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THE MEAN WINDS OF THE UPPER TROPOSPHERE OVER THE CENTRAL AND EASTERN PACIFIC

James C. Sadler

Hawaii University

Prepared for:

Environmental Prediction Research Facility (Navy)

June 1972

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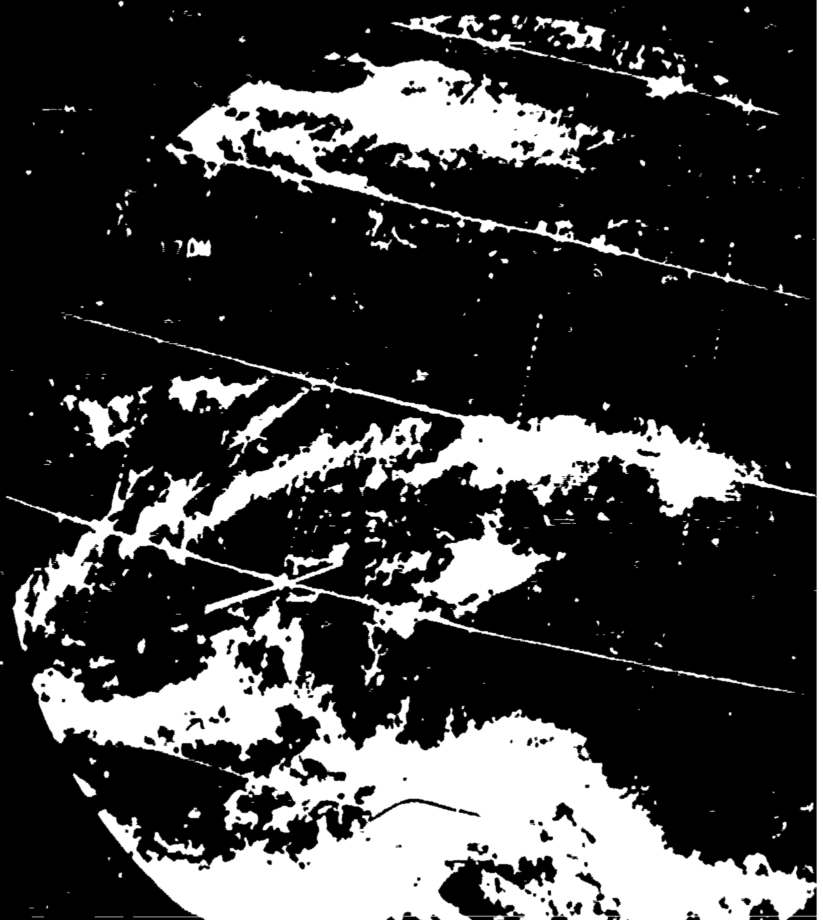

