
- Mean density and standard deviation
- Mean scalar wind speed and percentage of observations for each designated direction

Similarly summarized data for each half-month of the 1980-85 period are also available on magnetic tape. Summaries can be provided on magnetic media or in listing form by the National Climatic Data Center.

## REFERENCES

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Lorenc, A.C., 1981: A global three-dimensional multivariate statistical interpretation scheme. Monthly Weather Review, **109**, 701-721.

Lonnberg, P., J. Pailleux, and A. Hollingsworth, 1986: The new analyses system. ECMWF Technical Memorandum No. 125.

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Shaw, D.B., P. Lonnberg, and A. Hollingsworth, 1984: The 1984 revision of the ECMWF Analysis System. ECMWF Technical Memorandum, No. 92.

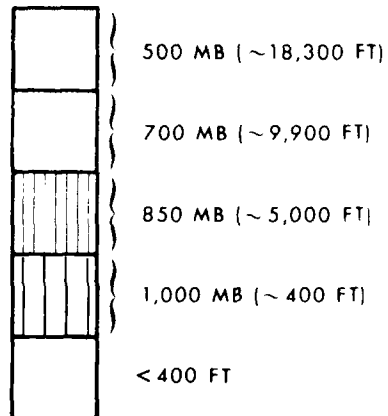
U.S. Navy, 1959: Upper Wind Statistics Charts of the Northern Hemisphere, VOL I-III, NAVAIR 50-1C-535.

U.S. Navy, 1966: Components of the 1000 mb Winds of the Northern Hemisphere, NAVAIR 50-1C-51.

**PRESSURE - HEIGHT**  
**(13 LEVELS, 1000 TO 30 MB)**

- Contours of mean height (solid and dashed lines) in geopotential dekameters; example: 580 is 5800 geopotential meters; solids labeled, dashed intermediates unlabeled
- Height labeled interval:
  - 6 dekameters ( 60 meters) - 1000 MB to 400 MB
  - 12 dekameters (120 meters) - 300 MB to 200 MB
  - 8 dekameters ( 80 meters) - 150 MB to 30 MB
- Vector mean wind in knots
- Contours blanked for geographic areas with elevations exceeding specified geopotential heights

**ELEVATION SCALE**



Mean Geopotential Height (gpm)

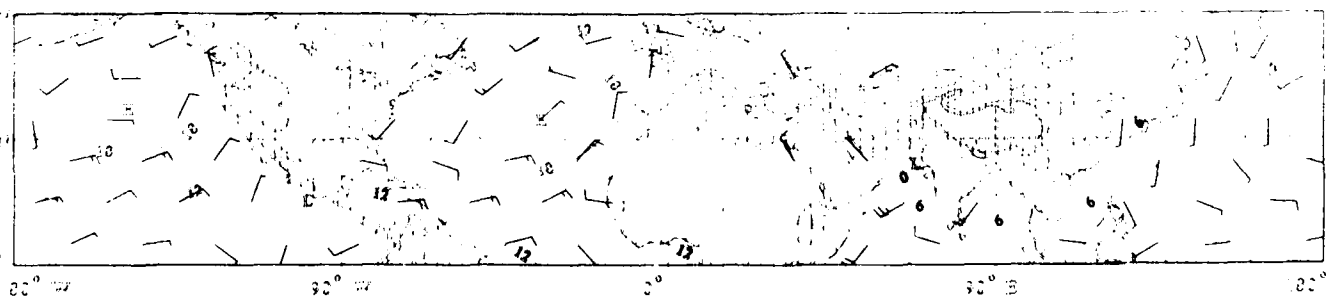
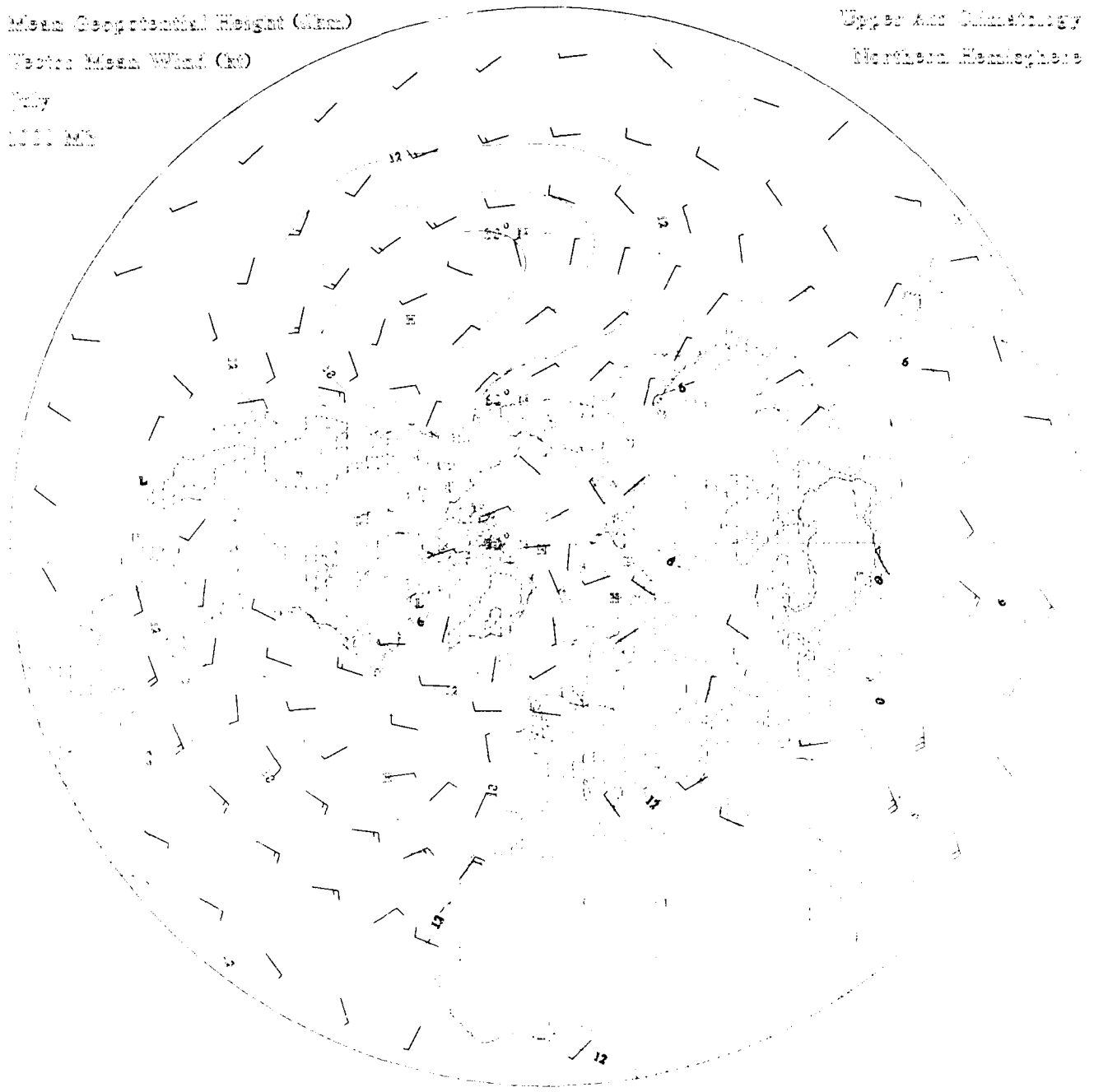
Vector Mean Wind (kt)

July

1000 MB

Upper Air Climatology

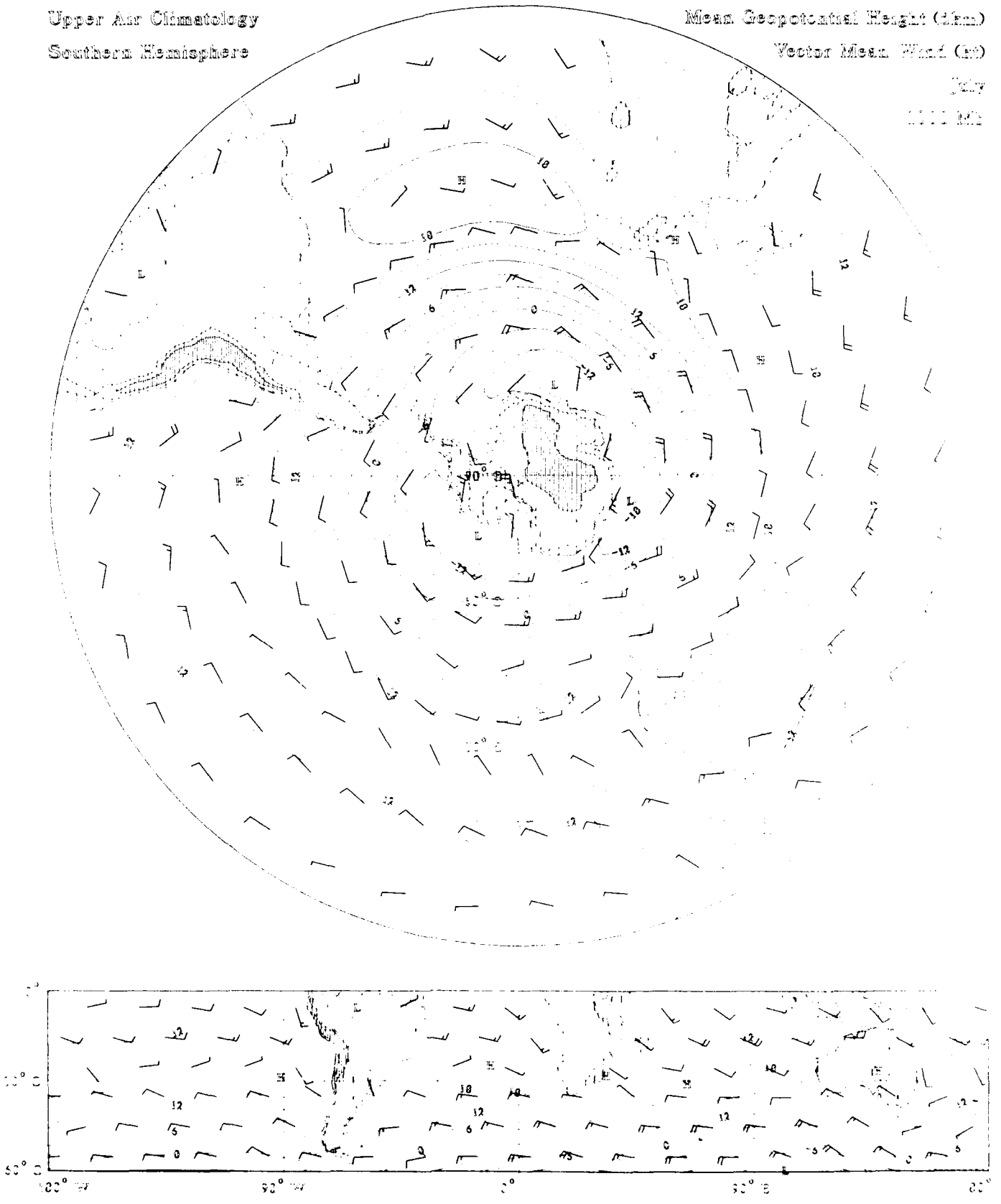
Northern Hemisphere



Upper Air Climatology  
Southern Hemisphere

Mean Geopotential Height (gpm)  
Vector Mean Wind (m/s)

July  
1971-1972



Mean Geopotential Height (dam)

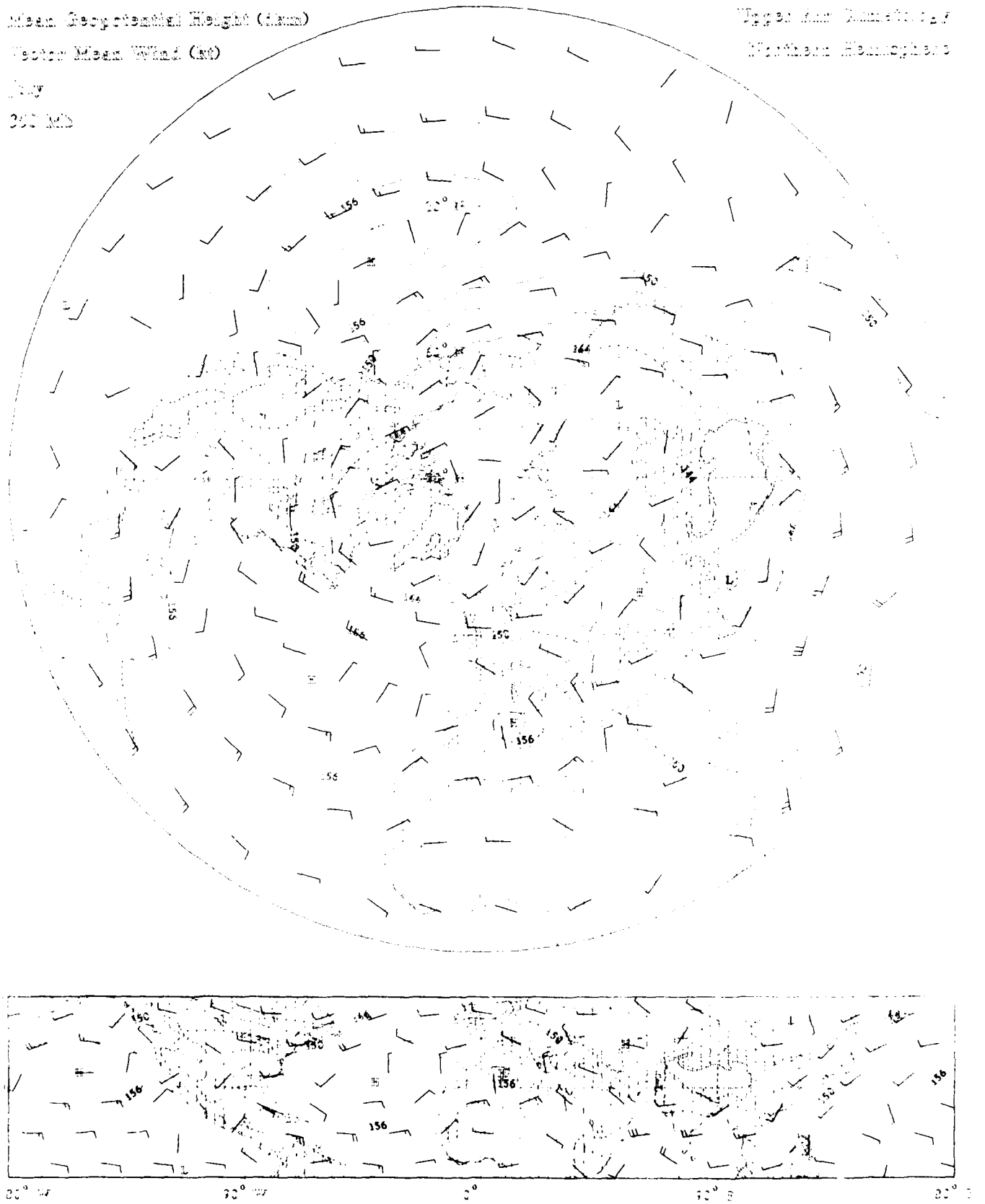
Vector Mean Wind (kt)

July

300 MB

Upper Air Chart of

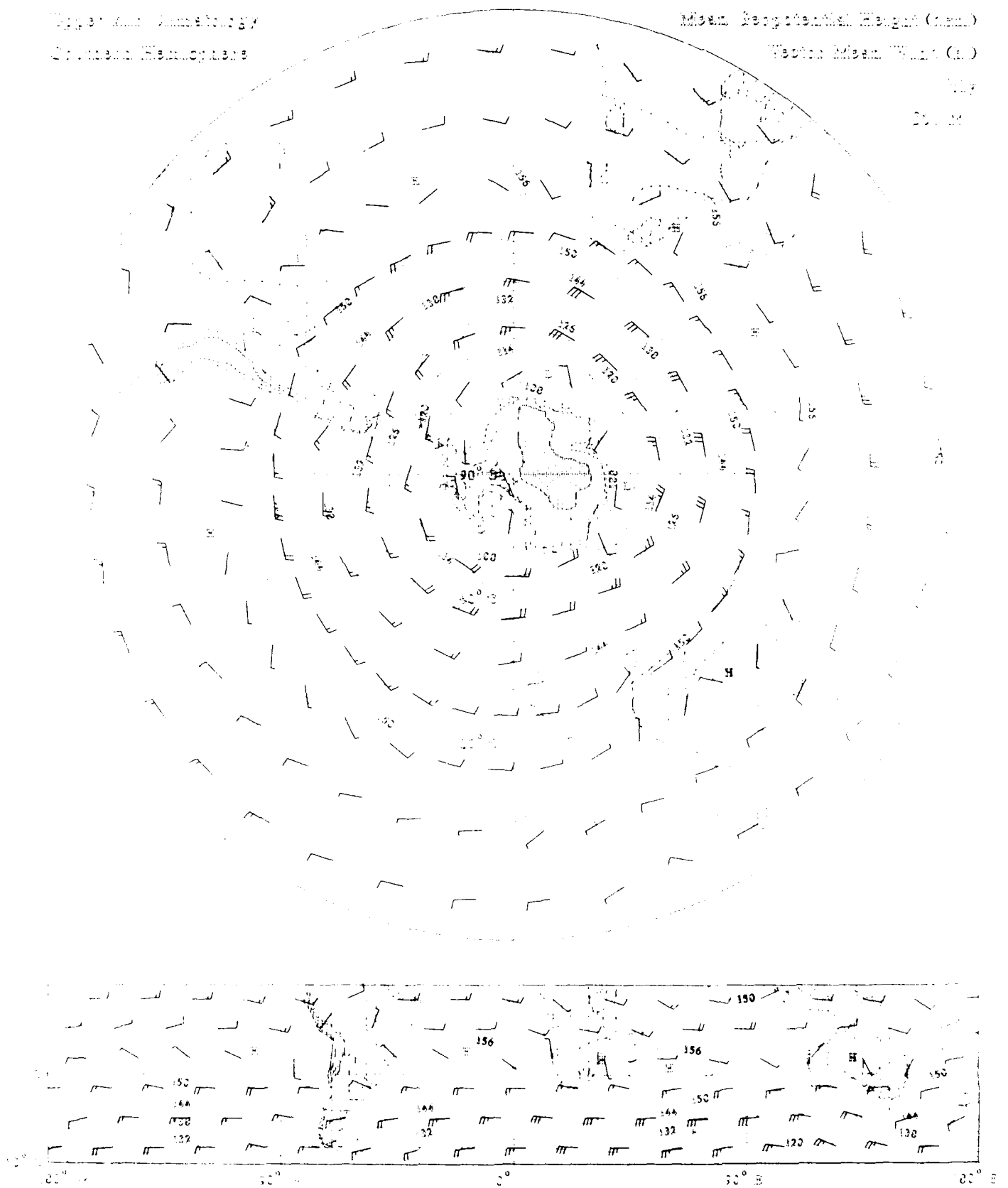
Northern Hemisphere



Upper Air Charts  
2000 ft. Isobars

Mean Sea Level Height (mm)  
Upper Mean Chart (H)

100  
200



Mean Sea Level Height (hPa)

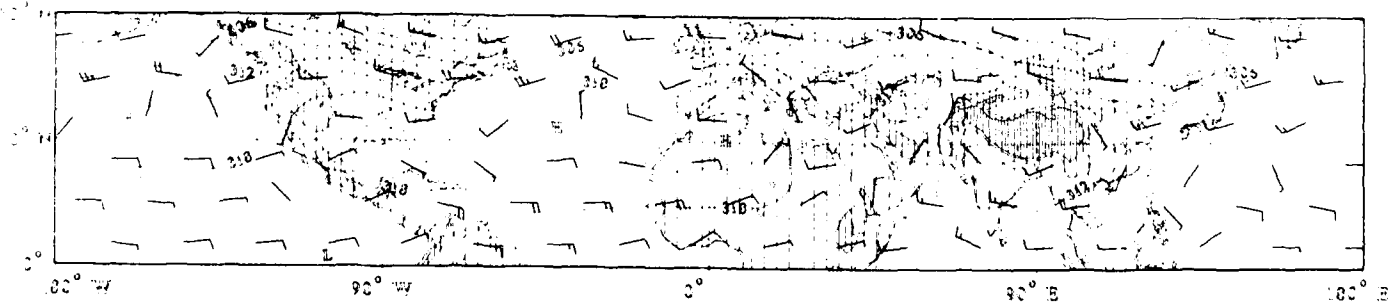
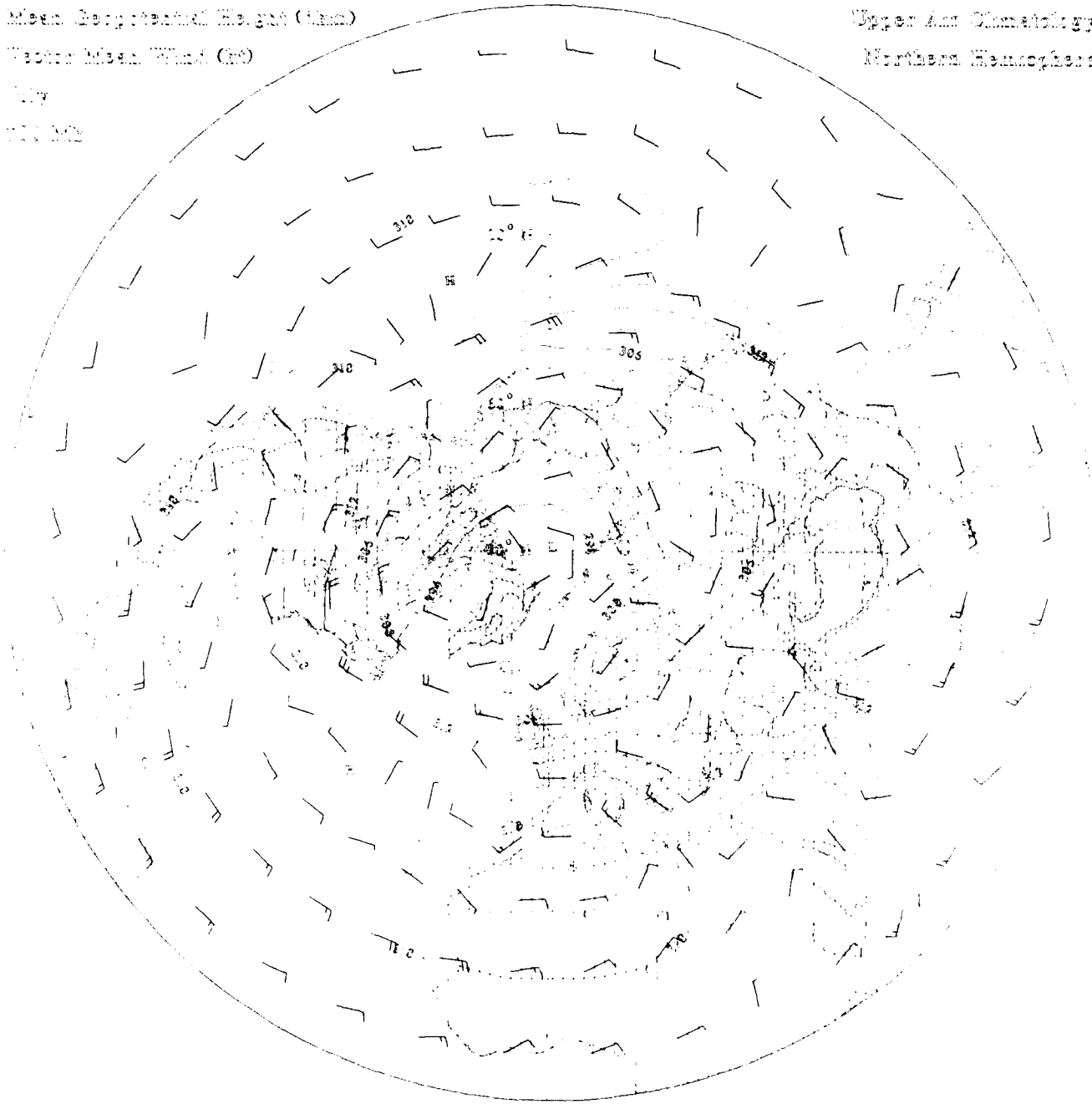
Vector Mean Wind (m/s)

July

1950-1952

Upper Air Climatology

Northern Hemisphere



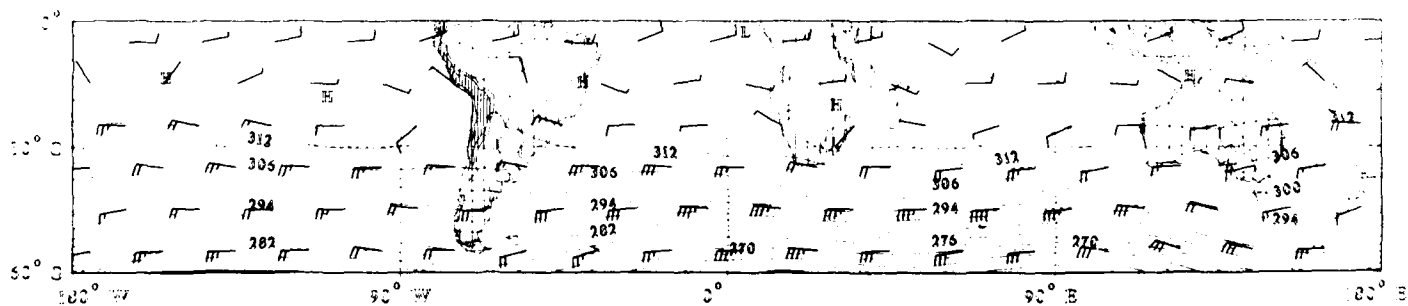
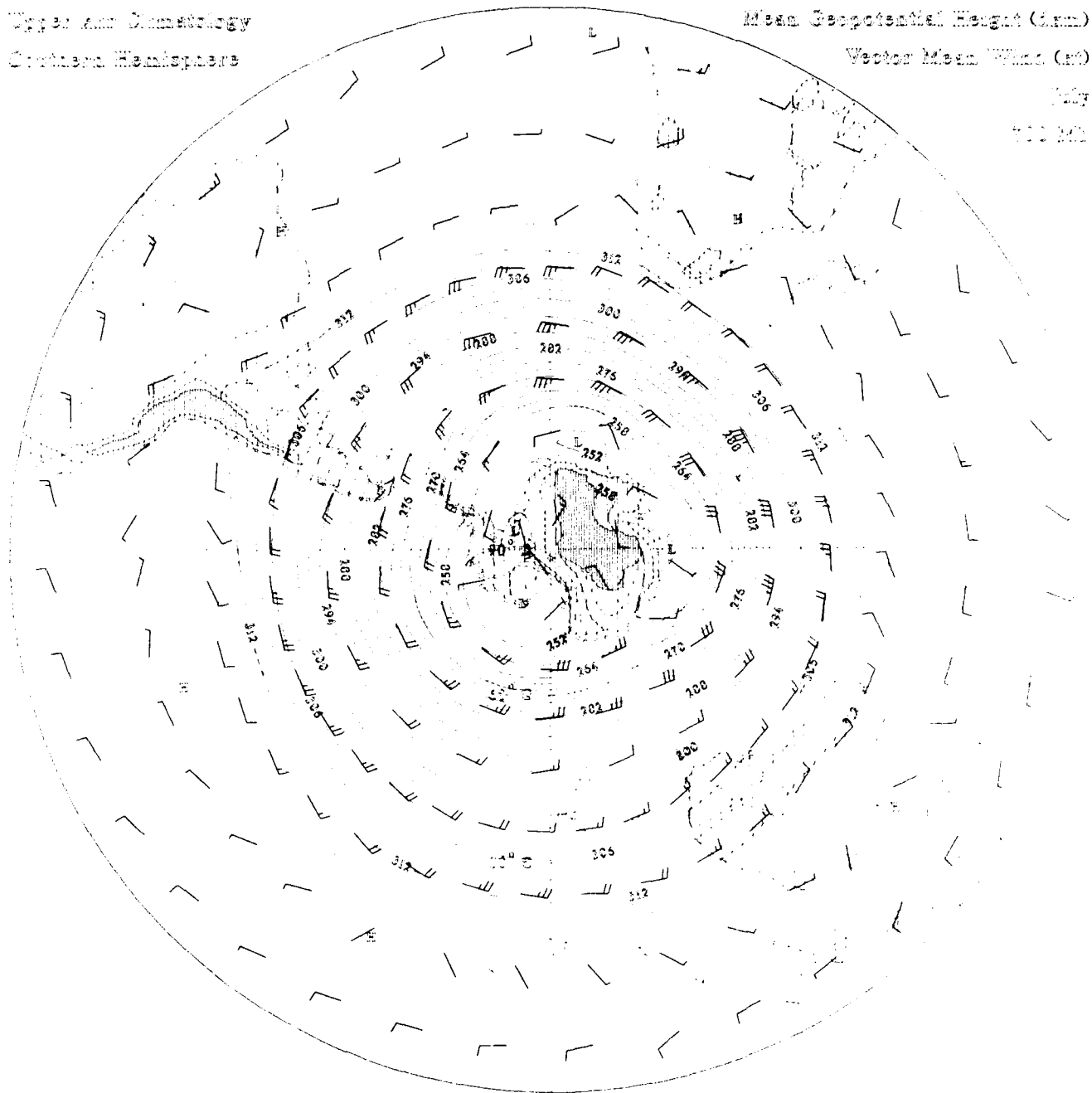
Upper Air Climatology  
Southern Hemisphere

Mean Geopotential Height (Gm)

Vector Mean Winds (m)

July

1950-54



Mean Geopotential Height (dgm)

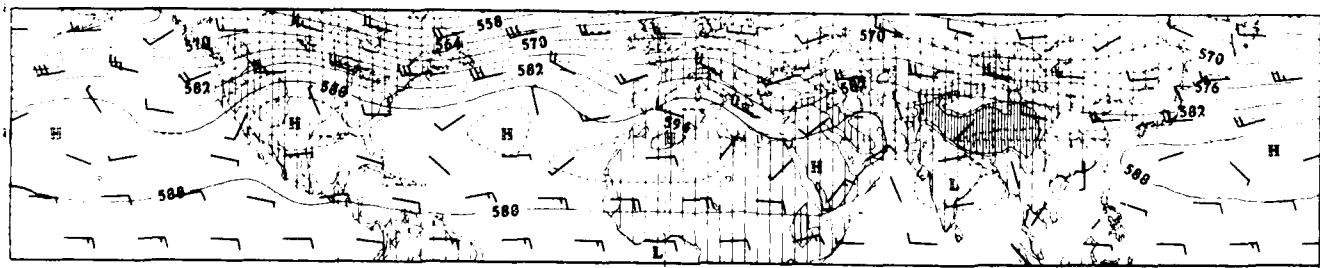
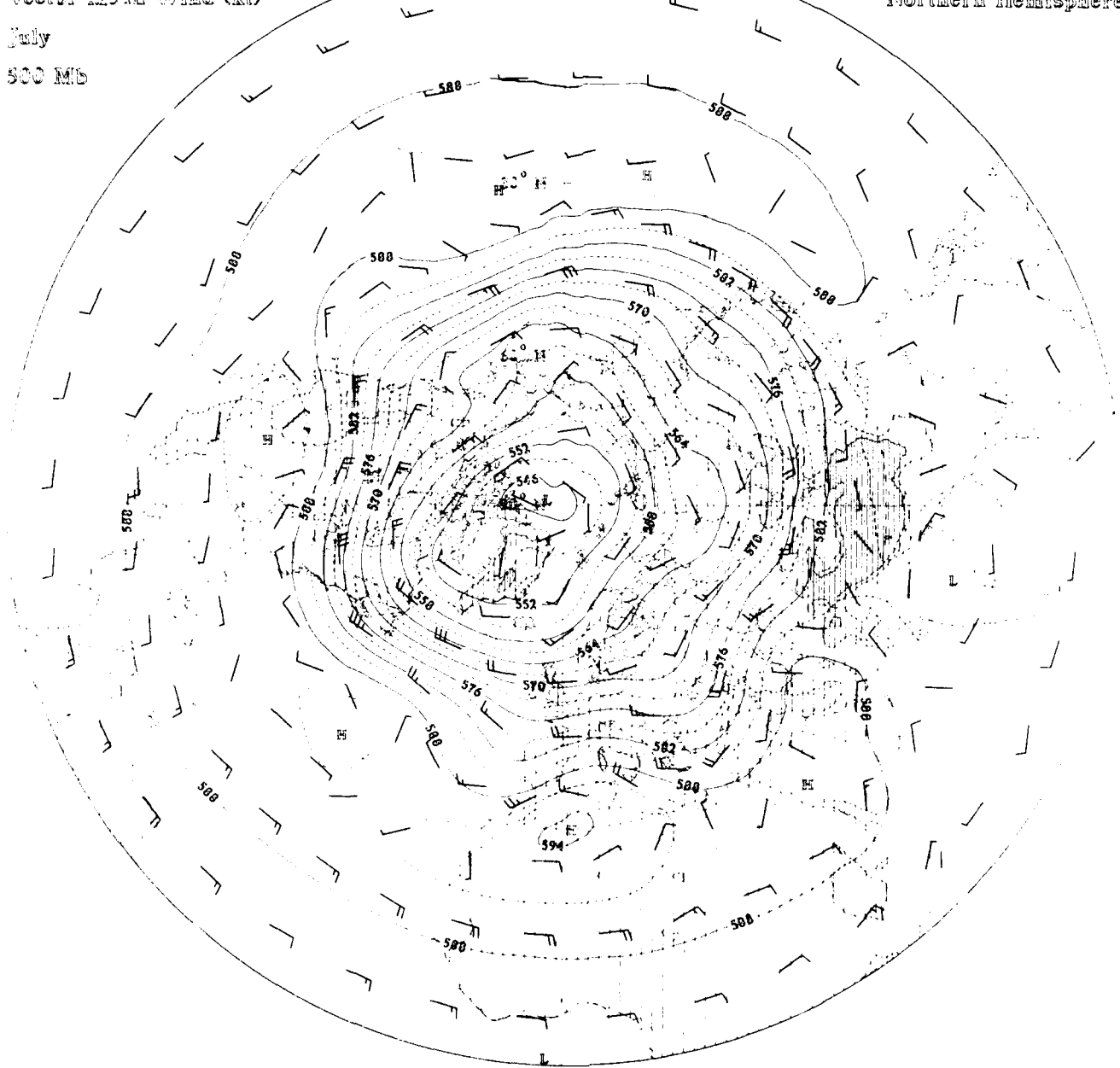
Vector Mean Wind (kt)

July

500 MB

Upper Air Climatology

Northern Hemisphere



180° W

90° W

0°

90° E

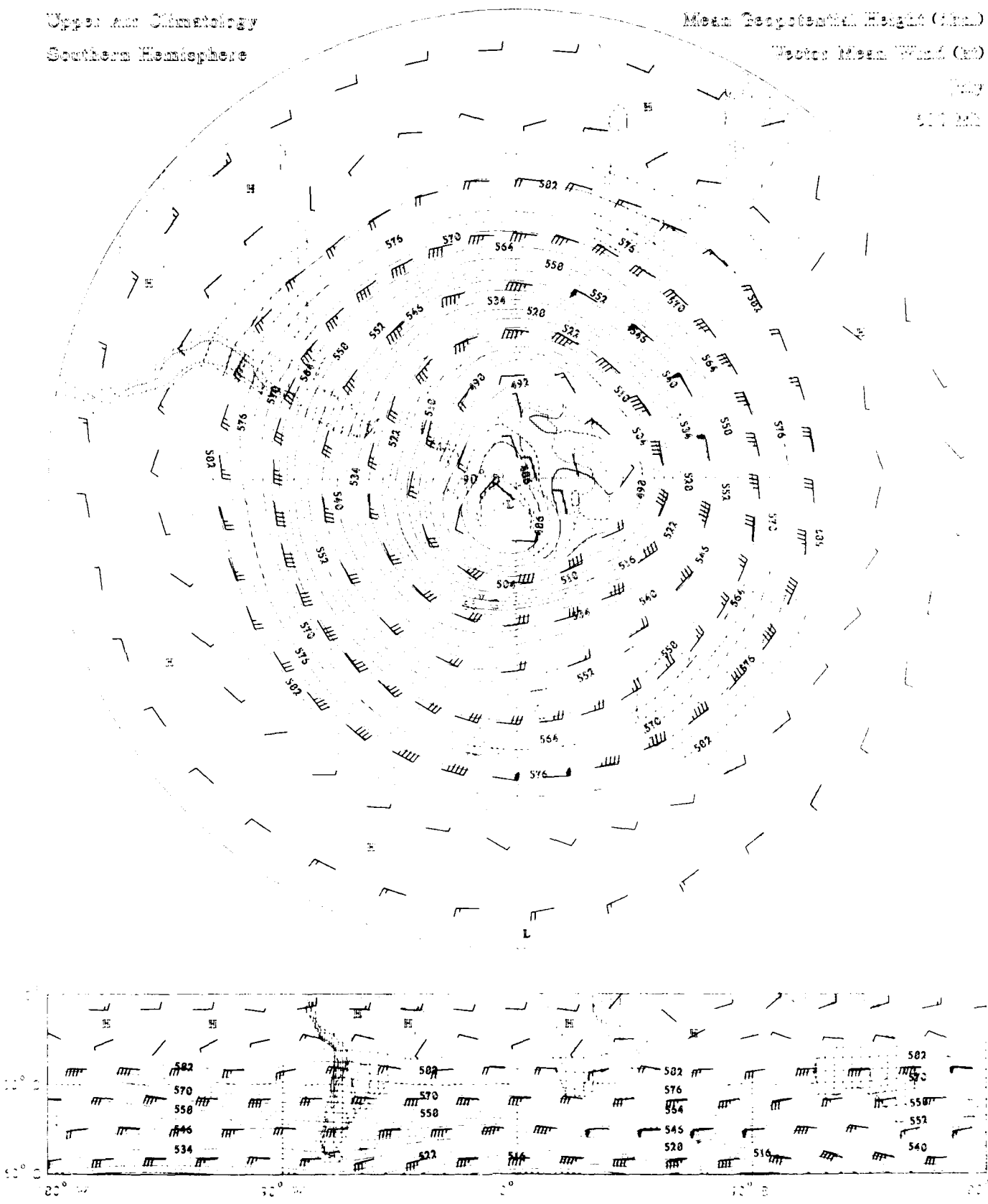
180° E

Upper Air Climatology  
Southern Hemisphere

Mean Geopotential Height (gms)

Vector Mean Wind (kt)

1000  
500 200



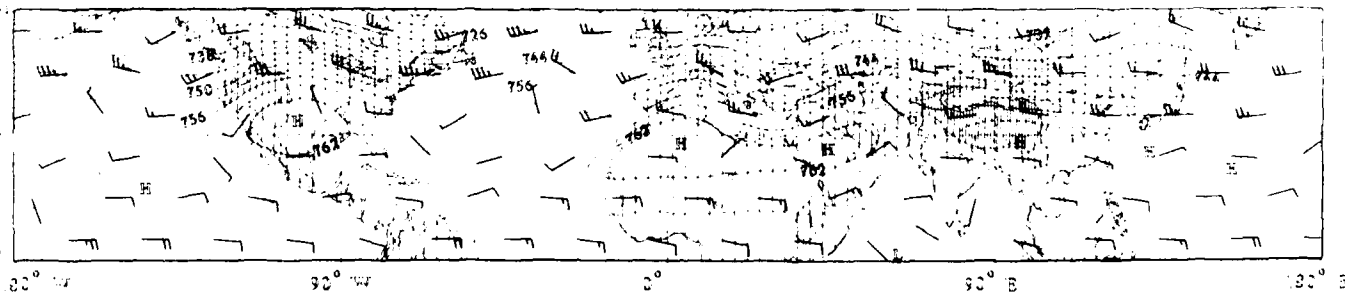
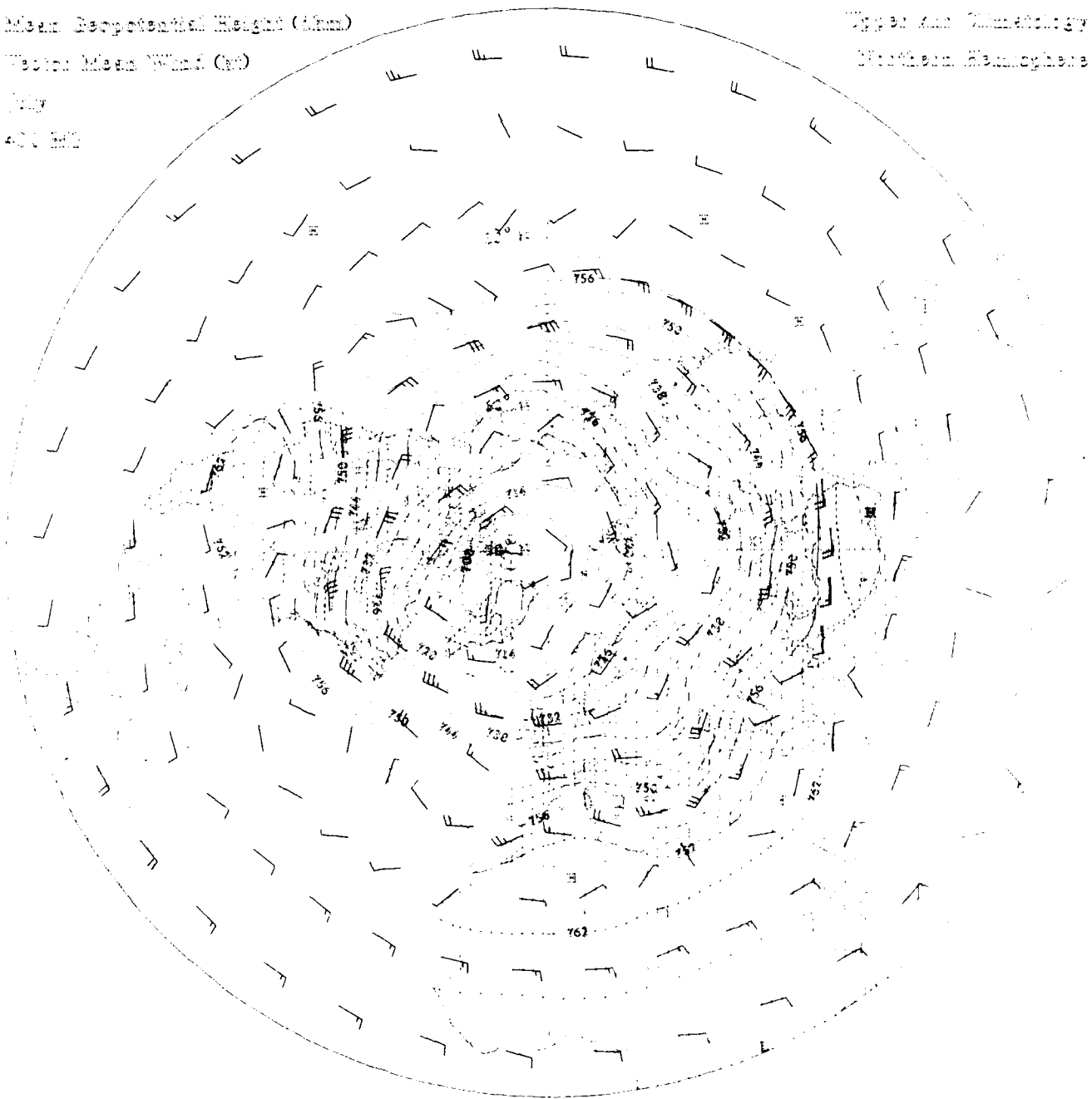
Mean Geopotential Height (GPM)

Vector Mean Wind (m/s)

July  
400 mb

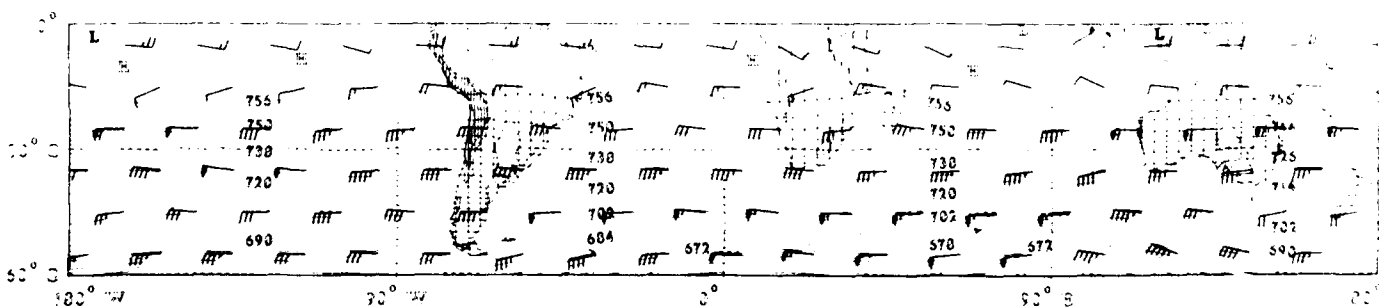
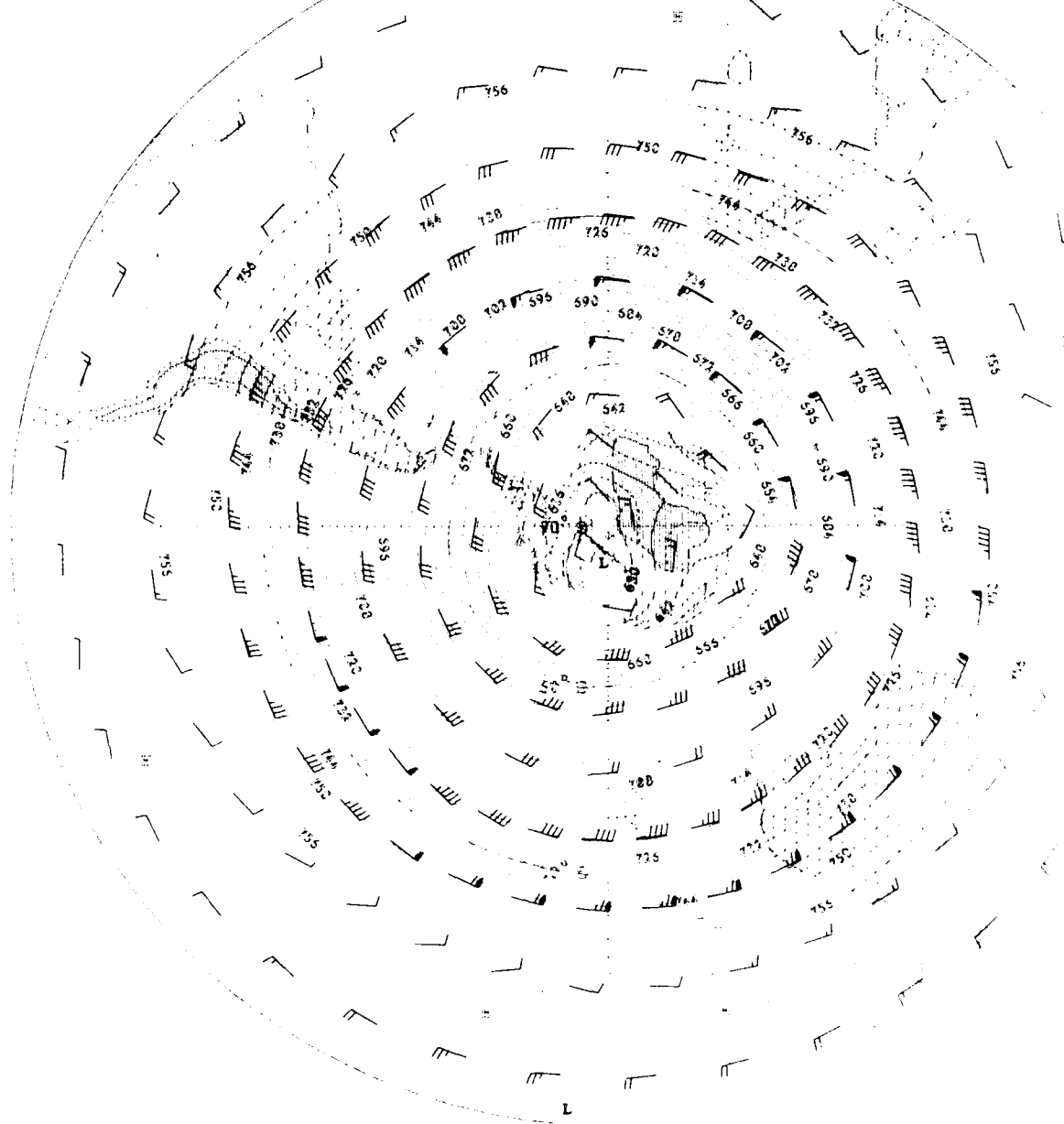
Typical Low Circulation

Northern Hemisphere



Upper Air Climatology  
Southern Hemisphere

Mean Barometric Height (mb)  
Vector Mean Wind (kt)



Mean Sea Level Height (G.M.M.)

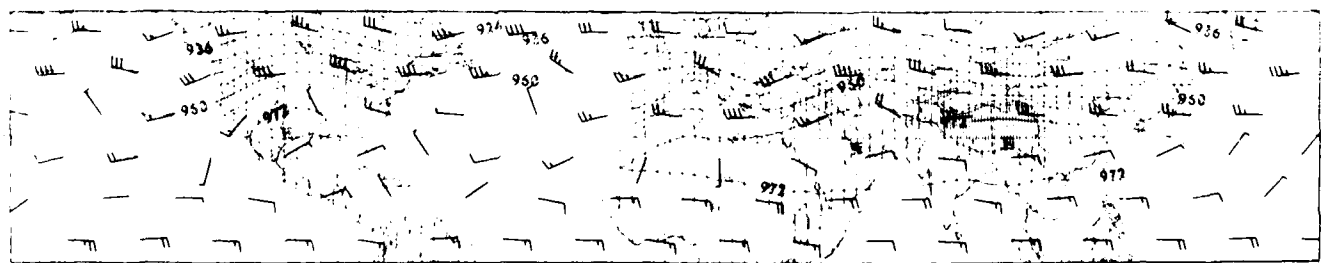
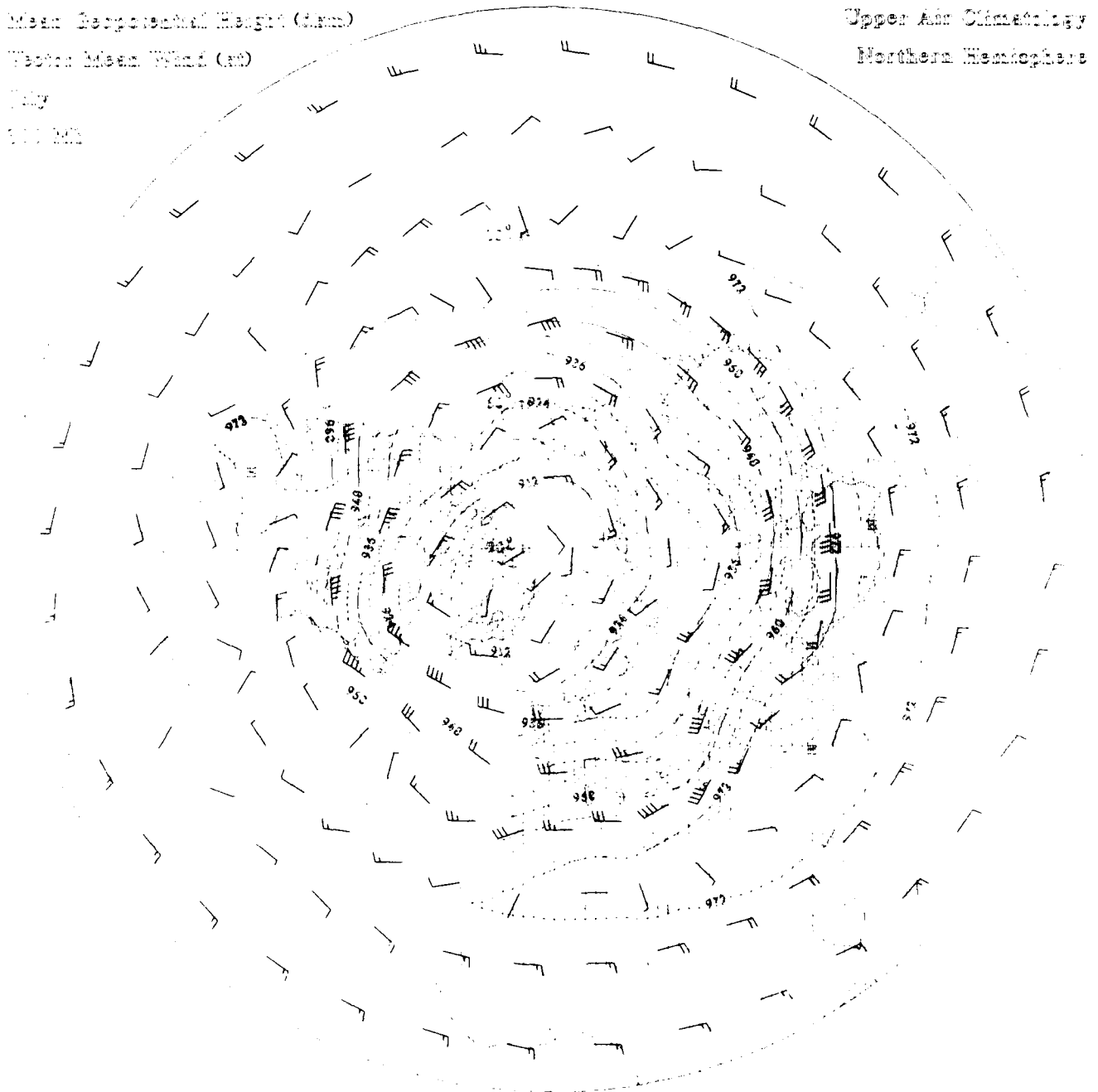
Vector Mean Wind (m)

July

1950

Upper Air Climatology

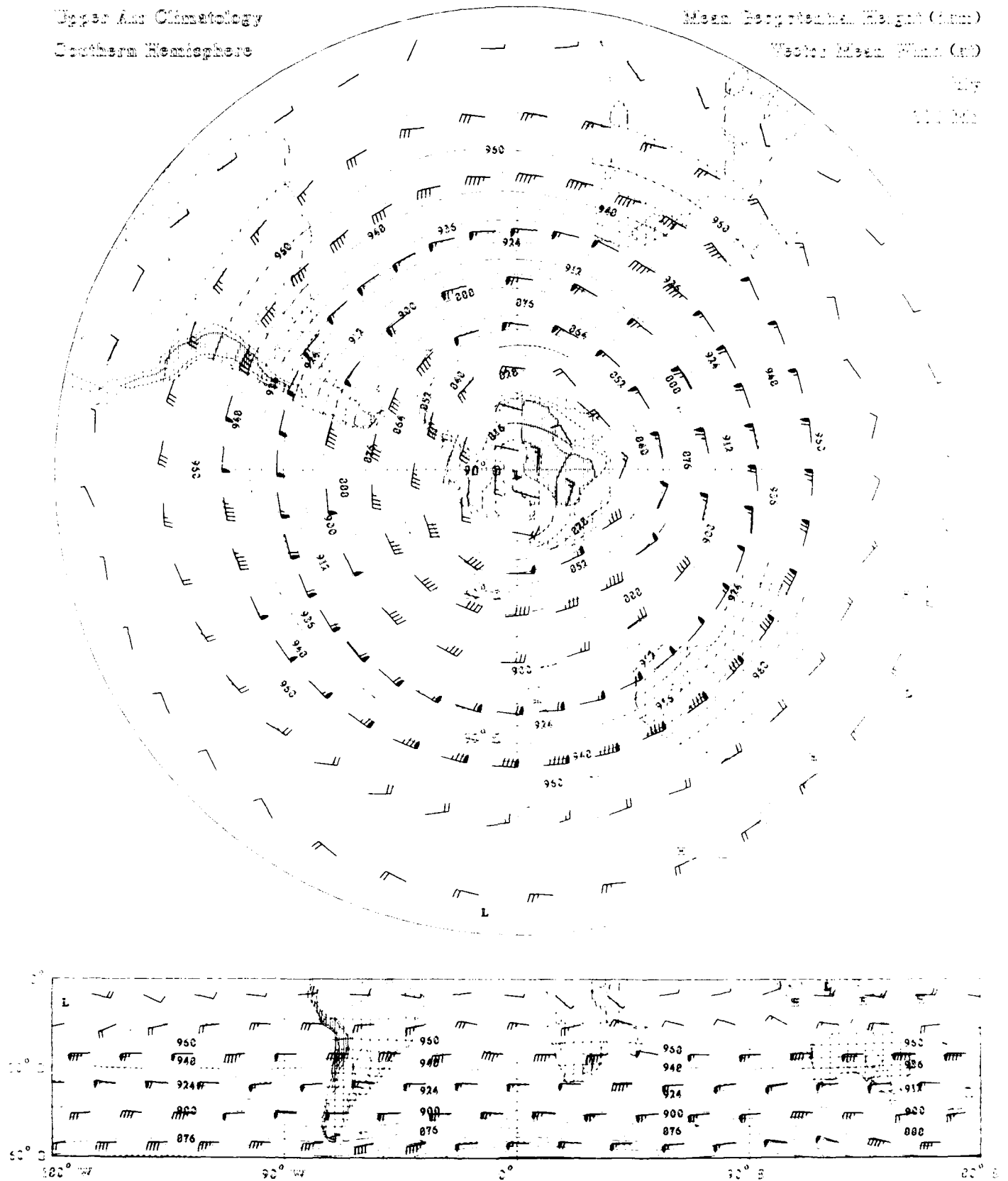
Northern Hemisphere



10° 20° 30° 40° 50° 60° 70° 80° 90°

Upper Air Climatology  
 Southern Hemisphere

Mean Sea Level Height (mm)  
 Vector Mean Wind (m/s)



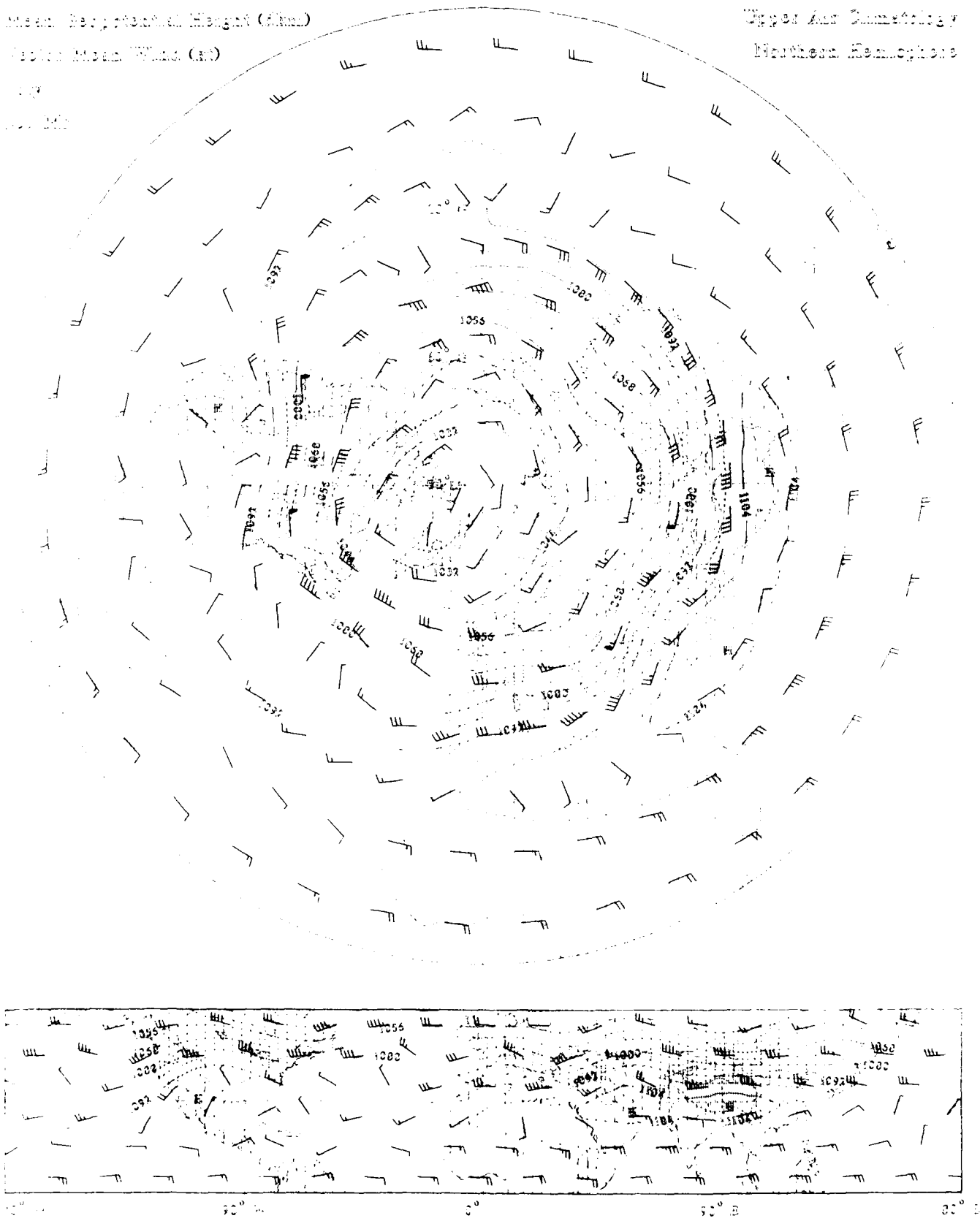
Mean Sea Level Height (dmm)

Upper Air Charting

Mean Wind (kt)

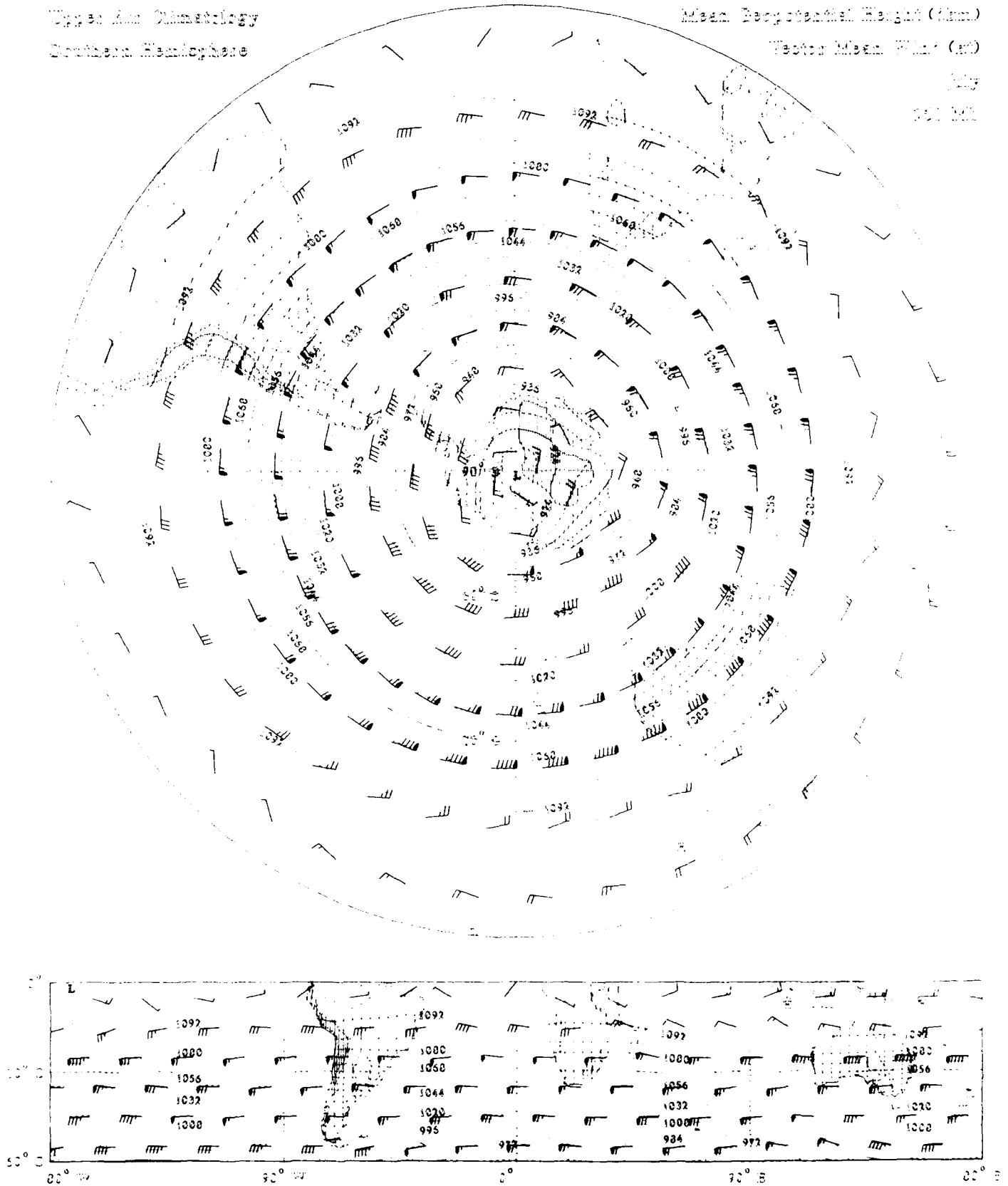
Northern Hemisphere

10  
20



Upper Air Climatology  
Southern Hemisphere

Mean Reciprocal Height (km)  
Vector Mean Wind (m)



Mean Sea Level Height (ft)

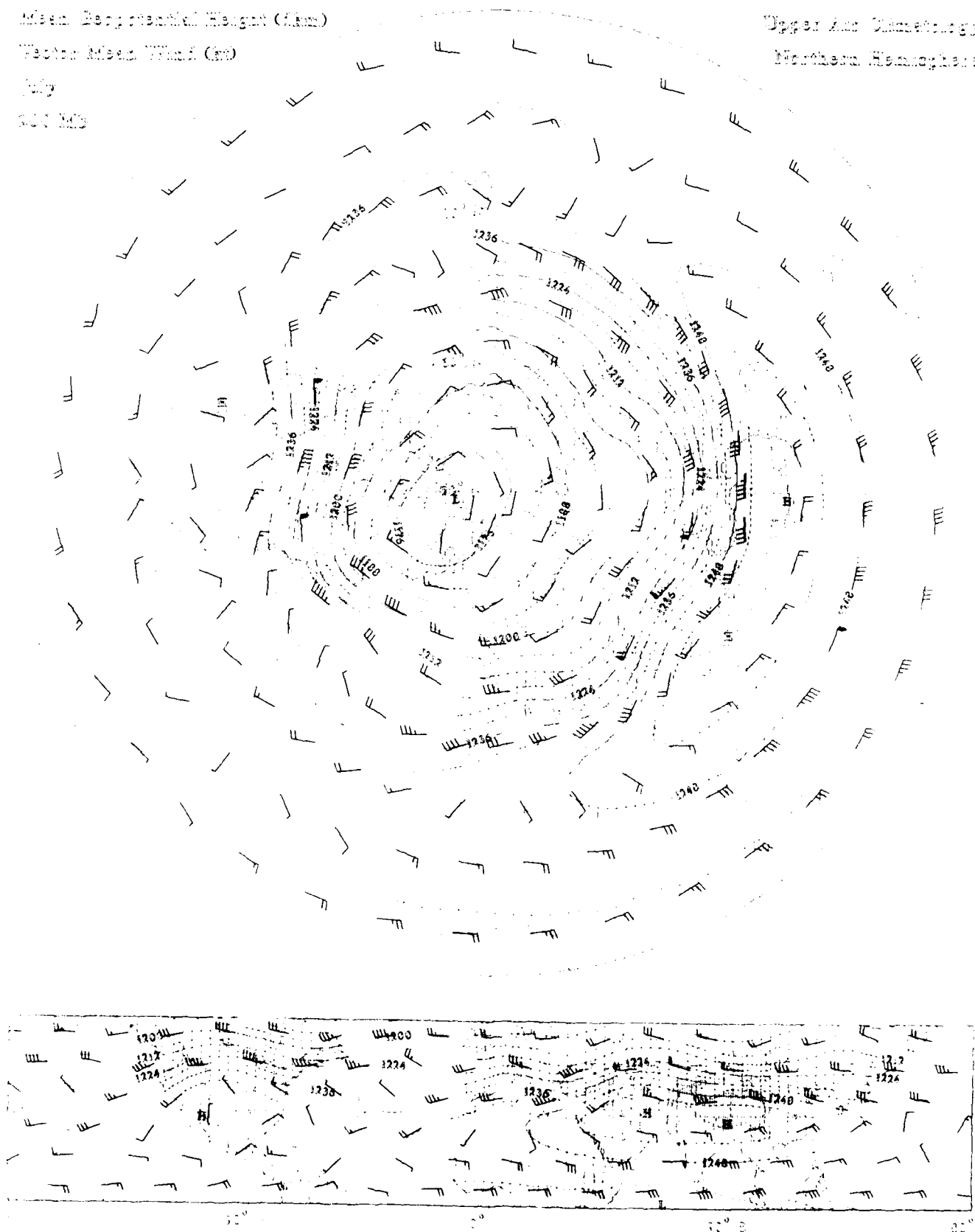
Tidal Mean Wind (kt)

July

1951-52

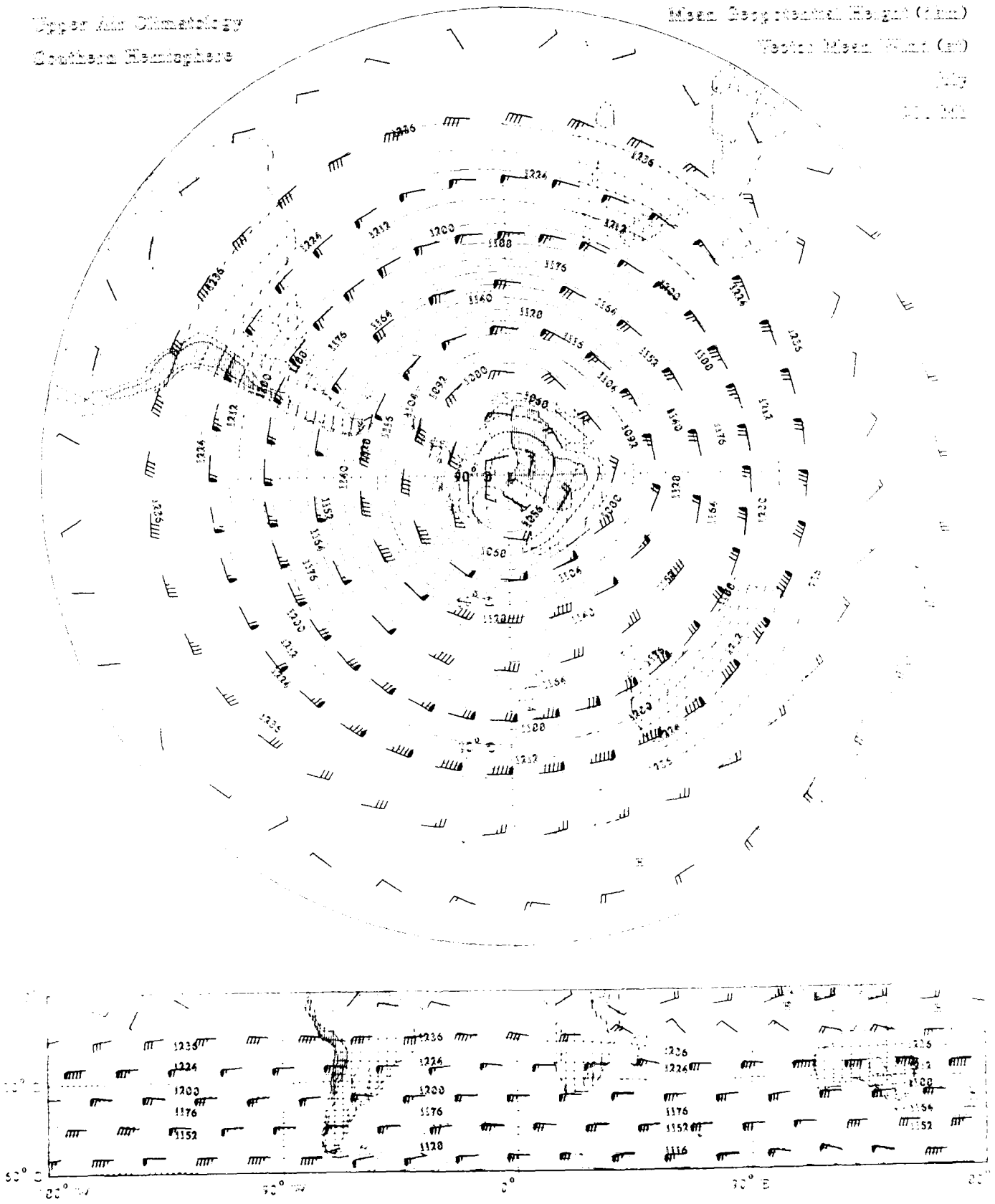
Upper Air Charts

Northern Hemisphere



Upper Air Climatology  
Southern Hemisphere

Mean Sea Level Height (mm)  
Vector Mean Wind (m/s)



Mean Sea Level Height (ftm)

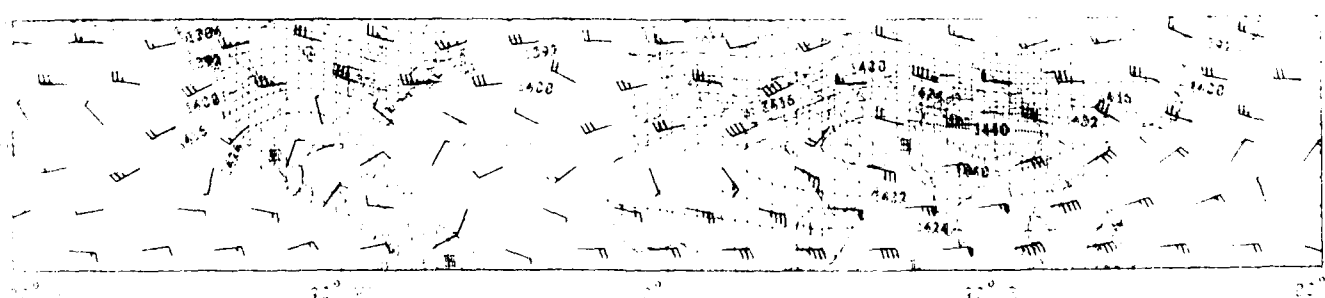
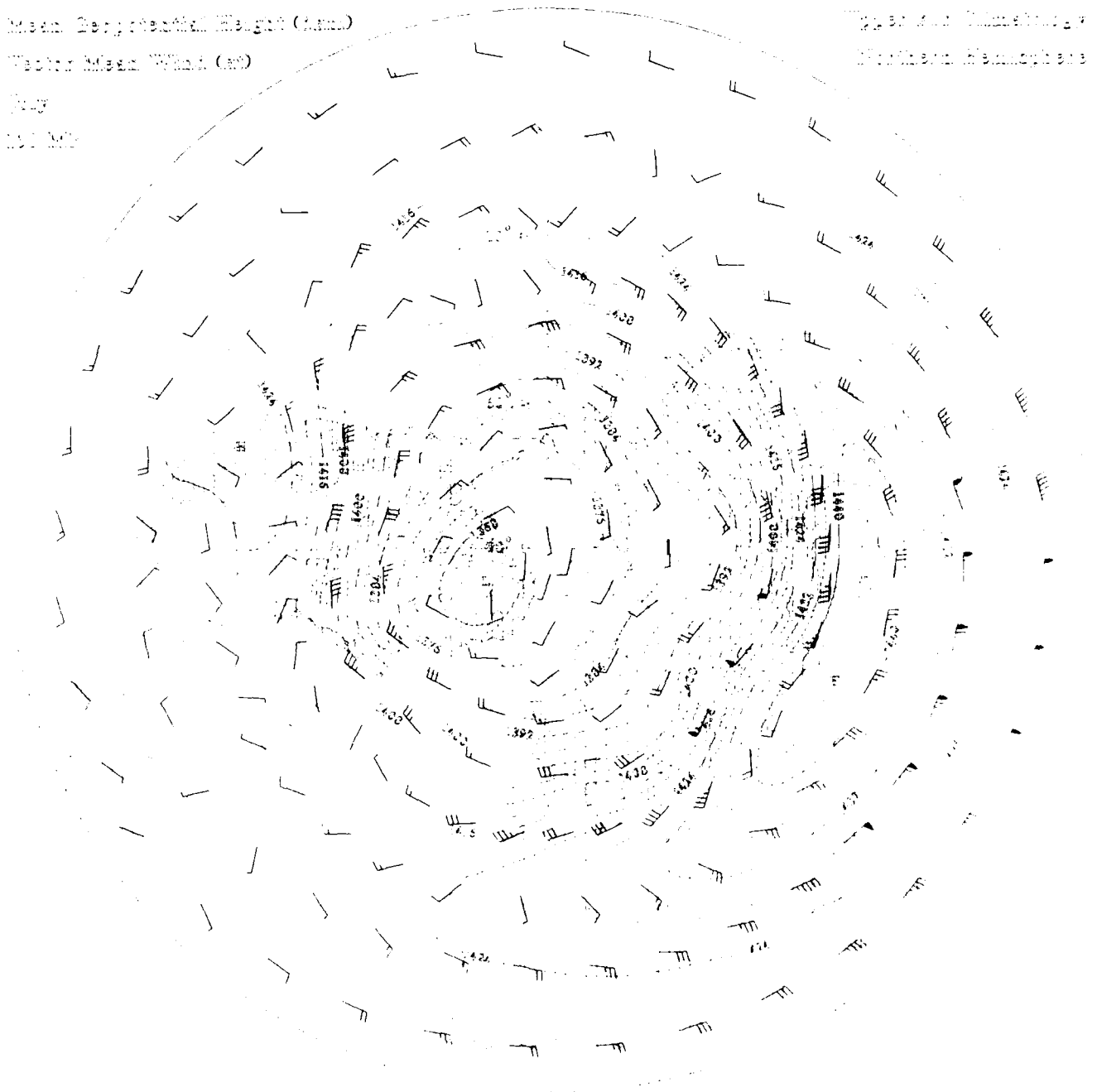
Vector Mean Wind (kt)

Day

01 JAN

2.5 ftm Contour Interval

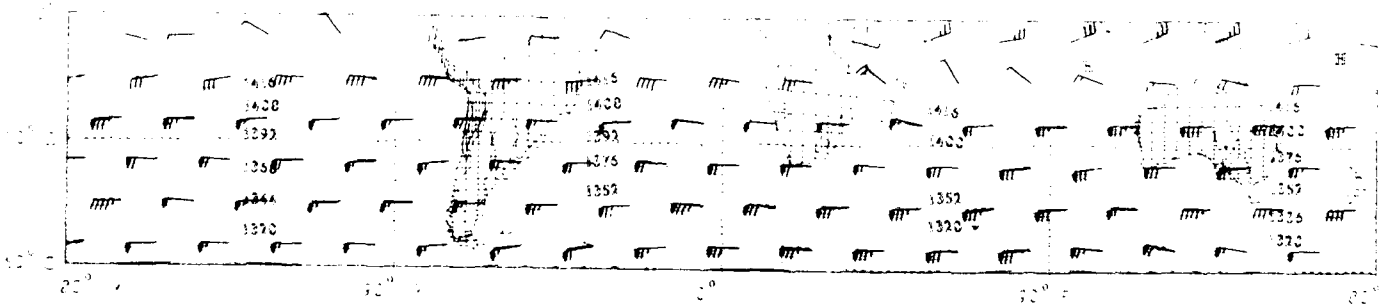
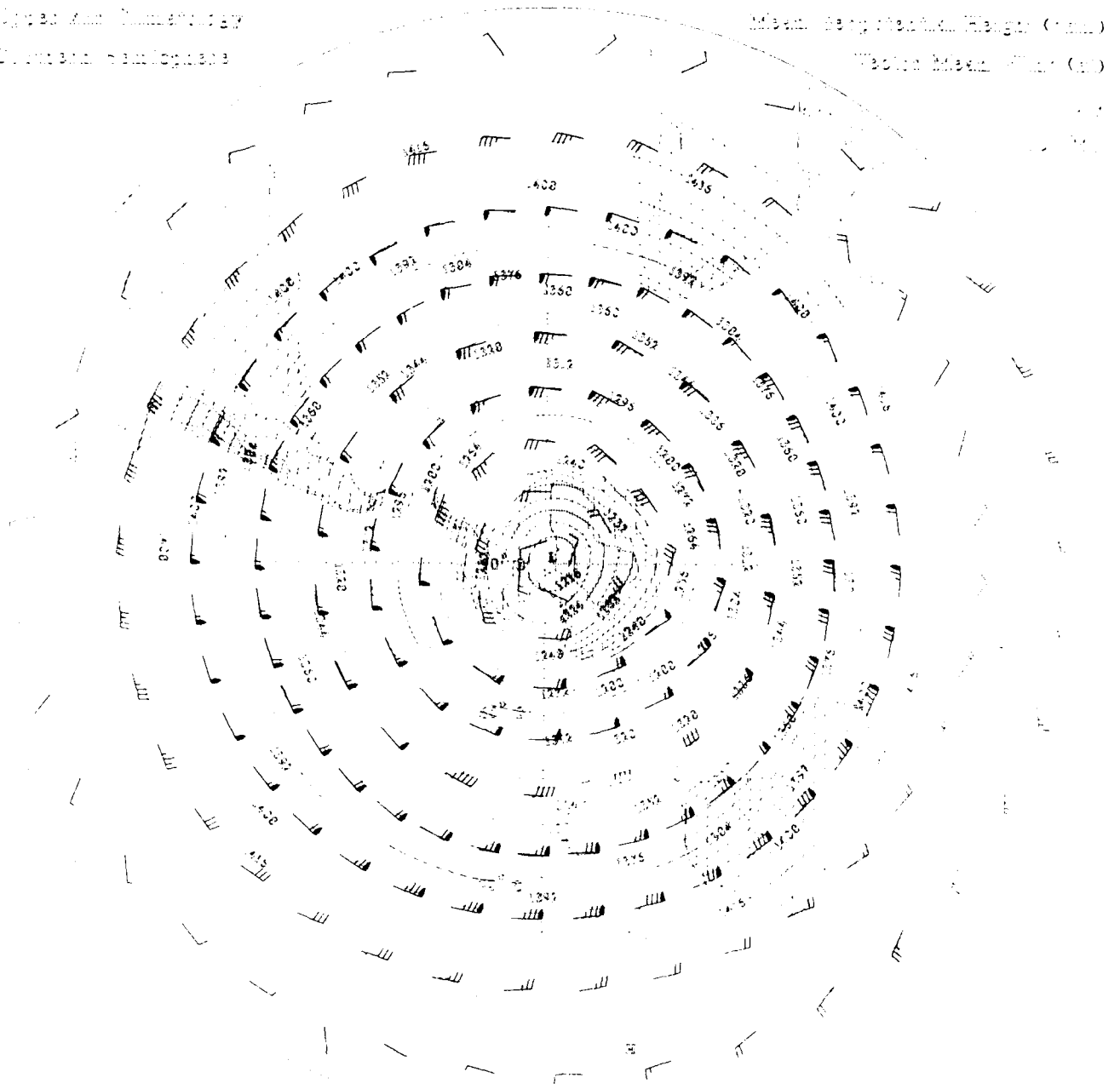
Direction by Arrowheads



Topographic Contour Map

Mean Sea Level (ft)

Mean Sea Level (m)



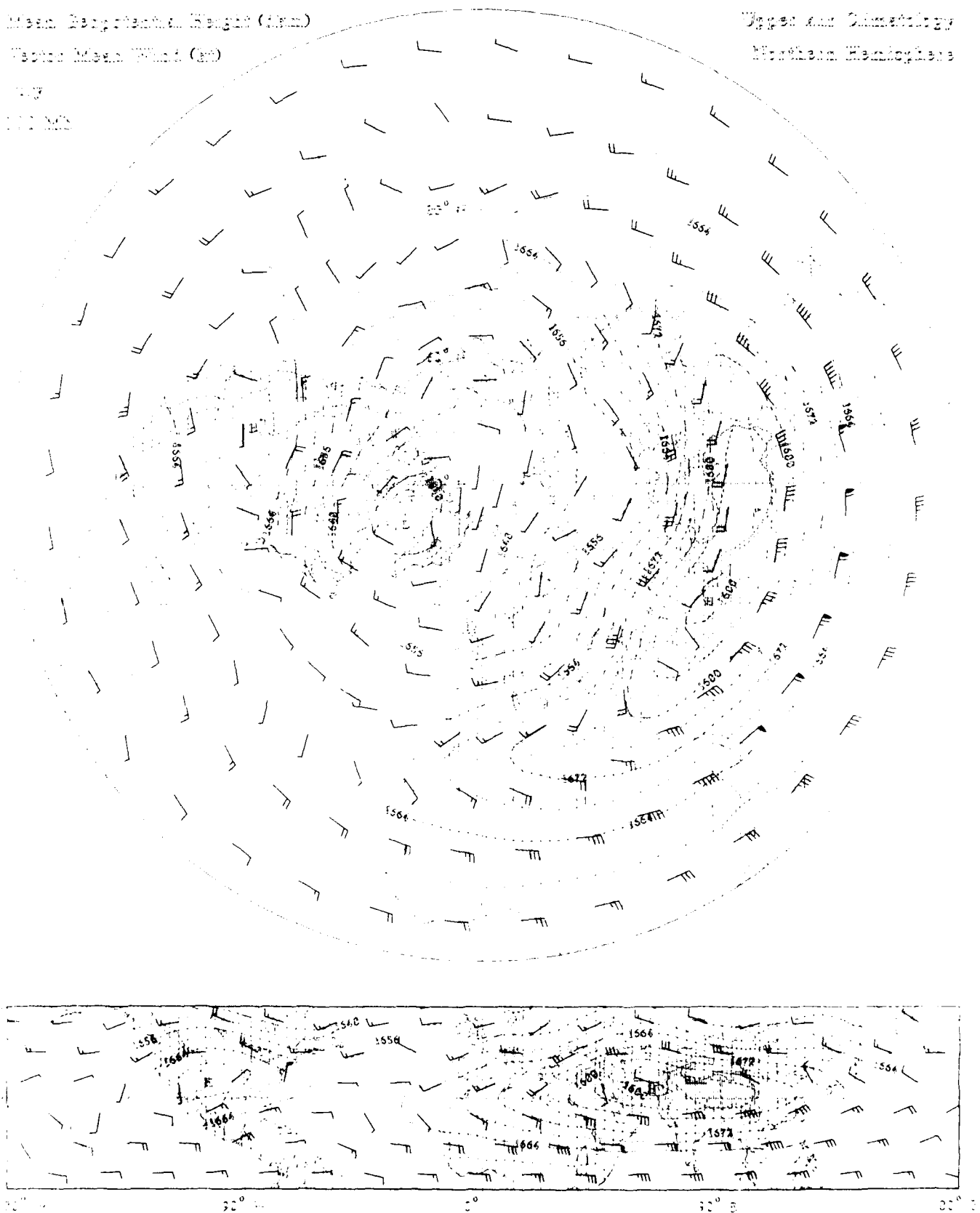
Mean Sea Level Height (ftm)

Vector Mean Wind (kt)

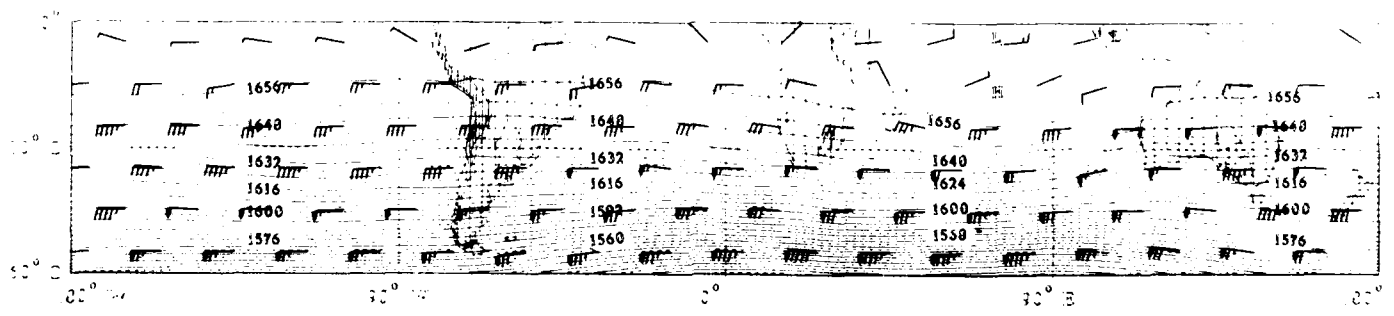
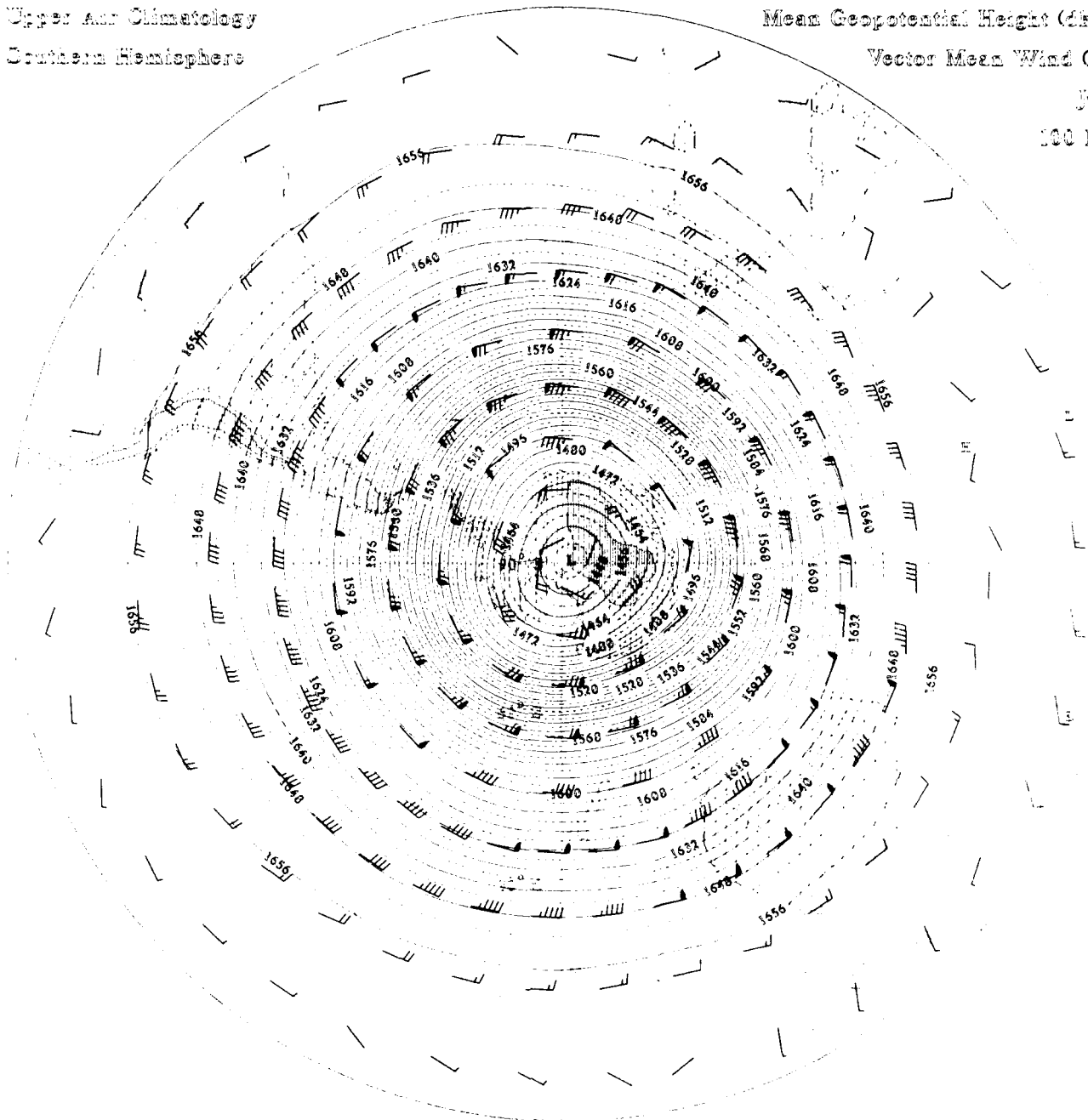
100  
200 Miles

Upper Air Climatology

Western Hemisphere



July  
100 MB



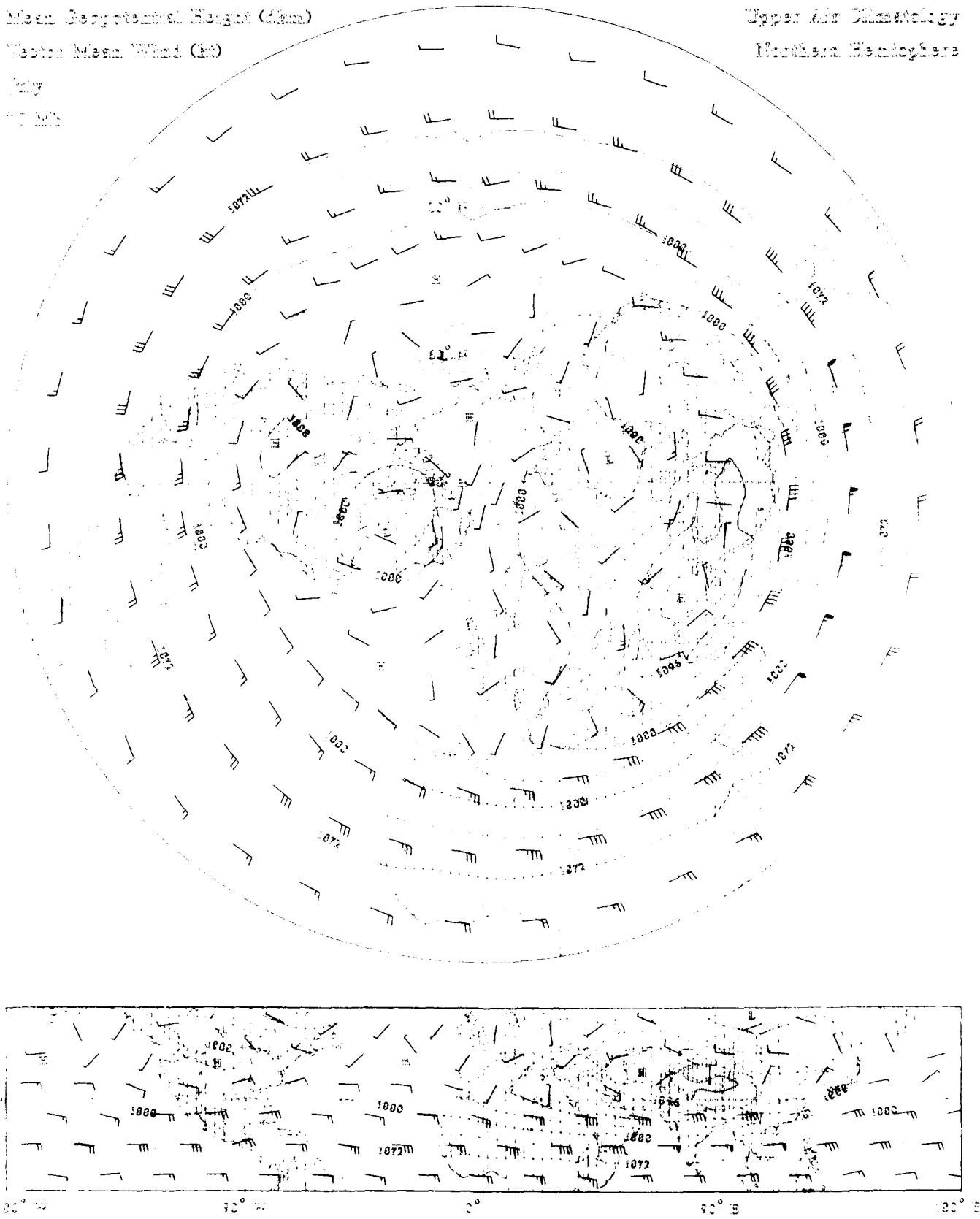
Mean Sea Level Height (ftm)

Vector Mean Wind (kt)

July  
1950

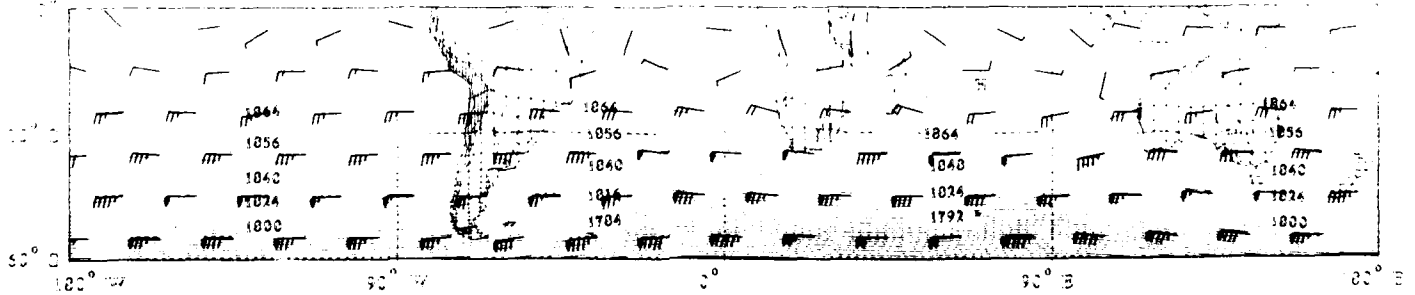
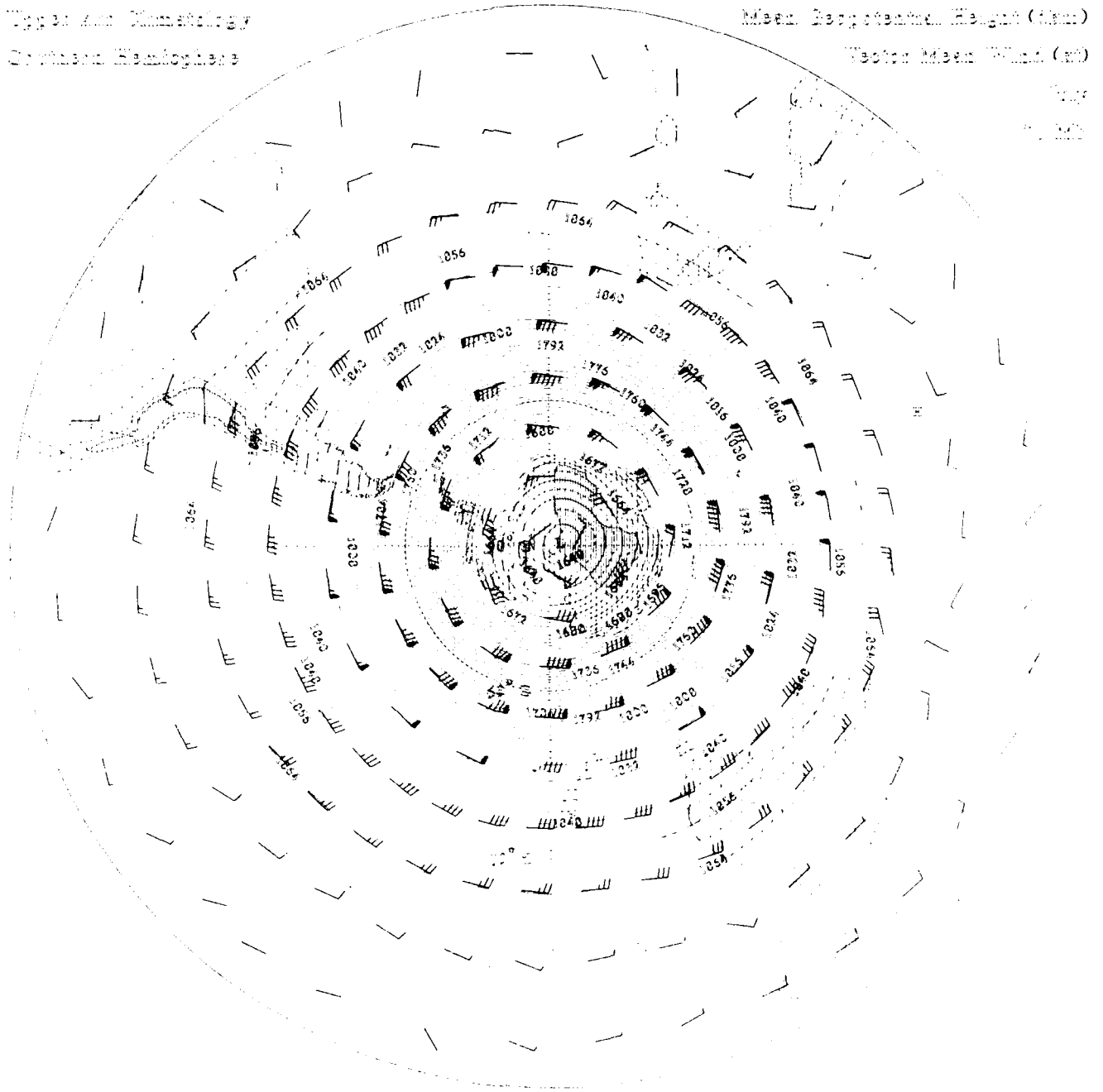
Upper Air Climatology

Northern Hemisphere



Topical Climatology  
Southern Hemisphere

Mean Sea Level Height (m)  
Vector Mean Wind (m/s)



Mean Geopotential Height (ghm)

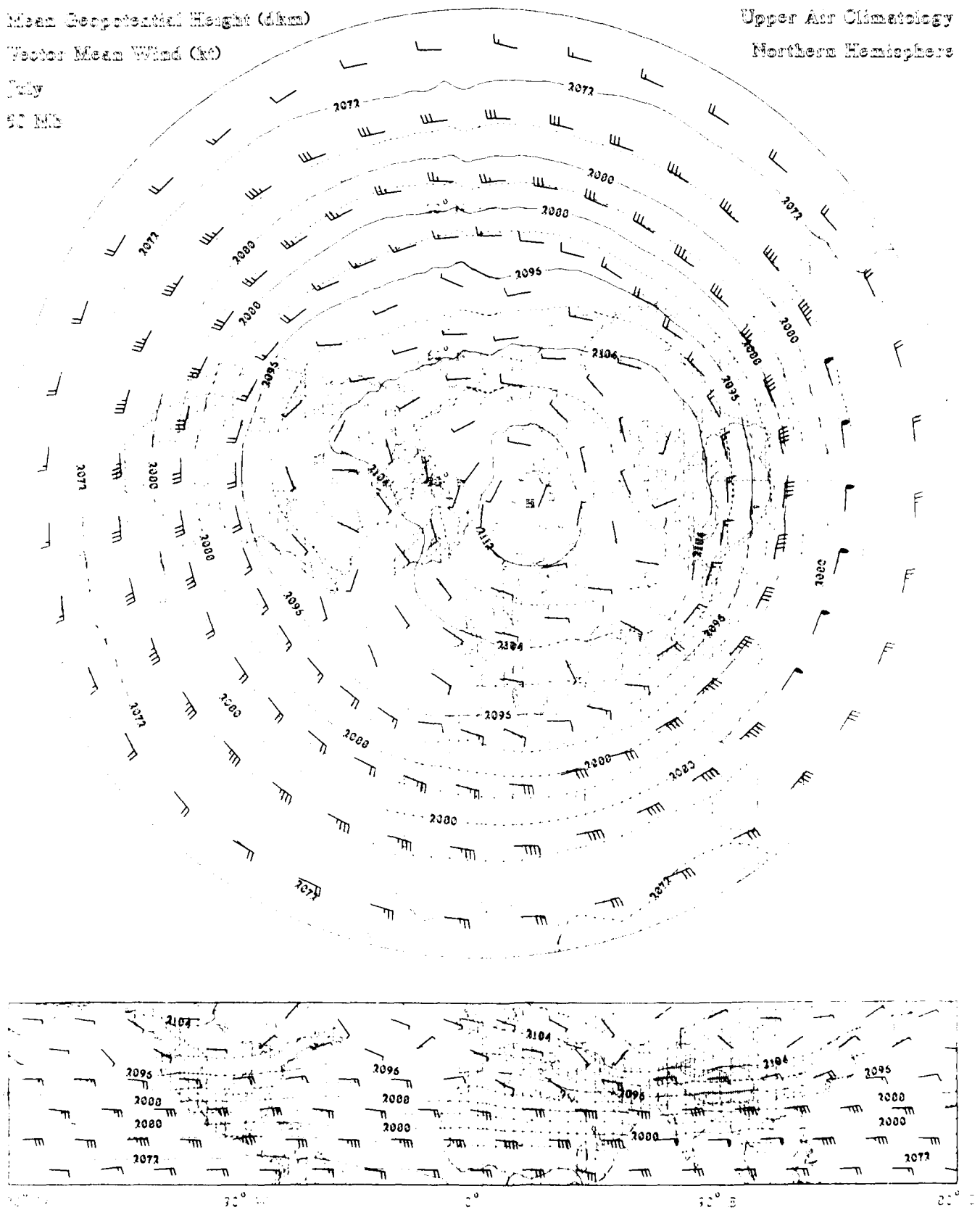
Vector Mean Wind (kt)

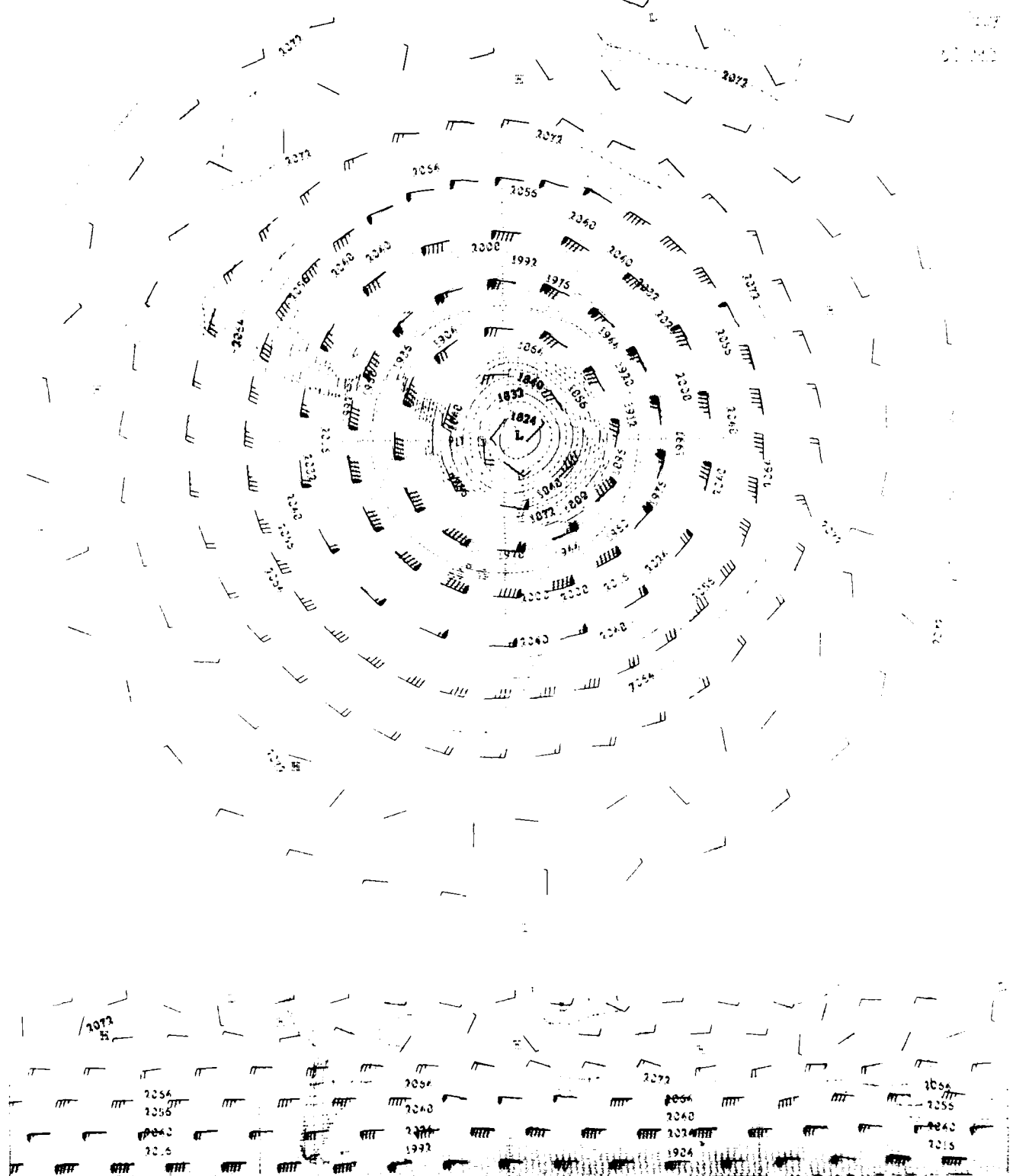
July

90 MB

Upper Air Climatology

Northern Hemisphere



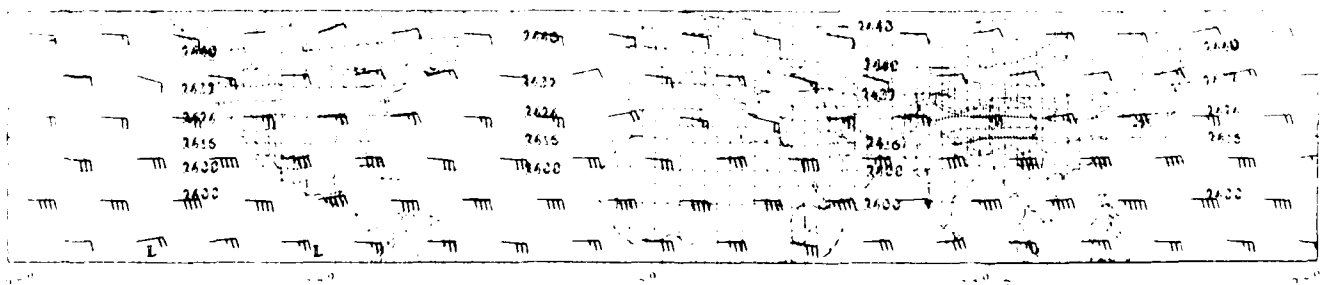
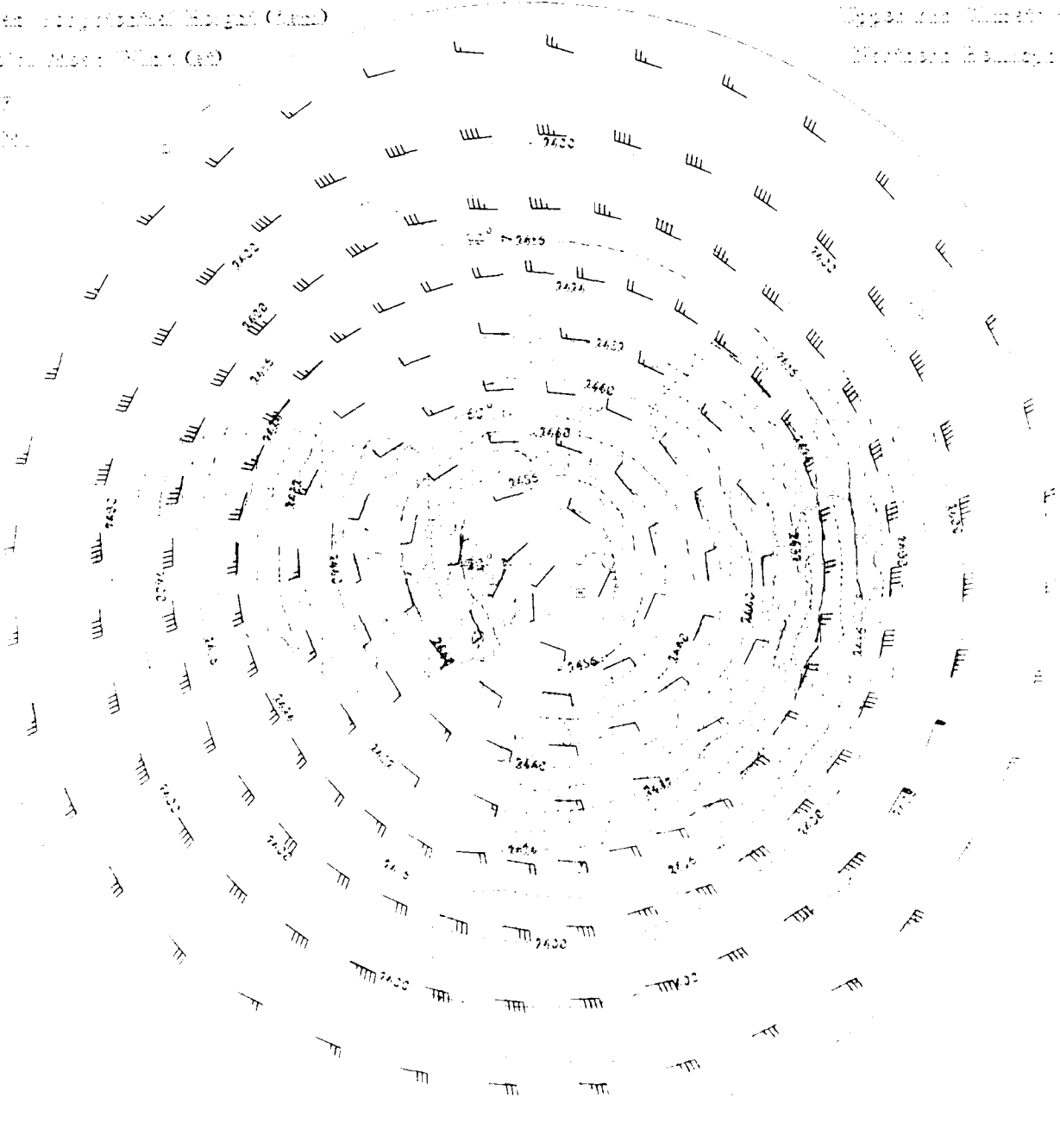


Mean ... (mm)

... (mm)

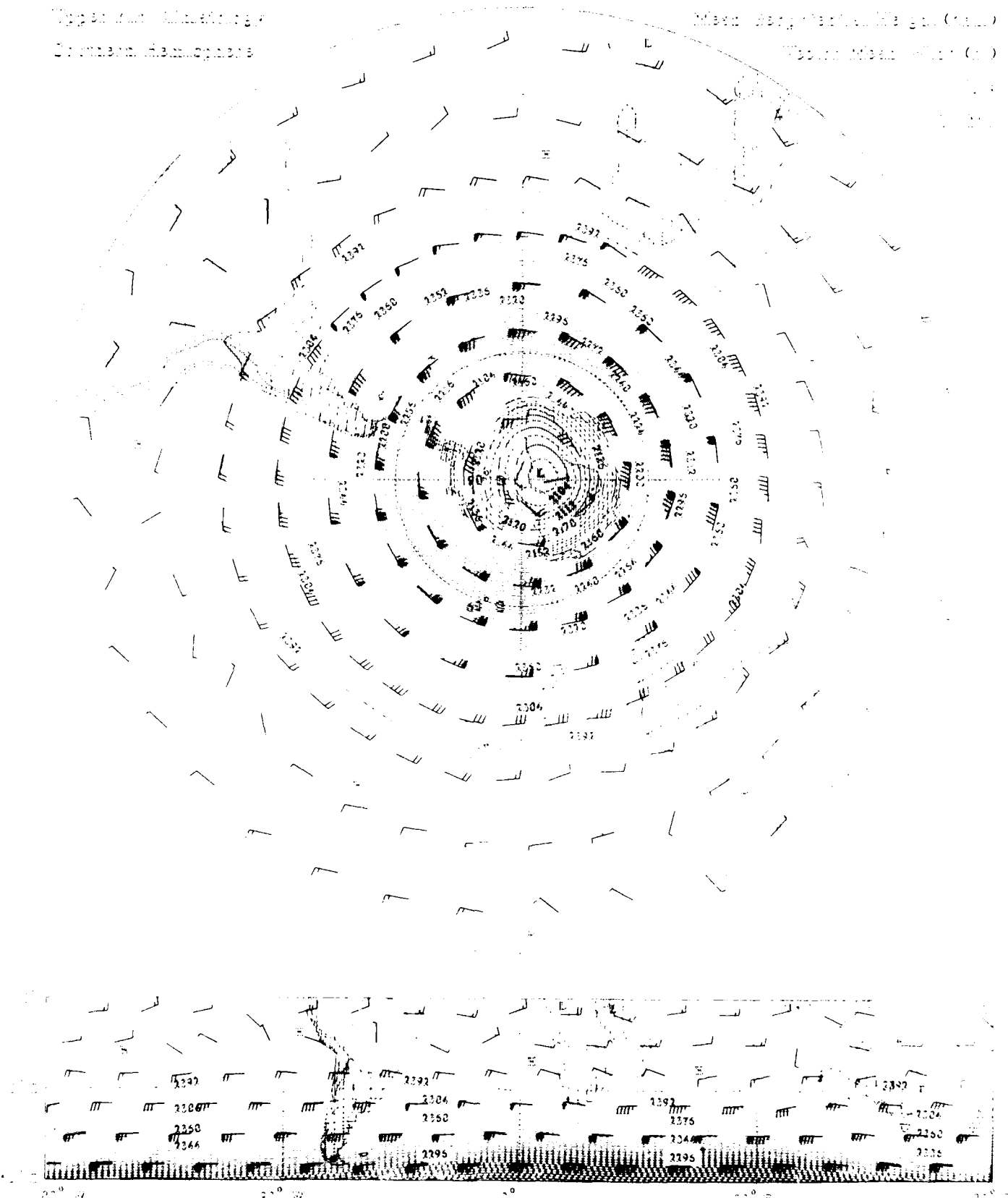
... (mm)

... (mm)



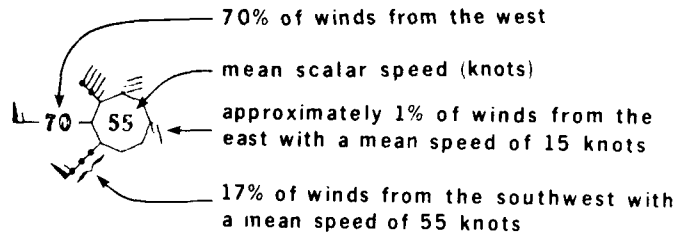
Topographic Information  
Drainage Information

Mean Sea Level (ft.)  
Elevation (ft.)

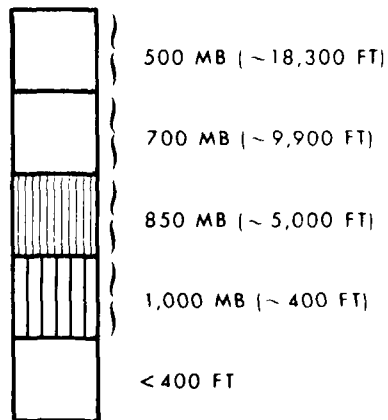


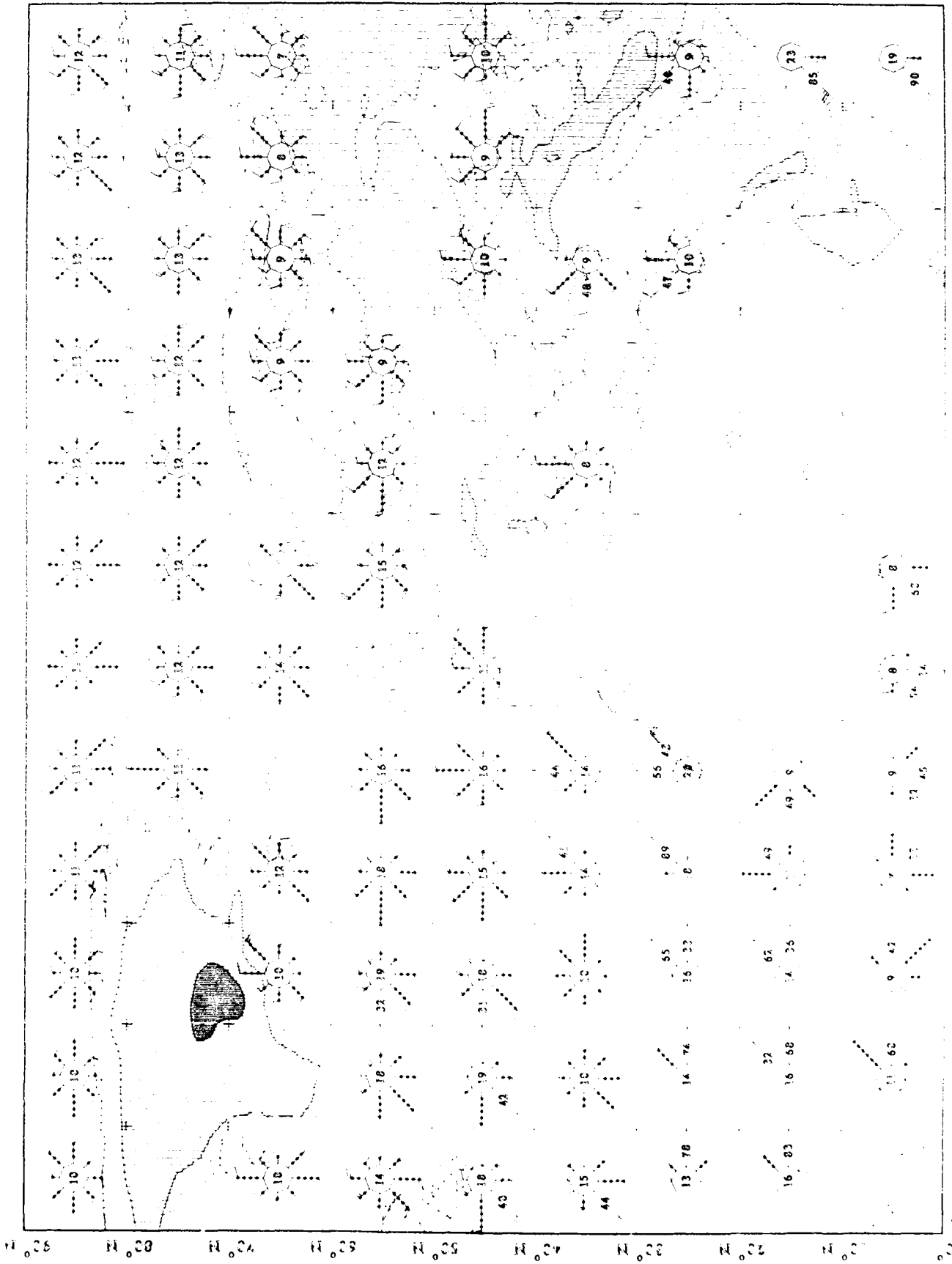
**WIND ROSES  
(13 LEVELS, 1000 TO 30 MB)**

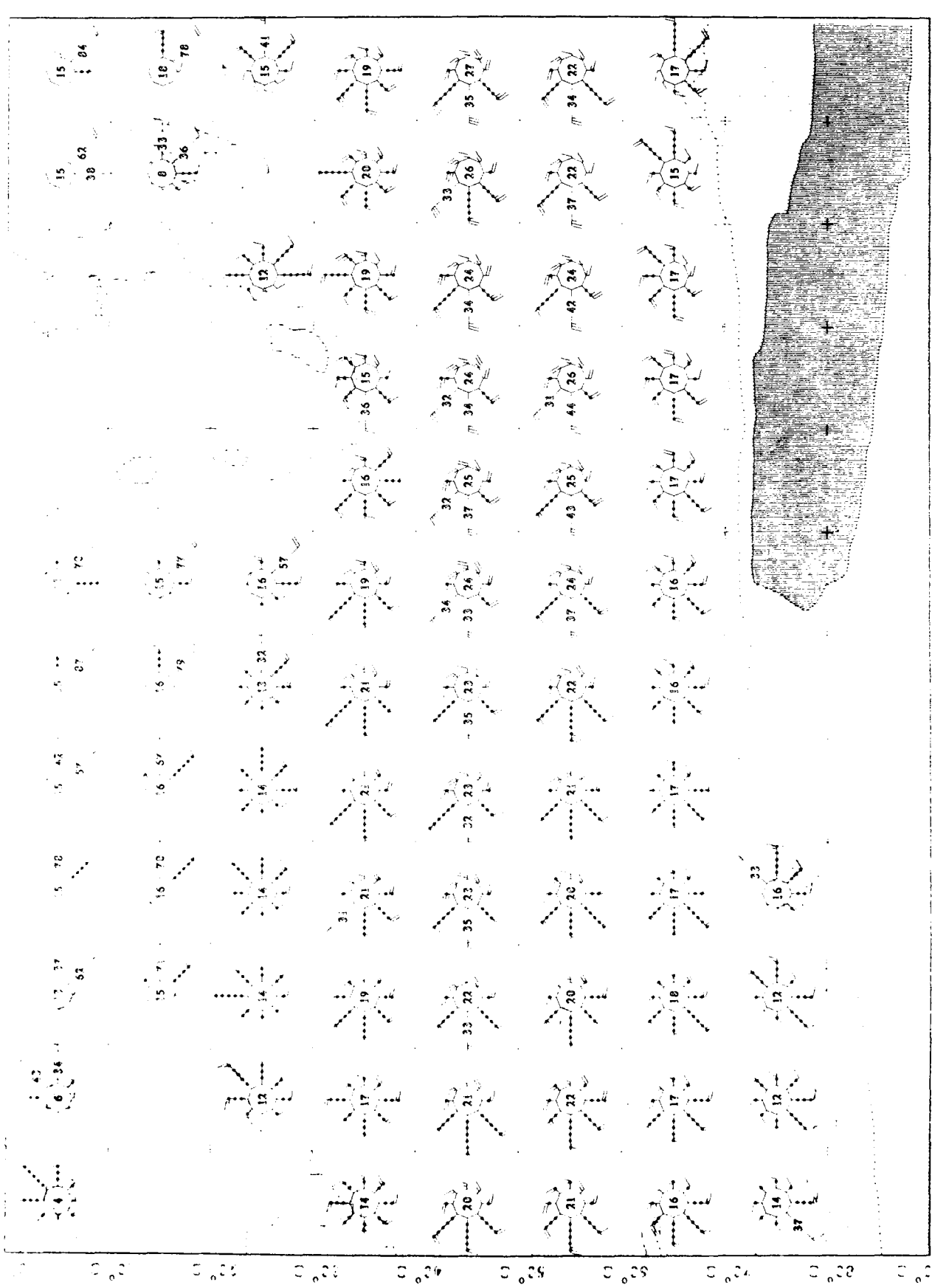
- Wind roses at 10 degree latitude/longitude grid points
- Directional mean wind speed in 5 knot increments
- Frequency proportional to barb length with individual dots representing 5% increments. Values greater than 30% are plotted directly on the barb.
- Roses blanked at grid points with elevations exceeding specified geopotential heights.
- Sample rose explanation:



**ELEVATION SCALE**







60° 00' 10° 00' 20° 00' 30° 00' 40° 00' 50° 00' 60° 00' 70° 00' 80° 00' 90° 00' 100° 00' 110° 00' 120° 00' 130° 00' 140° 00' 150° 00' 160° 00' 170° 00' 180° 00' 190° 00' 200° 00' 210° 00' 220° 00' 230° 00' 240° 00' 250° 00' 260° 00' 270° 00' 280° 00' 290° 00' 300° 00' 310° 00' 320° 00' 330° 00' 340° 00' 350° 00' 360° 00'

Upper Air Climatology  
Southern Hemisphere

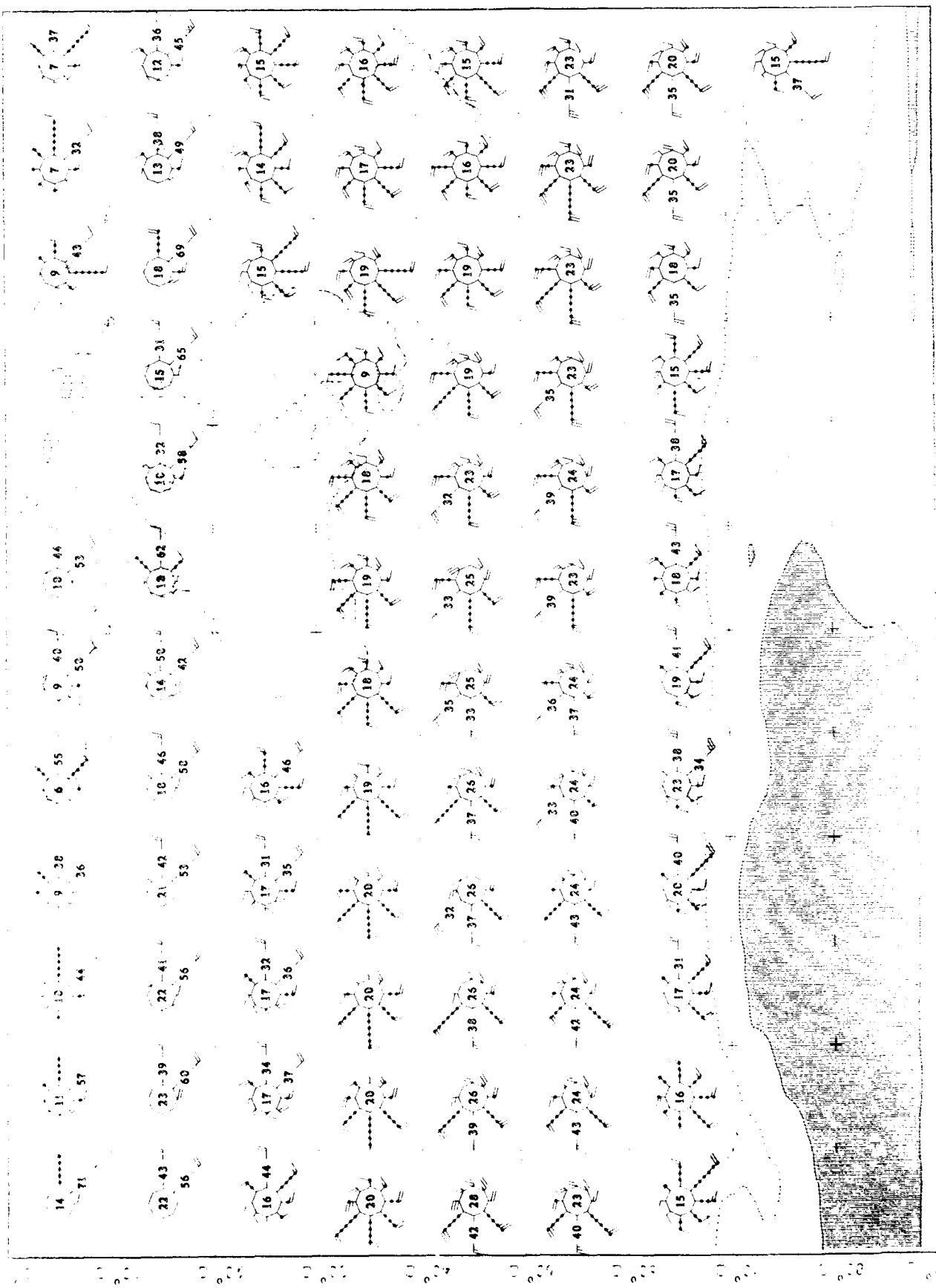
Figure 2.11  
Page 222

July  
2000

Types and Diminutives  
Northern Hemisphere

1911-1912  
1913-1914

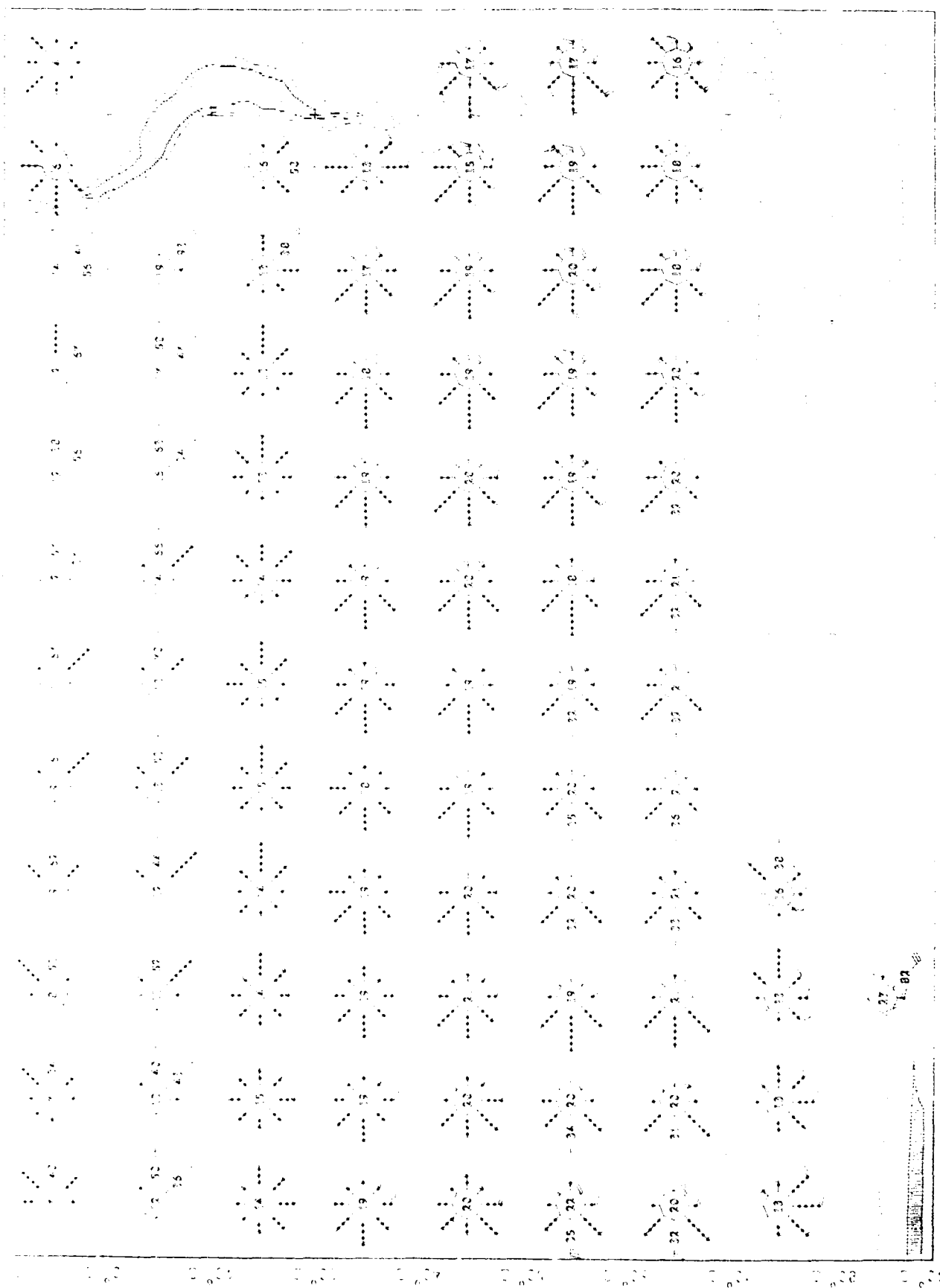
The image displays a grid of 72 numbered starburst patterns, arranged in 8 rows and 9 columns. The patterns are numbered 1 through 72, with some numbers appearing multiple times. The patterns are arranged in a grid, with a map of the Northern Hemisphere overlaid on the right side. The map shows the outlines of North America, Europe, and Asia. The patterns are numbered 1 through 72, with some numbers appearing multiple times. The patterns are arranged in a grid, with a map of the Northern Hemisphere overlaid on the right side. The map shows the outlines of North America, Europe, and Asia. The patterns are numbered 1 through 72, with some numbers appearing multiple times.



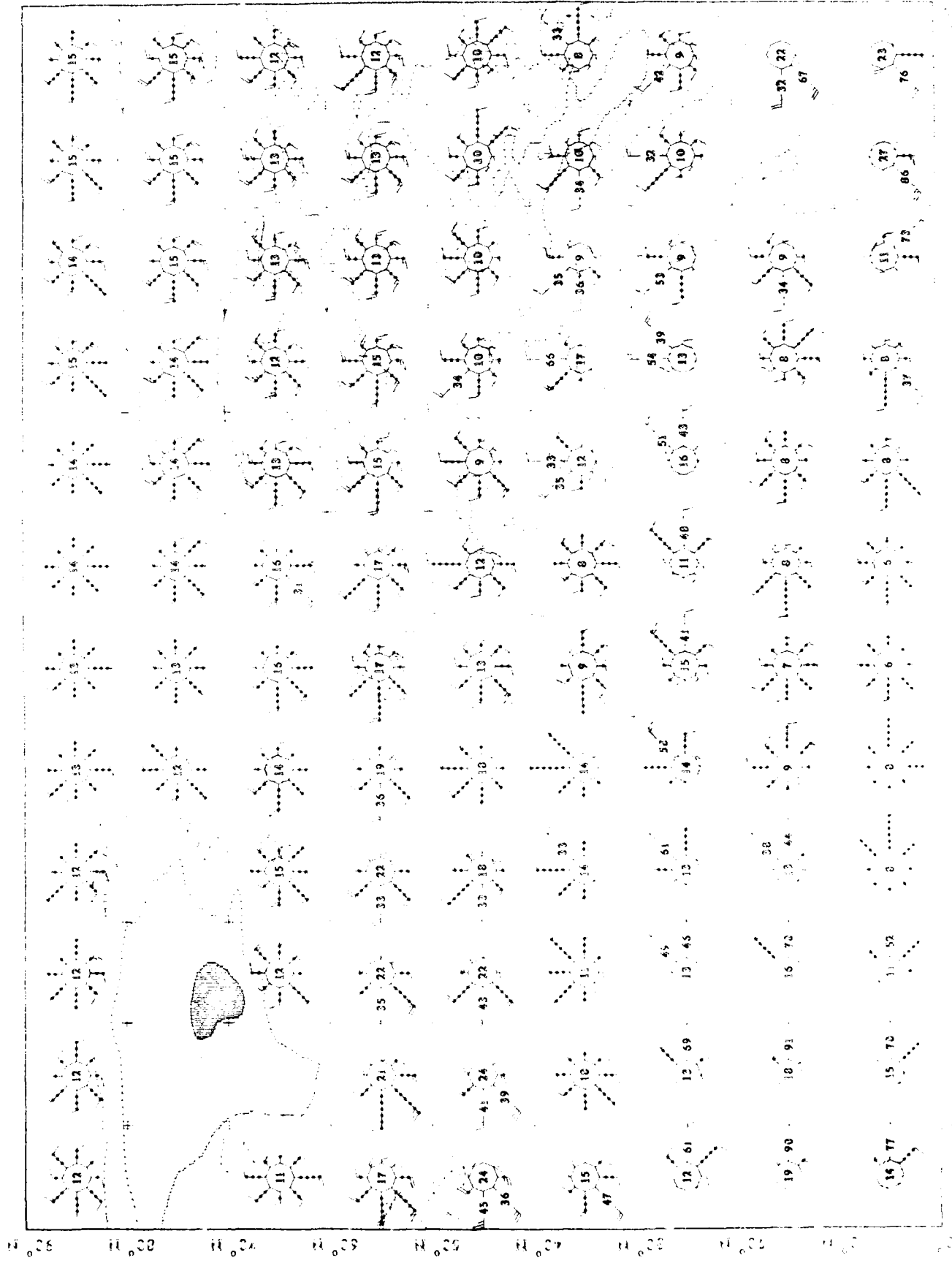
Upper Air Climatology  
 Northern Hemisphere

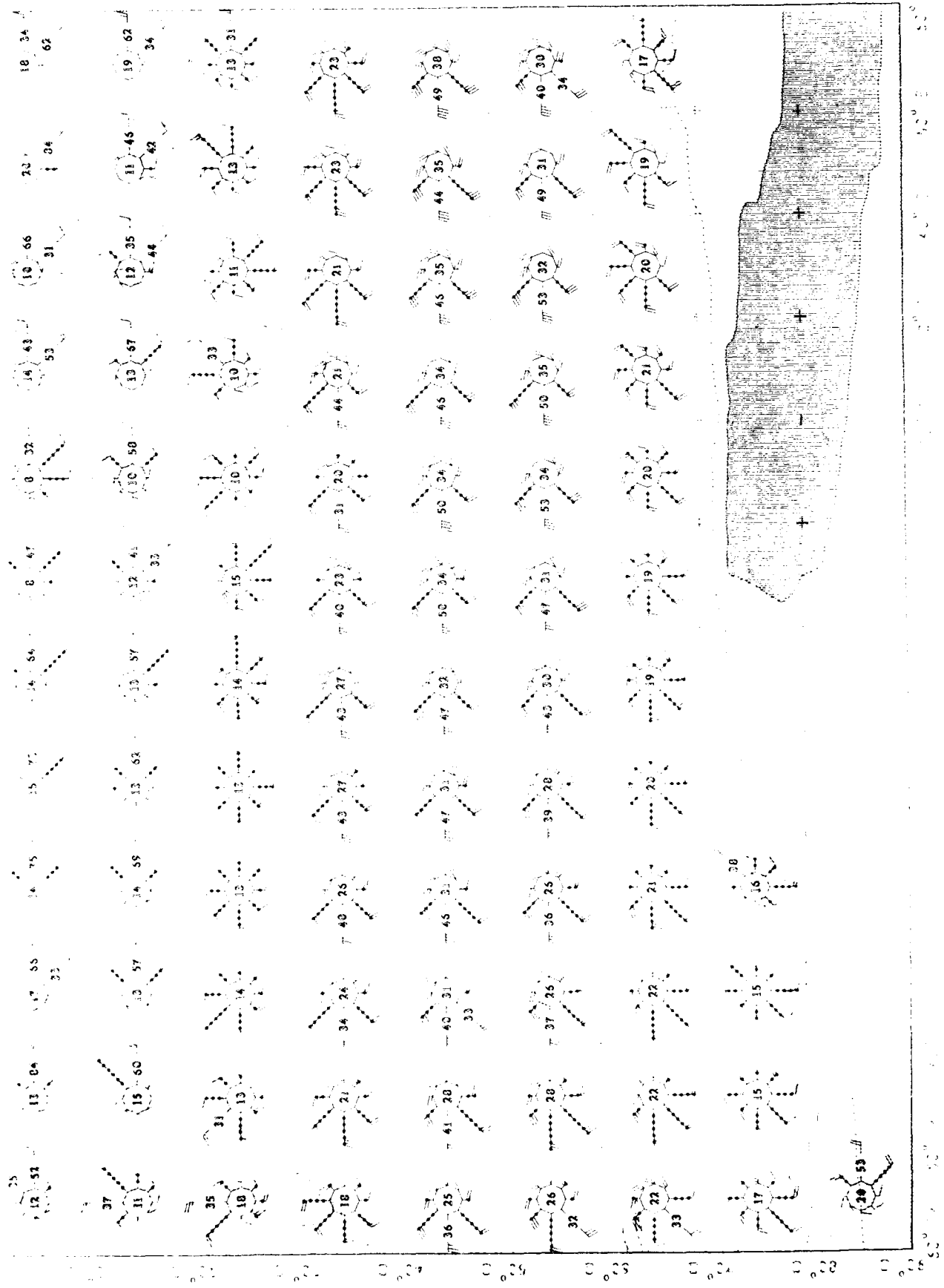
July  
 1000 mb





REPORT AND RECOMMENDATIONS  
 NATIONAL BUREAU OF STANDARDS

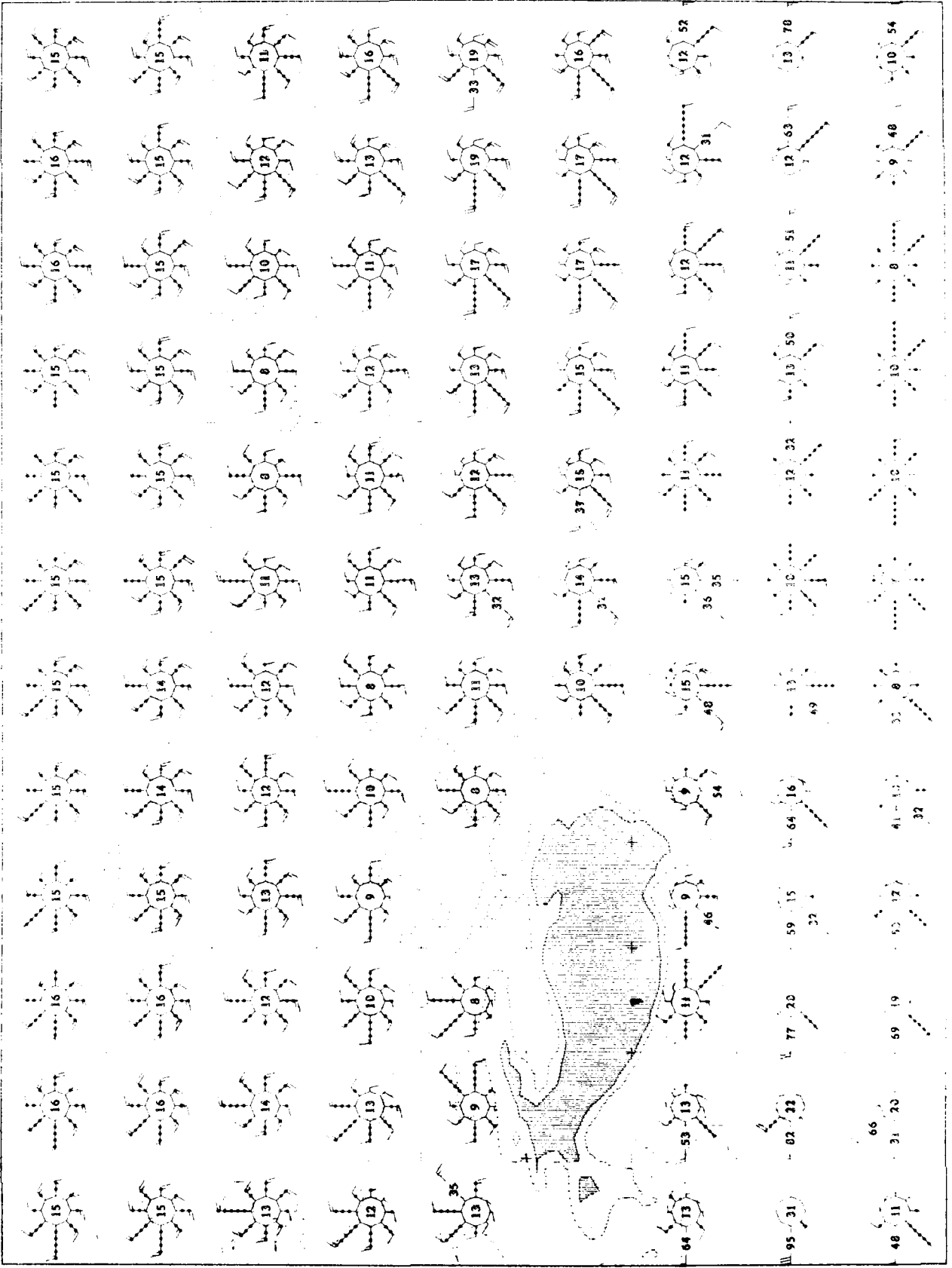


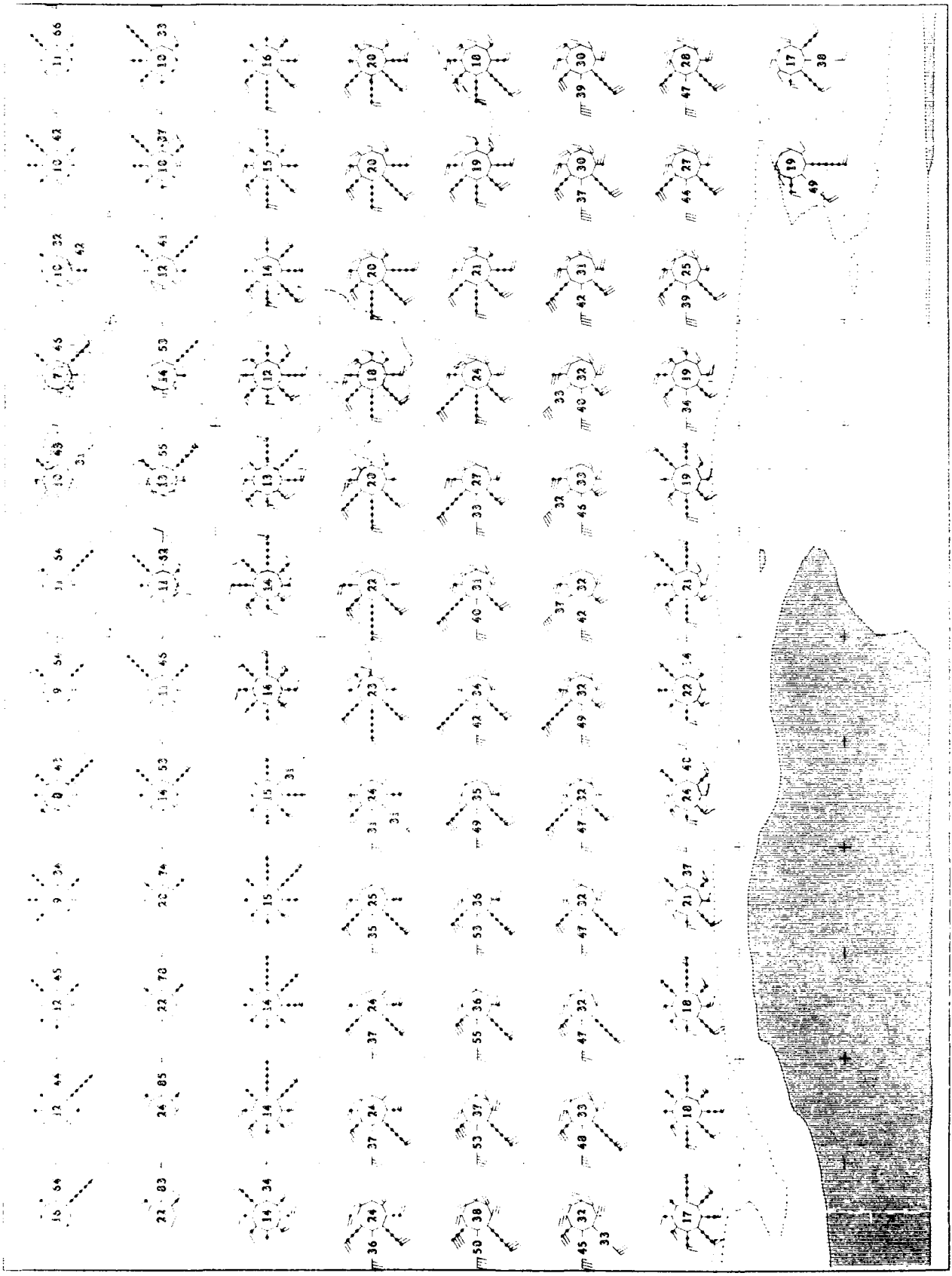


Upper Air Climatology  
 Southern Hemisphere

July 1954

July 1954

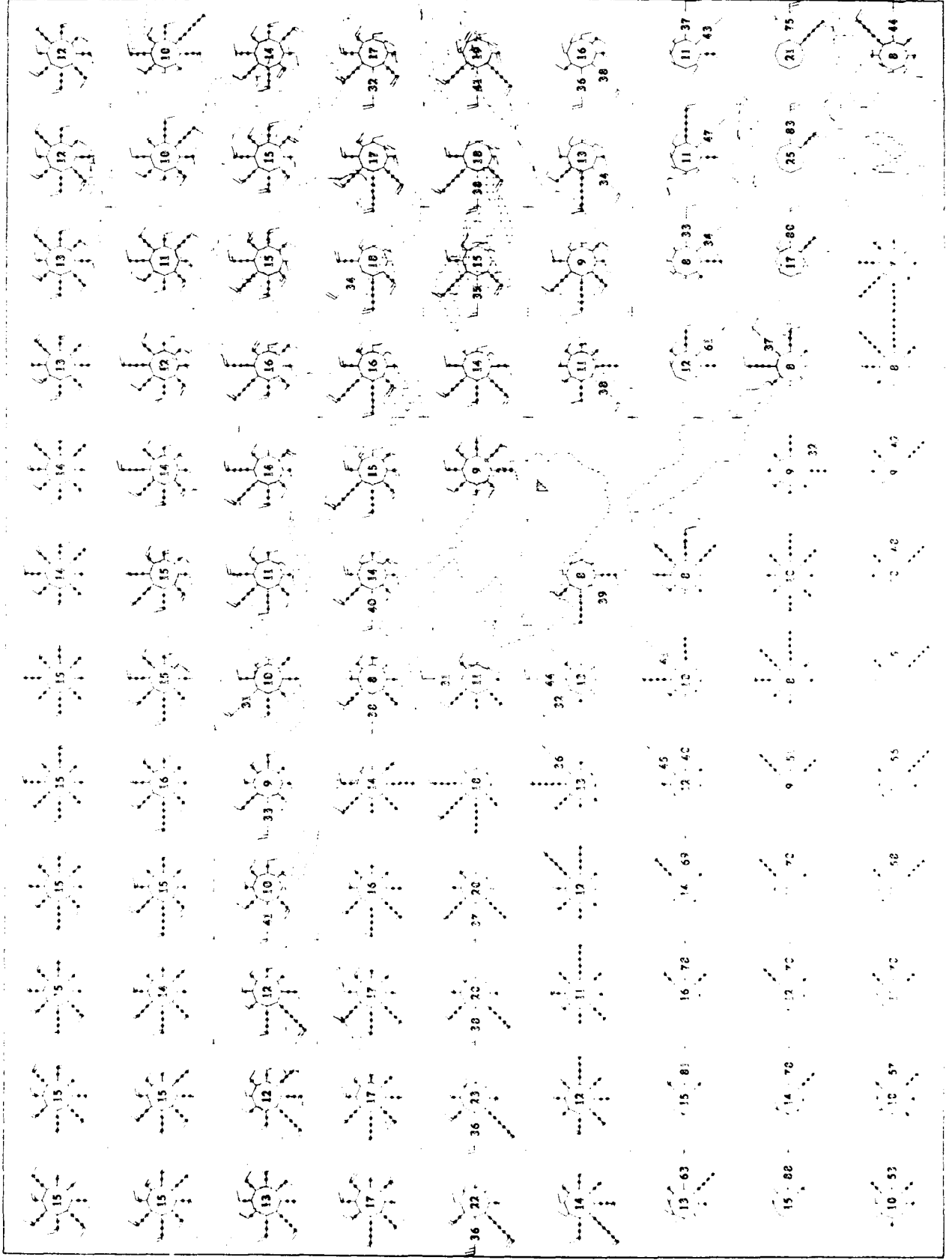


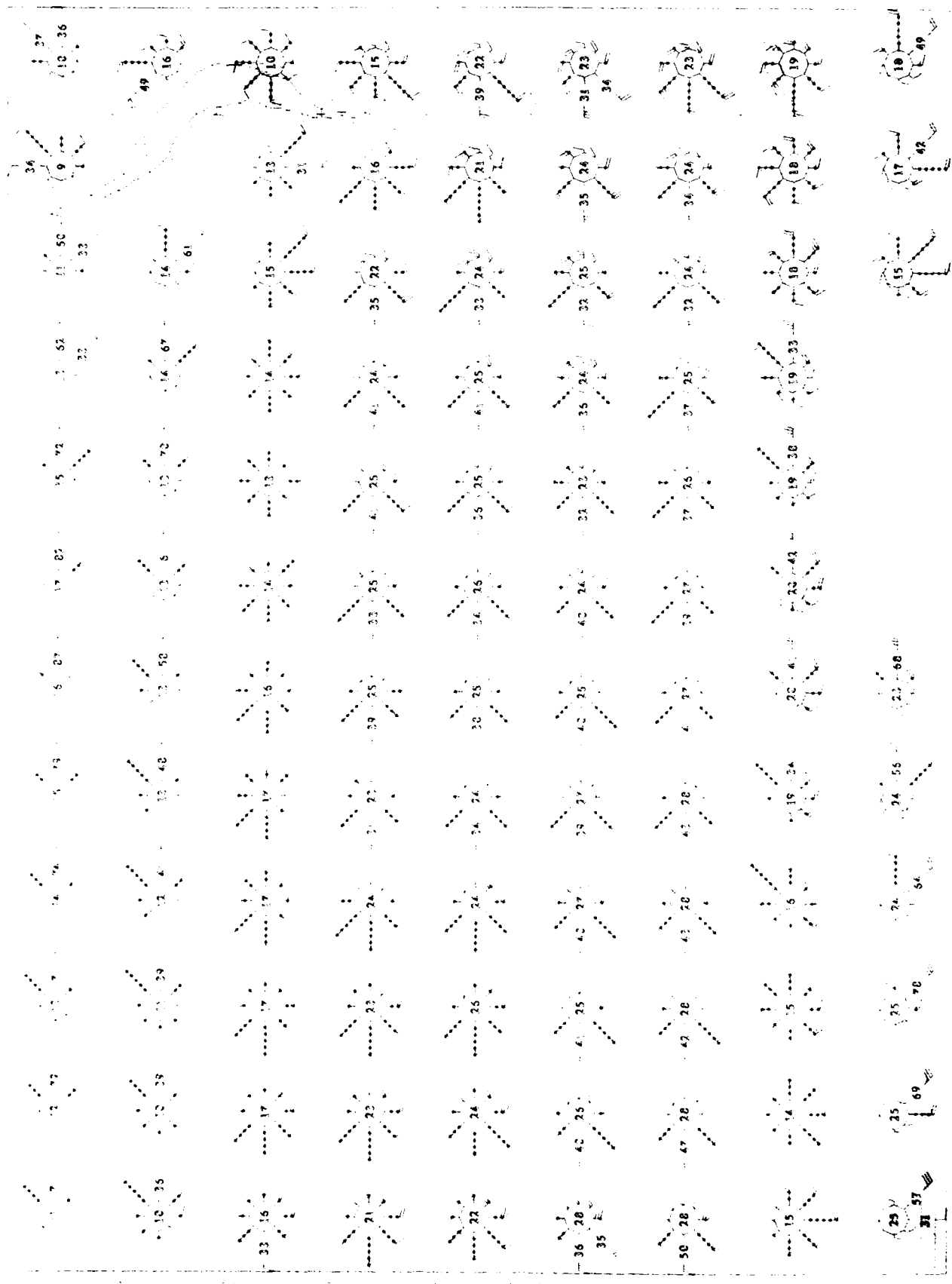


Wagner and Cummings  
 Psychological Research

Journal of Psychology  
 1930, Vol. 1, No. 1

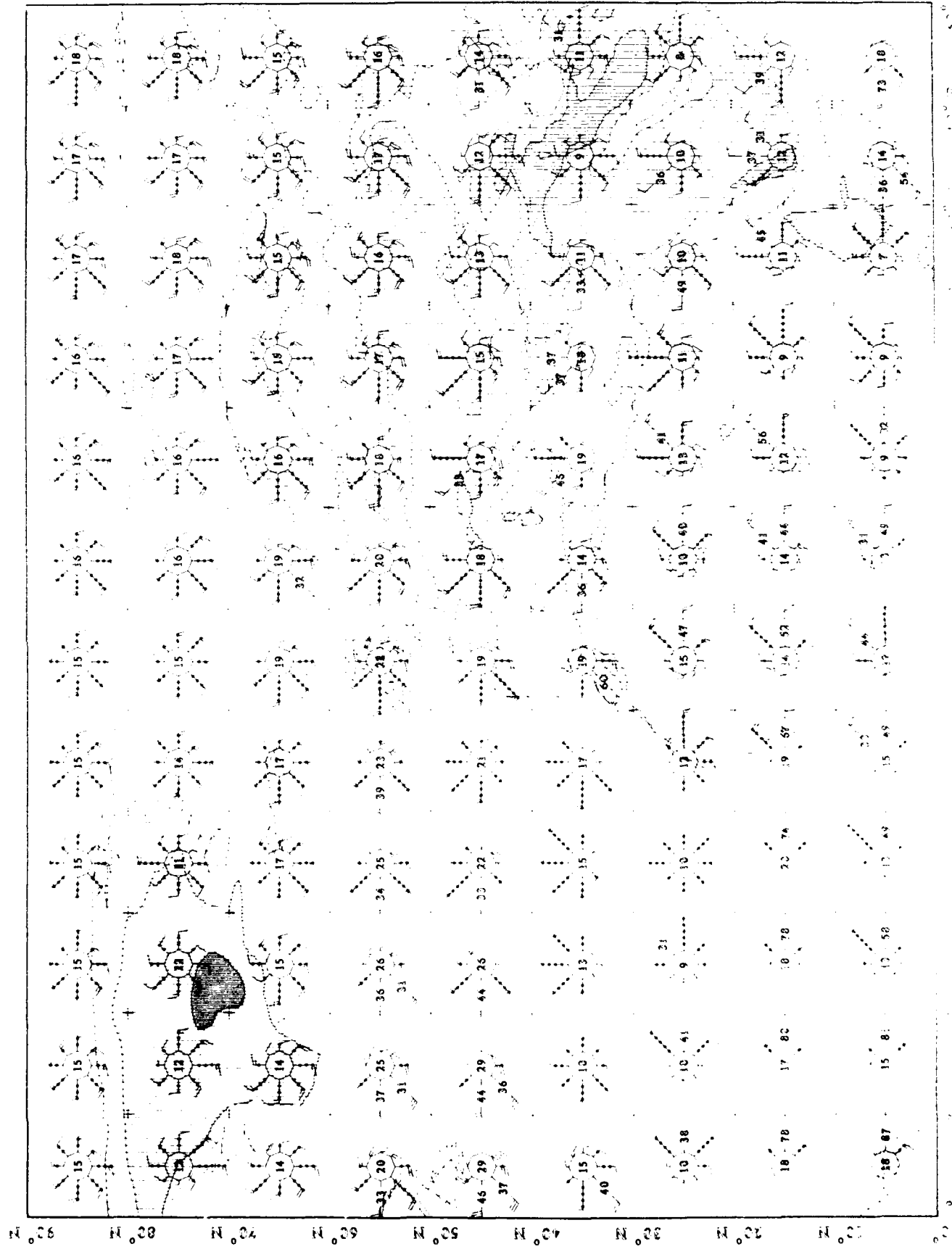
July  
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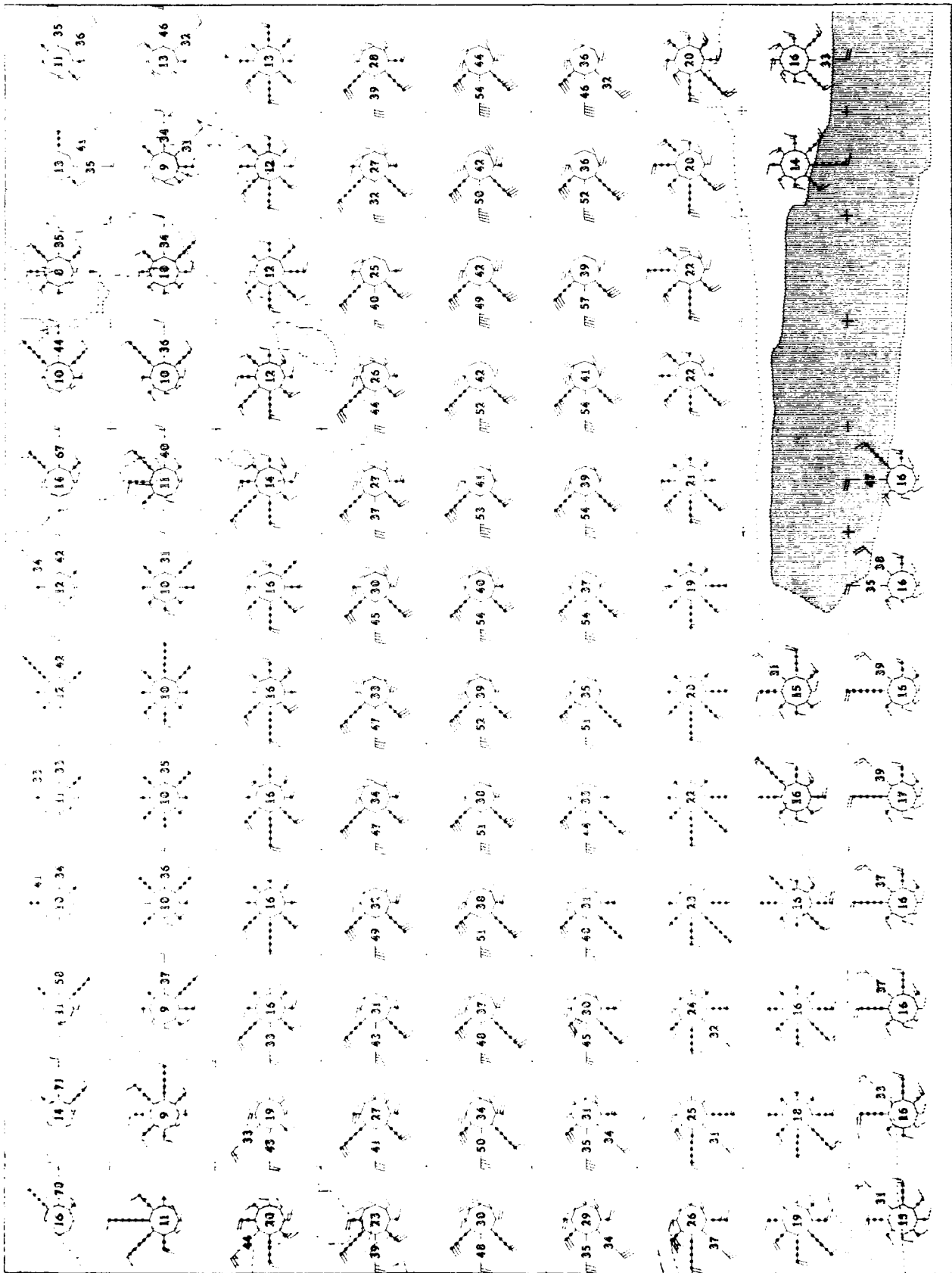




1930-1931  
H.B. ...

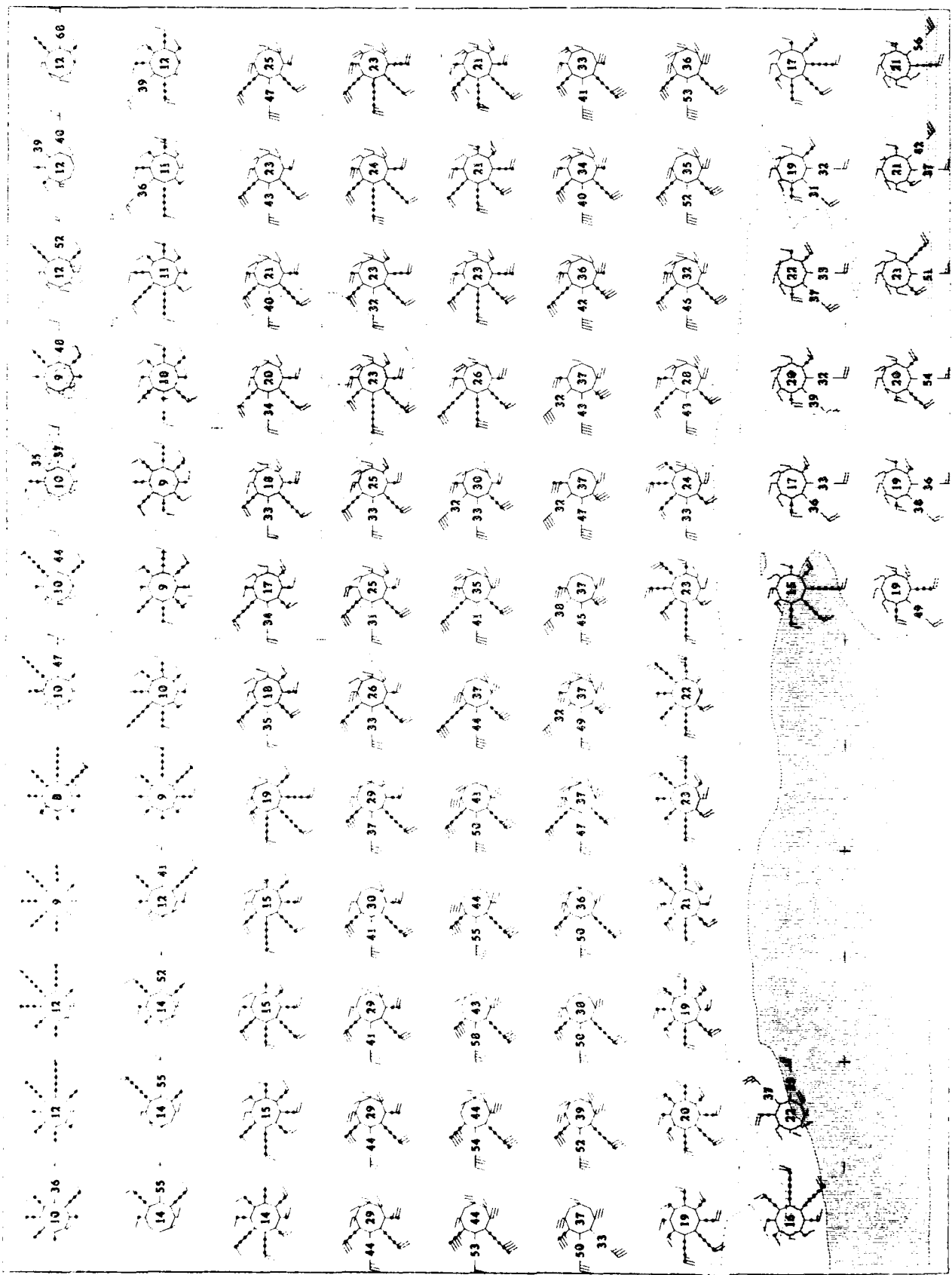
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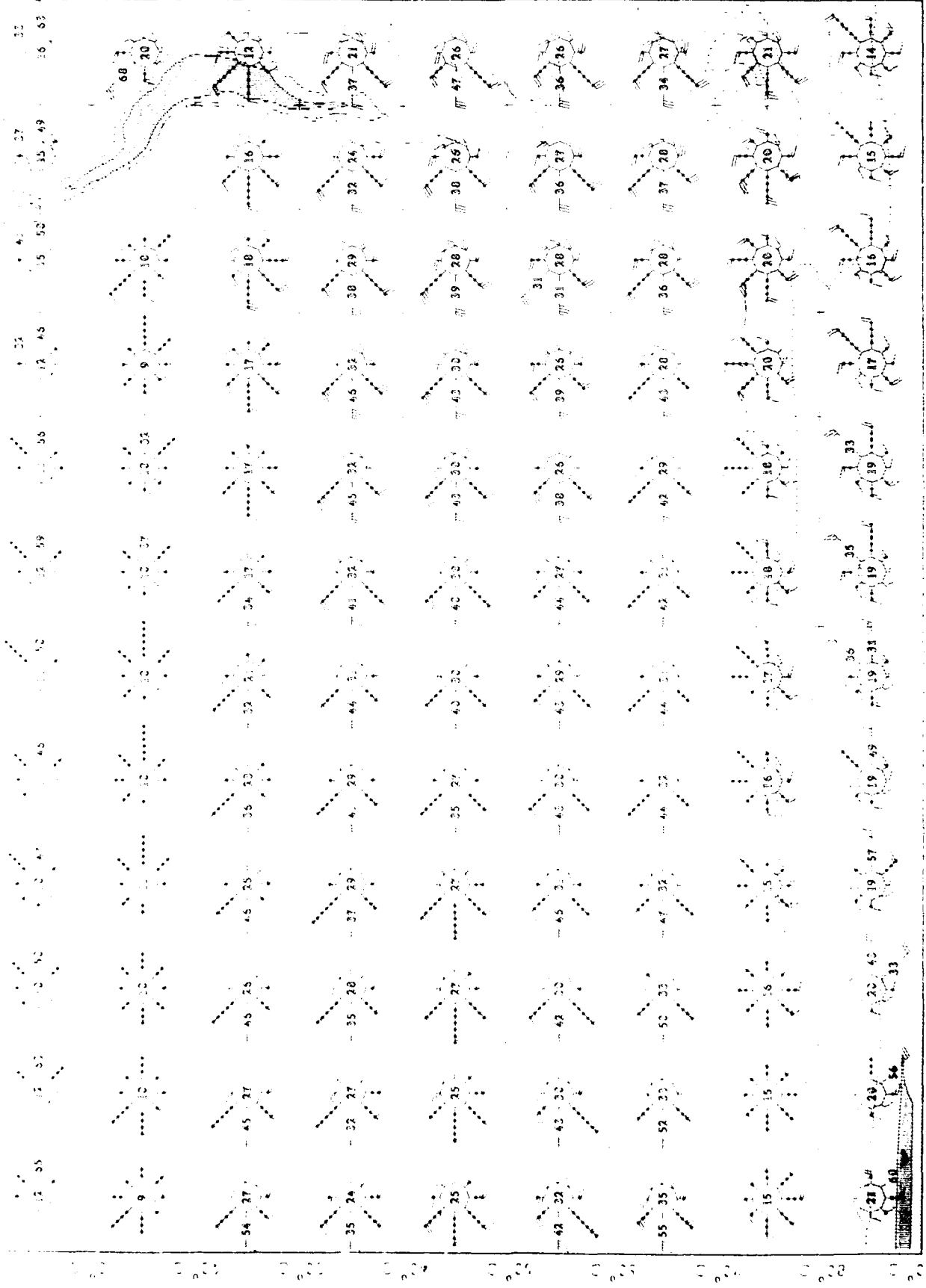
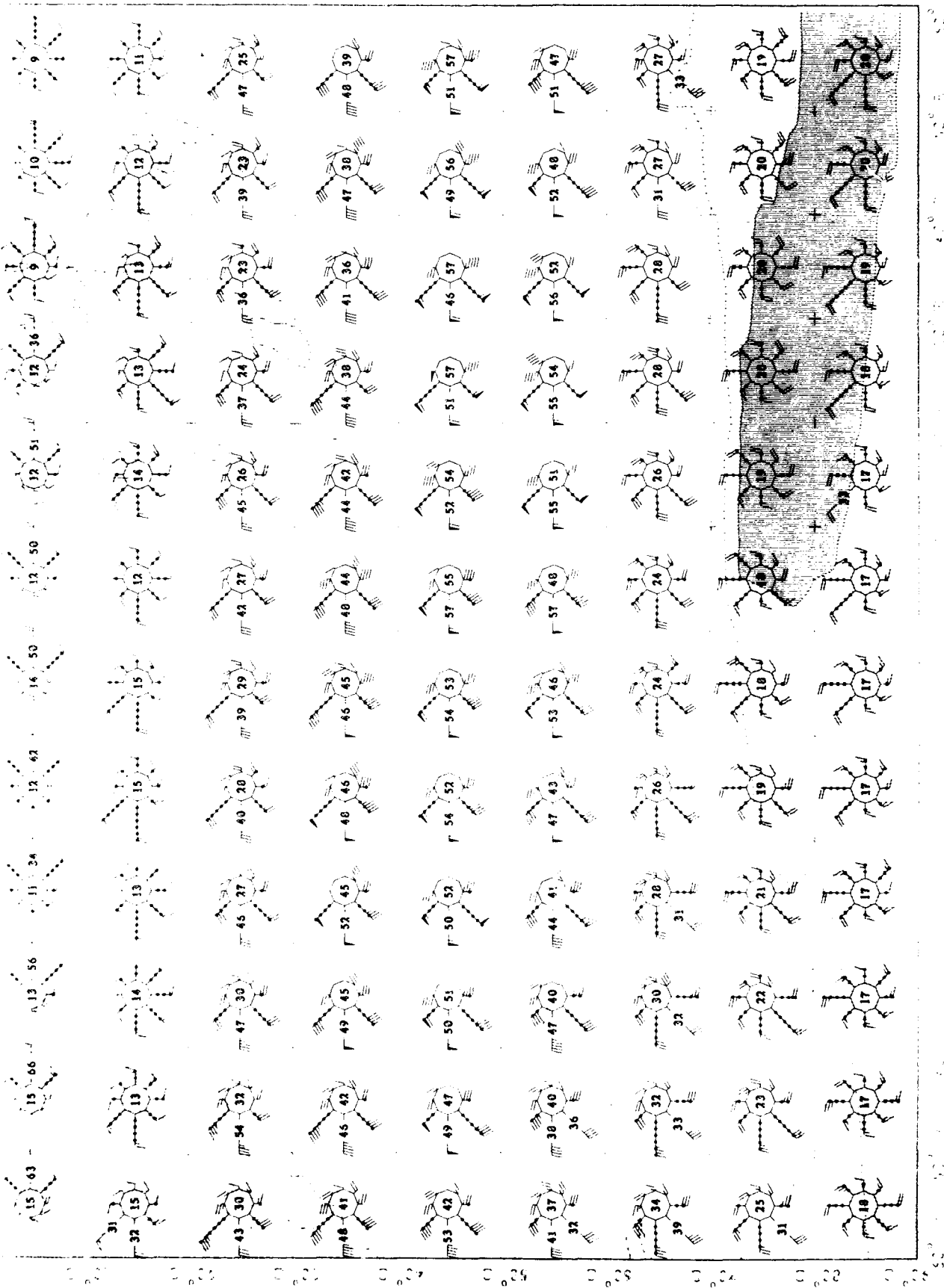


Figure A: Calibration by  
 Column. Hemisphere

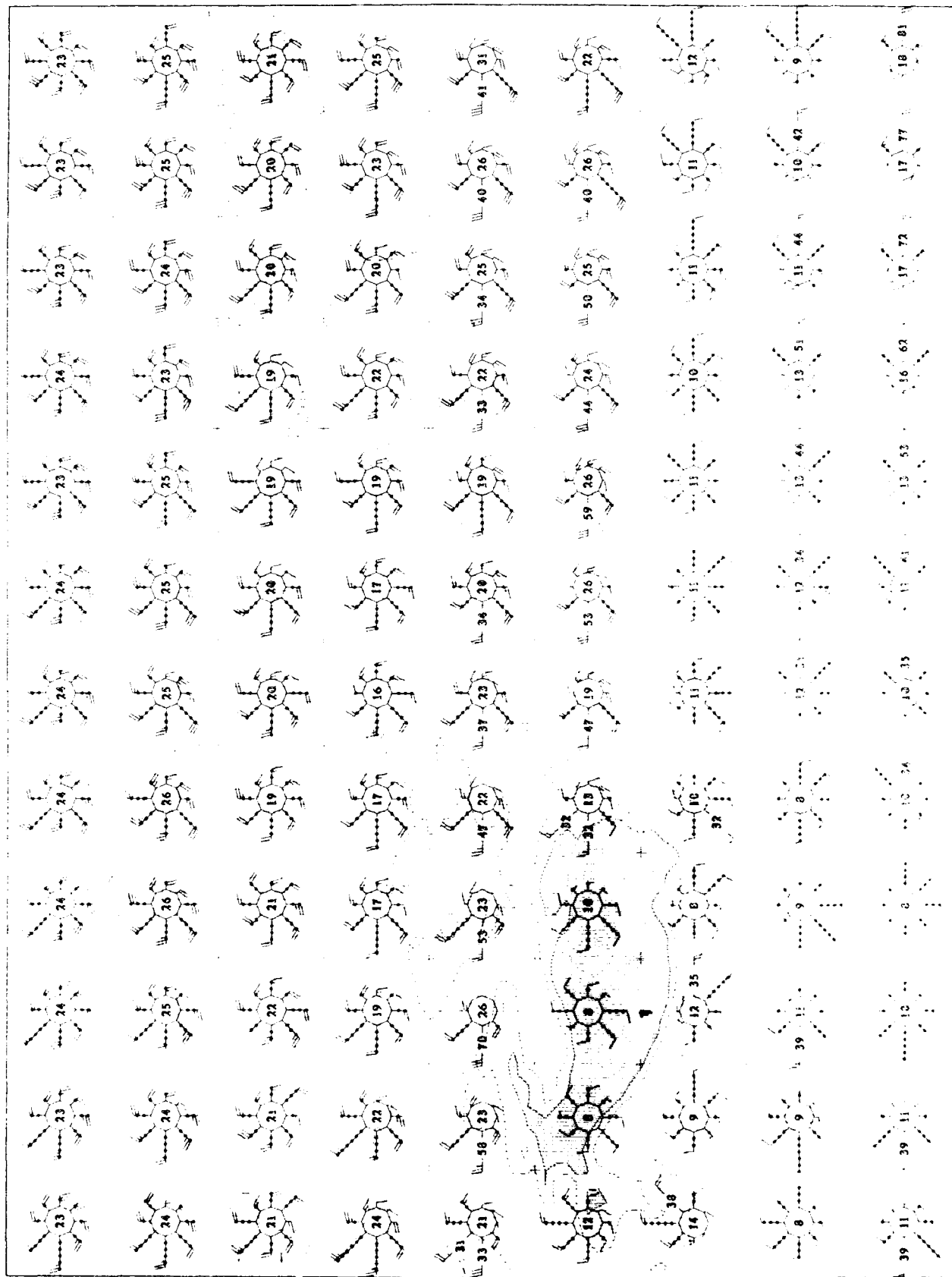
A grid of 100 spider-like figures for tracing, arranged in 10 rows and 10 columns. Each figure has a central body with a number and eight legs. The numbers are: Row 1: 23, 22, 22, 22, 21, 21, 20, 20, 21, 21; Row 2: 25, 24, 24, 22, 22, 20, 18, 16, 15, 14; Row 3: 21, 21, 21, 21, 22, 27, 26, 23, 23, 21; Row 4: 22, 22, 22, 23, 24, 27, 29, 31, 31, 34; Row 5: 24, 24, 24, 27, 27, 29, 31, 29, 29, 32; Row 6: 24, 24, 21, 23, 27, 30, 28, 28, 28, 33; Row 7: 15, 16, 16, 24, 24, 23, 23, 17, 17, 15; Row 8: 11, 9, 9, 10, 13, 11, 15, 11, 9, 9; Row 9: 12, 16, 12, 11, 11, 17, 20, 21, 20, 17; Row 10: 10, 11, 11, 13, 13, 14, 15, 15, 14, 16.

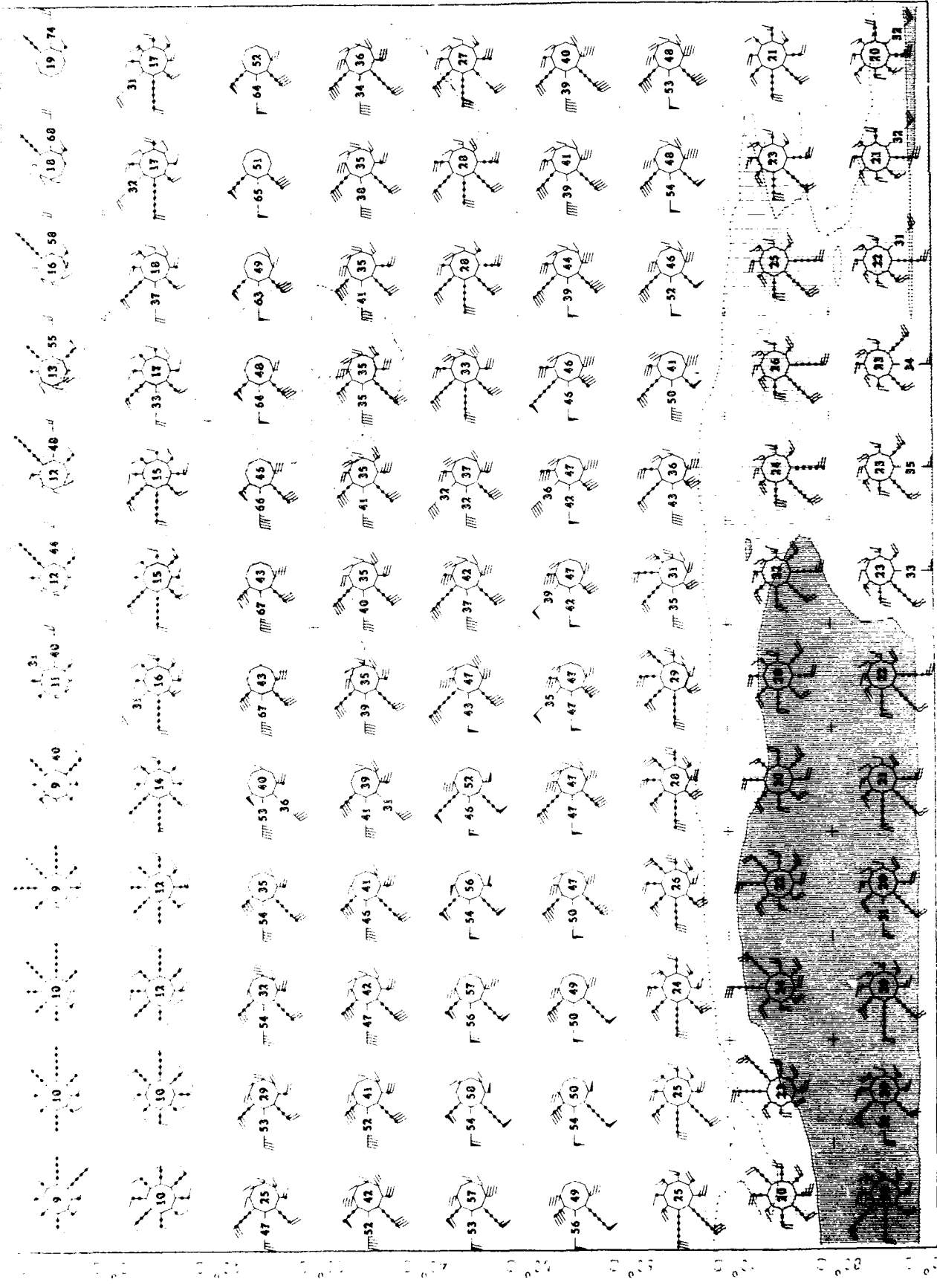


Upper Air Climatology  
Southern Hemisphere

500 mb 500 mb  
500 mb 500 mb

July  
500 mb





Upper Air Climatology  
Southern Hemisphere

July 1952

500 M.S.

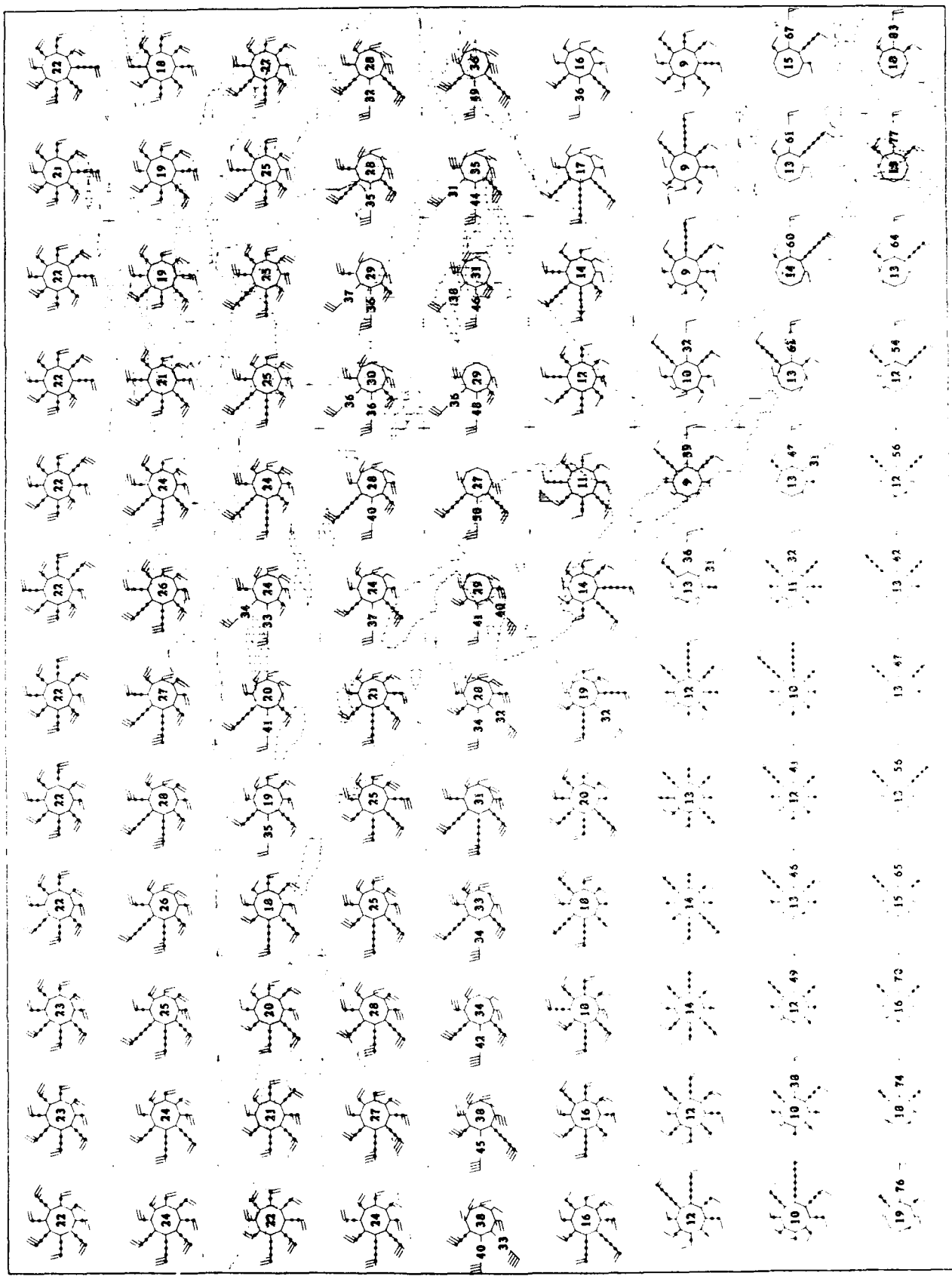
July

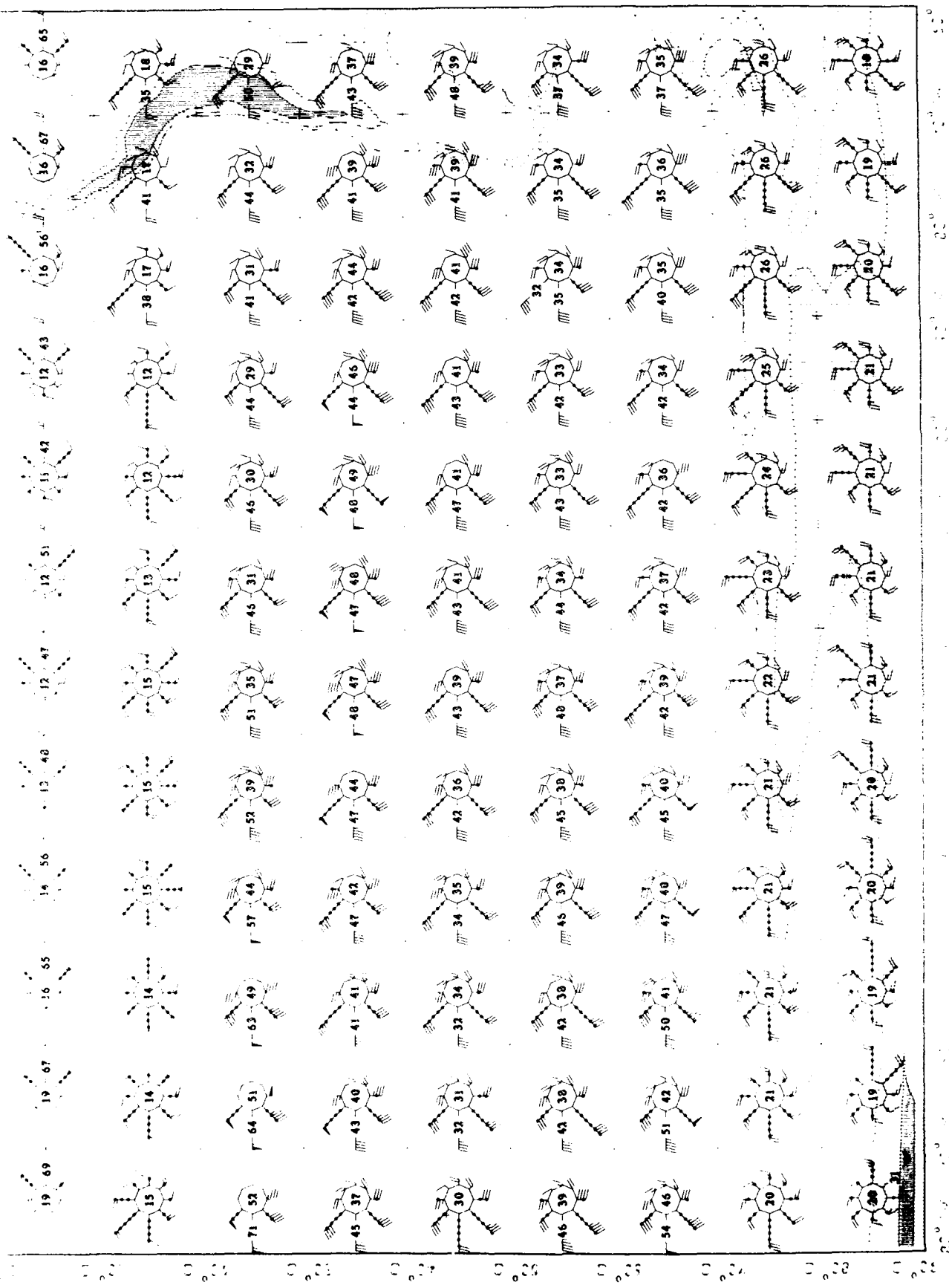
2000-2009

500 MB

Wind Speed

Upper Air Climatology  
Northern Hemisphere





Upper Air Climatology  
Southern Hemisphere

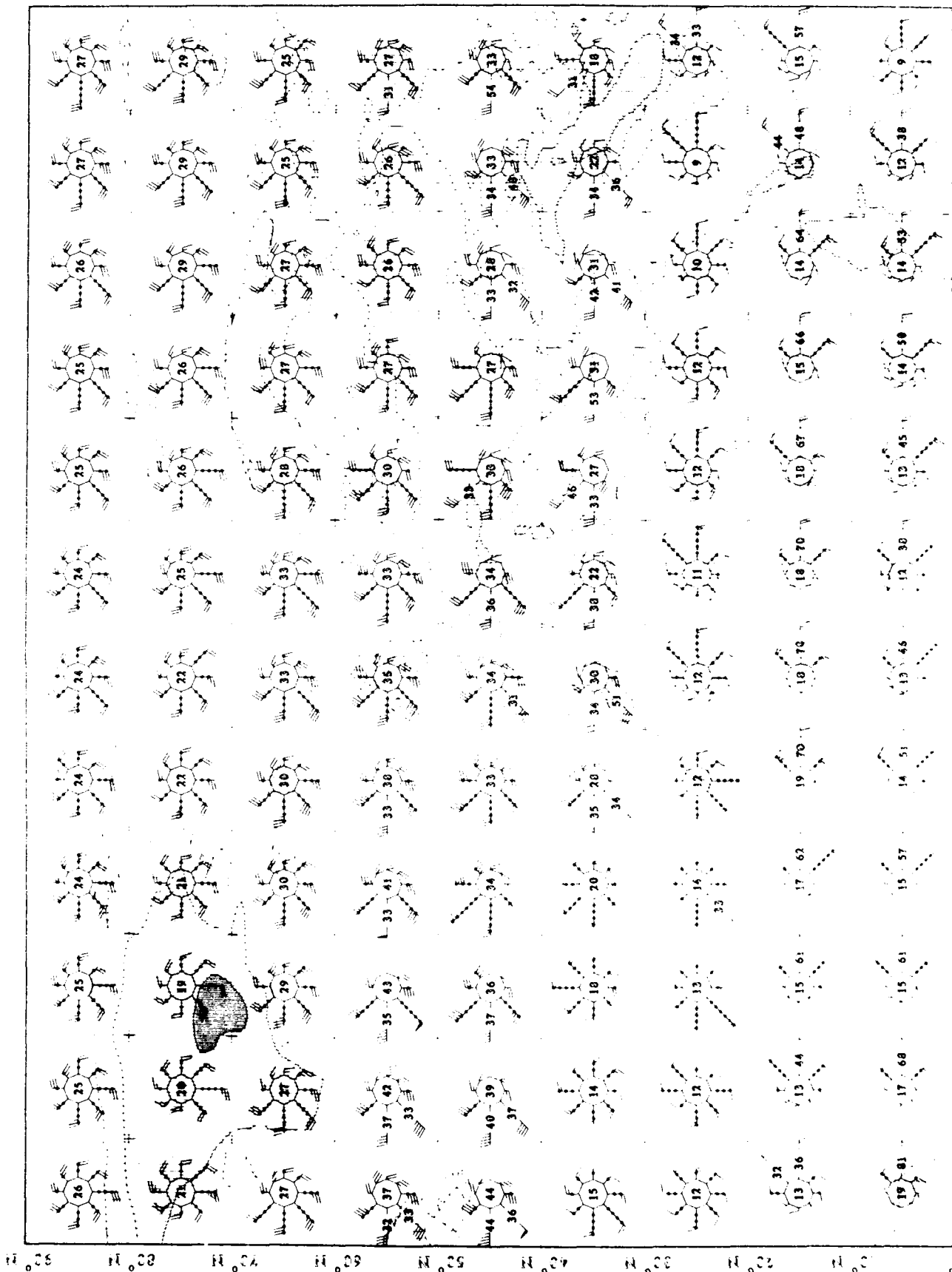
July 1960  
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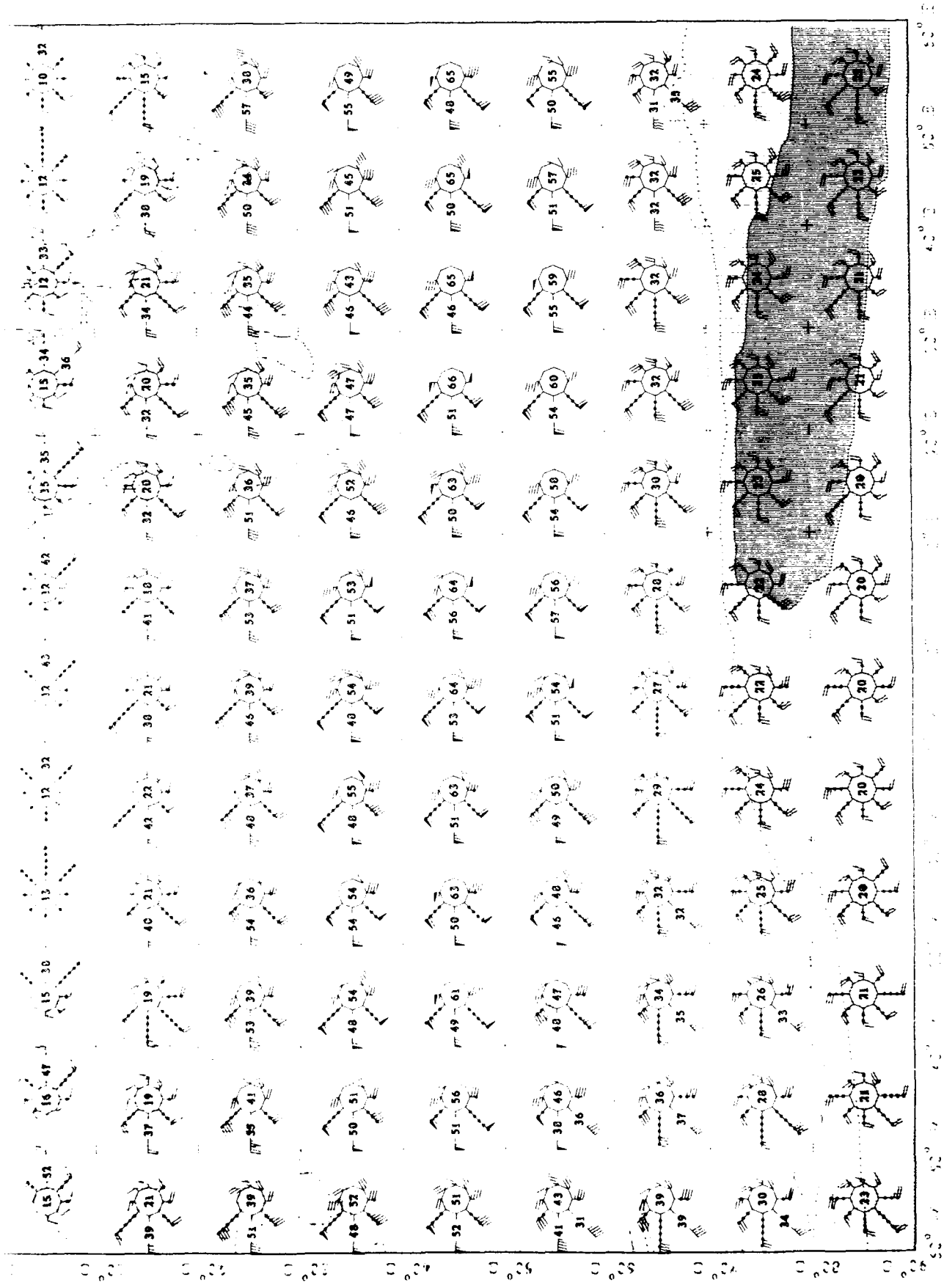
July  
500 mb

Upper Air Climatology  
Northern Hemisphere

500 mb  
Wind Vectors

July  
400 mb





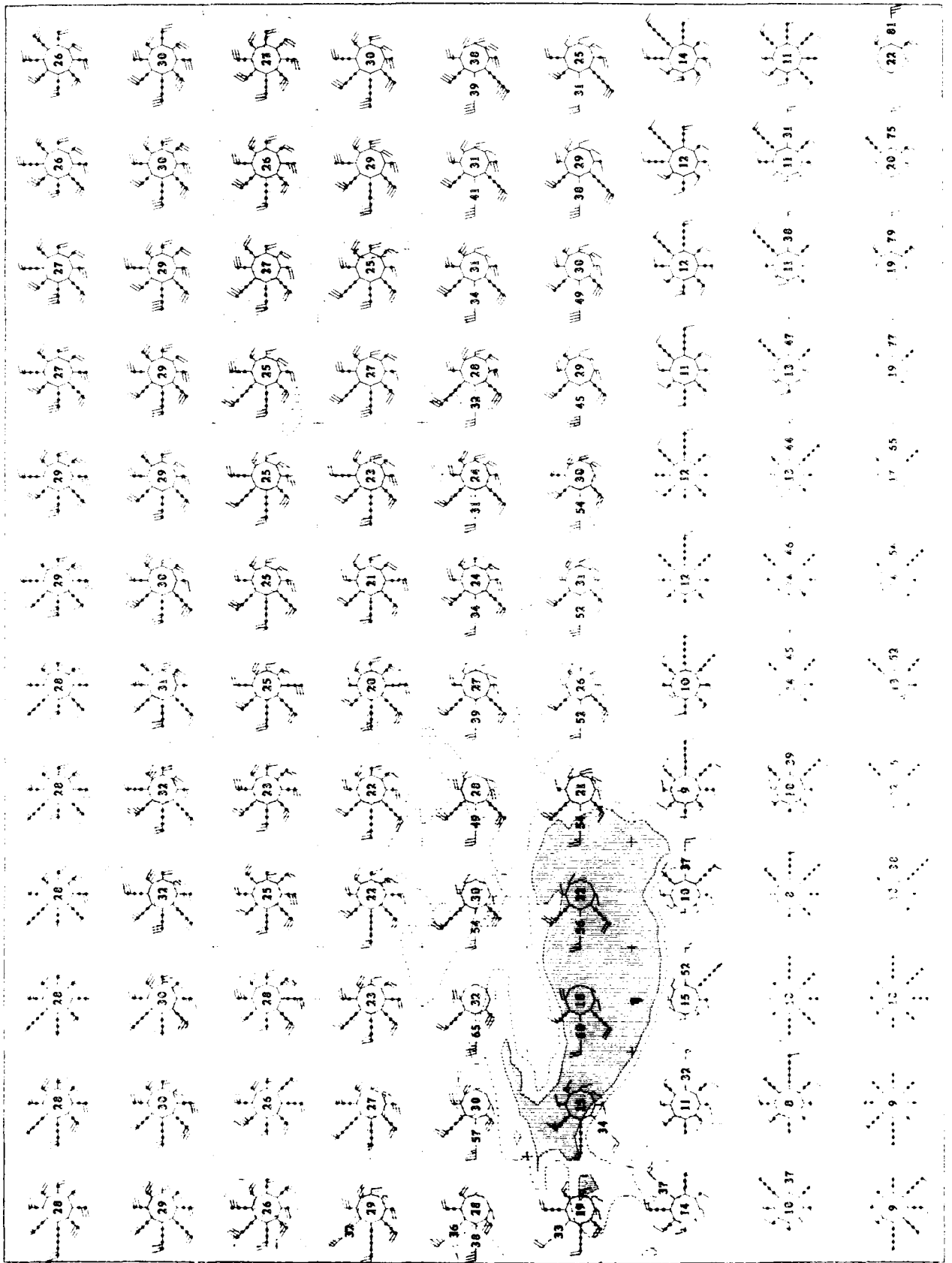
Upper Air Climatology  
Southern Hemisphere

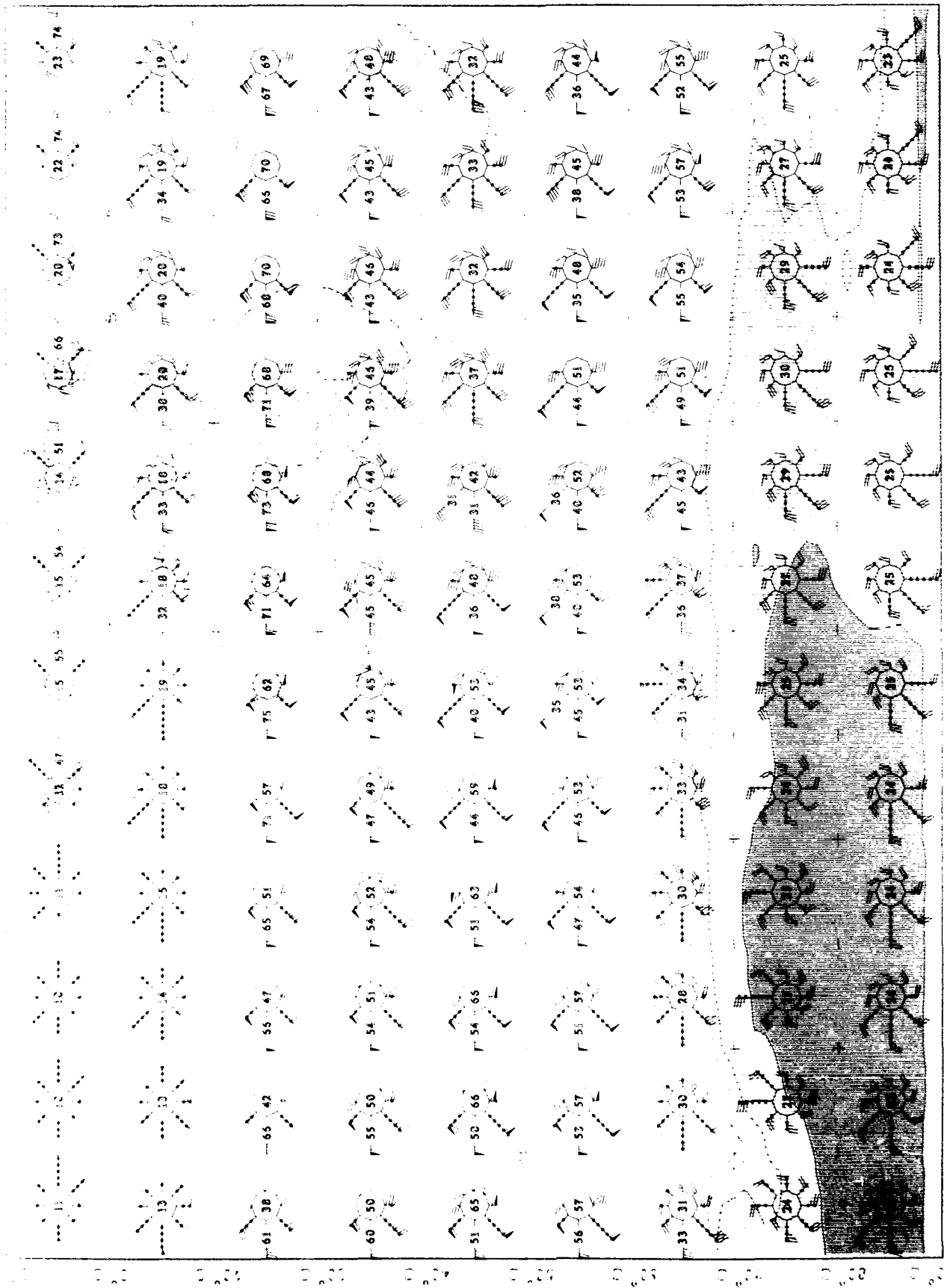
July 1950-1959

July  
400 mb

Figure 2  
Northern Hemisphere

1950-1955  
World Record





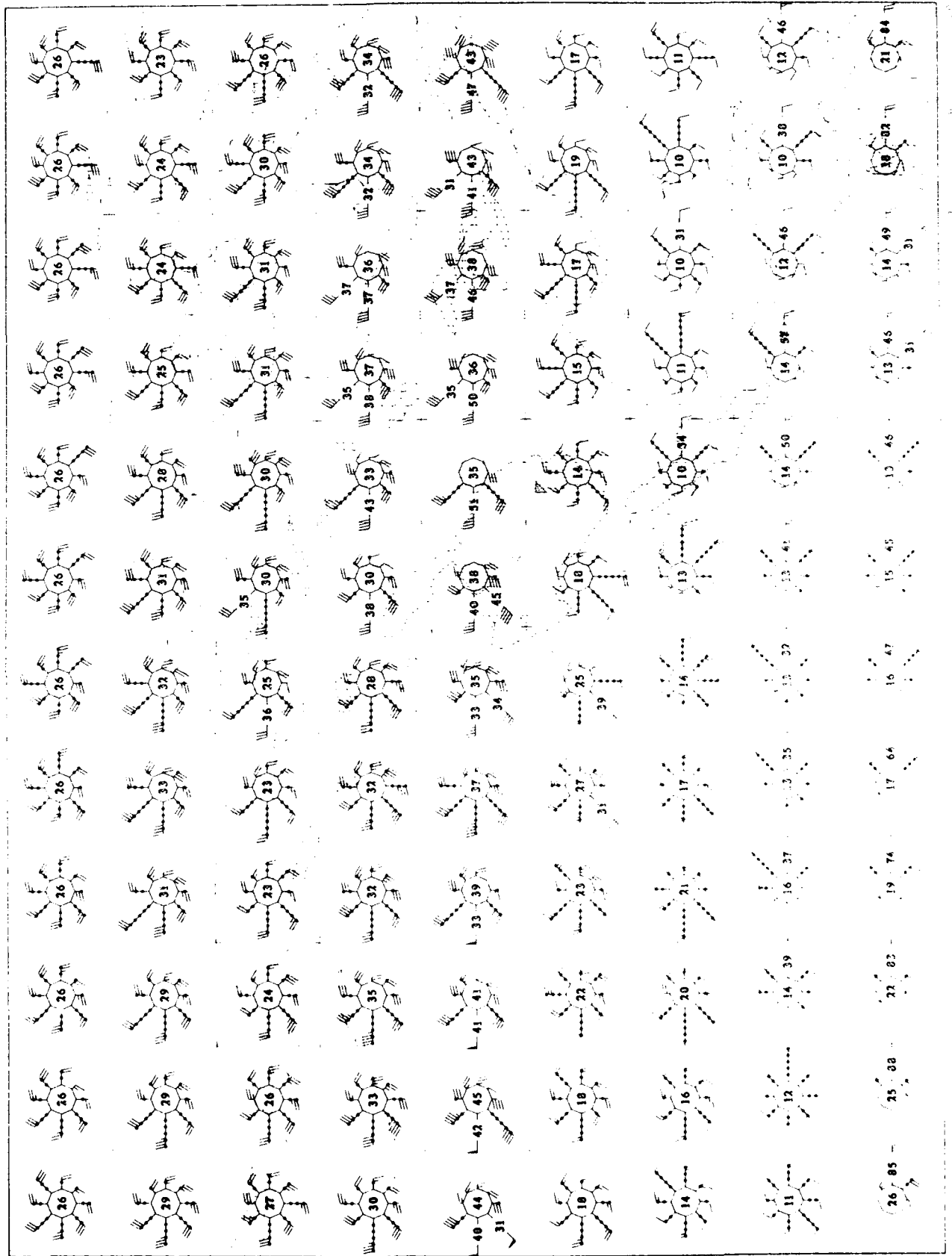
Upper Air Climatology  
 G. S. H. H. H. H. H.