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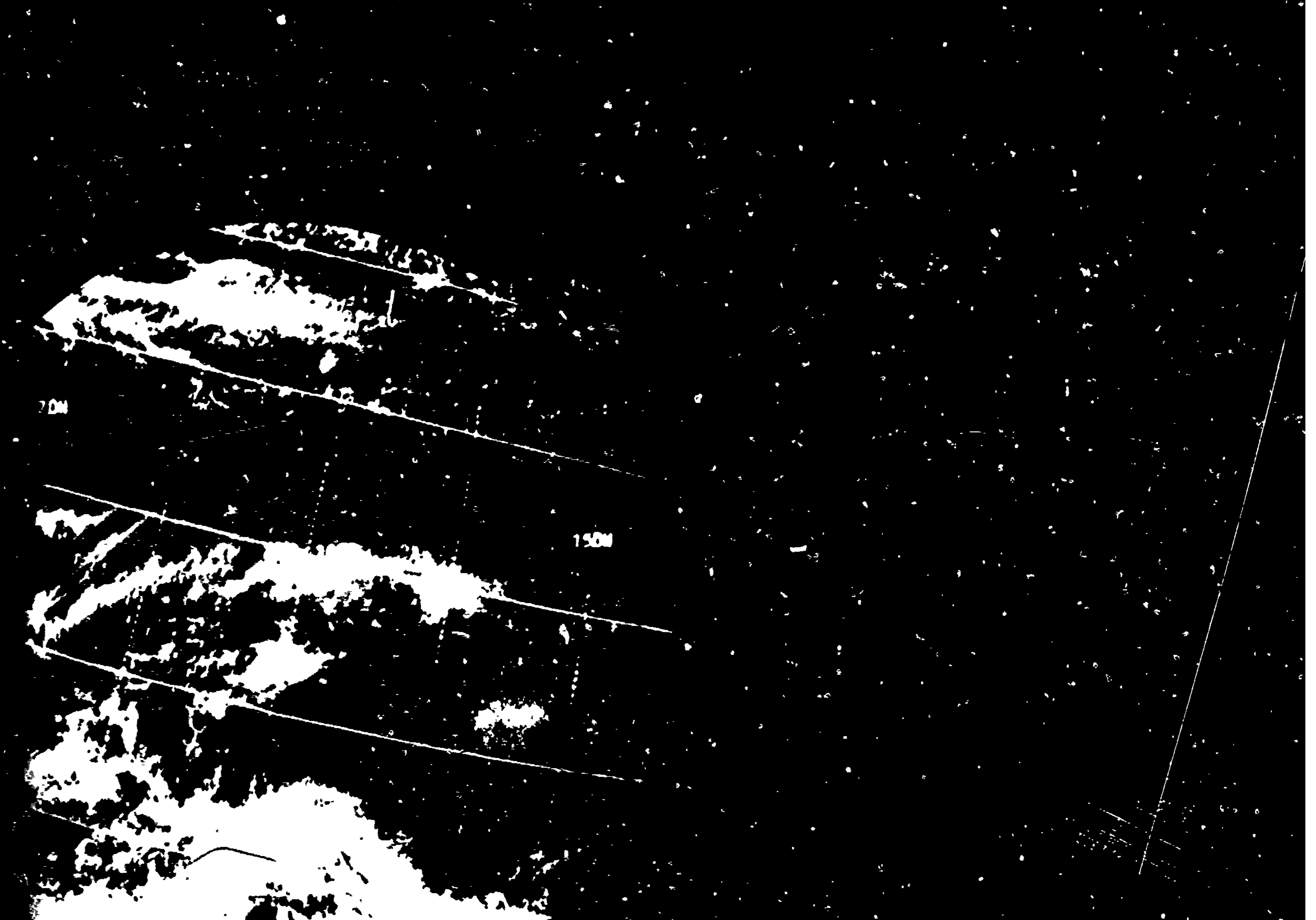