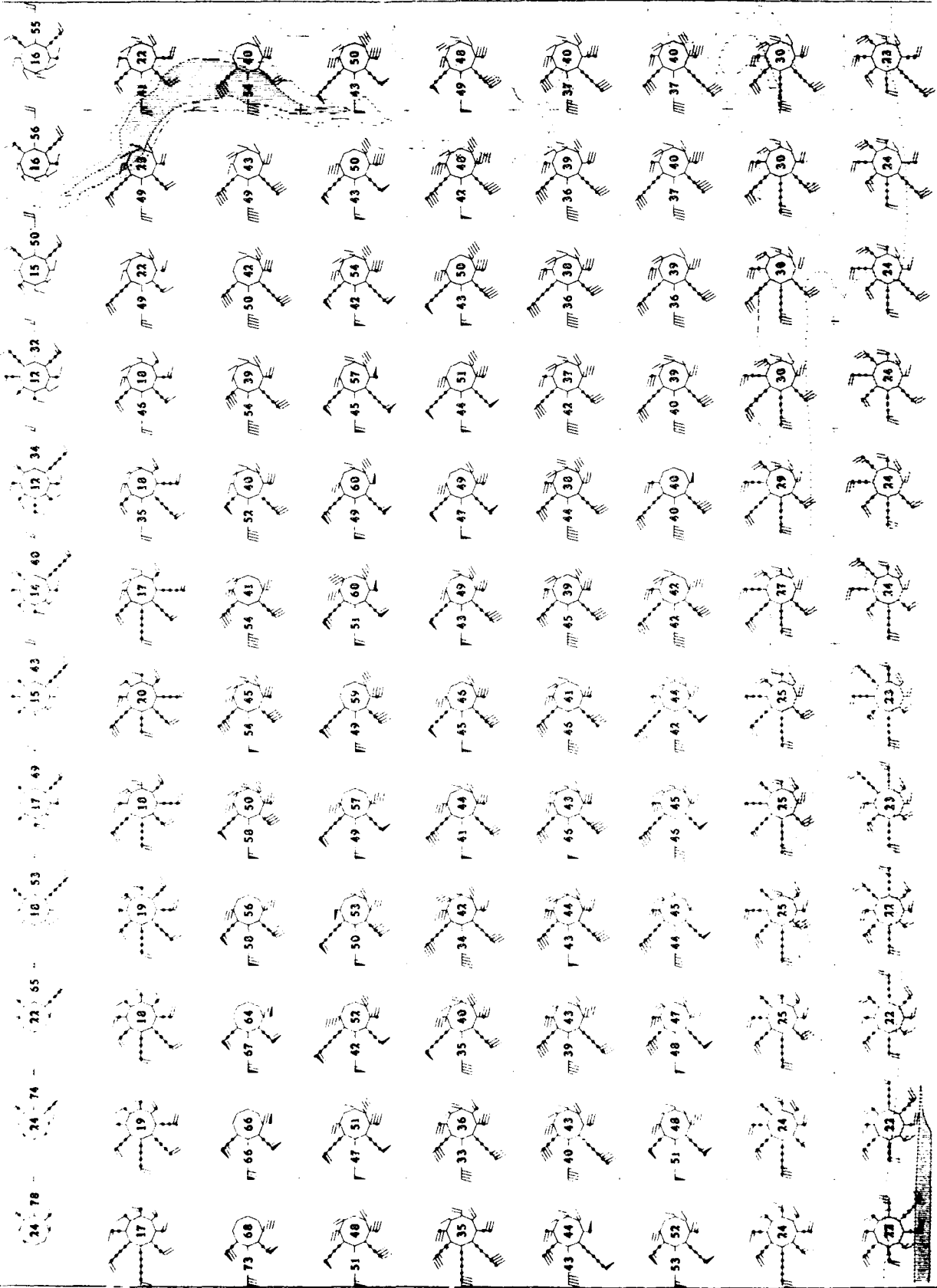
1957  
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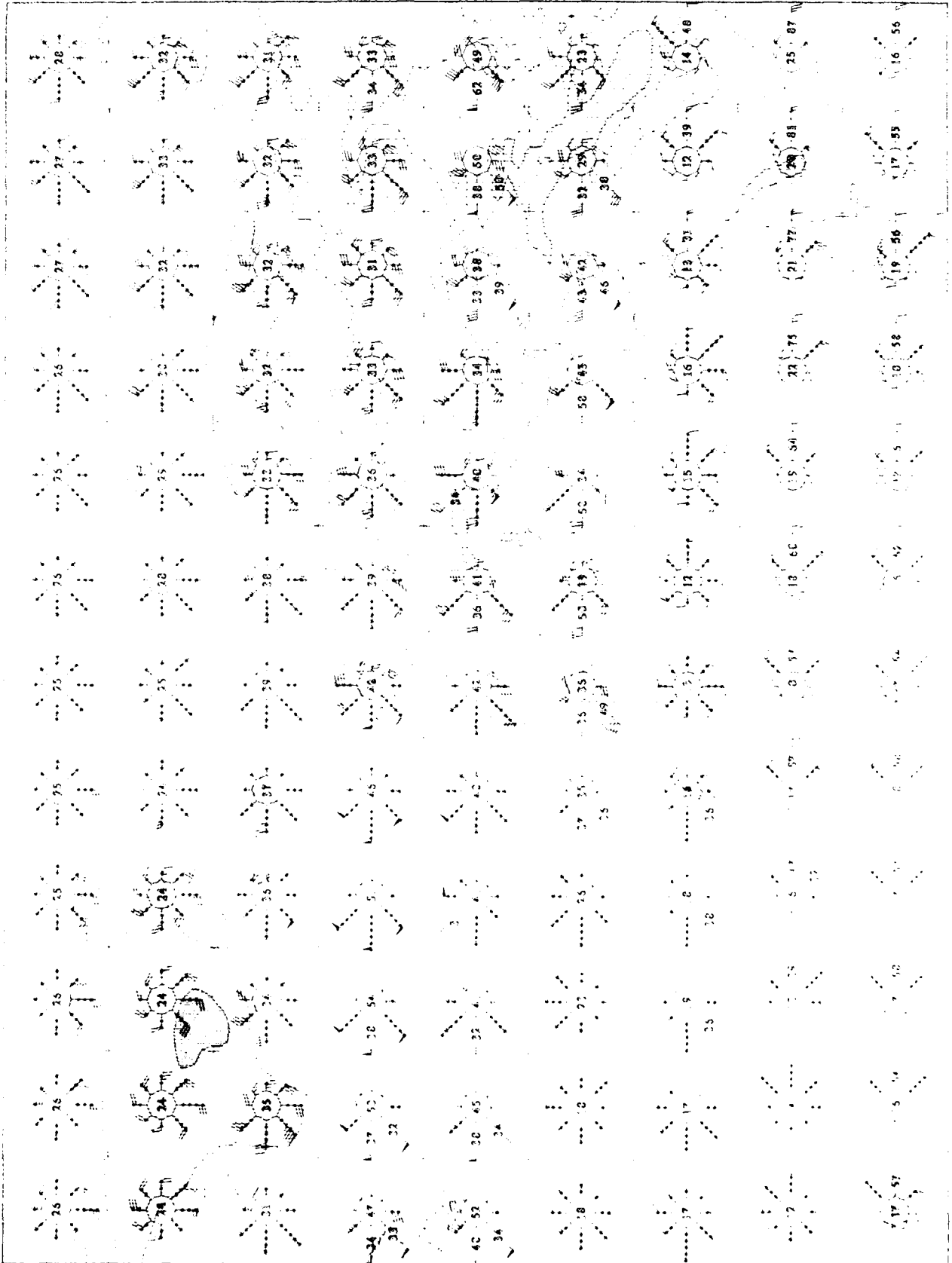
Upper Air Climatology  
Northern Hemisphere

500 mb  
Wind Roses

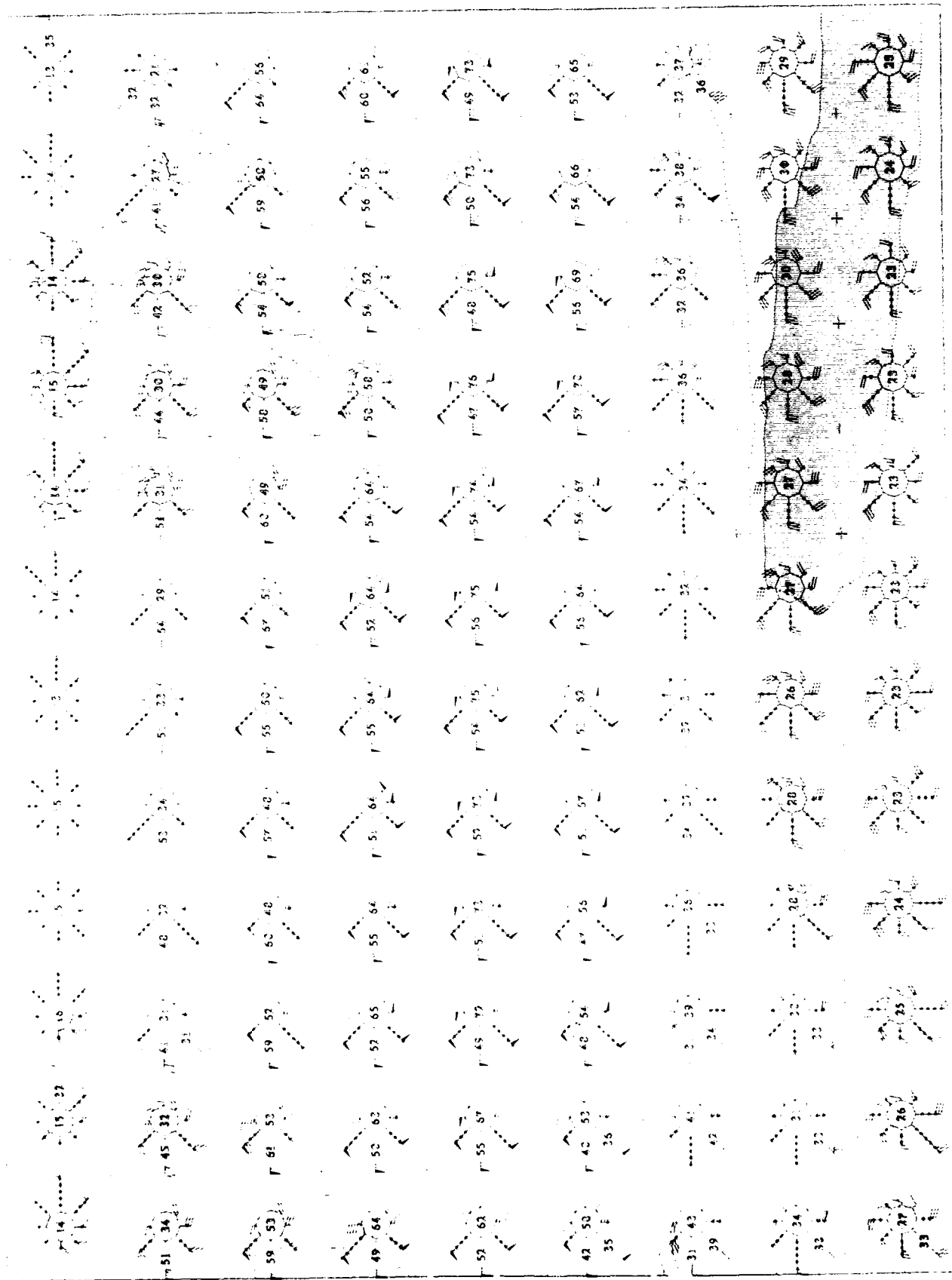
July  
400 MB

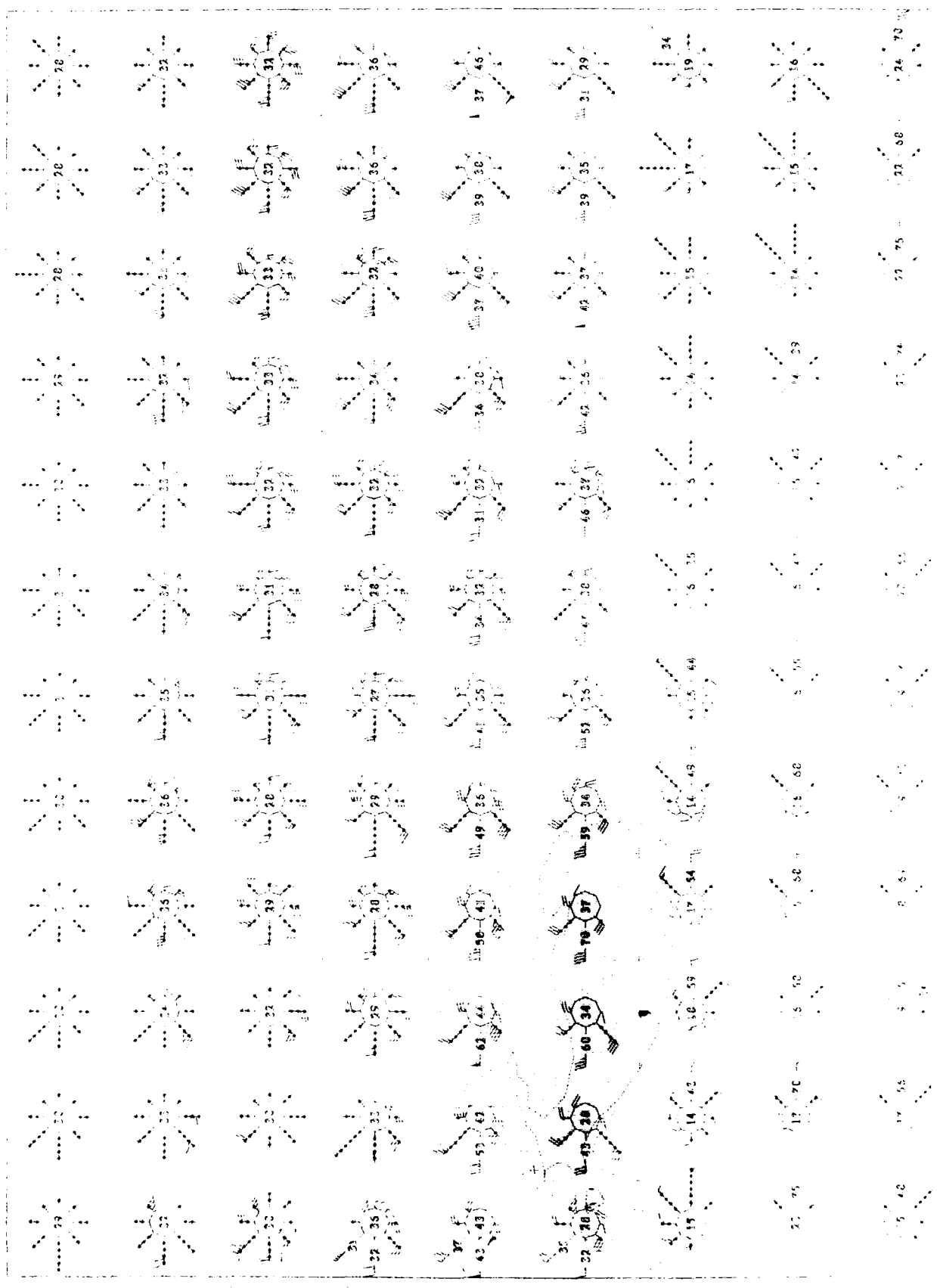


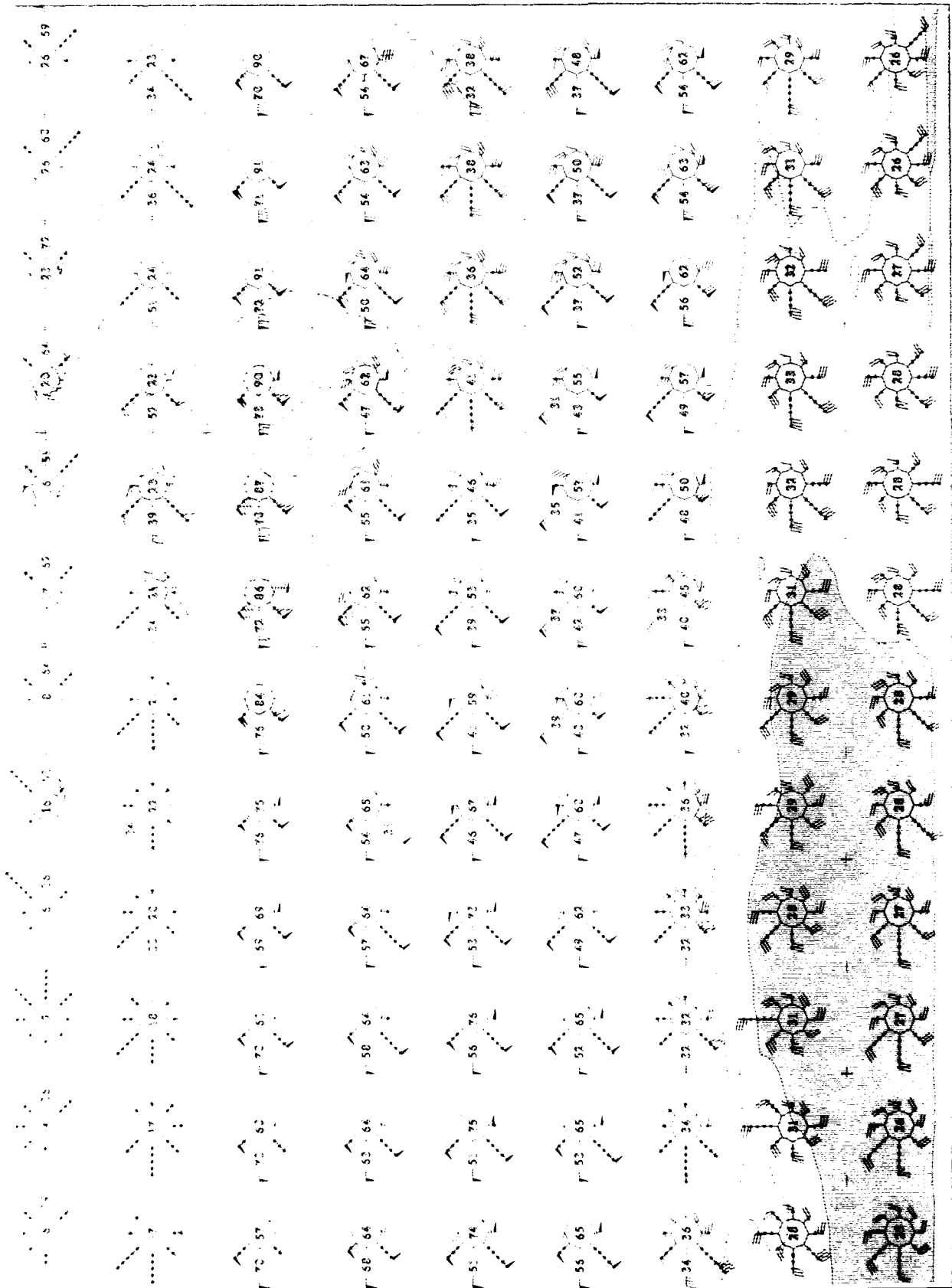




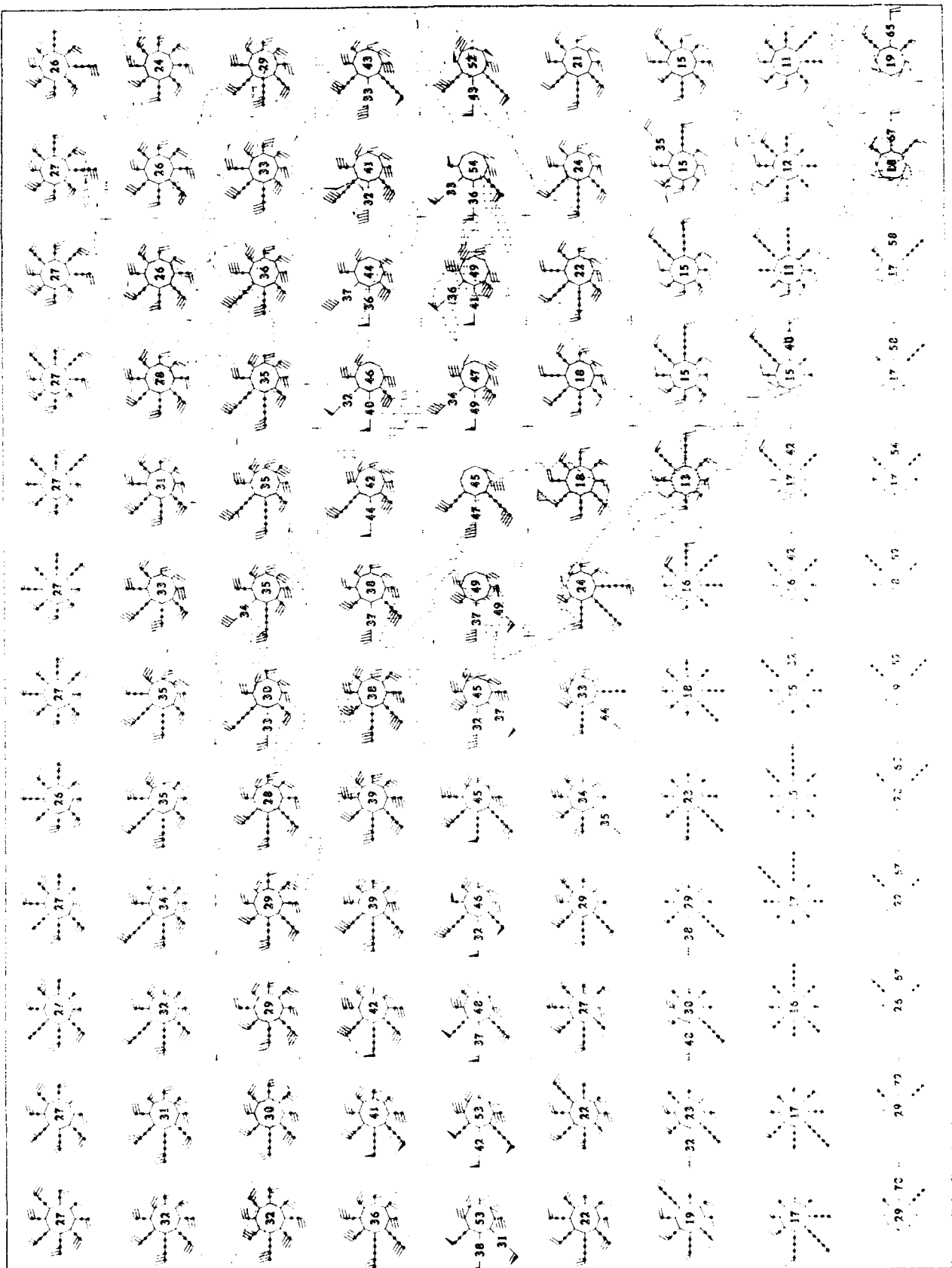
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Preparatory Exercises  
 Numbered Handwriting



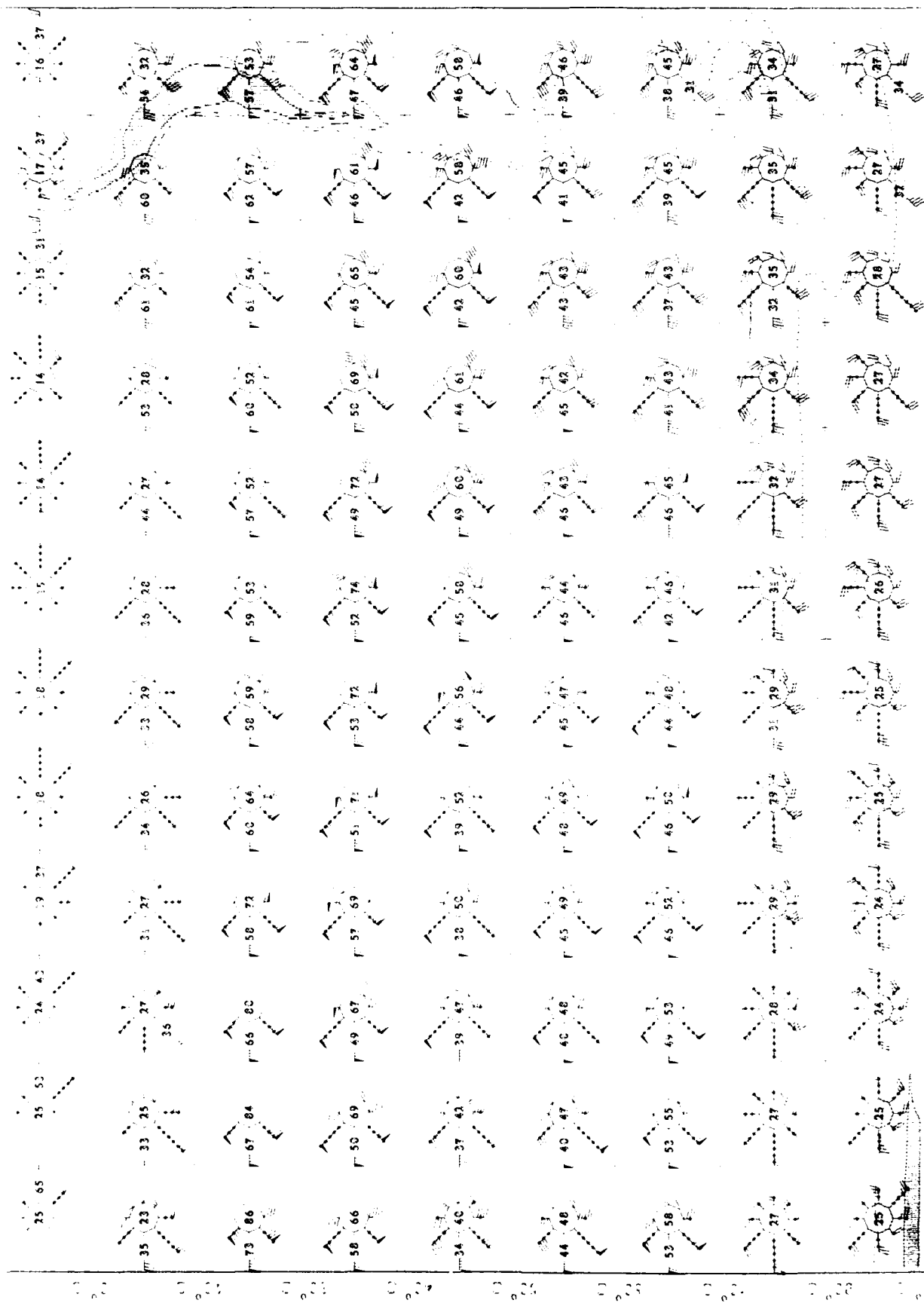
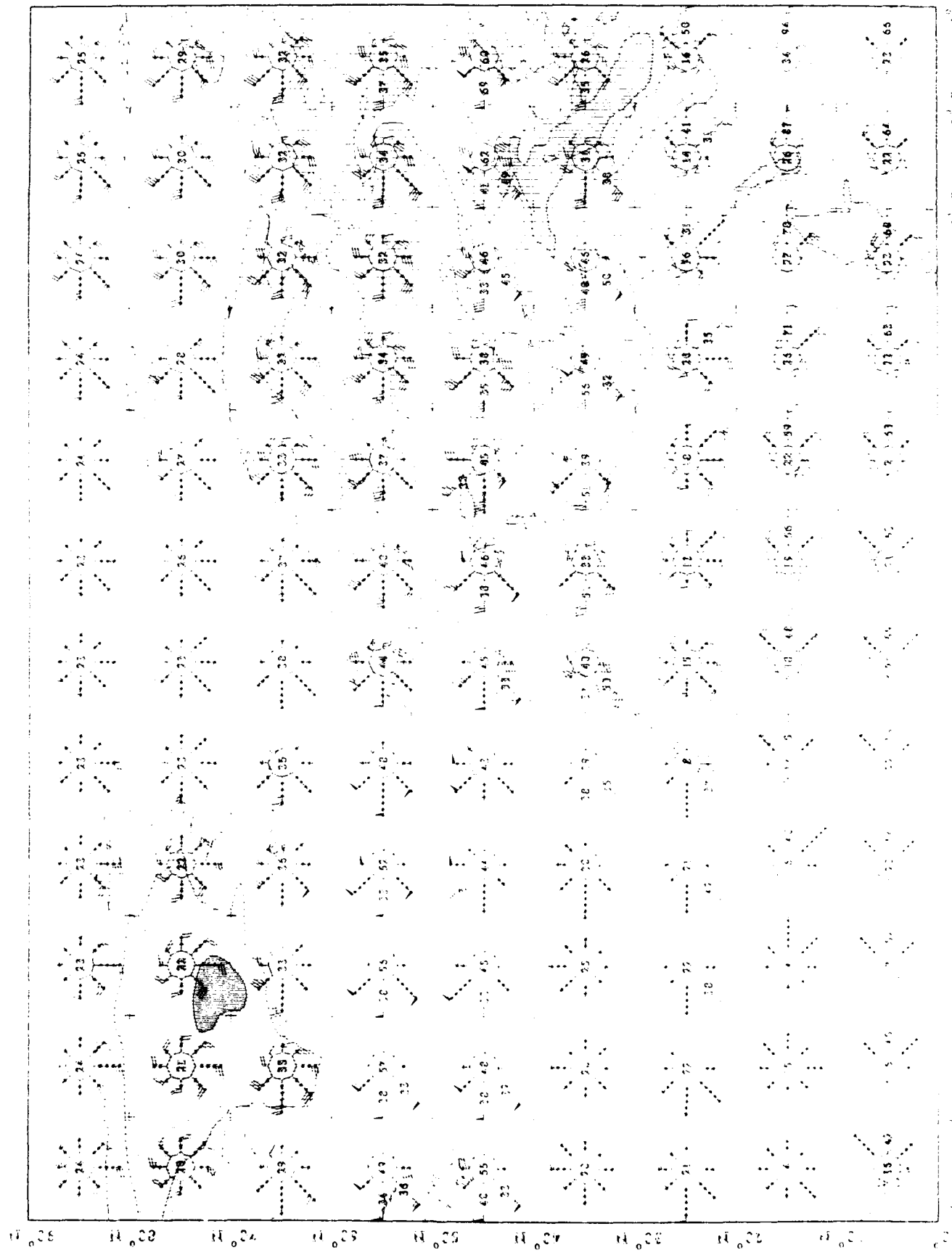
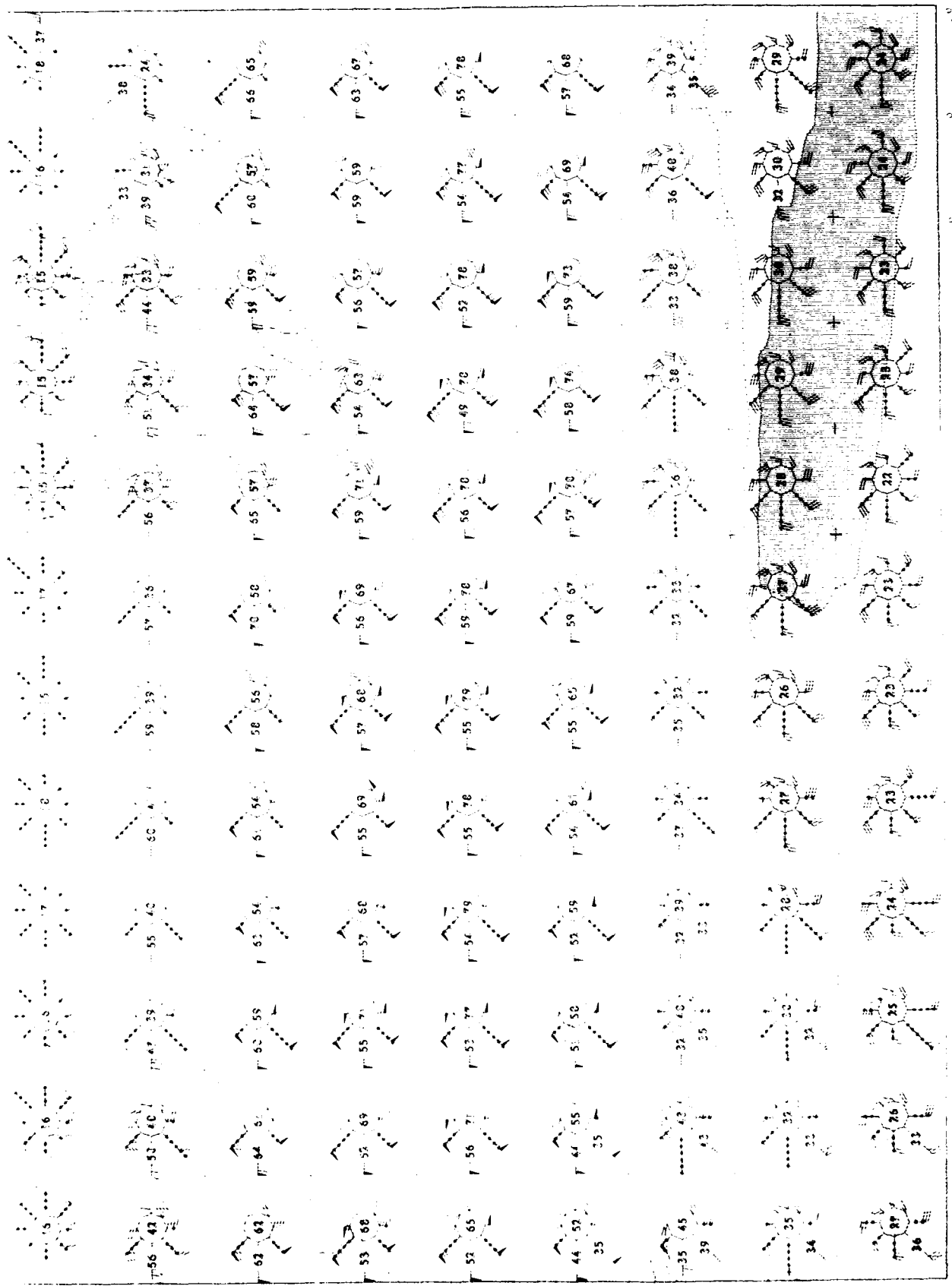


Figure 100: Stick Figure  
 Counters: 16-86

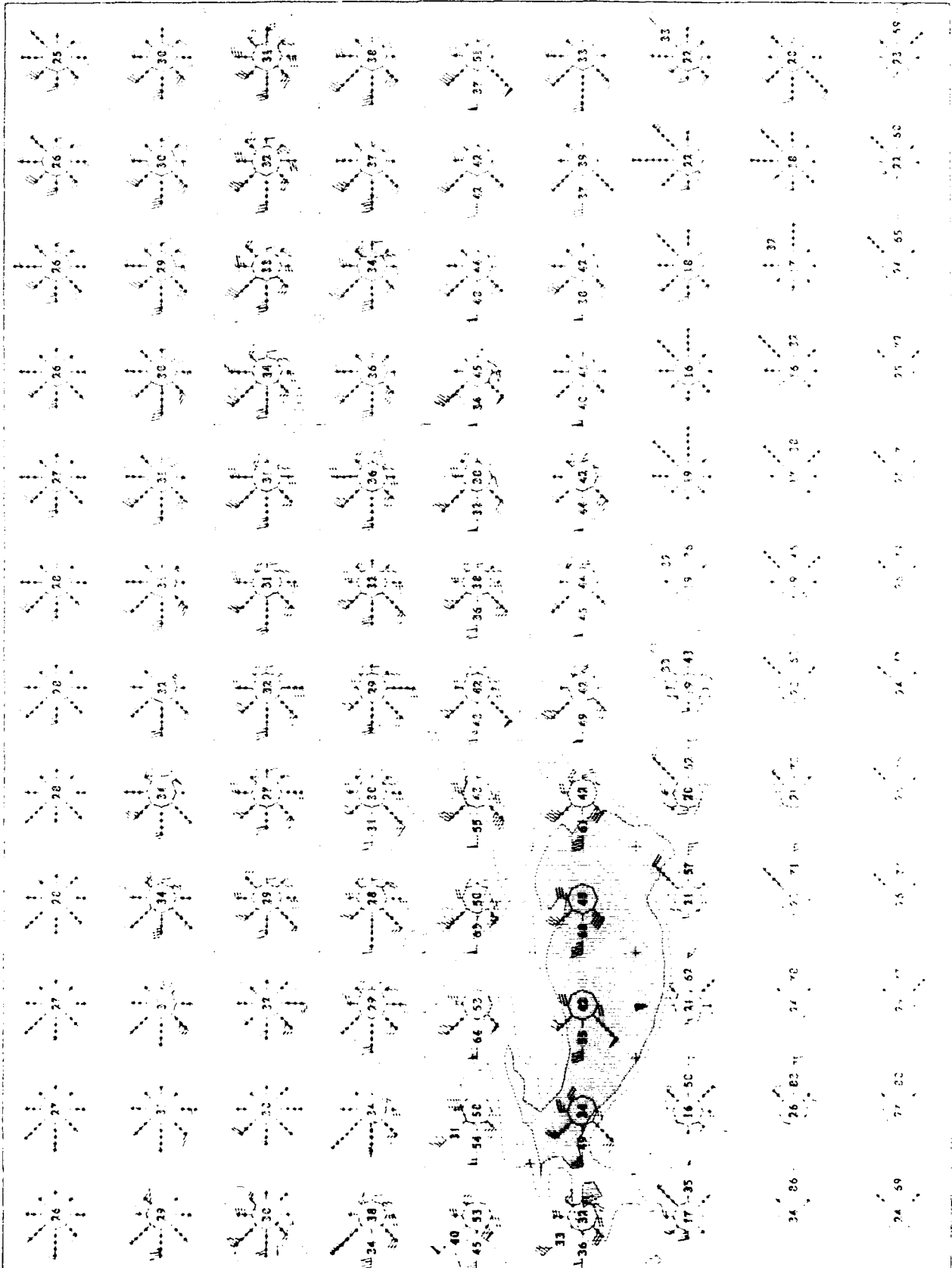
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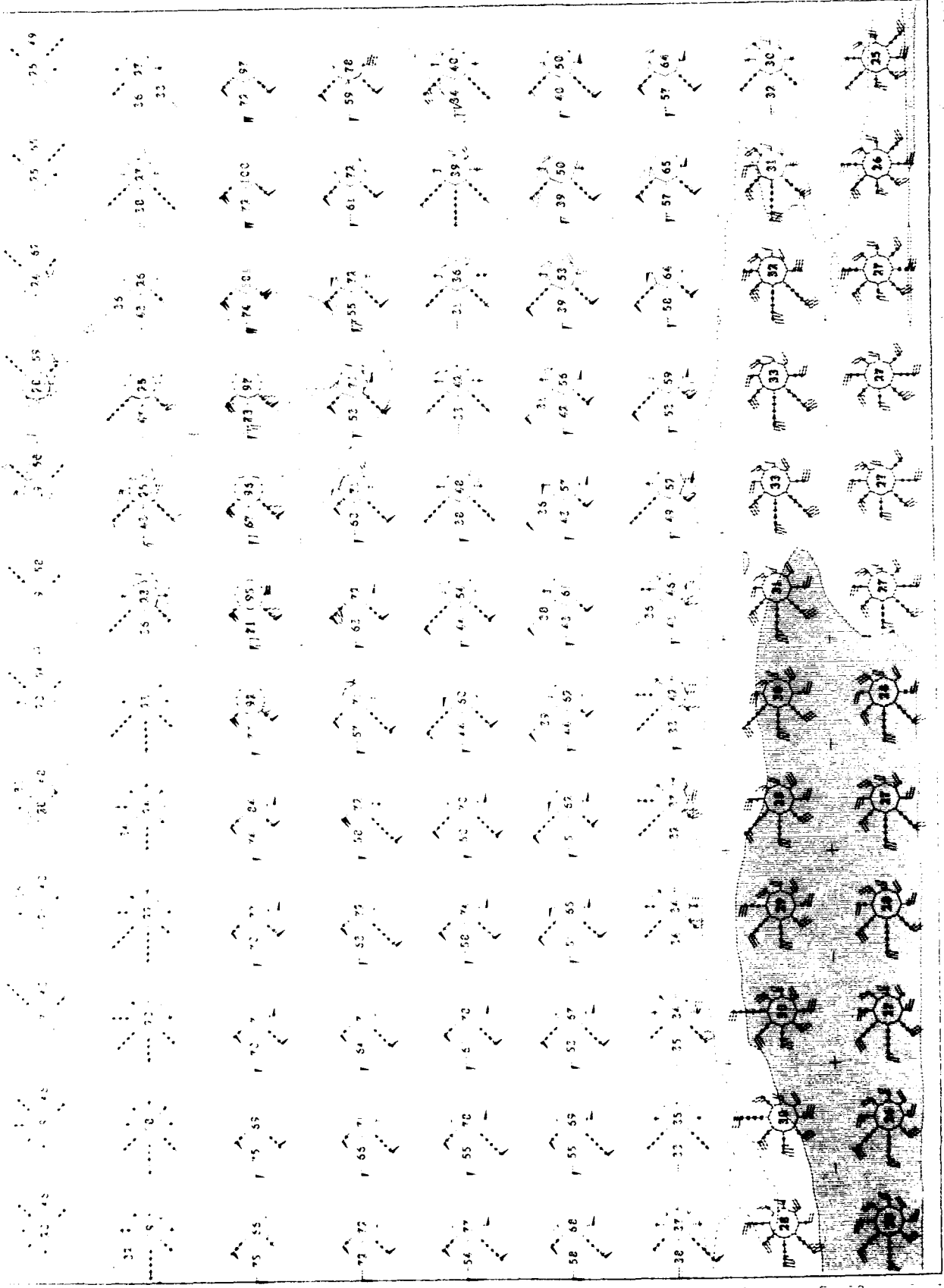




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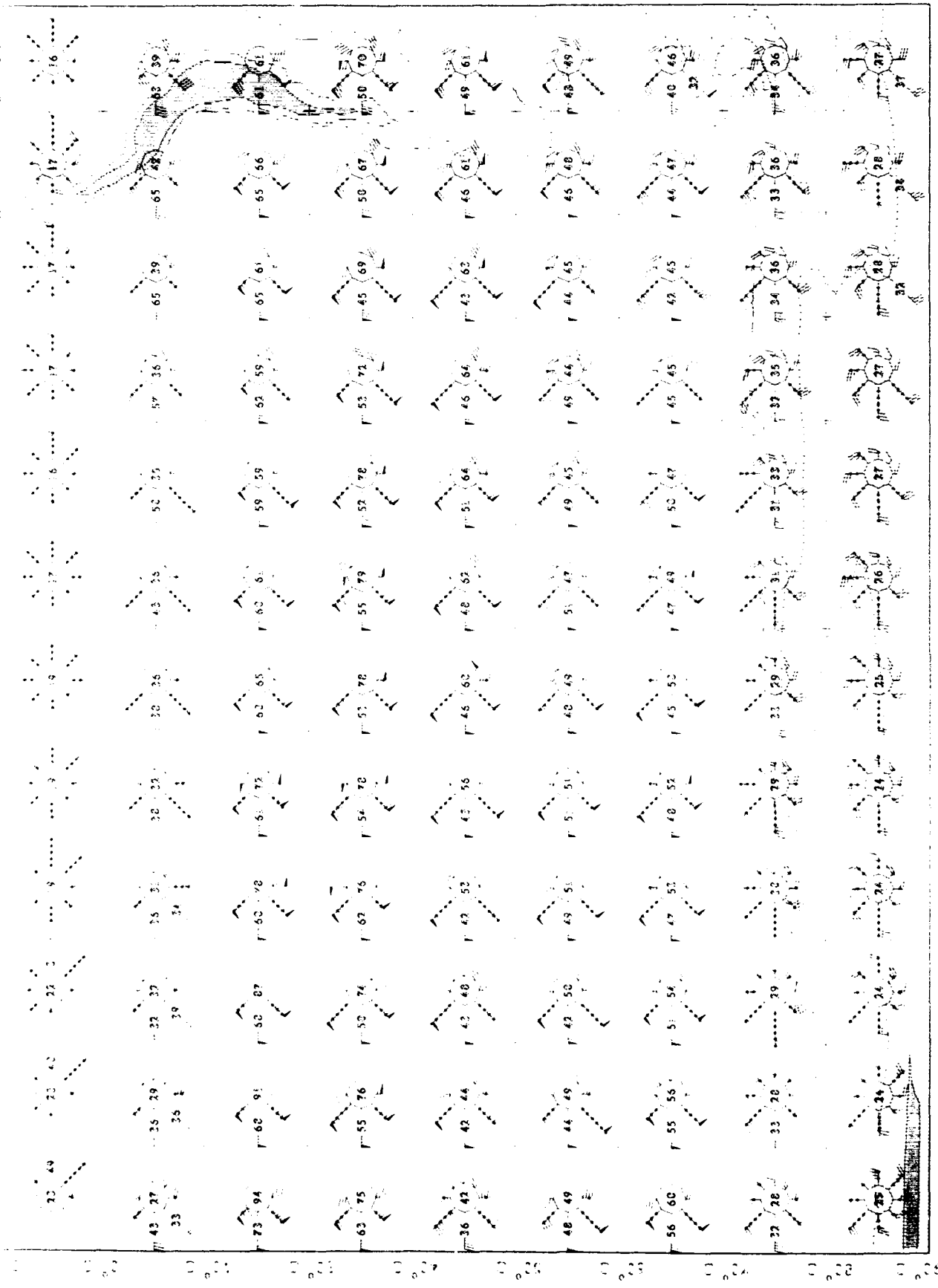
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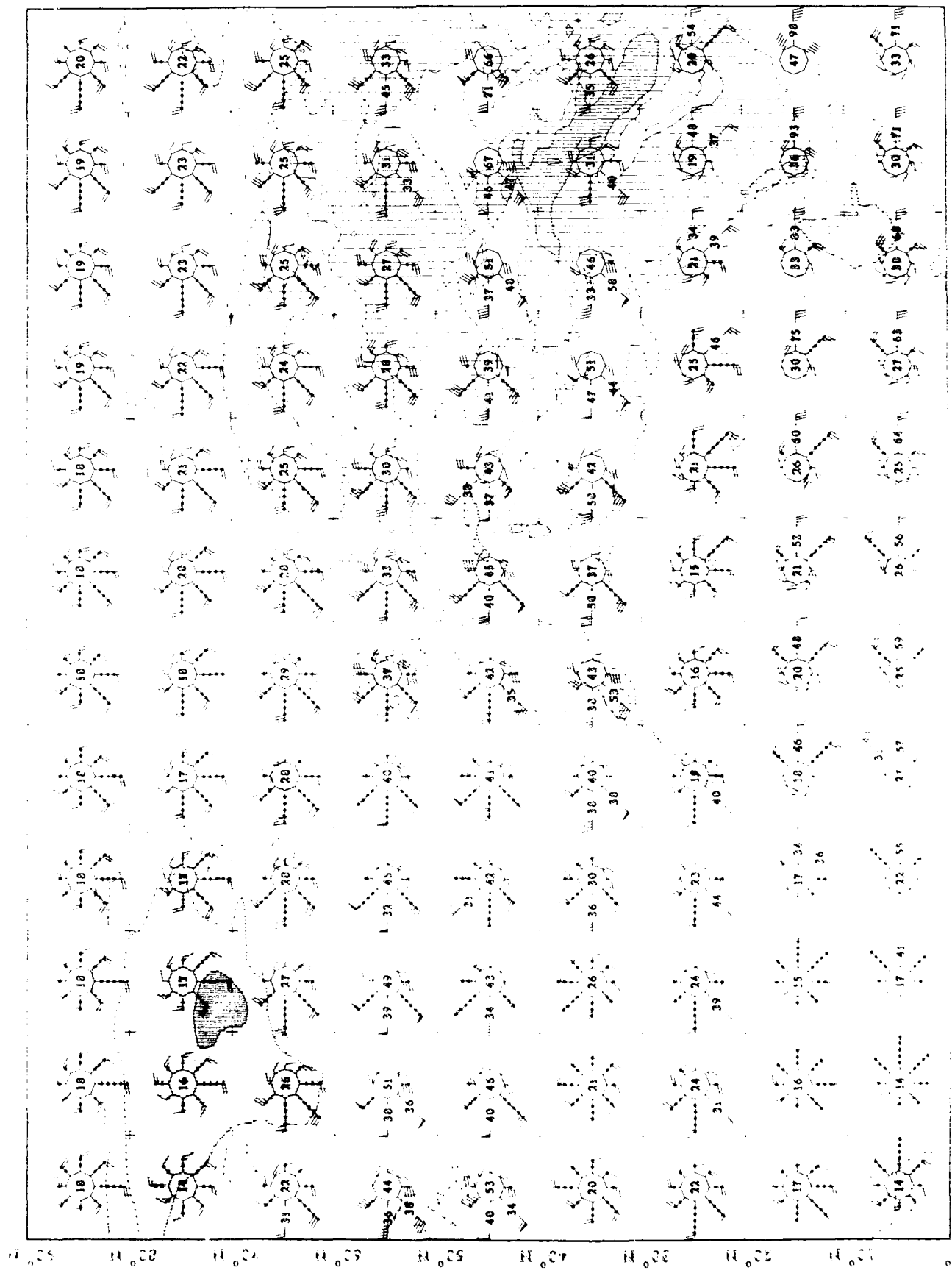


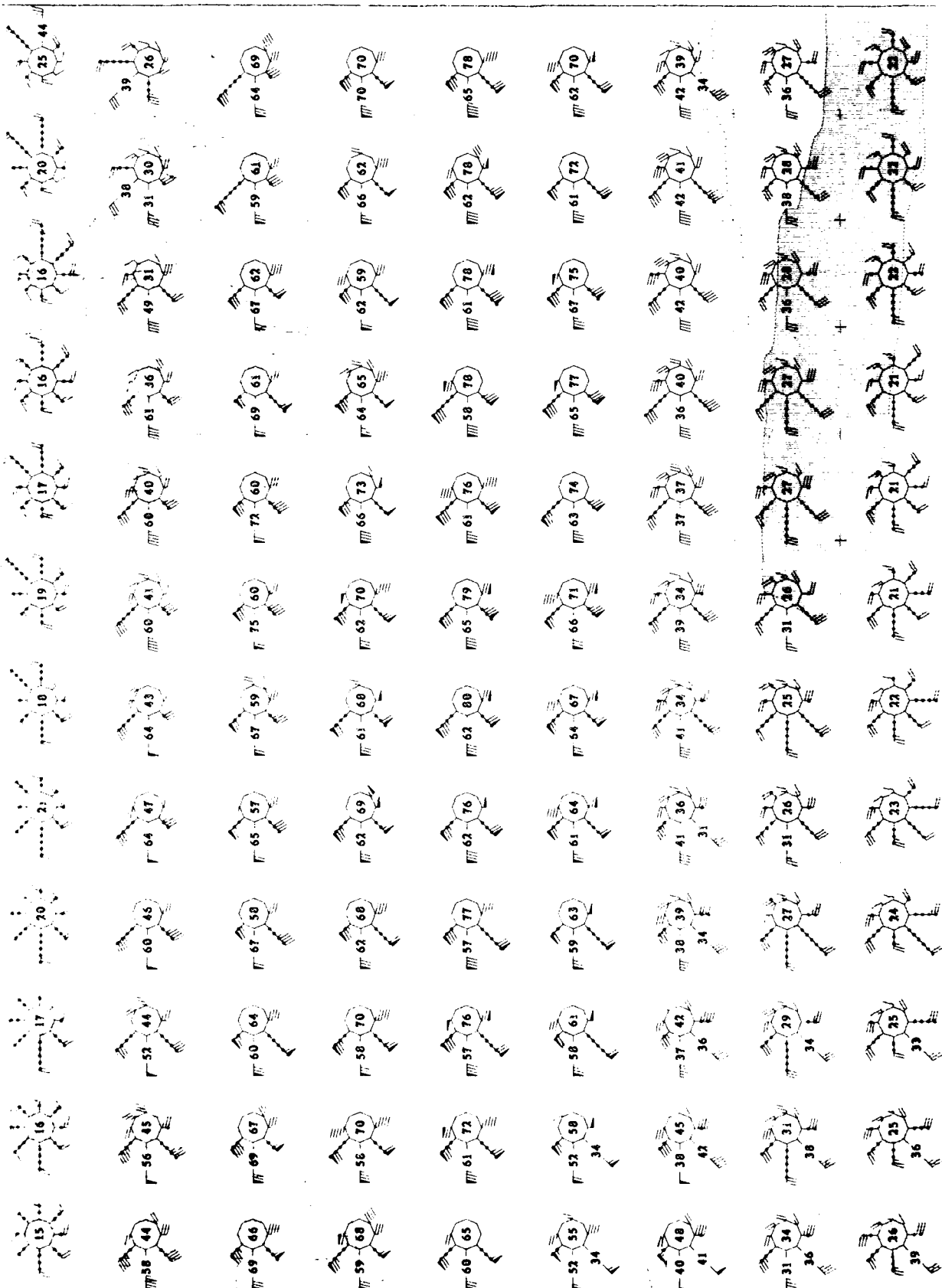
THE UNIVERSITY OF TEXAS AT AUSTIN  
LIBRARY

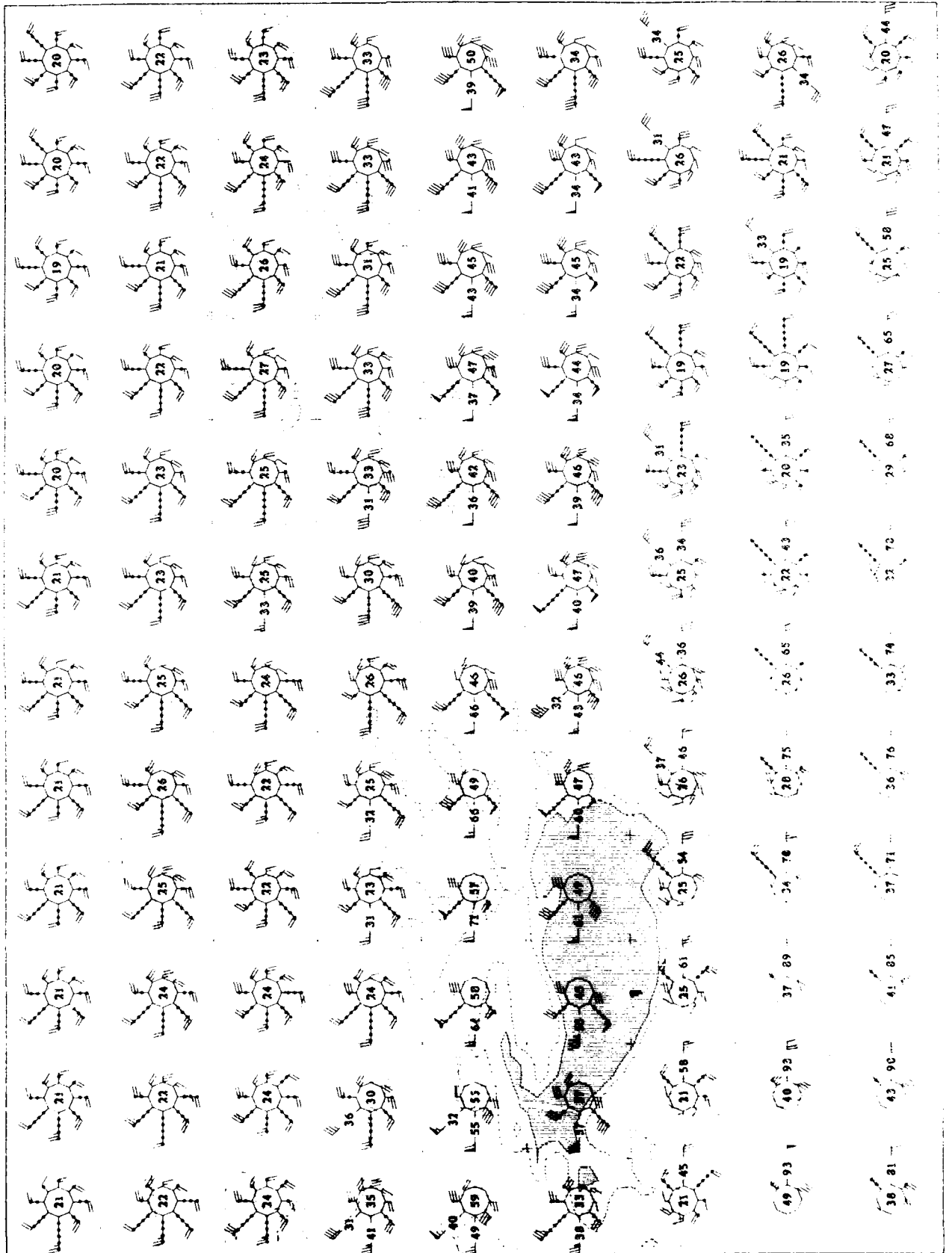
Map 33 Annular Velocity  
Northern Hemisphere

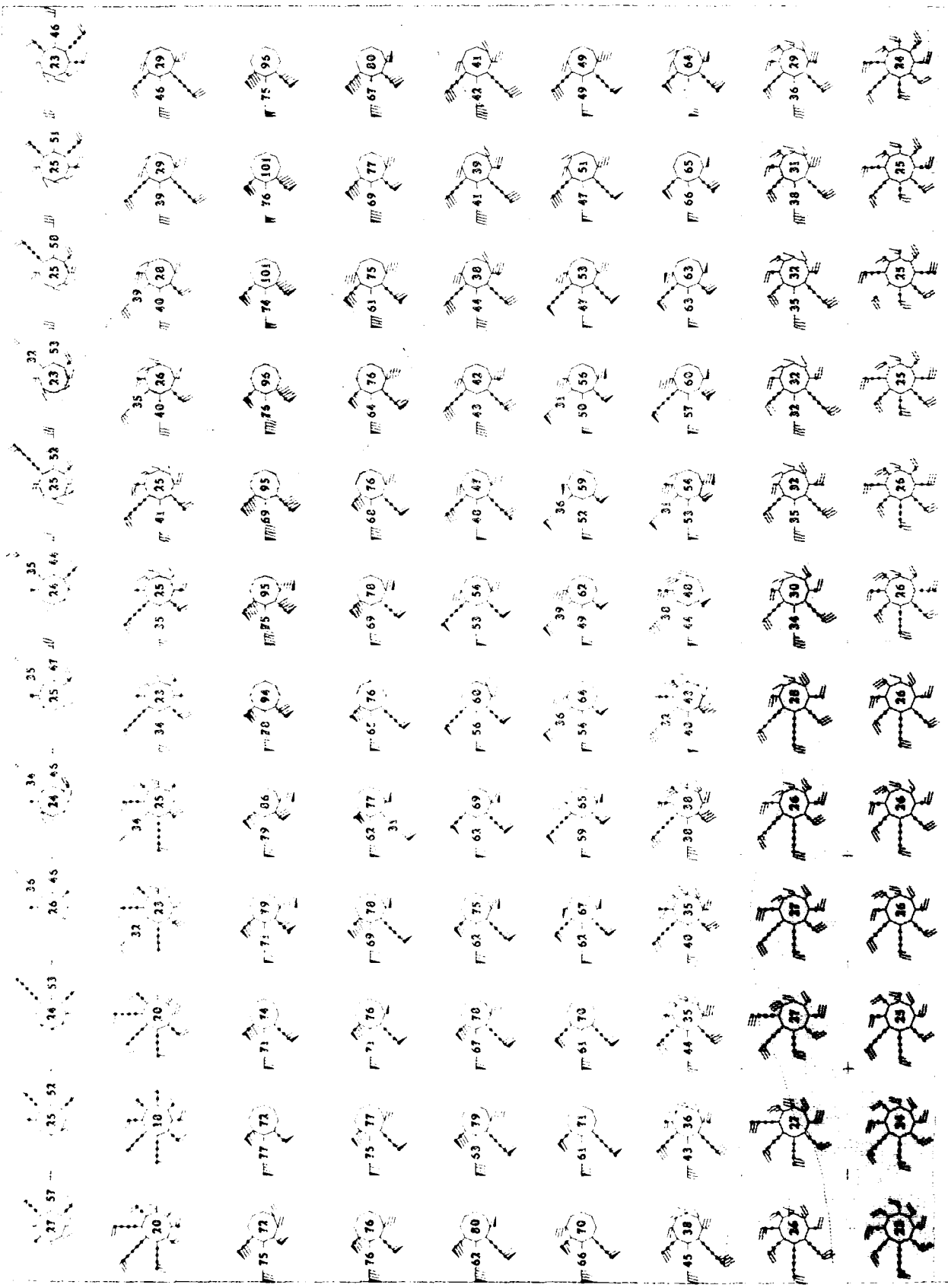
1950-1959

1950-1959



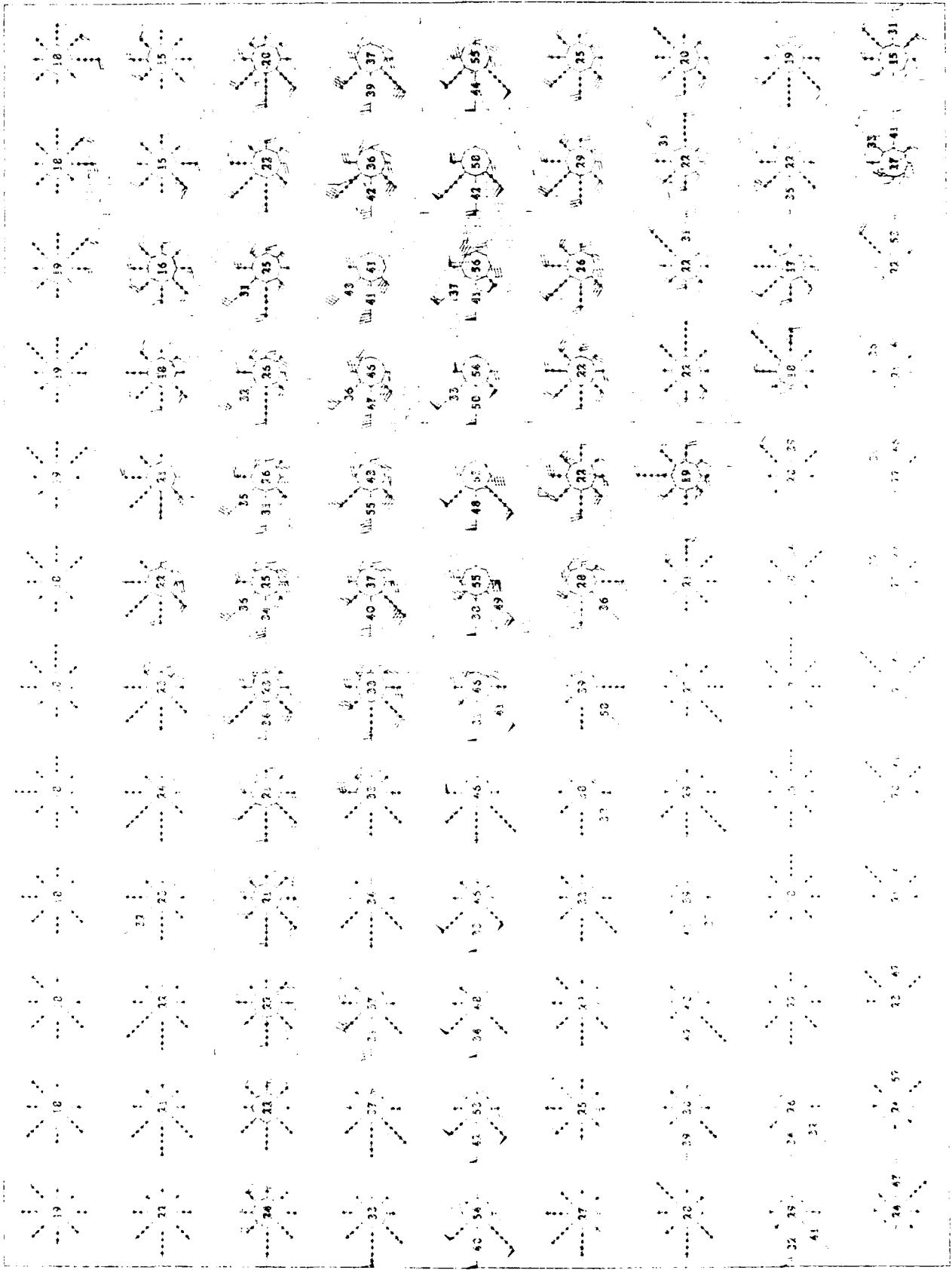


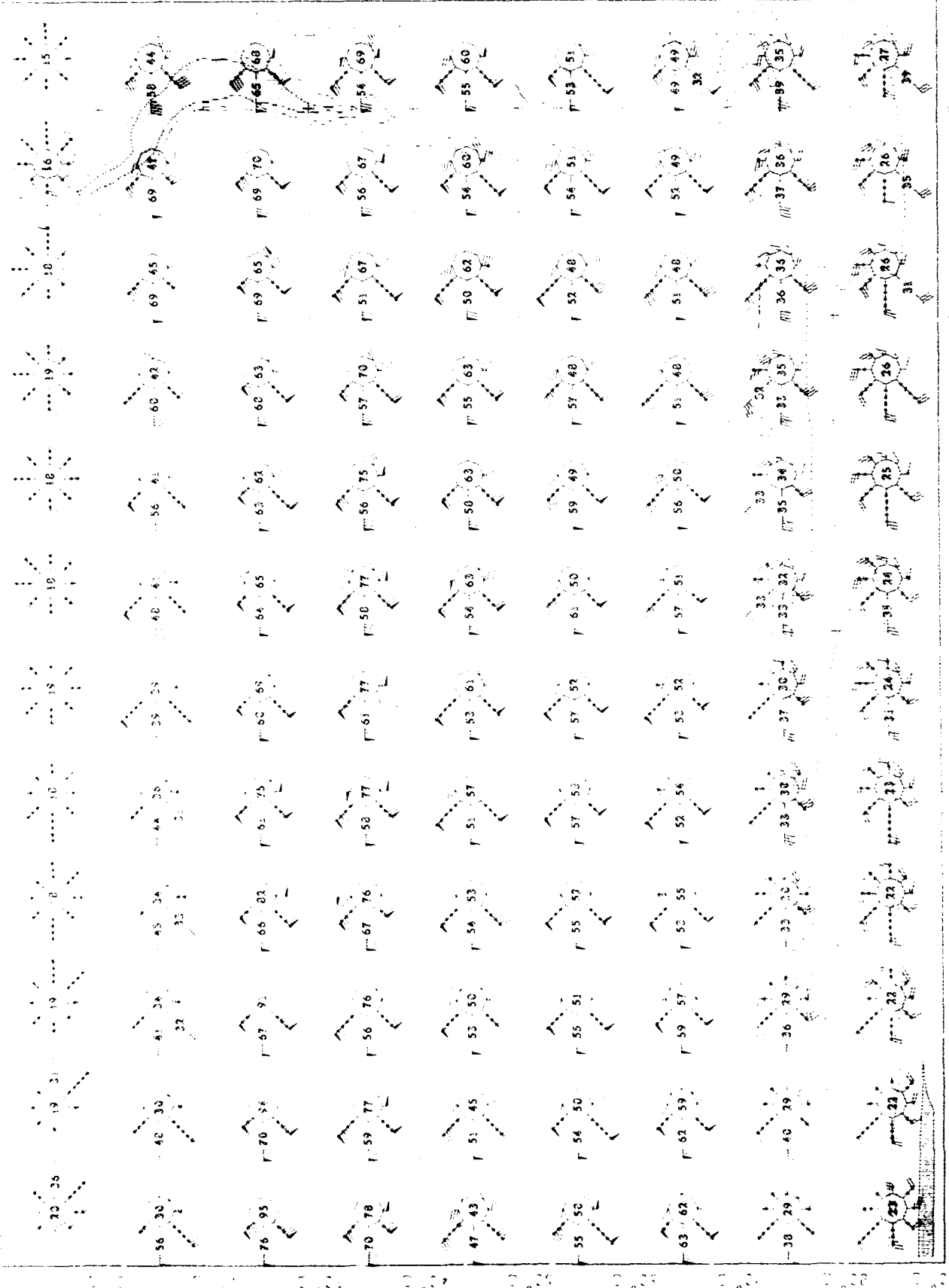




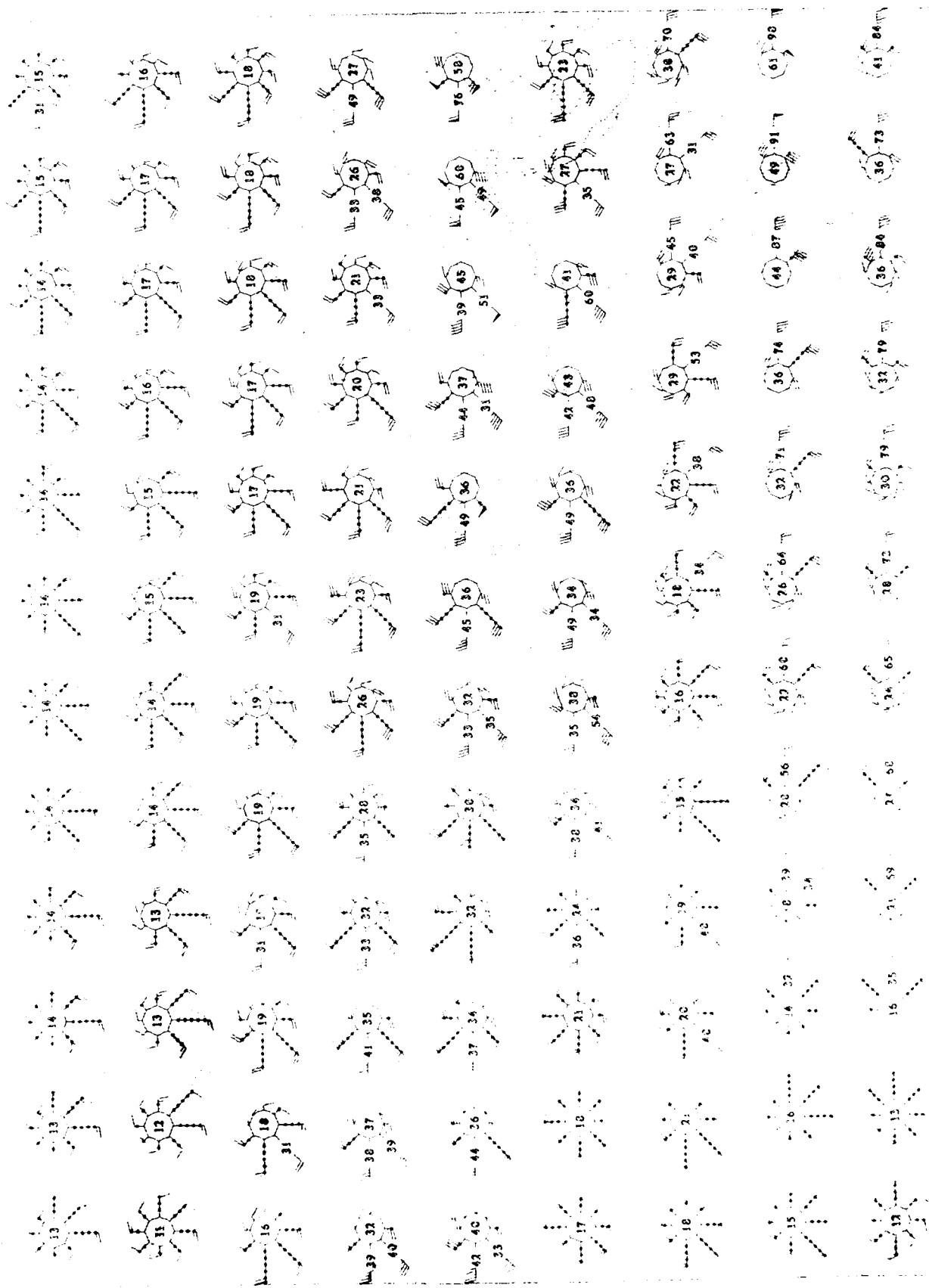
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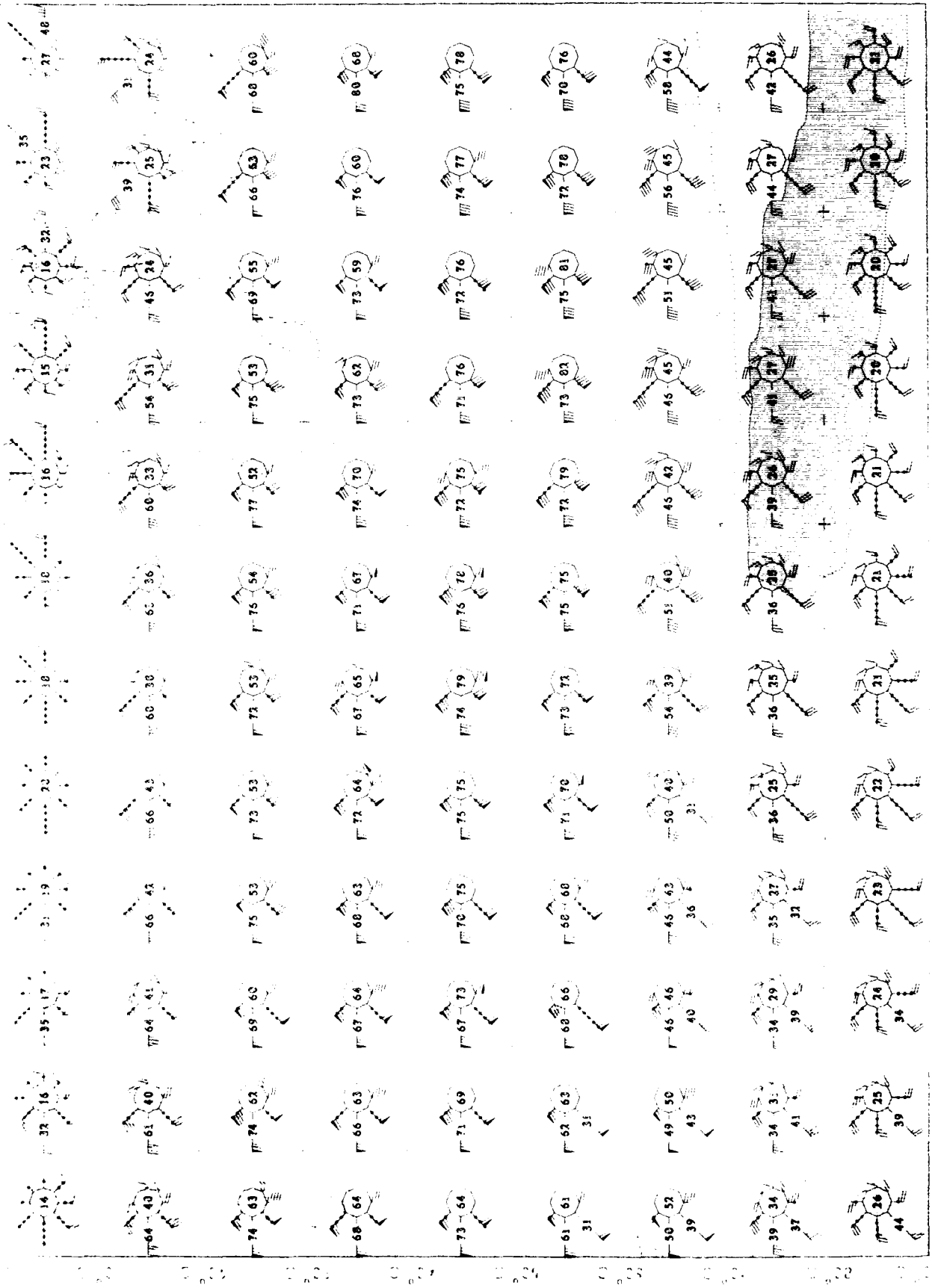
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1. The path starts at figure 44.  
 2. The path ends at figure 23.

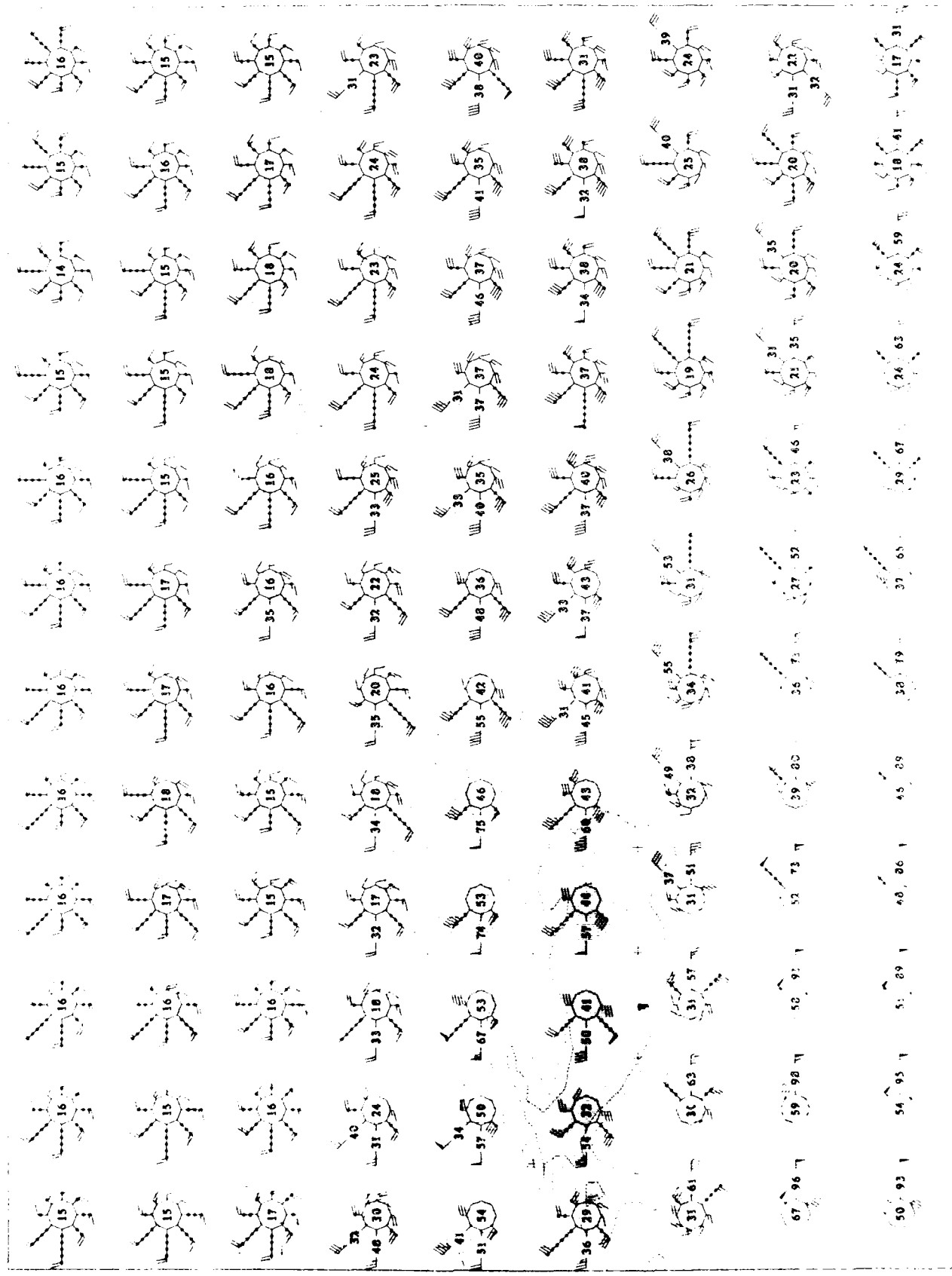


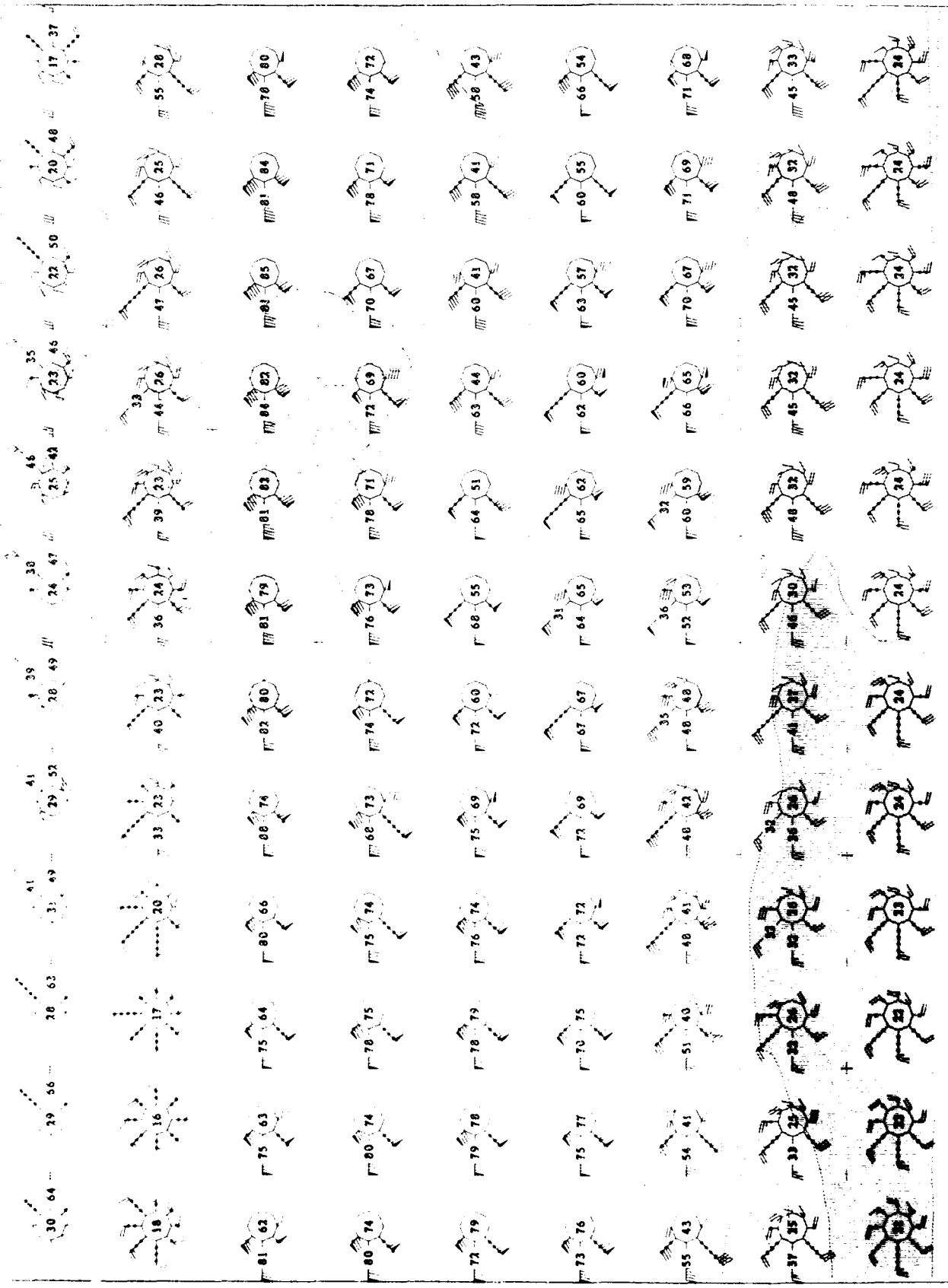


Upper Air Climatology  
Northern Hemisphere

July 1951

July 1951

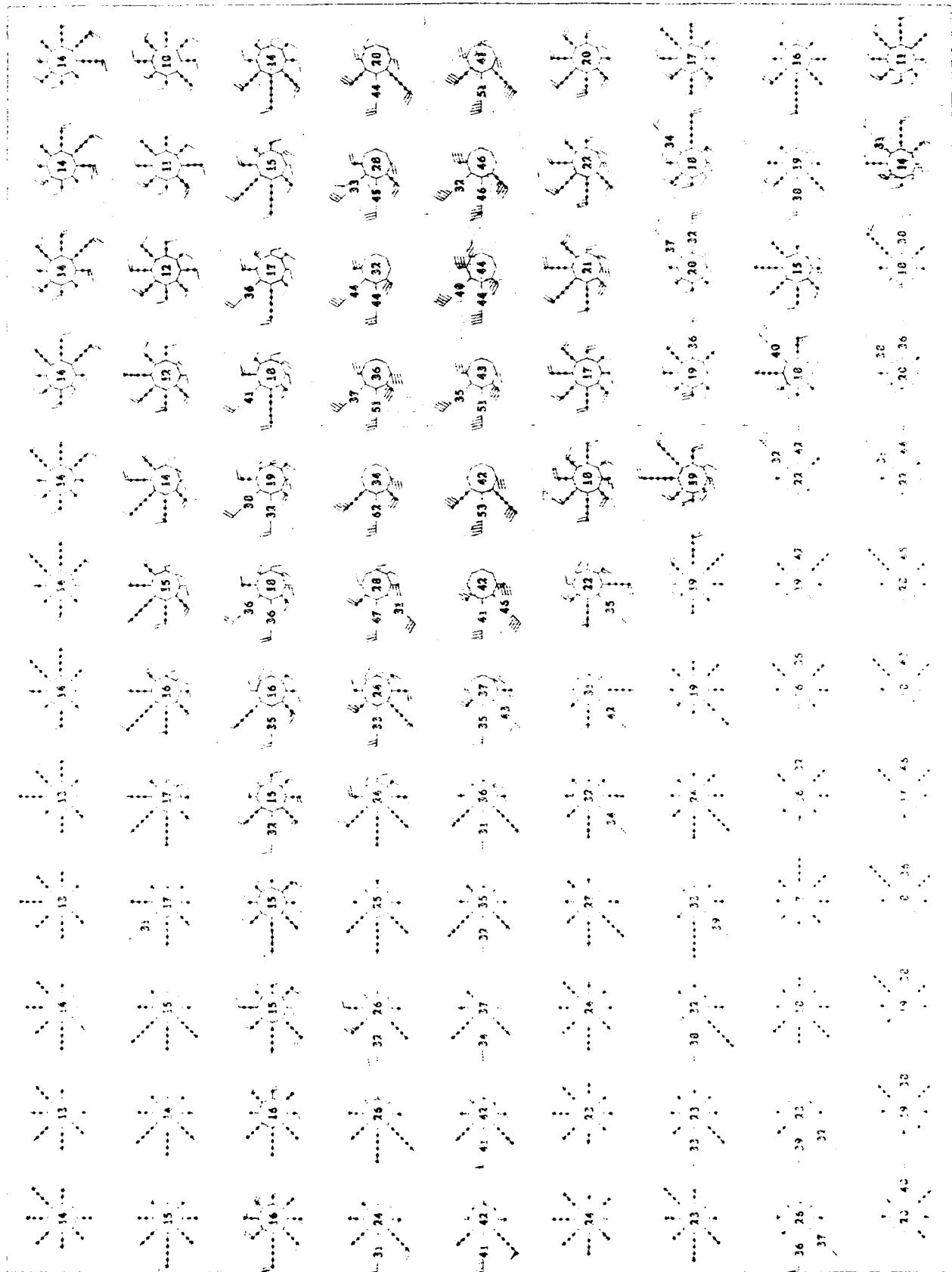


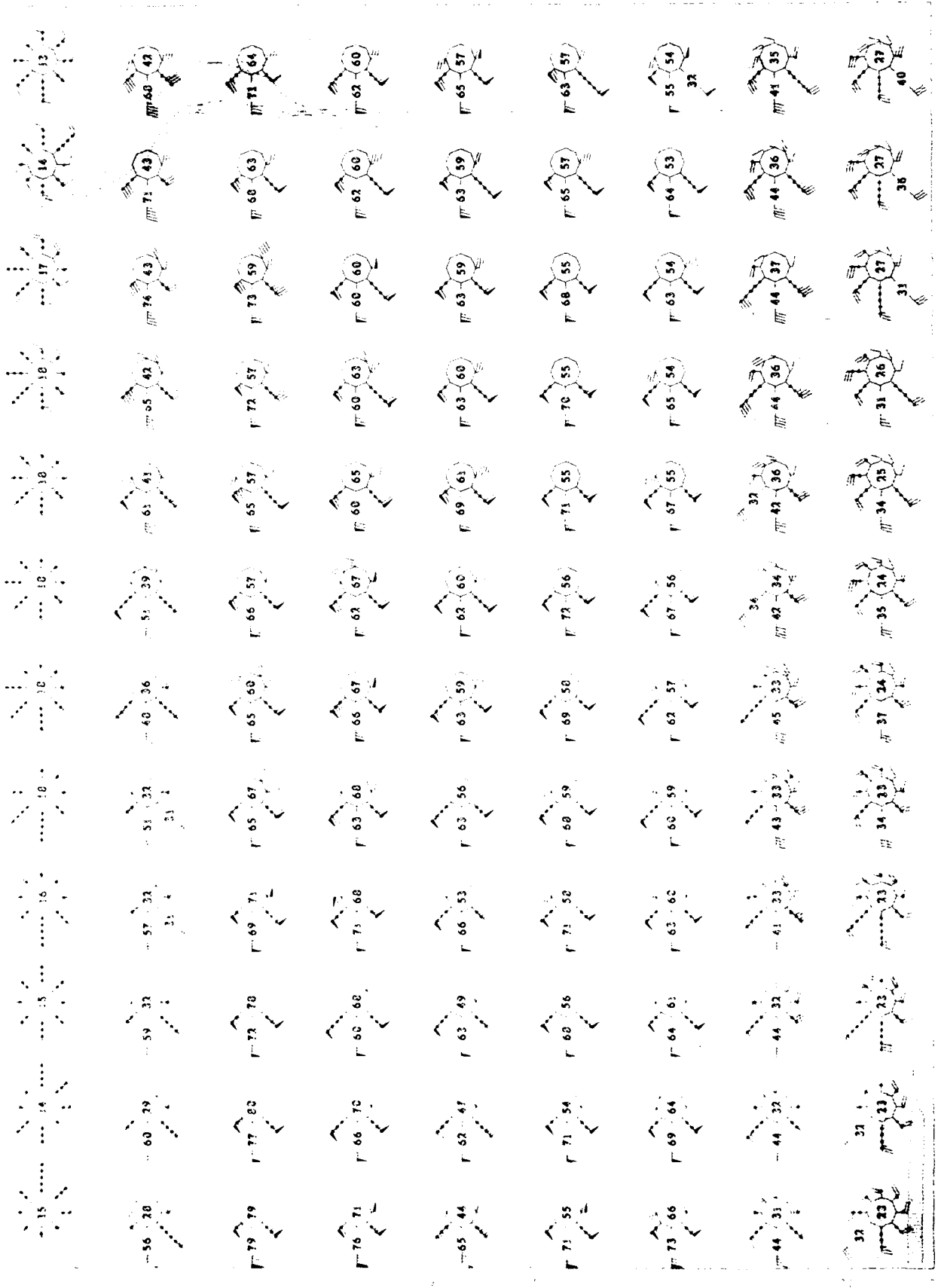


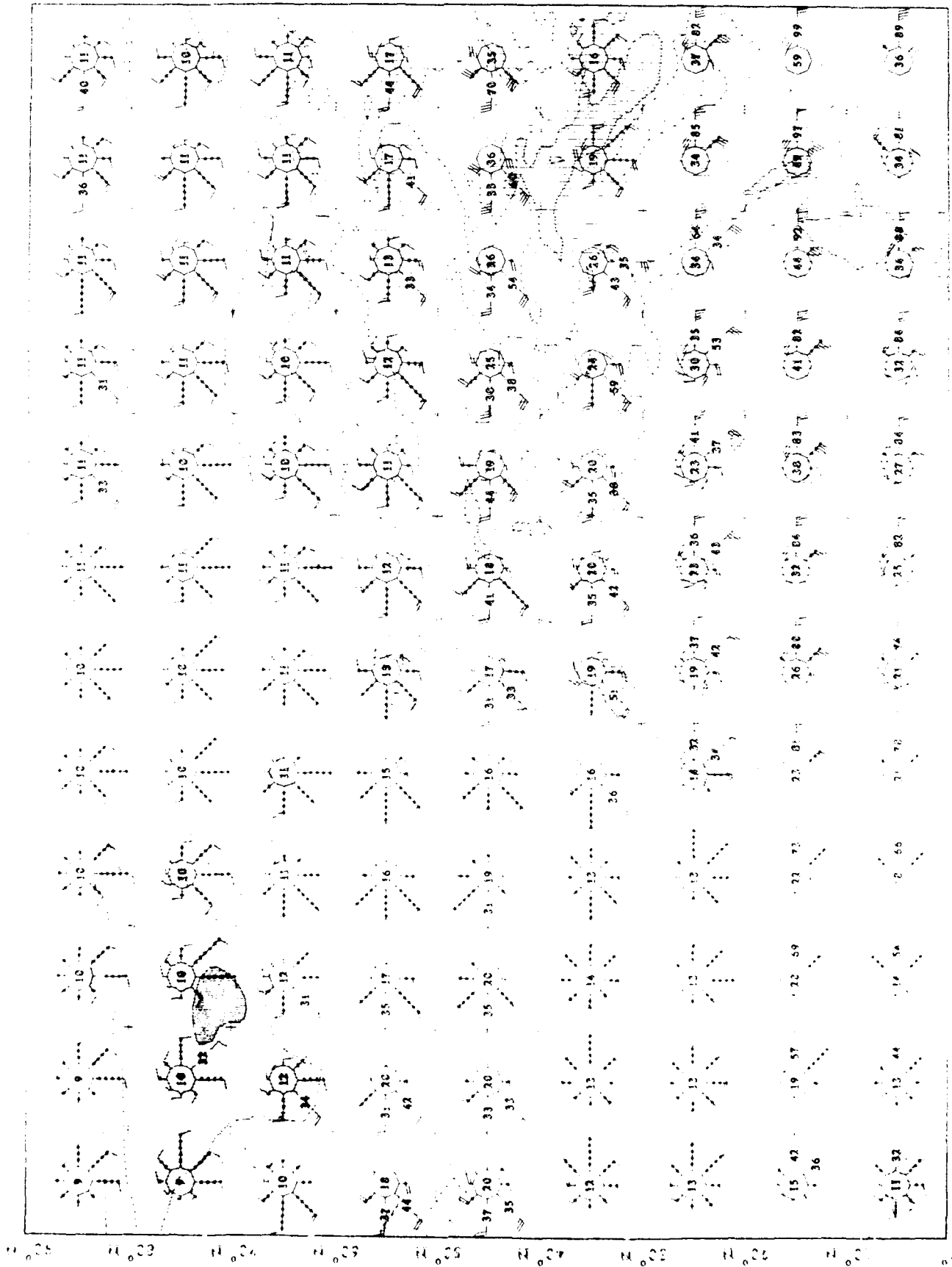
Upper Arm Chemistry  
 Crustal Hemisphere

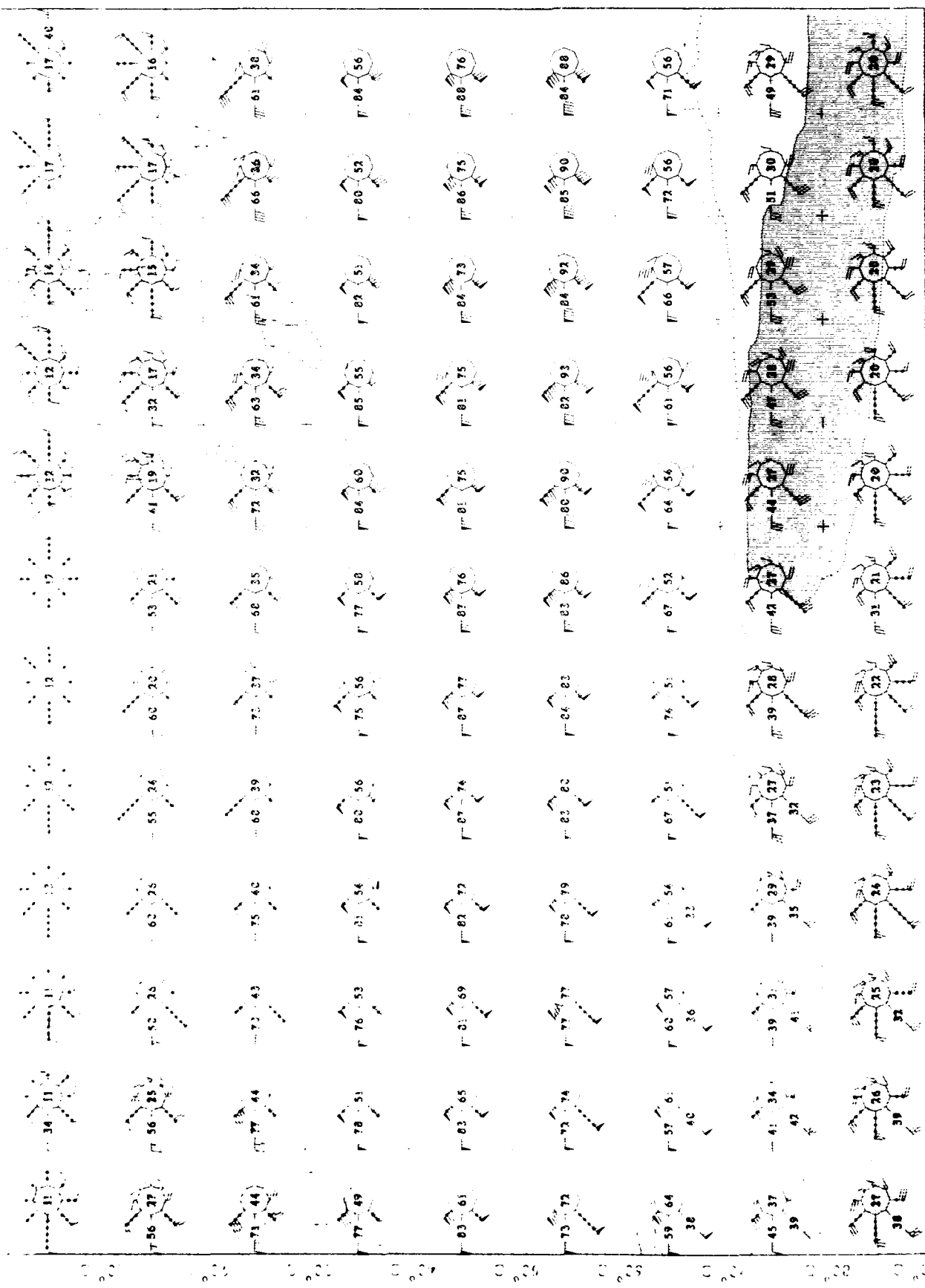
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150 M/C





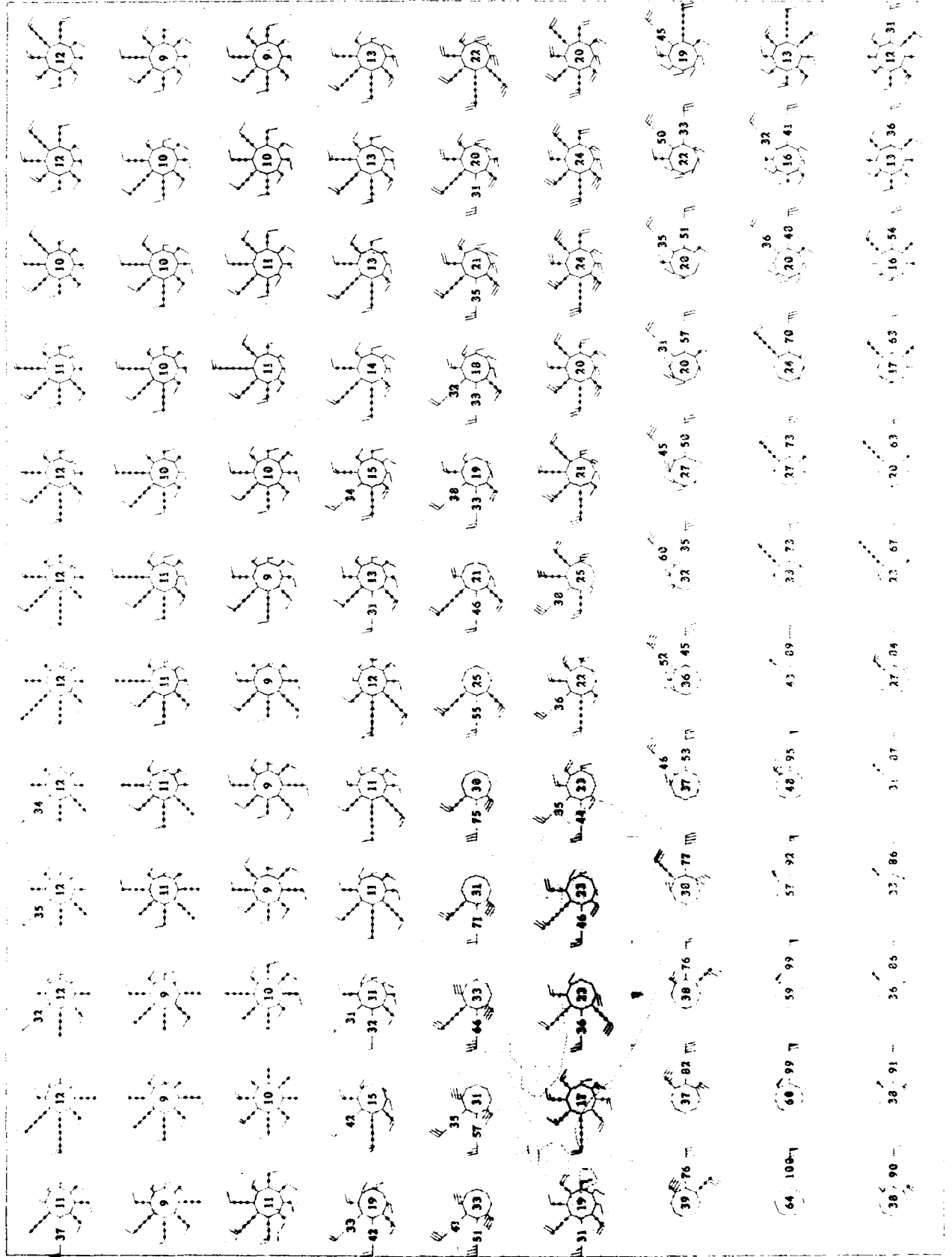


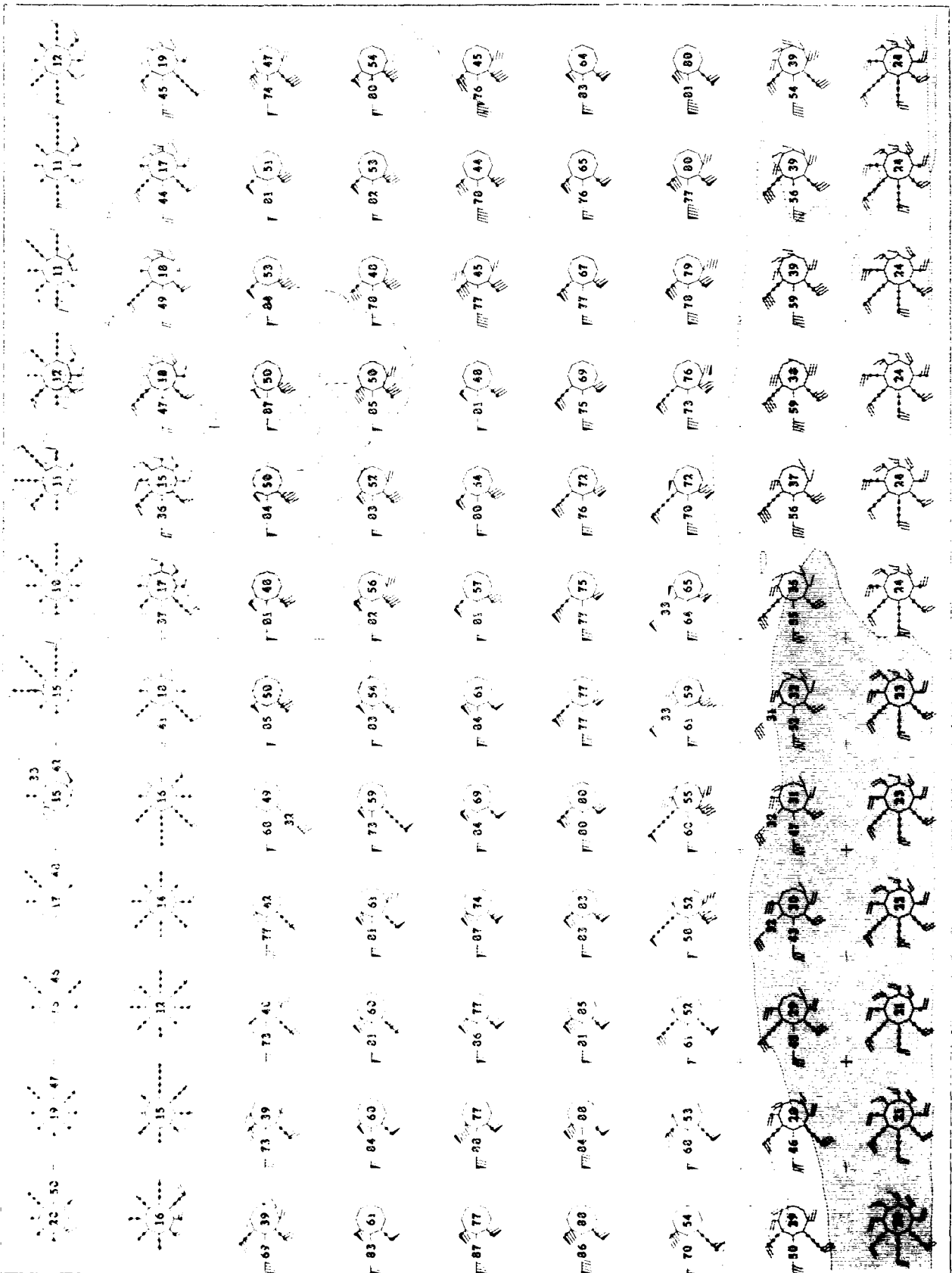


Upper Air Climatology  
 Southern Hemisphere

1950-1951

1950-1951

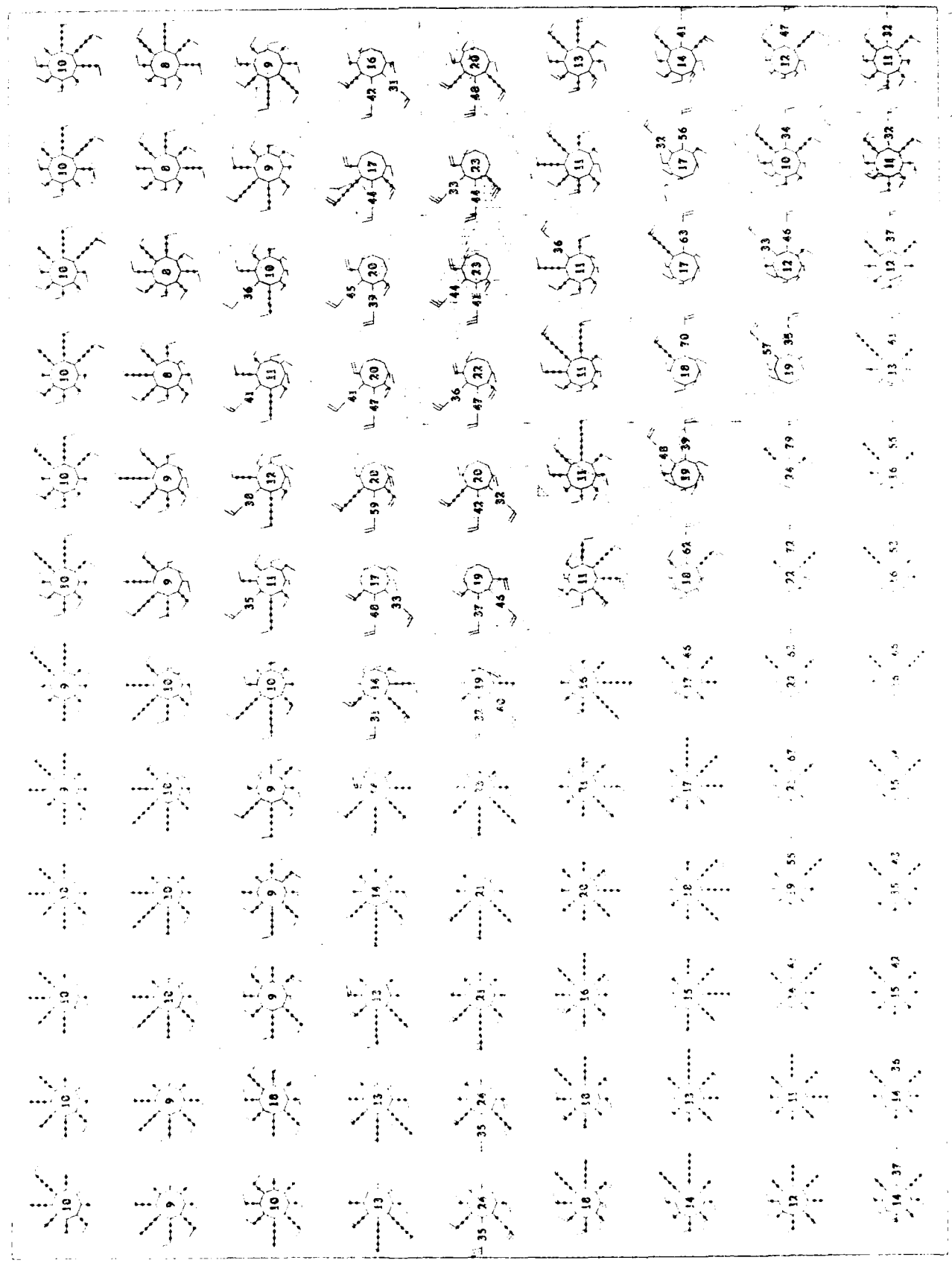


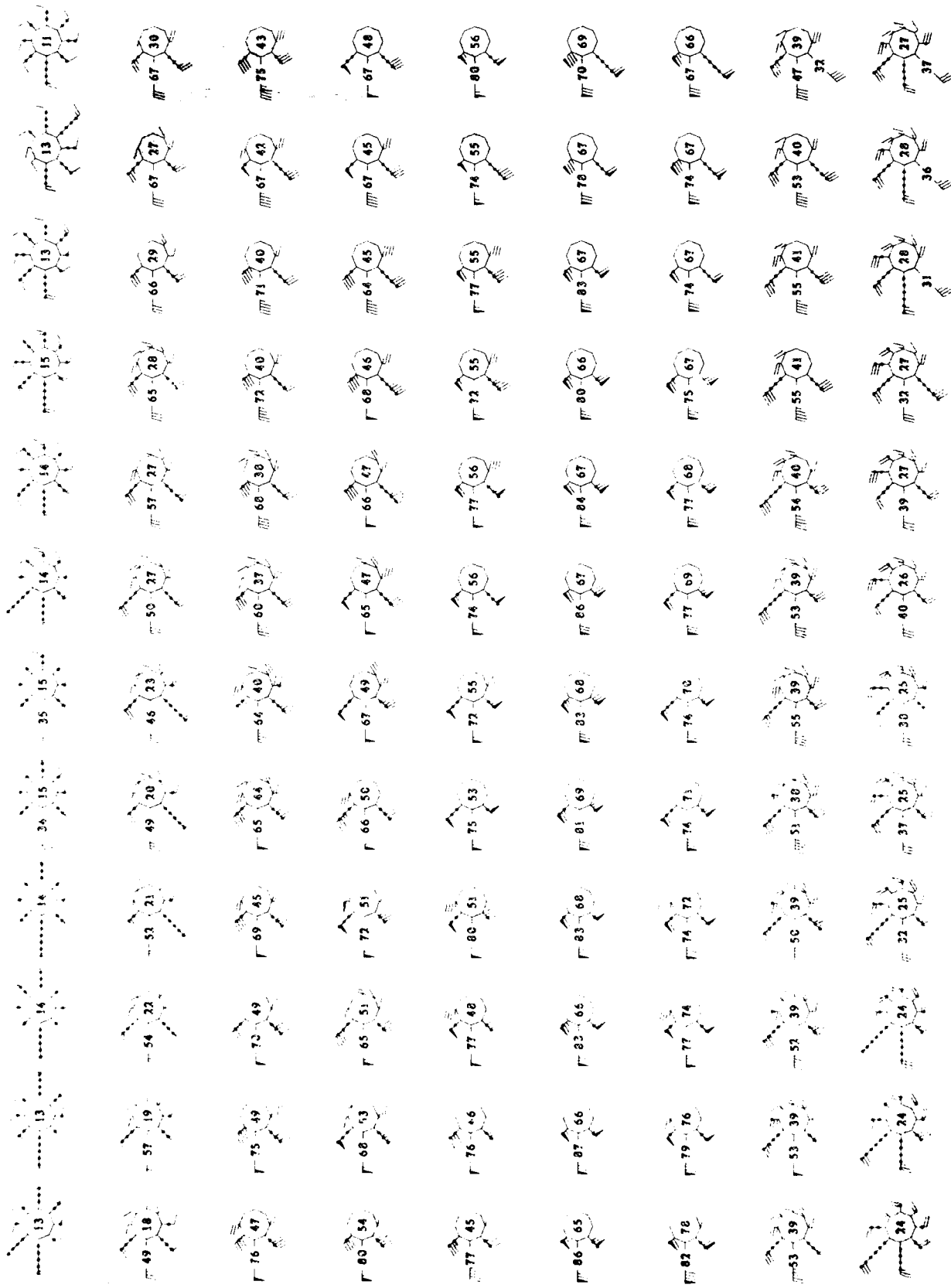


Upper Air Chiroptology  
 Geometric Hemisphere

1957

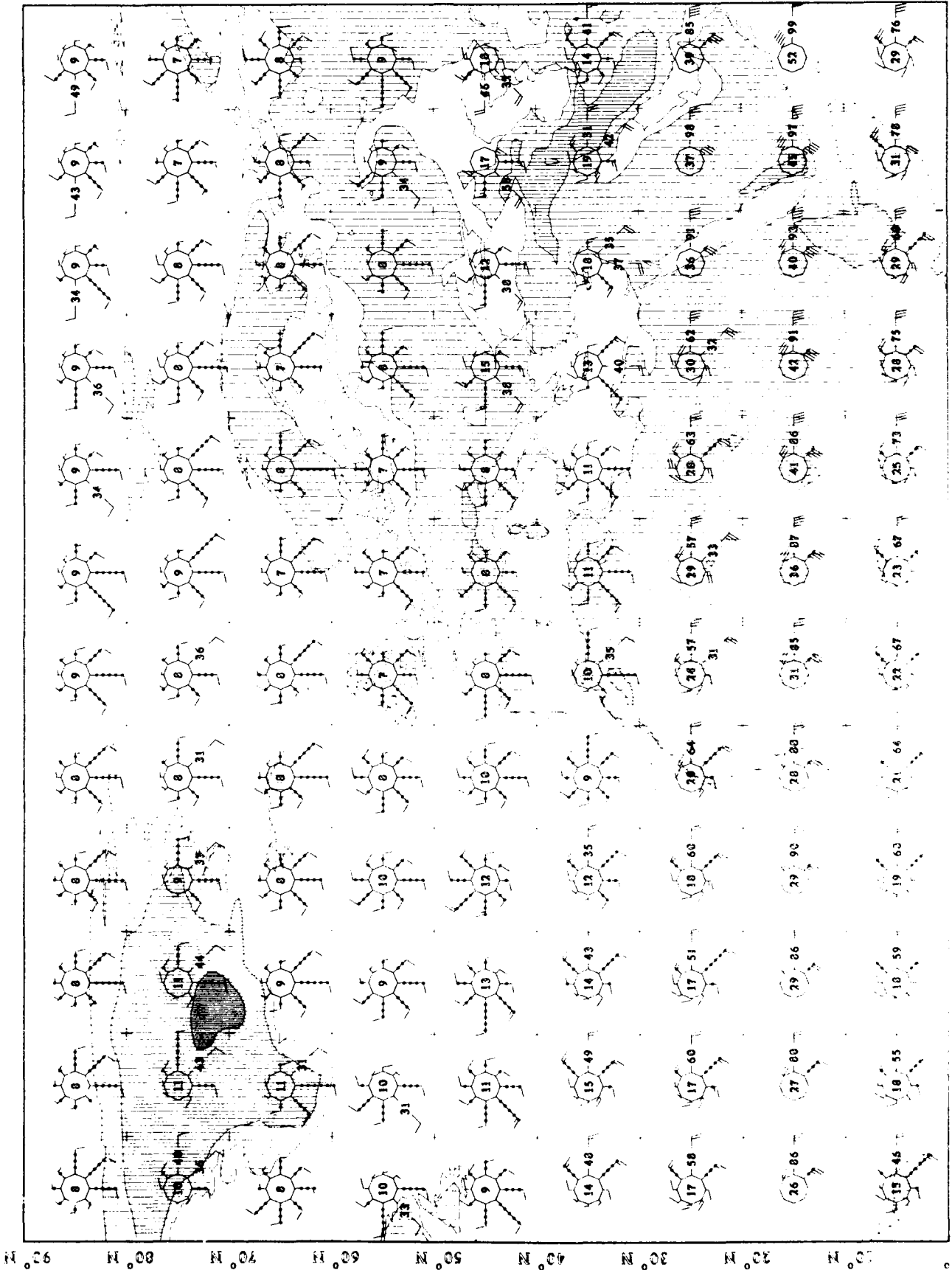
1957

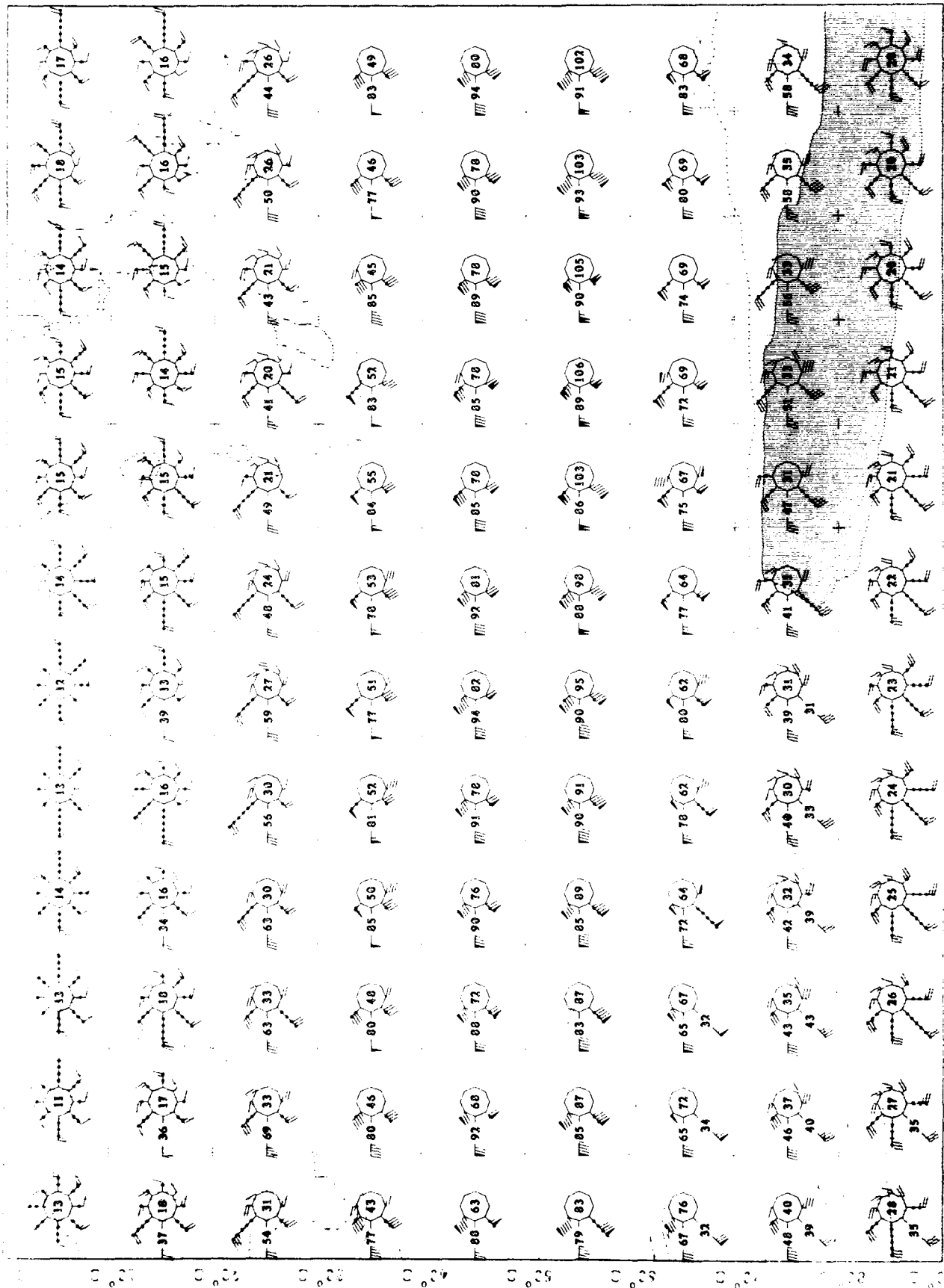




Upper Air Climatology  
Northern Hemisphere

July 700 mb  
Wind Roses

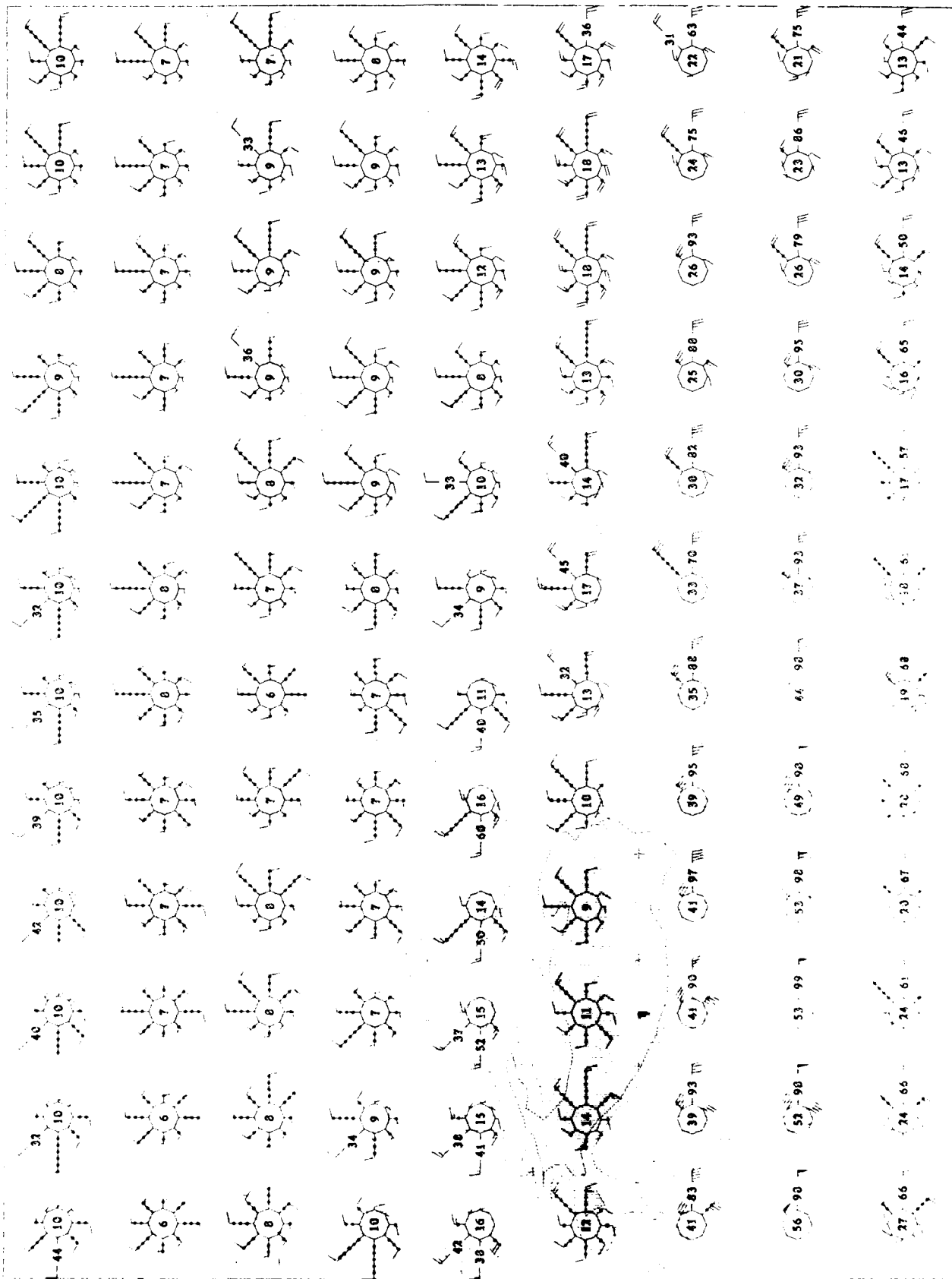


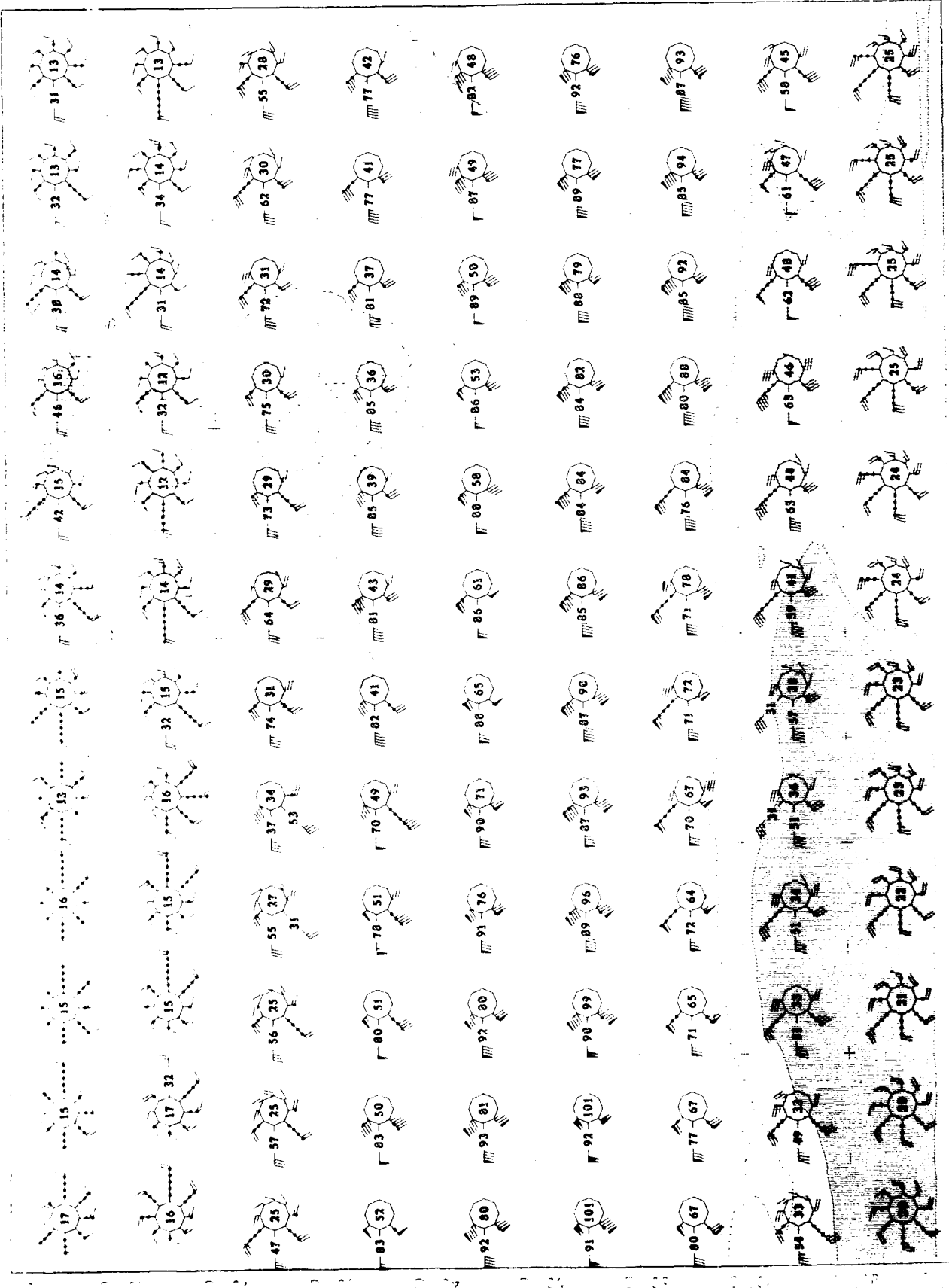


Upper Air Climatology  
Southern Hemisphere

1950-51  
1951-52

1952-53  
1953-54





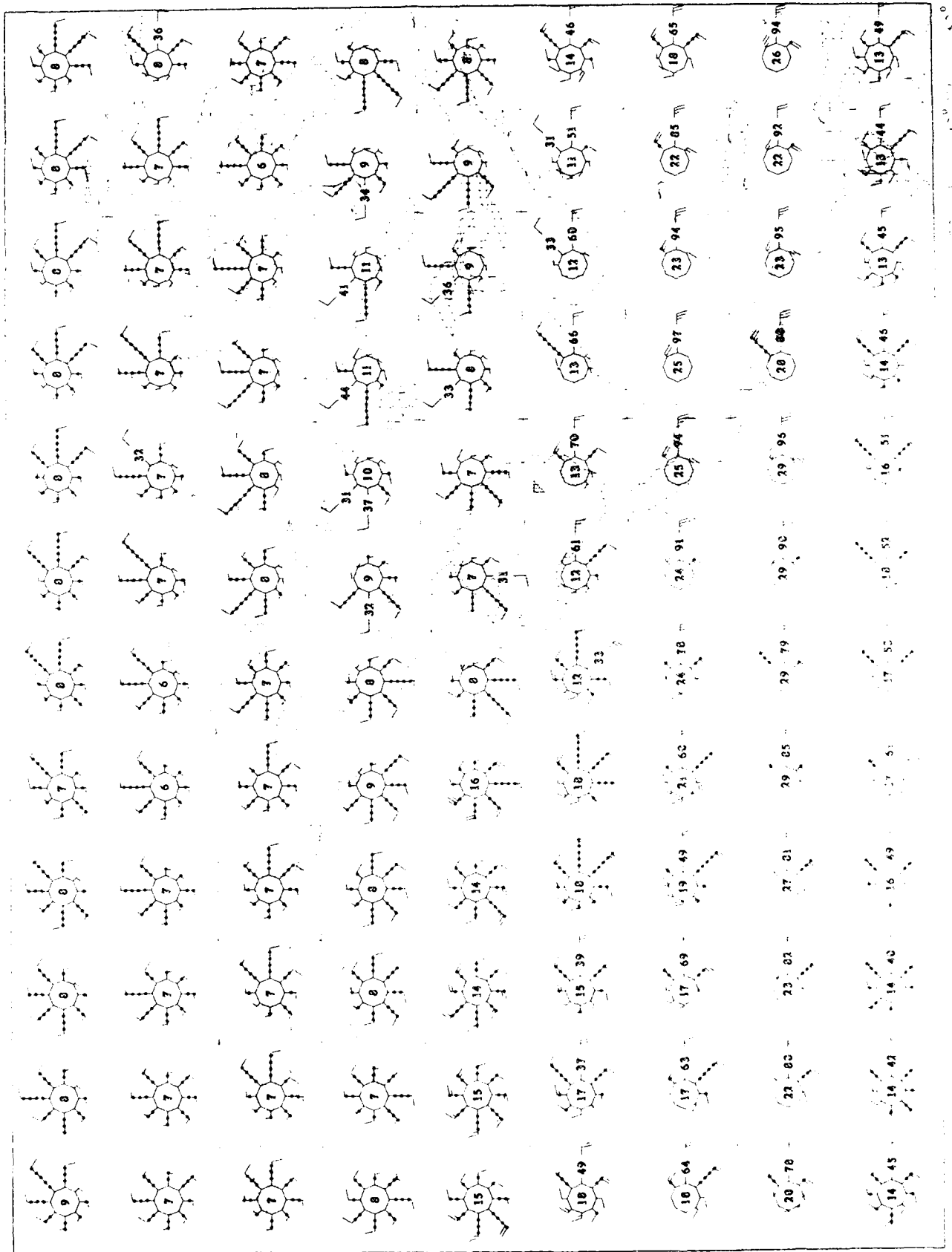
Upper Air Climatology  
Southern Hemisphere

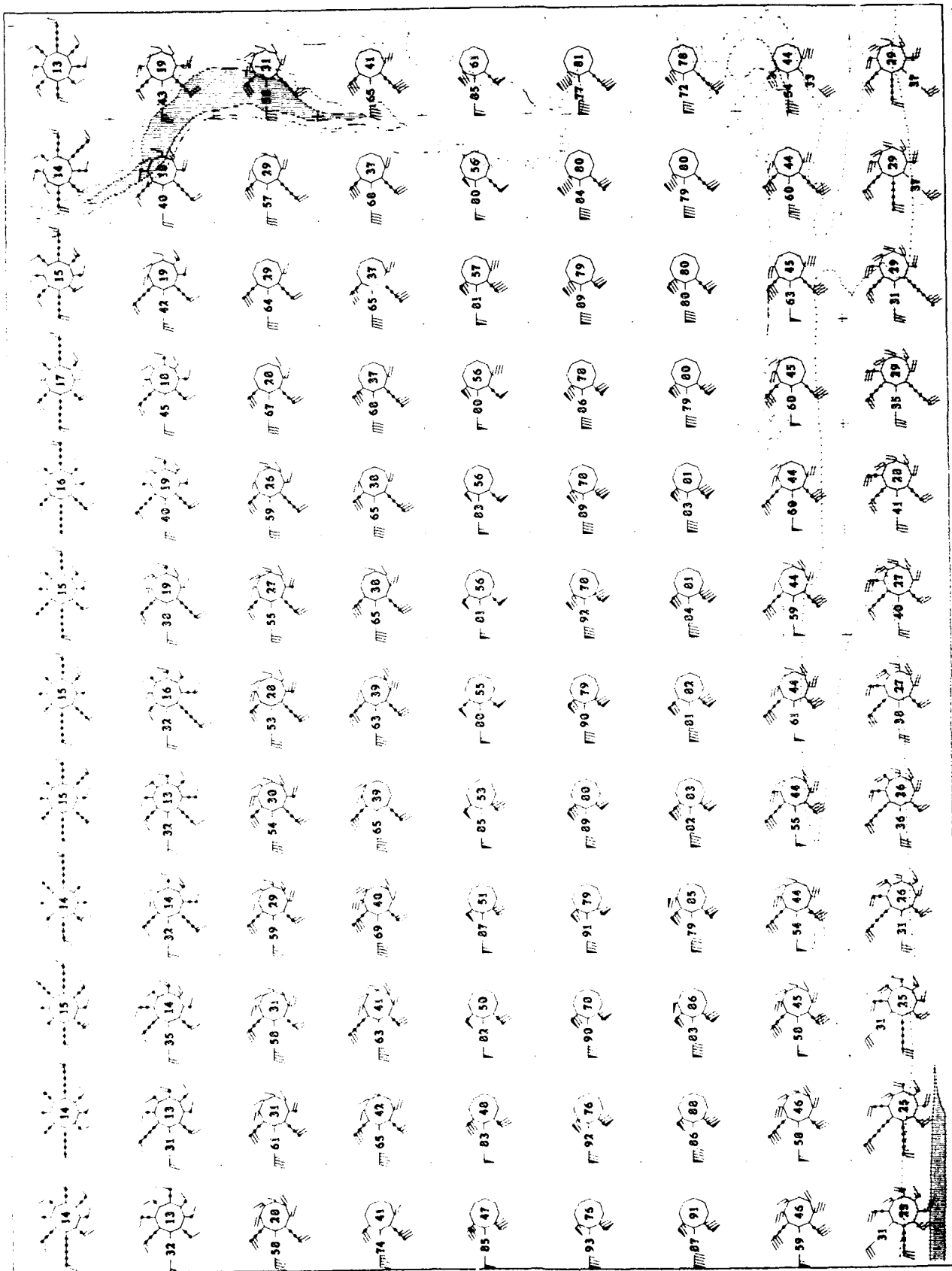
5.3.2.2  
5.3.2.3

July  
70 M<sub>2</sub>

1931 and 1932  
Northern Hemisphere

1931 and 1932  
Northern Hemisphere





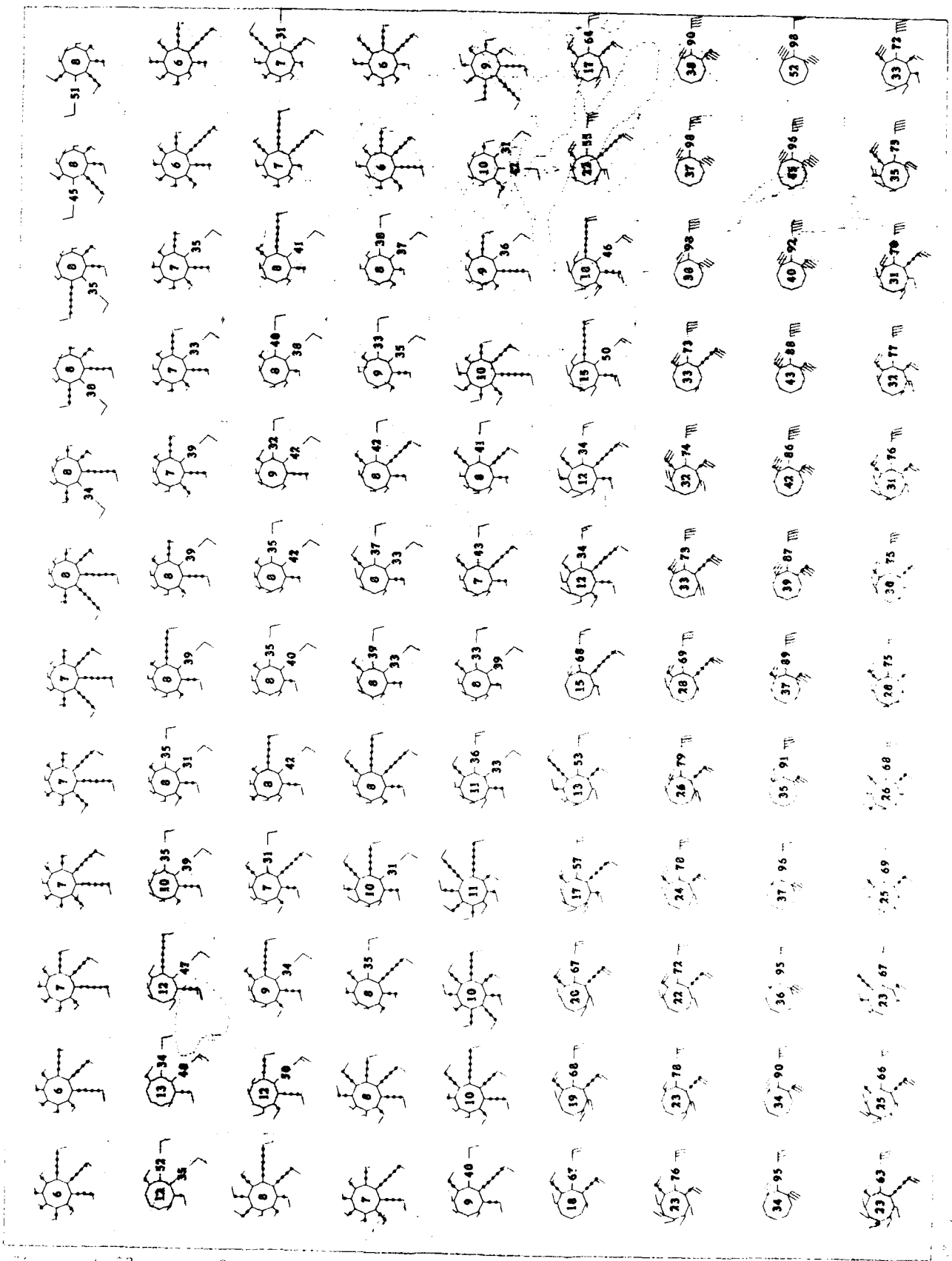
Upper Air Climatology  
Southern Hemisphere

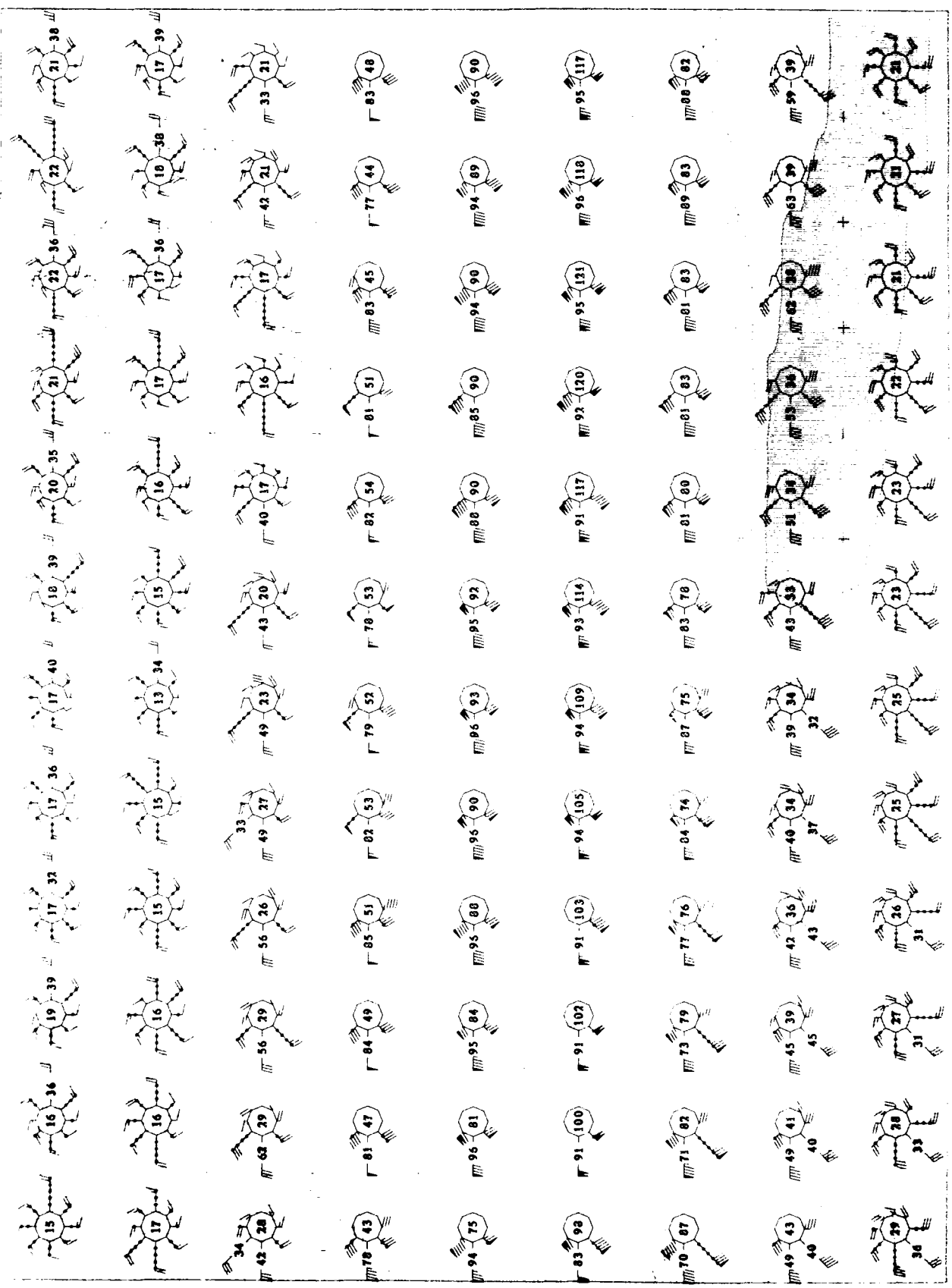
July 70  
70 245

SC 1112

Upper Air Climatology  
Northern Hemisphere

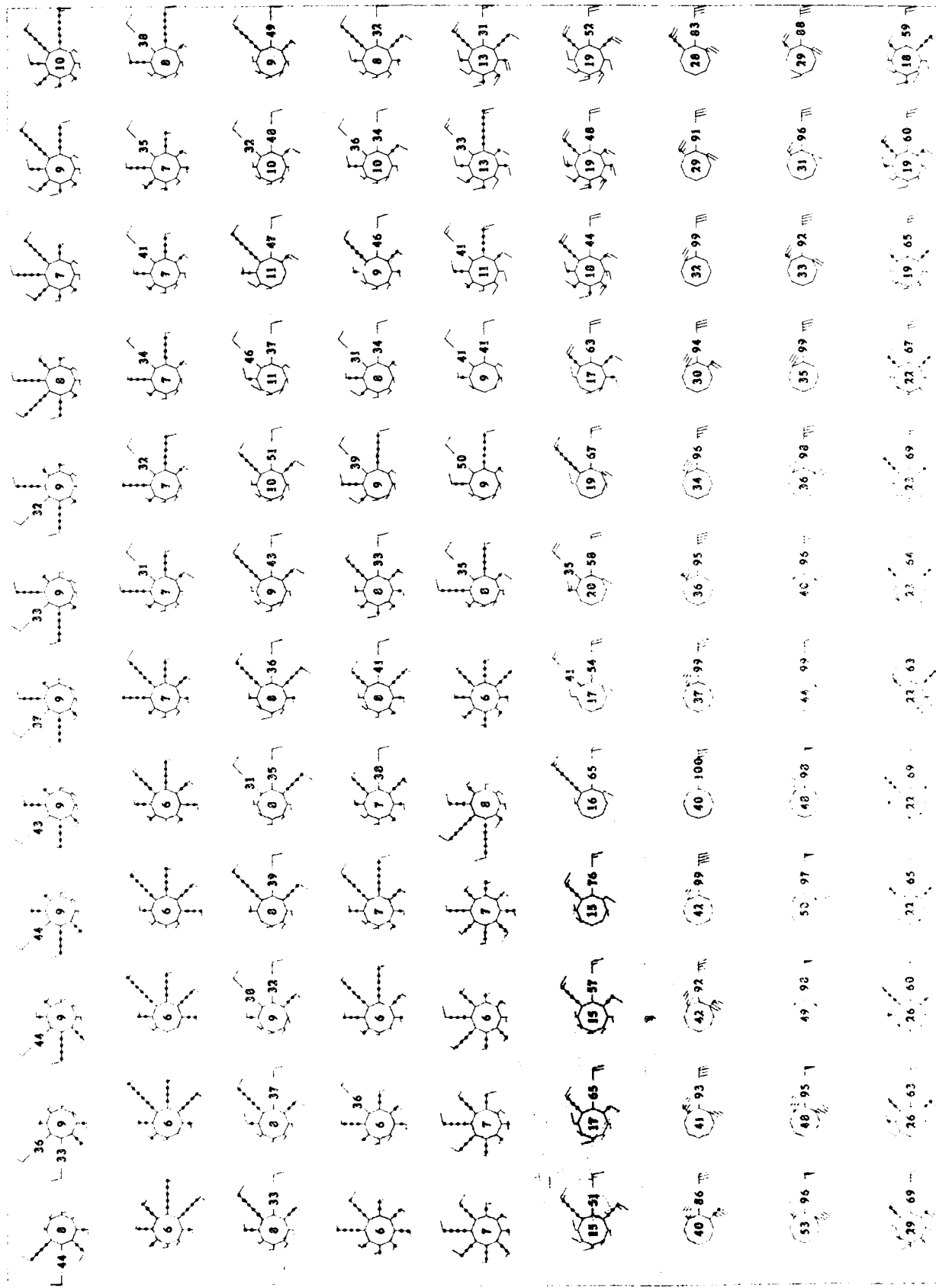
Upper Air Climatology  
Northern Hemisphere

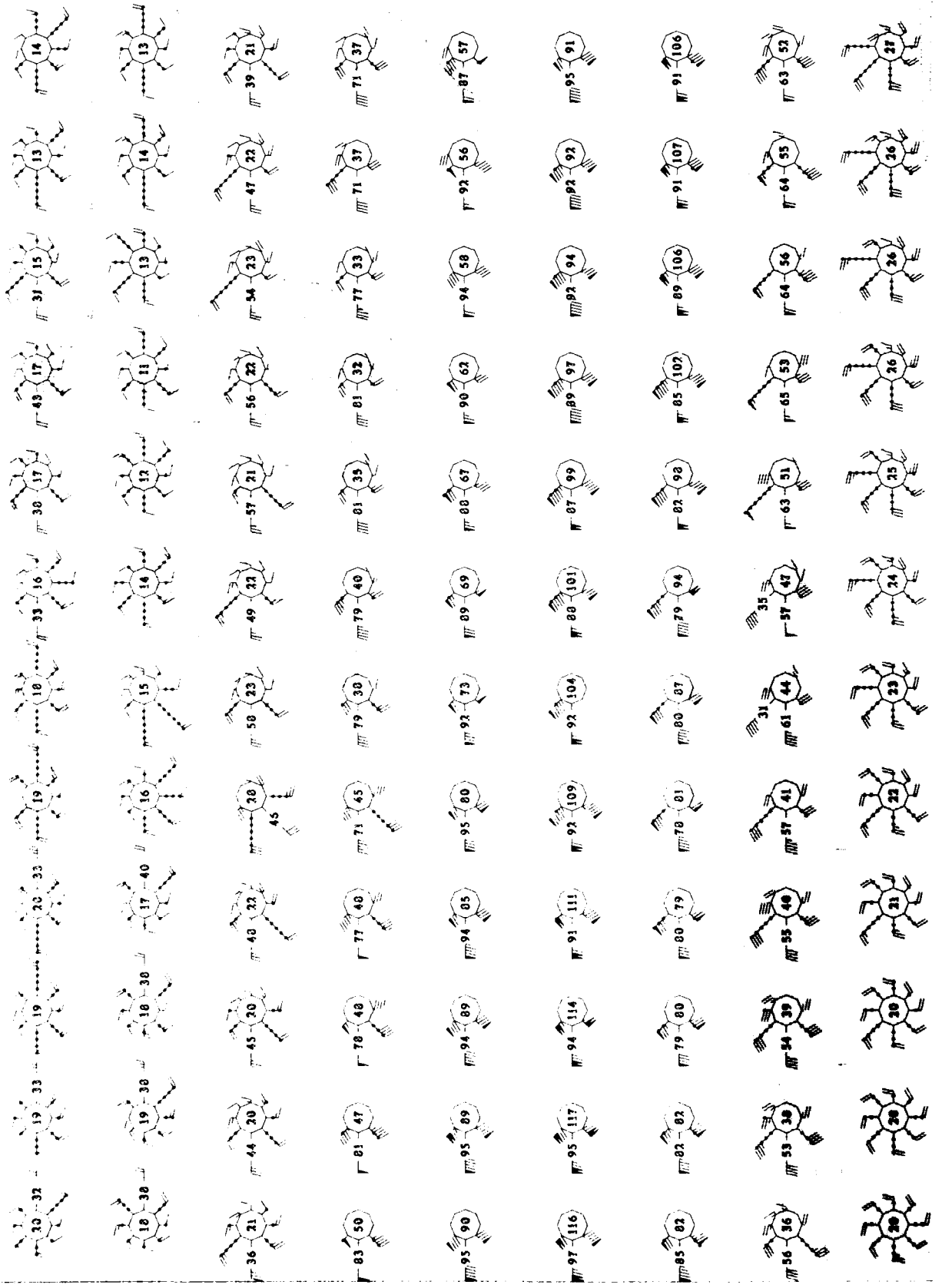




Upper Air Climatology  
Northern Hemisphere

500 mb  
Wind Roses

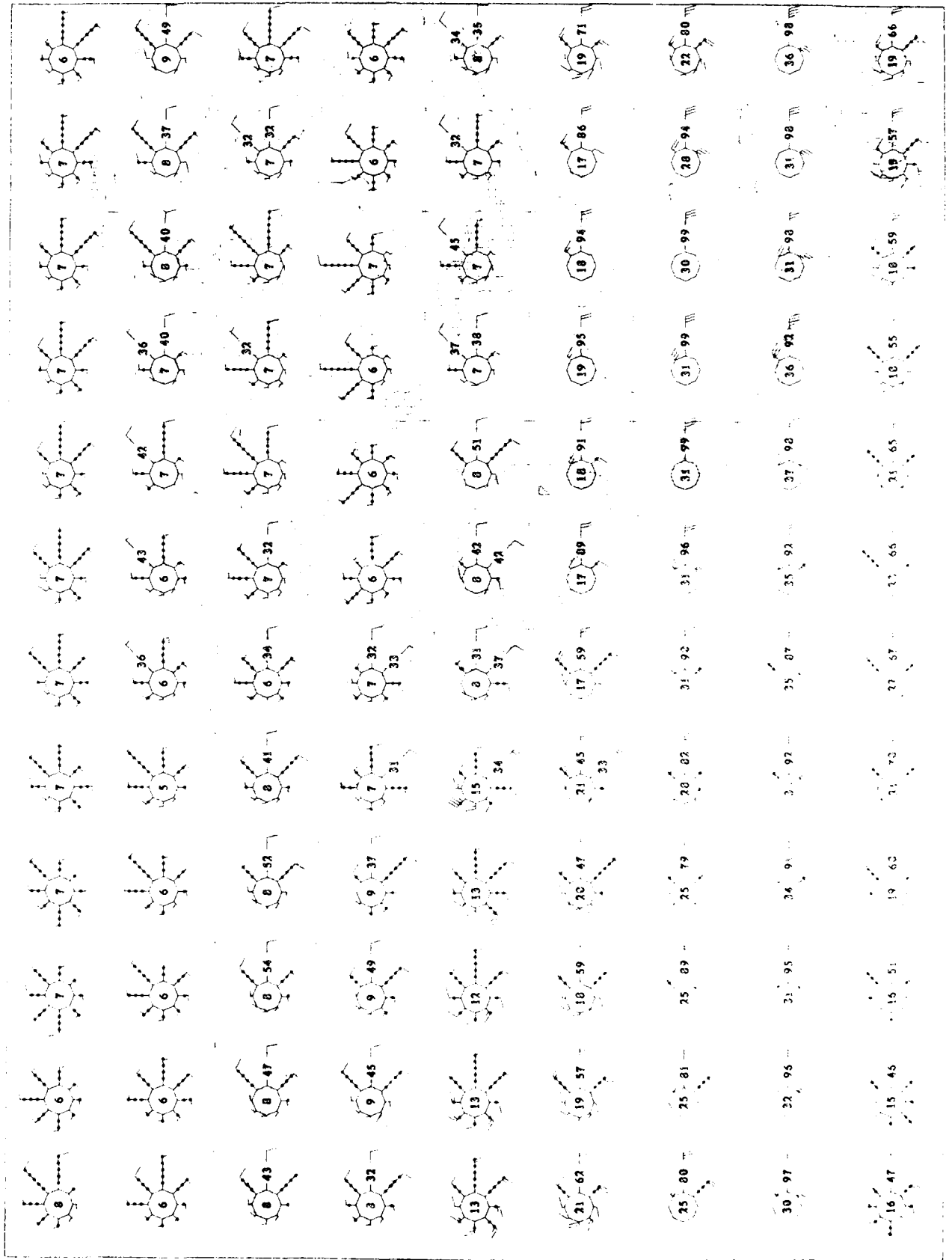


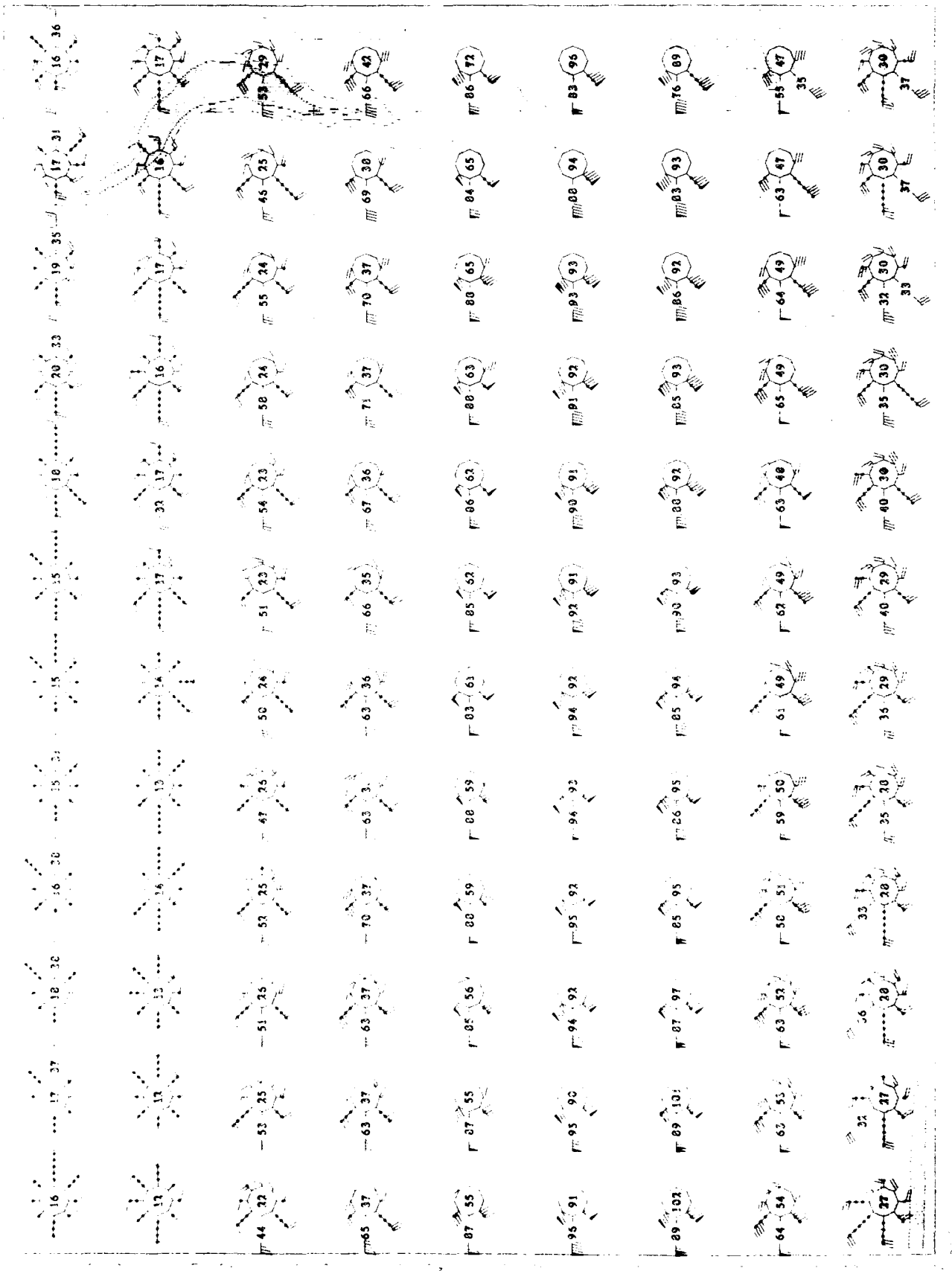


July  
50 Miles

July 1950  
White House

Upper Air Climatology  
Northern Hemisphere

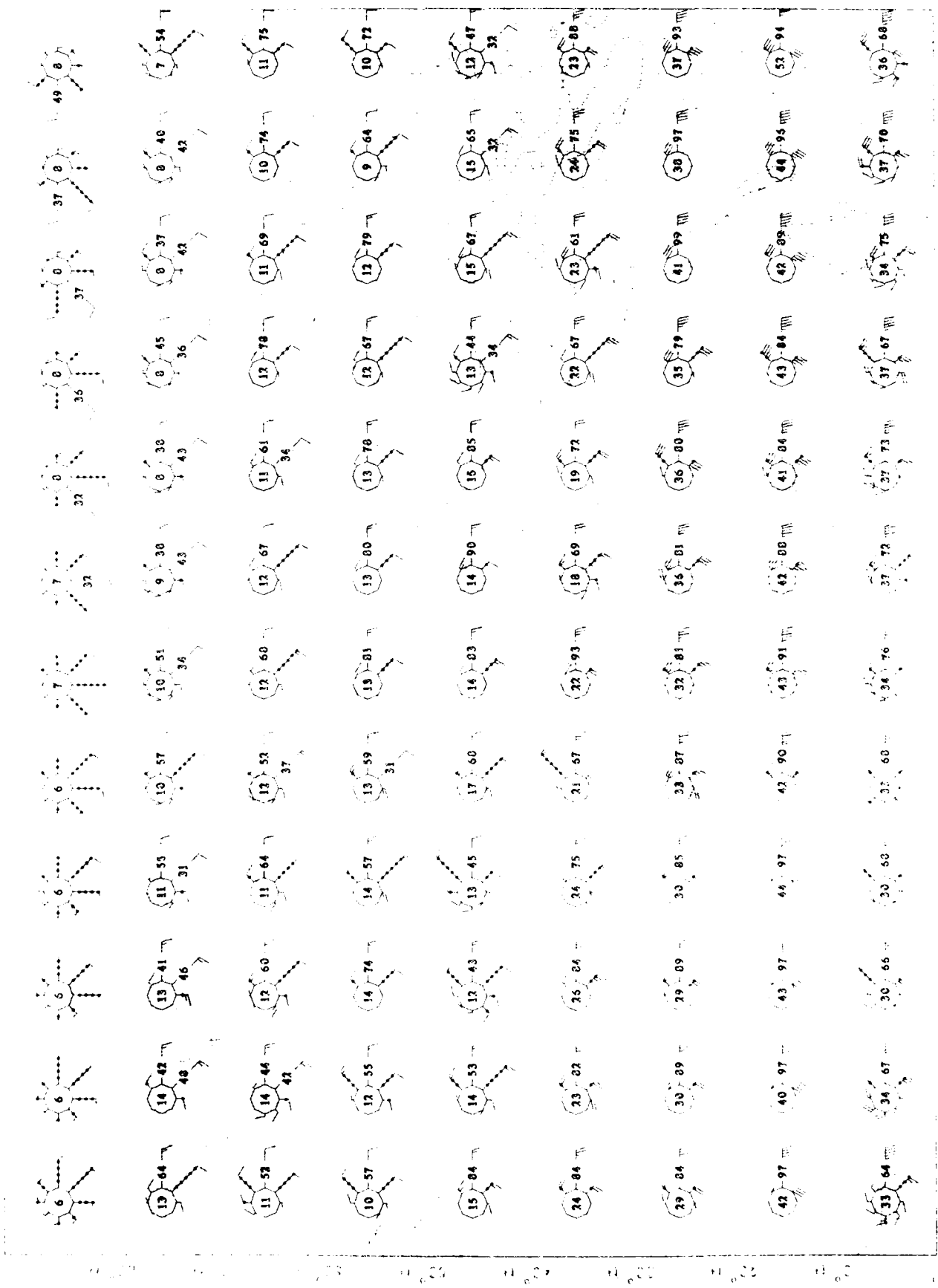


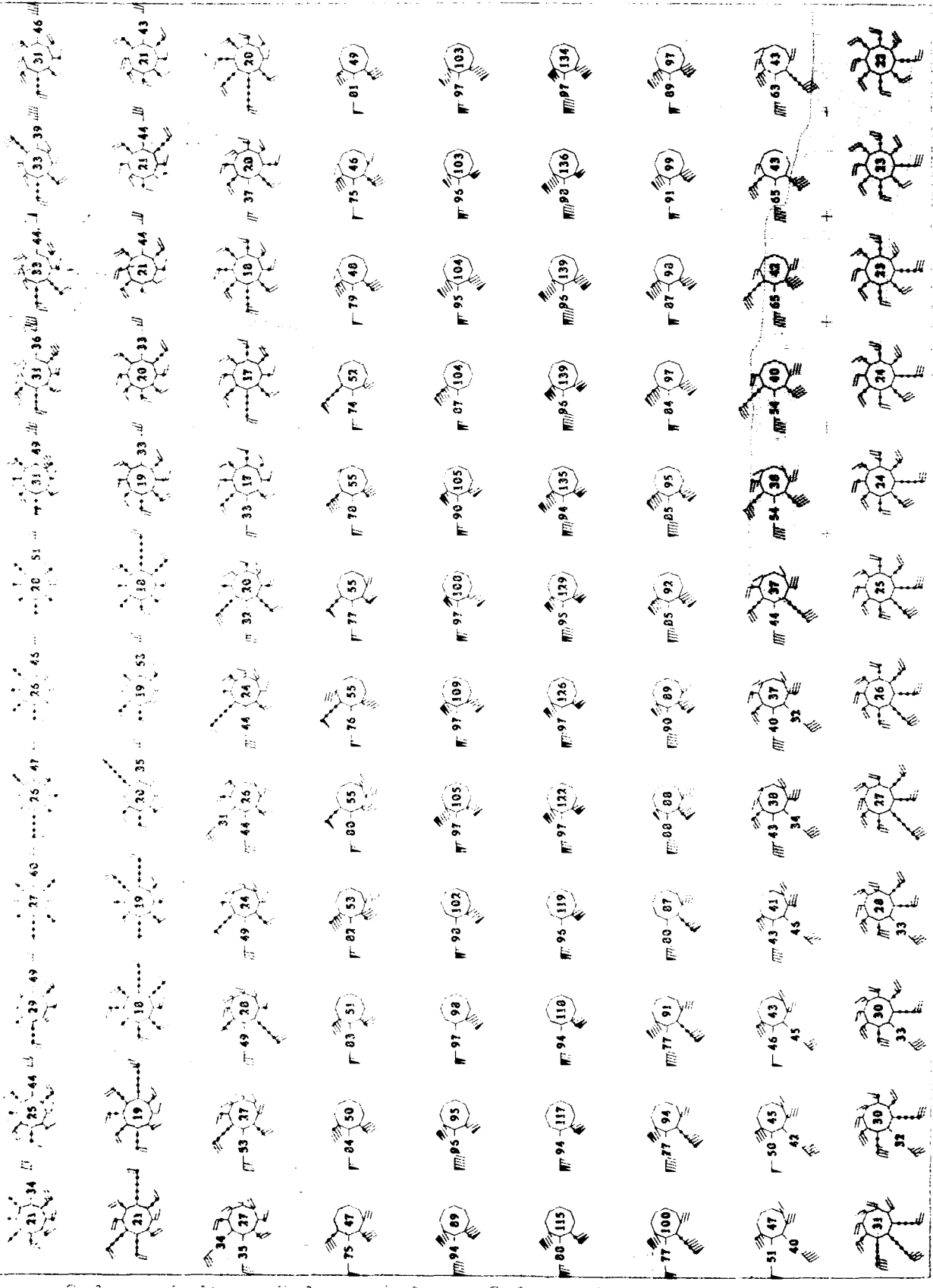


Upper Air Climatology  
Southern Hemisphere

1960-1961

1960-1961

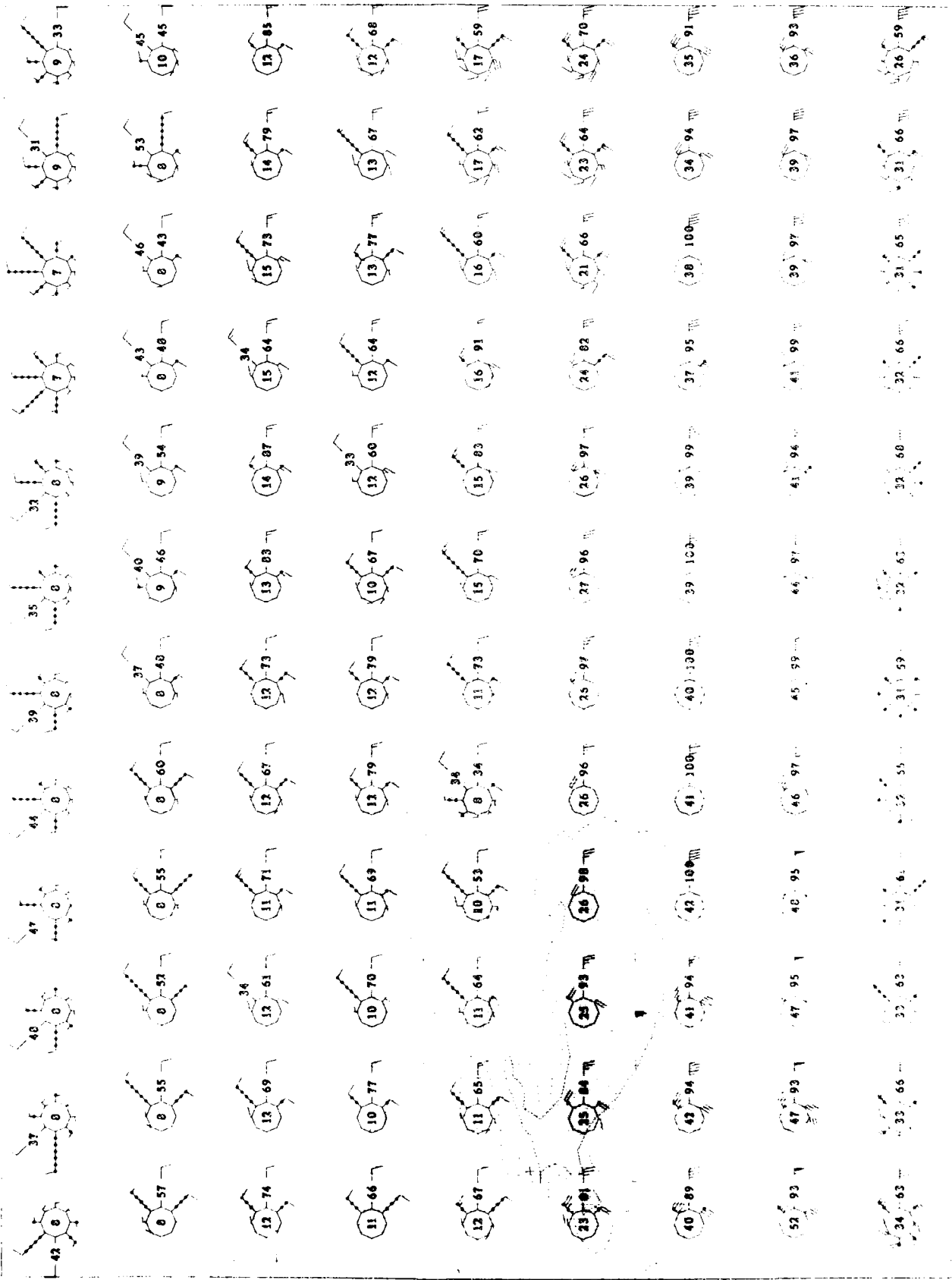


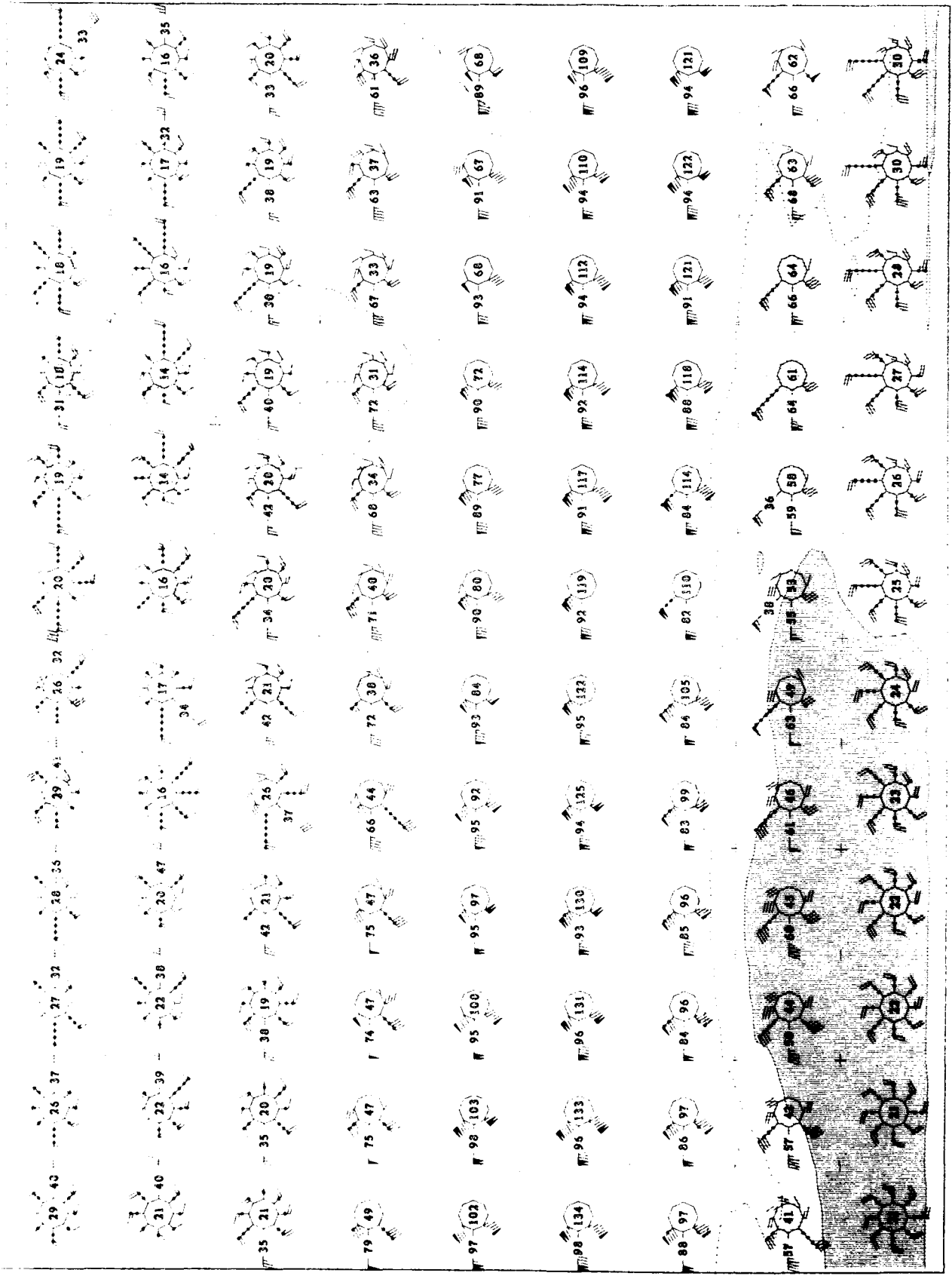


Upper Air Climatology  
 Southern Hemisphere

July 1953

July 30 ME

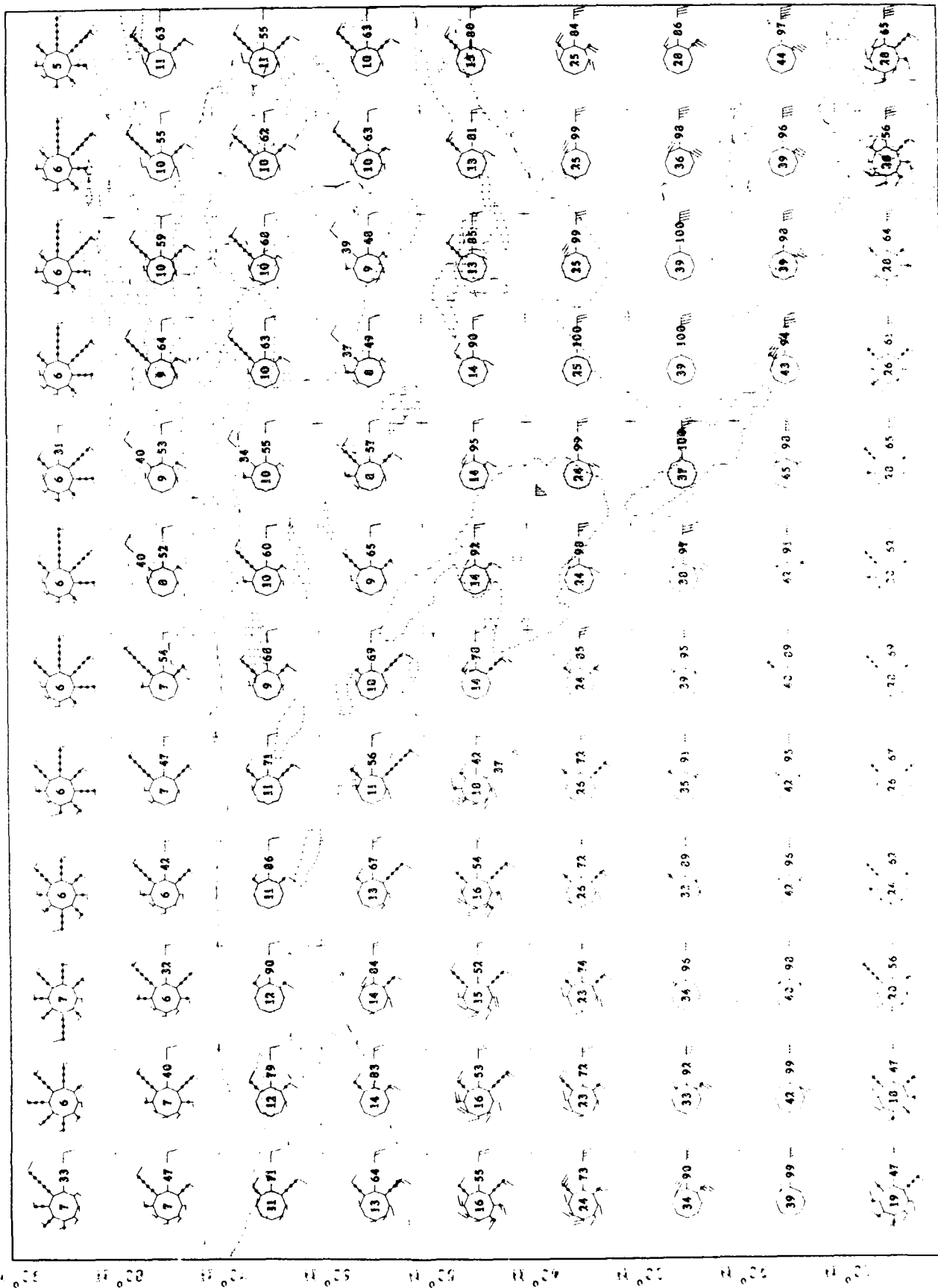




Upper Air Climatology  
 Southern Hemisphere

1950-1955

1950-1955



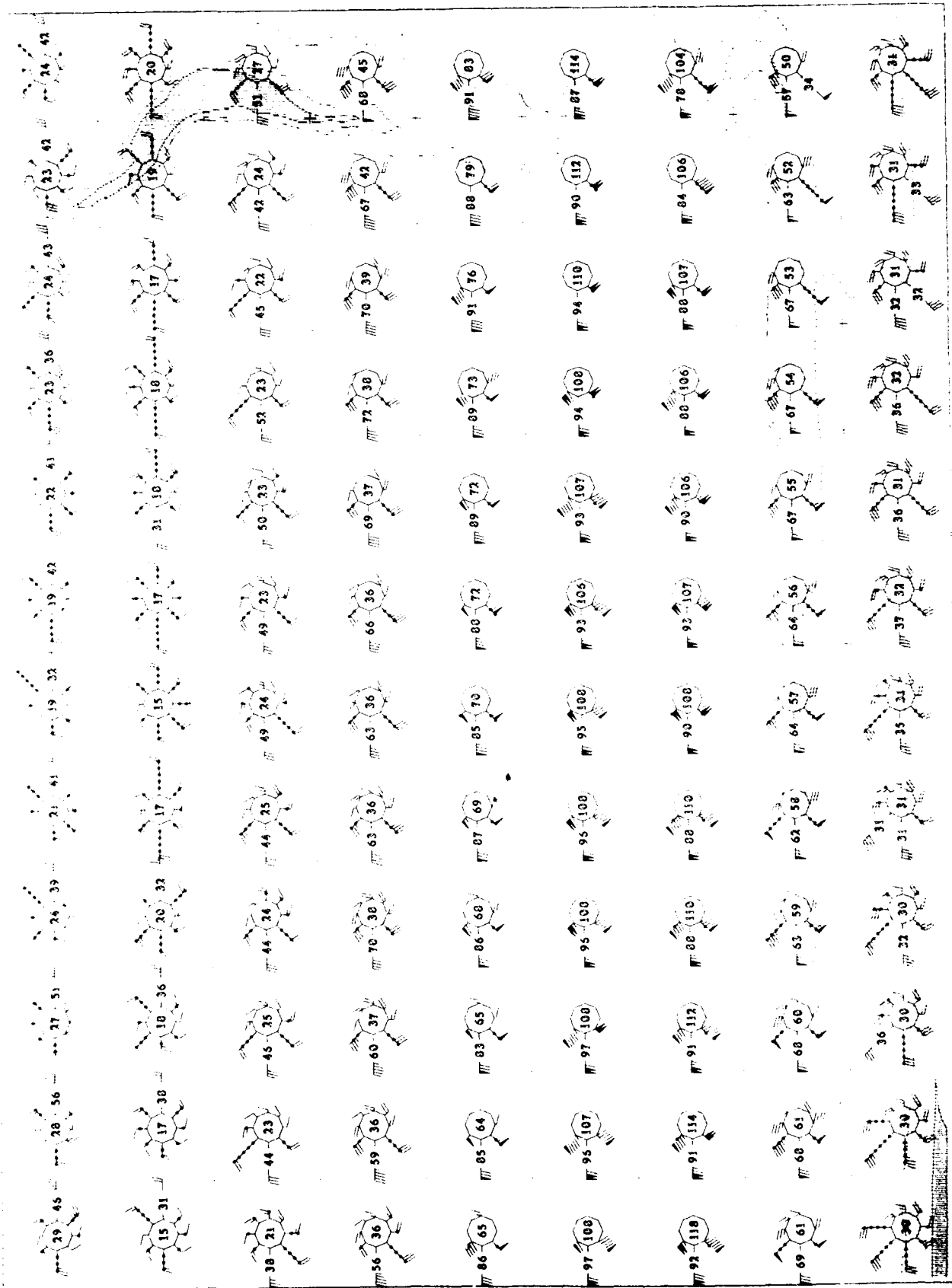


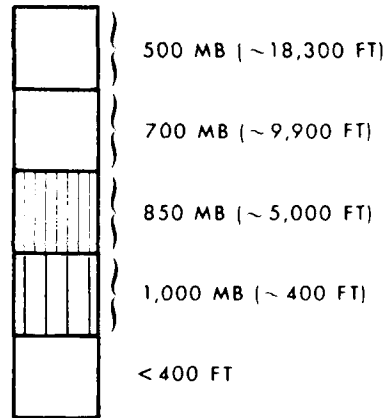
Figure 10: A grid of interconnected nodes, each with a central circle containing a number and four limbs. The nodes are arranged in a grid, with some nodes connected by dashed lines. The numbers in the nodes range from 15 to 114.

July  
1945

**JET STREAM  
(10 LEVELS, 500 TO 30 MB)**

- Contours of mean scalar wind speed in knots
- Minimum mean scalar speed: 50 knots
- Contour interval of mean scalar speed: 25 knots

**ELEVATION SCALE**



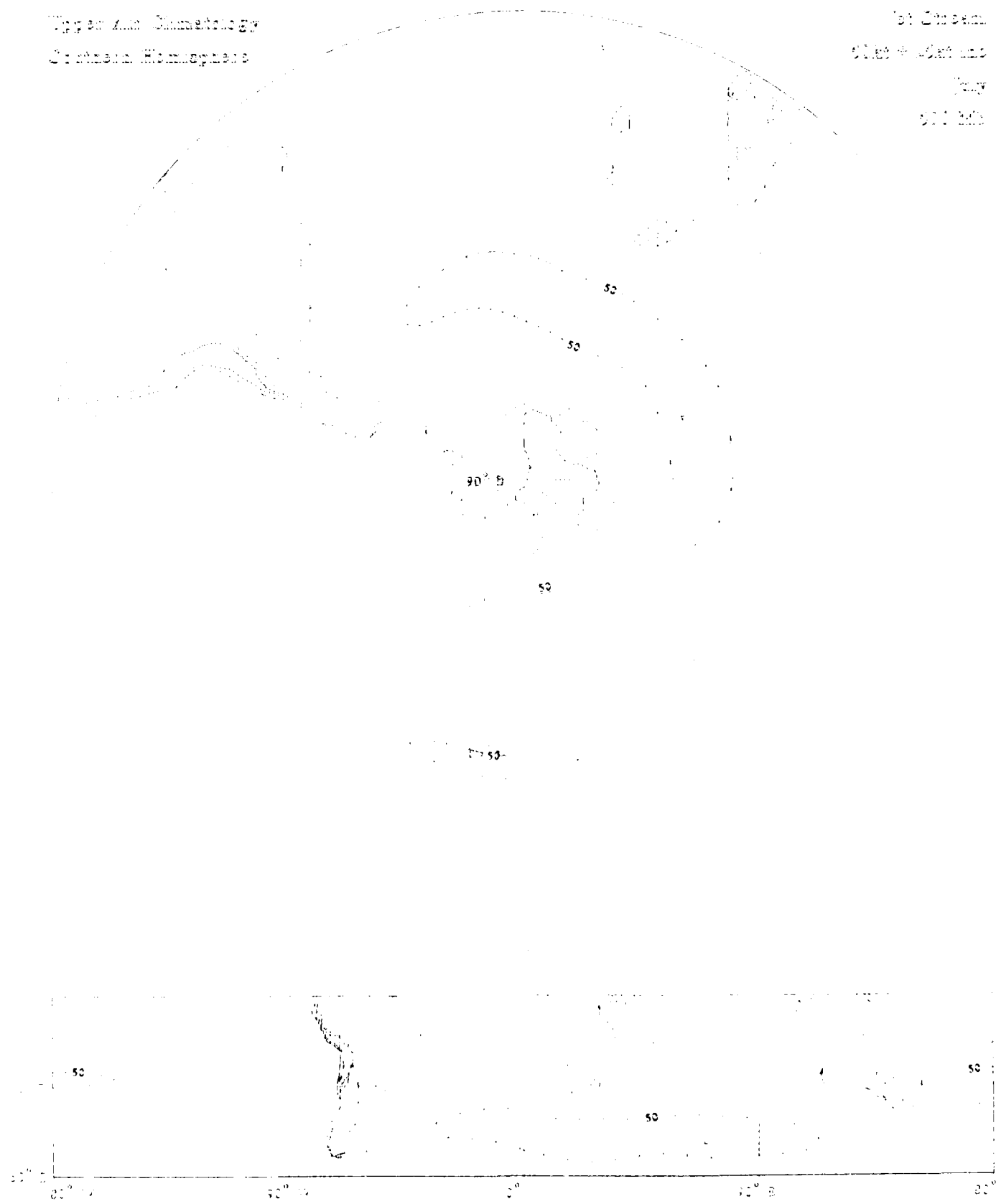
10. Stream  
0.1m + 0.5m  
100  
0.1m

Upper Air Climatology  
Northern Hemisphere

Wind = 50 KT

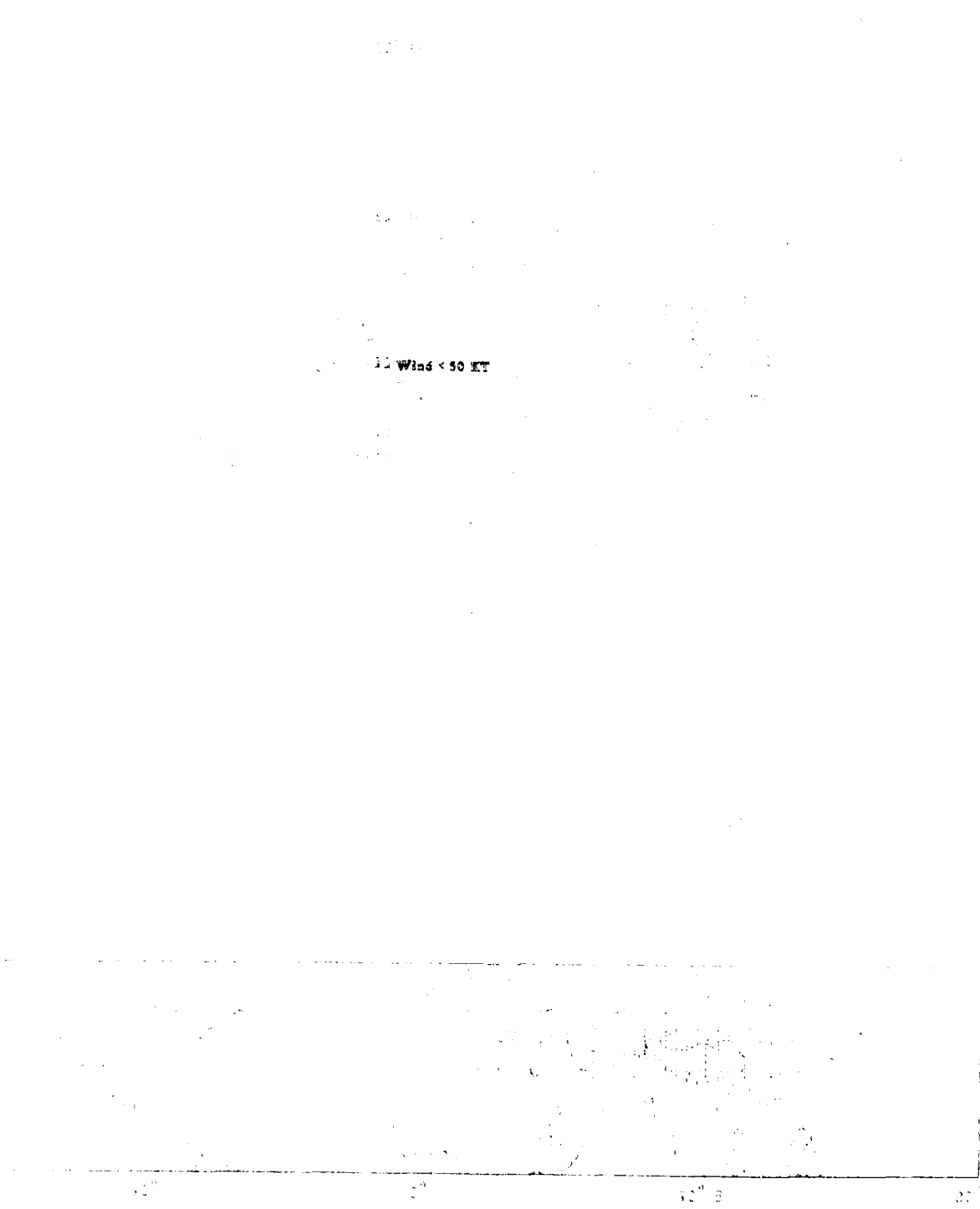
Typen zur Klimatologie  
Südlicher Hemisphäre

1st. Südsee  
2. Mittelmeer  
3. Ind. Ozean  
4. Südatl.



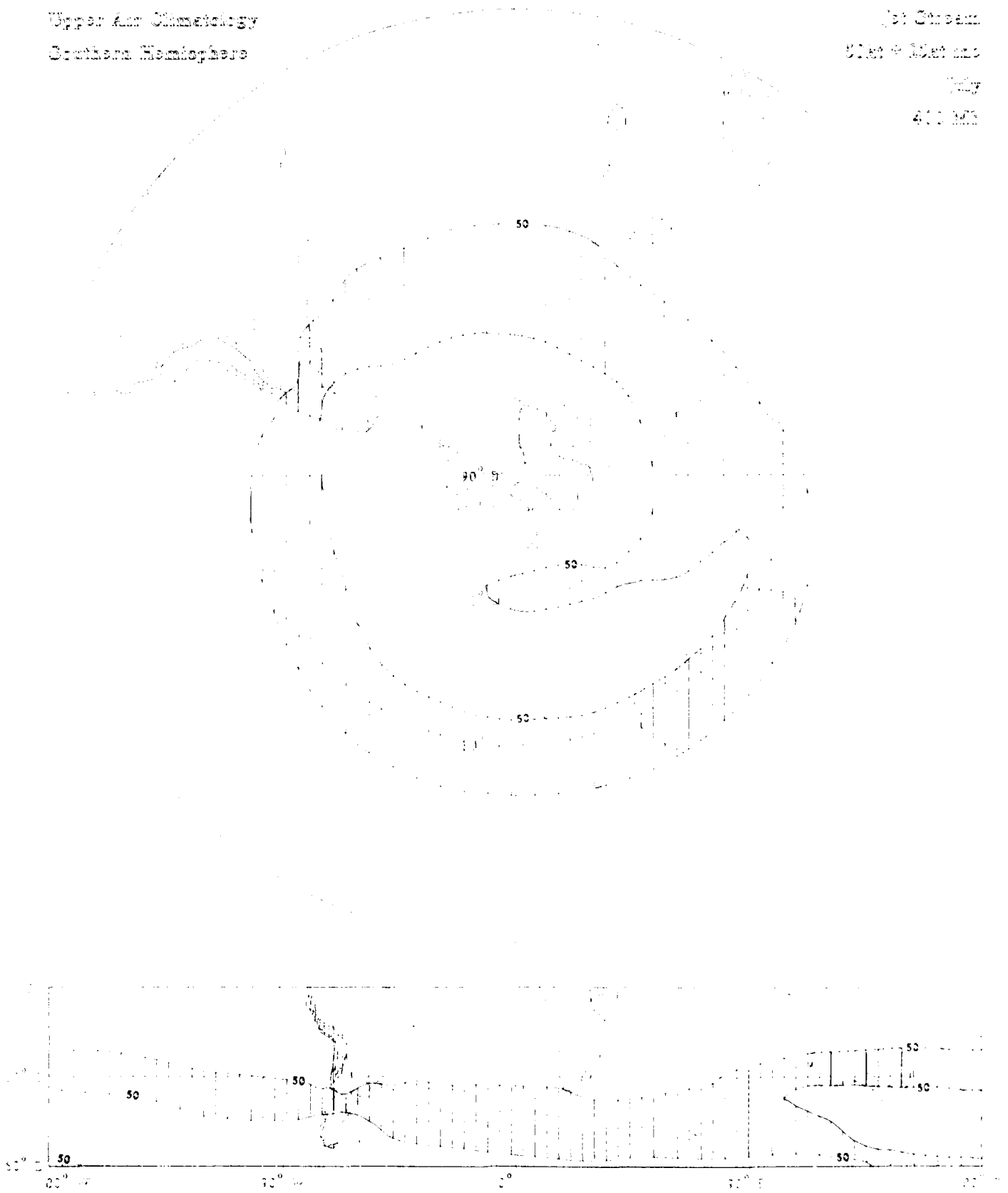
31 Stream  
30kt + 35kt and  
July  
400 MB

Upper Air Climatology  
Northern Hemisphere



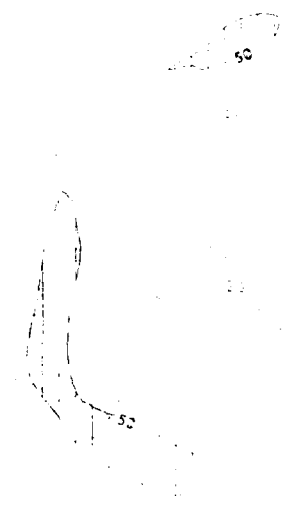
Upper Air Climatology  
Southern Hemisphere

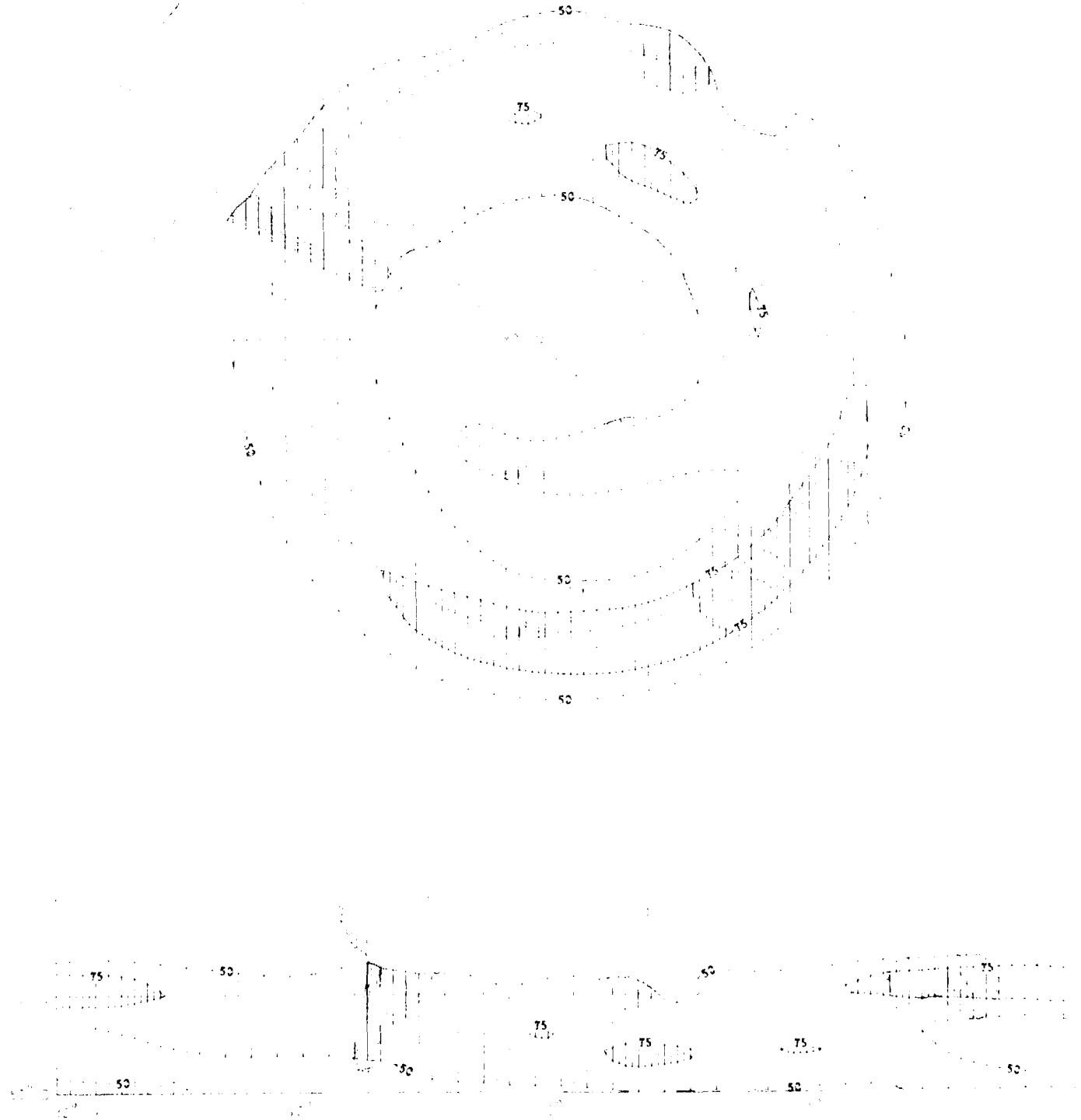
Jet Stream  
500 hPa  
July  
400 MB



1st Stream  
2nd + 3rd and  
July  
1912

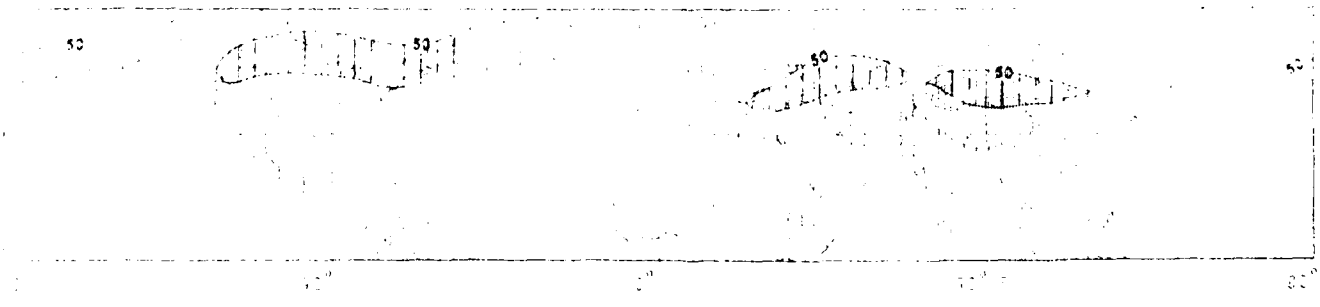
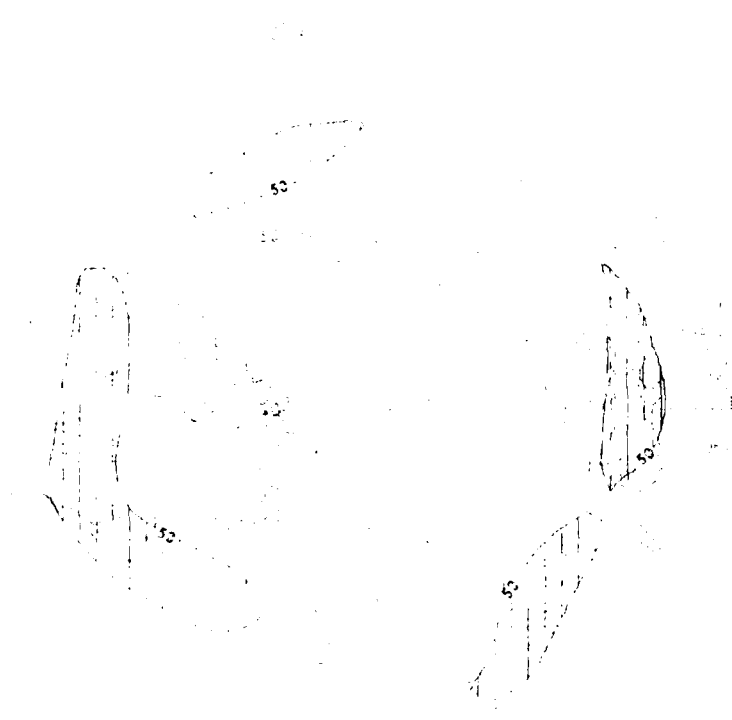
Types and Quantities  
Northern Hemisphere





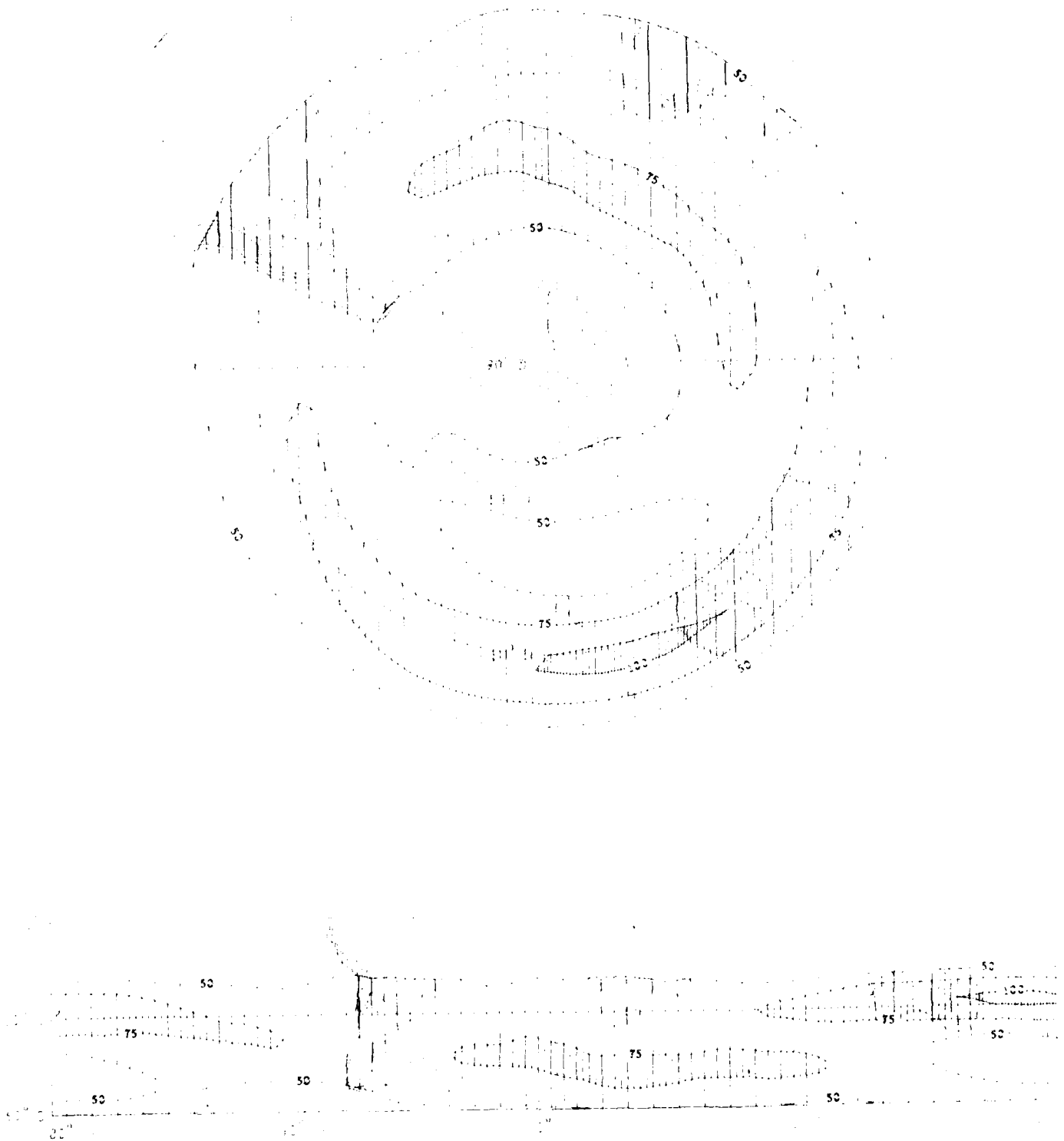
1st Street  
61st & 65th and  
July  
1912

Upper and Lower  
Hemisphere



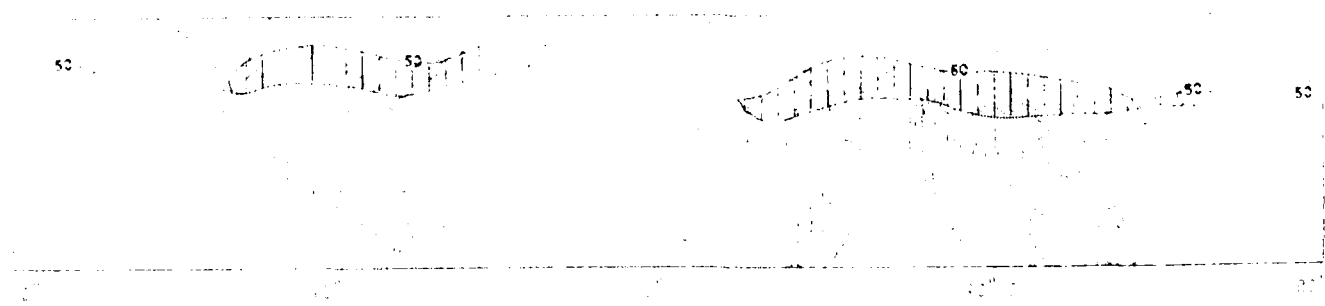
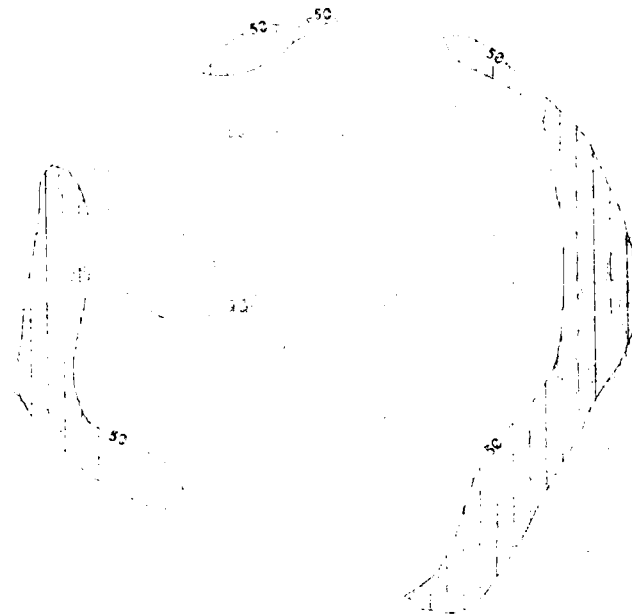
Upper and Lower  
Cretaceous