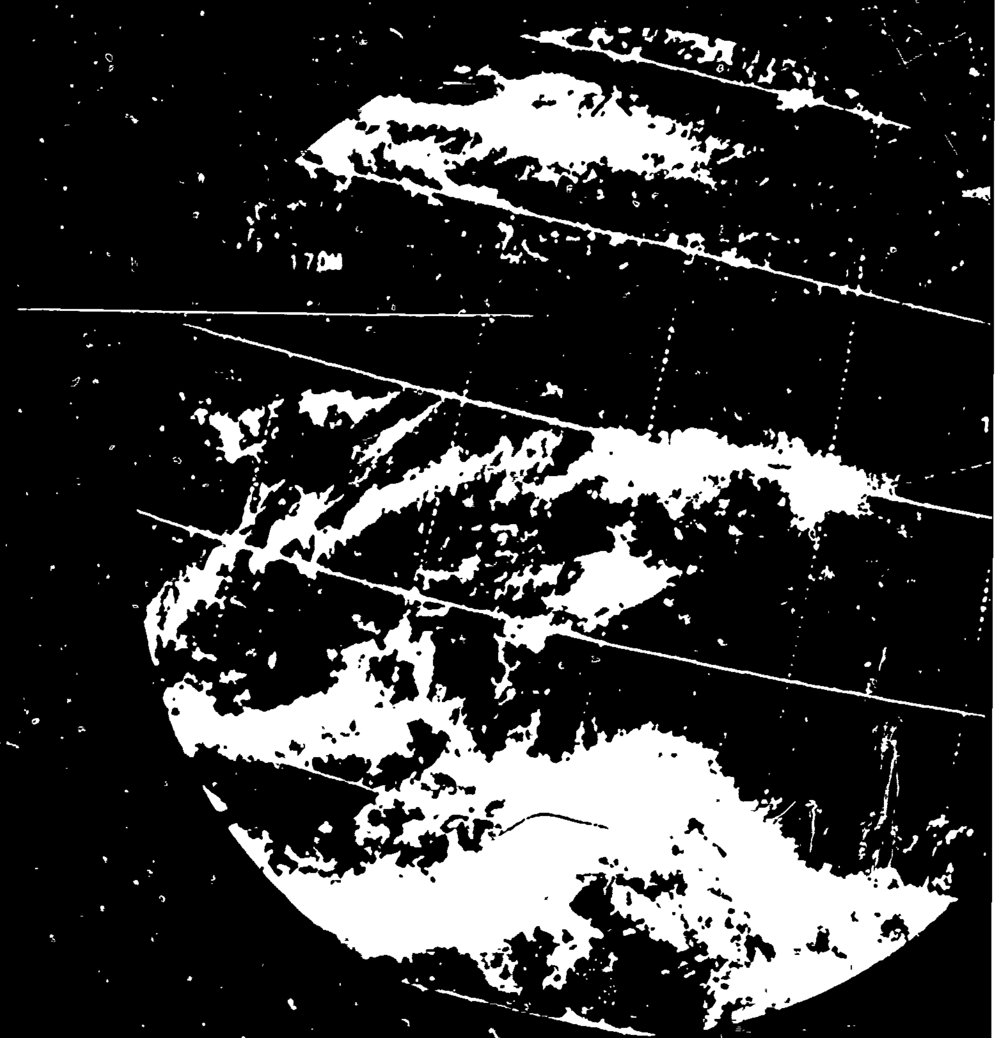

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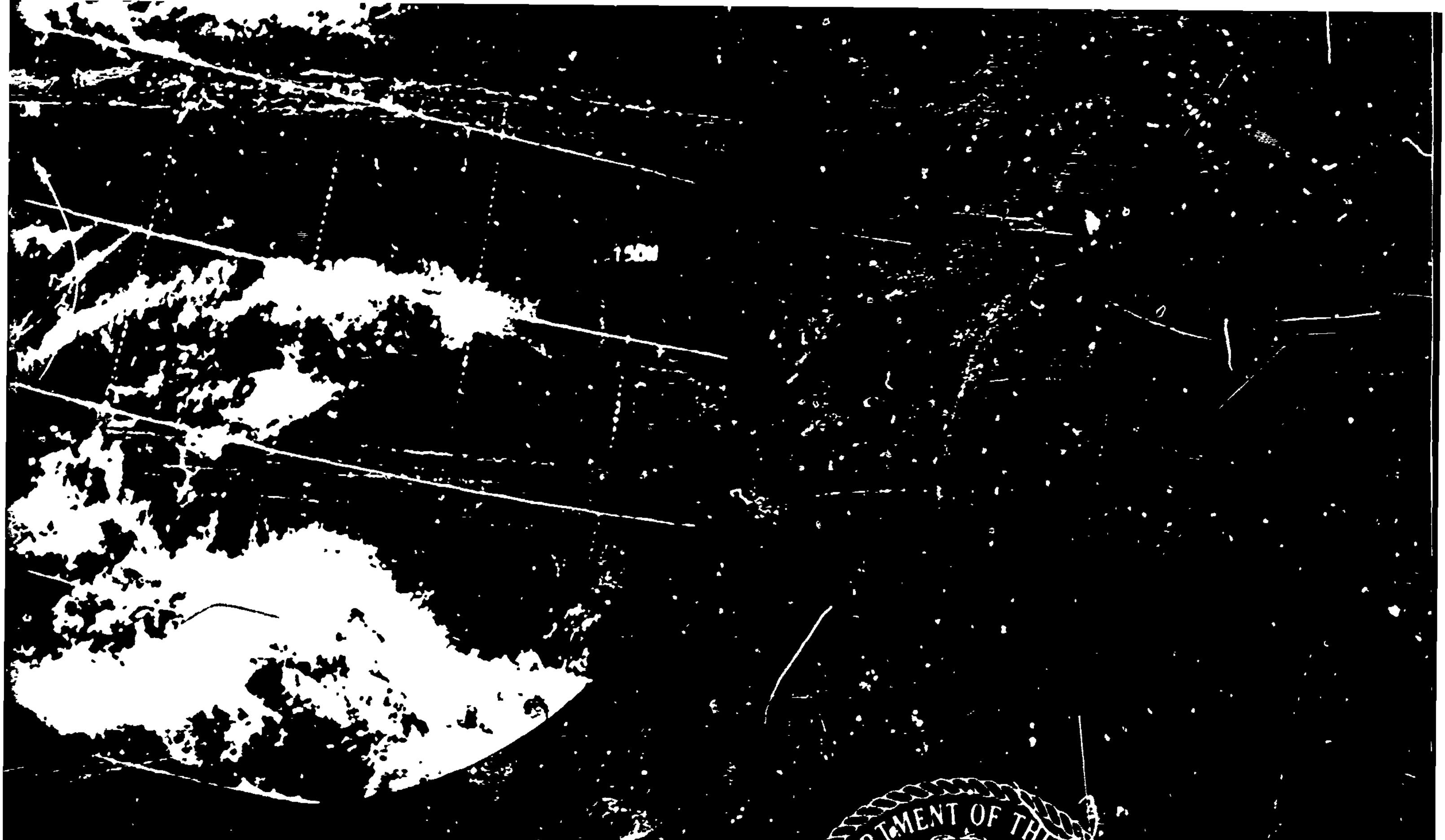

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ABSTRACT

Analyses of mean monthly upper-tropospheric winds for the 200-, 250- and 300-mb levels are presented for the eastern and central Pacific region. Analyses are based on 9 years of PIREP winds measured on commercial jet aircraft as well as rawins from fixed stations. The upper troposphere is discussed in terms of its major features and their changes from month to month.