1st Edition  
1907  
1913



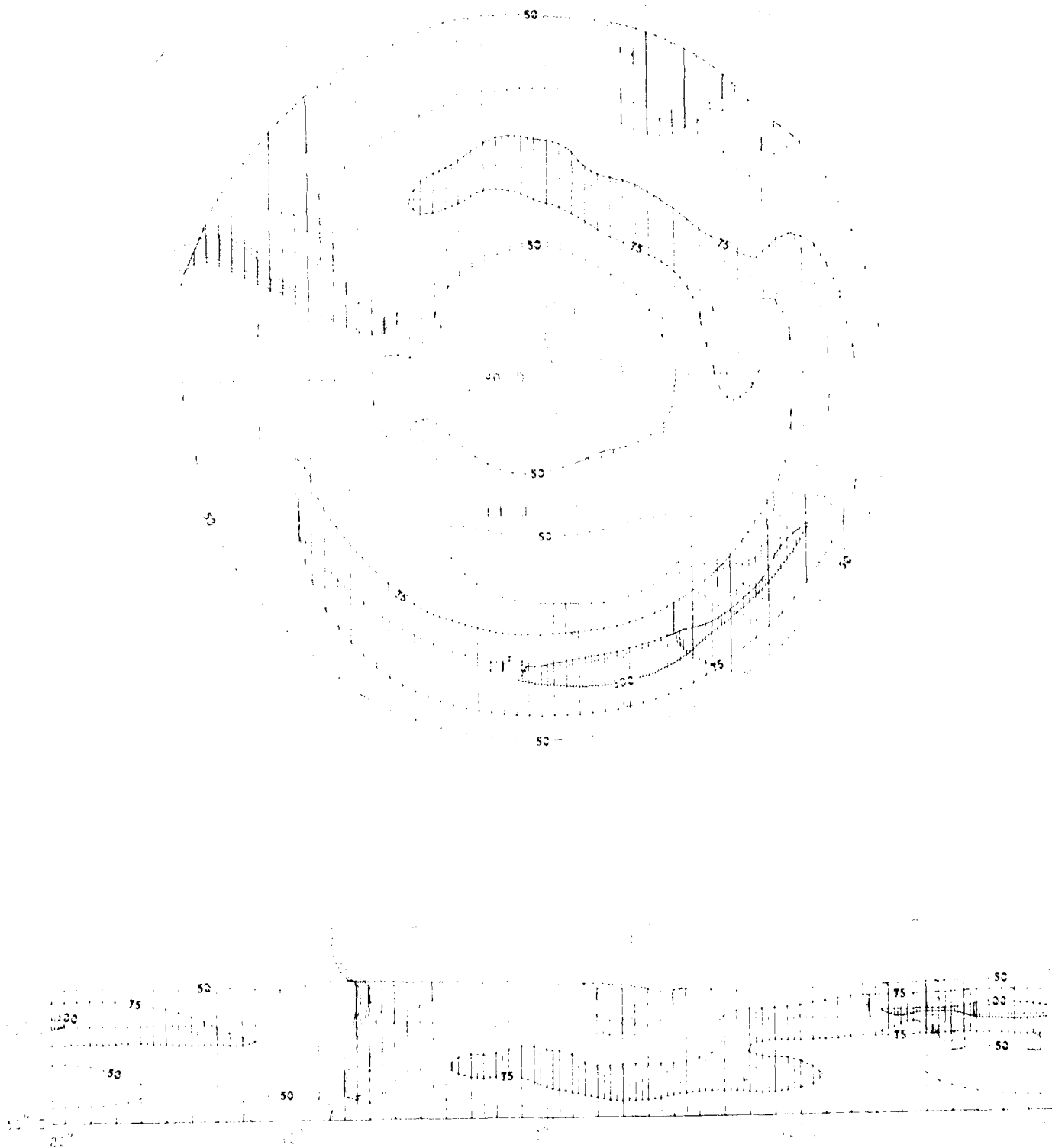
101. 21. 1950  
102. 22. 1950  
103. 23. 1950  
104. 24. 1950

Upper Air Climatology  
Northern Hemisphere



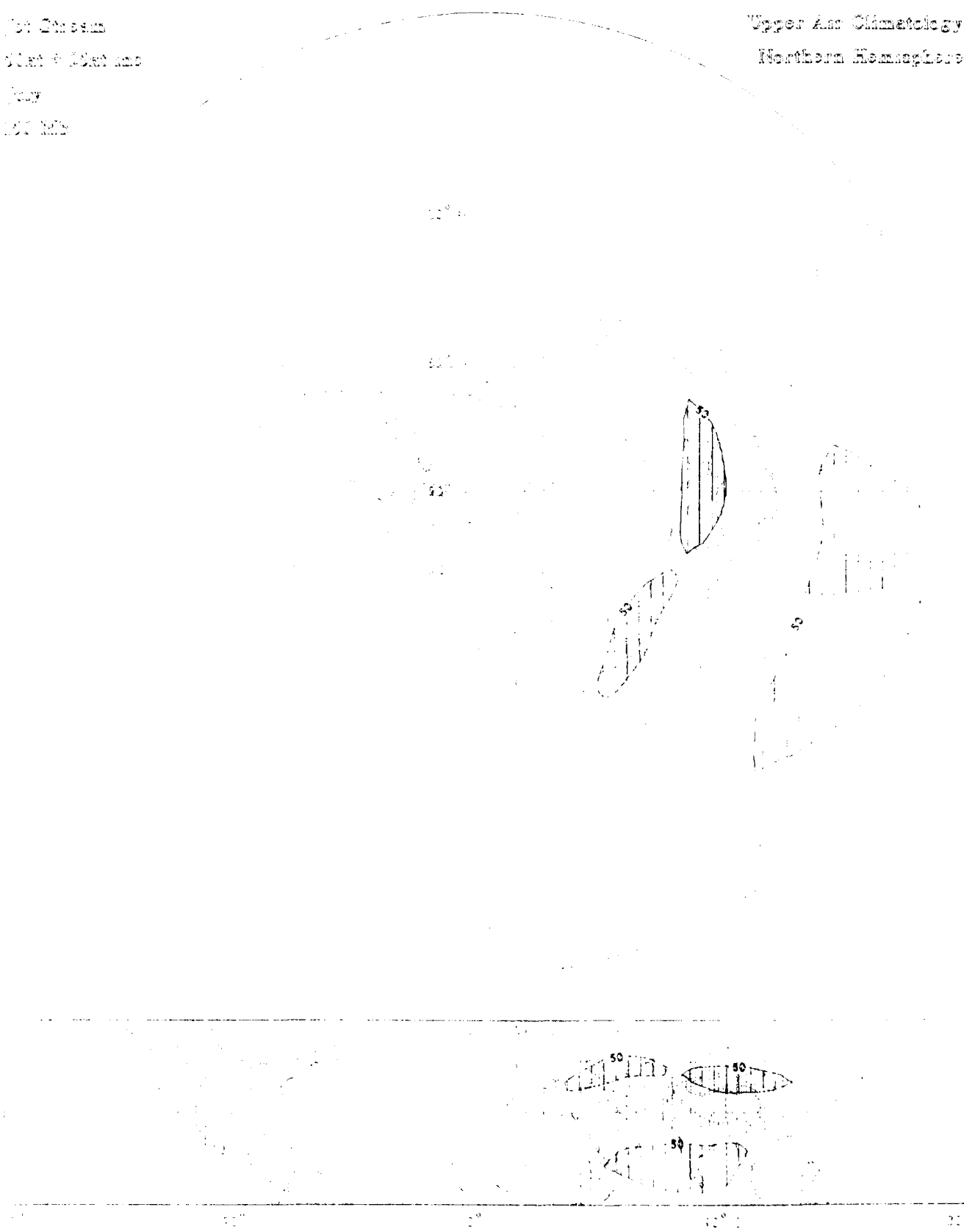
Types and Climatology  
of the Homogeneous

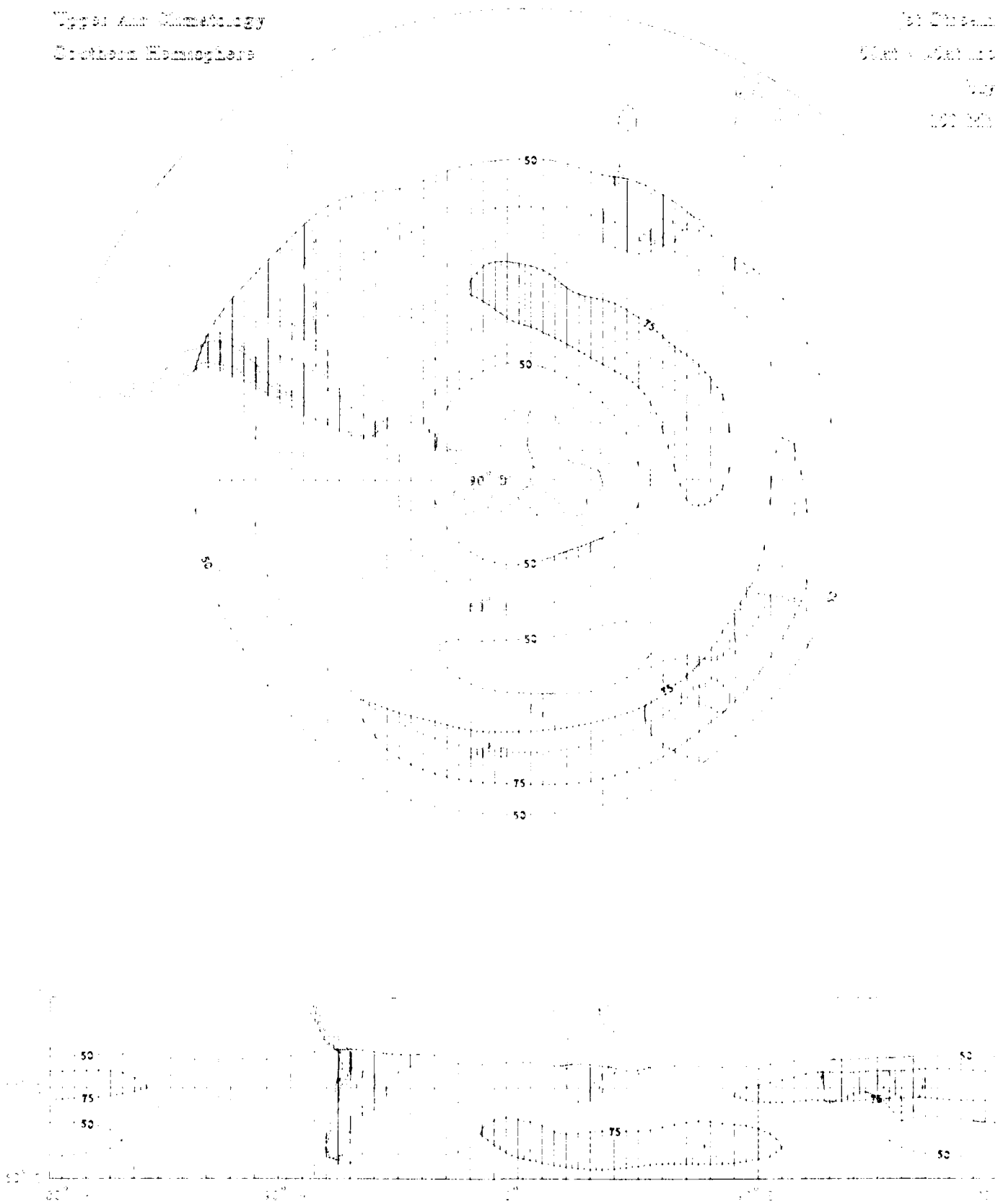
of the Homogeneous  
of the Homogeneous  
of the Homogeneous



1000 mb  
1000 mb  
July  
1970

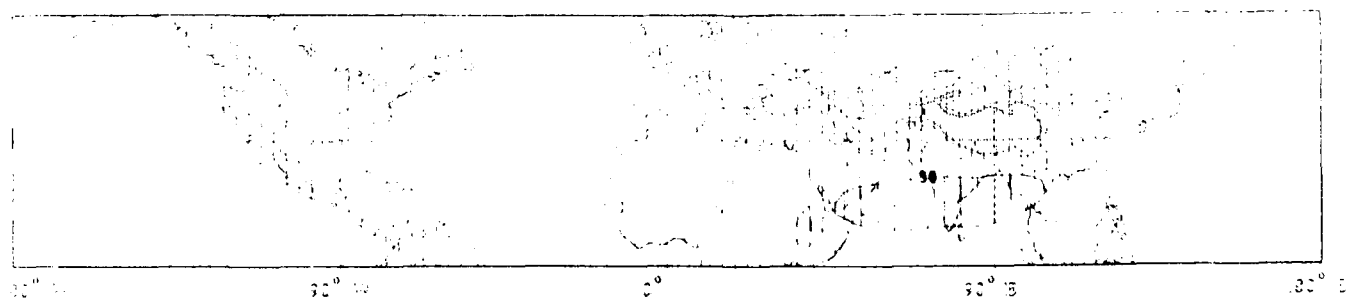
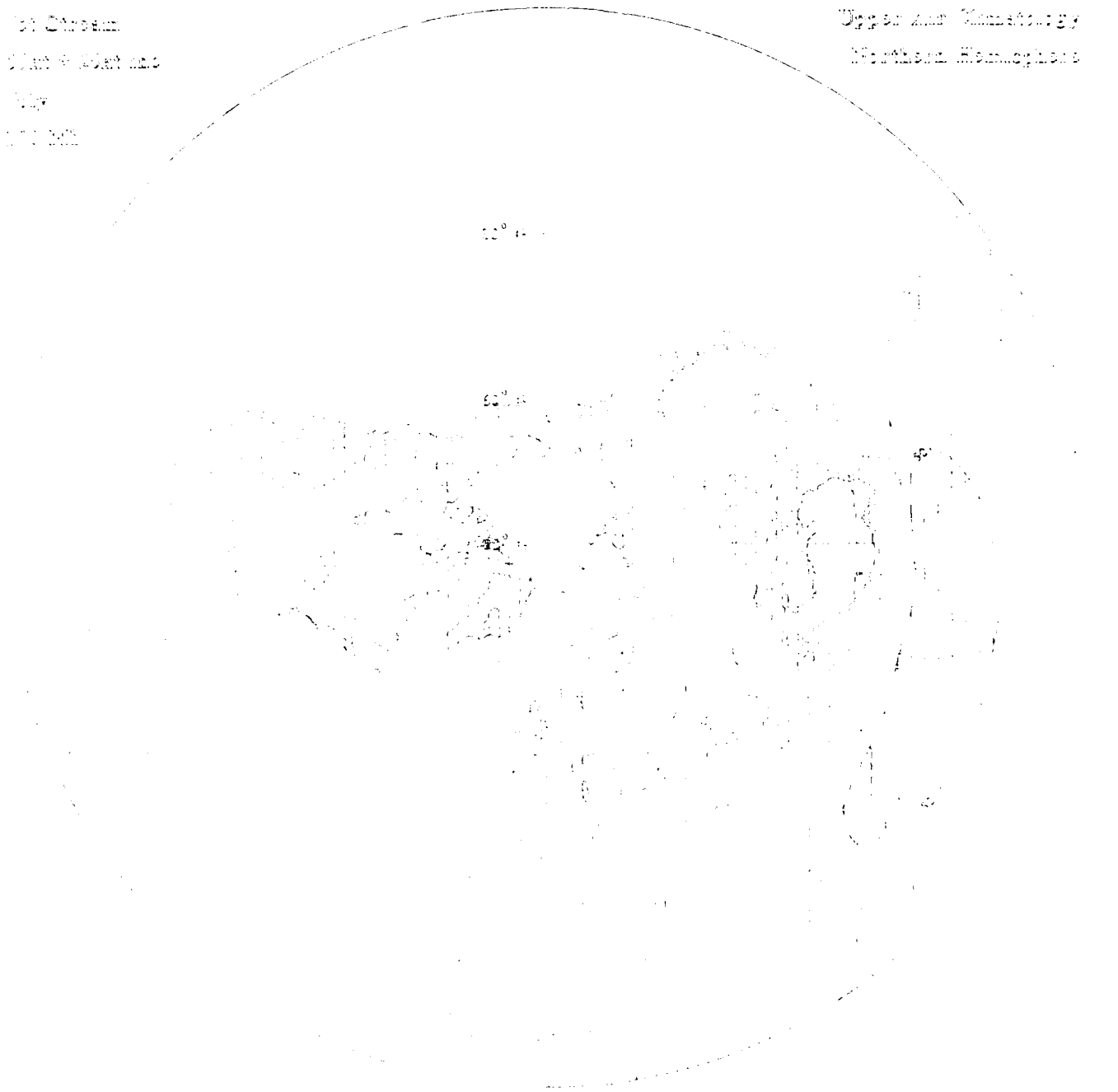
Upper Air Climatology  
Northern Hemisphere





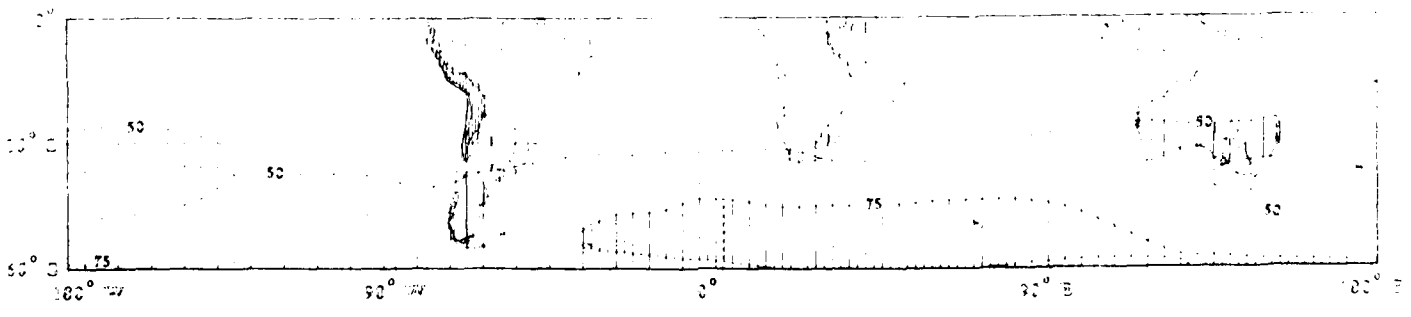
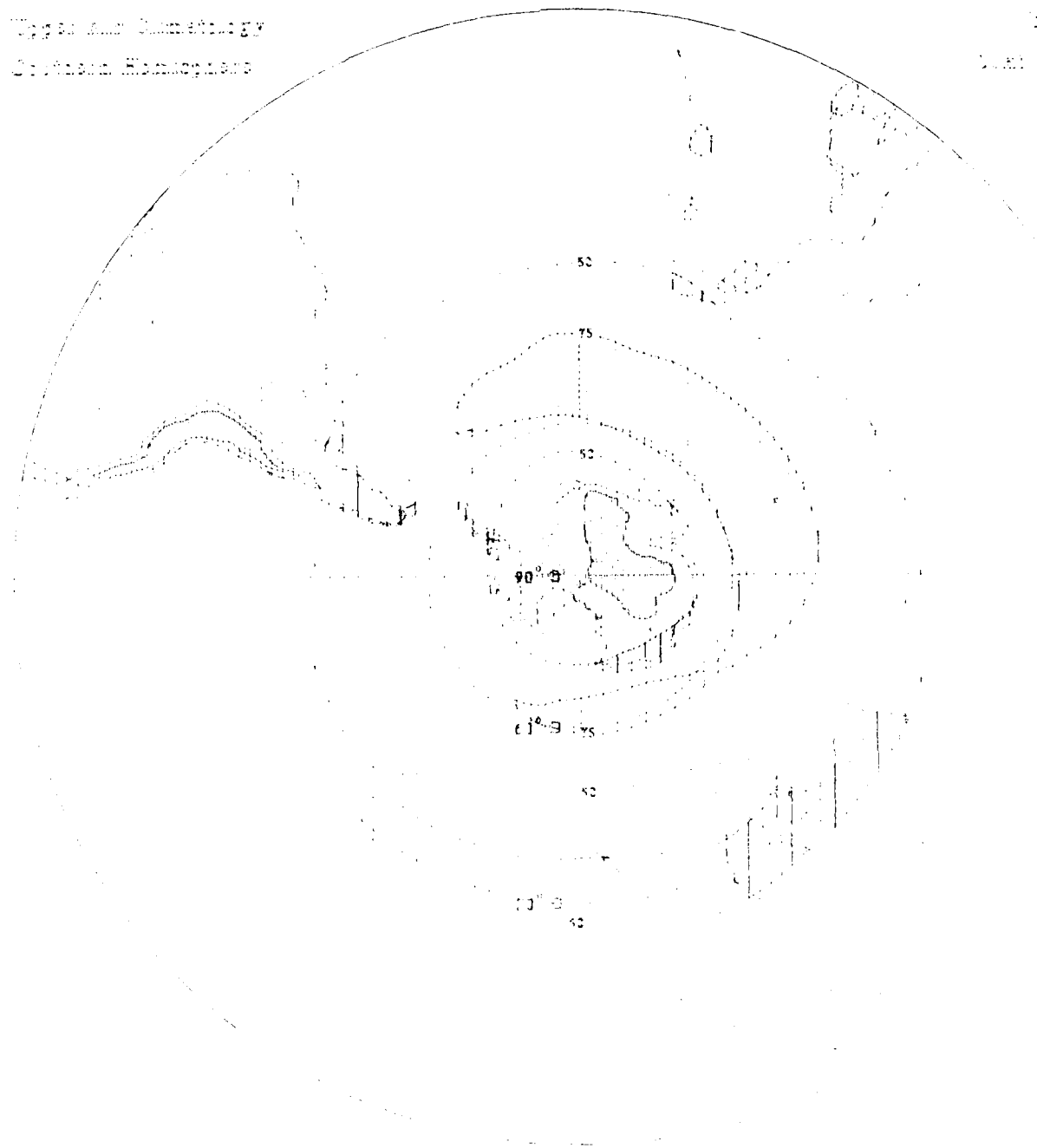
St. Croix  
St. Croix  
St. Croix  
St. Croix

Upper and Lower  
Northern Hemisphere



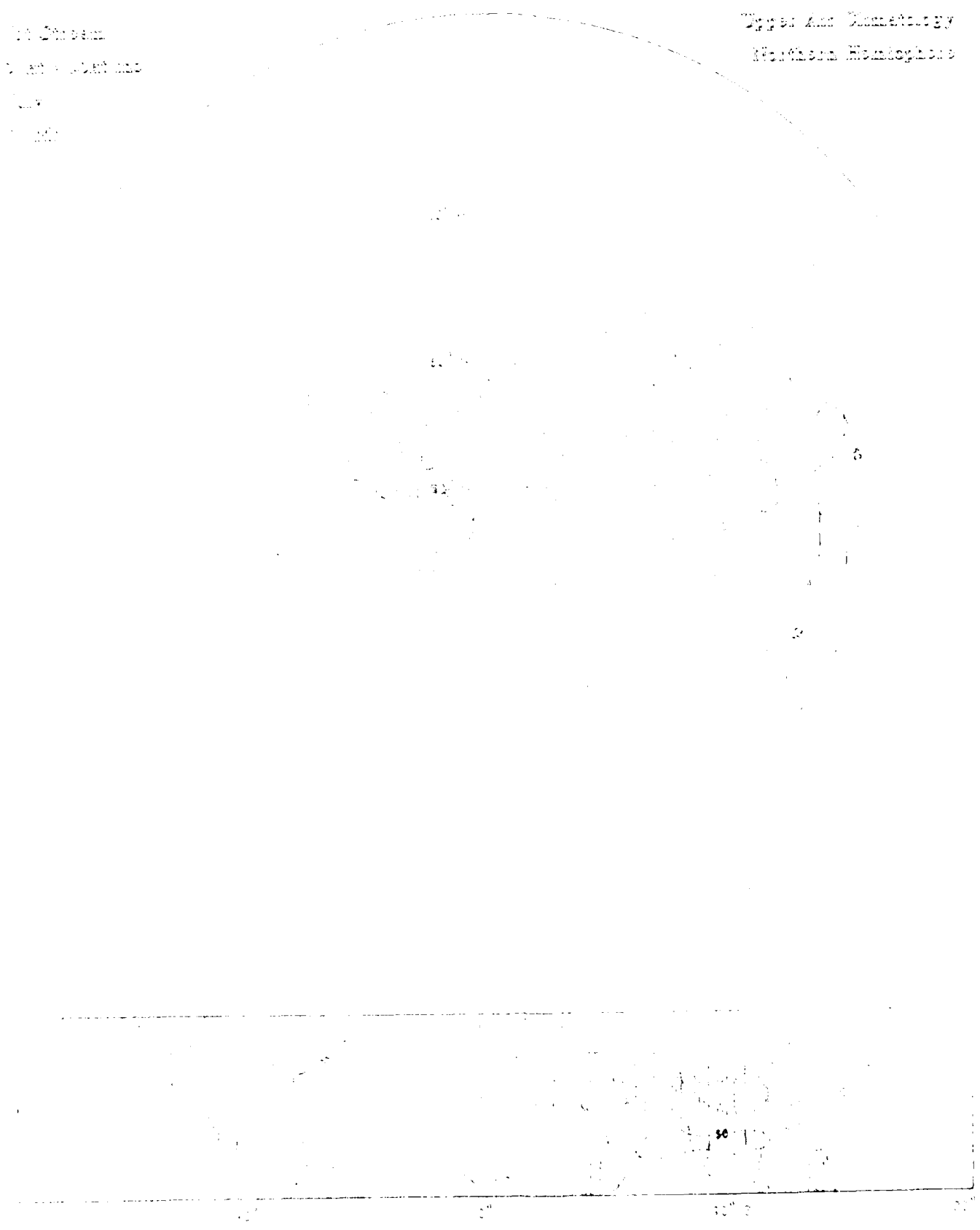
Types and Geometry  
of Areas Homogeneous

10000  
1000  
100



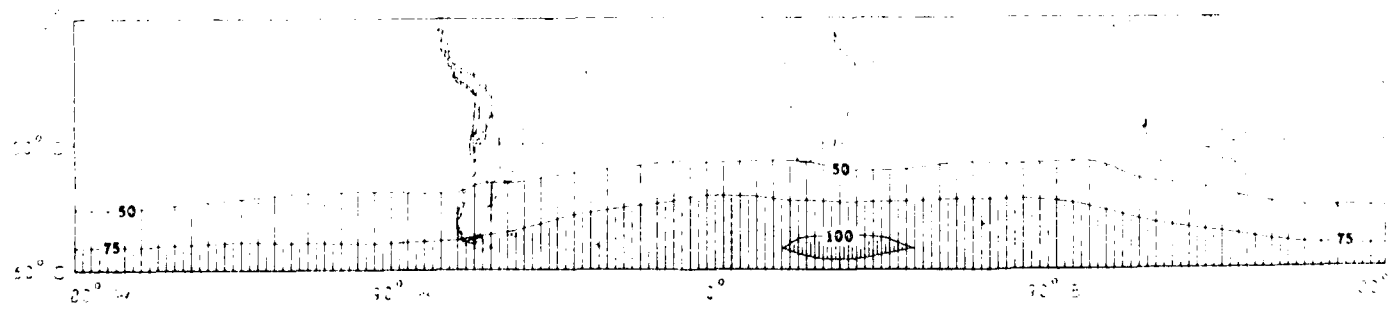
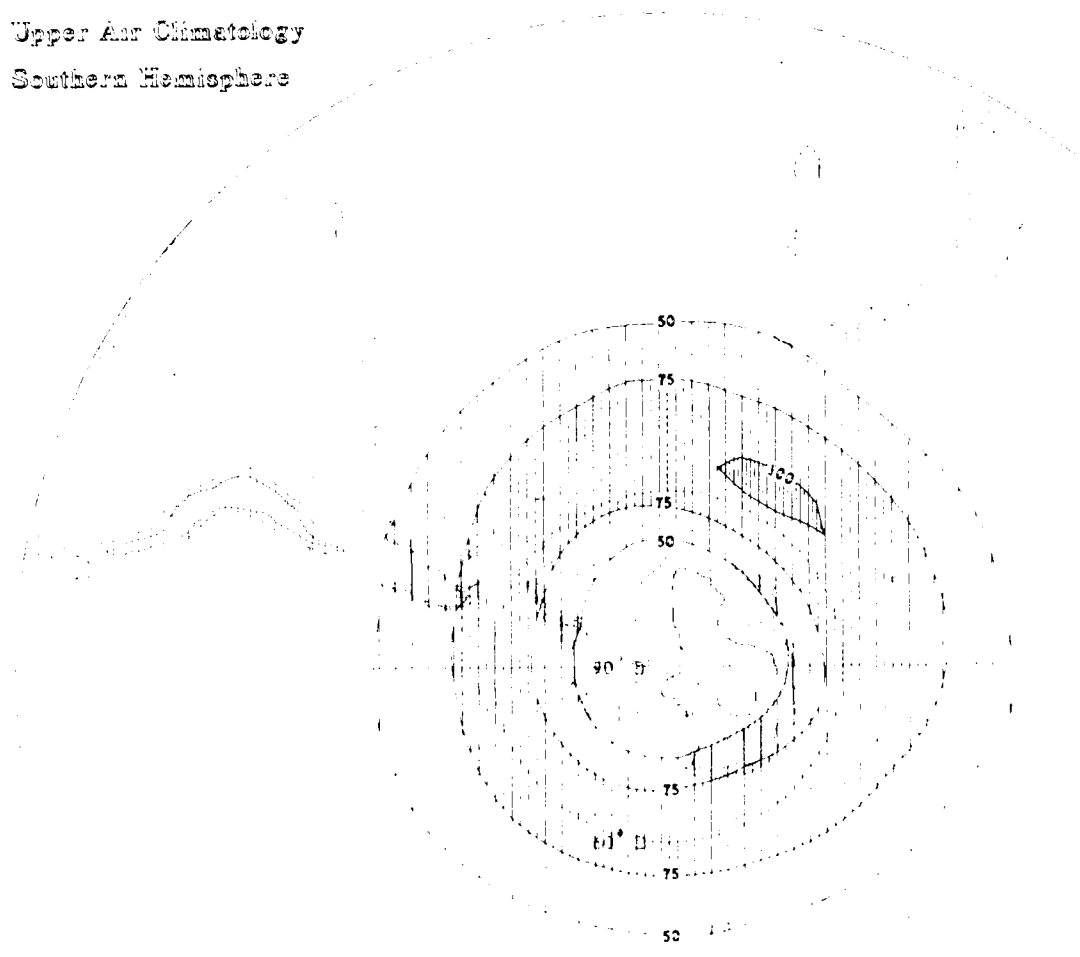
Upper Air Climatology  
Northern Hemisphere

1000 mb  
500 mb  
200 mb



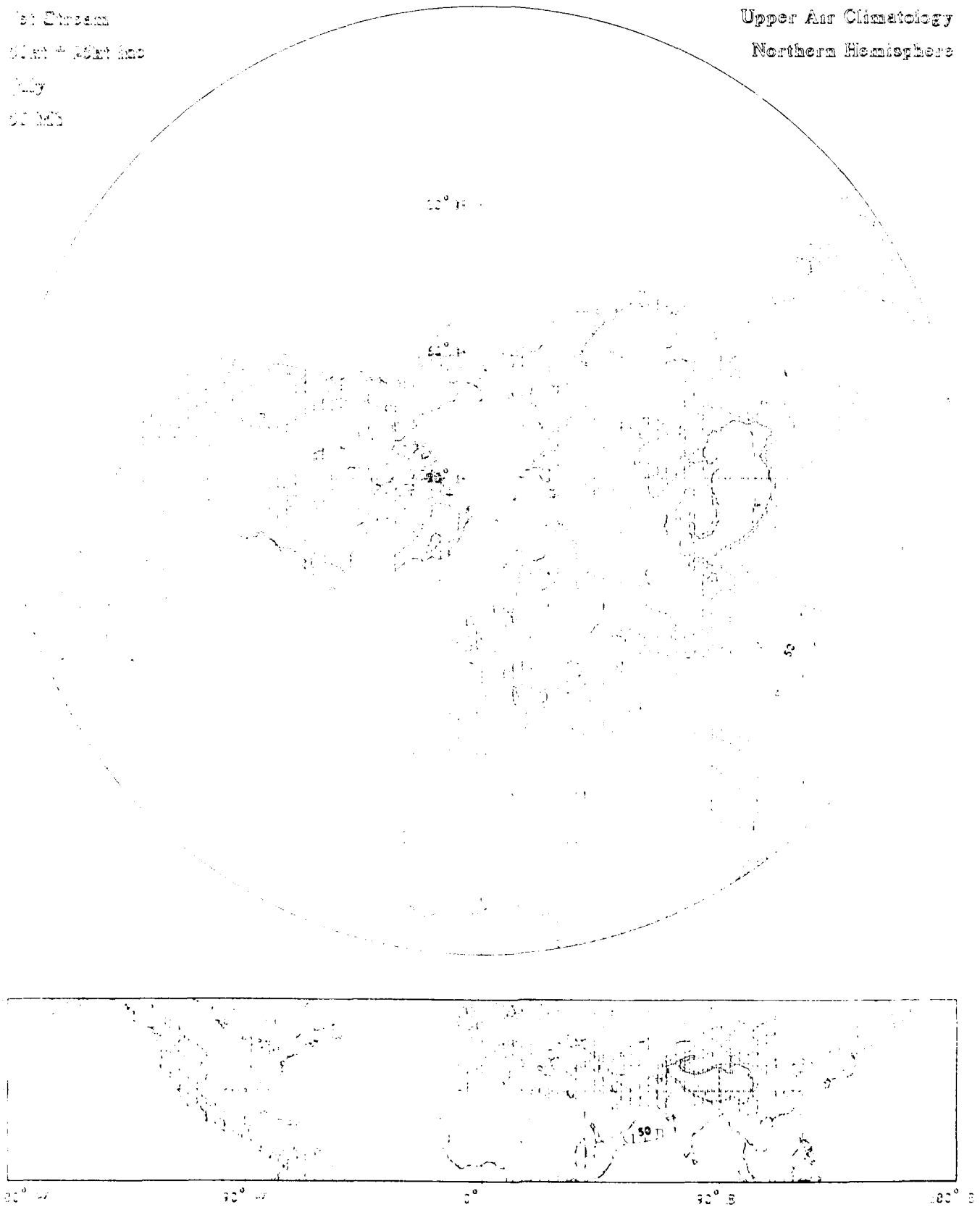
Upper Air Climatology  
Southern Hemisphere

Jet Stream  
50kt + 20kt line  
July  
75 MB



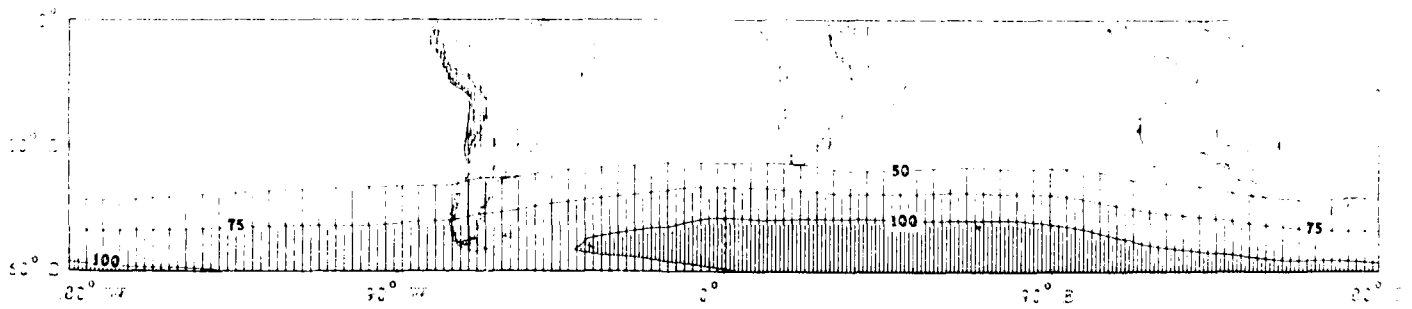
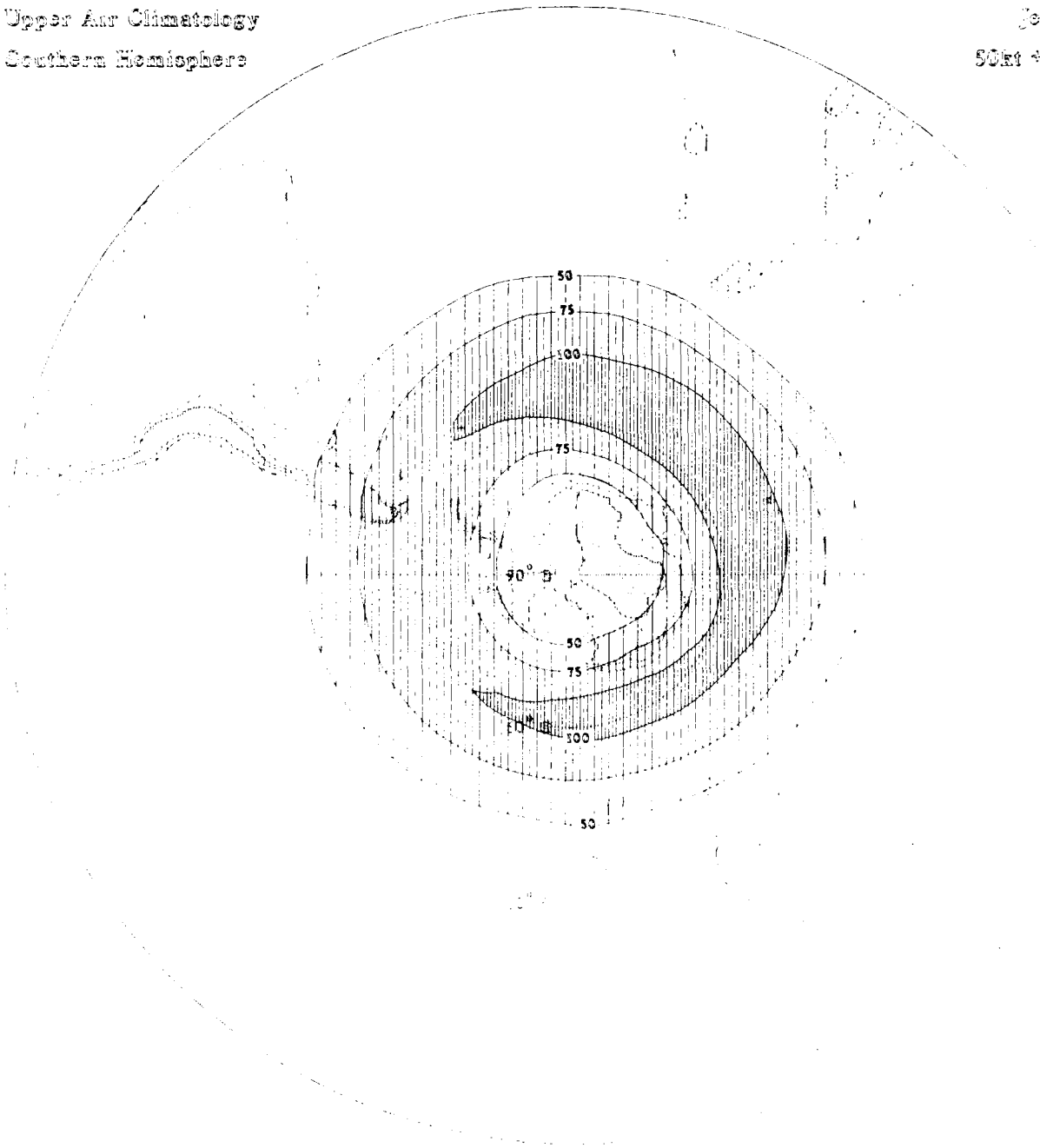
Jet Stream  
51st + 58th and  
July  
50 mb

Upper Air Climatology  
Northern Hemisphere



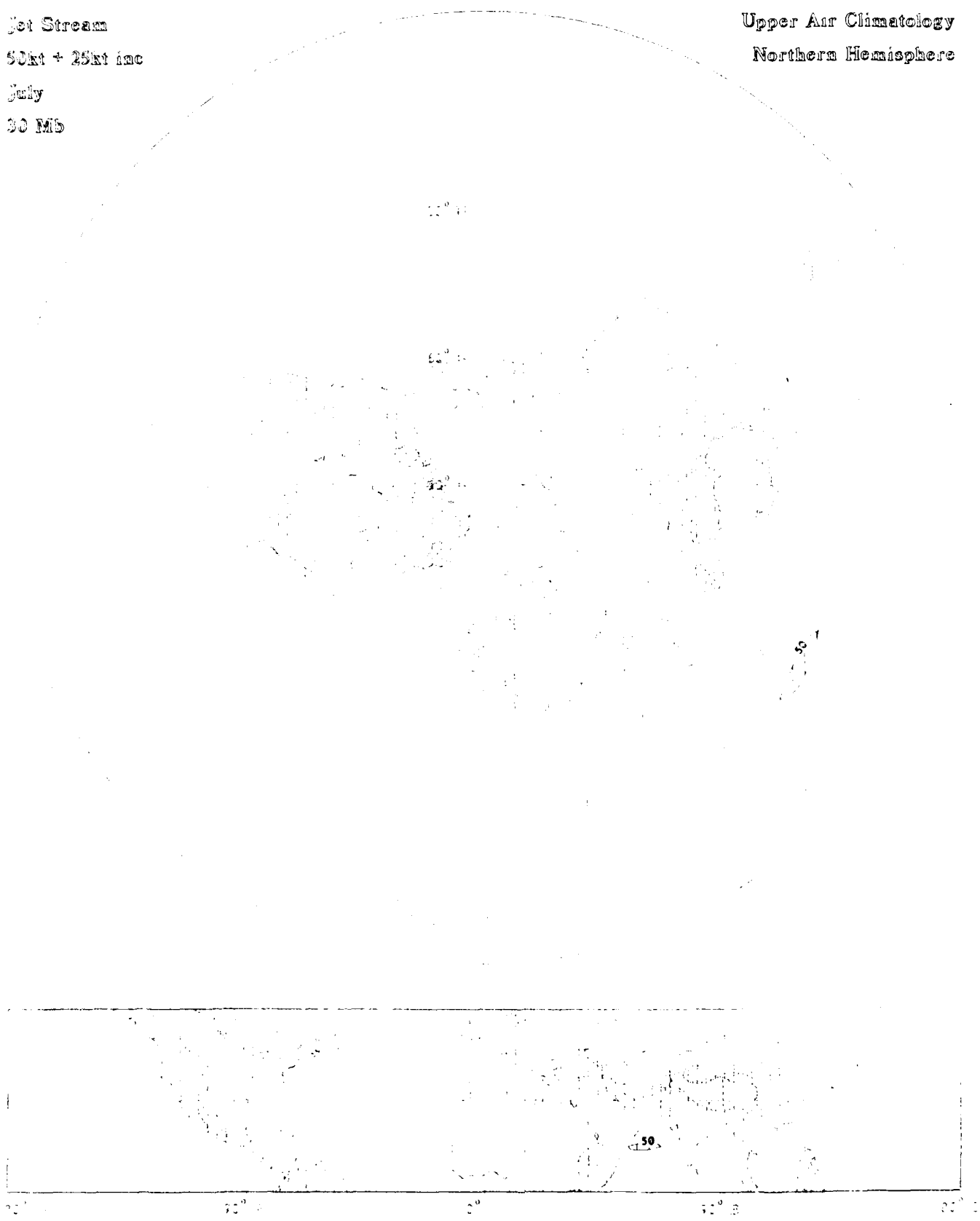
Upper Air Climatology  
Southern Hemisphere

Jet Stream  
50kt + 25kt inc  
July  
50 MB



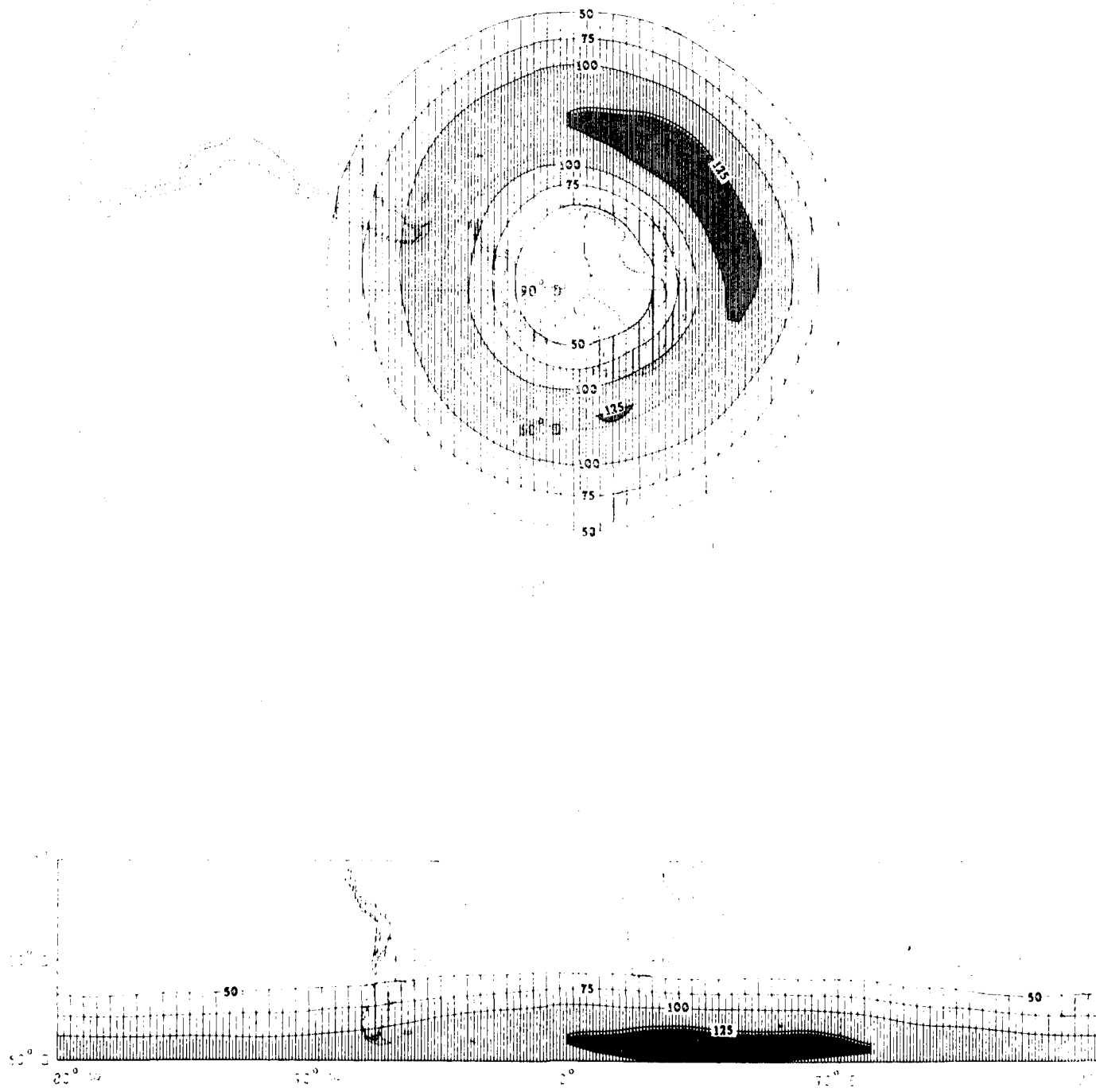
Jet Stream  
50kt + 25kt inc  
July  
30 Mb

Upper Air Climatology  
Northern Hemisphere



Upper Air Climatology  
Southern Hemisphere

Jet Stream  
50kt + 15kt line  
July  
50 100



TEMPERATURE  
(13 LEVELS, 1000 TO 30 MB)

- Contours of mean temperature (solid and dashed lines) in °C; solids labeled, dashed intermediates unlabeled
- Temperature labeled interval: 5°C
- Contours of standard deviation of temperature (dotted lines) in °C
- Standard deviation of temperature labeled interval: 2.5°C
- Contours blanked for geographic areas with elevations exceeding specified geopotential heights

ELEVATION SCALE

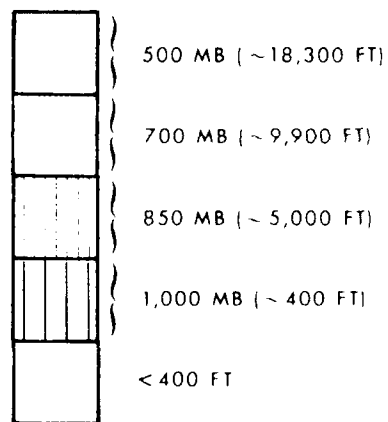
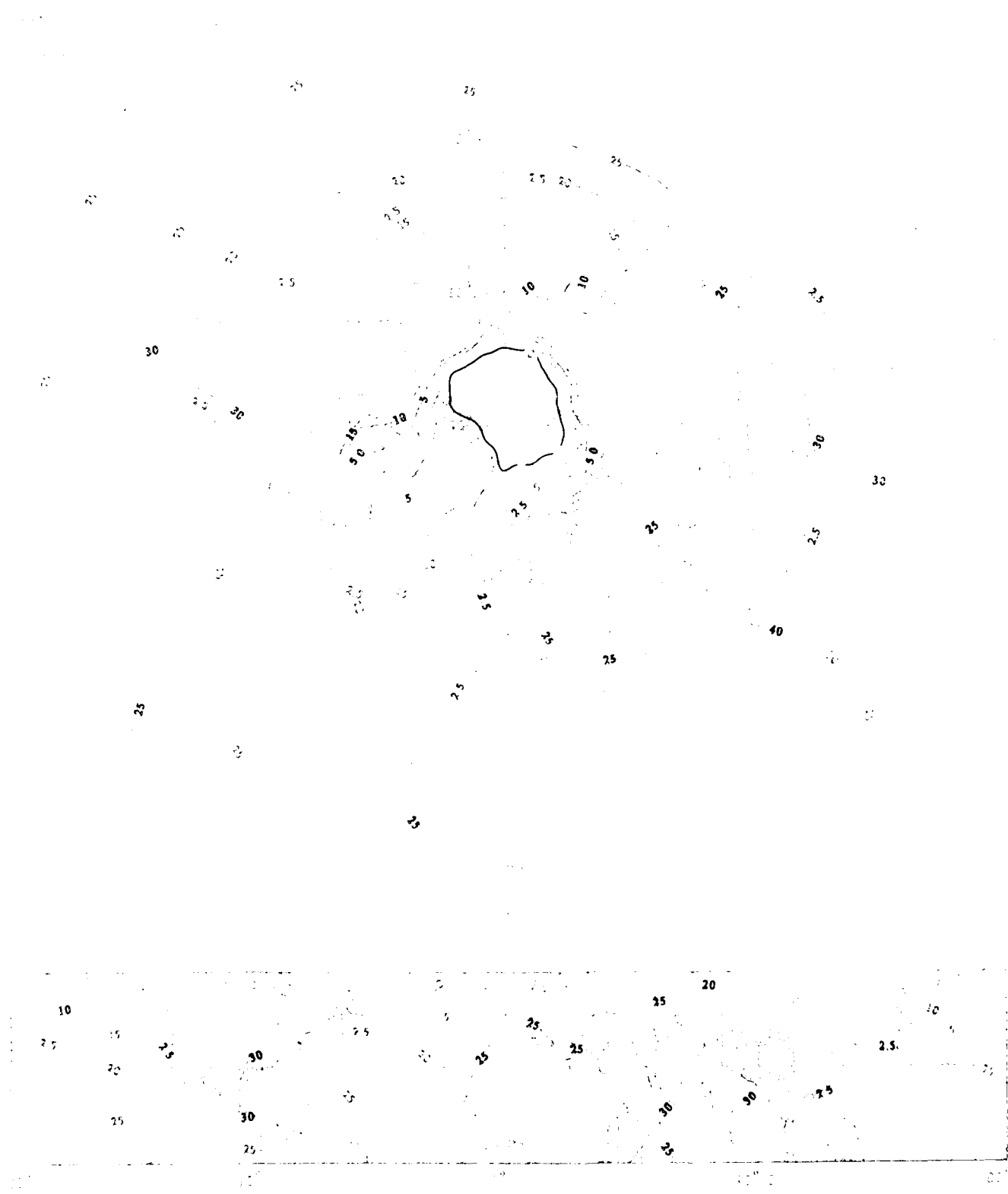


Figure 10 (continued)

Figure 10 (continued)

Figure 10 (continued)

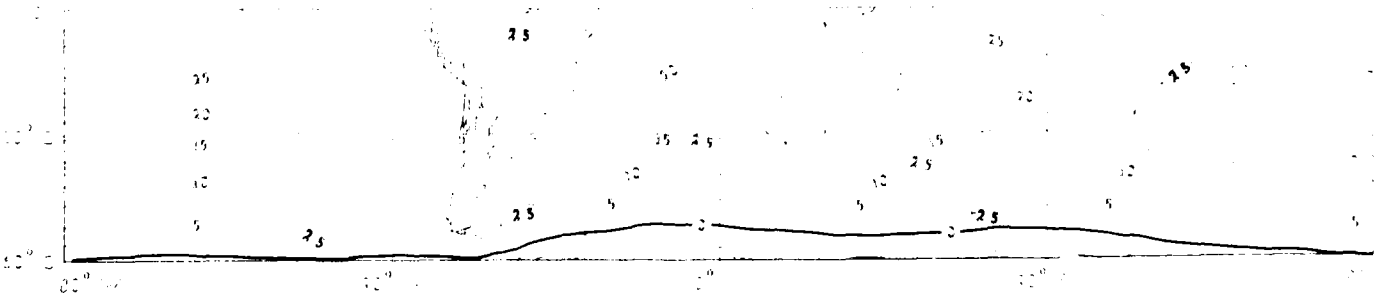
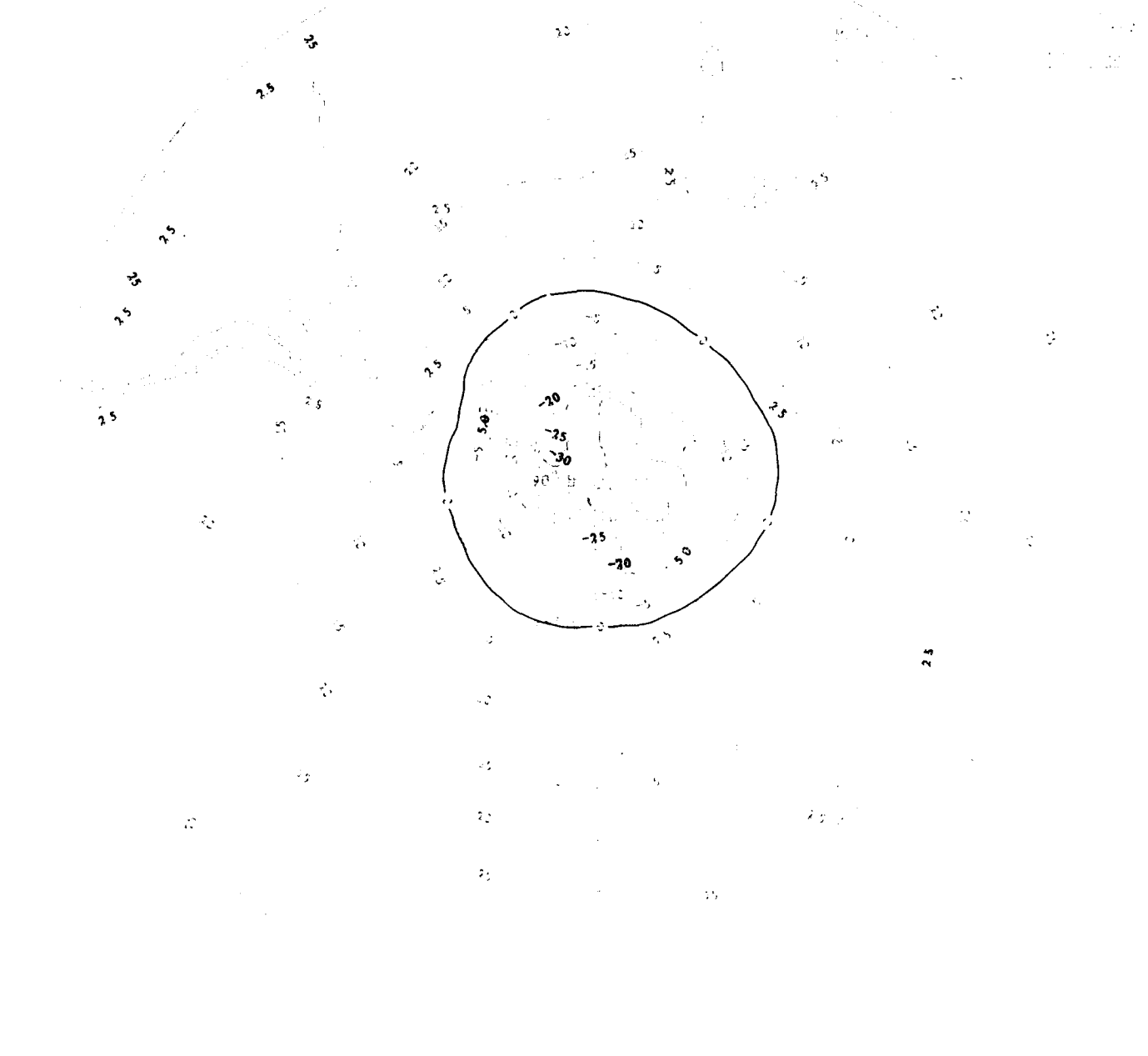
Figure 10 (continued)



Topographic Contouring  
of the ...

Map of ...

Scale 1:50,000



Mean Temperature (C)

in Day 10 month

1979  
01/01/79

Depth and Duration by

Maximum Humidity

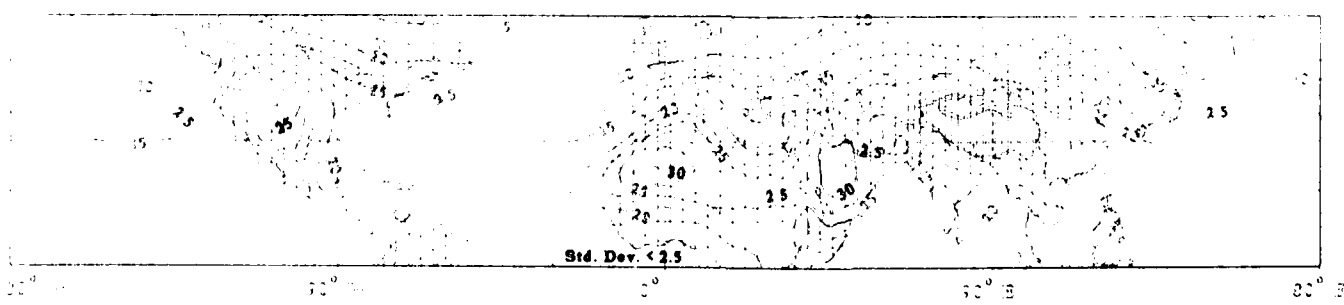
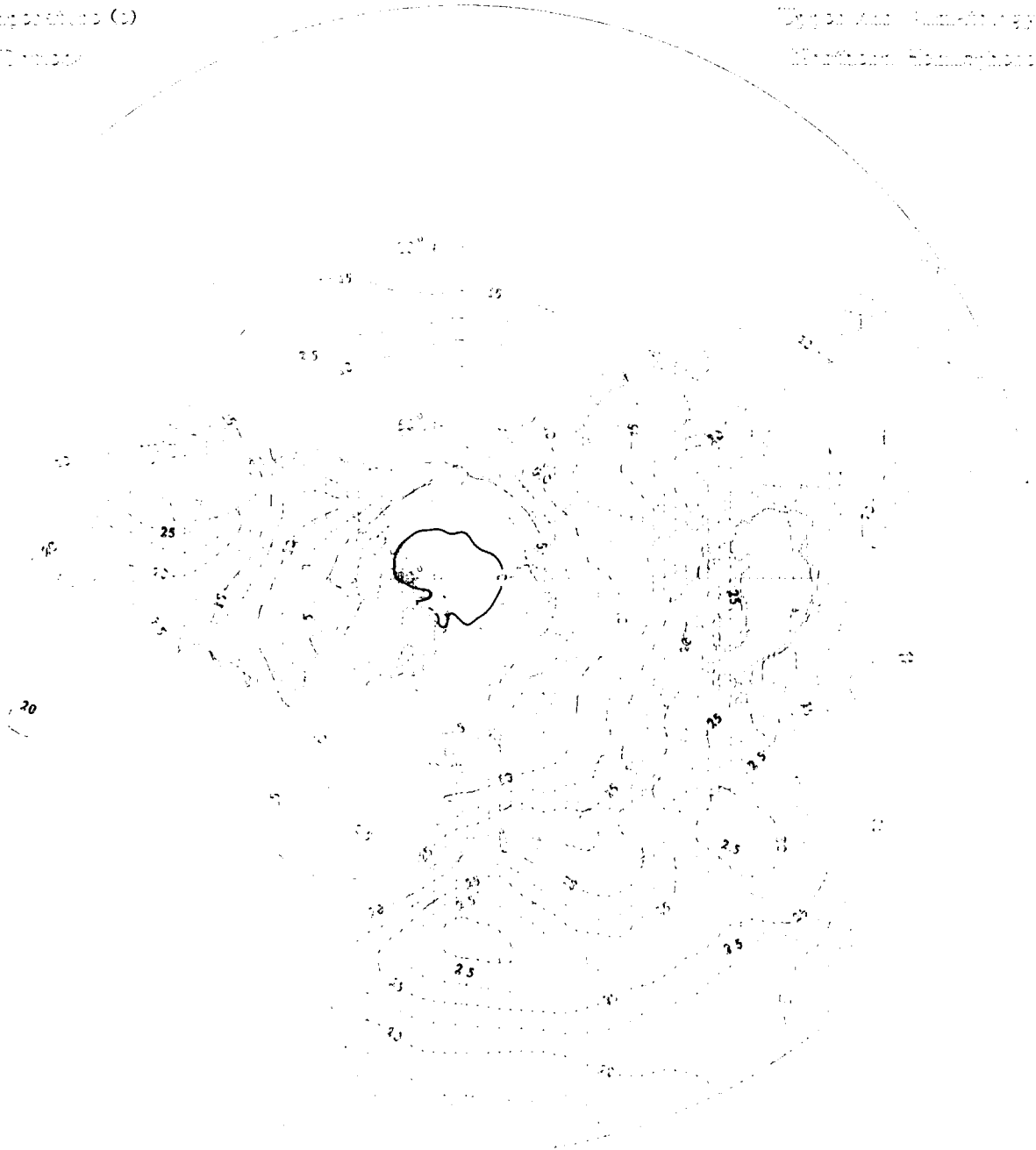
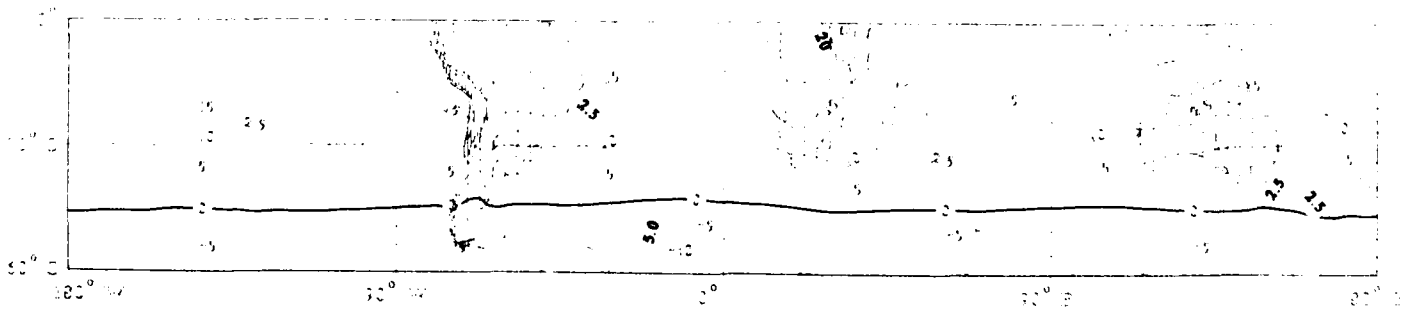
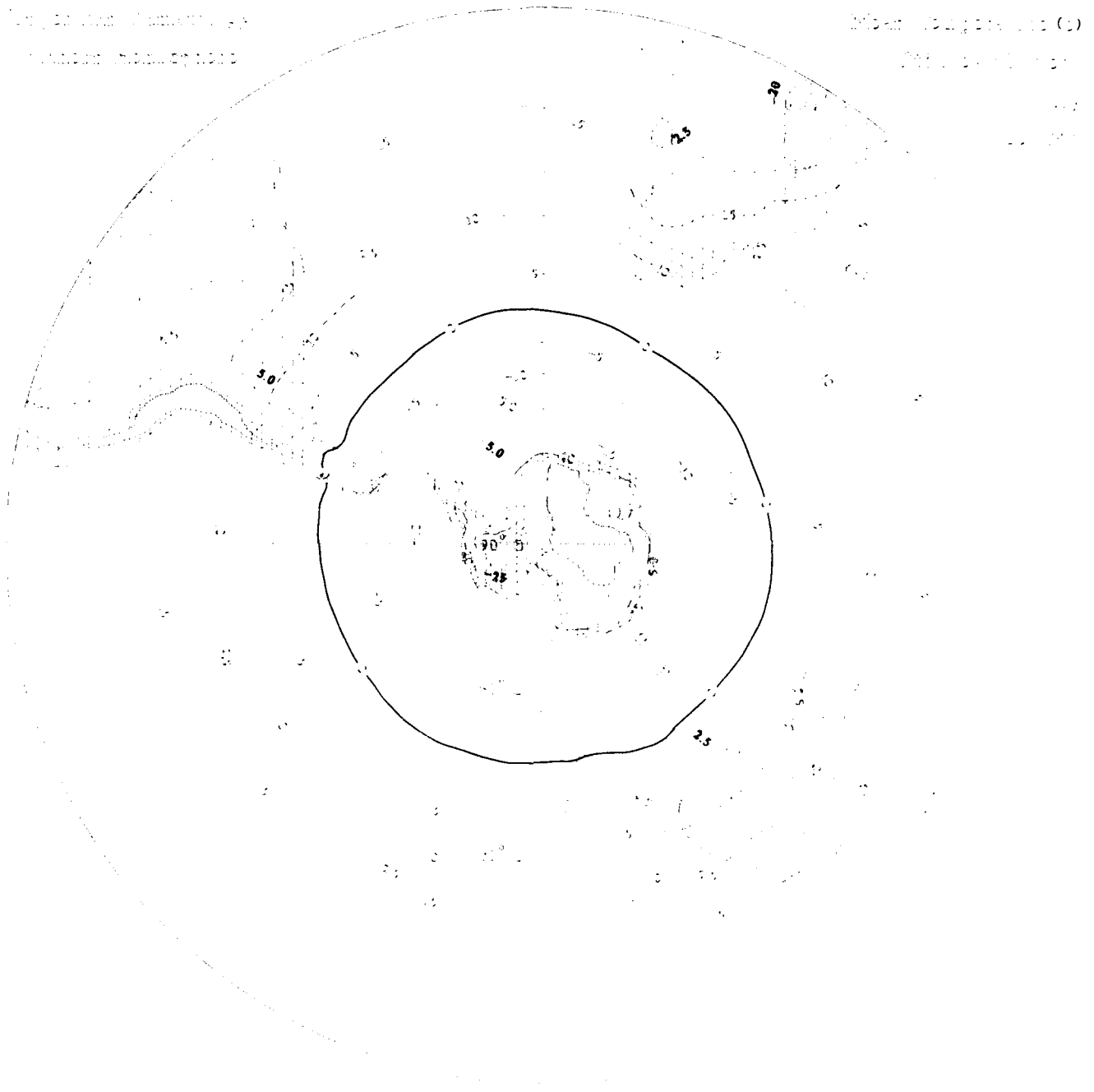


Figure 20. Contour plot of the  
standard deviation of the  
...

Figure 21. Contour plot of the  
standard deviation of the  
...



Water Temperature (C)

Temperature Contouring

Northward Flowing

1000 m depth

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

1000

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1000

1000

1000

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1000

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1000

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1000

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1000

1000

1000

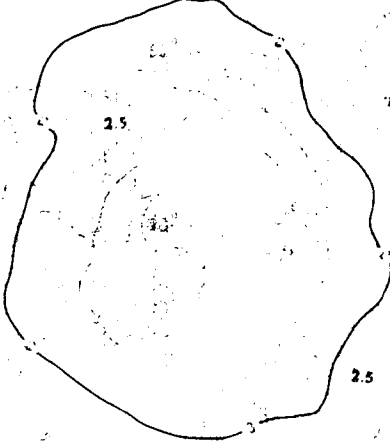
1000

1000

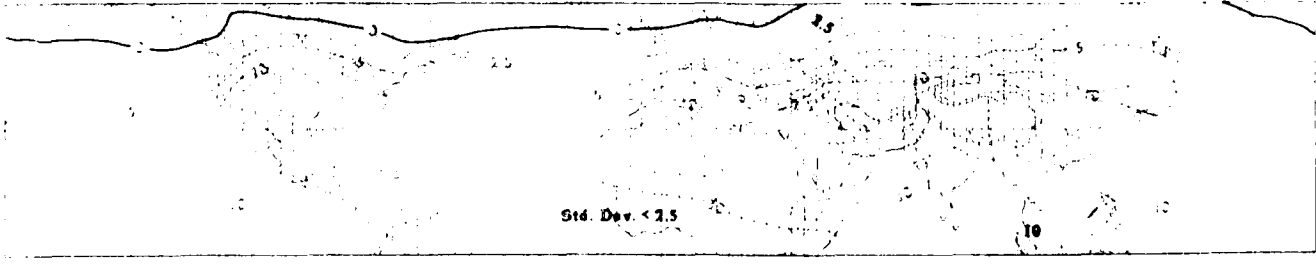
1000

1000

1000



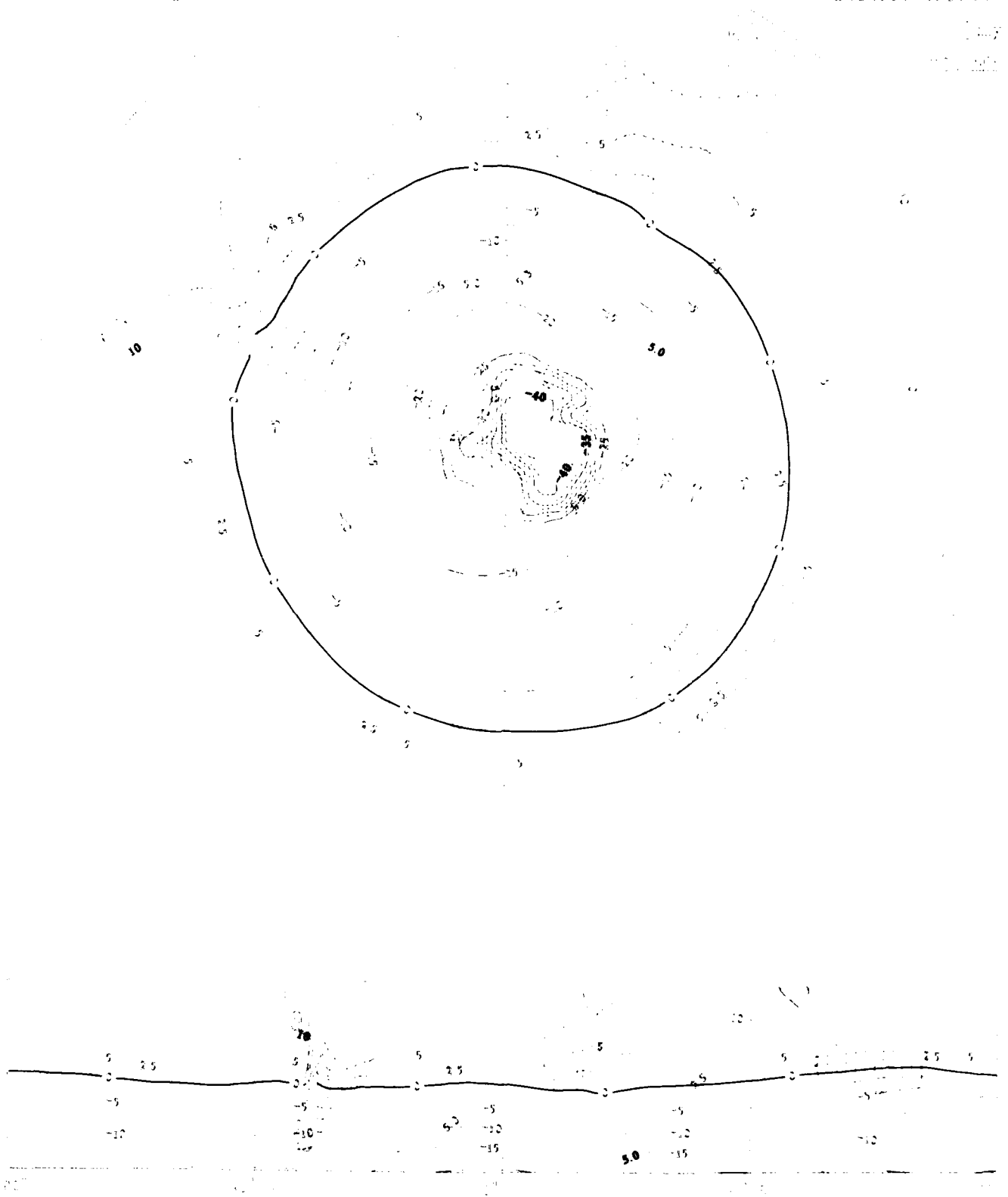
Std. Dev. < 2.5



Std. Dev. < 2.5

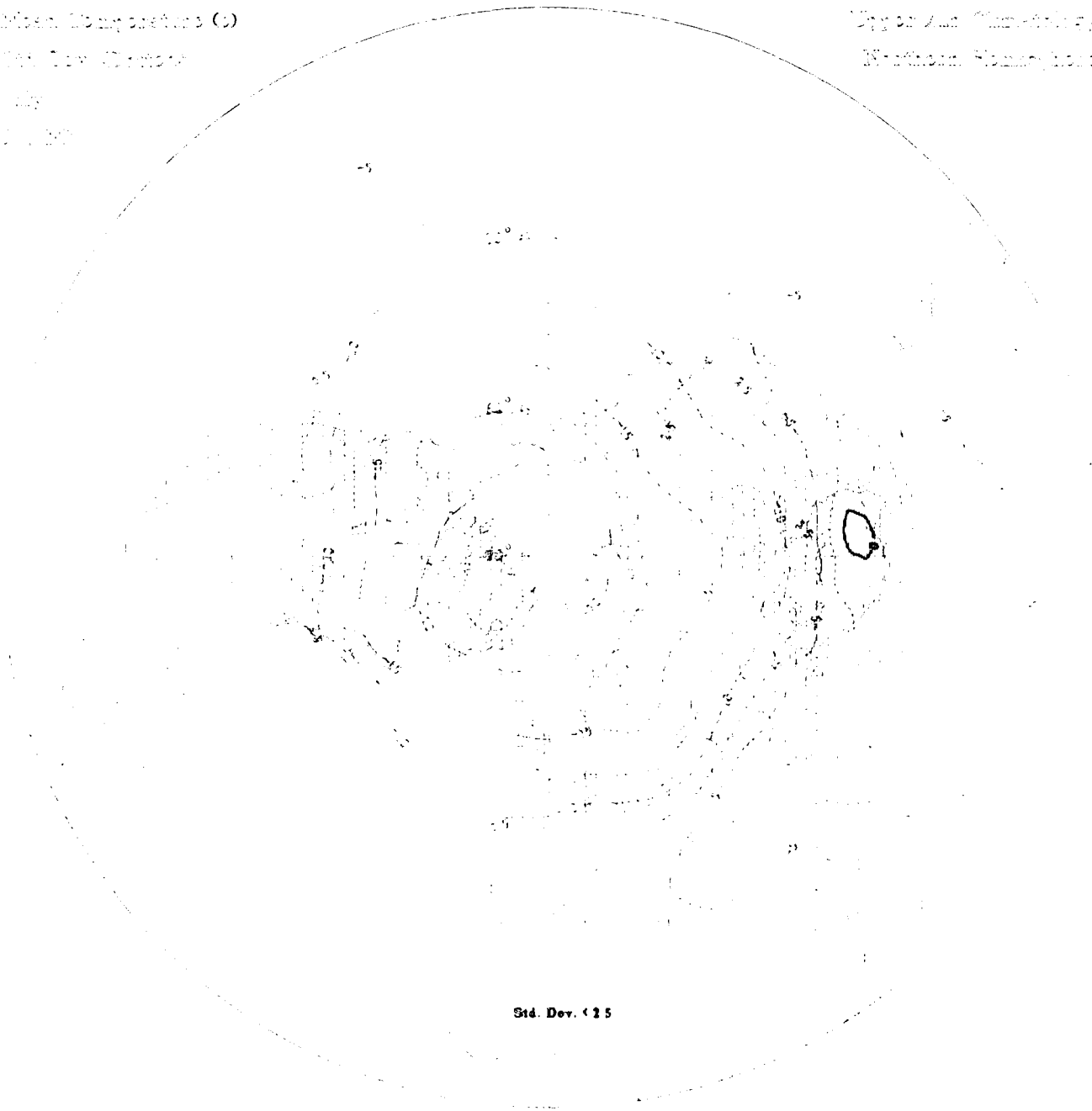
Topographic Meteorology  
of Western Hemisphere

Mean Temperature (C)  
0000 UTC 01/01/00  
1000 hPa

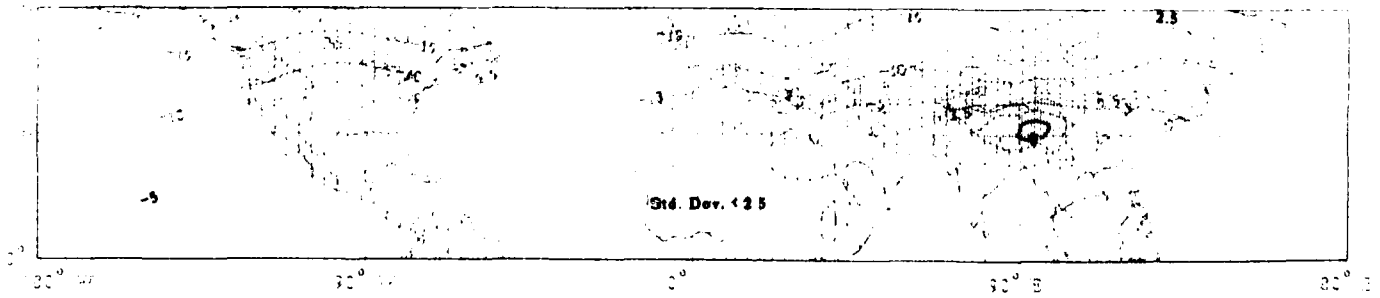


Mean Temperature (C)  
1951-1980  
1980

Department of Meteorology  
National Meteorological



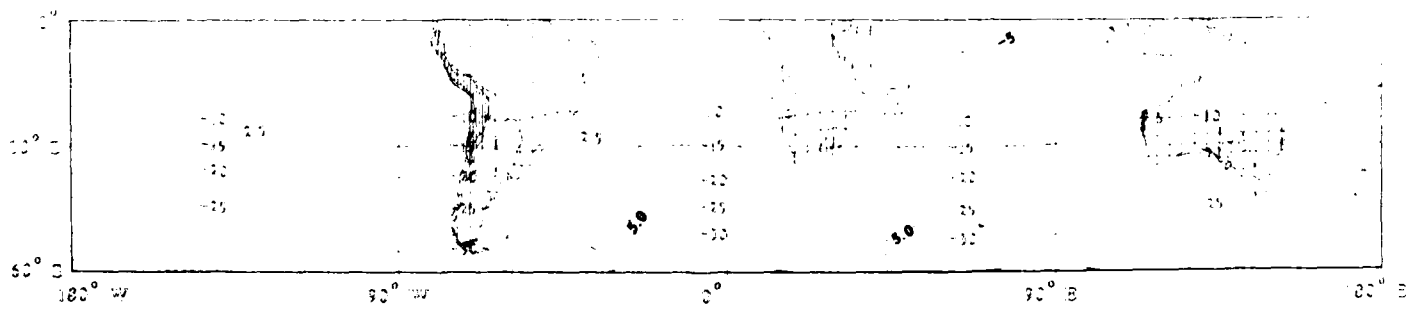
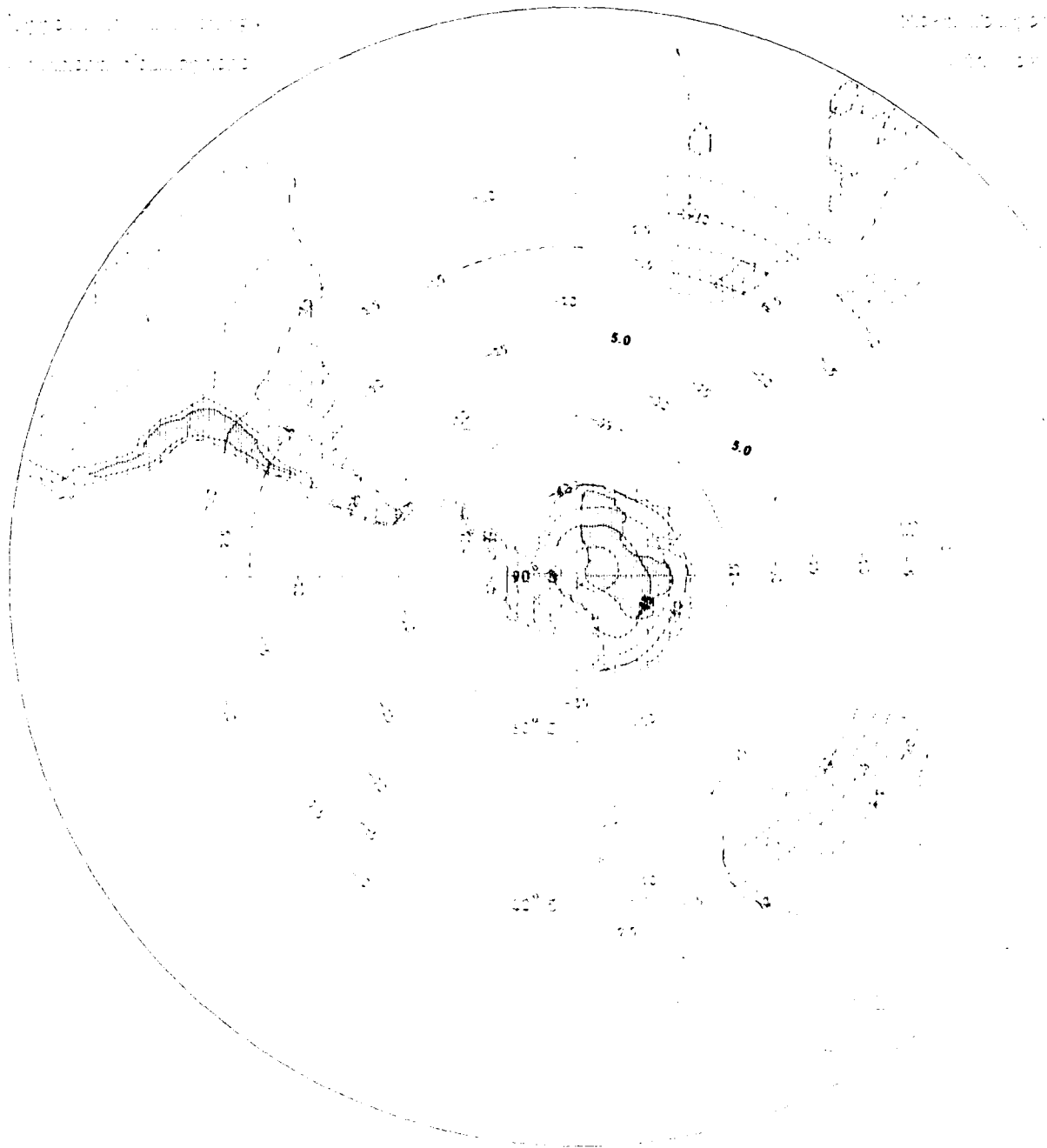
Std. Dev. < 25



Std. Dev. < 25

Topographic contours  
contour interval 1000m

Mean monthly precipitation (mm)  
contour interval 50mm



1.1.1.1.1 (C)

Top of Ann. Homology  
Western Hemisphere

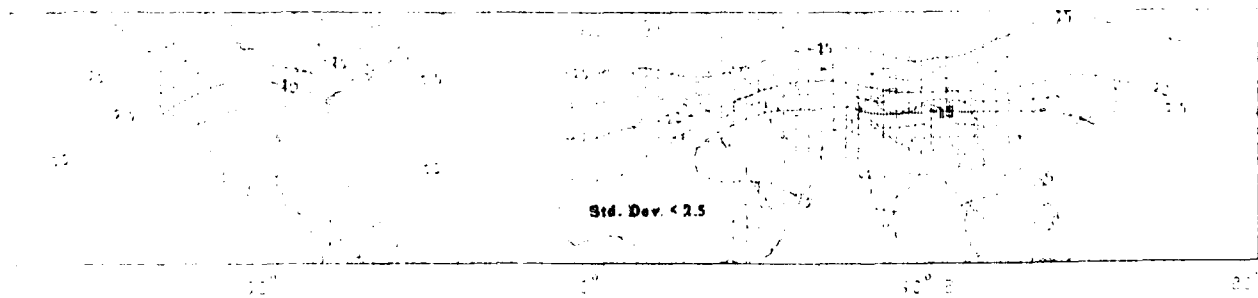
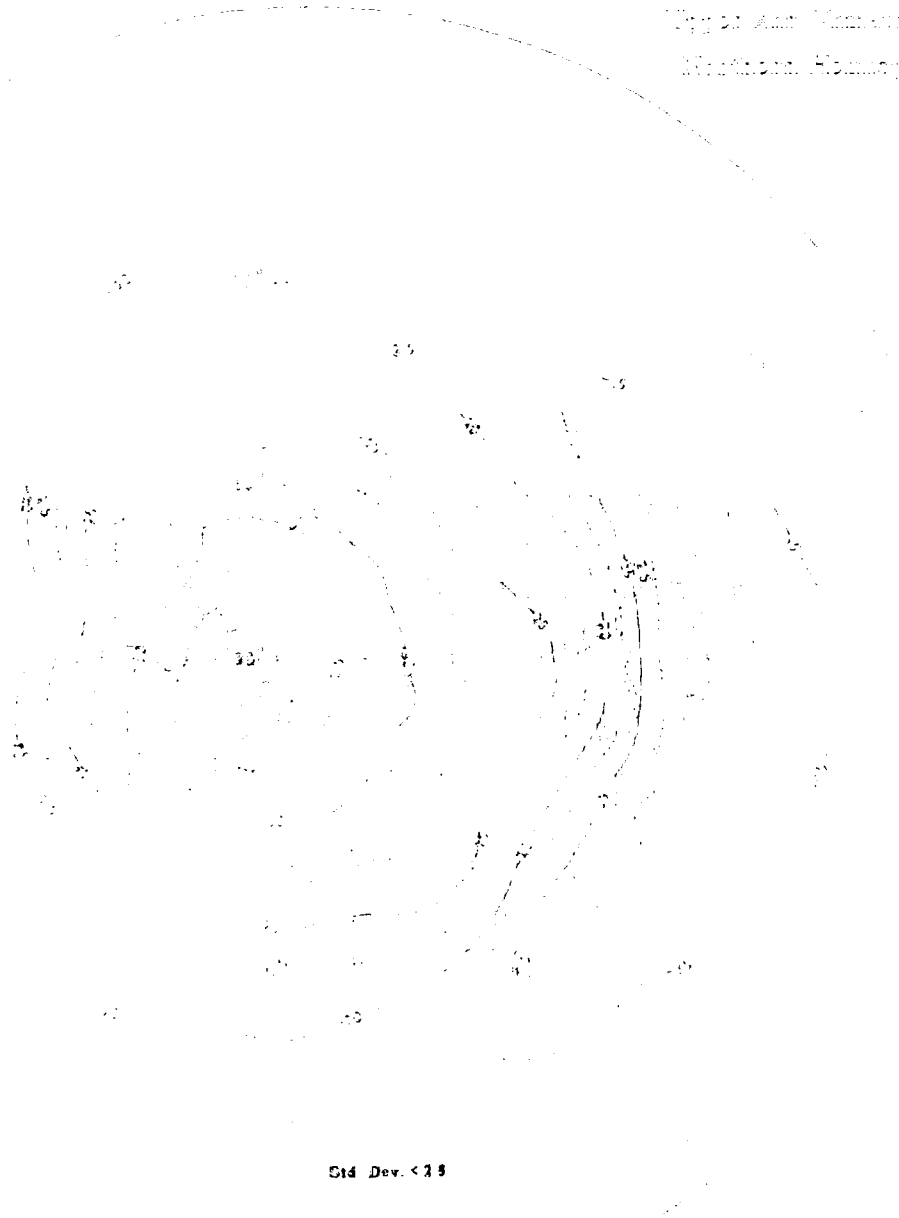


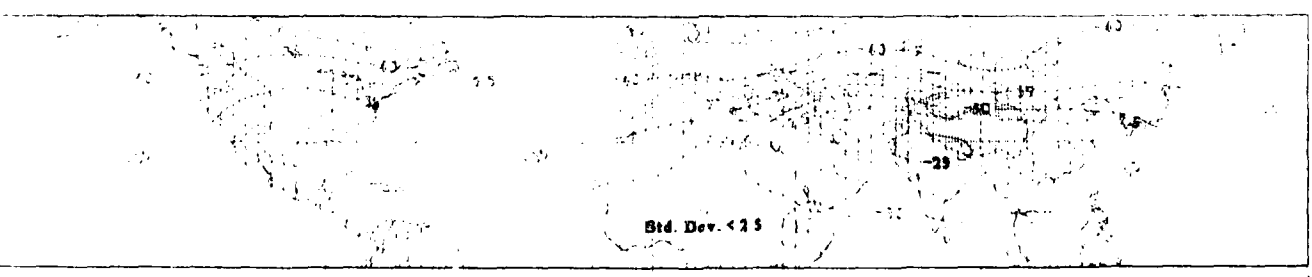
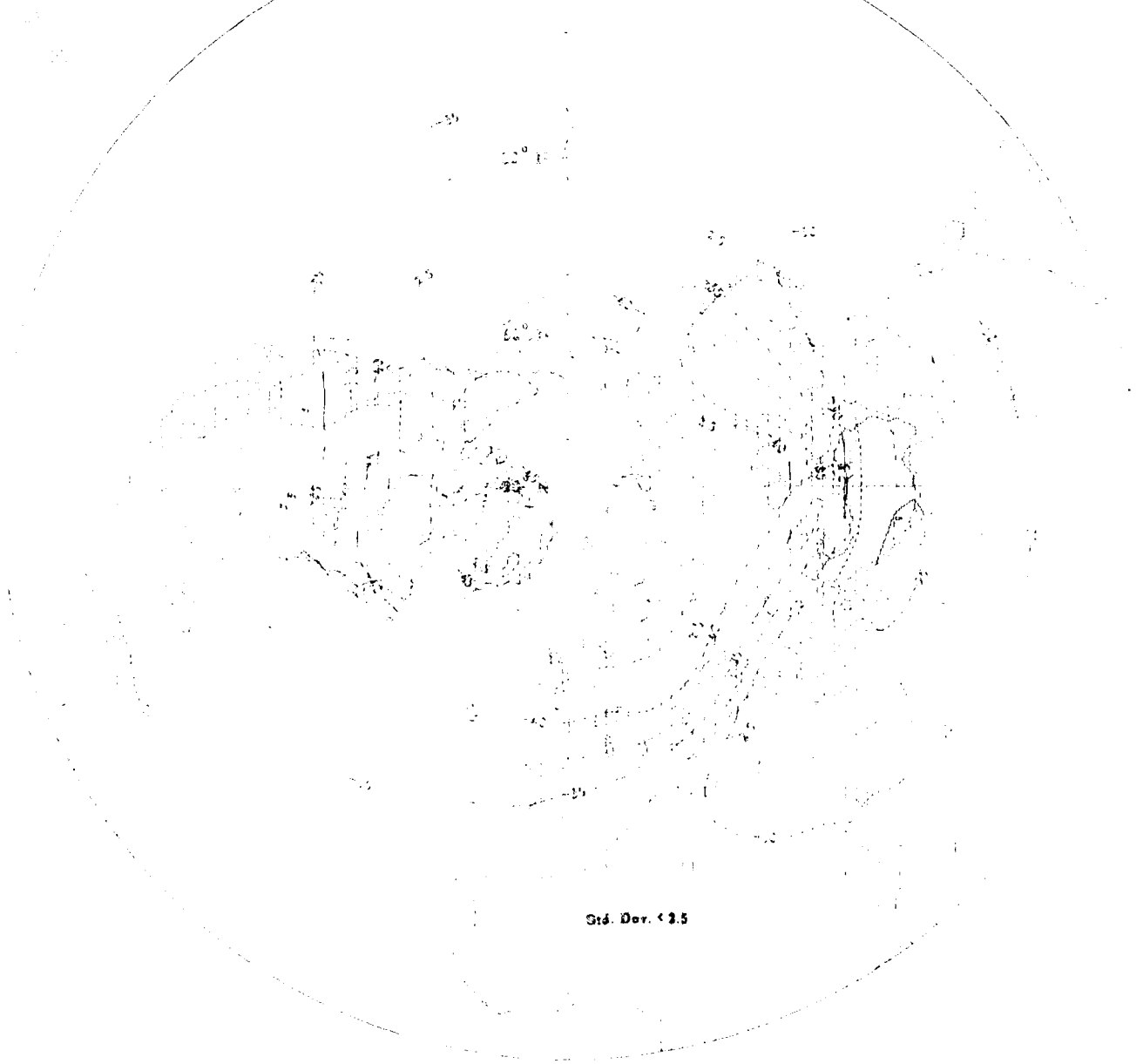


Figure 1 (continued)

Figure 1 (continued)

Figure 1 (continued)

Figure 1 (continued)



90° W 90° W 0° 90° E 180° E



Wind: 100000000 (2)

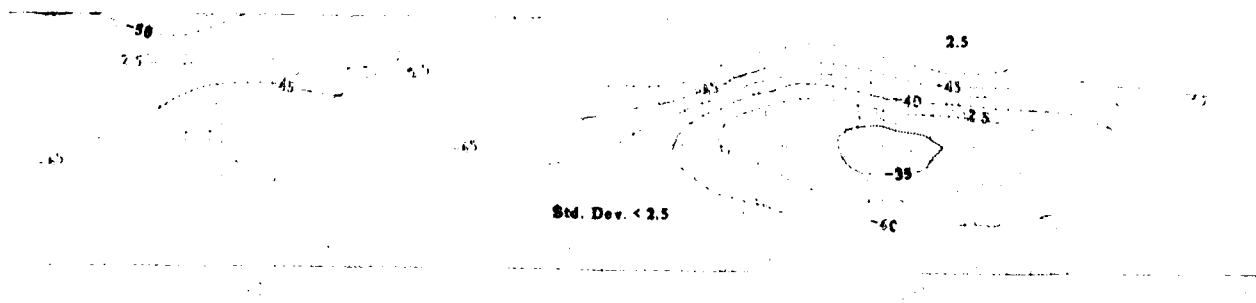
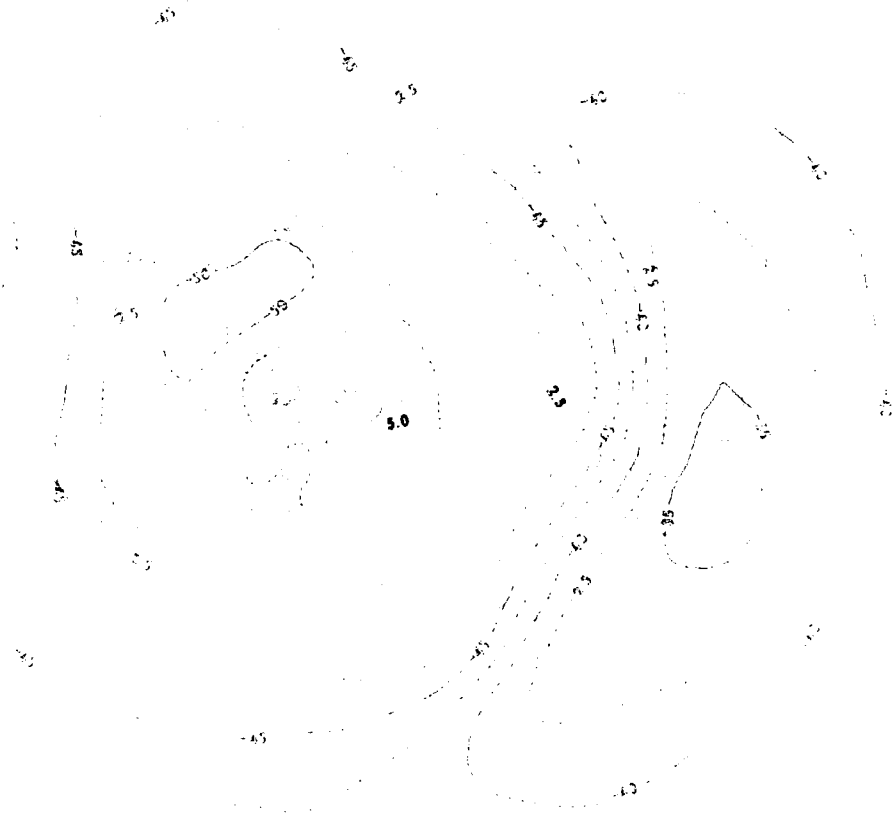
100000000

1000

1000000

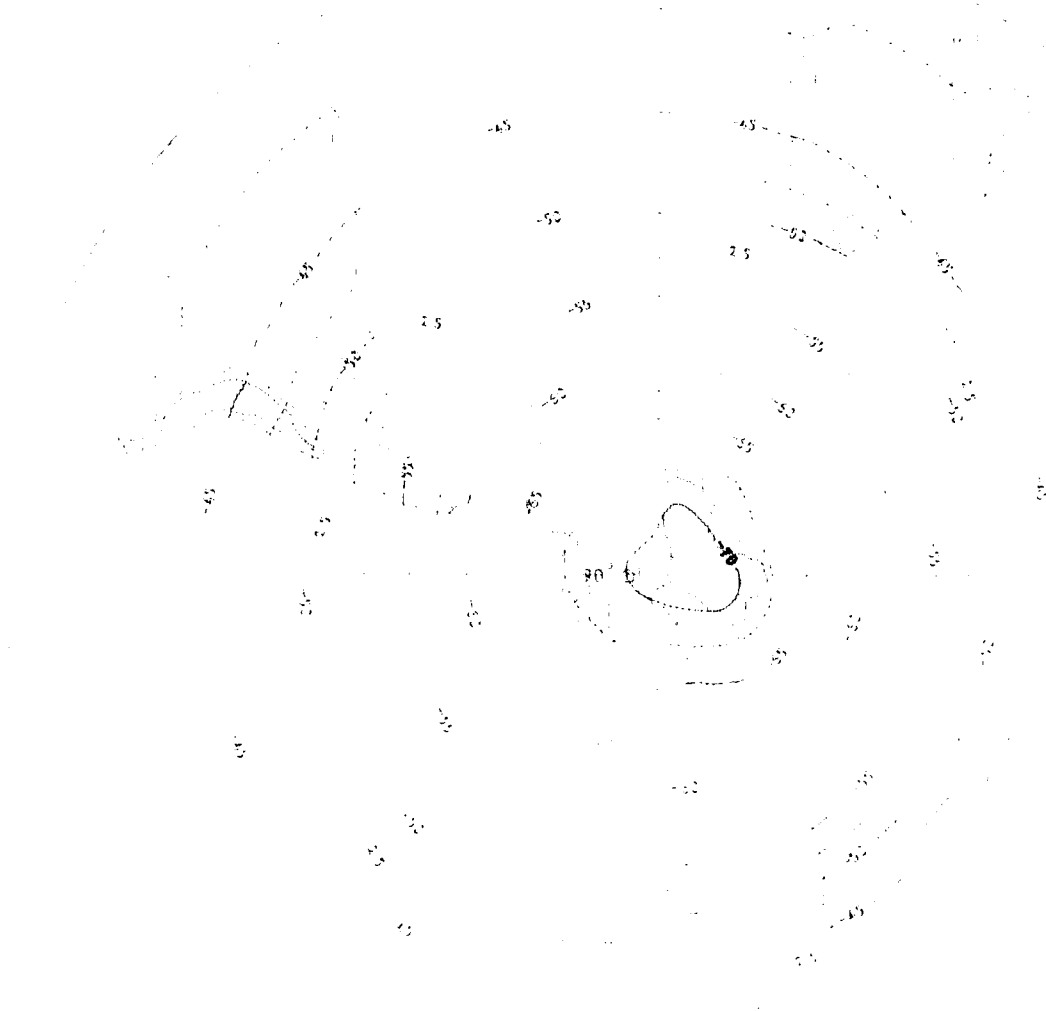
100000000

100000000

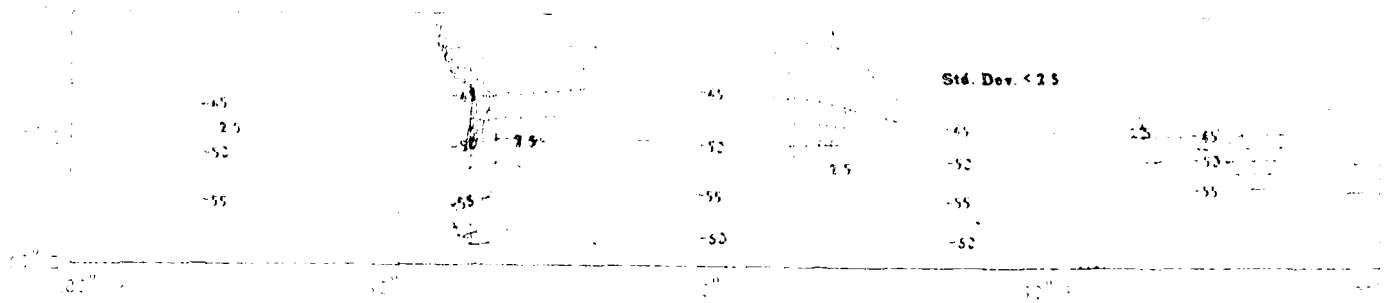


Top of the Mountains  
of the Mountains

Mean Temperature (C)  
Date: 10/10/1960  
1960  
1960



Std. Dev. < 2.5





Std. Dev. < 2.5



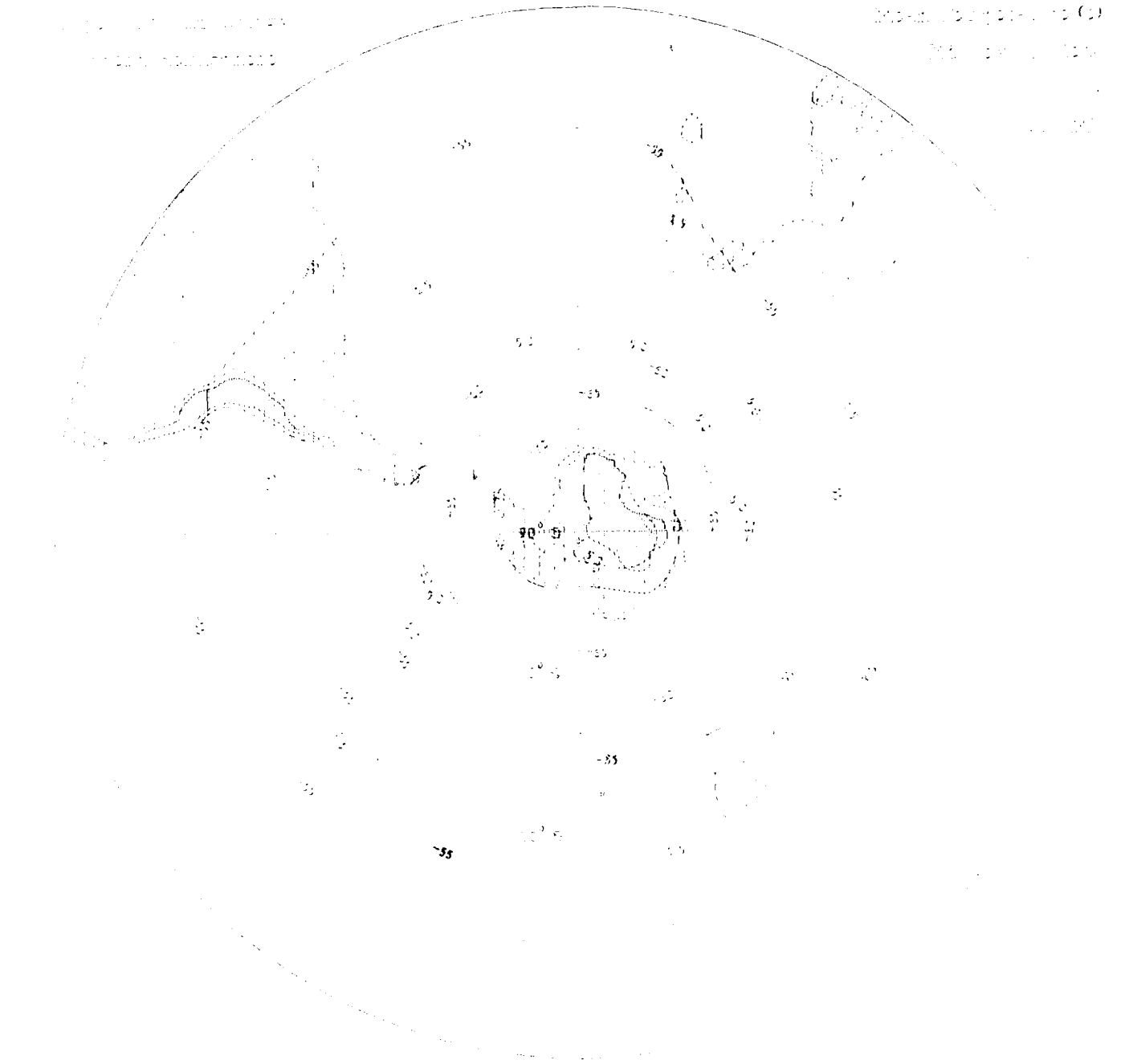
Std. Dev. < 2.5

1000 hPa

Mean Sea Level (m)

2000 hPa

1000 hPa



Mean Temperature (°C)

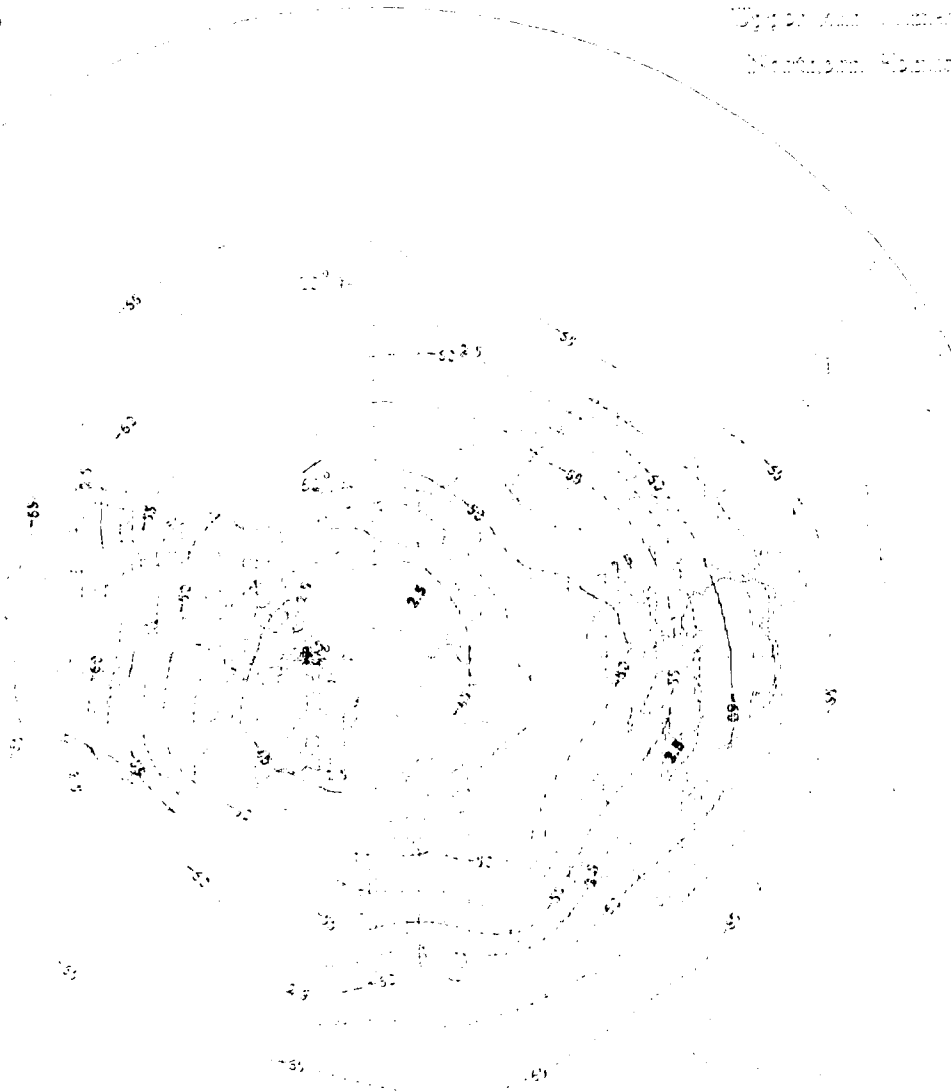
1950-1959

1960

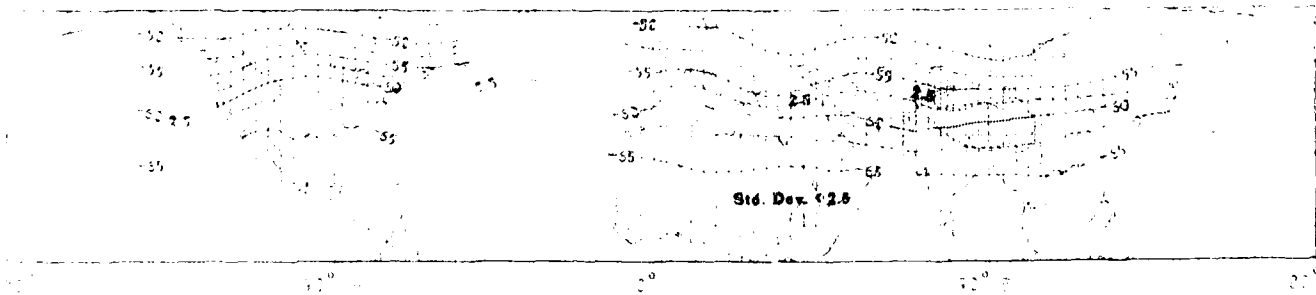
1961

Temperature Anomaly

Mean Annual



Std. Dev. < 2.5



Std. Dev. < 2.5

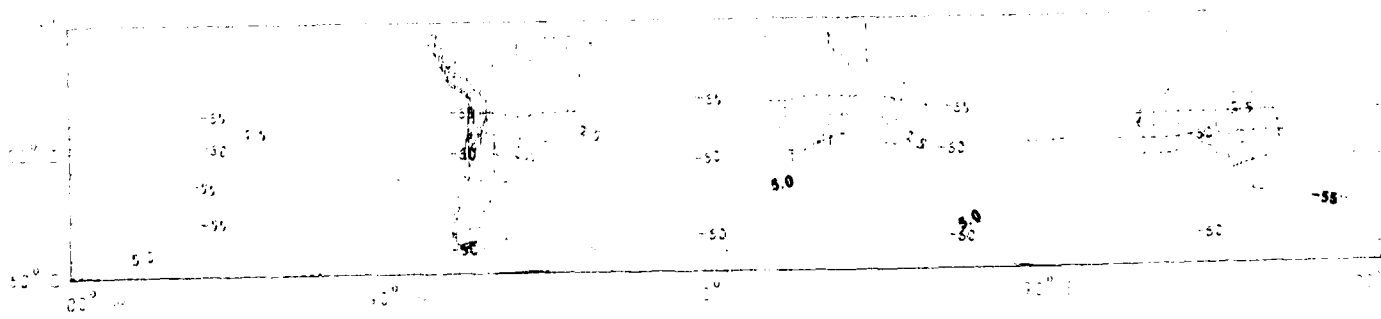
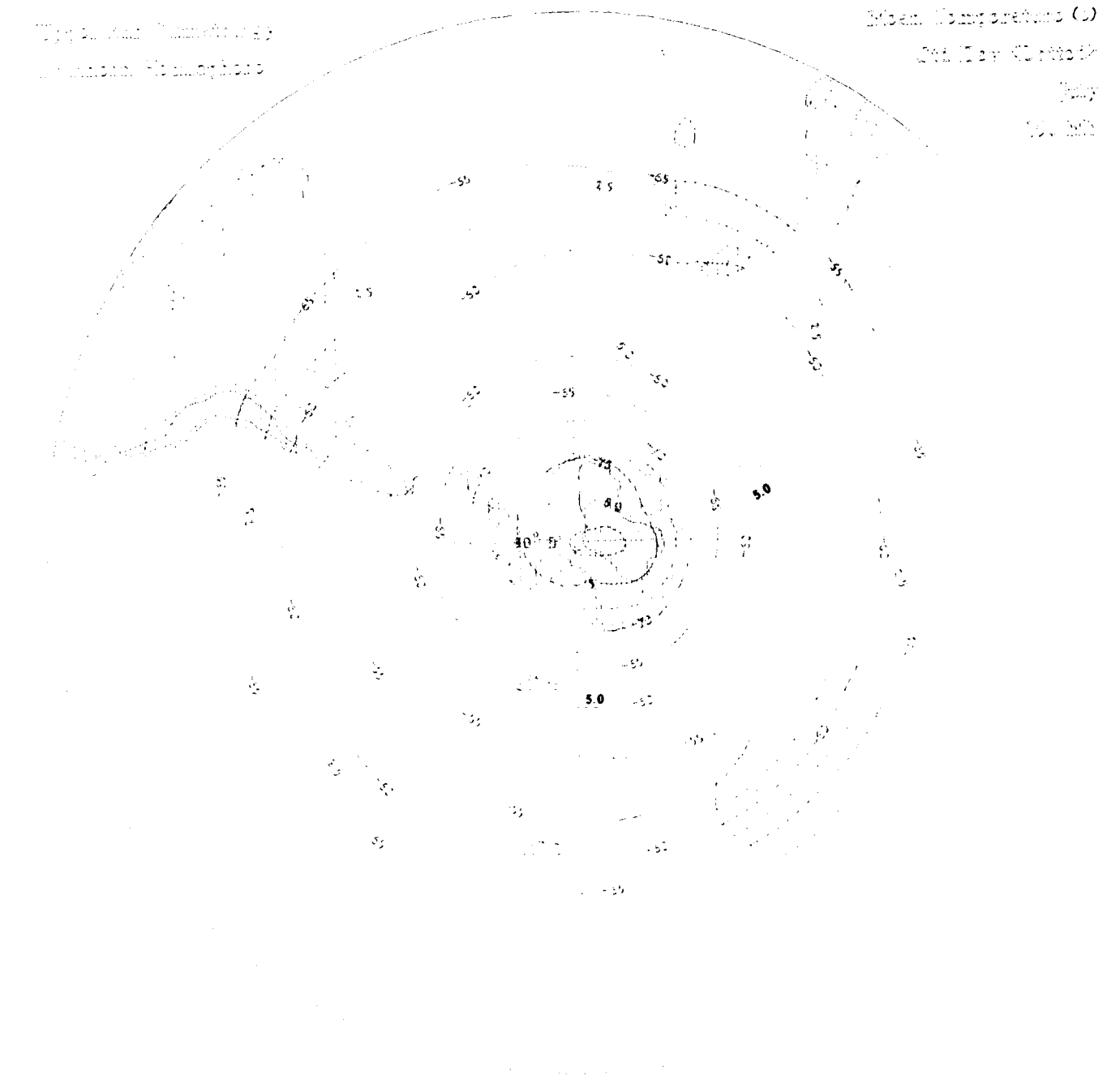
Typical and Unusually High  
Minimum Temperatures

Mean Temperature (°C)

24th July (1950)

July

1950



Mean Temperature (C)

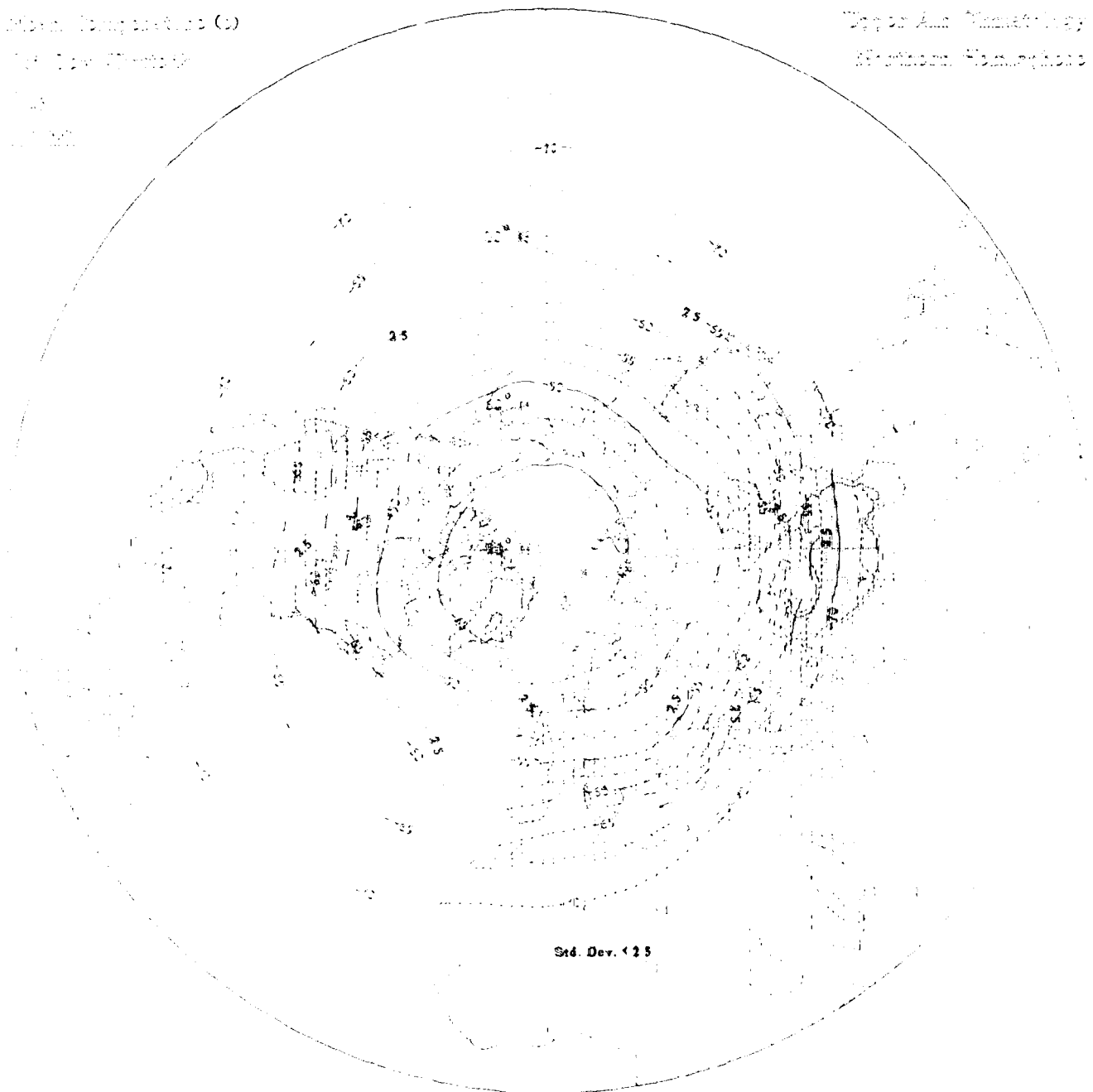
Sea Level Pressure (hPa)

Wind

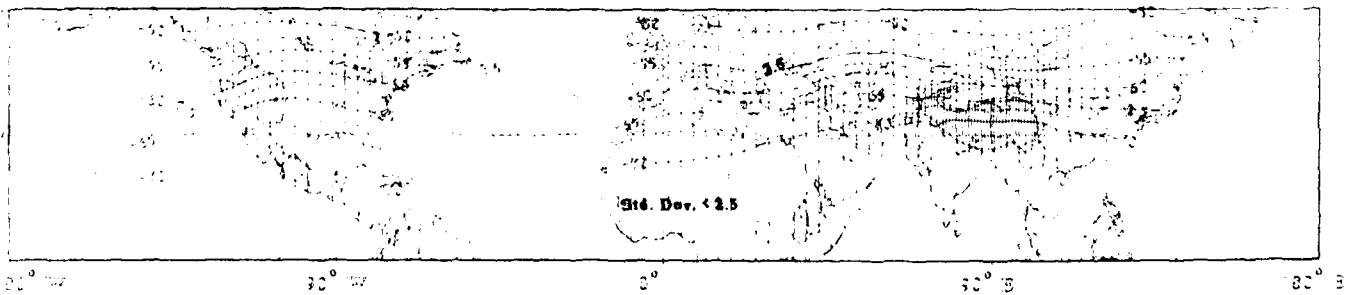
Clouds

Depth and Wind Velocity

Atmospheric Humidity



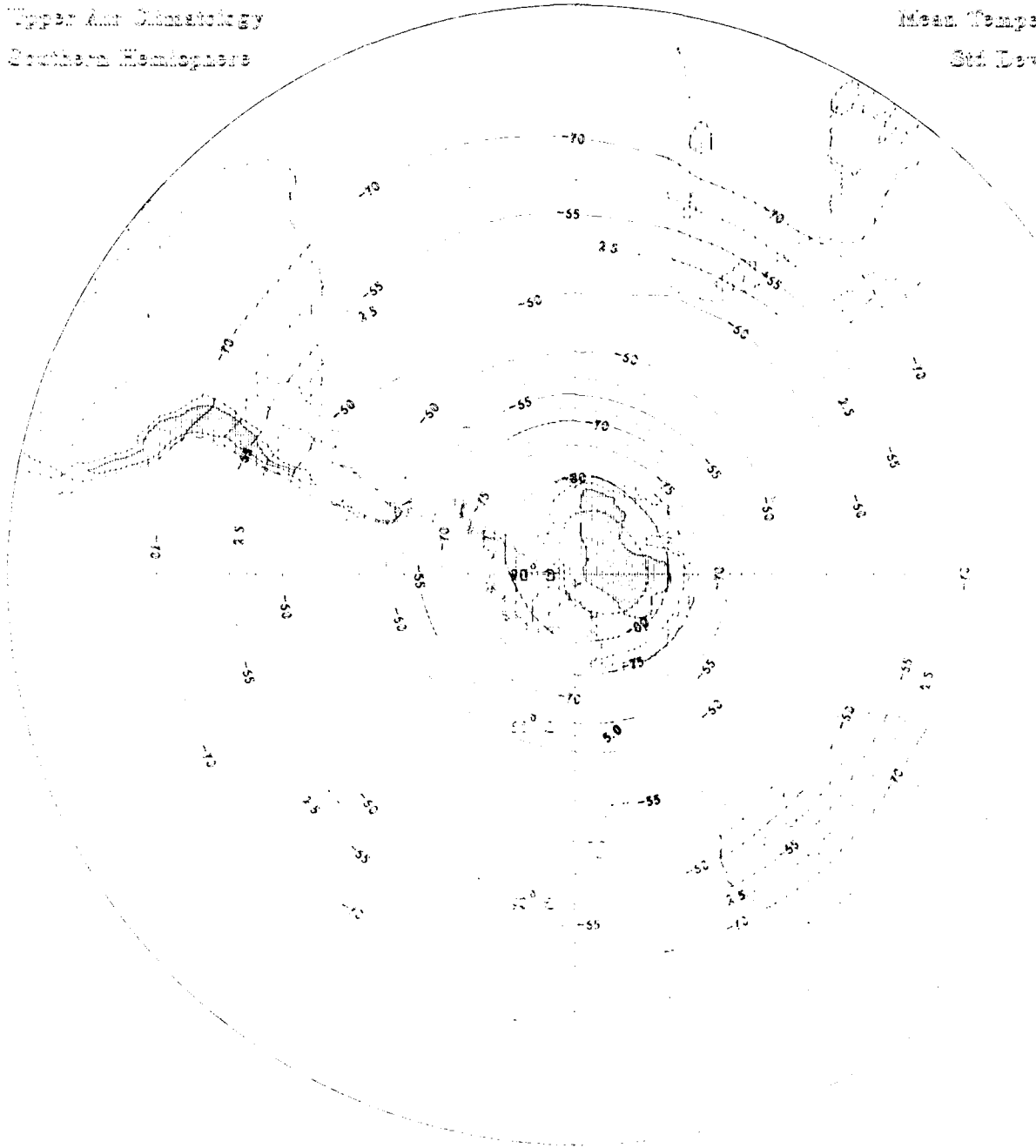
Std. Dev. 1.25



Std. Dev. 1.25

Upper Air Climatology  
Southern Hemisphere

Mean Temperature (C)  
Std Dev (Cents)  
July  
1951-55



Mean Temperature (c)

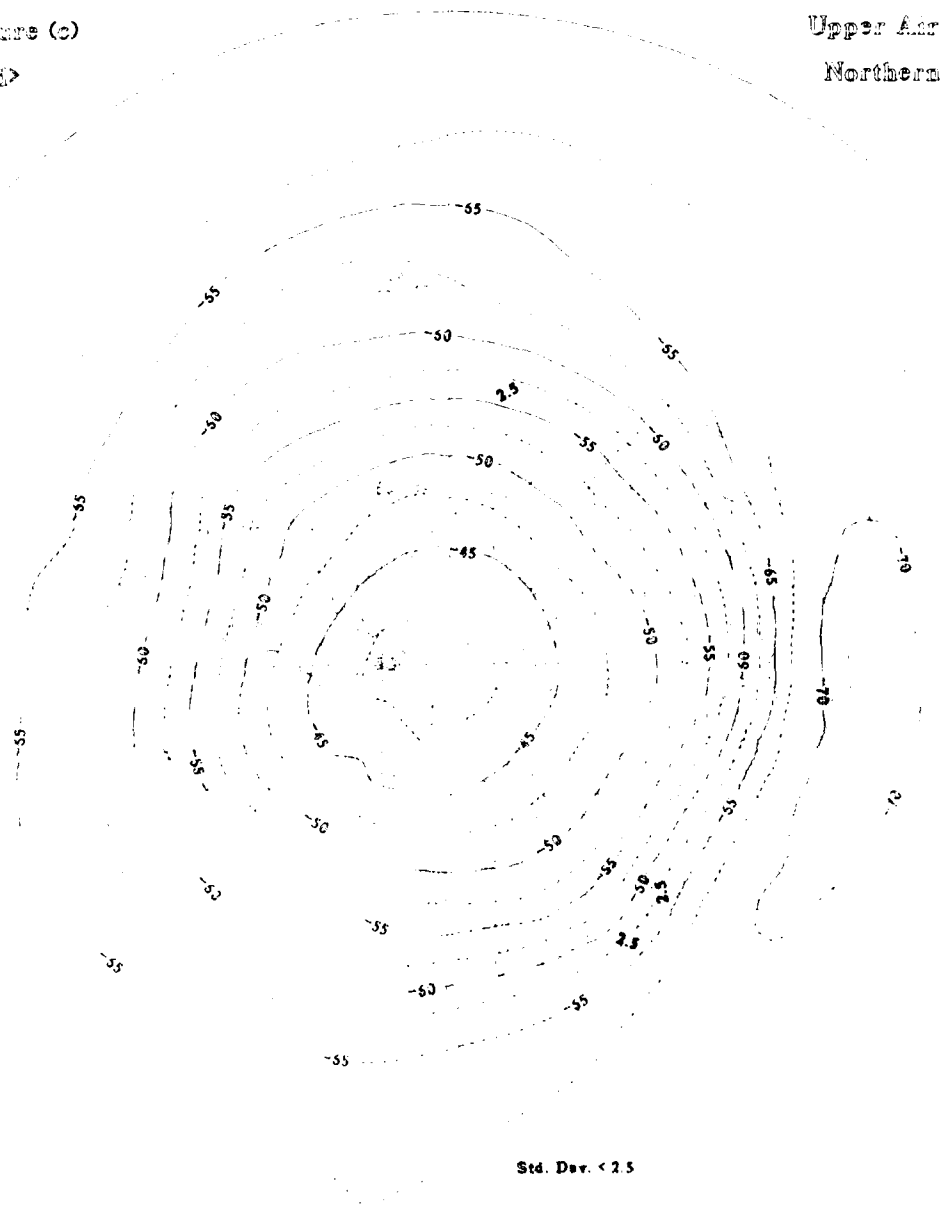
Std Dev (Dotted)

July

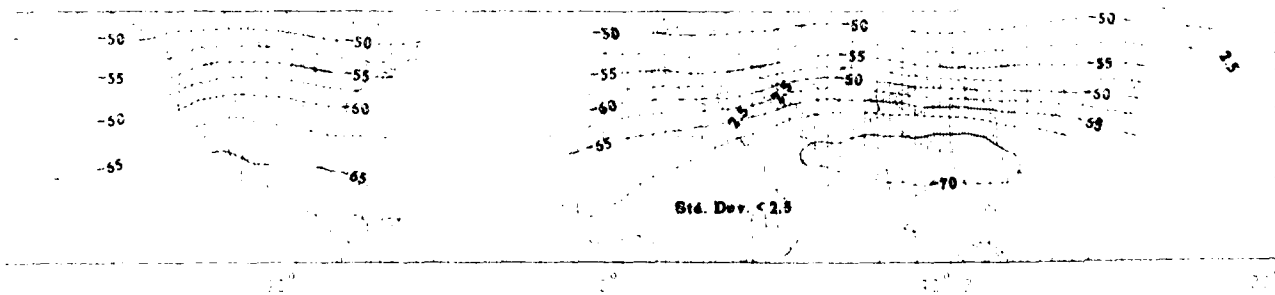
1979

Upper Air Climatology

Northern Hemisphere



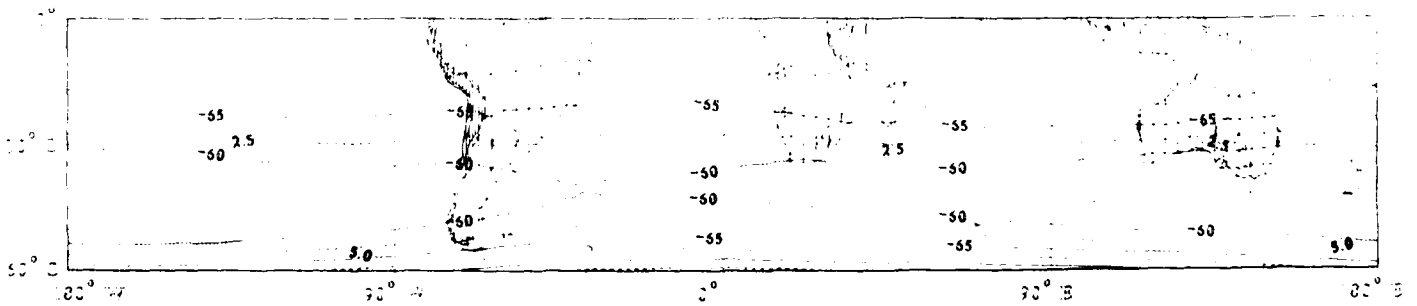
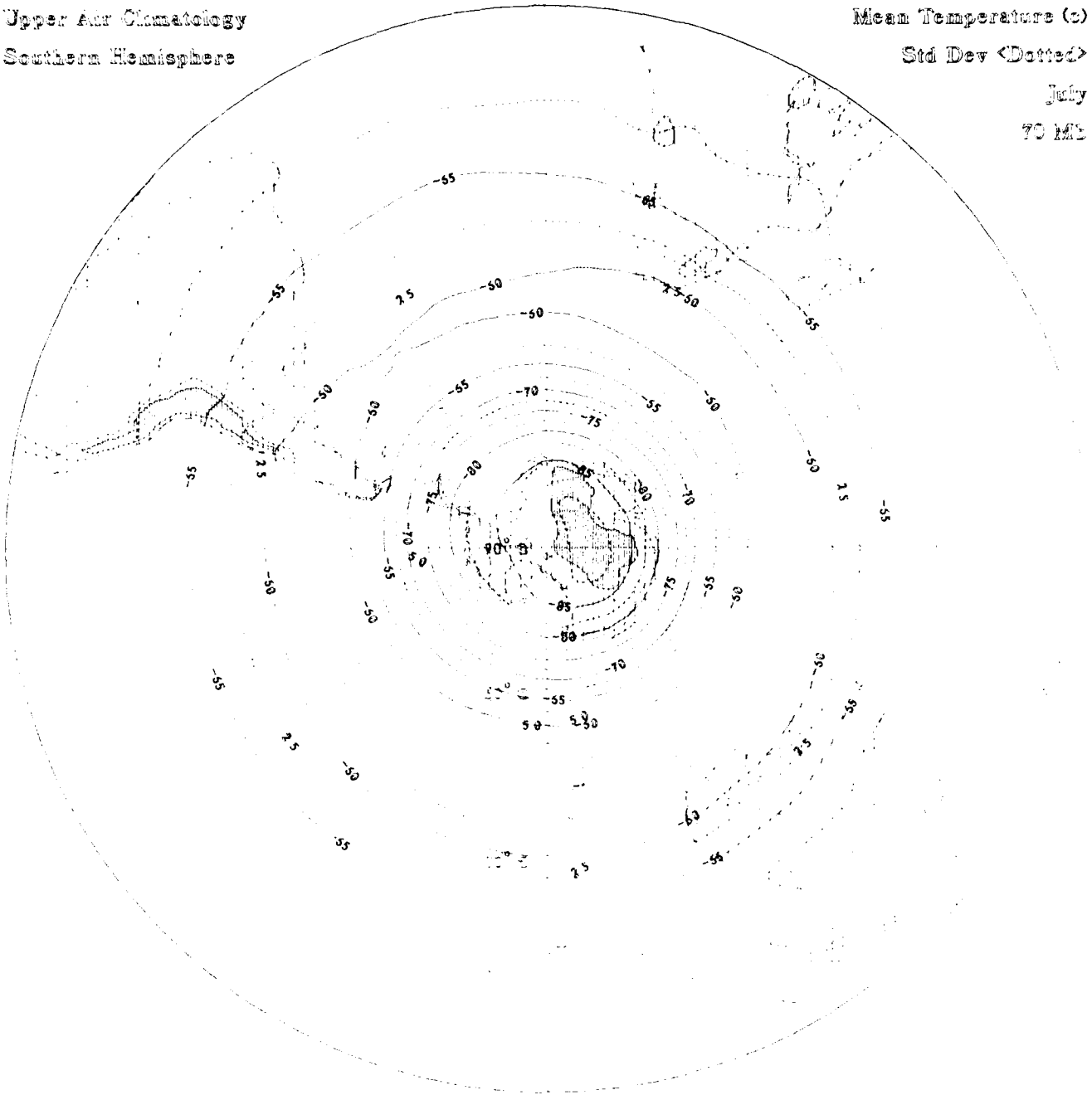
Std. Dev. < 2.5



Std. Dev. < 2.5

Upper Air Climatology  
Southern Hemisphere

Mean Temperature (—)  
Std Dev (Dotted)  
July  
70 MB



Mean Temperature (c)

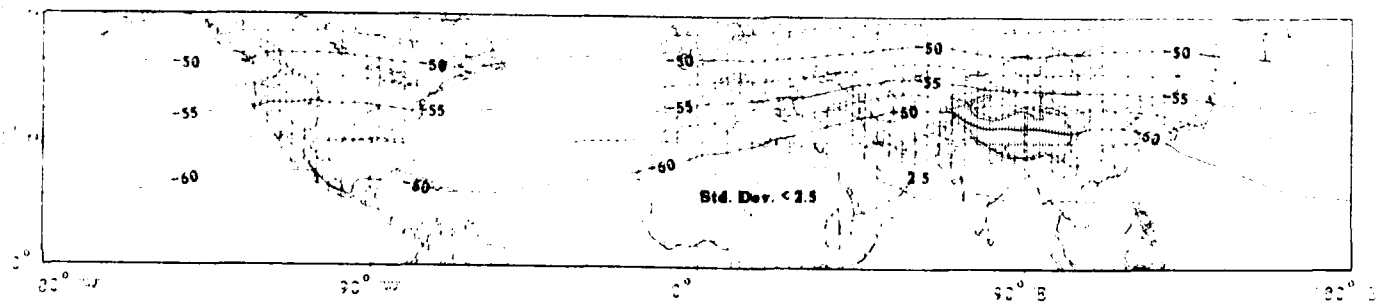
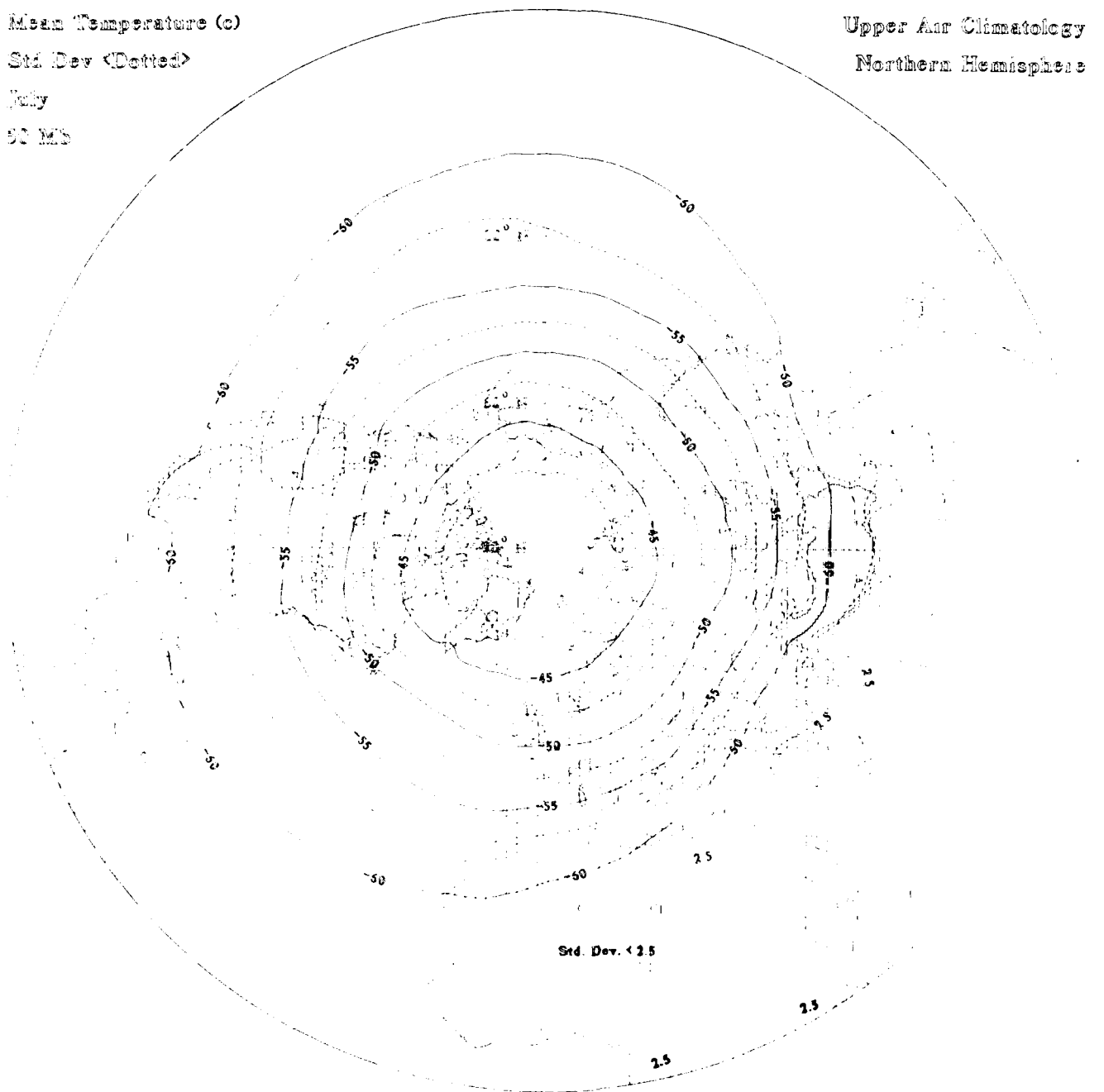
Std. Dev. <Dotted>

July

50 MB

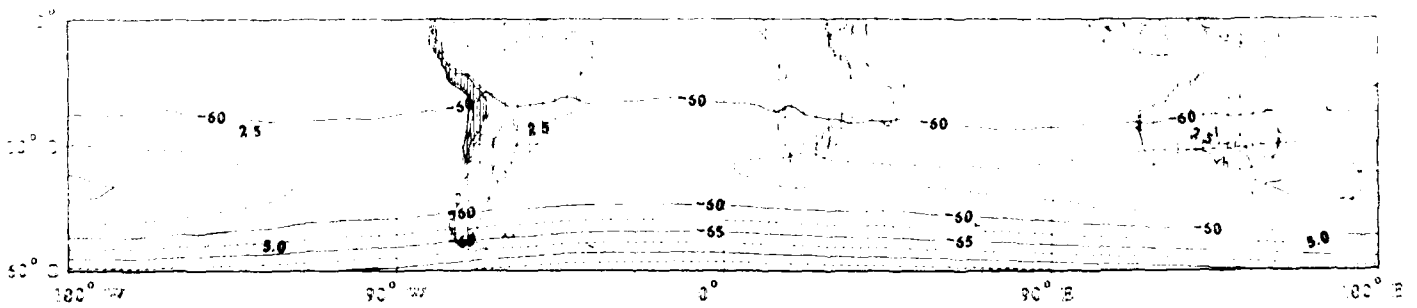
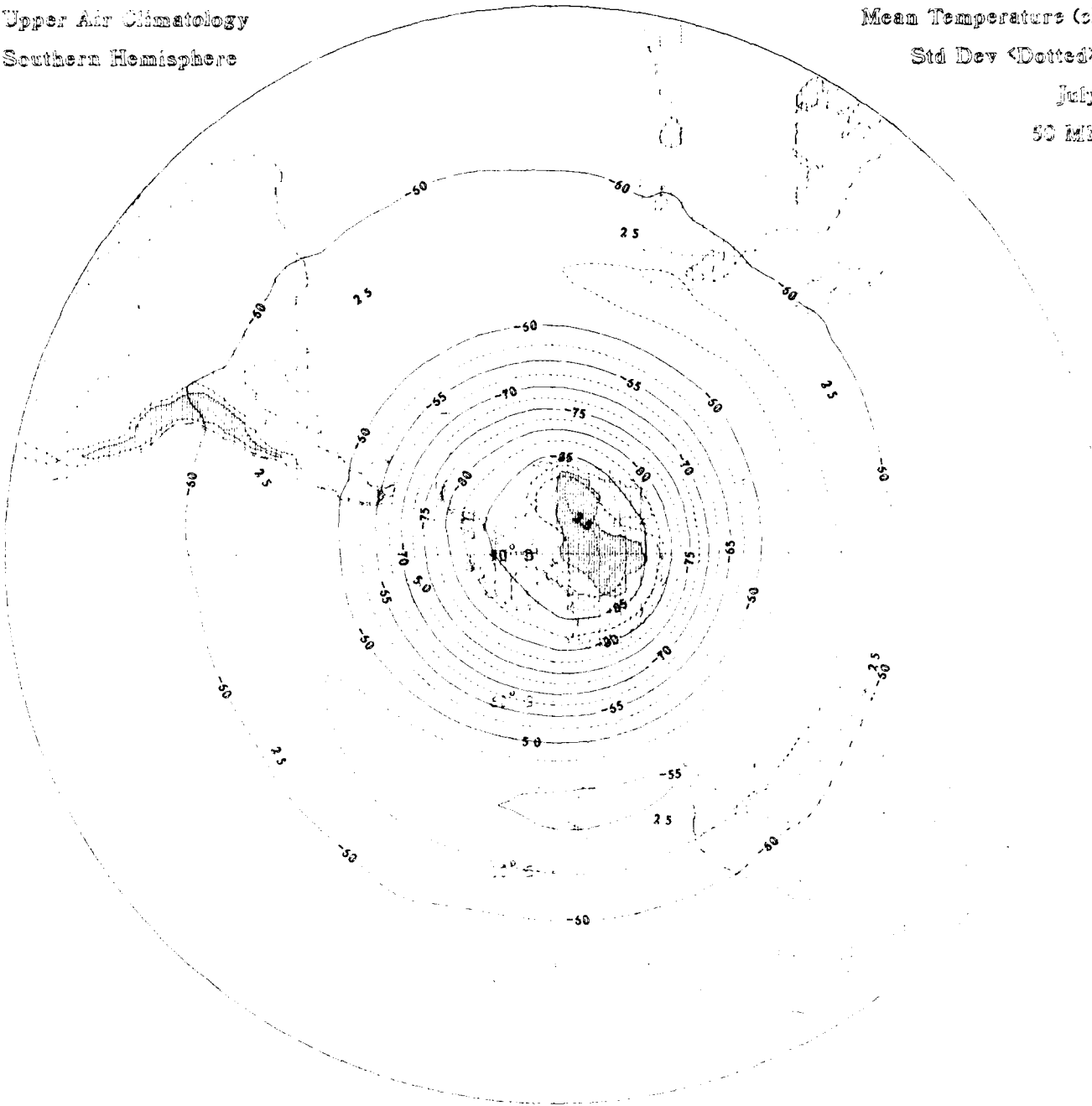
Upper Air Climatology

Northern Hemisphere



Upper Air Climatology  
Southern Hemisphere

Mean Temperature (°)  
Std Dev (Dotted)  
July  
50 MB



Mean Temperature (C)

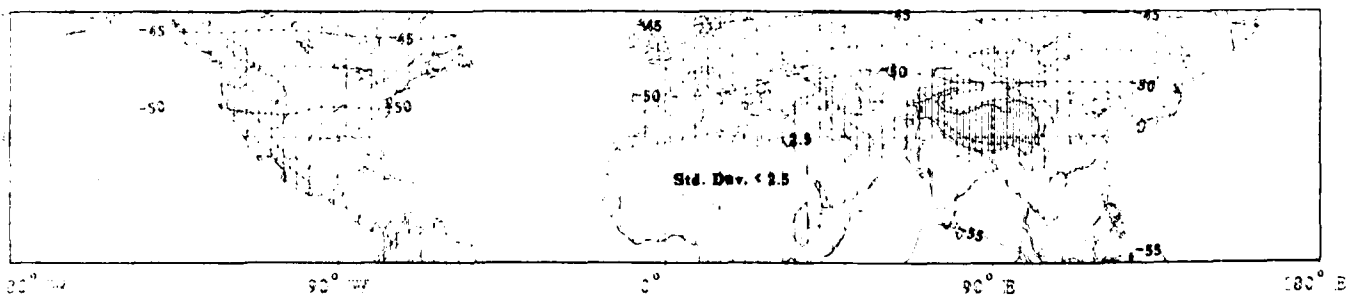
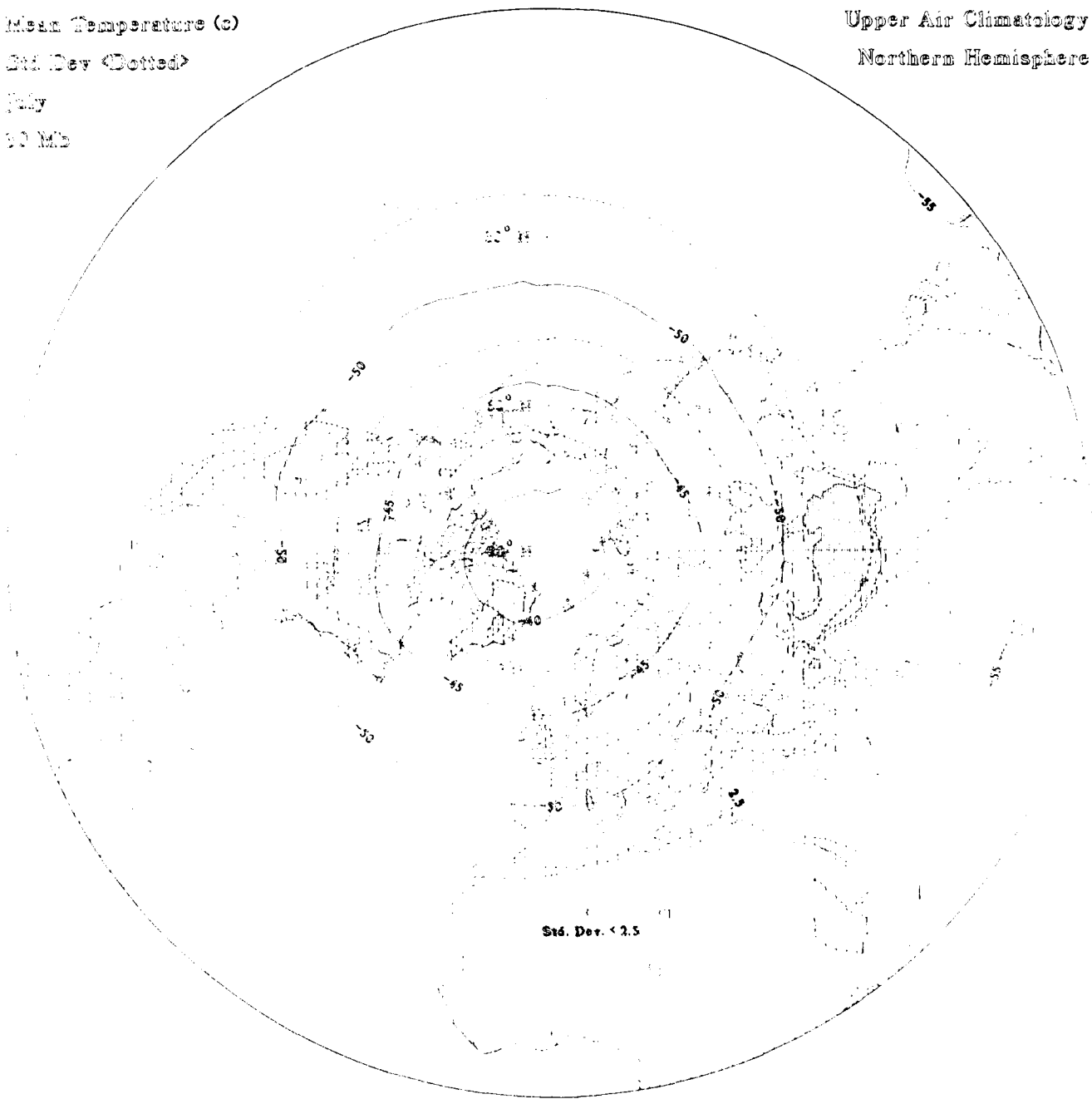
Std. Dev. (Dotted)

July

50 Mb

Upper Air Climatology

Northern Hemisphere



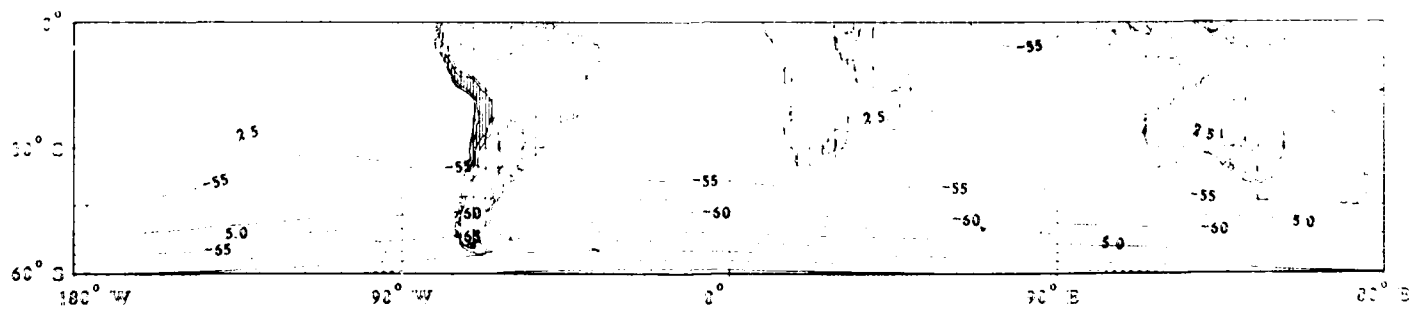
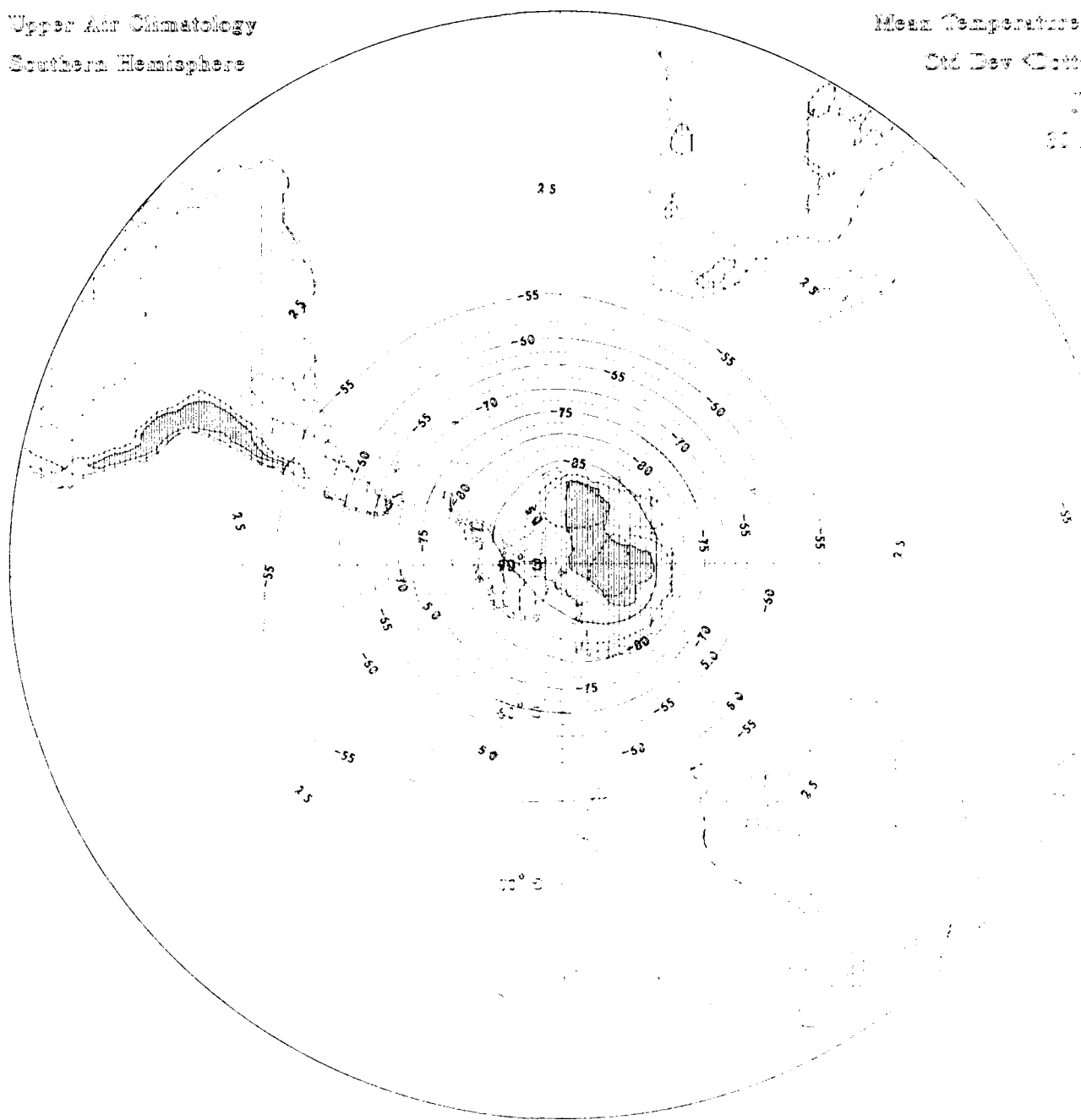
Upper Air Climatology  
Southern Hemisphere

Mean Temperature (°C)

Std Dev (Coded)

July

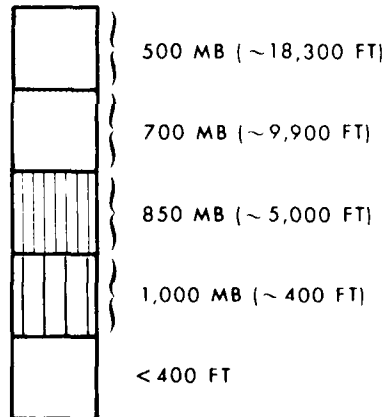
31 MS



**DEW POINT**  
**(6 LEVELS, 1000 TO 300 MB)**

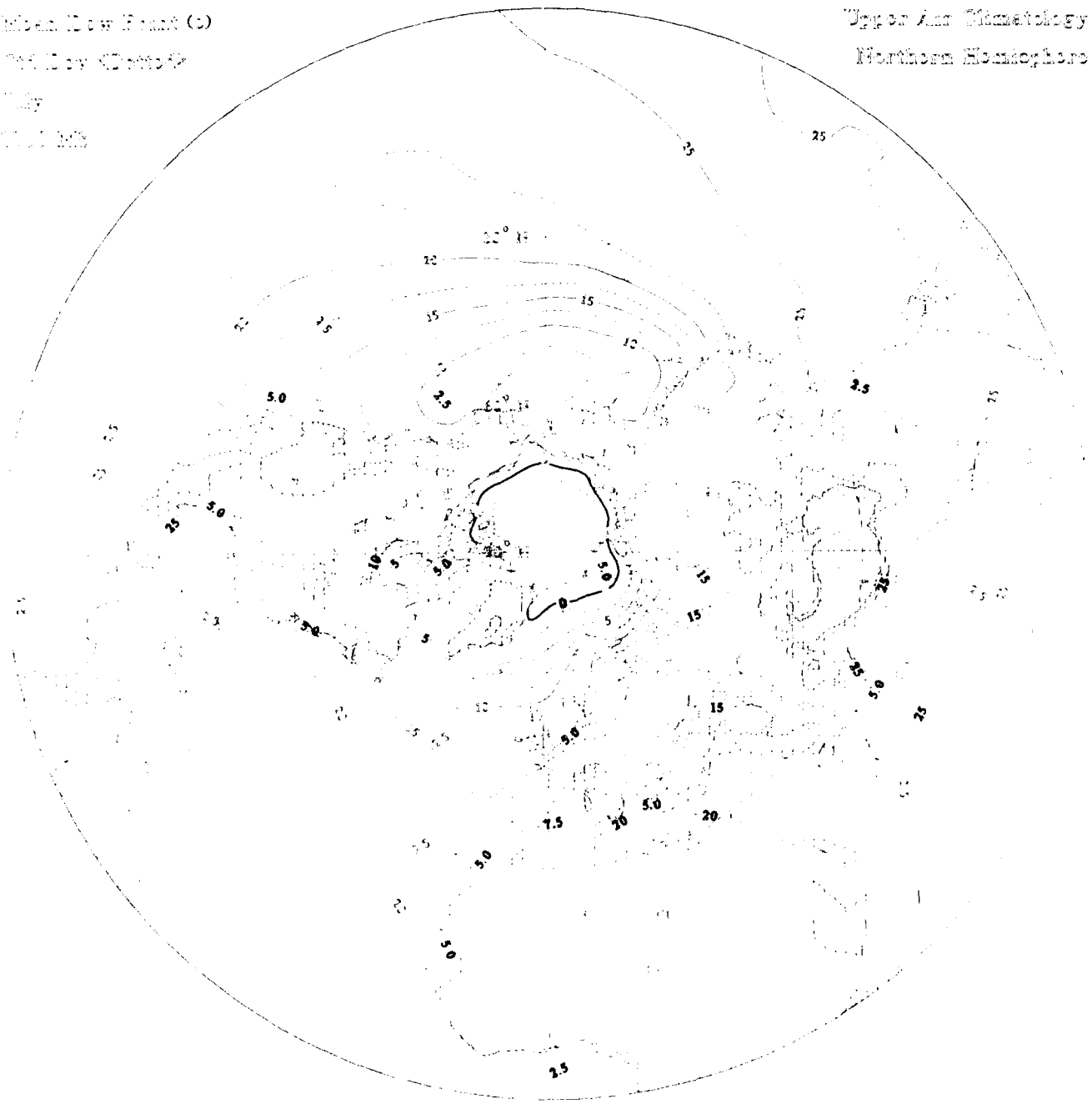
- Contours of mean dew point (solid and dashed lines) in °C; solids labeled, dashed intermediates unlabeled.
- Dew point labeled interval: 5°C
- Contours of standard deviation of dew point (dotted lines) in °C
- Standard deviation of dew point labeled interval: 2.5°C
- Contours blanked for geographic area with elevations exceeding specified geopotential heights

**ELEVATION SCALE**



Mean Dew Point (°C)  
Sea Level (Dashed)  
1000  
500 mb

Upper Air Climatology  
Northern Hemisphere

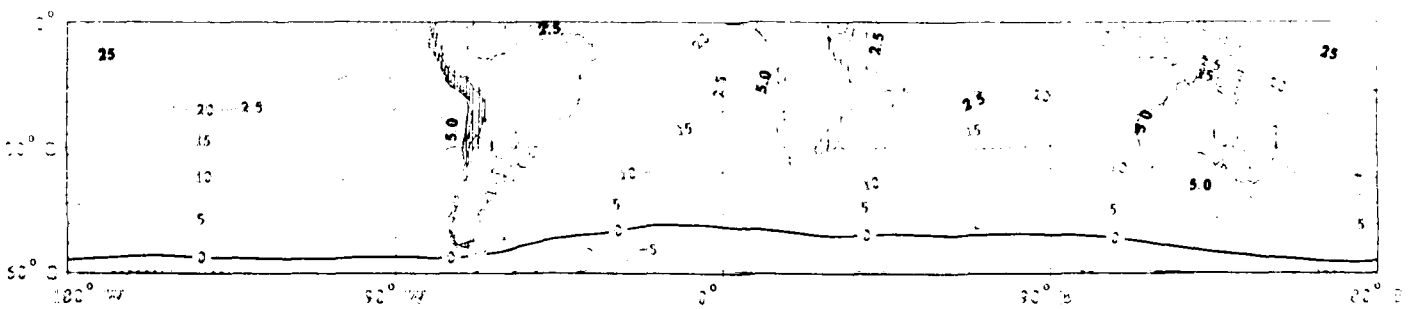
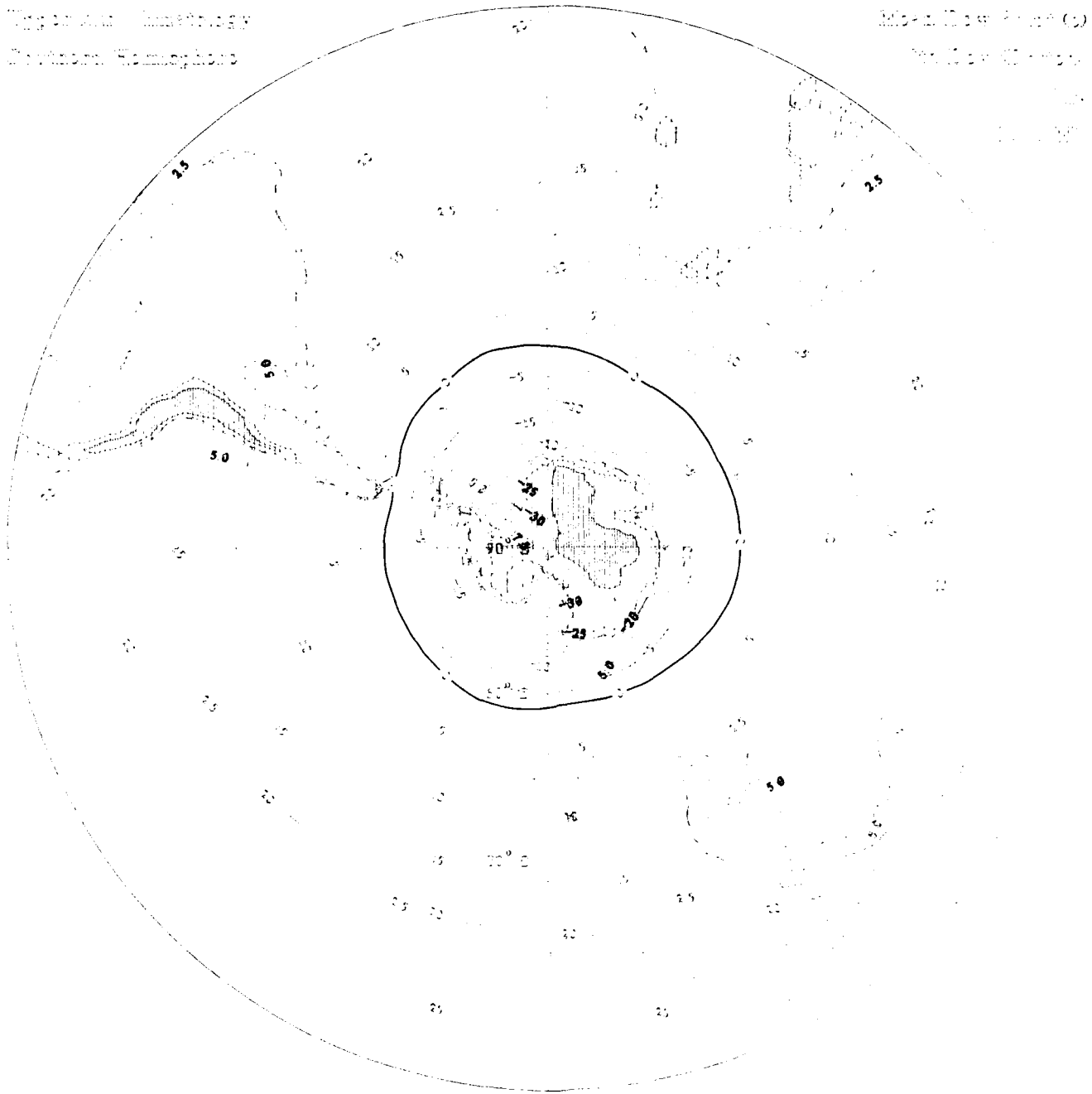


Topographic Contour  
Elevation: Feet

Mean Low Water (2)

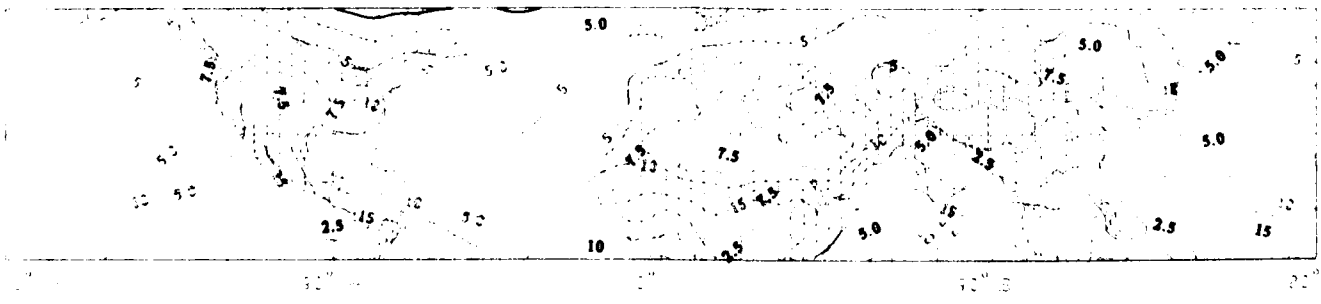
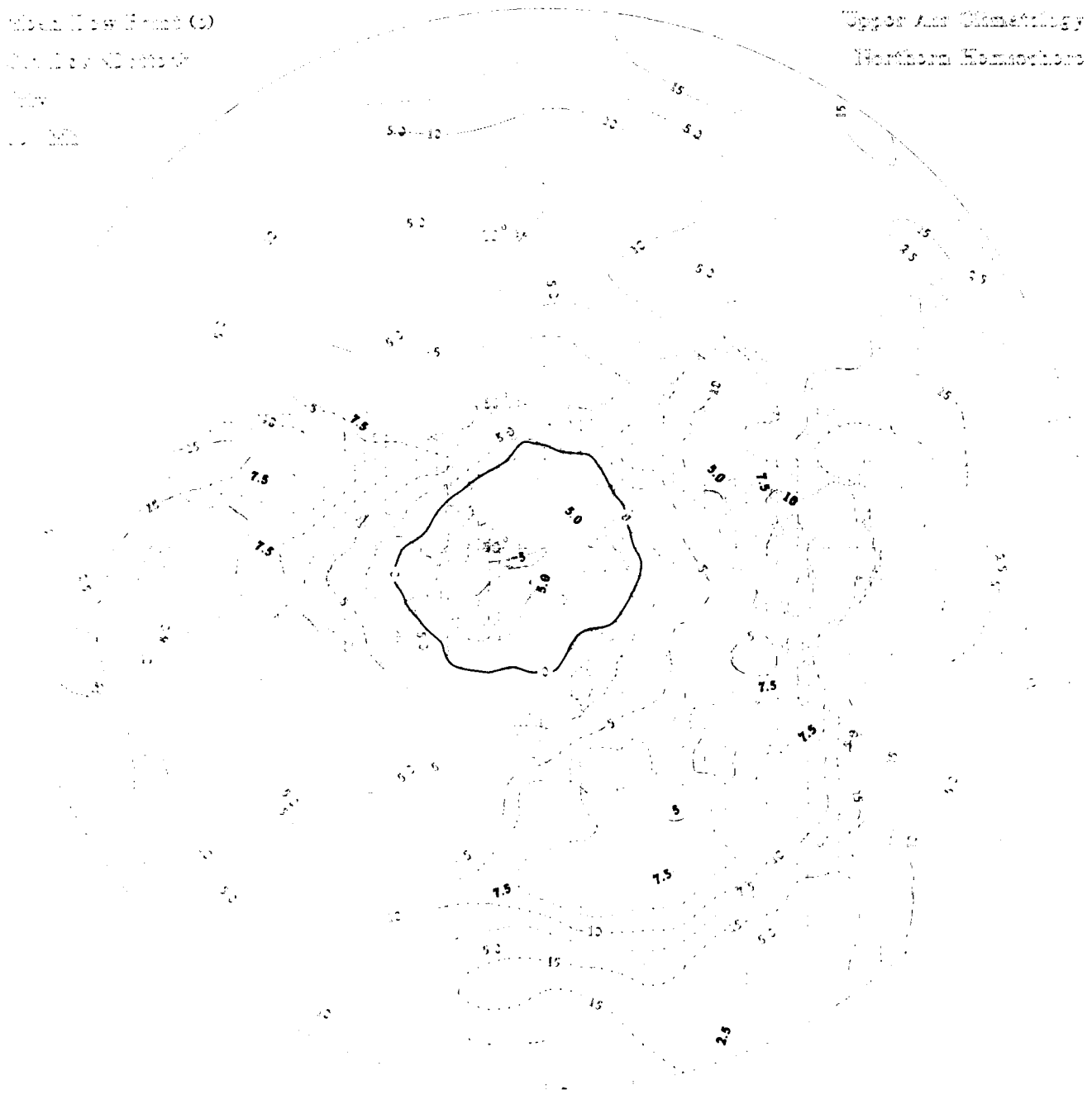
Sea Level Contour

1:250,000



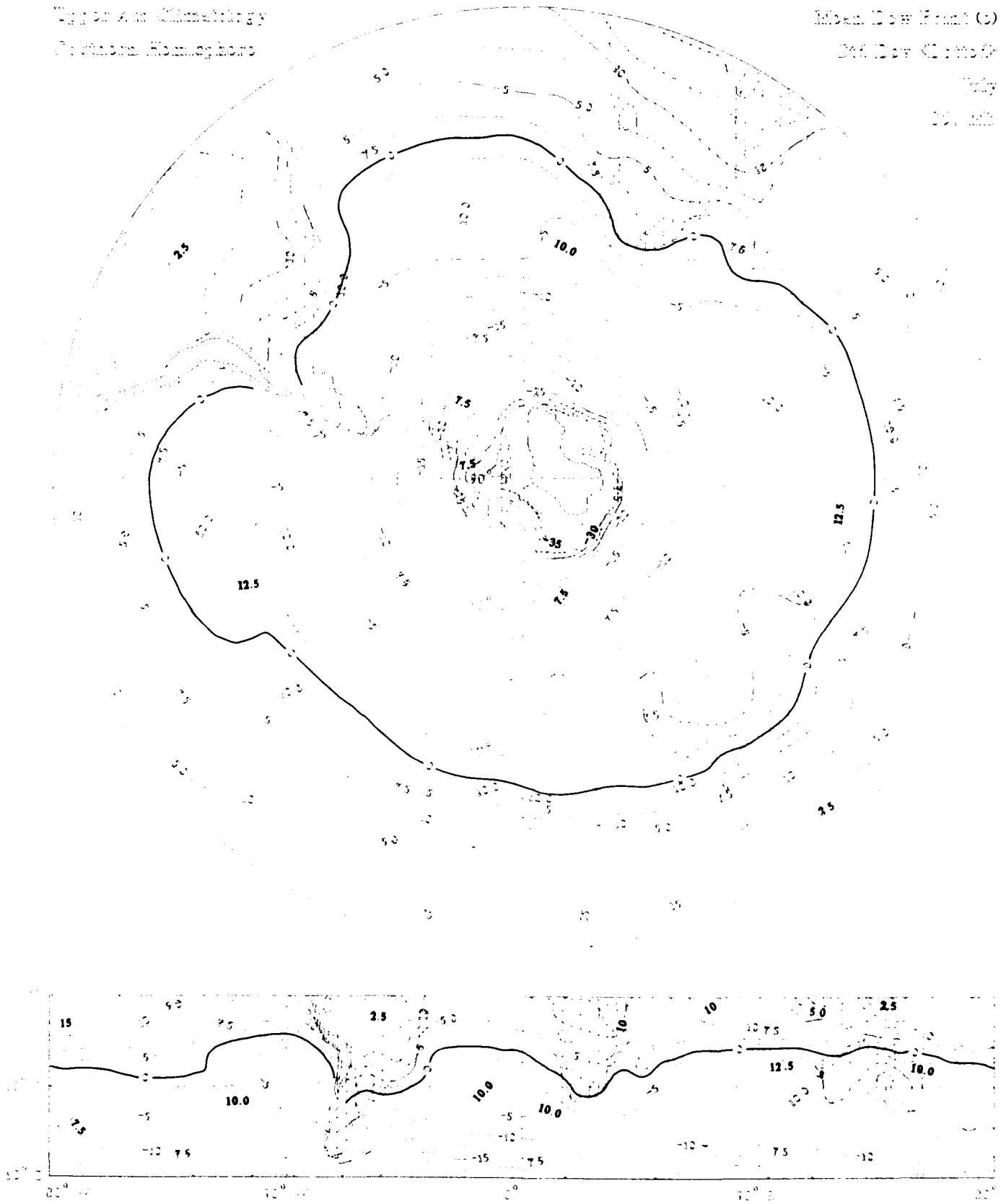
Mean Flow Height (C)  
Contour Interval 0.5  
1950

Upper Air Climatology  
Northern Hemisphere



Typical Climatology  
Polaroid Homologous

Mean Dew Point (°)  
Sea Day Climate  
July  
1950



Lower Ocean Front (c)

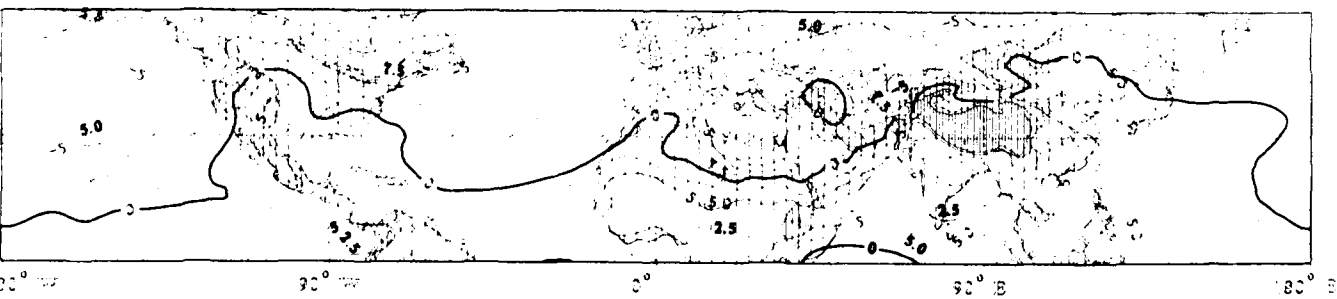
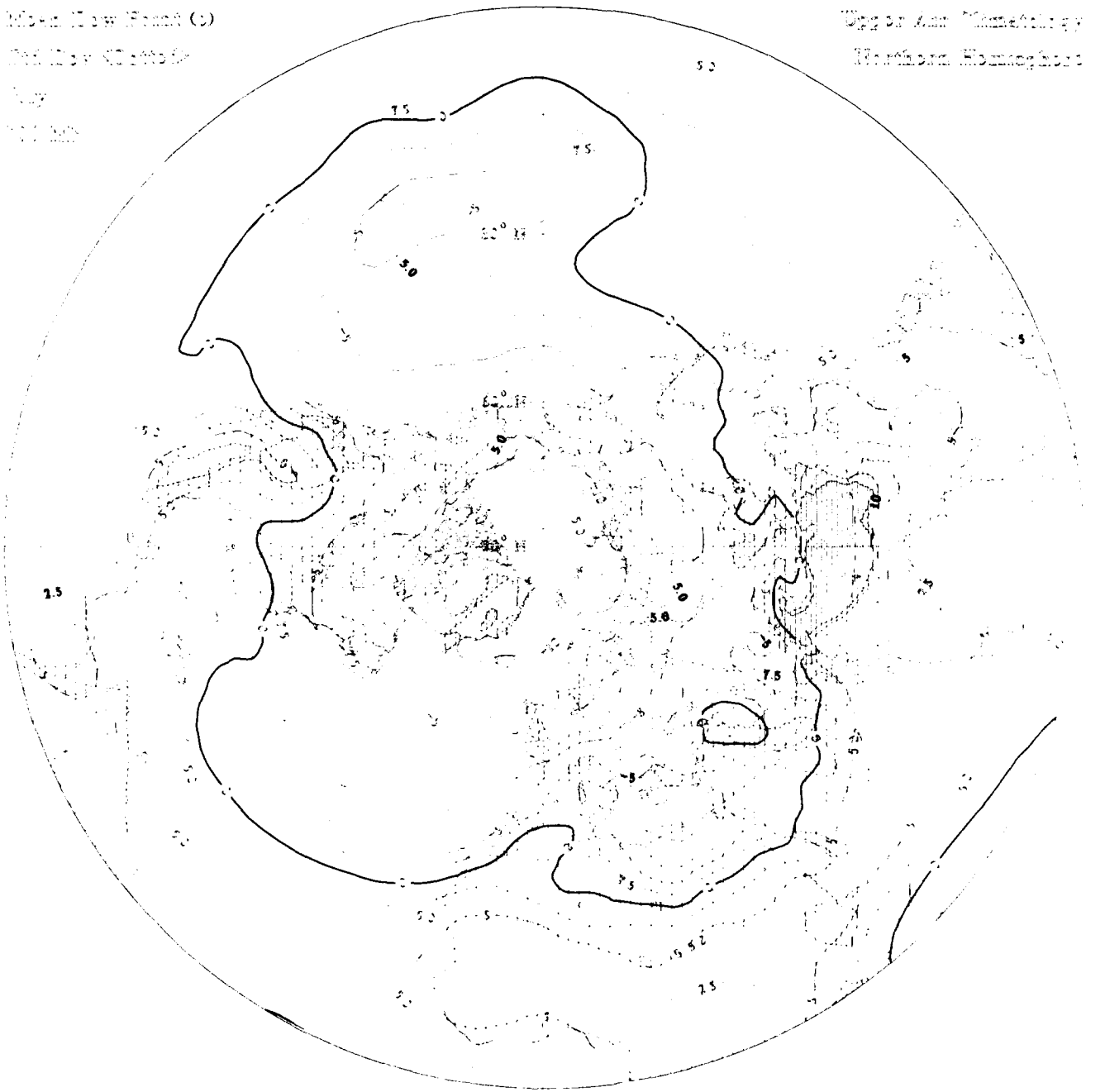
1962-63

July

1962-63

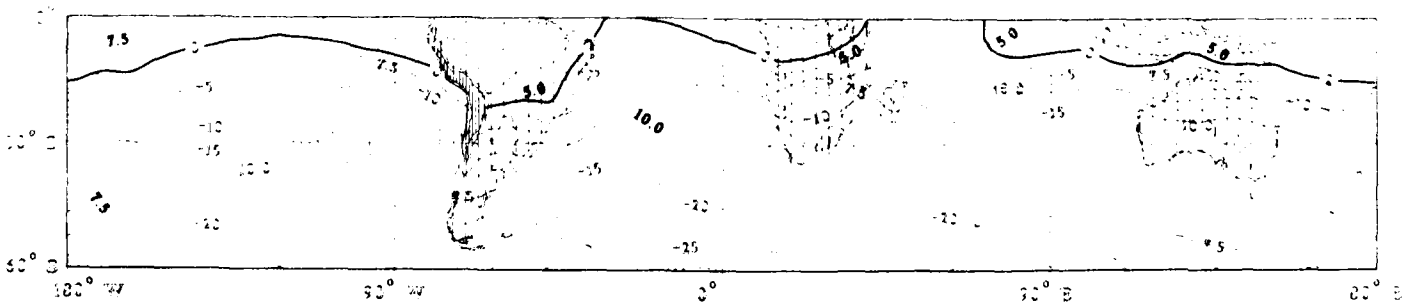
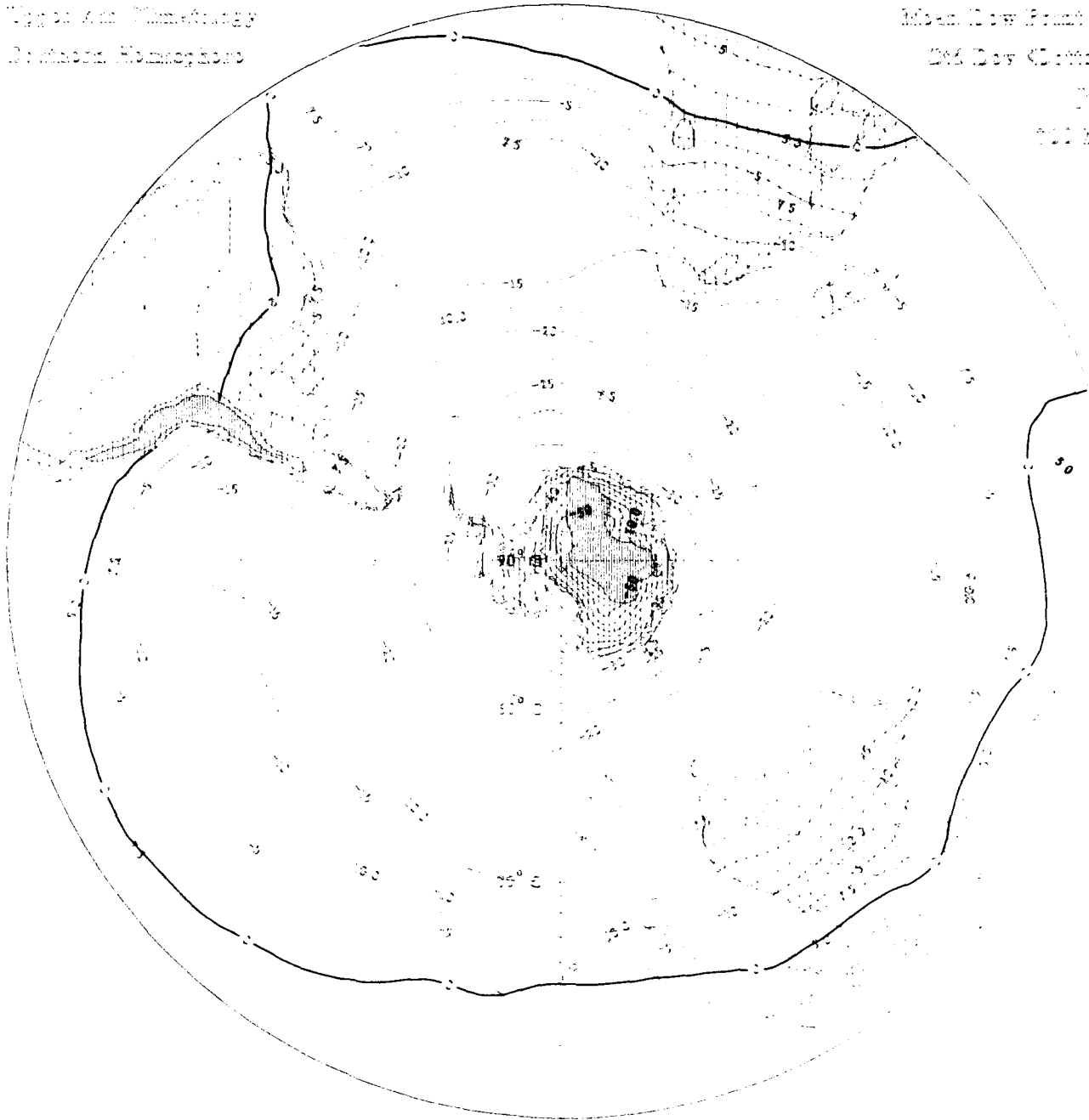
Upper Ocean Temperature

1962-63



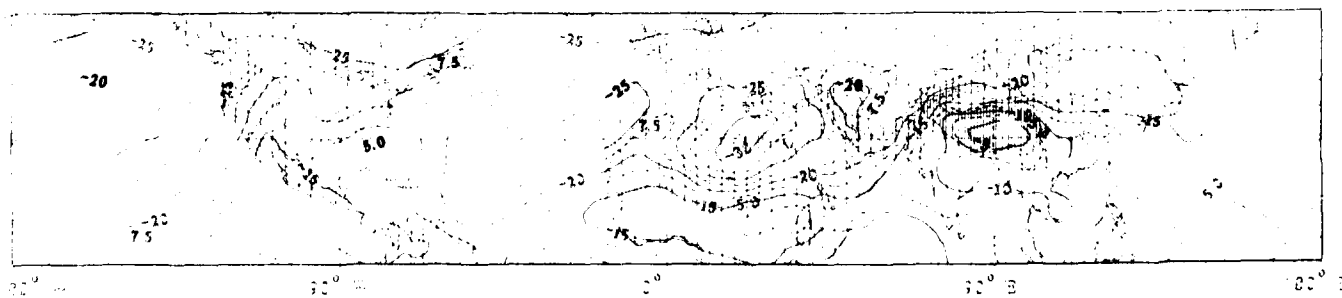
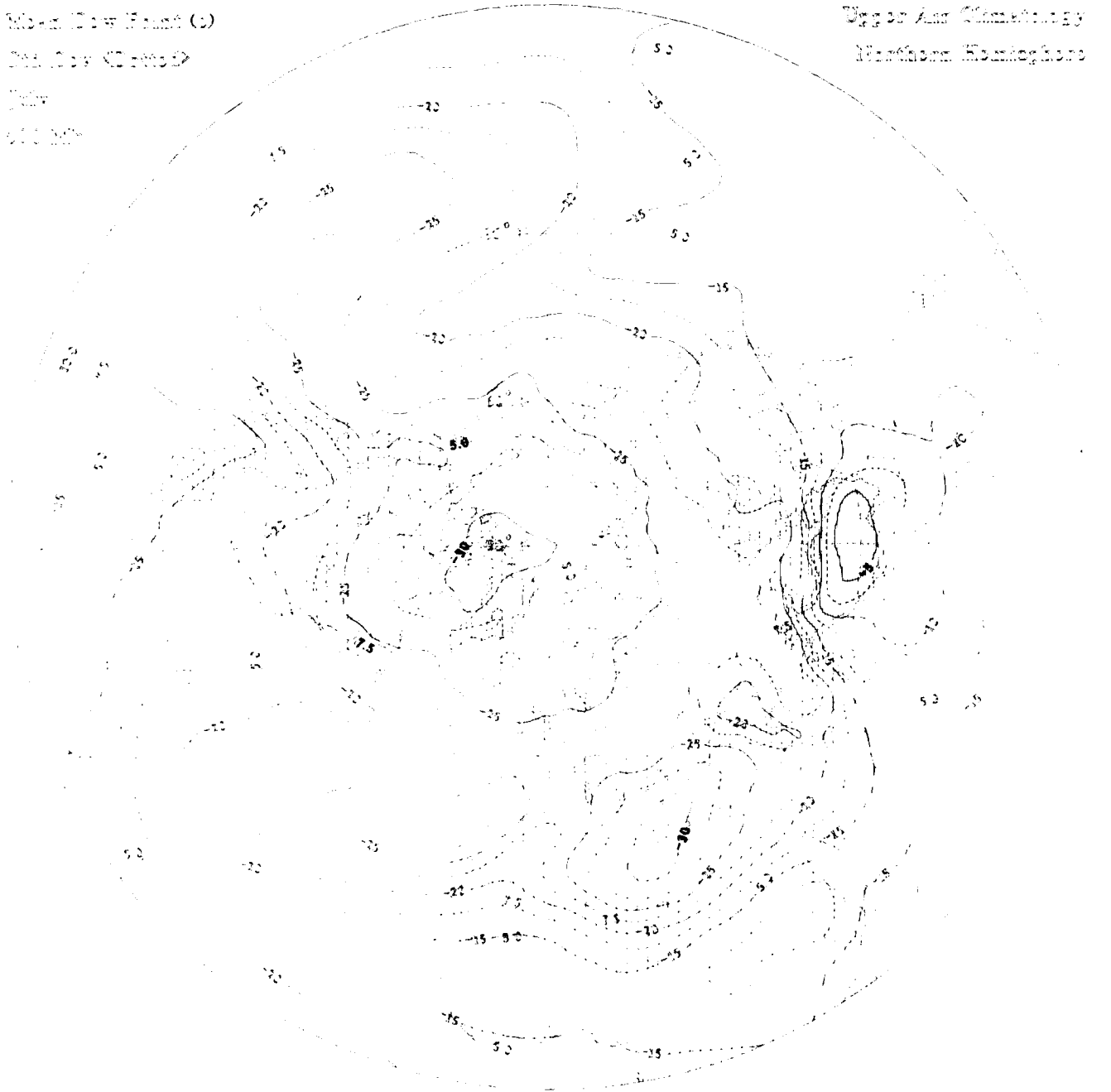
Upper Air Climatology  
Dynamical Homophones

Mean Low Level (C)  
Sea Level (Contour)  
1000  
500  
200



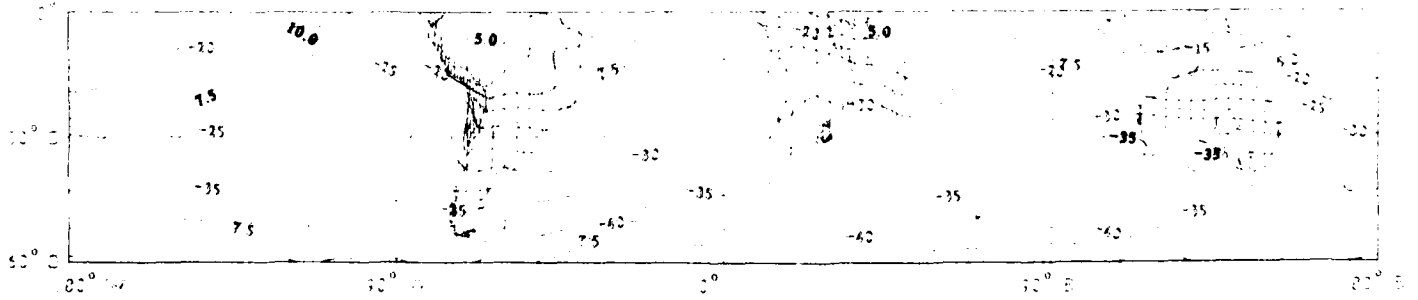
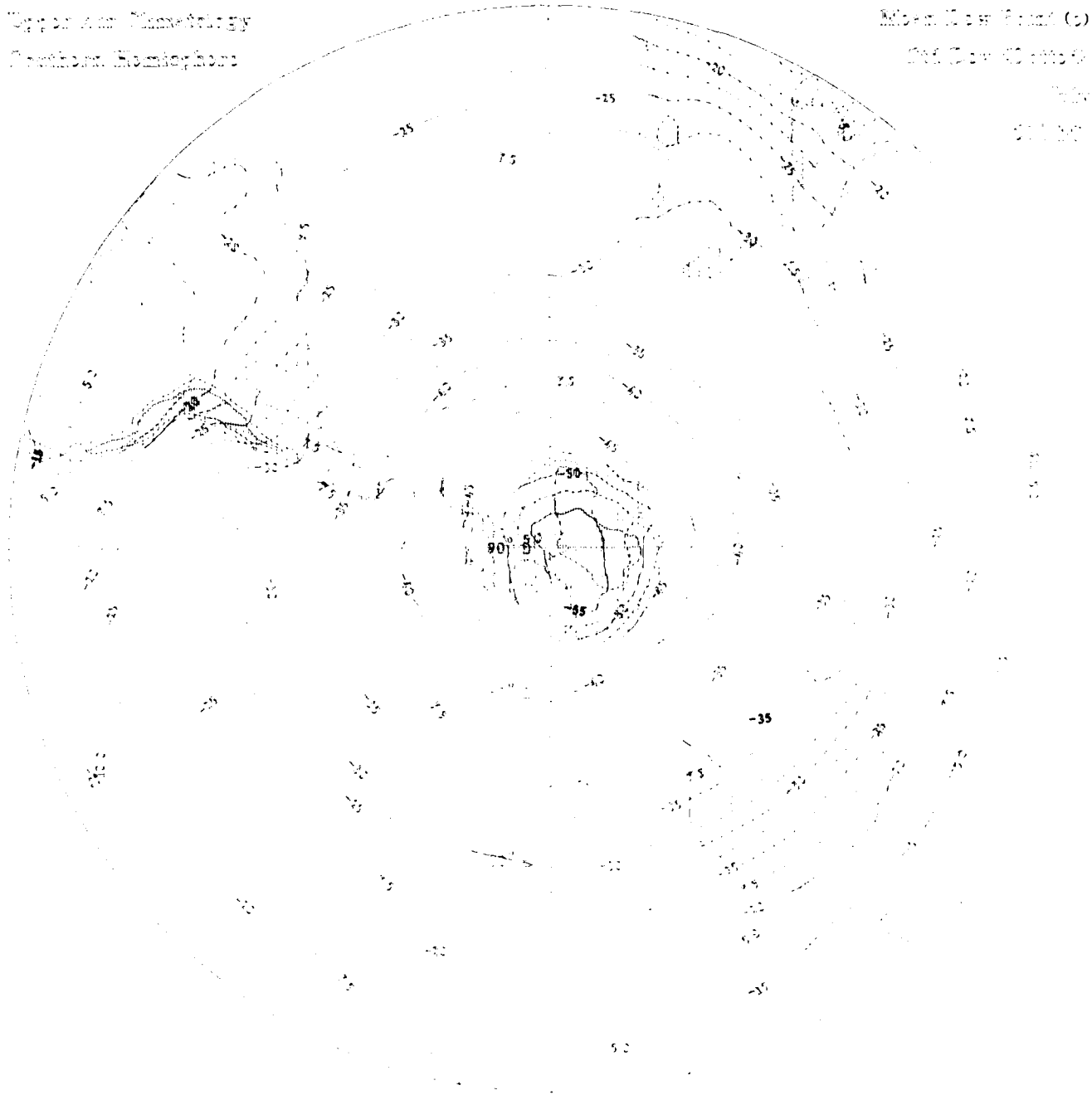
Mean Dew Point (°C)  
Sea Level (msl)  
July  
1950

U.S. Air Climatology  
Hartmann-Kleinpell



Upper Air Meteorology  
Southern Hemisphere

Mean Sea Level (2)  
Sea Level (2) (m)  
01100



Mean Dew Point (°C)

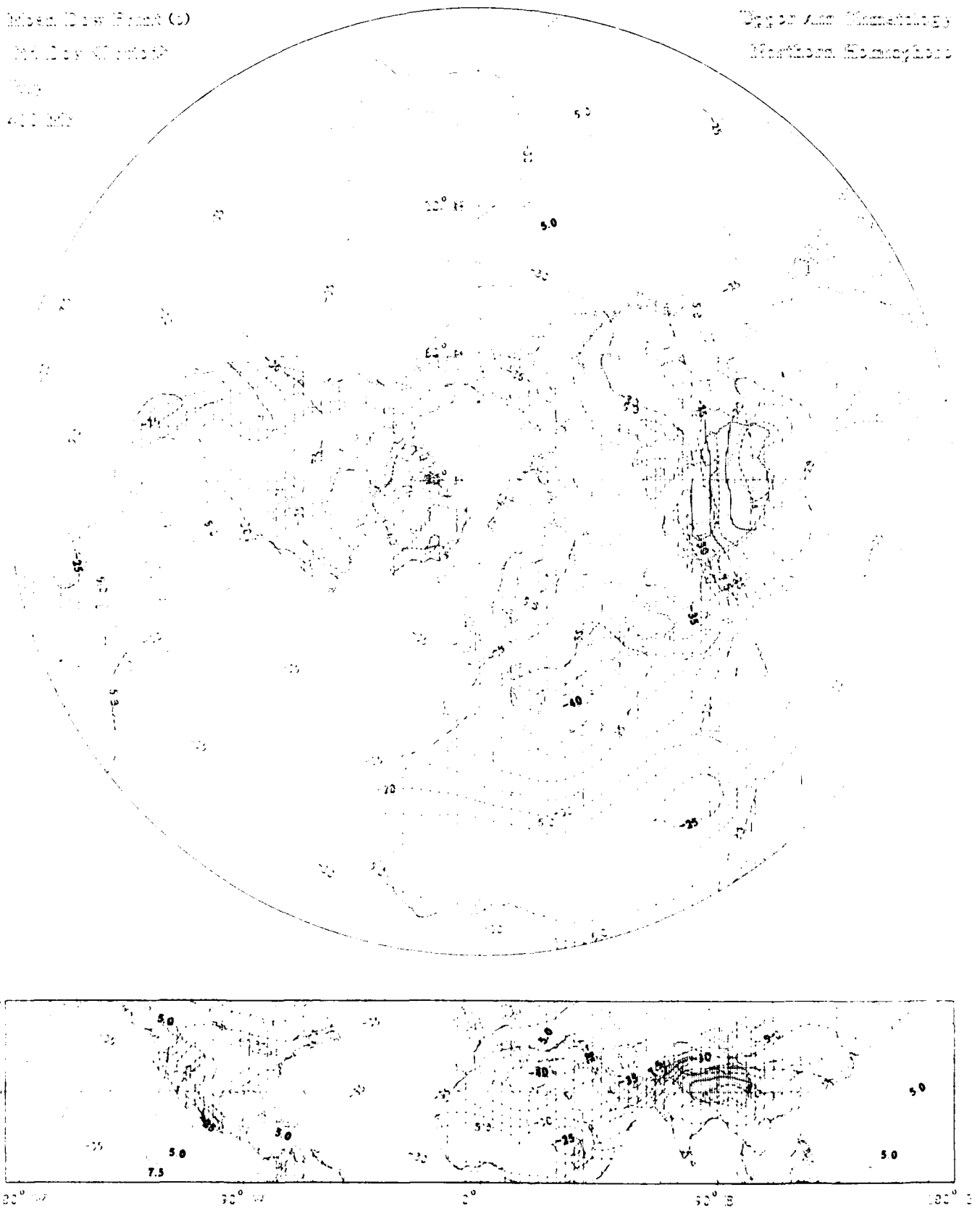
Sea Level (msl)

1000

400 mb

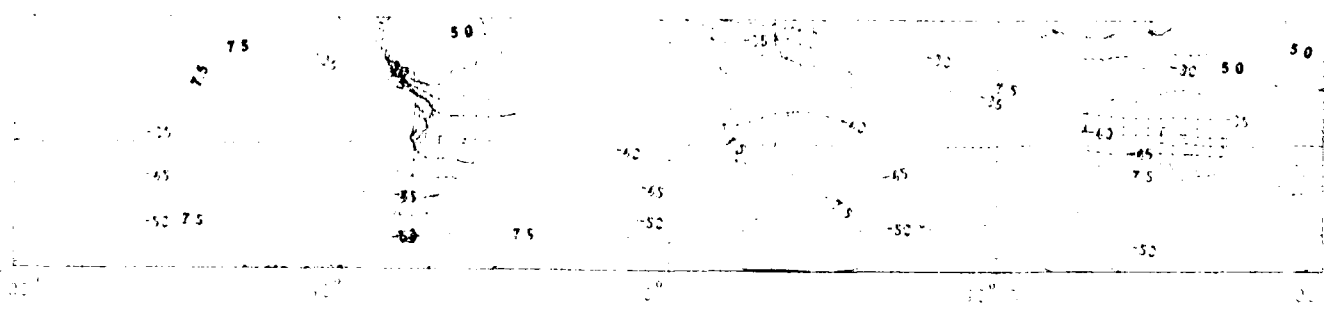
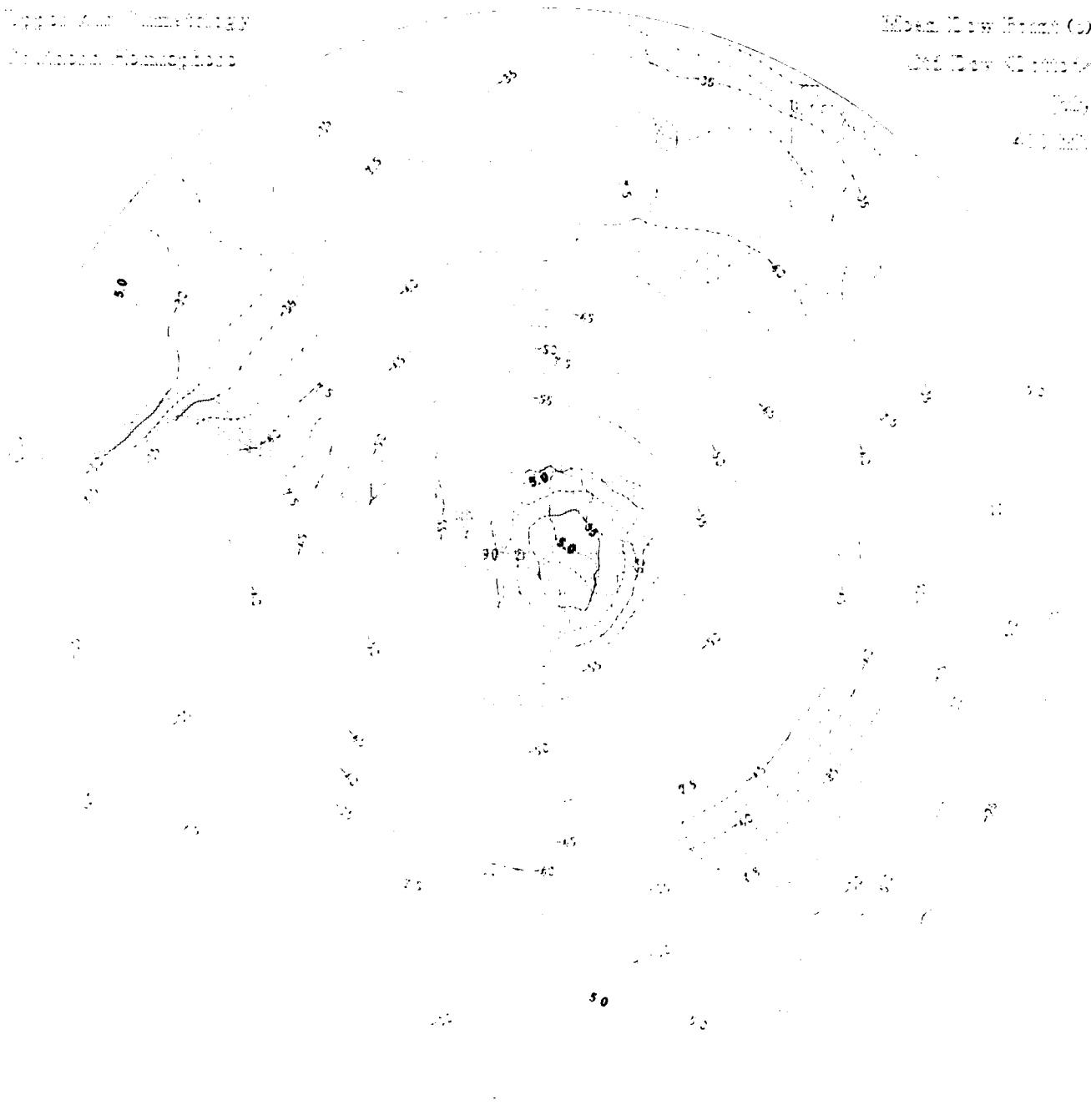
Upper Air Meteorology

Northern Hemisphere



Upper Air Climatology  
Polaroid Homographs

Mean Dew Point (C)  
Std Dev (C/100)  
700  
400 mb



Mid-Low Front (C)

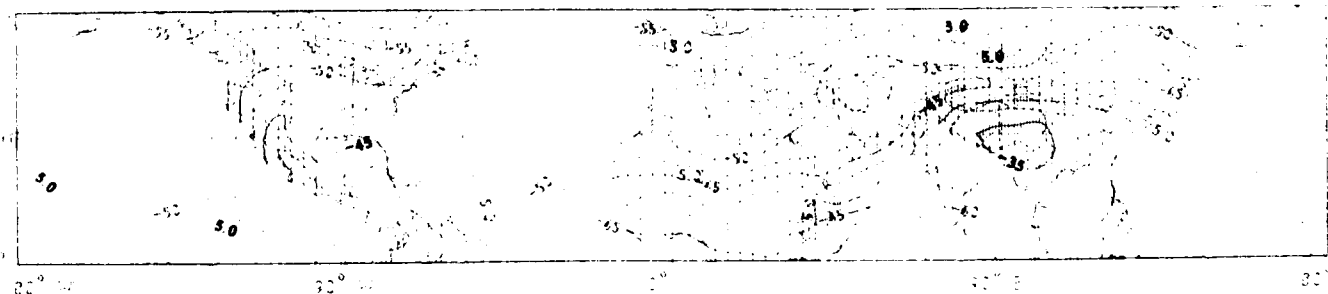
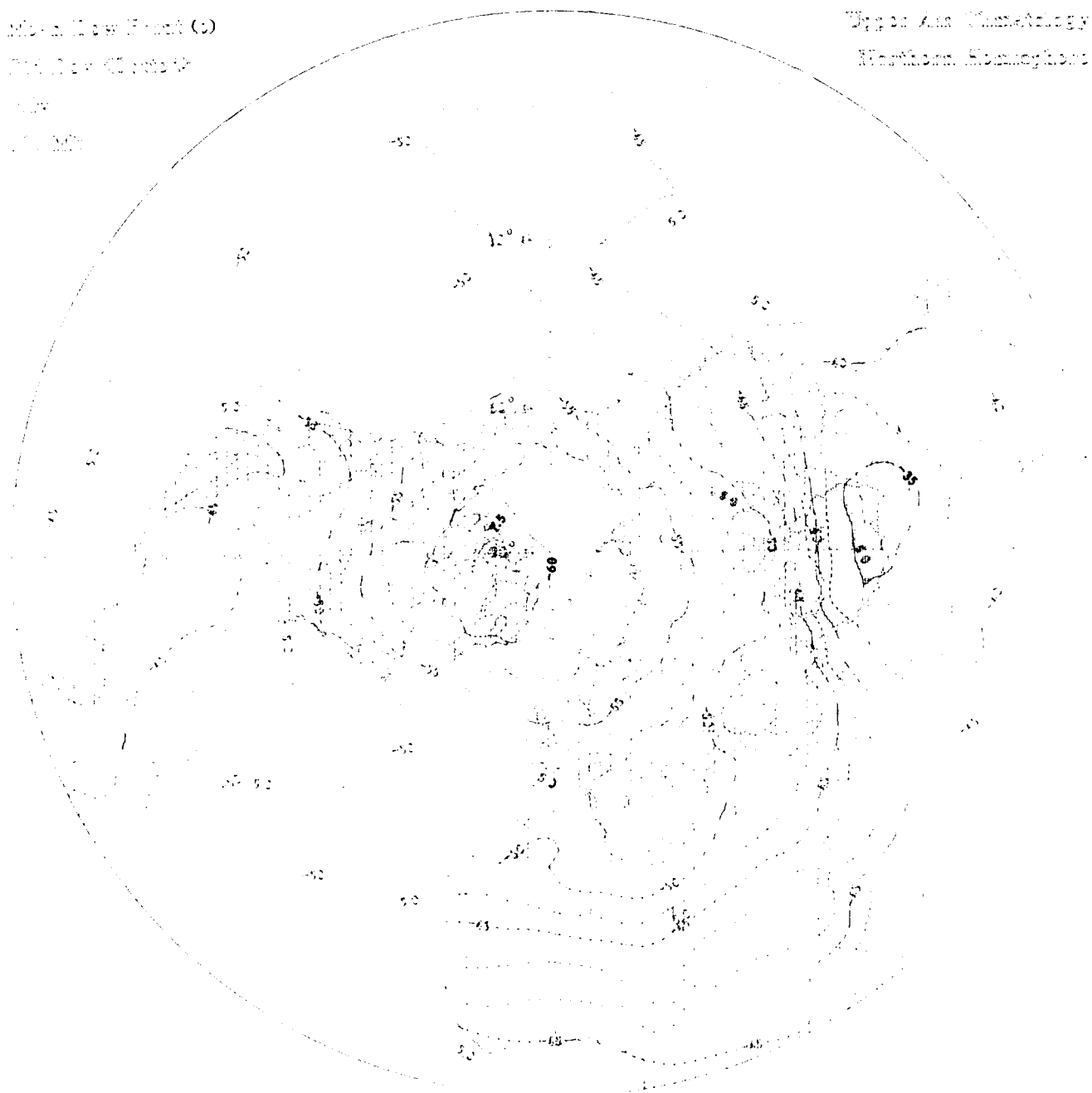
2000 hPa 40 mb/s

1000

1000 mb

Upper Air Climatology

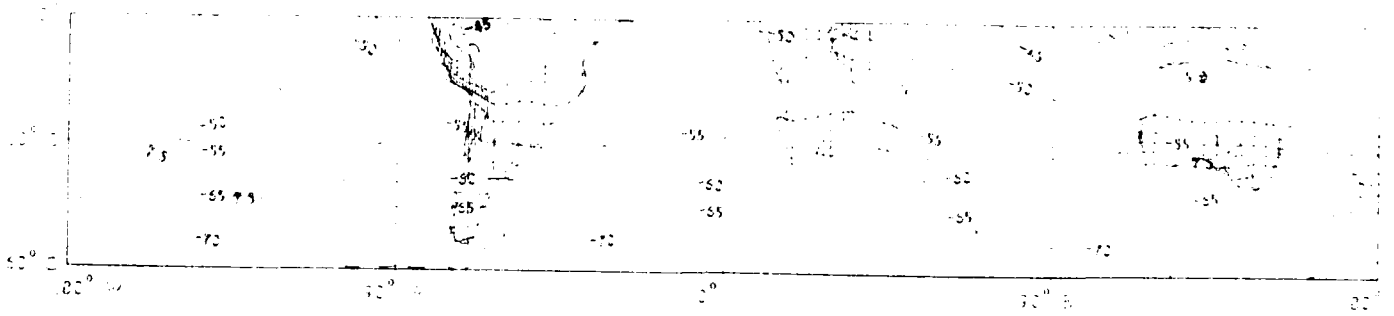
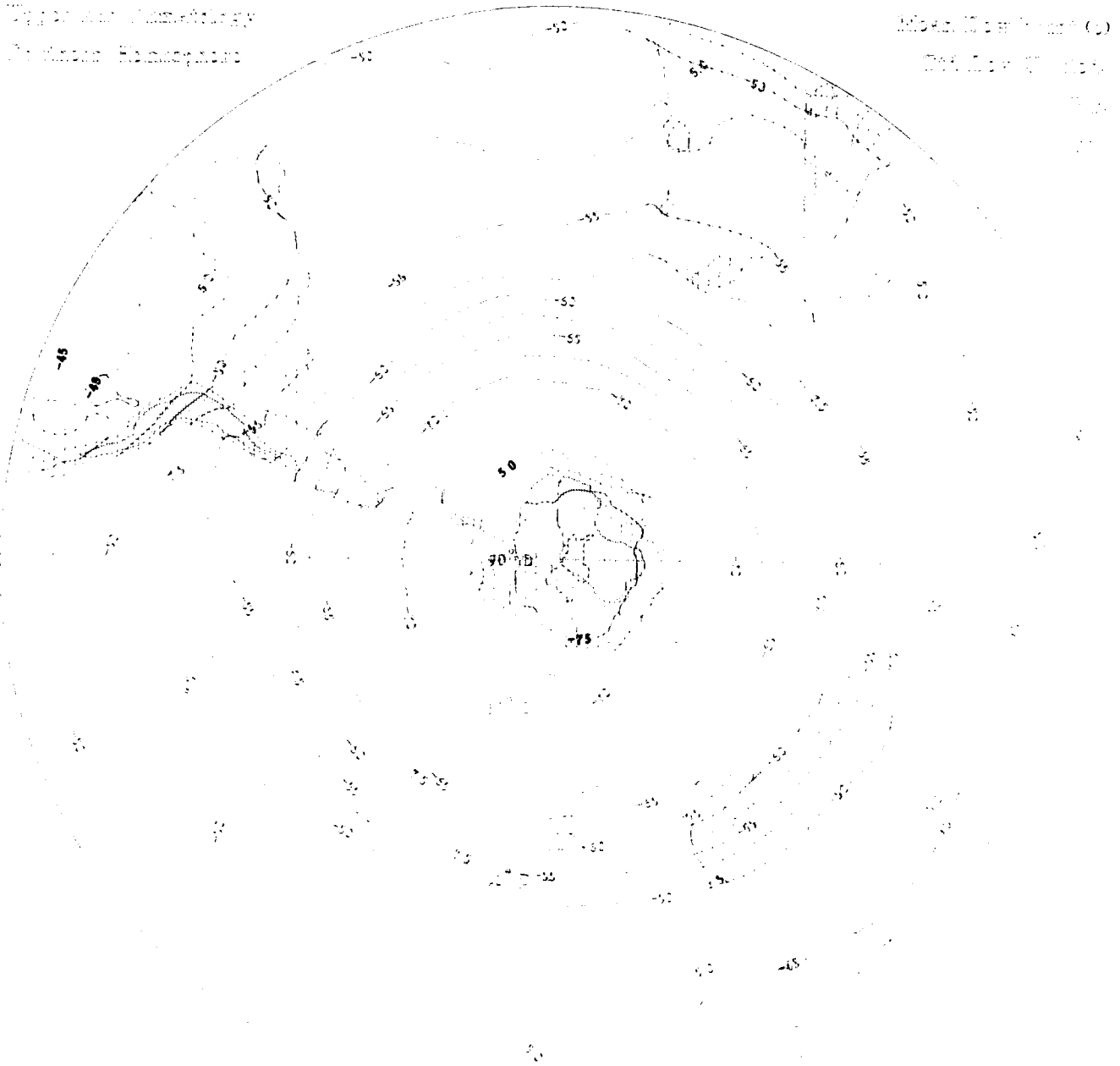
Northwest Hemisphere



Upper Air Climatology  
Polar Regions

Mean Sea Level (1)

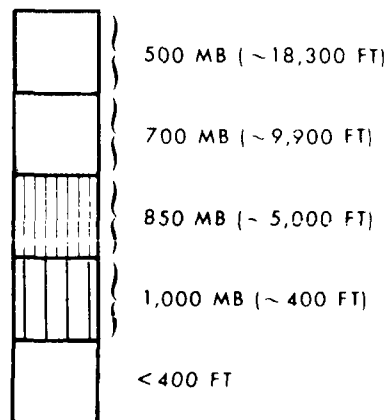
Pressure (hPa)



**DENSITY**  
**(13 LEVELS, 1000 TO 30 MB)**

- Contours of mean density (solid and dashed lines) in kilograms/cubic meter:  
solids labeled, dashed intermediates unlabeled
  
- Density labeled interval:
  - .02 kilograms/cubic meter - 1000 MB to 400 MB
  - .01 kilograms/cubic meter - 300 MB to 200 MB
  - .006 kilograms/cubic meter - 150 MB to 30 MB
  
- Contours of standard deviation of density (dotted lines) in kilograms/cubic meter
  
- Standard deviation of density labeled interval:
  - .01 kilograms/cubic meter - 1000 MB to 400 MB
  - .005 kilograms/cubic meter - 300 MB to 200 MB
  - .003 kilograms/cubic meter - 150 MB to 30 MB
  
- Contours blanked for geographic areas with elevations exceeding specified geopotential heights

**ELEVATION SCALE**



Mean Density (mg. ml.)