I2.

1. INTRODUCTION

The use of electronic navigation equipment has improved the general quality of aircraft wind observations (PIREP winds). The bulk of the observations for the past decade has been concentrated at the jet aircraft flying levels between 30,000 and 40,000 ft. These data have been used in calculating mean-monthly flow over tropical regions where data from fixed stations are extremely sparse. Pearson (1968) has used two years (1962 and 1963) of data from transequatorial flights to produce mean-monthly wind analyses over portions of the central and eastern Pacific. Additionally, averaged aircraft wind reports have been used in preparing the International Indian Ocean Expedition Meteorological Atlas (Ramage and Raman, 1972). In the Atlantic averaged PIREPS have been used in monthly streamline analyses (Aspliden, et al., 1966).

This atlas utilizes the PIREP winds from the first nine years of the commercial jet aircraft age in conjunction with radiowinds and radarwinds (rawins) from fixed stations to define the upper-troposphere wind climatology of the central and eastern Pacific Ocean.

2. DATA

2.1 Winds from PIREPS

Aircraft wind reports at 28,000 ft and above, for the area 30S to 50N between 155E and 120W for the period 1960-1968 were extracted from the manuscript maps of the National Weather Service at Honolulu Airport. These were supplemented east of 120W with data extracted from flight logs of the Canadian Pacific and UTA airlines. Monthly mean resultant winds were computed for each 5 degree latitude-longtitude grid square and located at the averaged position of the reports. Wind steadiness* and percentage of observations with an easterly wind component were computed to aid in analysis and interpretation. The data are homogeneous in neither time nor space. With

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*Wind steadiness = $\frac{\text{mean resultant wind speed}}{\text{mean wind speed}} \times 100\%$.

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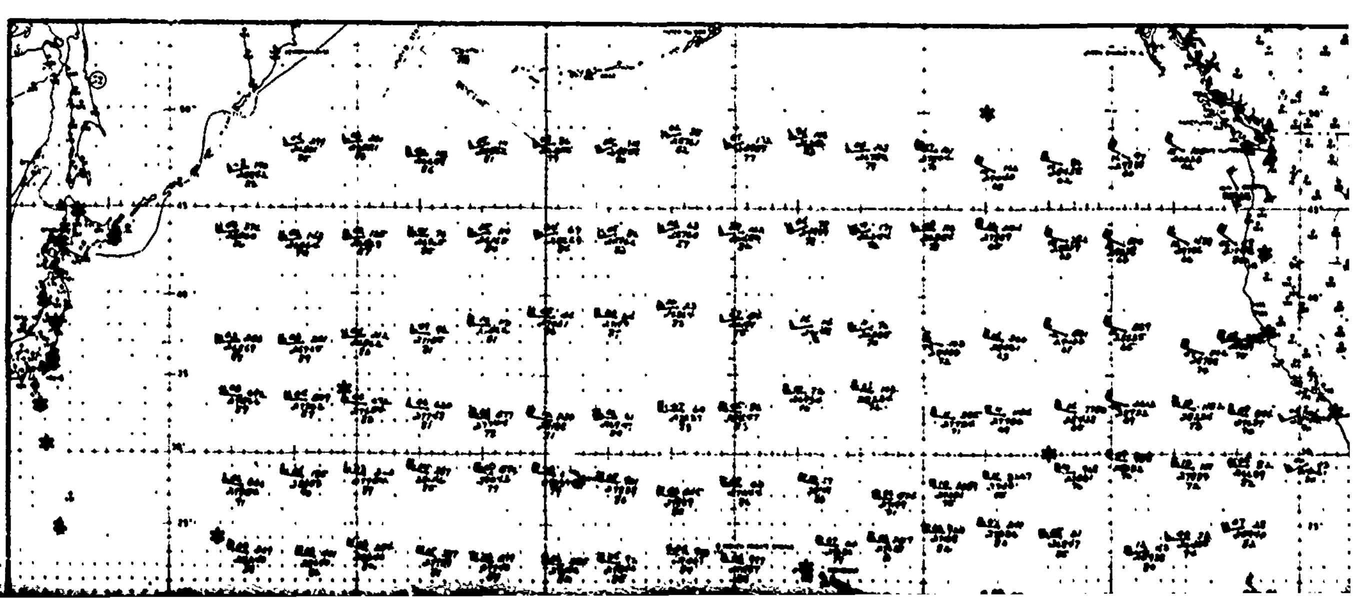