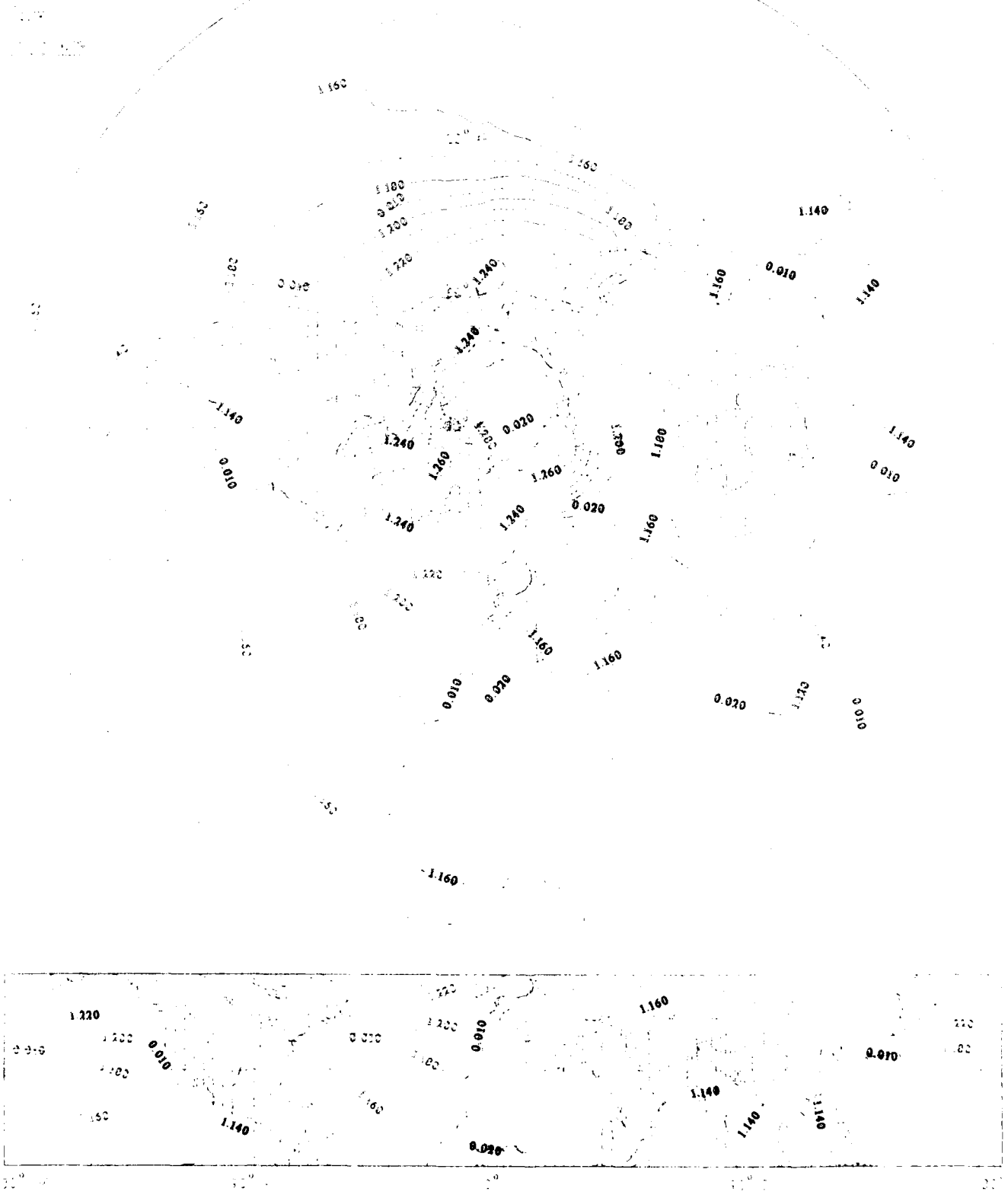
at 15°C (63°F)

1957

1958

Upper Air Climatology

Northern Hemisphere





Mean Density (mg ml<sup>-1</sup>)

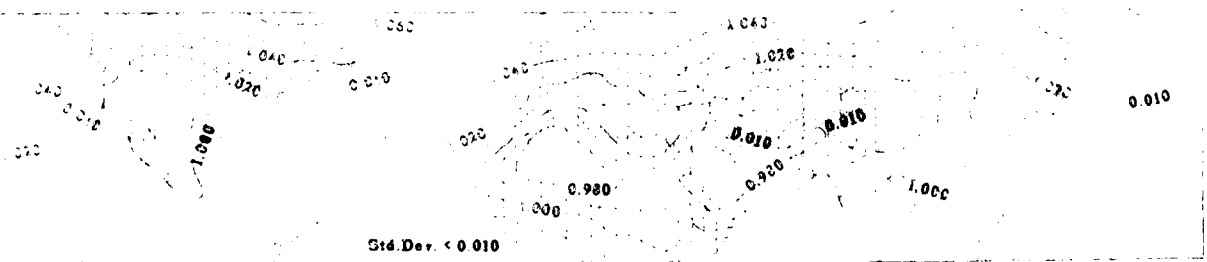
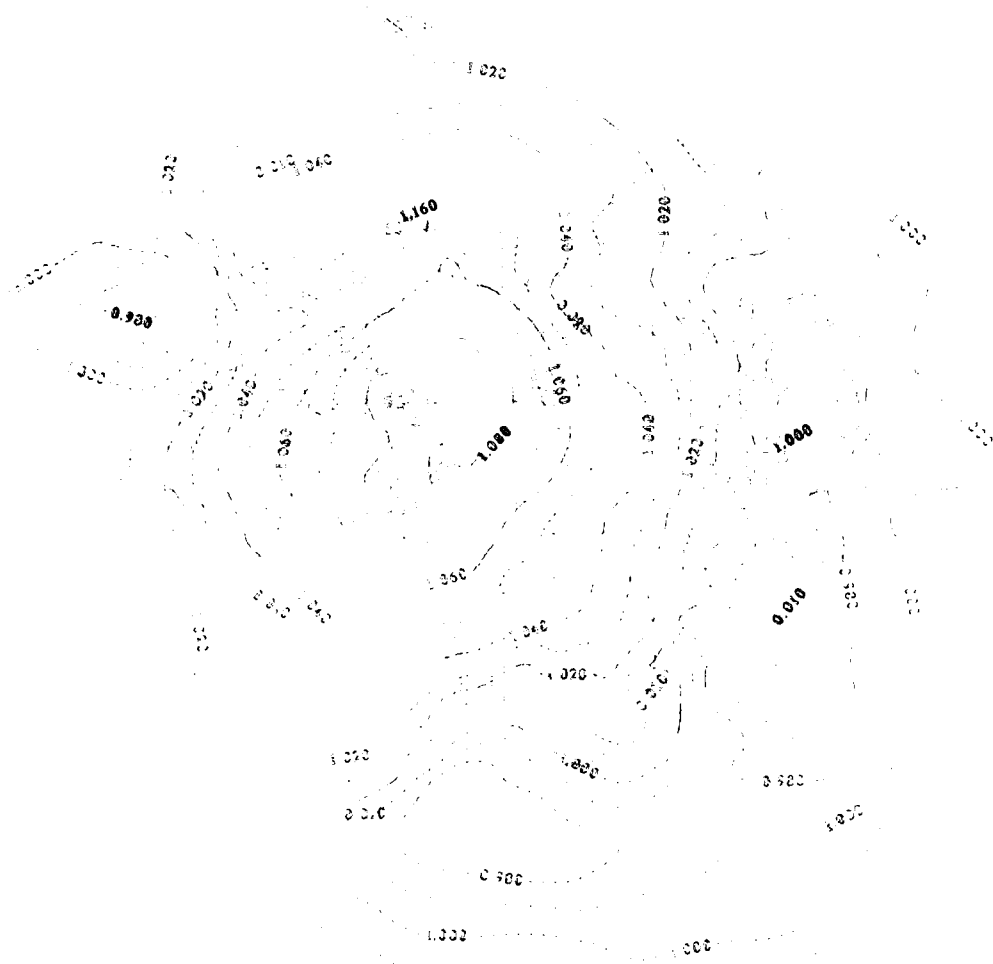
Std. Dev. (0.0001)

Key

0.010

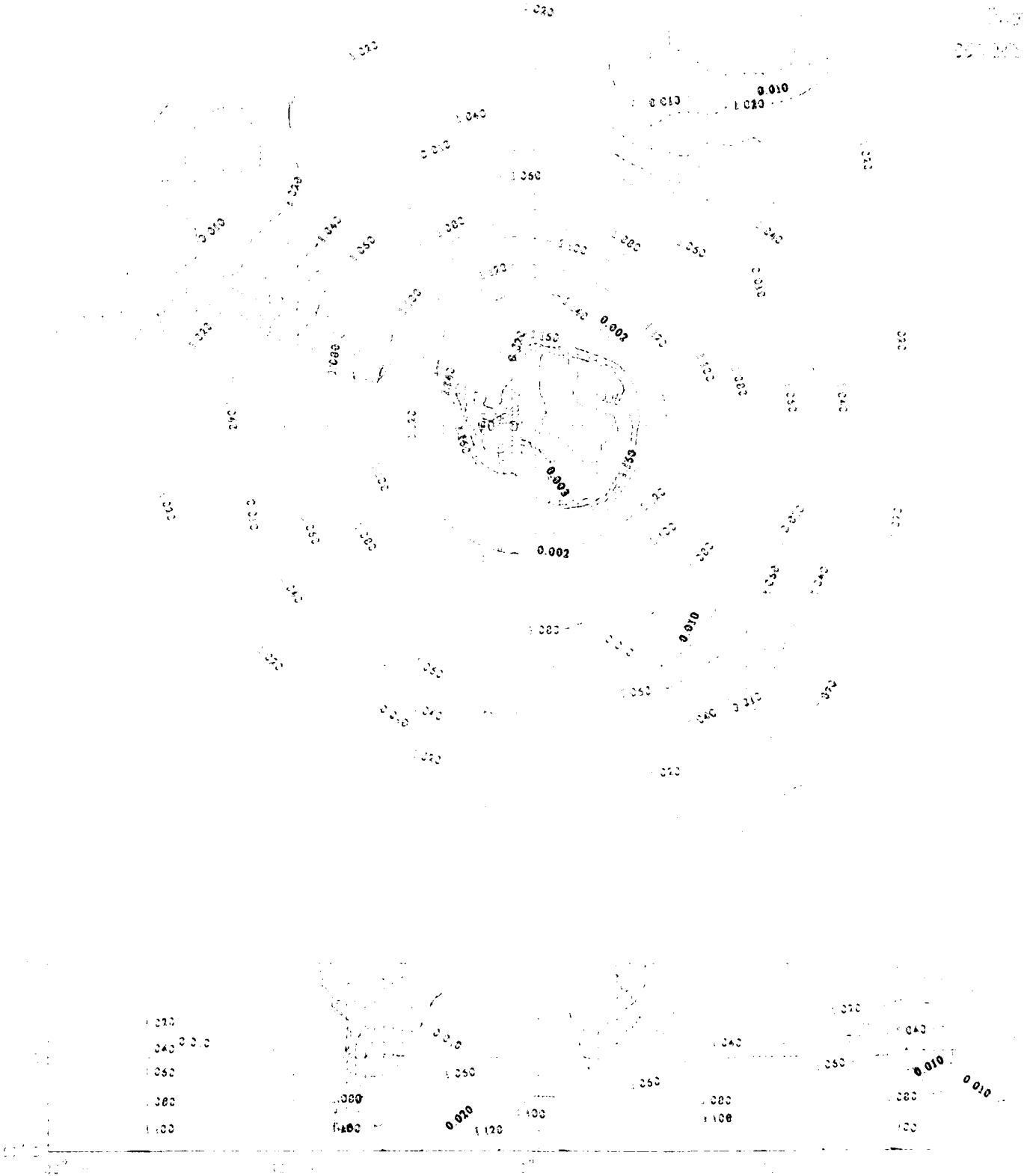
Upper and Intermediate

Northern Hemisphere



Topographic Contouring  
of the area shown on page 176

Minimum Elevation (meters)  
200.00  
200.00  
200.00

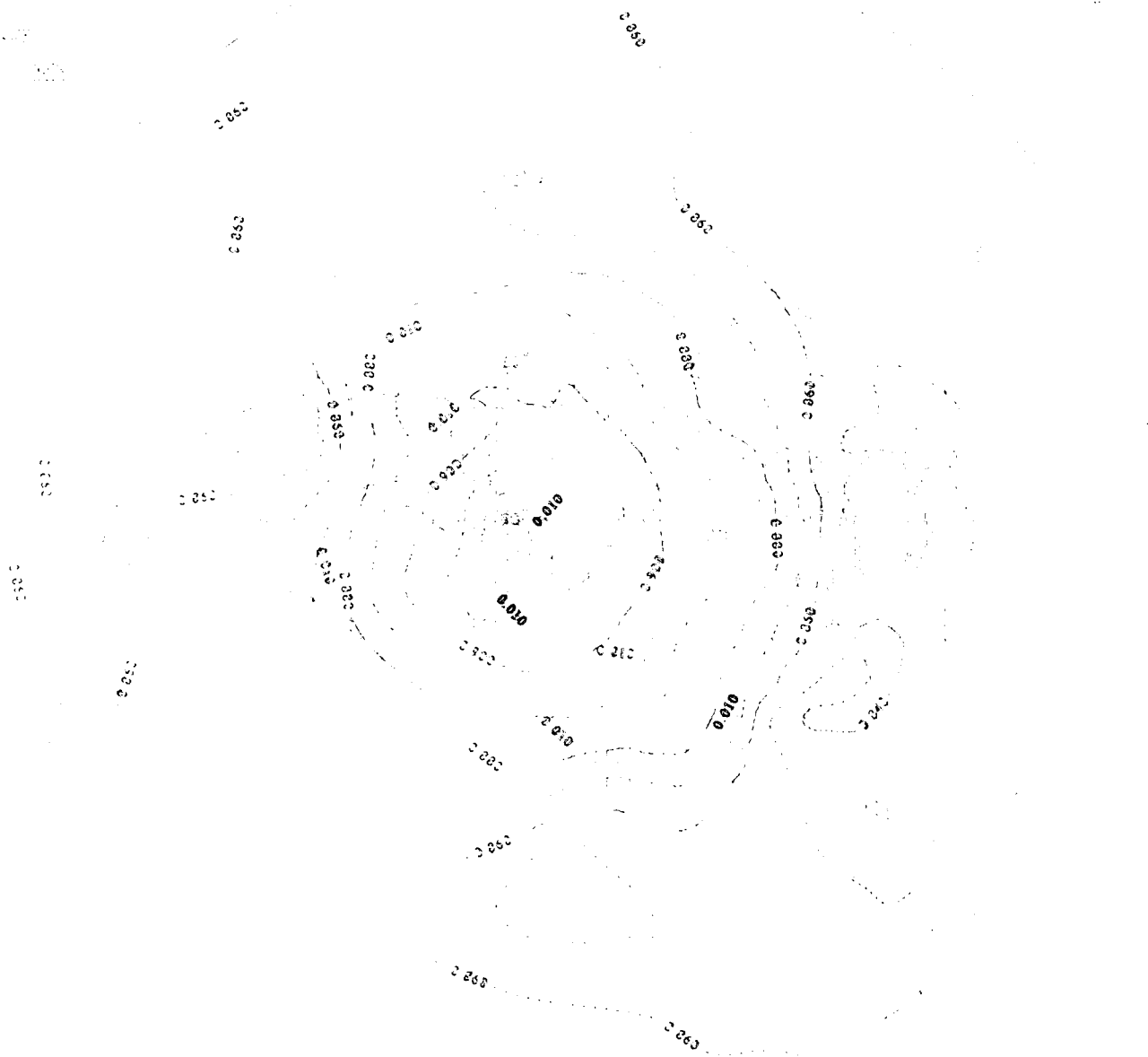


Mean Density (mg/dl)

Contour Interval 0.010

Upper Air Xanthology

Maritime Biogeography



Std. Dev. < 0.010



Std. Dev. < 0.010

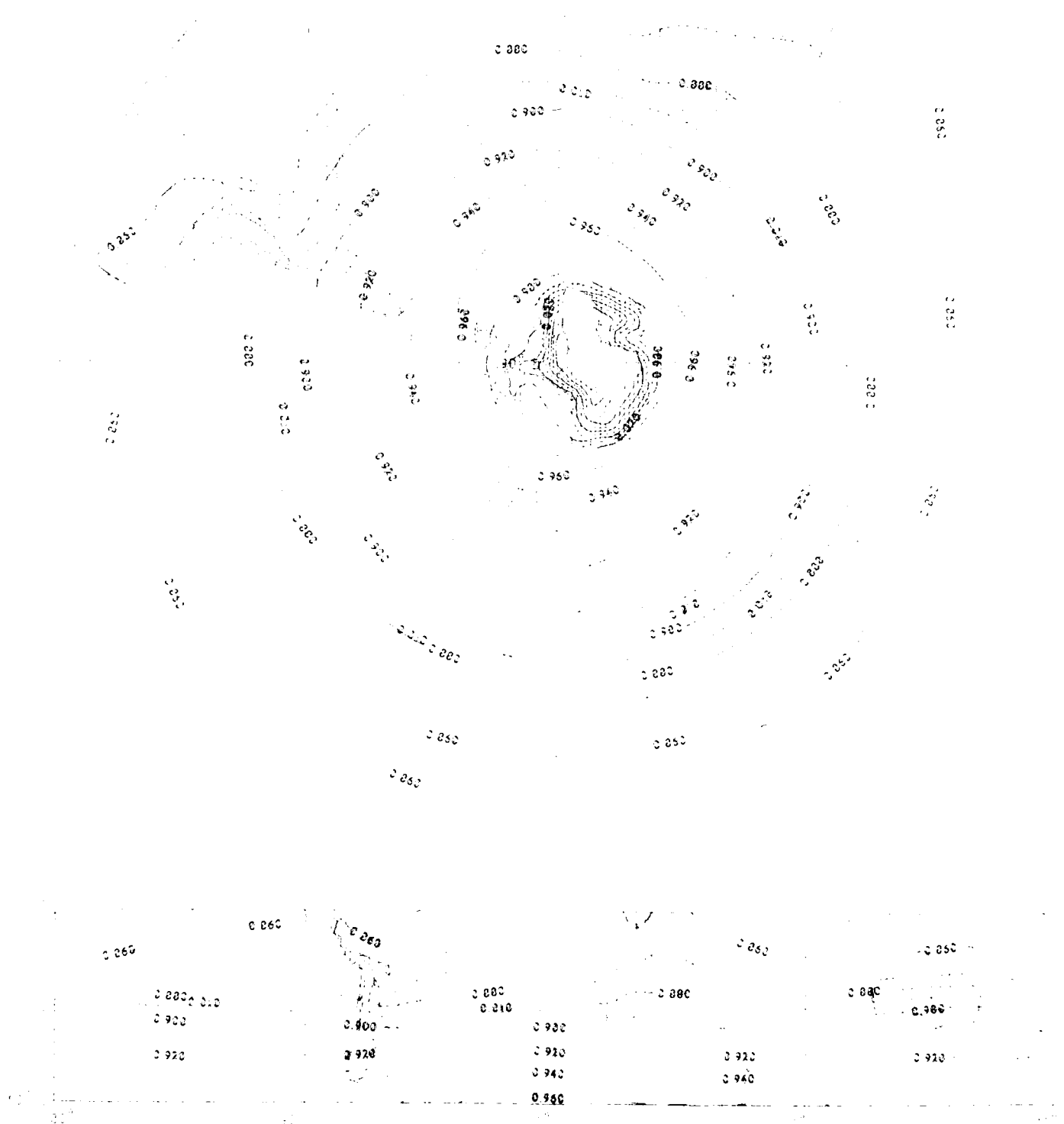
Topographic Contour Map  
of the Hawaiian Islands

Mean Elevation (meters)

Scale 1:50,000

1950

1950



Mean Density (g/cm<sup>3</sup>)

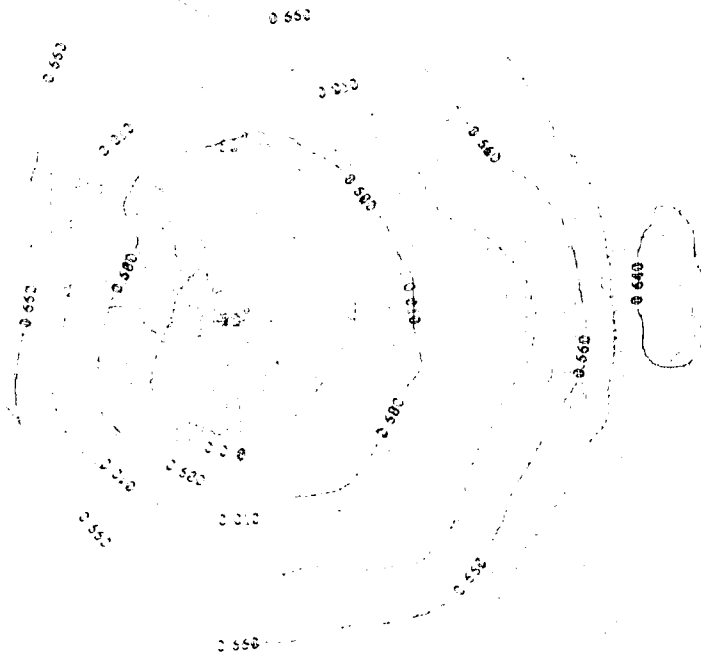
Latitude (°N)

Time

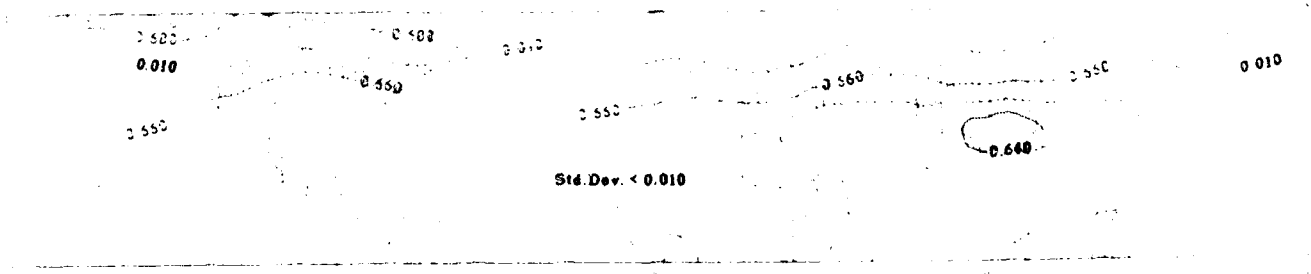
Date

Upper and Lower Density

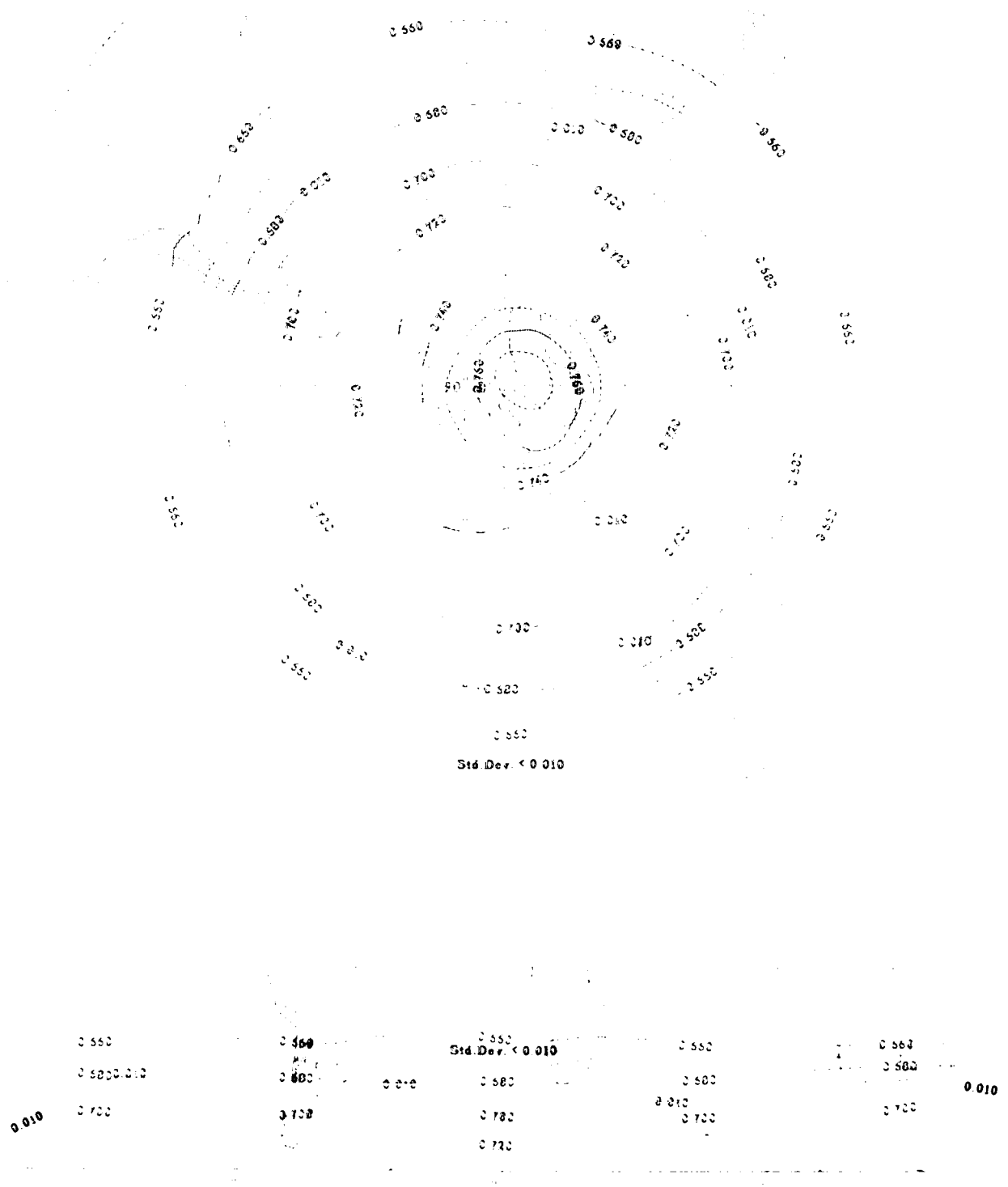
Vertical Histograms



Std.Dev. < 0.010



Std.Dev. < 0.010



Water Pollution (g/g)

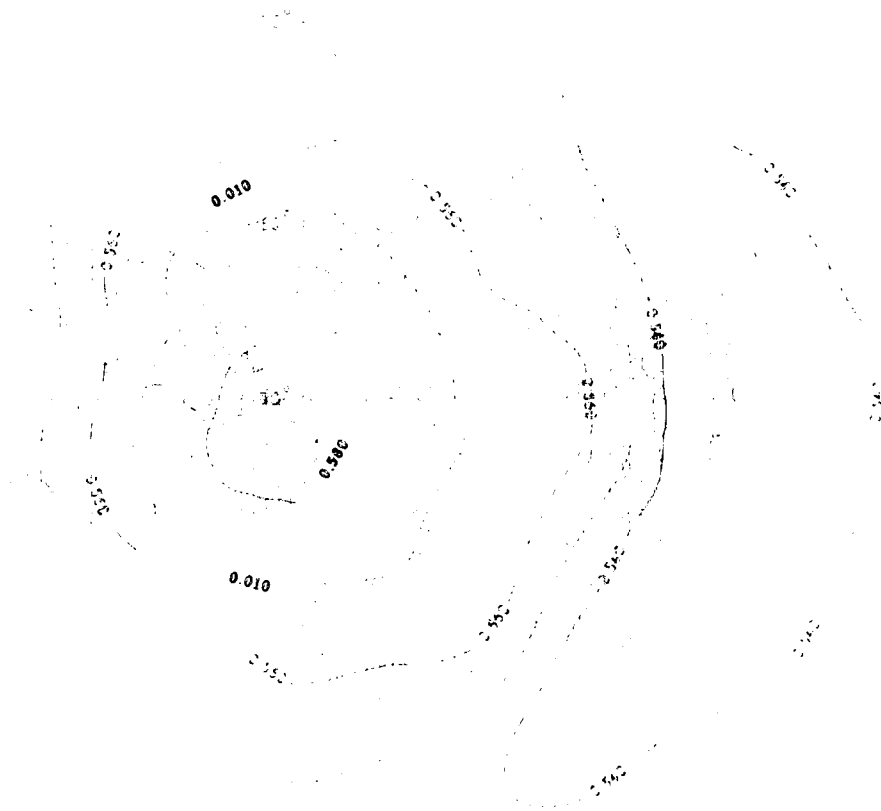
Water Pollution (g/g)

1997

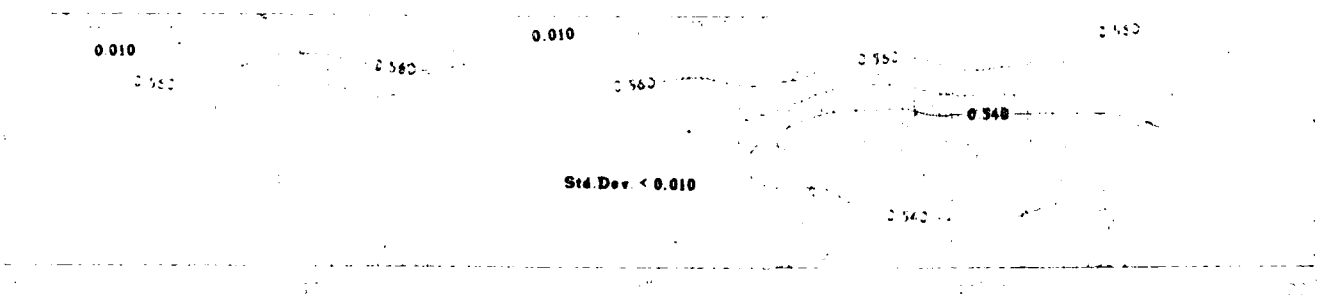
4-1-2000

Water Pollution (g/g)

Water Pollution (g/g)



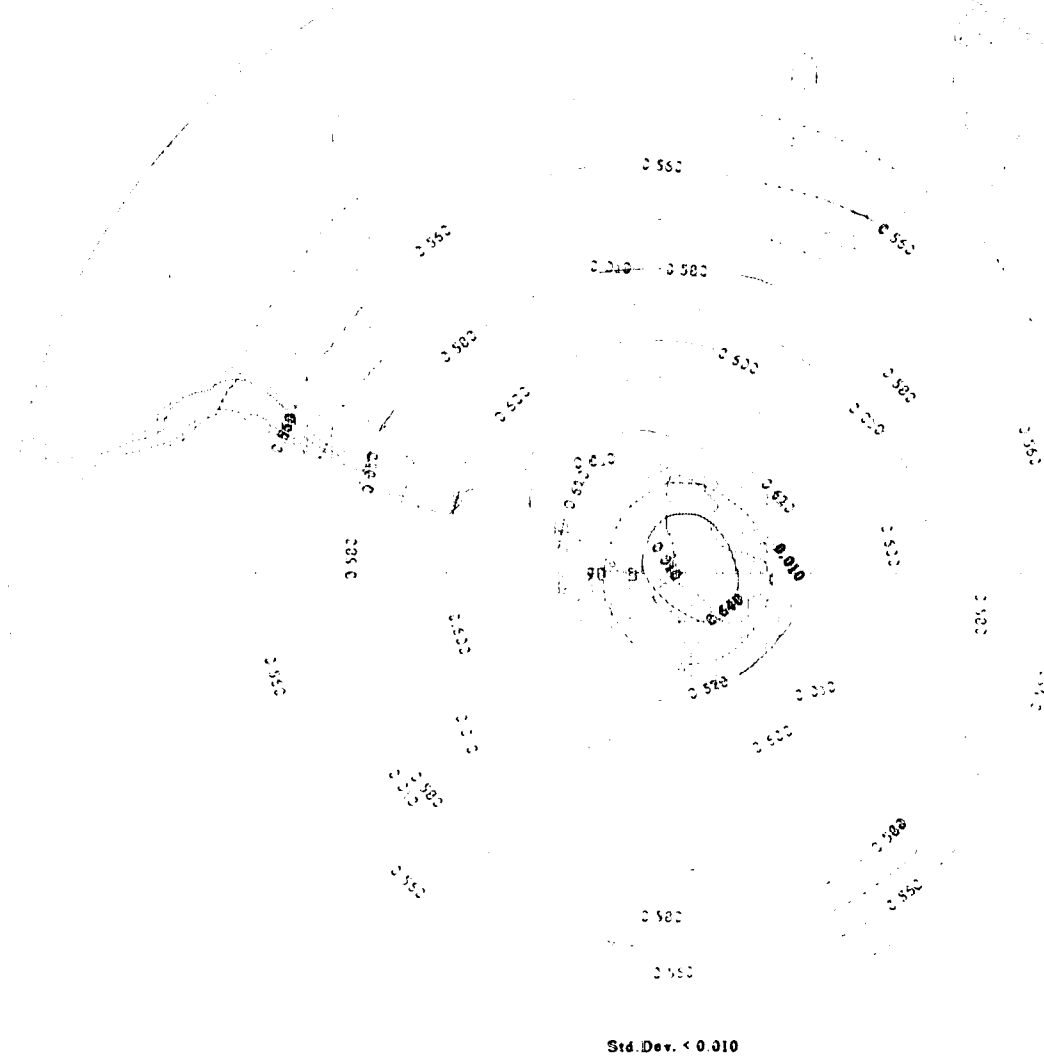
Std. Dev. < 0.010



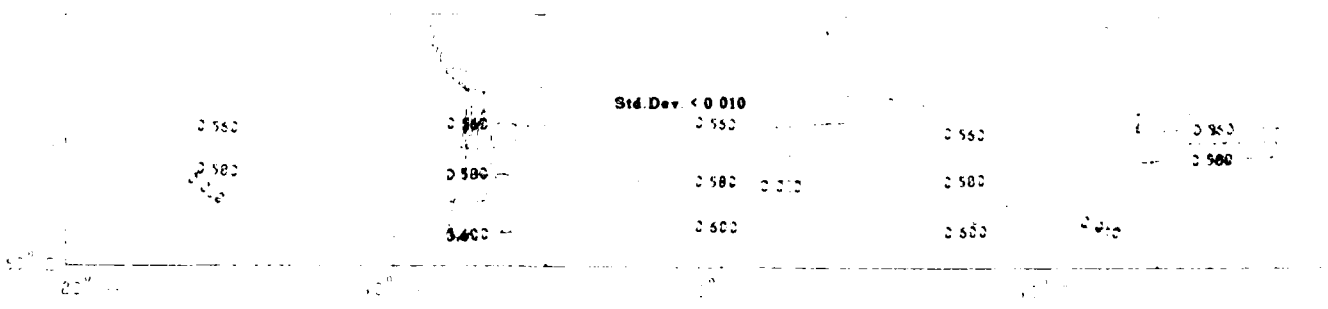
Std. Dev. < 0.010

Topo and Bathymetry  
of the Eastern Bismarck Sea

Mean Density ( $\sigma_t$ )  
Data by (D-1965)  
Date  
4/11/66



Std. Dev. < 0.010



Std. Dev. < 0.010

Mean Velocity (gms/m)

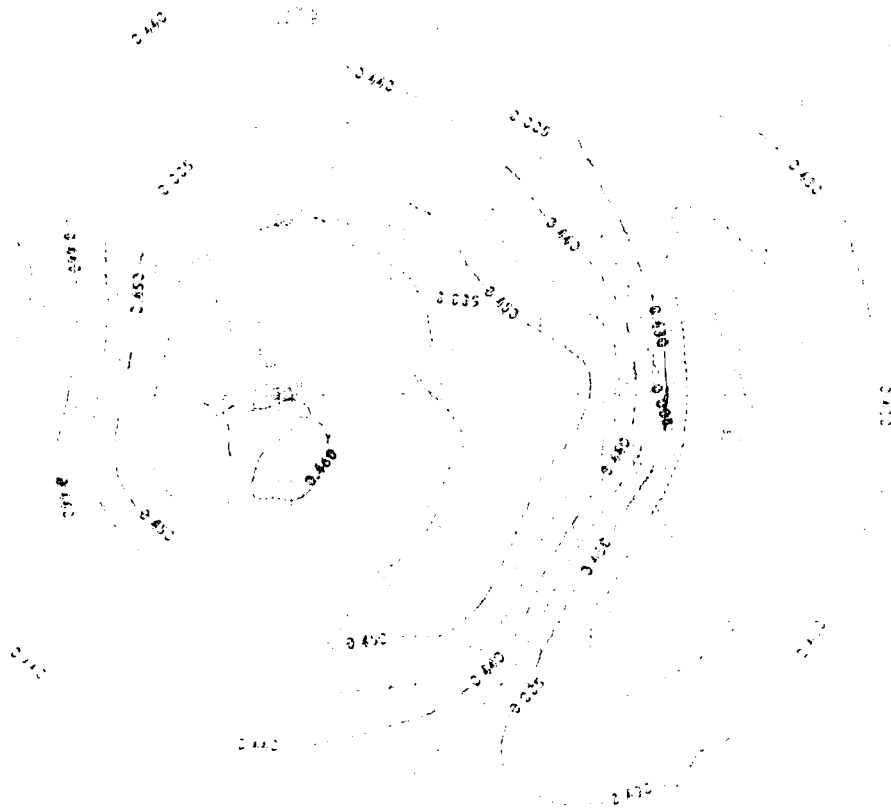
2000-1950

1950

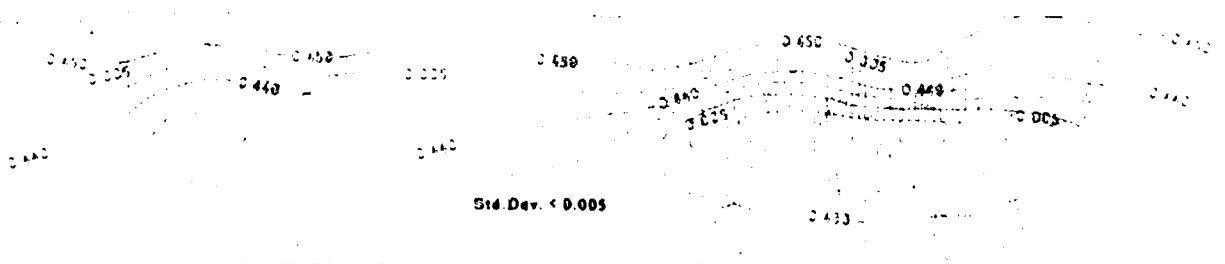
1950

Upper and Intermediate

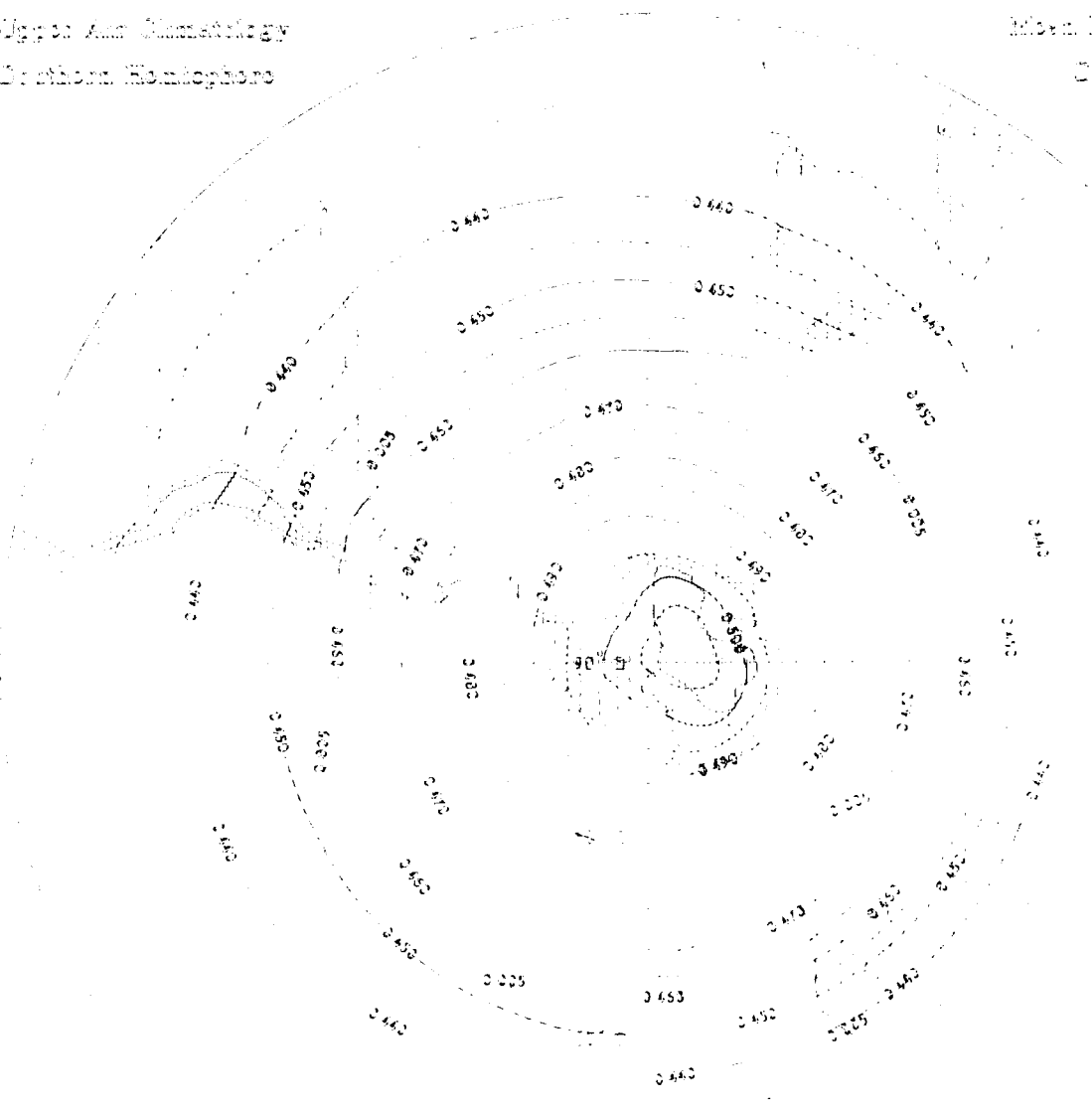
Western Hemisphere



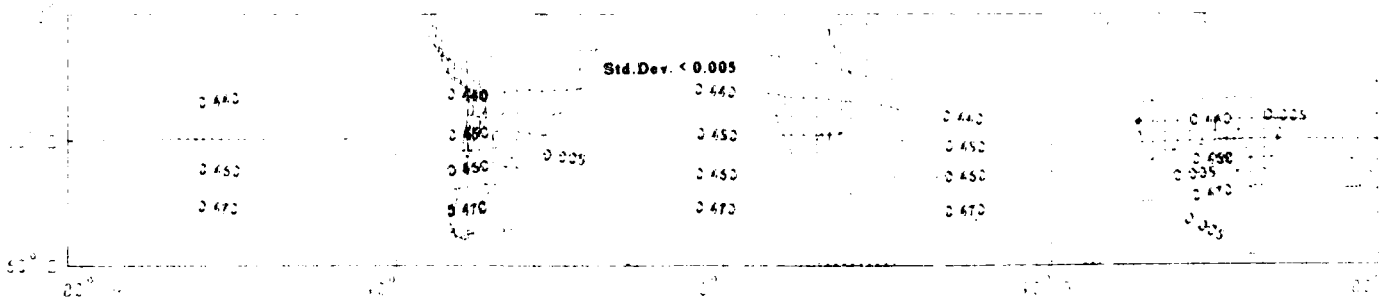
Std. Dev. < 0.005



Std. Dev. < 0.005



Std.Dev. < 0.005



Std.Dev. < 0.005

Mean Density (kg/m<sup>3</sup>)

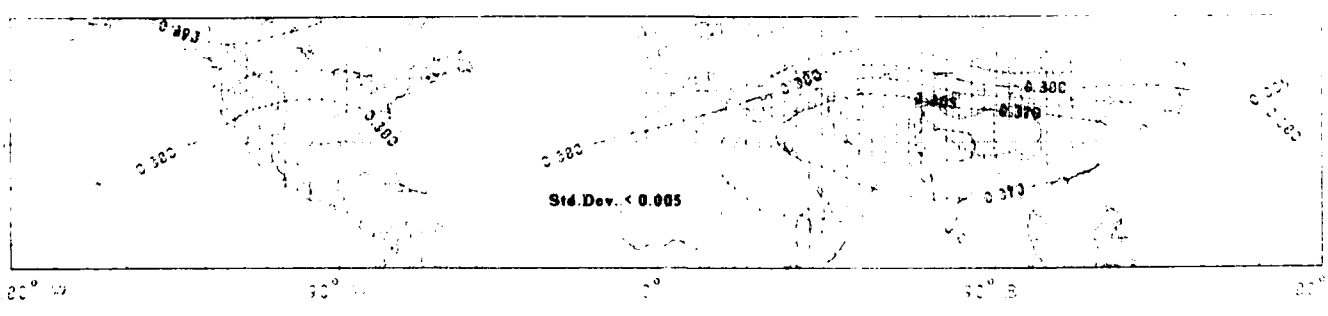
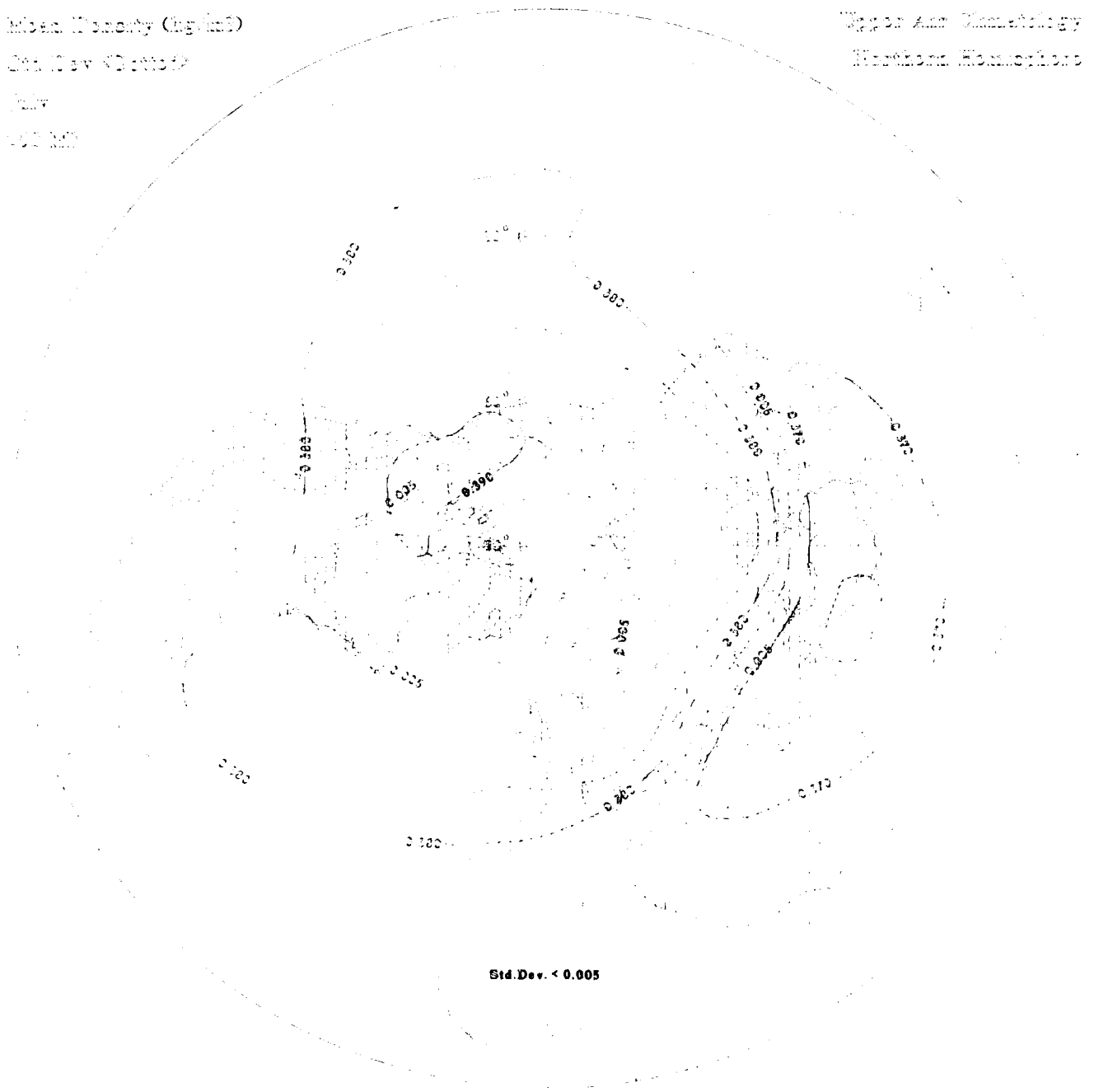
Sea Level (Dress)

July

1000 MB

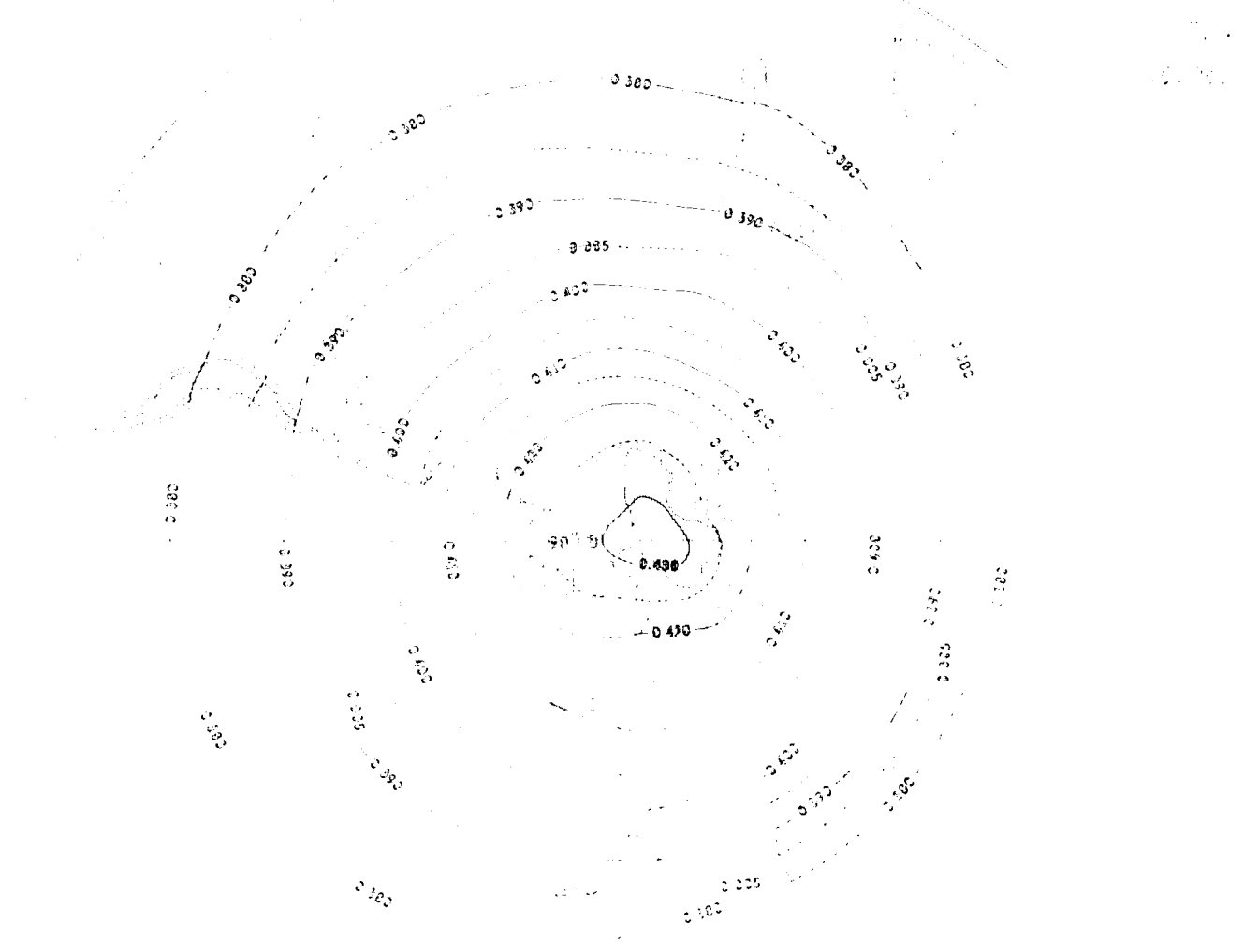
Upper Air Climatology

Northern Hemisphere

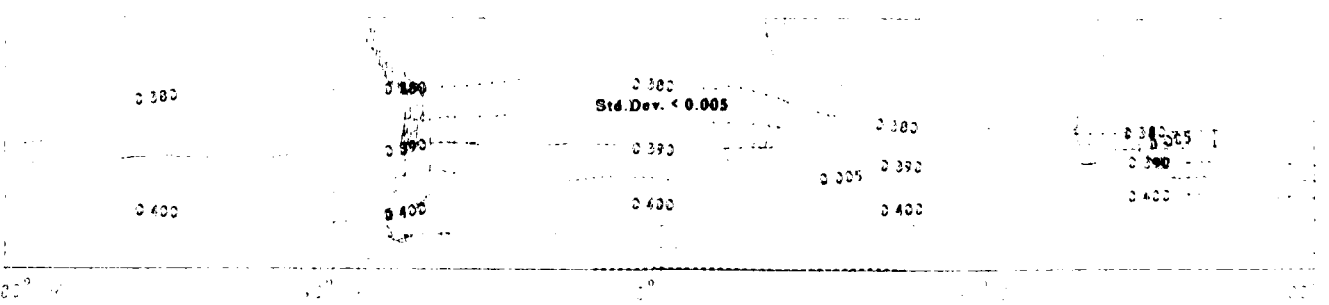


Types and Symmetry  
Dynamical Hysteresis

Mean Velocity (mg sec<sup>-1</sup>)  
0.400 to 0.500



Std. Dev. < 0.005

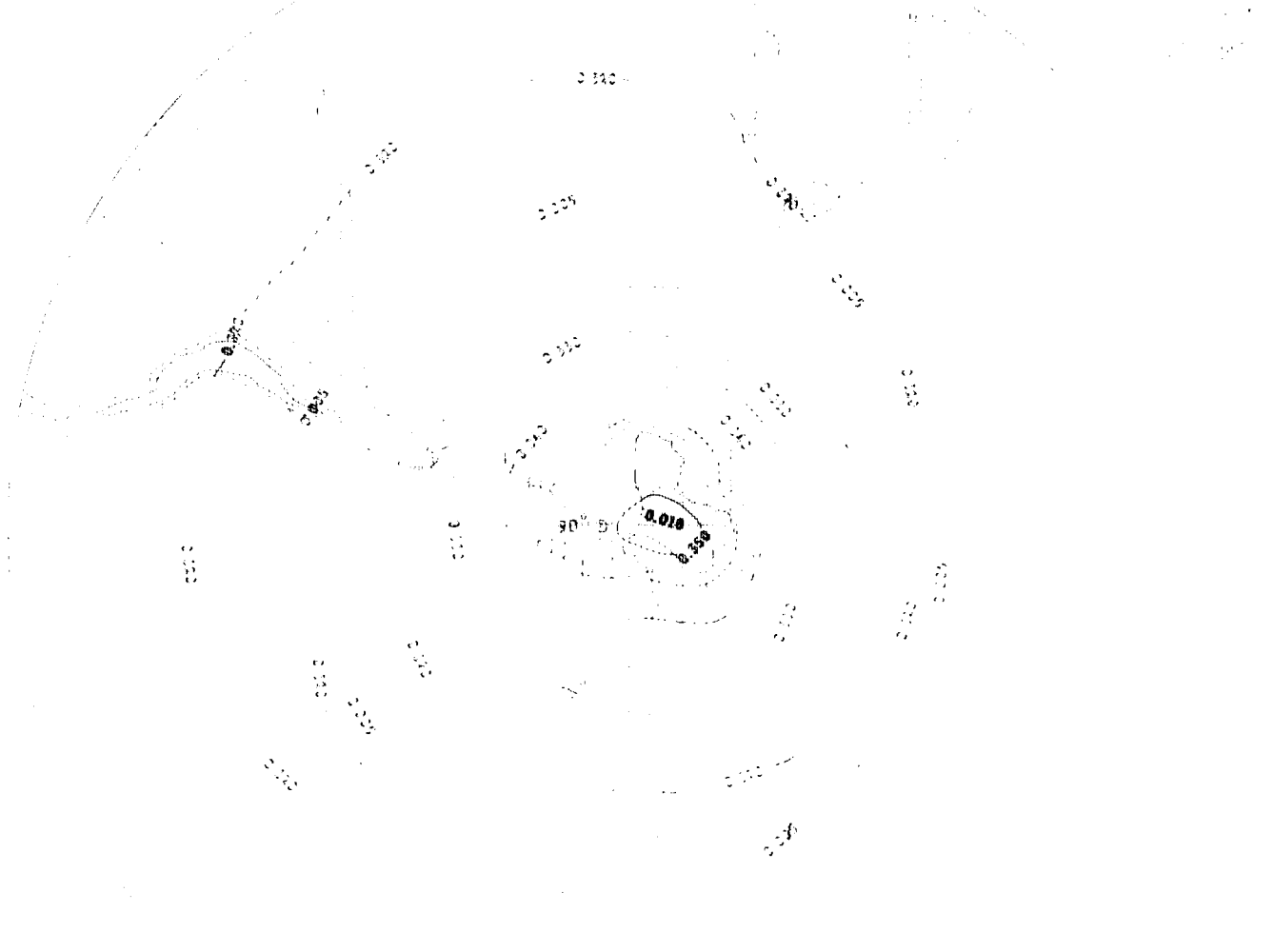


Std. Dev. < 0.005

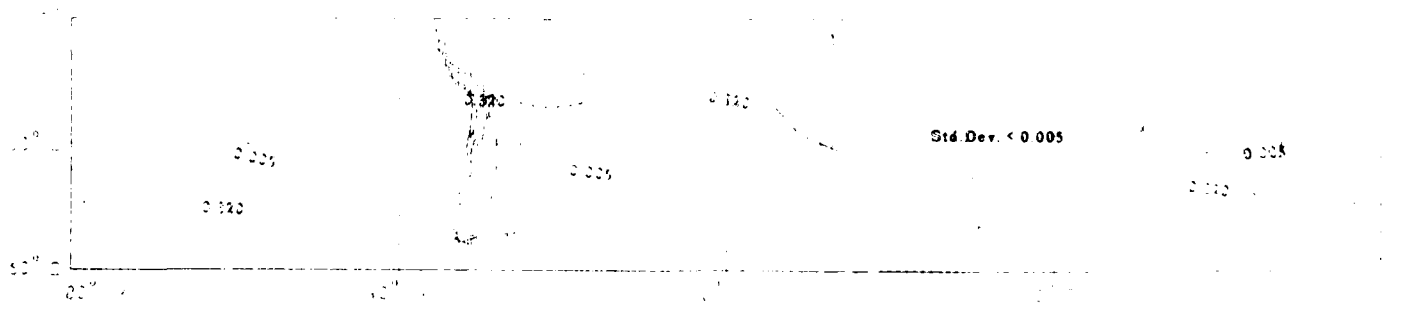


Figure 4.14 - Contouring  
of the Data

Mean Density (g/cc)  
200.00 - 200.05



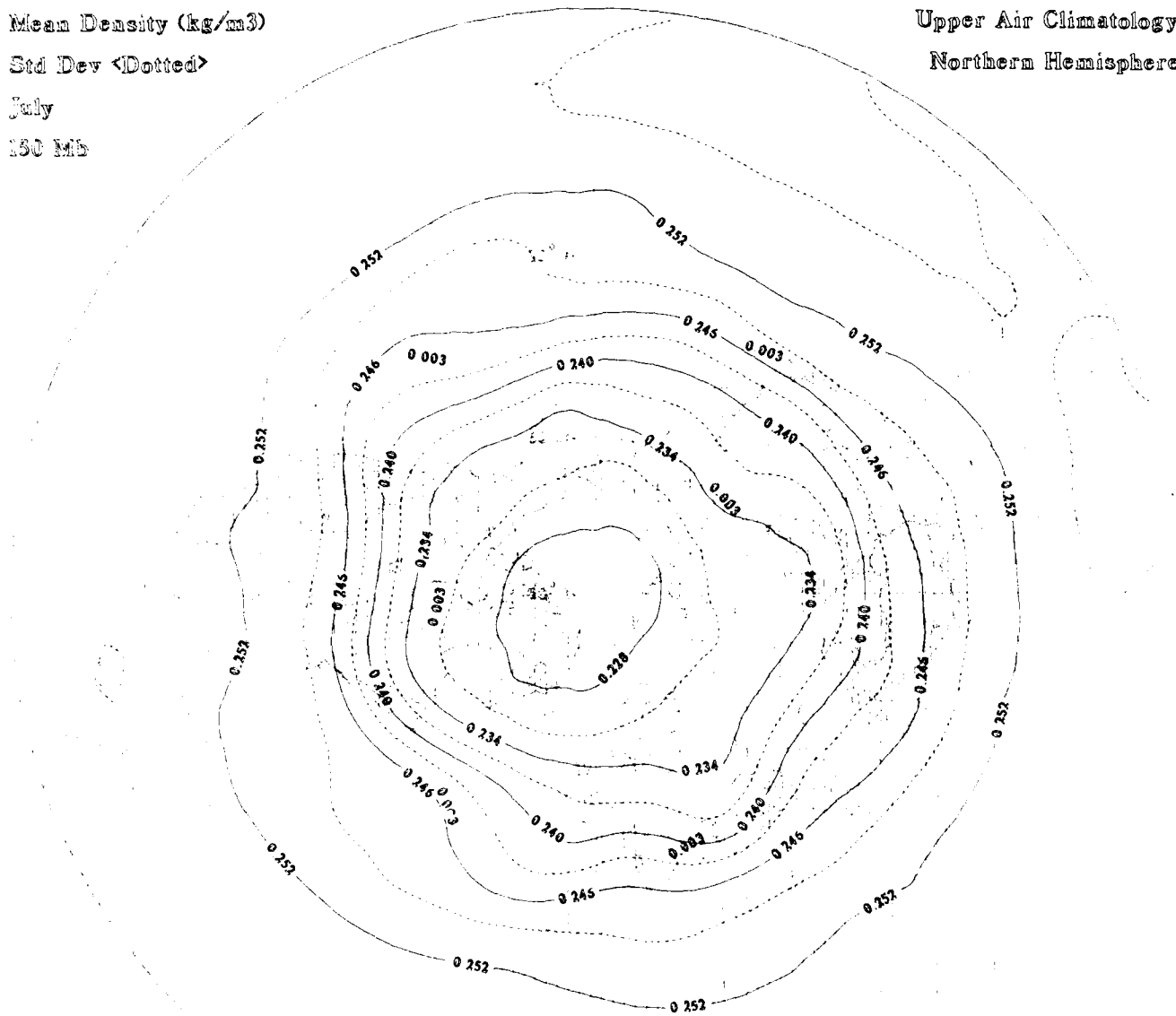
Std. Dev. < 0.005



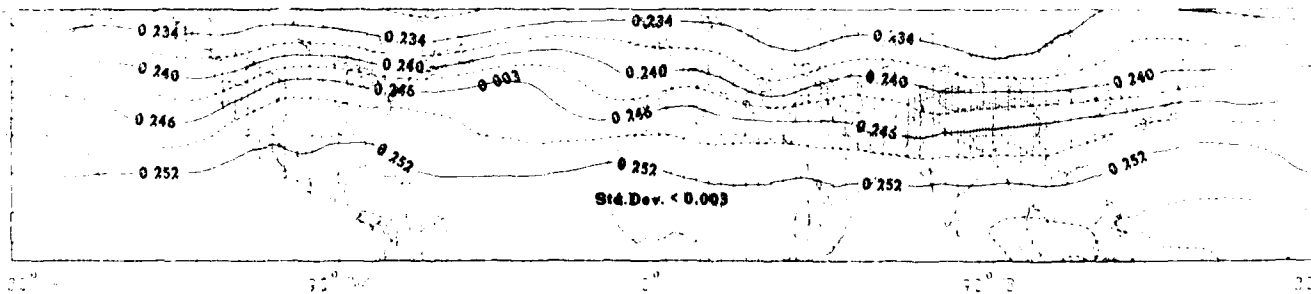
Std. Dev. < 0.005

Mean Density (kg/m<sup>3</sup>)  
Std Dev <Dotted>  
July  
150 Mb

Upper Air Climatology  
Northern Hemisphere



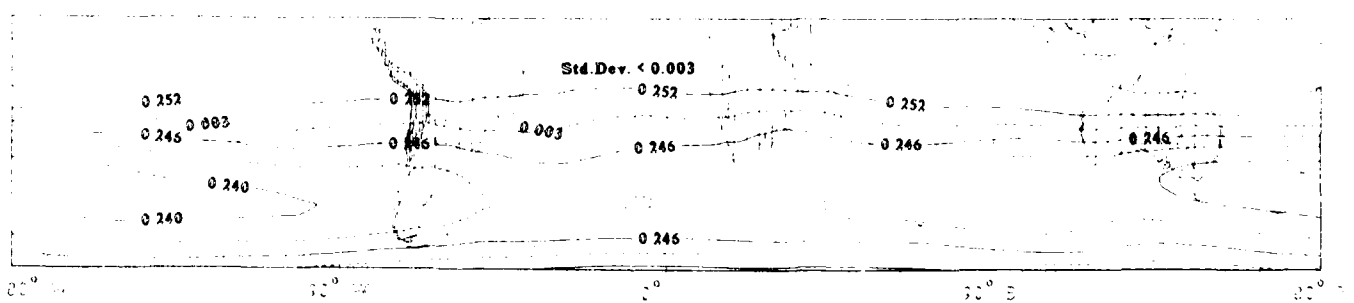
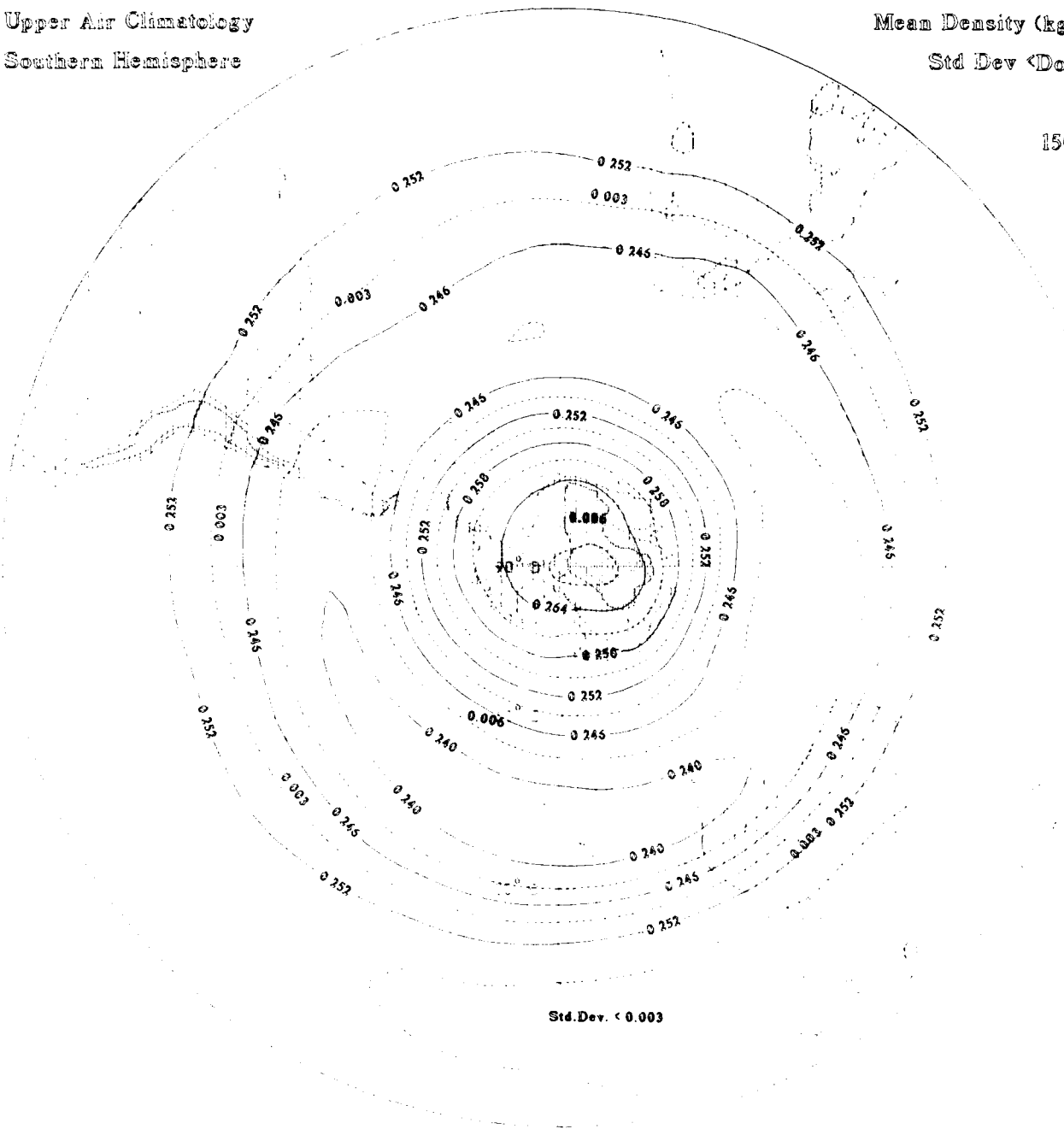
Std.Dev. < 0.003



Std.Dev. < 0.003

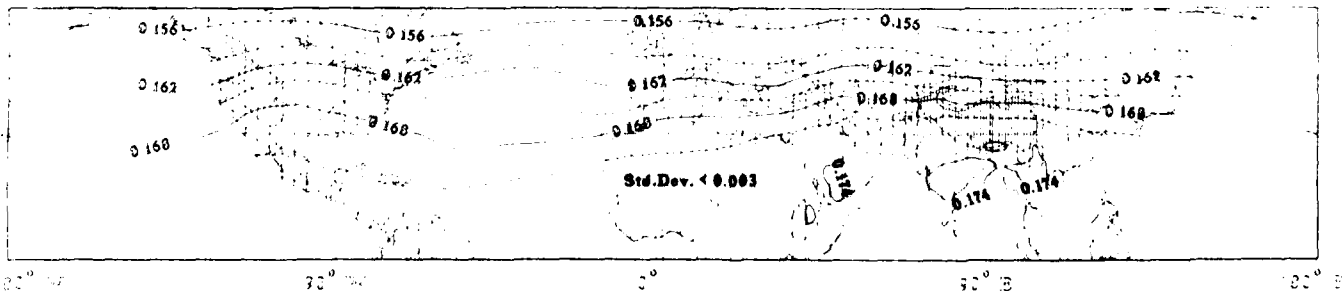
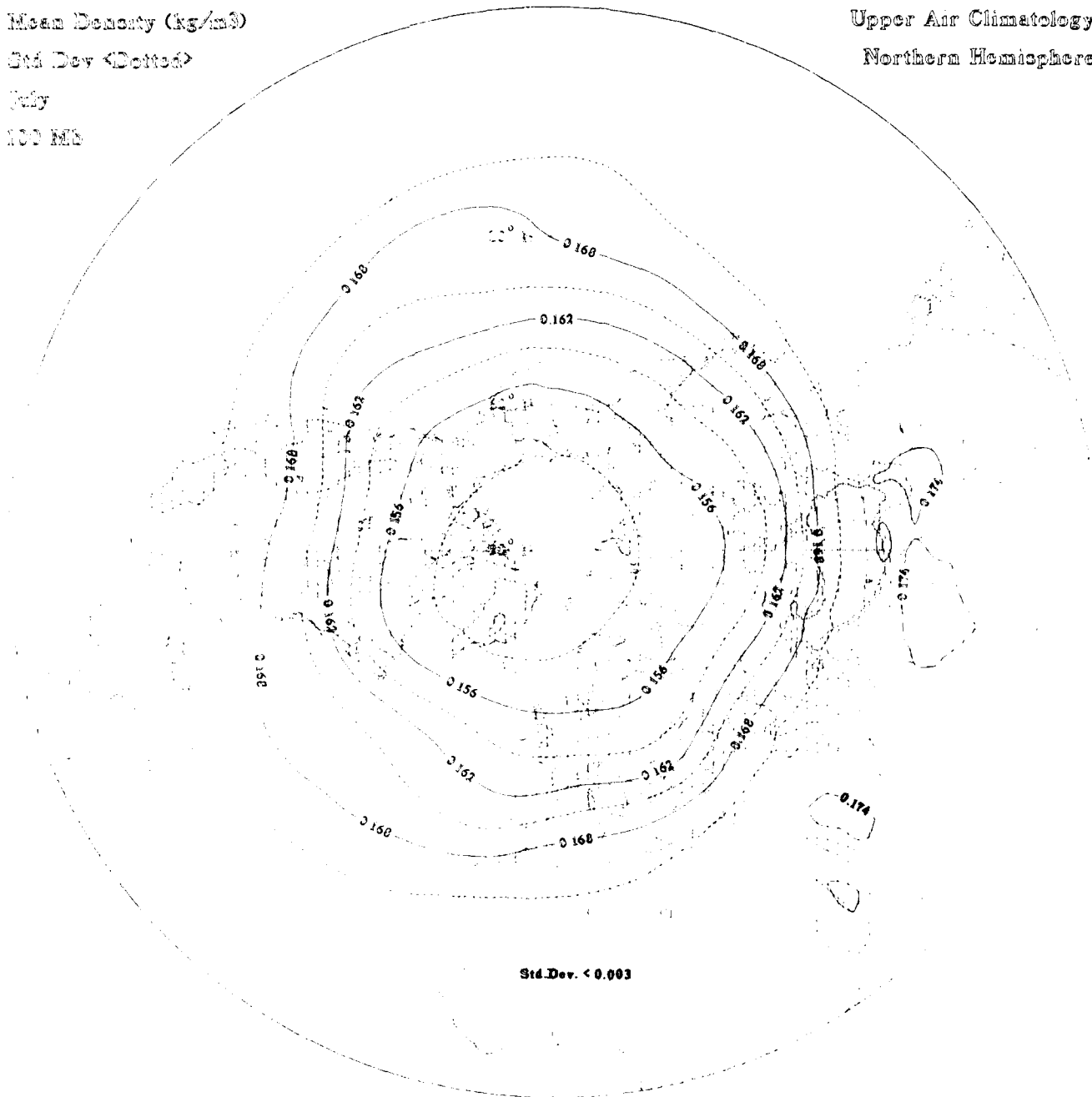
Upper Air Climatology  
Southern Hemisphere

Mean Density (kg/m<sup>3</sup>)  
Std Dev <Dotted>  
July  
150 Mb



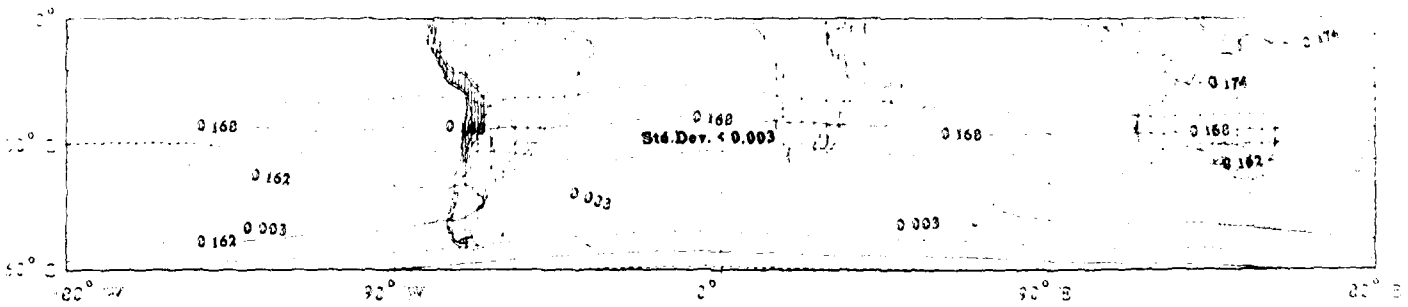
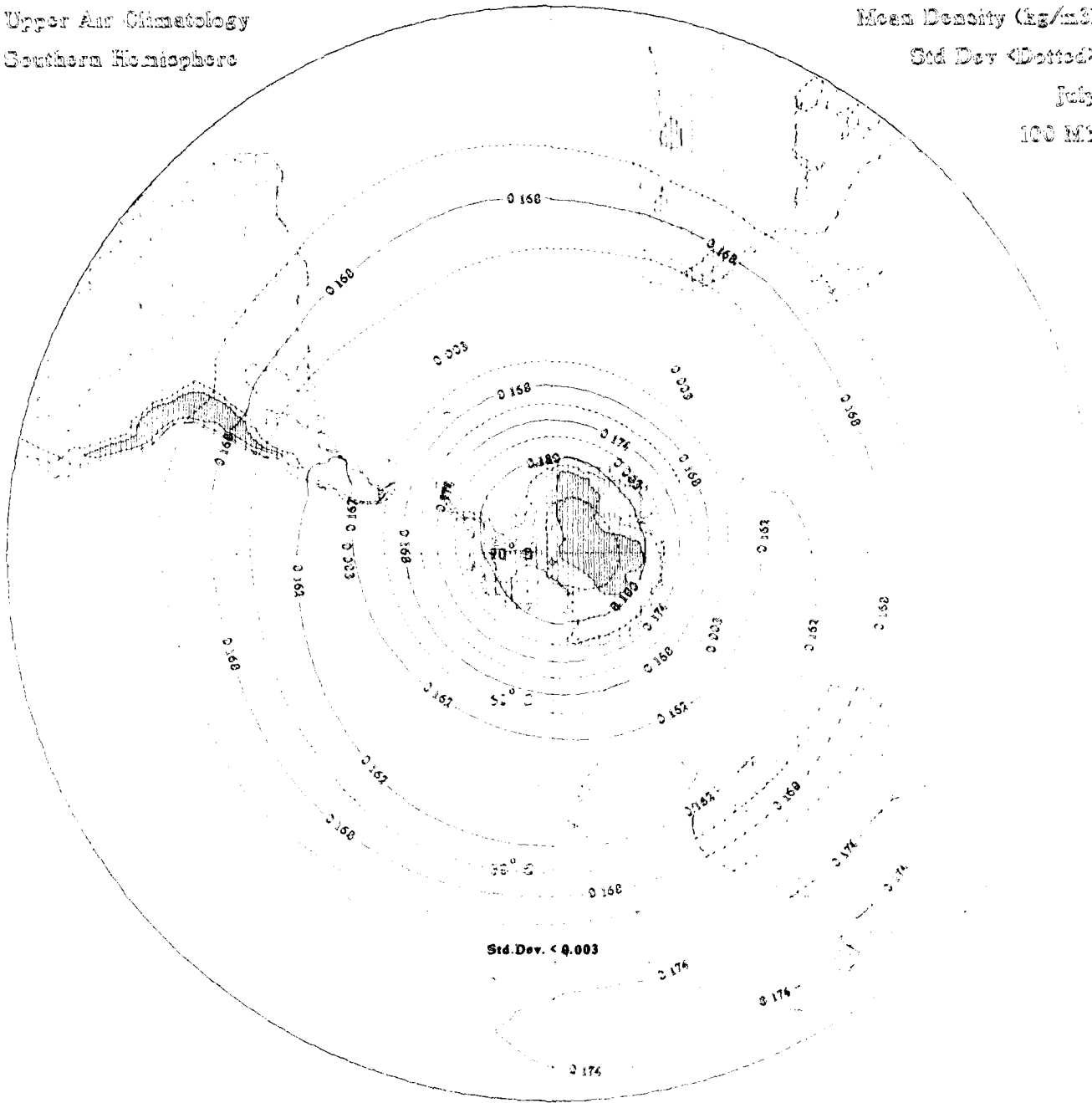
Mean Density (kg/m<sup>3</sup>)  
Std. Dev. (Dotted)  
July  
100 MB

Upper Air Climatology  
Northern Hemisphere



Upper Air Climatology  
Southern Hemisphere

Mean Density ( $\text{kg/m}^3$ )  
Std Dev (Dotted)  
July  
100 mb



Mean Density (kg/m<sup>3</sup>)

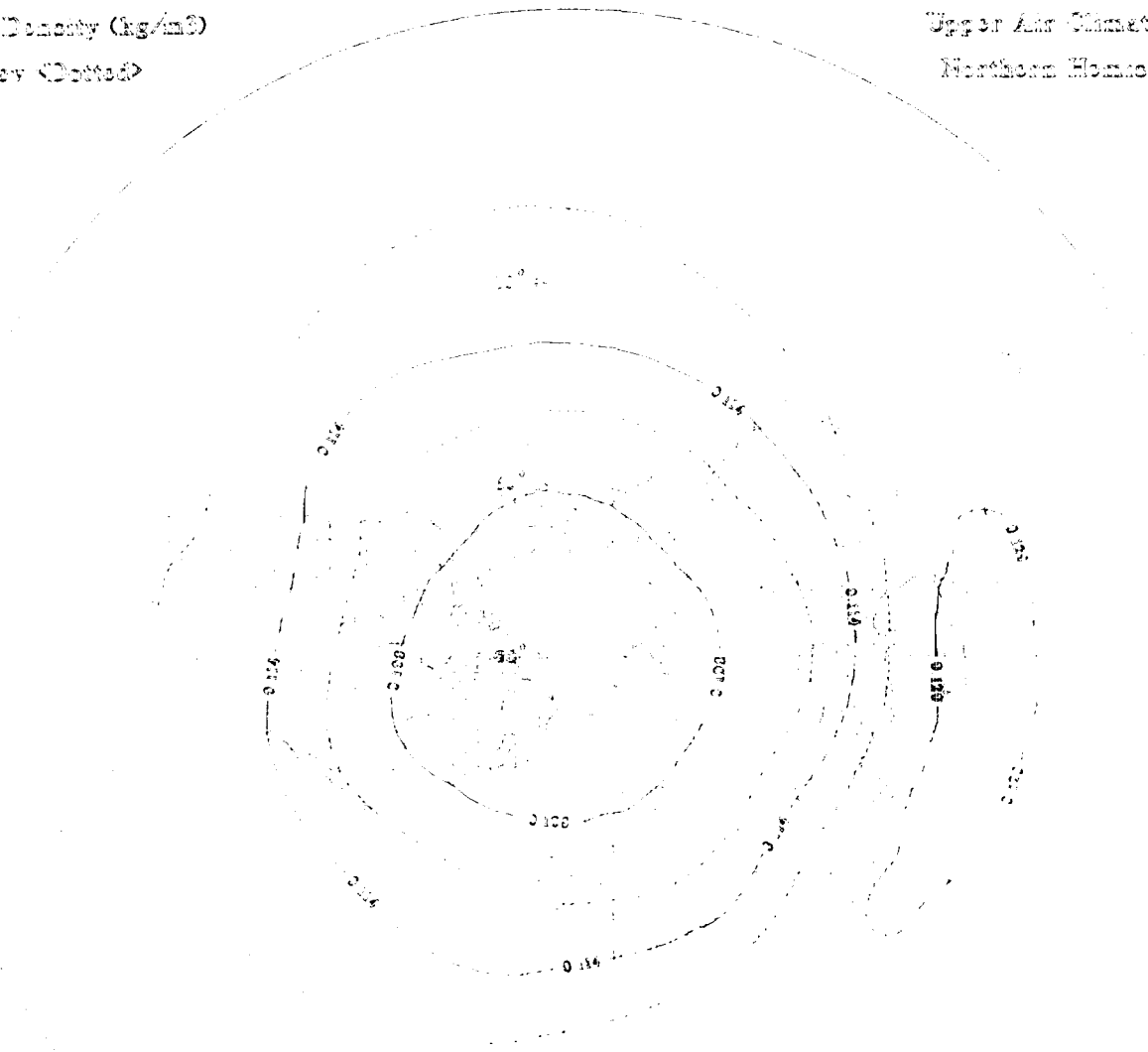
Std Dev (Dotted)

July

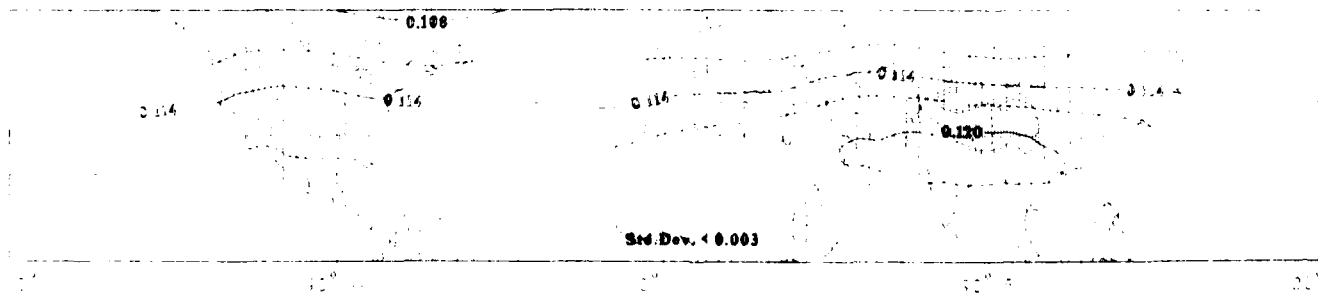
10 MB

Upper Air Climatology

Northern Hemisphere



Std. Dev. < 0.003



Std. Dev. < 0.003

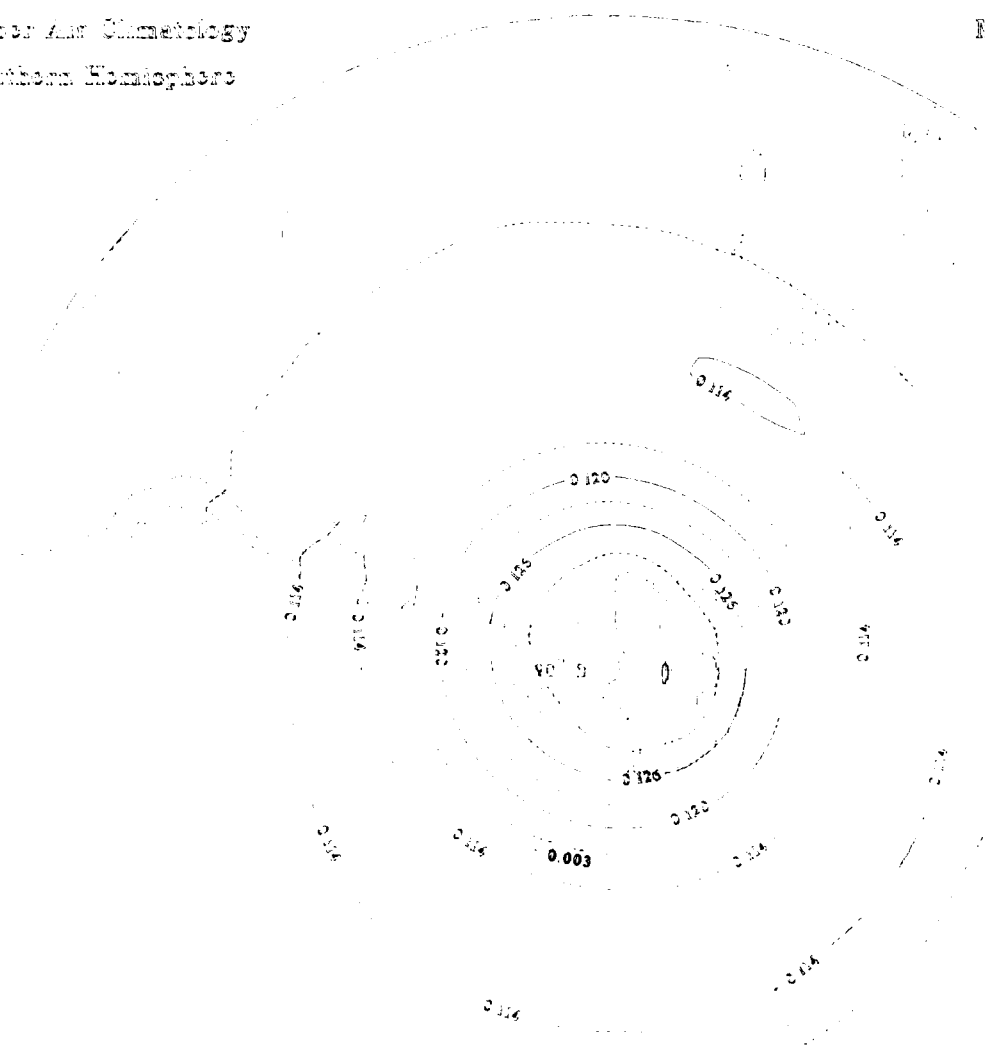
Upper Air Climatology  
Southern Hemisphere

Mean Density (kg/m<sup>3</sup>)

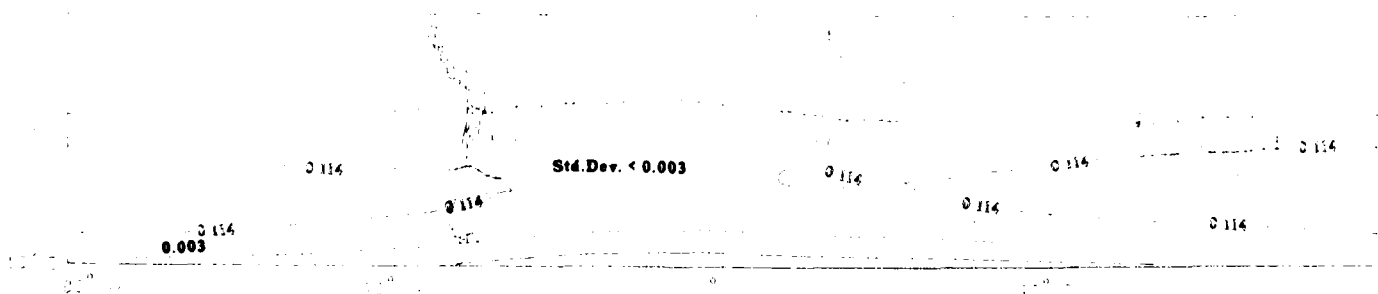
Std. Dev. (Dotted)

July

01 MS



Std. Dev. < 0.003



Mean Density (kg/m<sup>3</sup>)

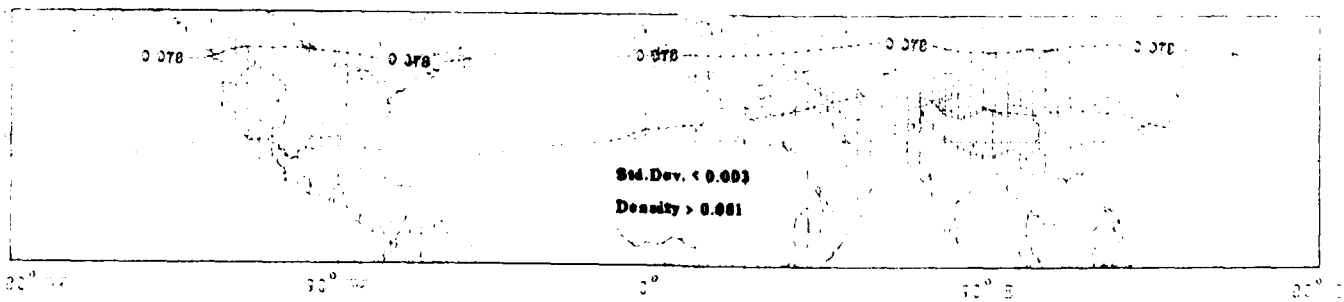
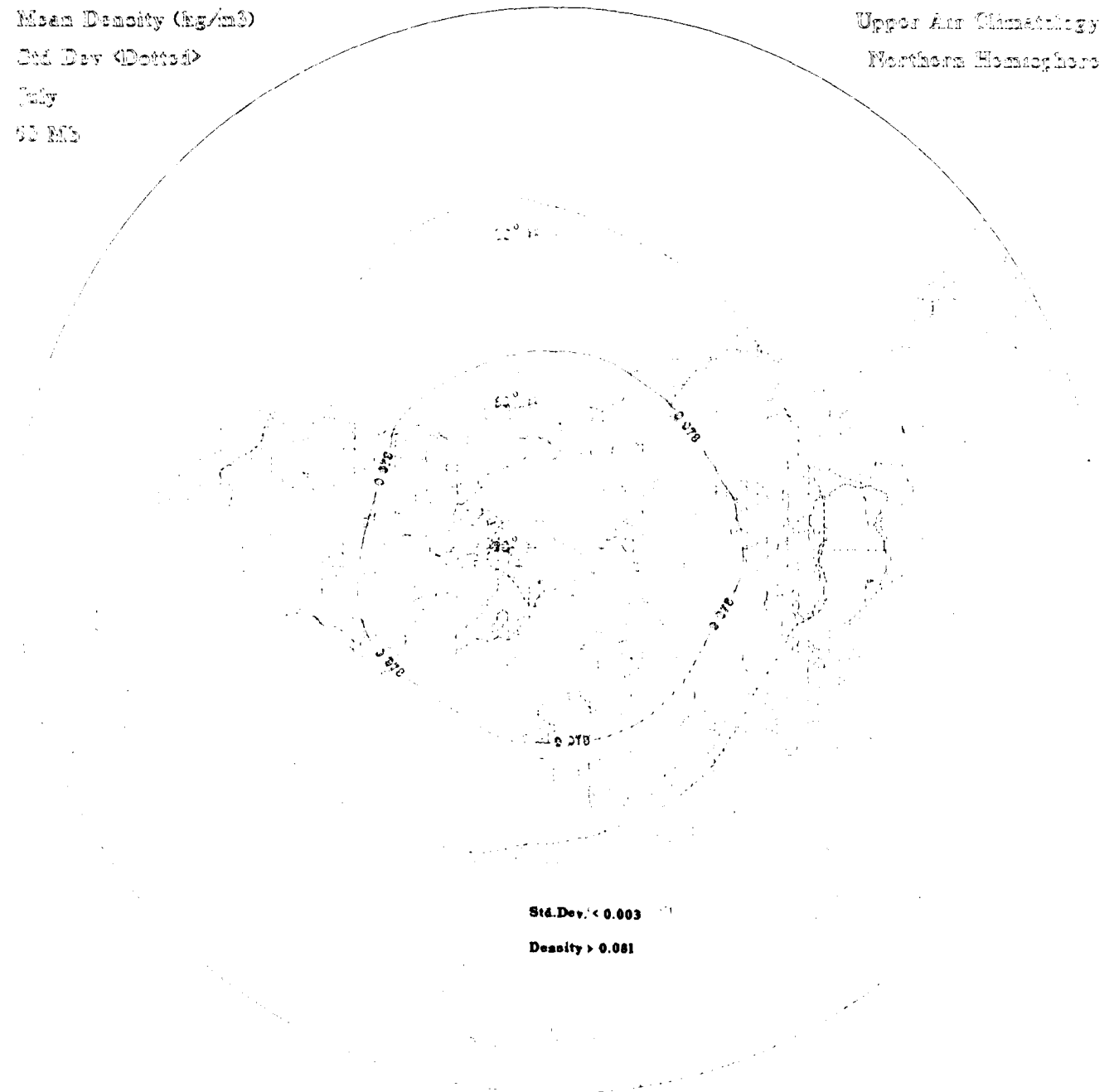
Std Dev (Dotted)

July

50 MB

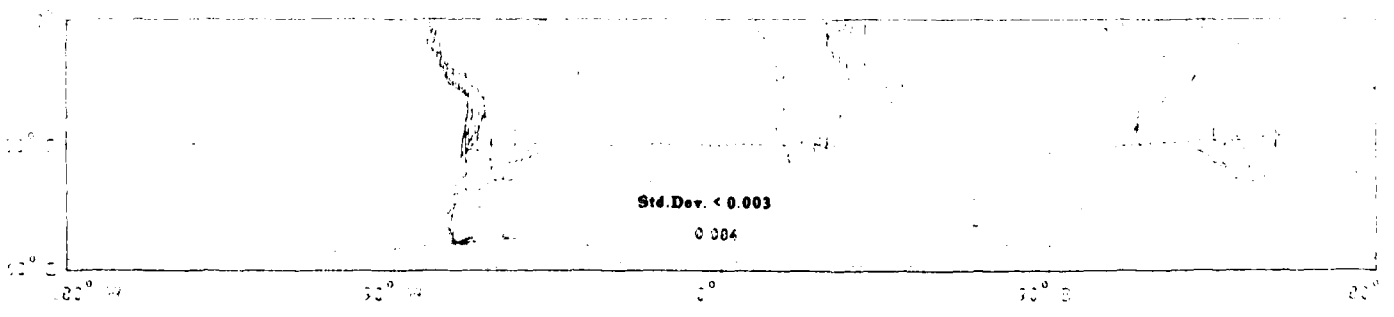
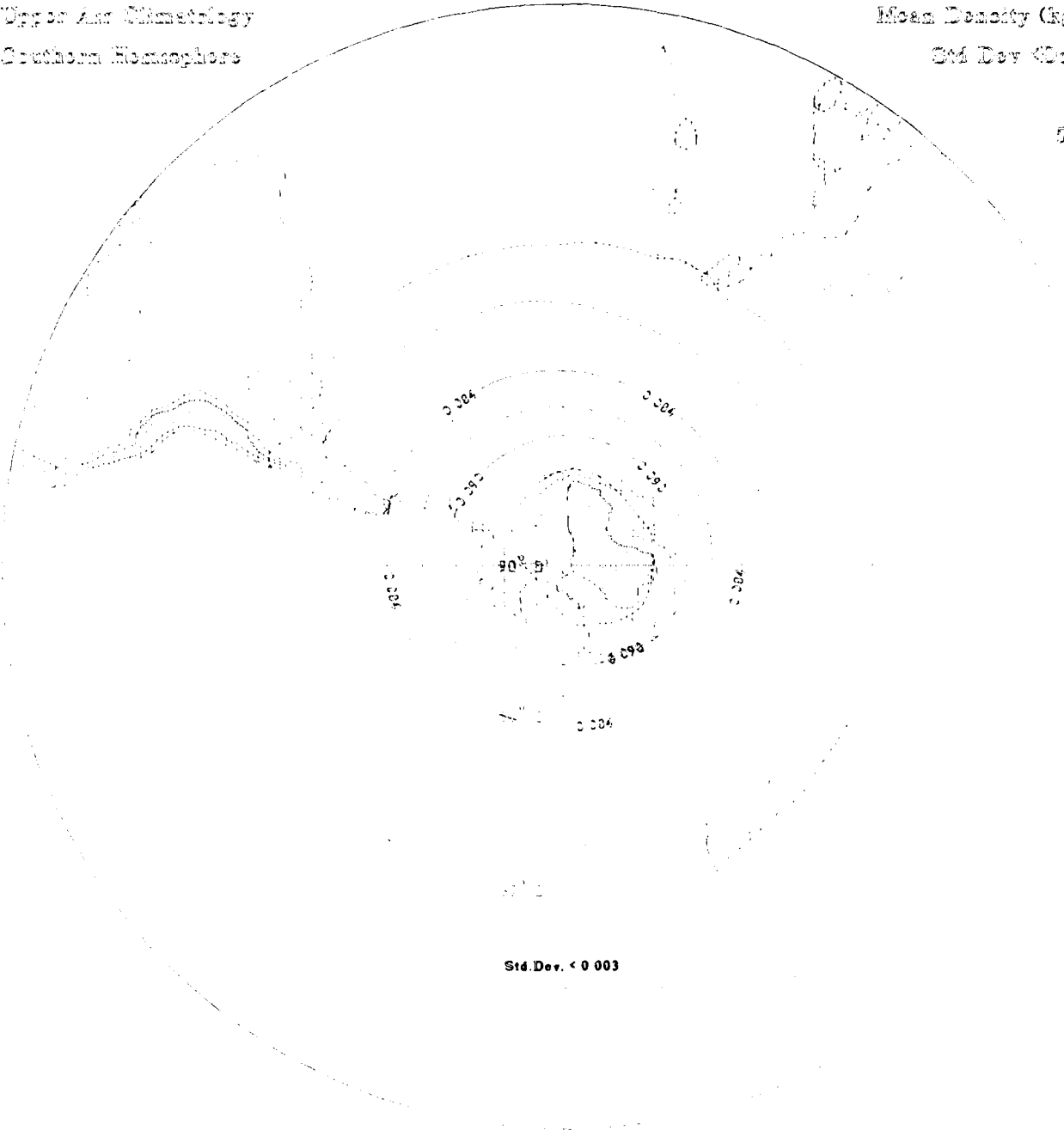
Upper Air Climatology

Northern Hemisphere



Upper Air Climatology  
Southern Hemisphere

Mean Density (kg/m<sup>3</sup>)  
Std Dev (Circles)  
July  
51 MB



Mean Density (g/cm<sup>3</sup>)

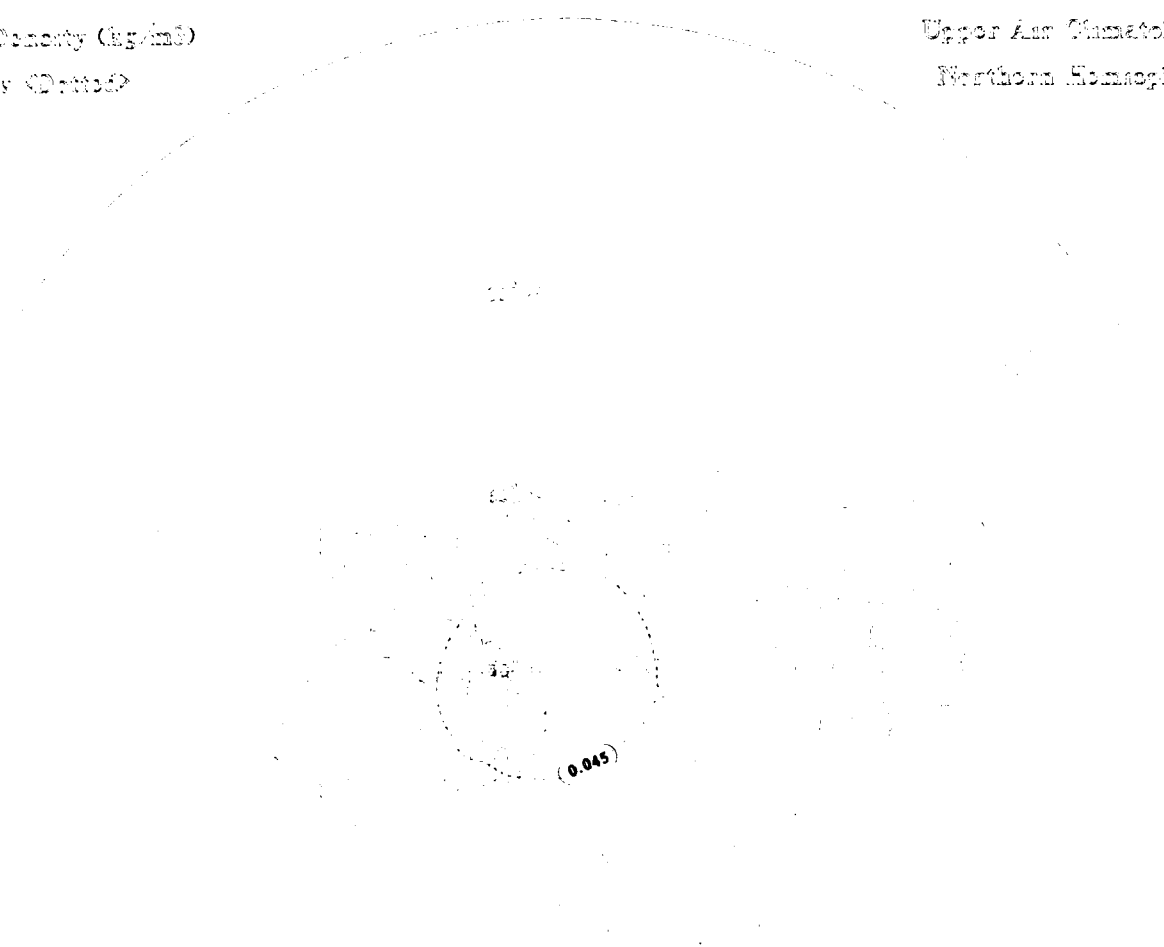
Std. Dev. (Dotted)

July

10 MB

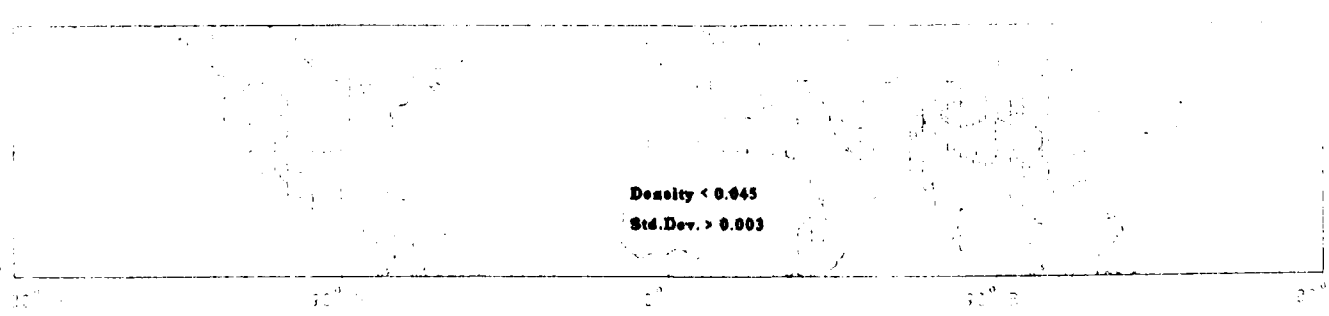
Upper Air Climatology

Northern Hemisphere



Std.Dev. < 0.003

Density > 0.045

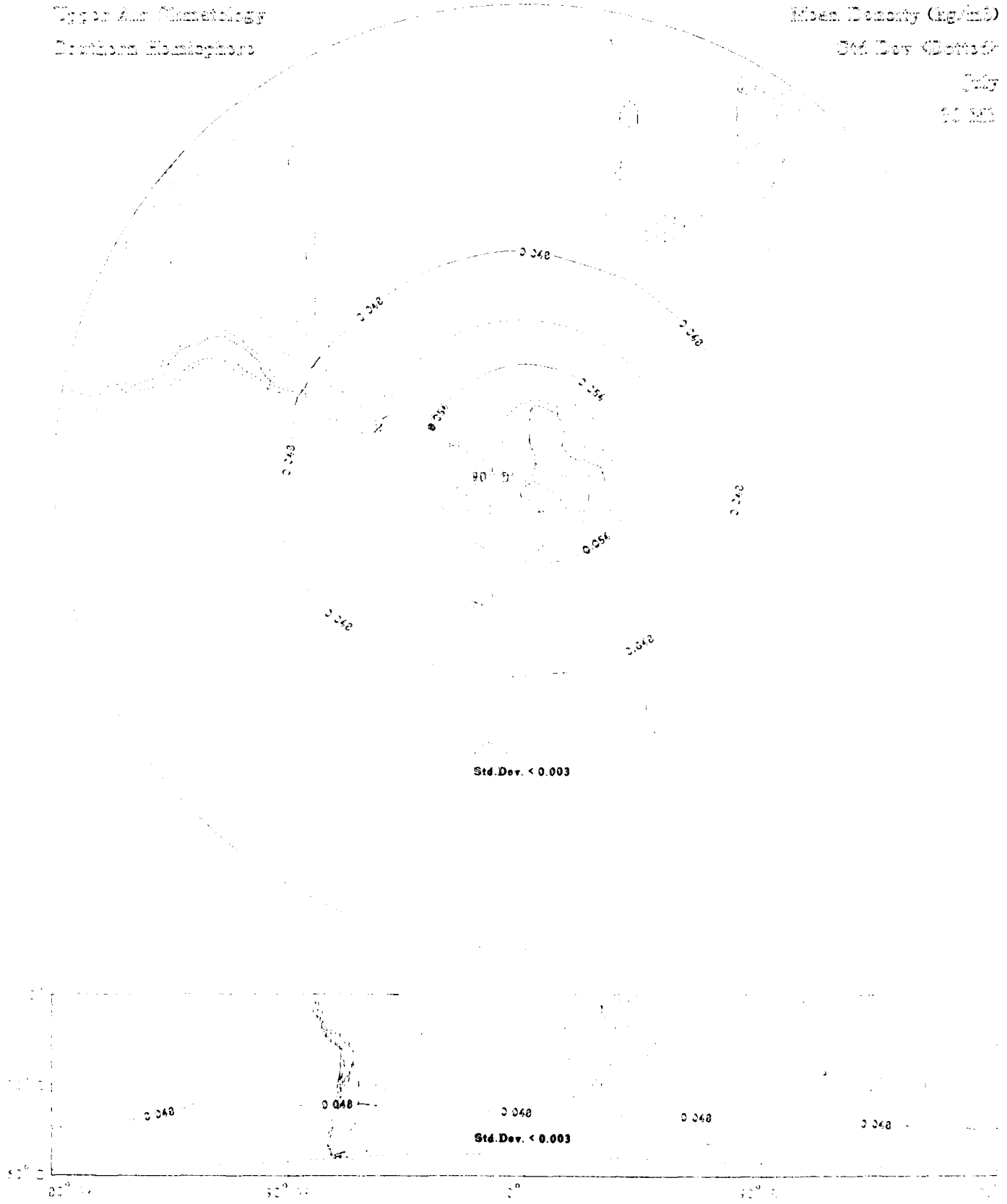


Density < 0.045

Std.Dev. > 0.003

Upper Air Climatology  
Northern Hemisphere

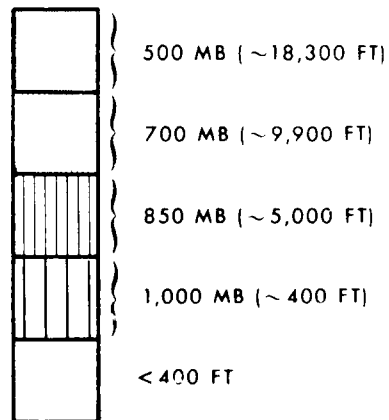
Mean Density (kg/m<sup>3</sup>)  
Day 00000  
July  
1953



STANDARD DEVIATION OF HEIGHT  
STANDARD DEVIATION OF VECTOR MEAN WIND  
(13 LEVELS, 1000 TO 30 MB)

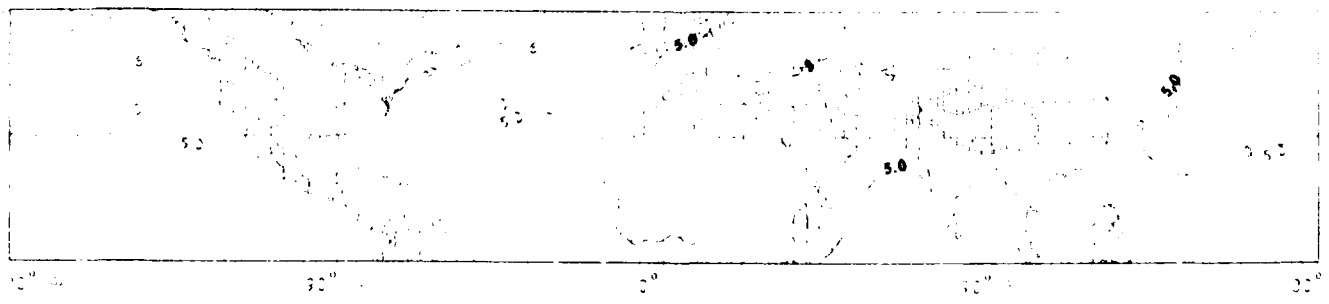
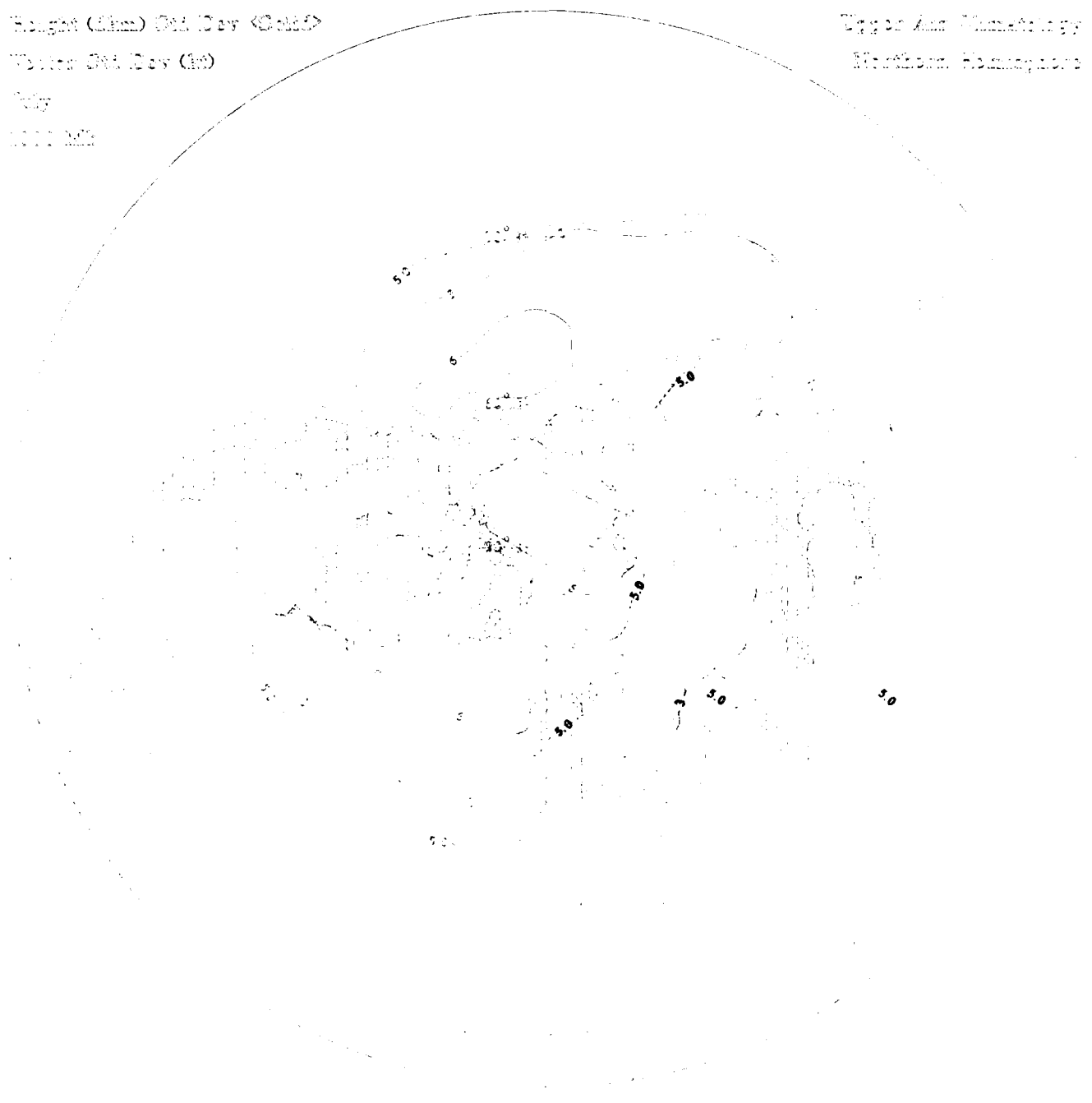
- Contours of standard deviation of height (solid lines) in geopotential dekameters
- Standard deviation of height labeled interval:
  - 3 dekameters (30 meters) - 1000 MB to 400 MB
  - 6 dekameters (60 meters) - 300 MB to 200 MB
  - 4 dekameters (40 meters) - 150 MB to 30 MB
- Contours of standard deviation of vector mean wind (dashed lines) in knots
- Standard deviation of vector mean wind labeled interval: 5 knots
- Contours blanked for geographic areas with elevations exceeding specified geopotential heights

ELEVATION SCALE



Height (ft) 011 Day (011)  
Water 011 Day (11)  
July  
1011 111

Upper Air Climatology  
Hatched Homography



Topographic Contour  
Interval: 100 meters

Elevation (ft) Contour Interval

100

200

300



Height (ft) 1000

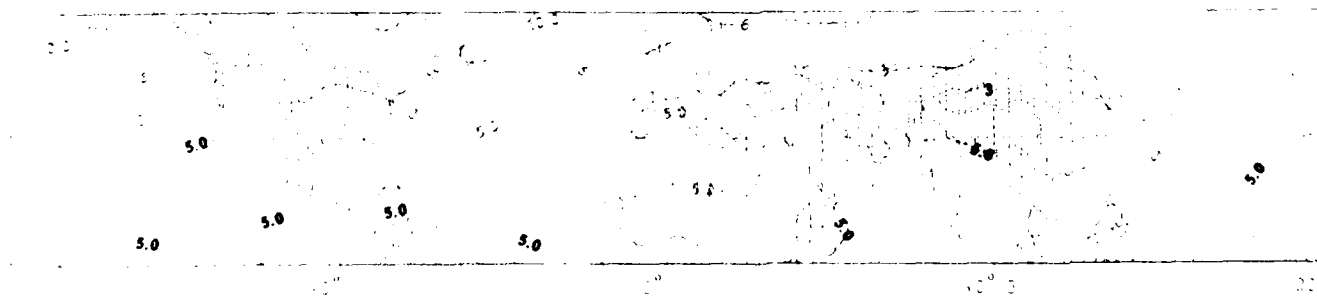
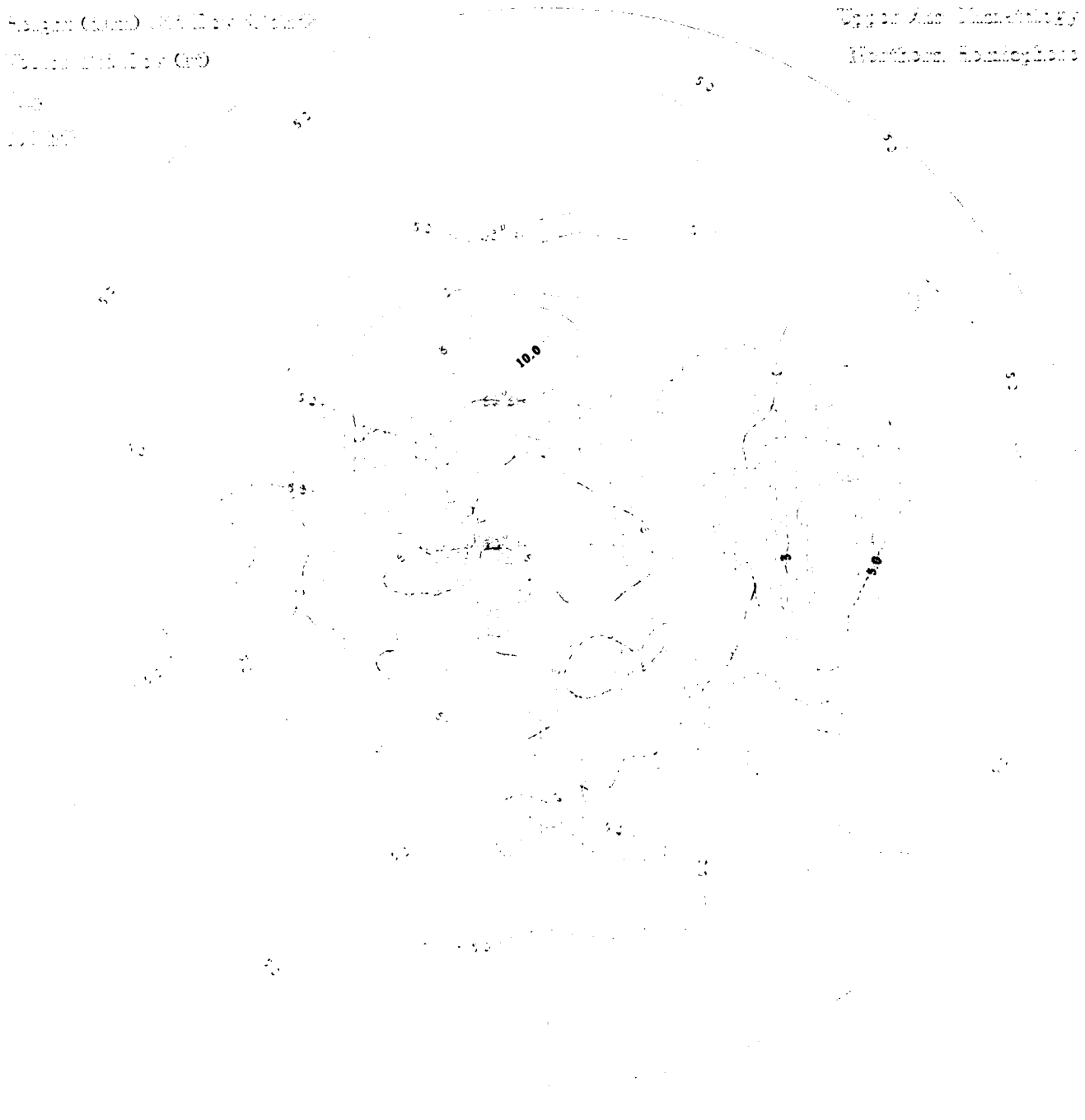
1000

1000

1000

Upper Air Masses

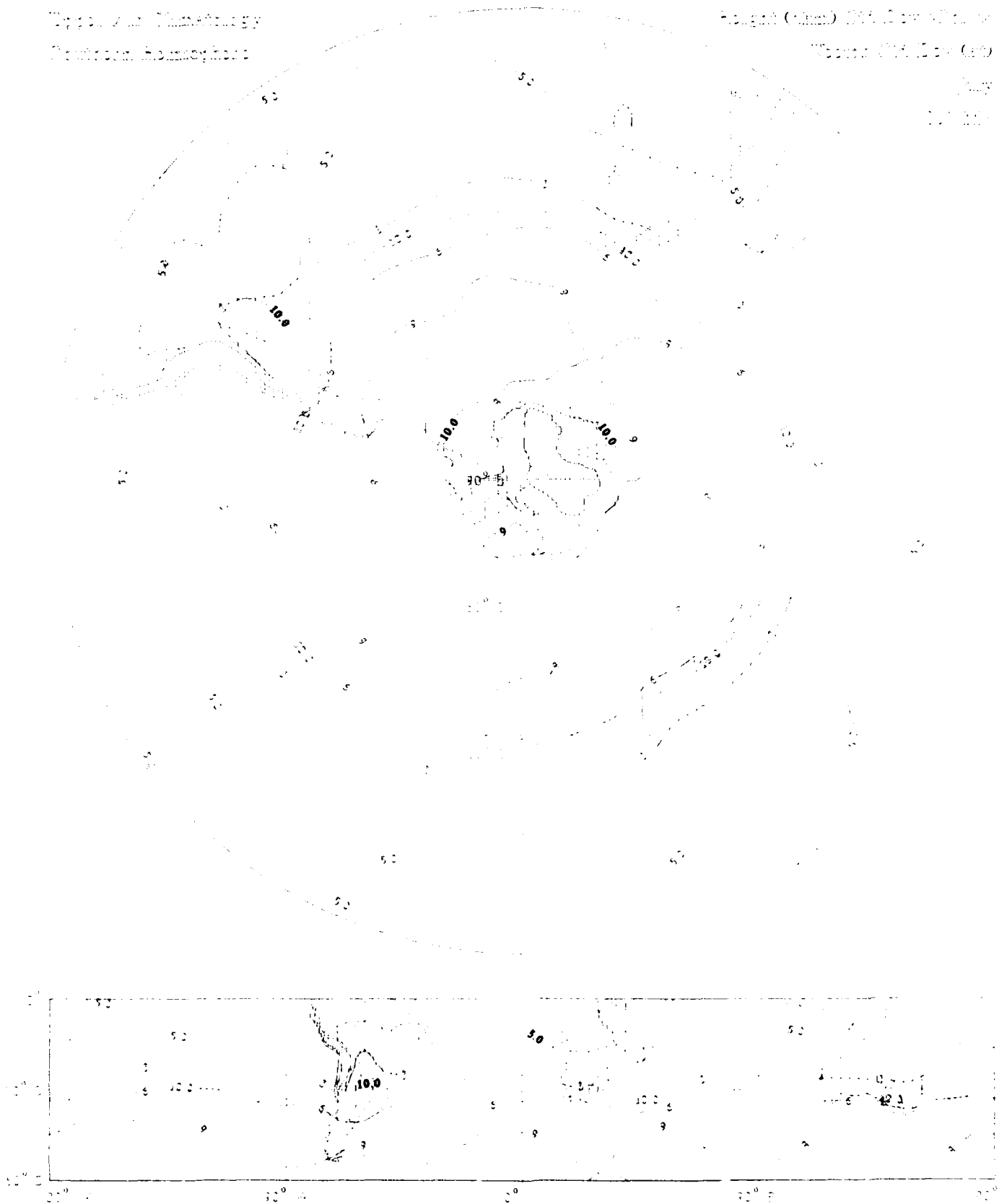
Western Hemisphere



Topography  
Contour Interval: 1000

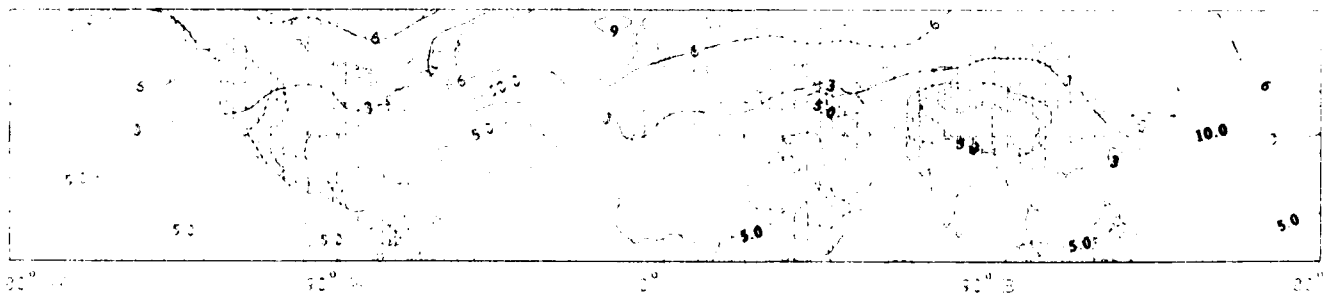
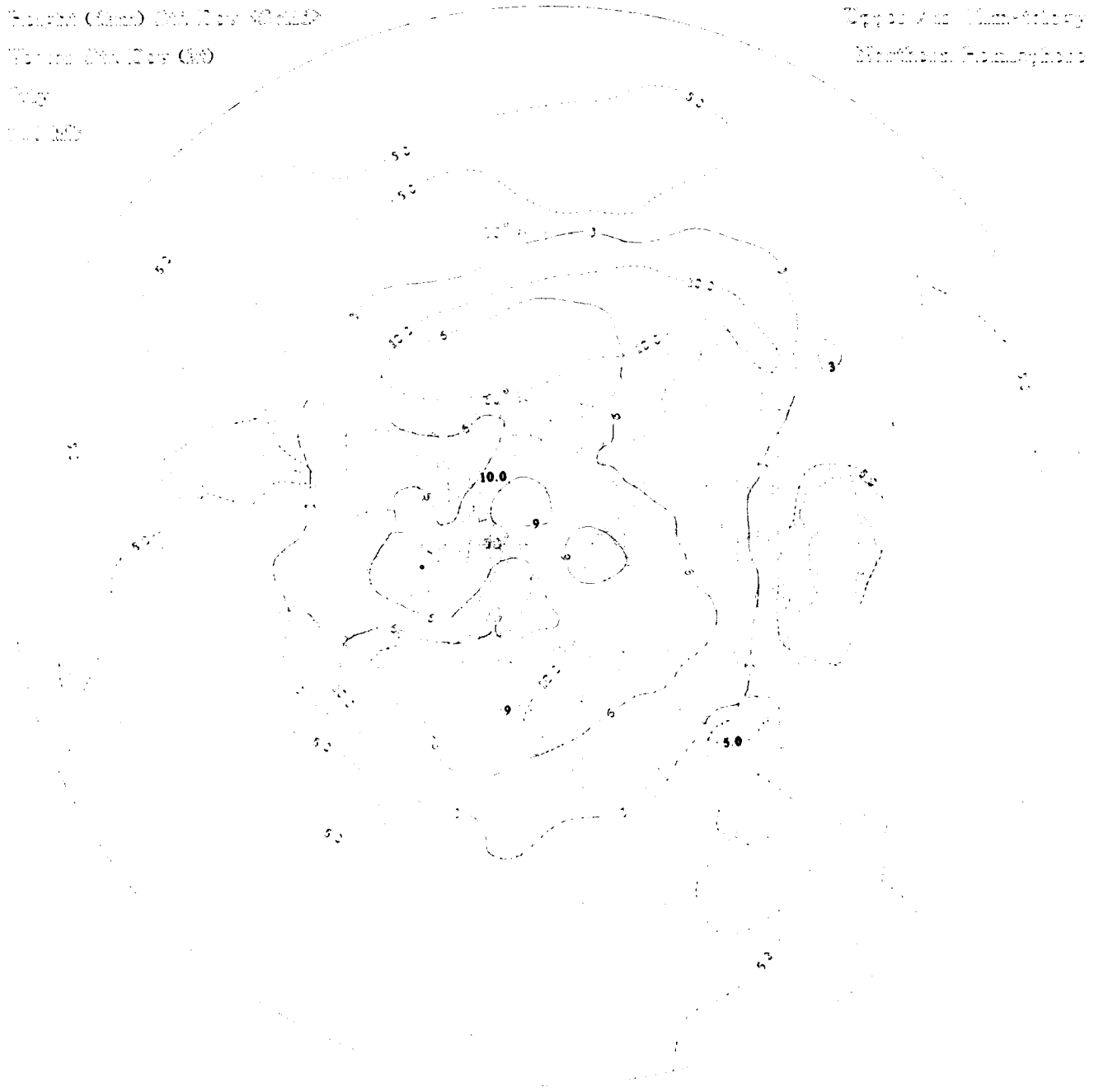
Height (ft) 1994 Contour Interval  
1000

July  
1994



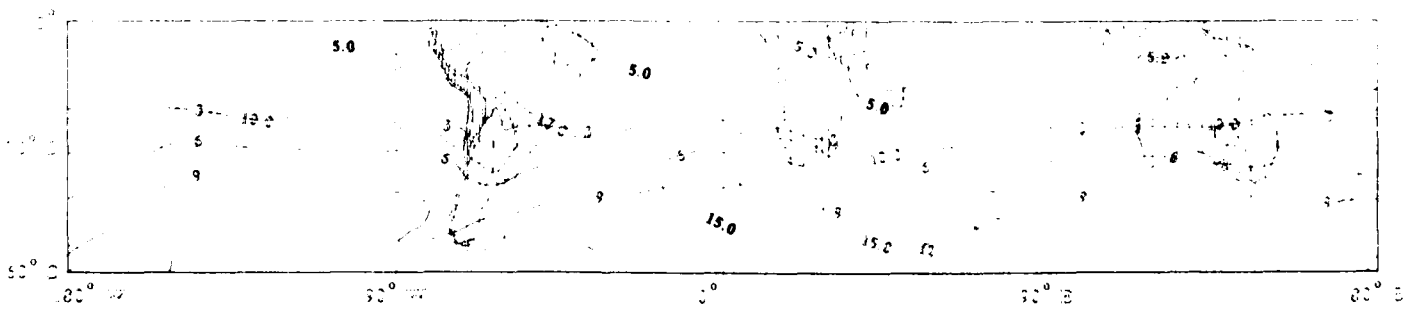
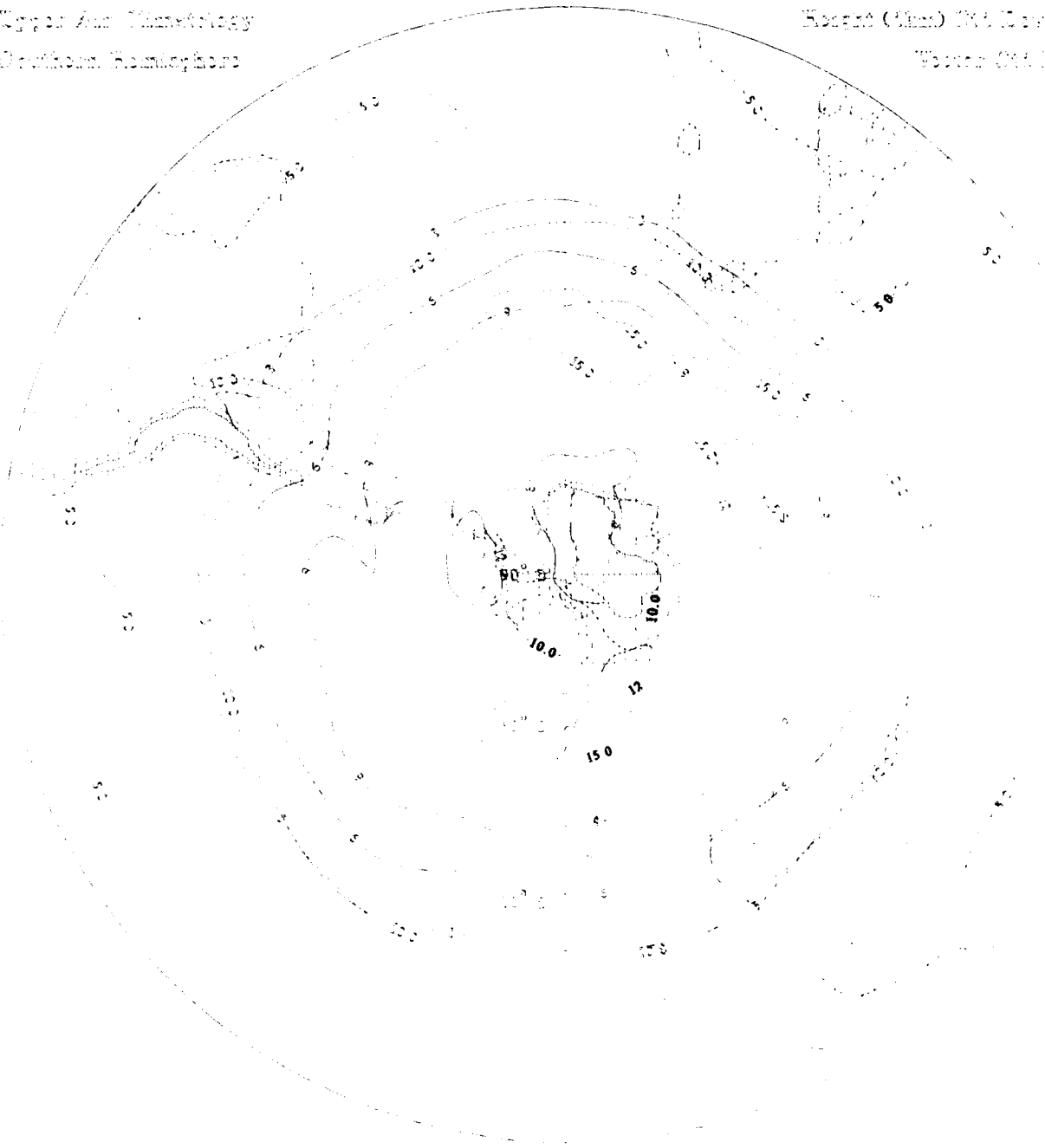
Height (ft) Oct Day (Cont'd)  
Tides Oct Day (30)  
Day  
1950

Upper Air Temperature  
Mean Sea Level Pressure



Upper Air Characteristics  
Deviation from Normal

Height (GMS) 700 Millibars  
Volume (GMS) 1000  
Date  
01. 200





Upper Air Climatology  
Southern Hemisphere

Height (GMS) Off. Day (P) 9  
Time Off Day (hr)  
Day  
1971-1972

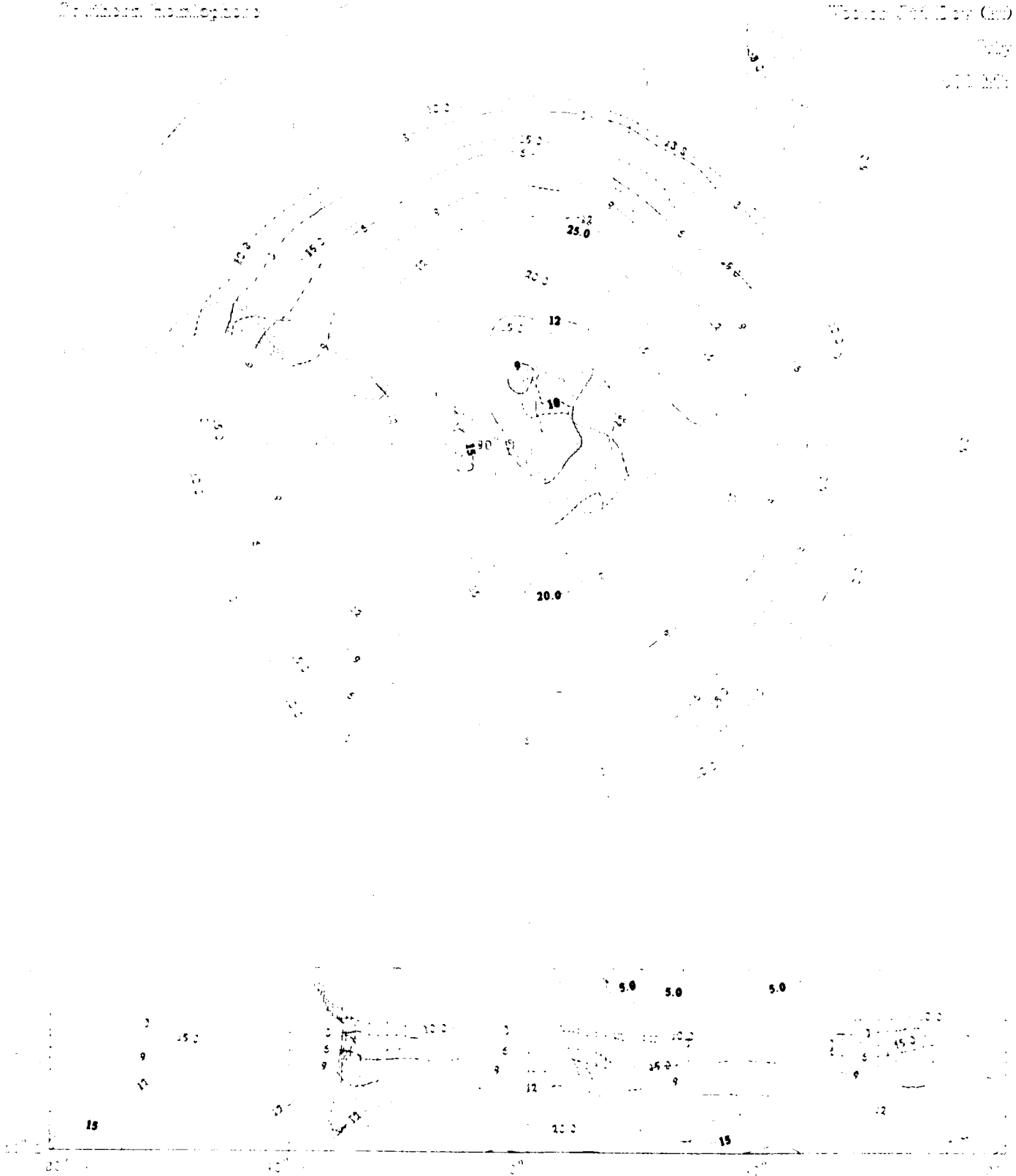


Figure 1 (Cont) - 10/10/1964

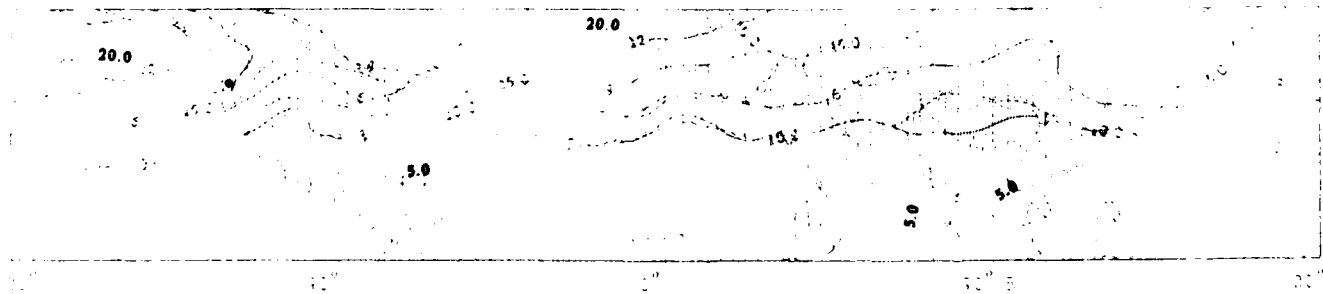
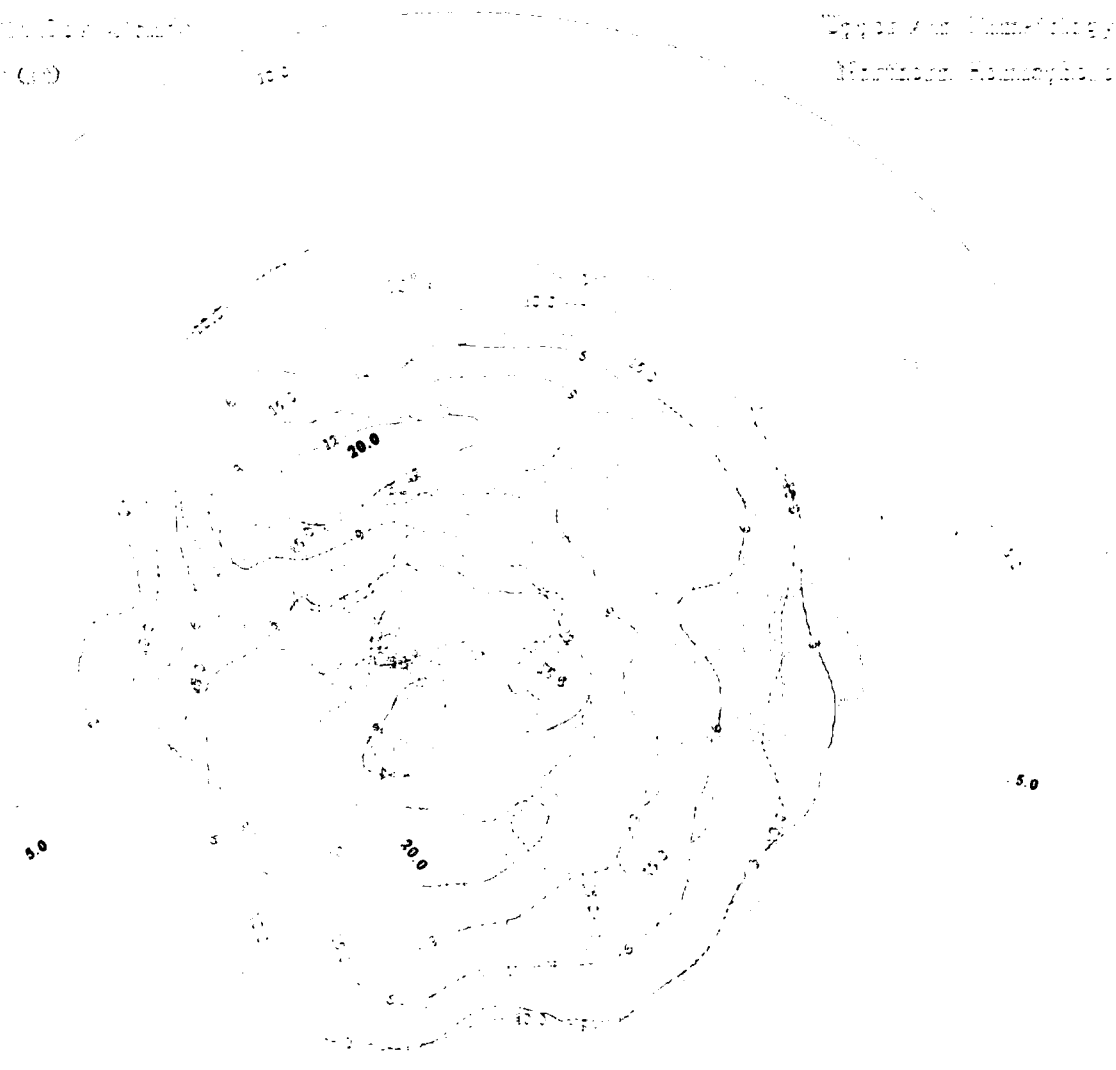
Figure 1 (Cont) - 10/10/1964

10/10/1964

10/10/1964

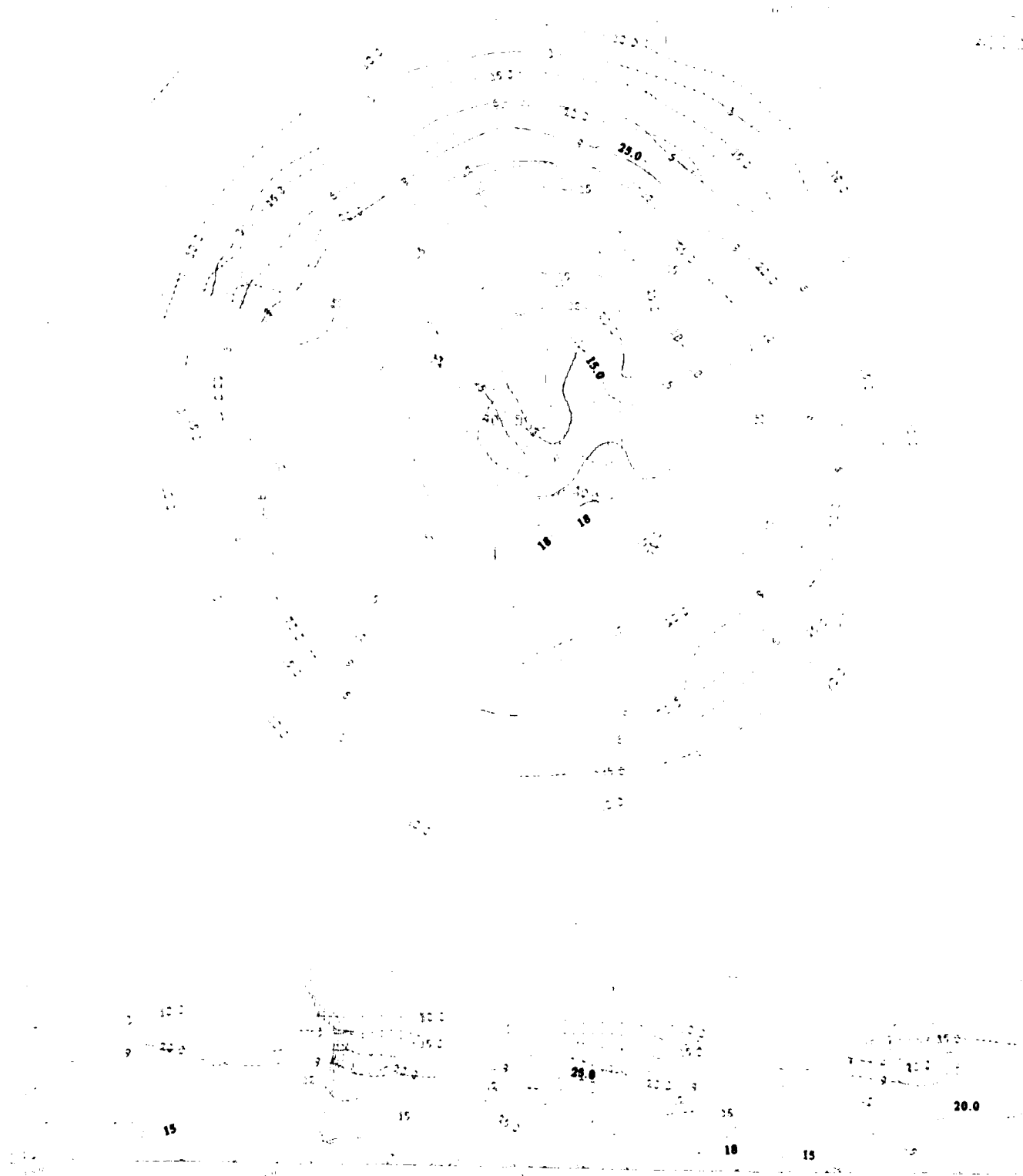
Figure 1 (Cont) - 10/10/1964

Figure 1 (Cont) - 10/10/1964



Topographic Map  
of the Hawaiian Islands

Scale (1:100,000)  
North Arrow



Height (km) 0.0 10000 (0.0)

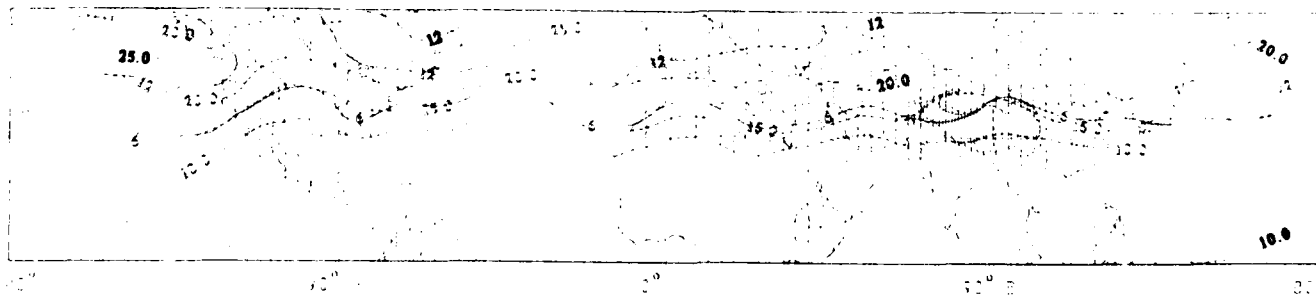
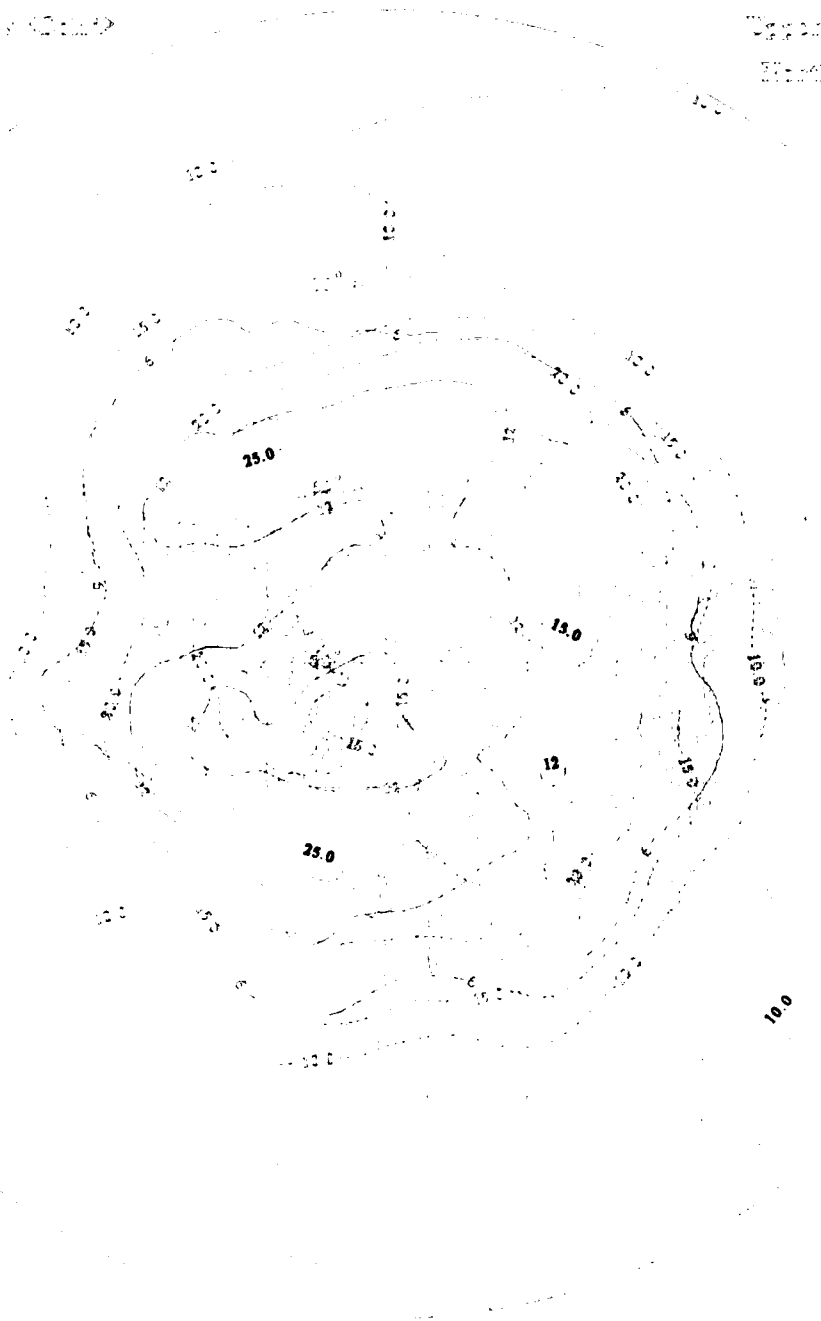
Time (hr) 0.0 12.0 (0.0)

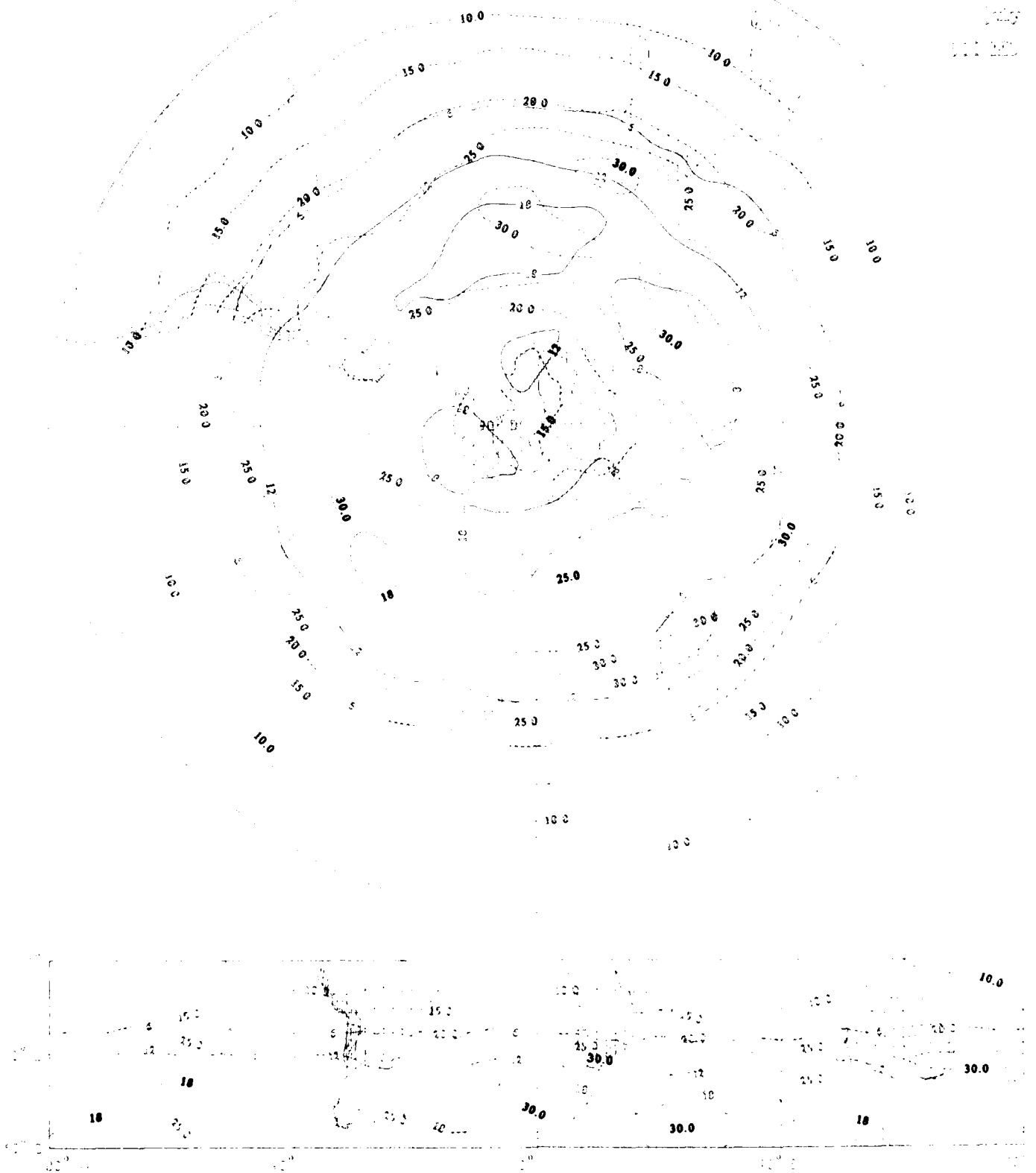
Day

100000

Upper Air Climatology

Eastern Hemisphere





Height (km) Std Dev <Solid>

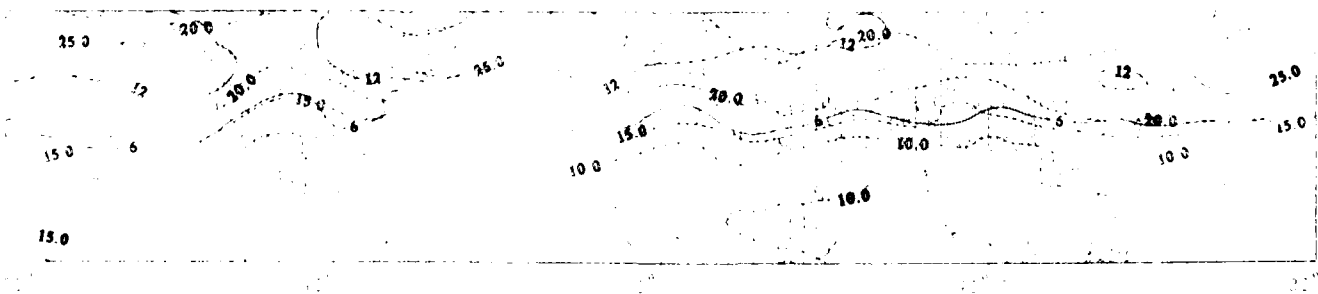
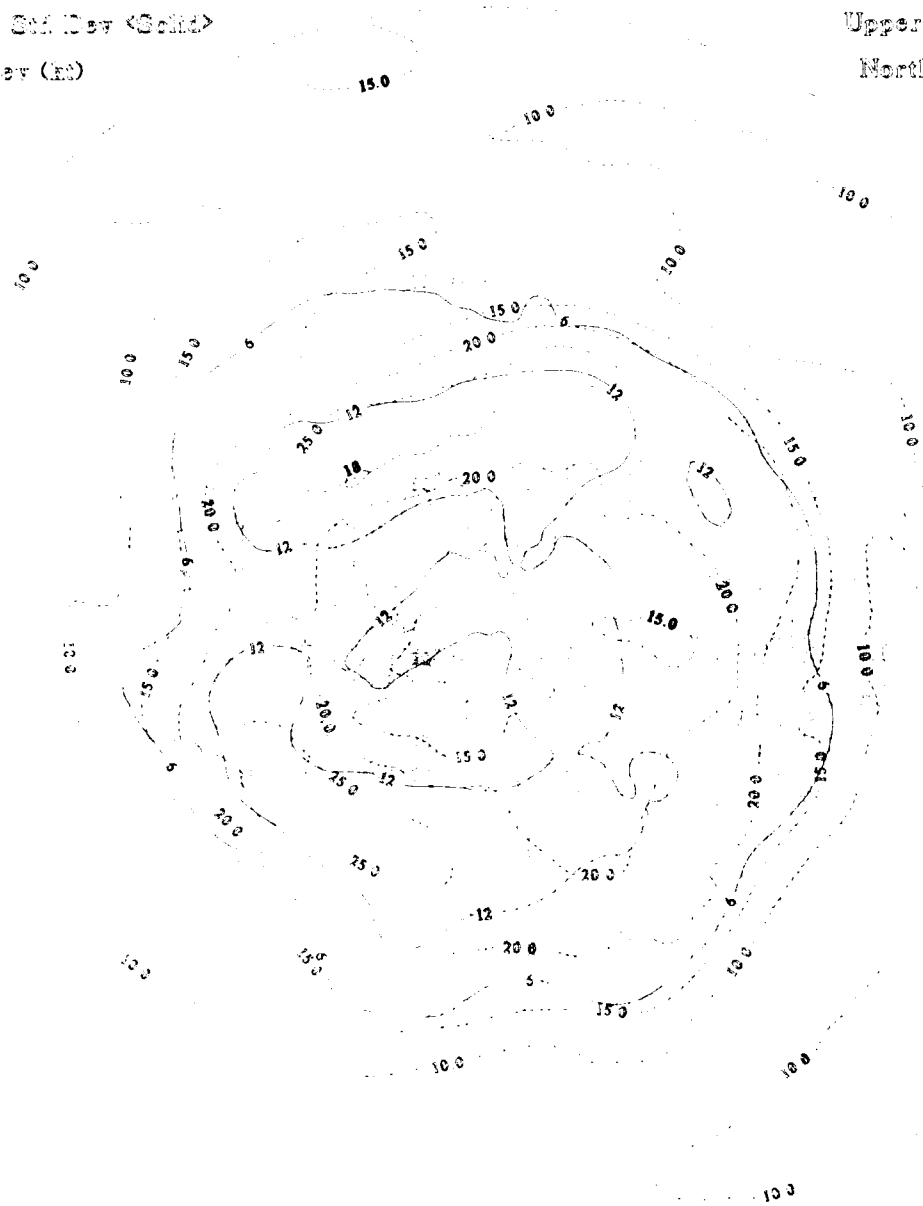
Wester Std Dev (in)

July

351 mb

Upper Air Climatology

Northern Hemisphere



Types and Climatology  
Southern Hemisphere

Height (kms) Sta. Day Count

Feet Sta. Day (ft)

1000  
2000



Height (ft) Sea Level (MSL)

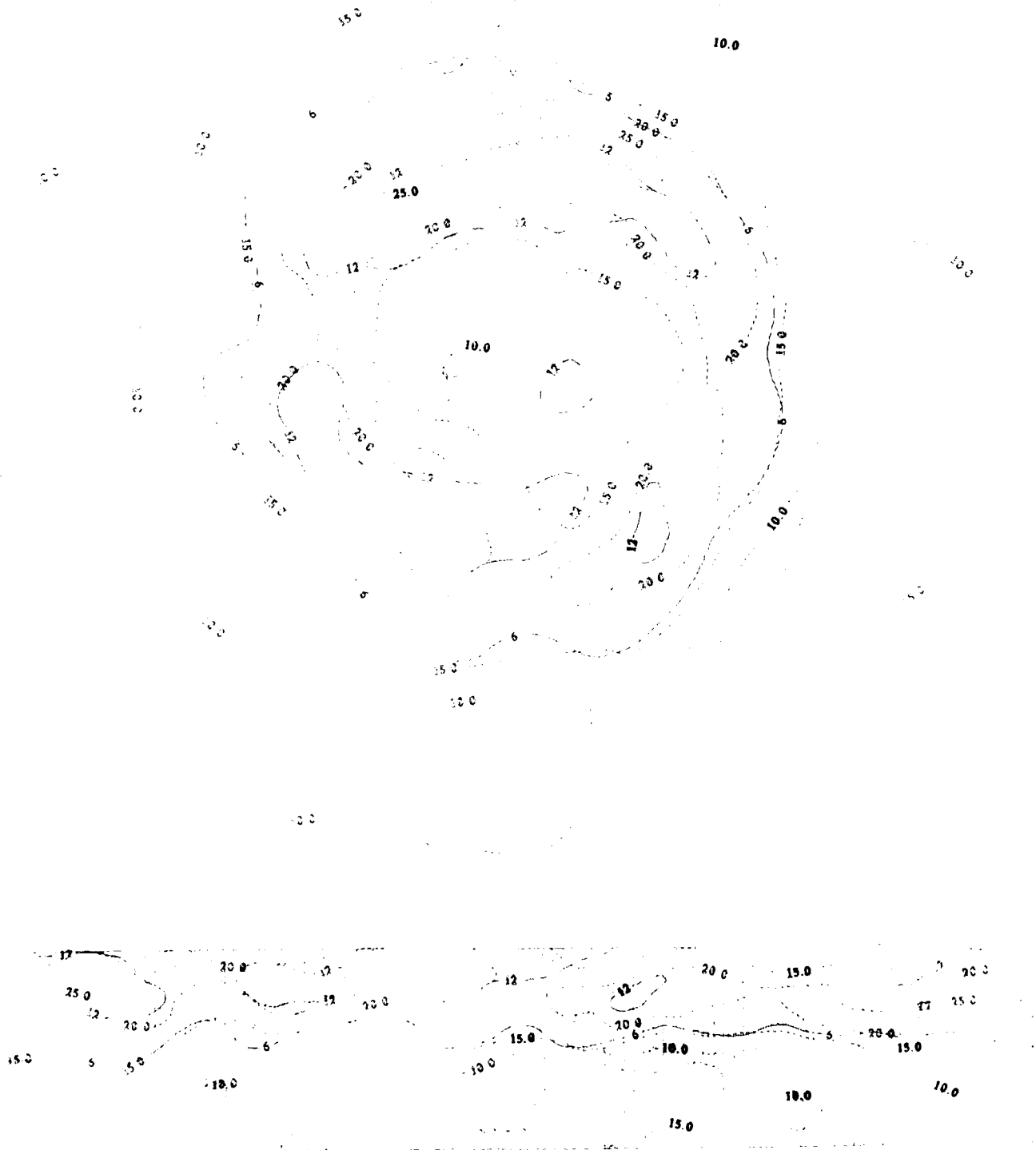
Depth (ft) Sea Level (MSL)

July

1971

Upper Air Climatology

Northern Hemisphere



1958-59  
1959-60

Height (ft) 200 150 100 50

Water Level (ft)



Height (km) Std Dev (GMSD)

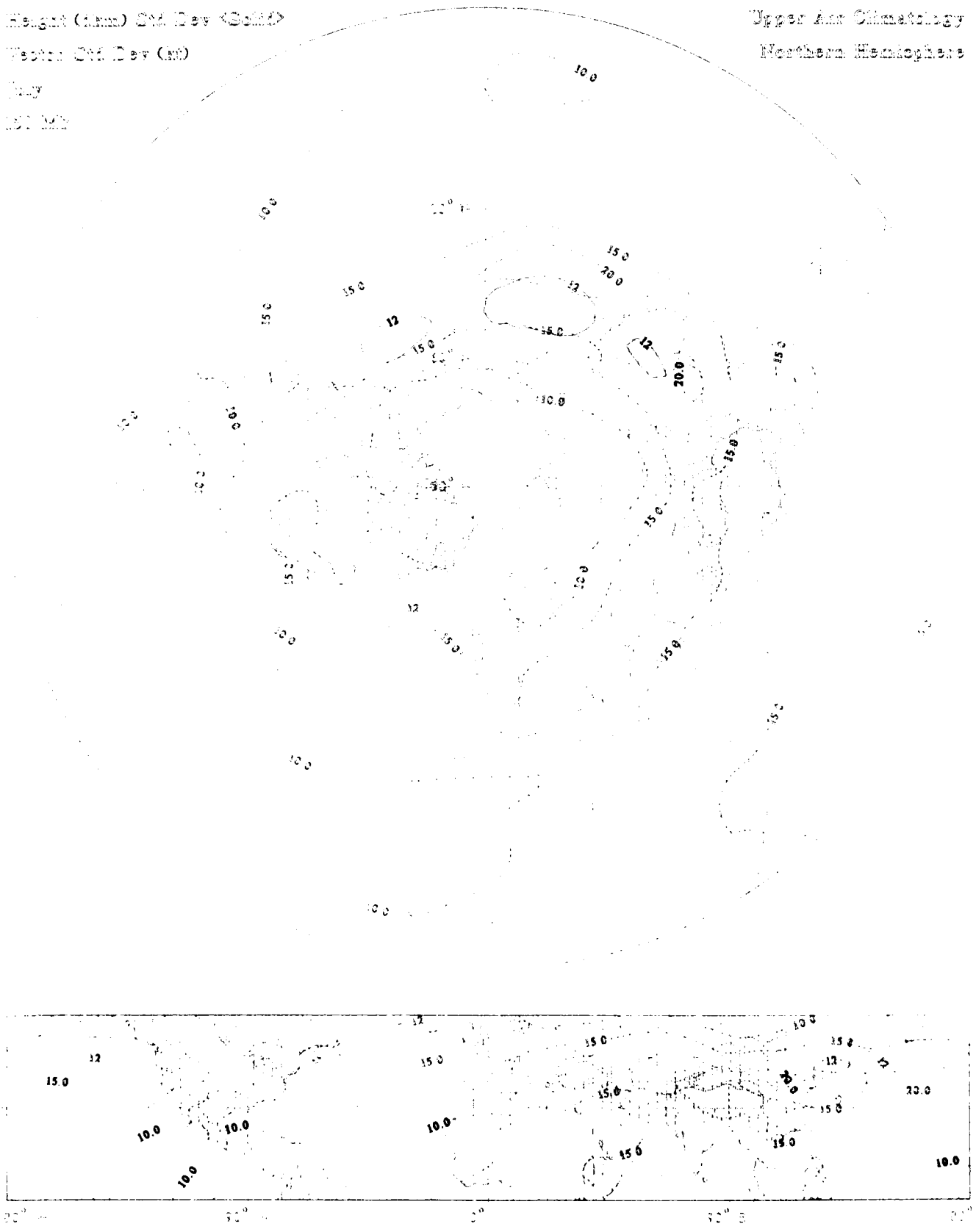
Temp Std Dev (M)

July

1971-72

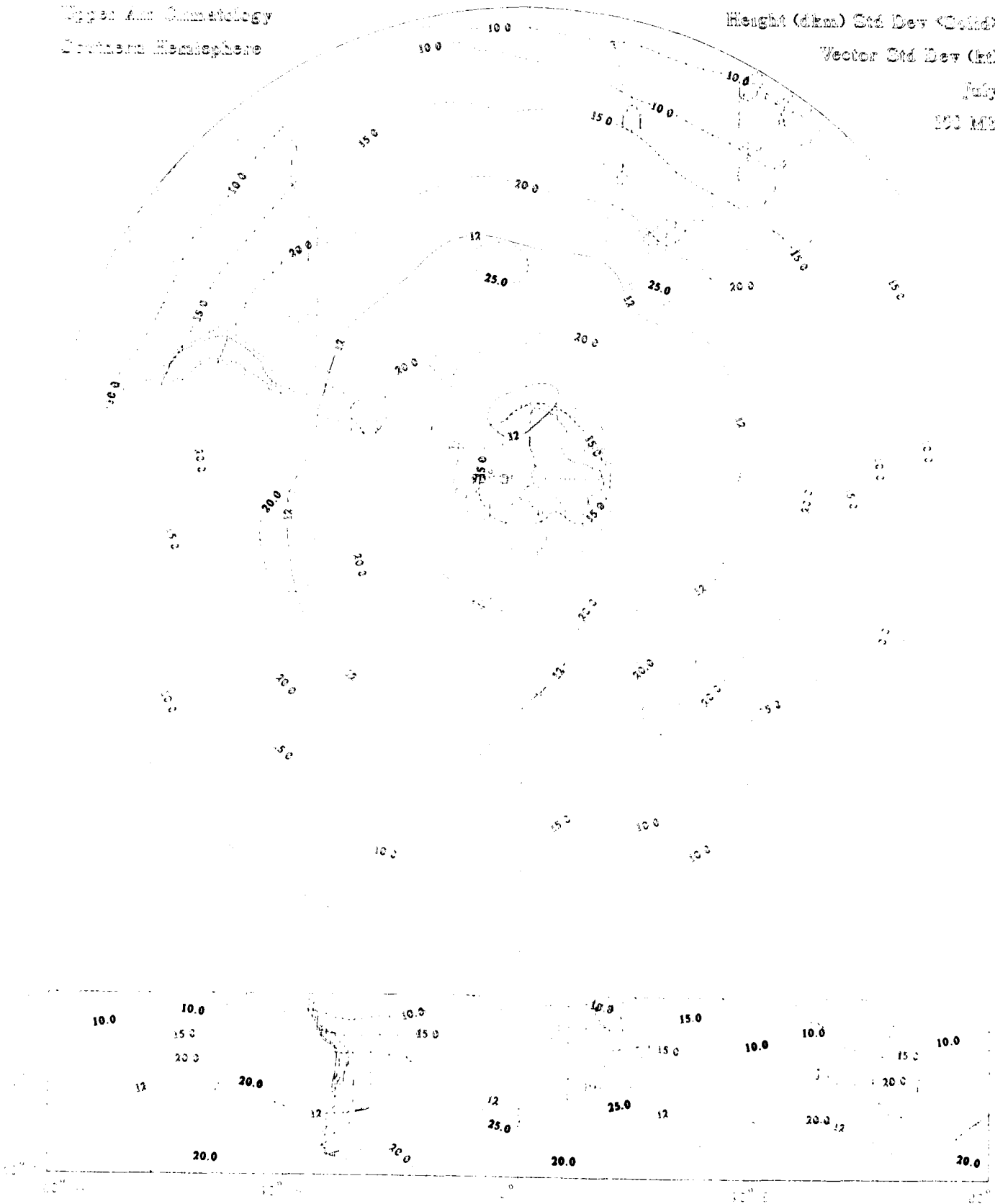
Upper Air Climatology

Northern Hemisphere



Upper Air Climatology  
Northern Hemisphere

Height (dkm) Std Dev (Cm)  
Vector Std Dev (kt)  
July  
100 MB



Height (km) Std. Dev. (km)

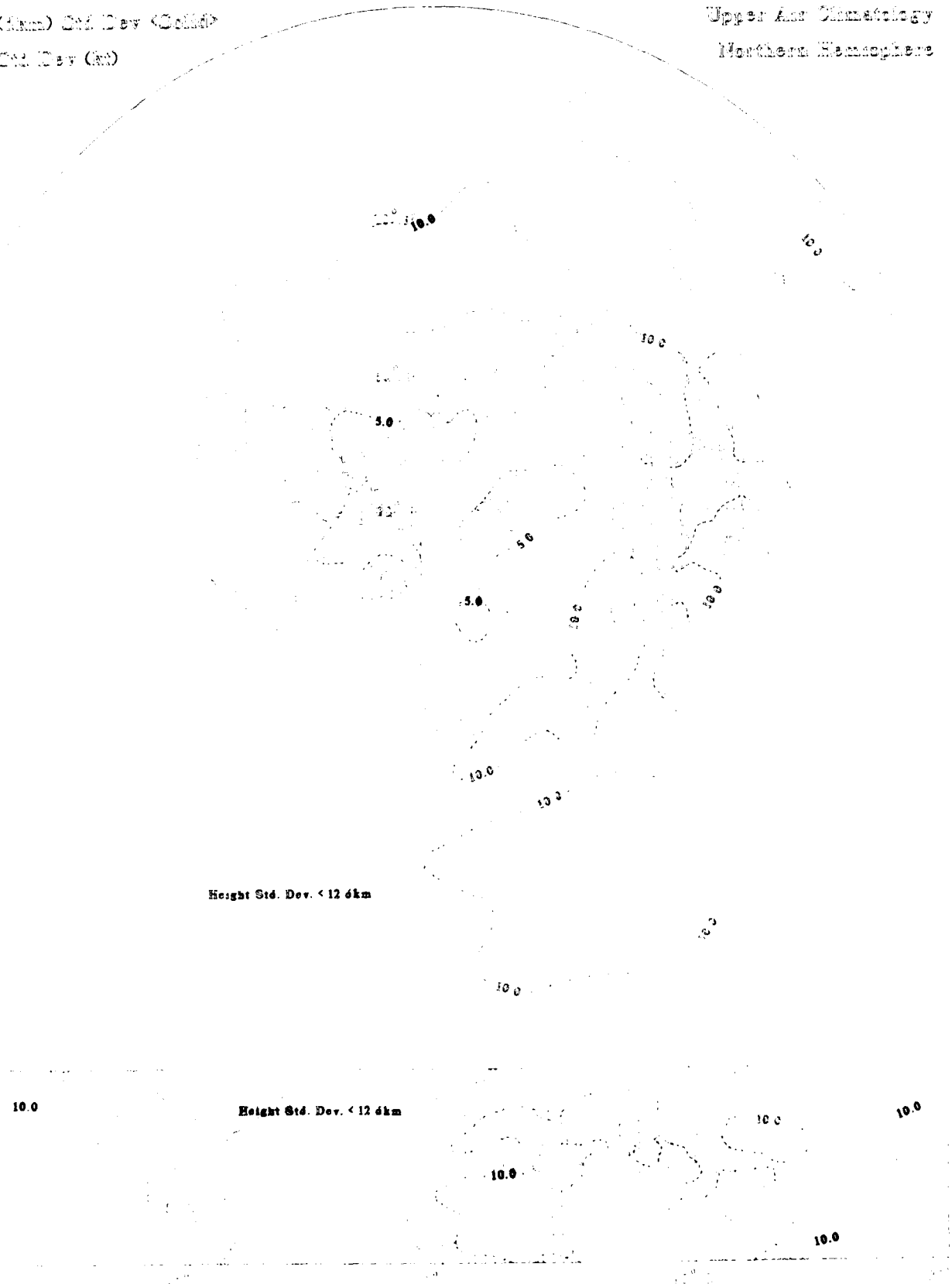
Weight (km) Std. Dev. (km)

Day

170 185

Upper Air Climatology

Northern Hemisphere



Height Std. Dev. < 12.6 km

Height Std. Dev. < 12.6 km

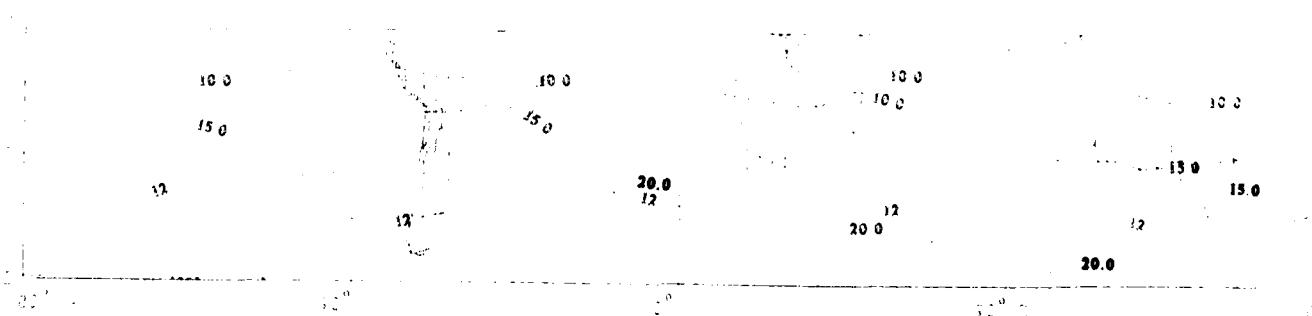
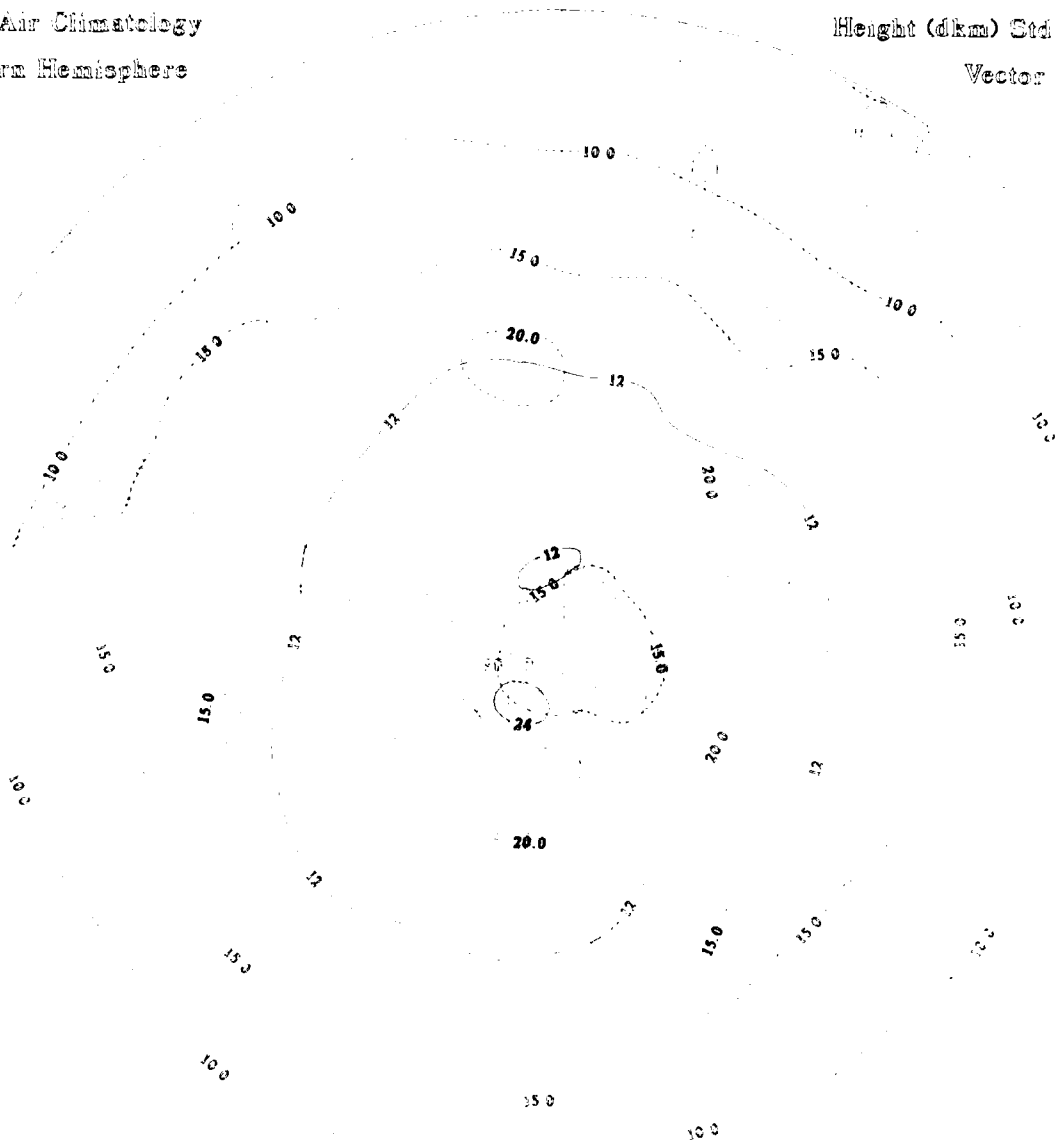
Upper Air Climatology  
Southern Hemisphere

Height (dkm) Std Dev <Solid>

Vector Std Dev (h)

July

100 MB

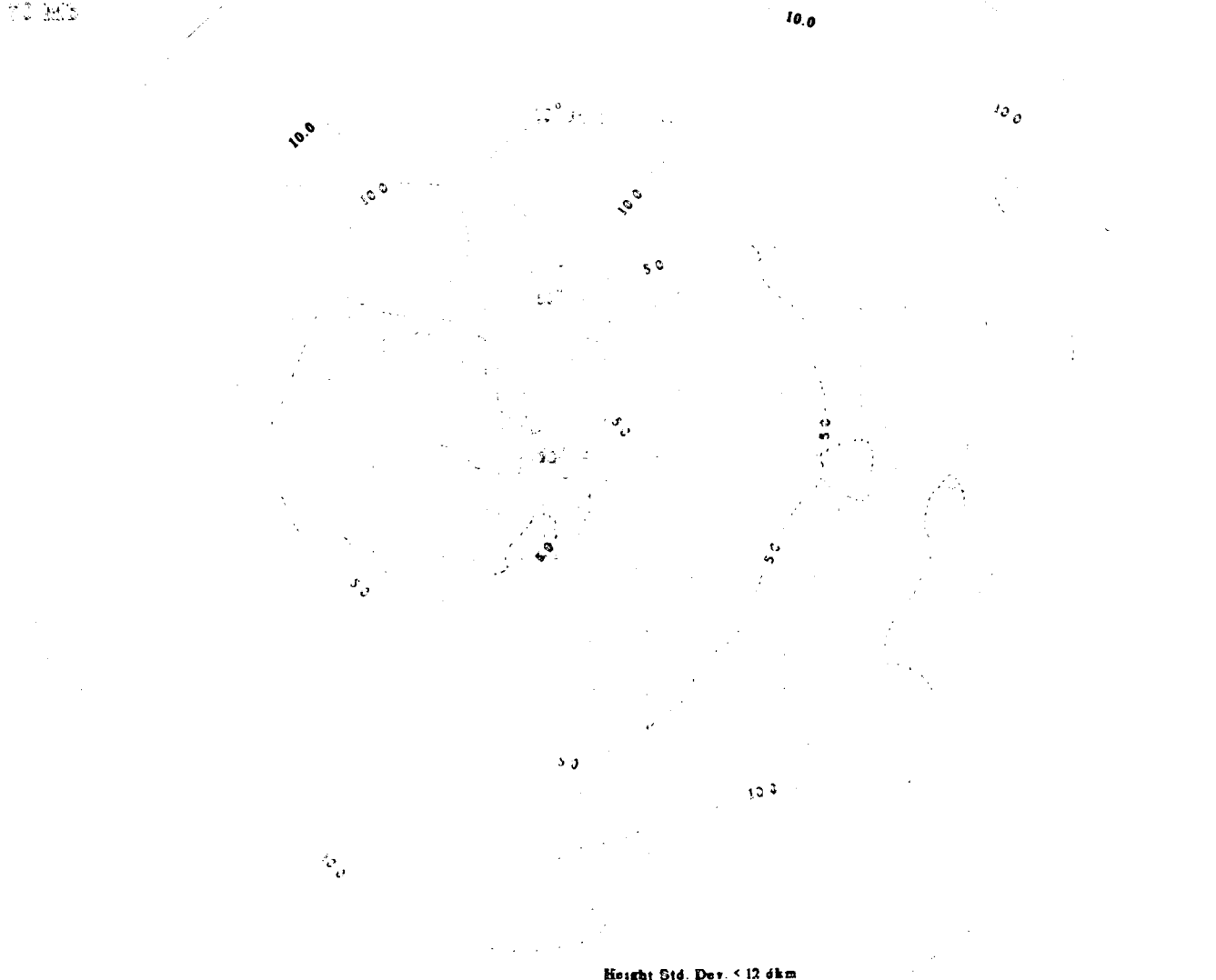


Height (km) Std Dev <Solid>

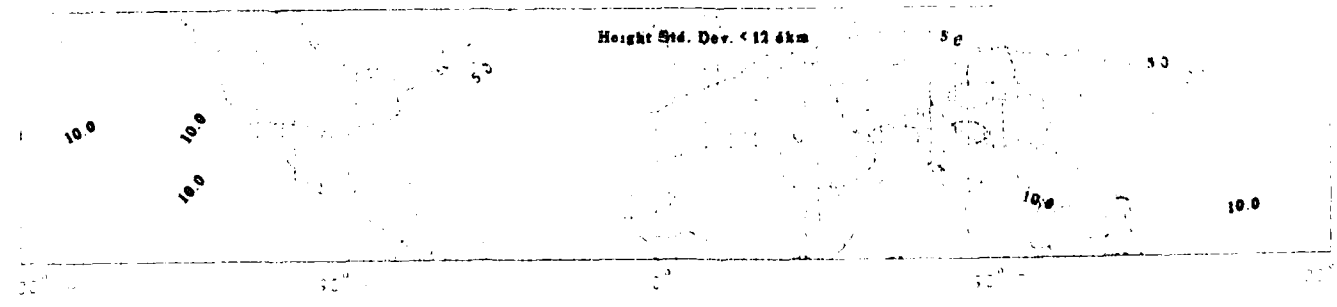
Vector Std Dev (kt)

July  
10 M/S

Upper Air Climatology  
Northern Hemisphere



Height Std. Dev. < 12 km

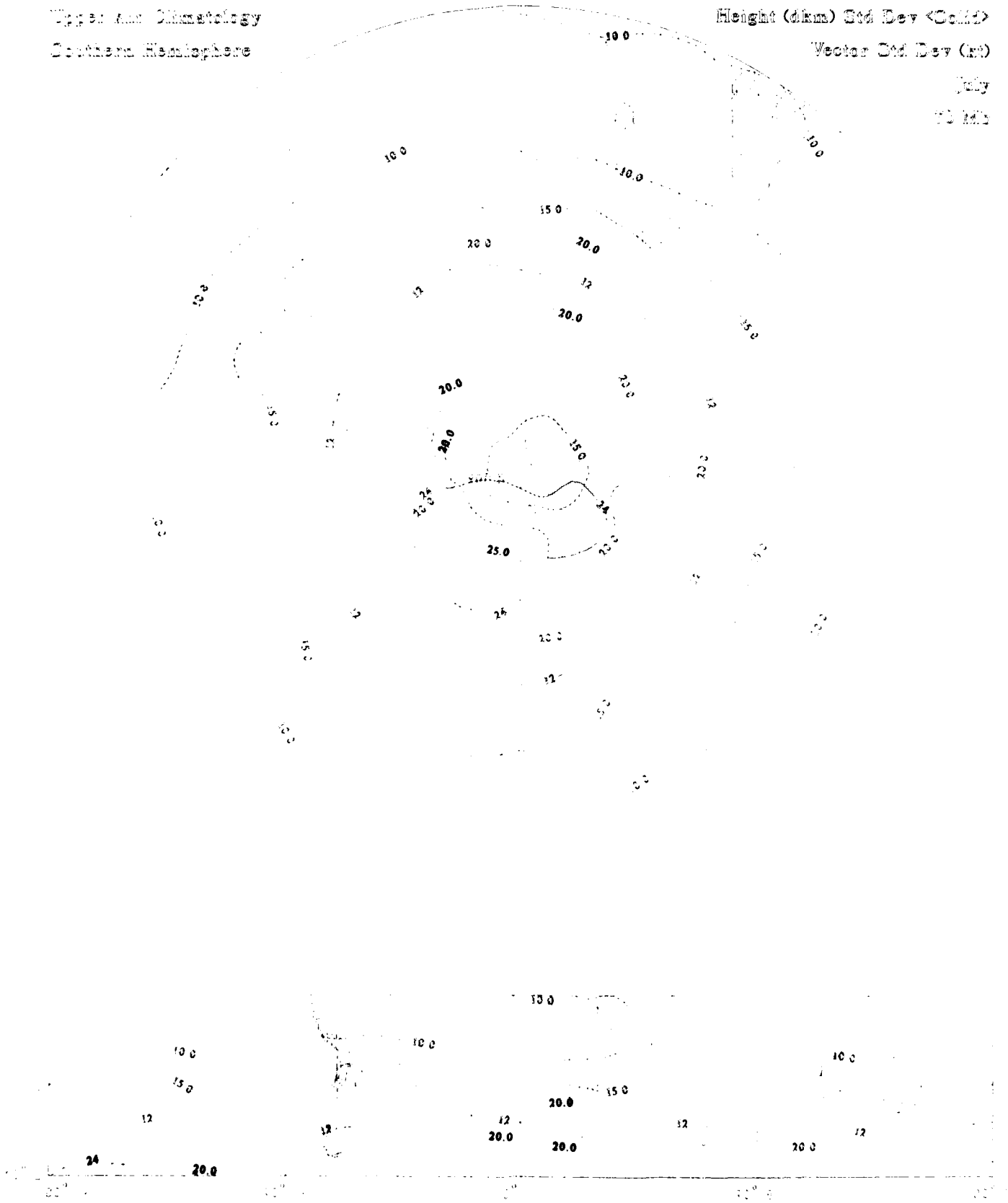


Height Std. Dev. < 12 km

Type: Air Climatology  
Southern Hemisphere

Height (dkm) Std Dev <Cont>  
Vector Std Dev (m)

July  
10 MB



Height (dkm) Std Dev <Solid>

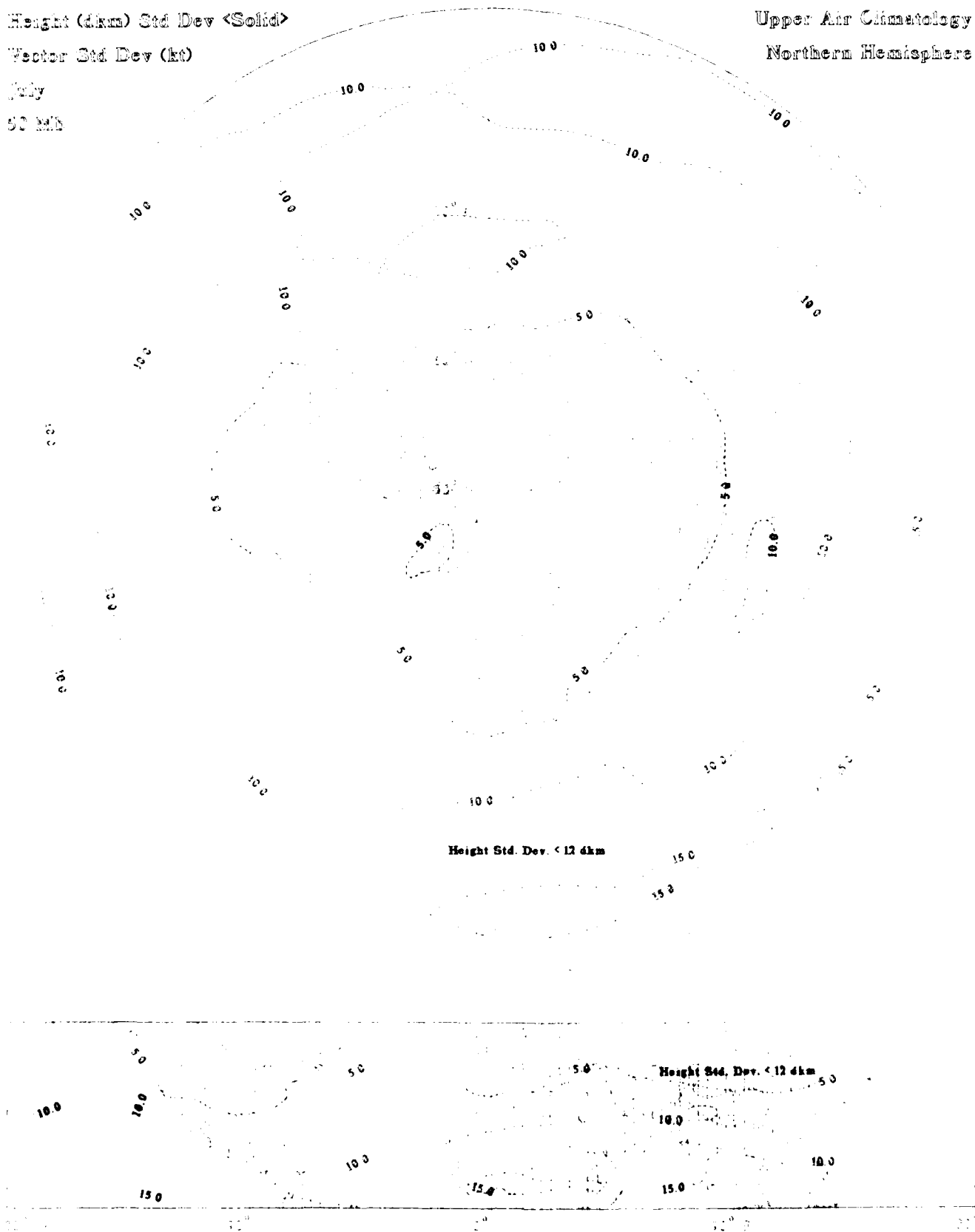
Vector Std Dev (kt)

July

50 mb

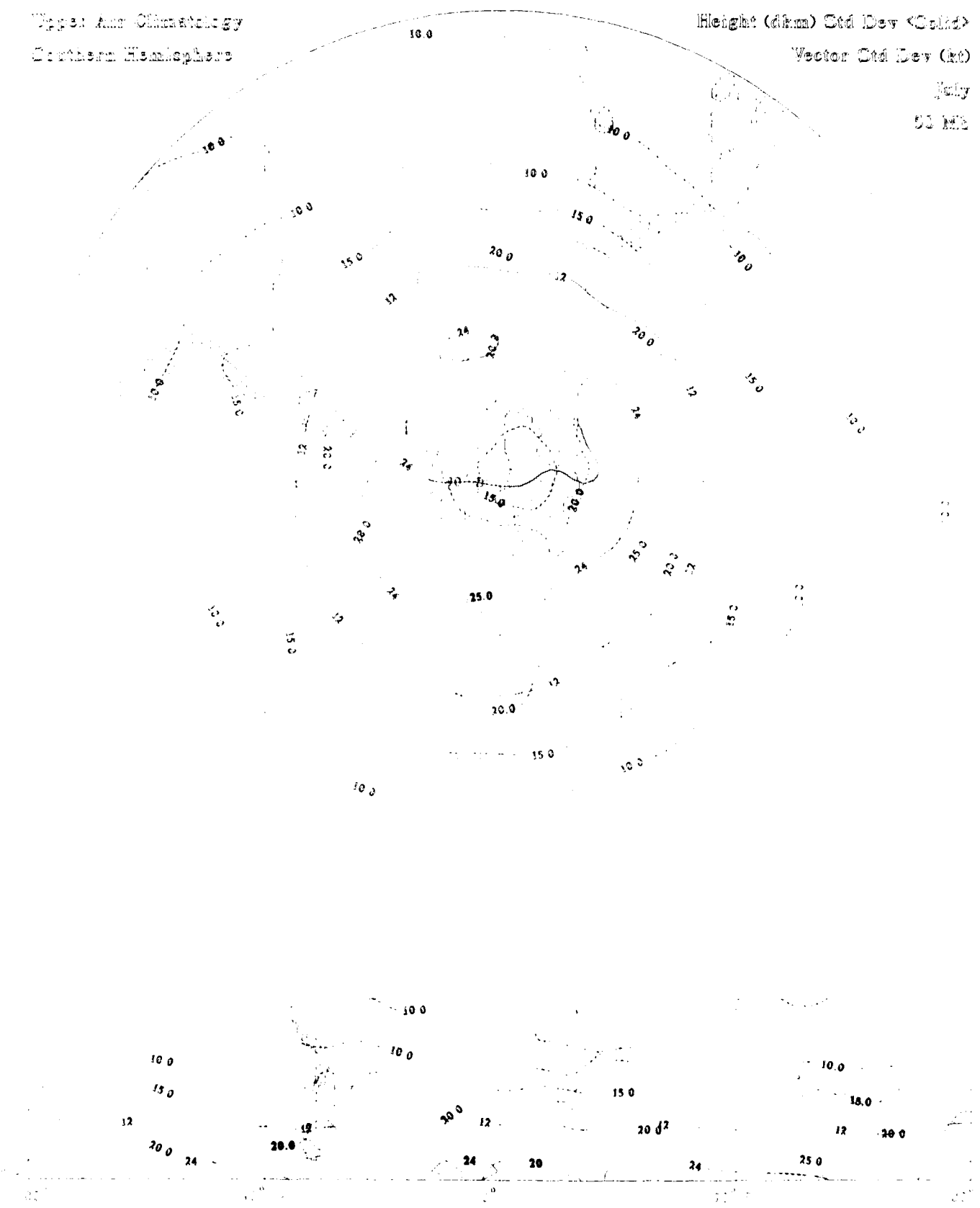
Upper Air Climatology

Northern Hemisphere



Upper Air Climatology  
Southern Hemisphere

Height (dkm) Std Dev <Cont'd>  
Vector Std Dev (kt)  
July  
50 MB



Height (km) Std. Dev. (Solid)

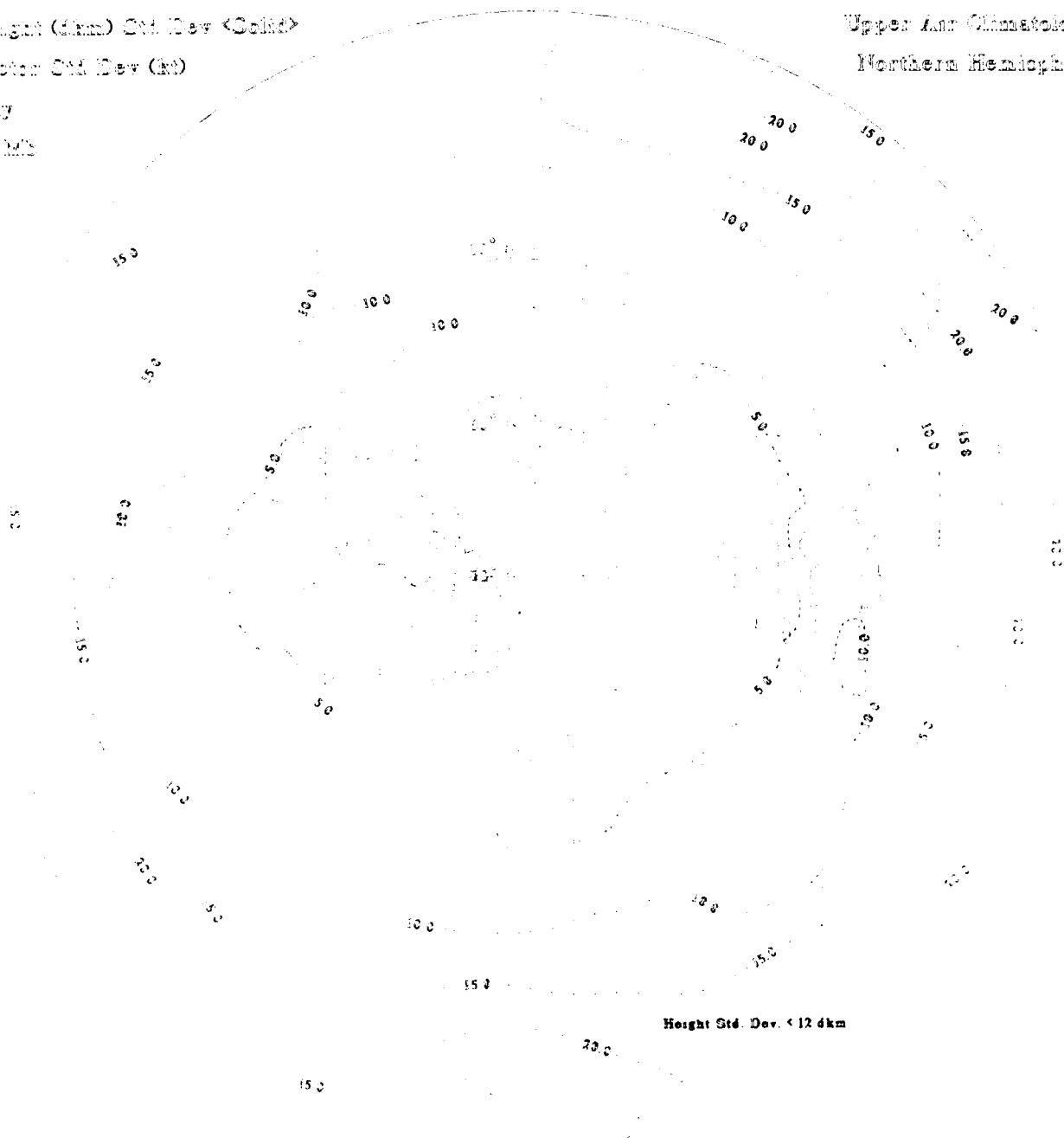
Weighted Std. Dev. (dashed)

July

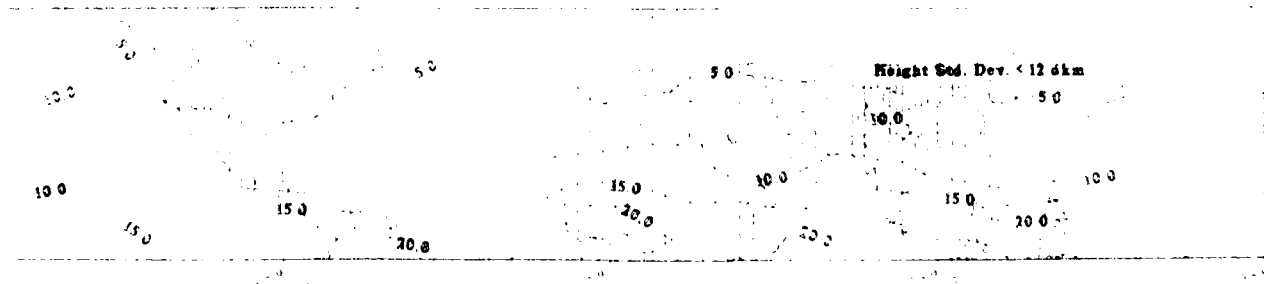
1200 UTC

Upper Air Climatology

Northern Hemisphere



Height Std. Dev. < 12 dkm



Height Std. Dev. < 12 dkm

July  
1968