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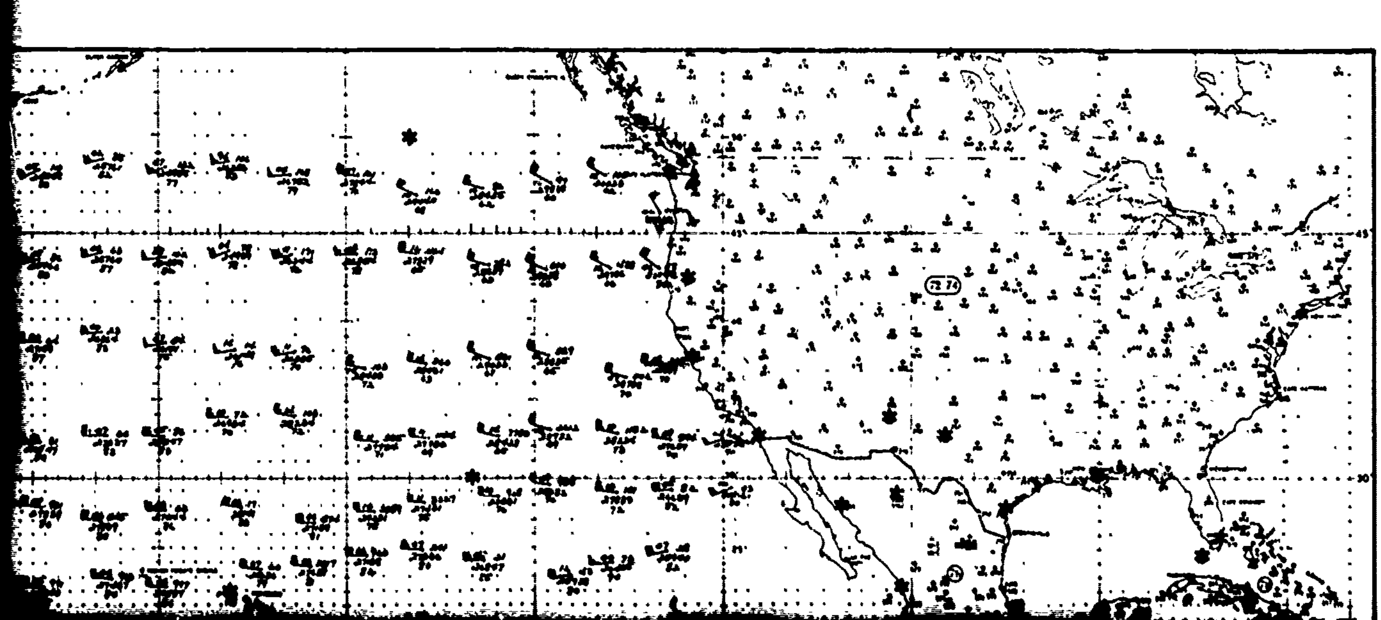
each succeeding year the number of observations increased as did the average flight level. Observations are concentrated along heavily traveled air routes. The corridor between Honolulu and the west coast of the United States has about triple the data volume of any other route. The monthly data sample averages near 75,000 observations. A typical monthly distribution of data is shown in Figure 1.

Four sets of mean resultant winds were determined for each month. All altitudes were first composited. The observations were then stratified by height intervals to mesh with the rawins at mandatory constant pressure surfaces. The stratification intervals were: 28,000-32,000 ft (300 mb); 33,000-36,000 ft (250 mb); and 37,000 ft and above (200 mb).

2.2 Rawins

Updated summaries of wind data were prepared for most fixed land and ship stations over the ocean area, Mexico, Central America, and along the west coasts of South and North America. Where possible, the summaries covered the same period as the PIREP data. Data for stations not listed in "Monthly Climatic Data for the World" were obtained from various other sources. Data for most Southern Hemisphere stations, including the newly established French stations in the Society, Tuamotu, and Marquesas Islands, were extracted from the Daily Weather Bulletins of the New Zealand Meteorological Service. Summaries for the Pacific islands of Eniwetok, Kwajalein, Canton, and Midway, the islands of the Caribbean, and all stations in the United States except those along the west coast were obtained from the National Climatic Center (Asheville, North Carolina) and do not correspond in time to the period of the PIREPS. They are for varied lengths of record during the period 1945-1962.



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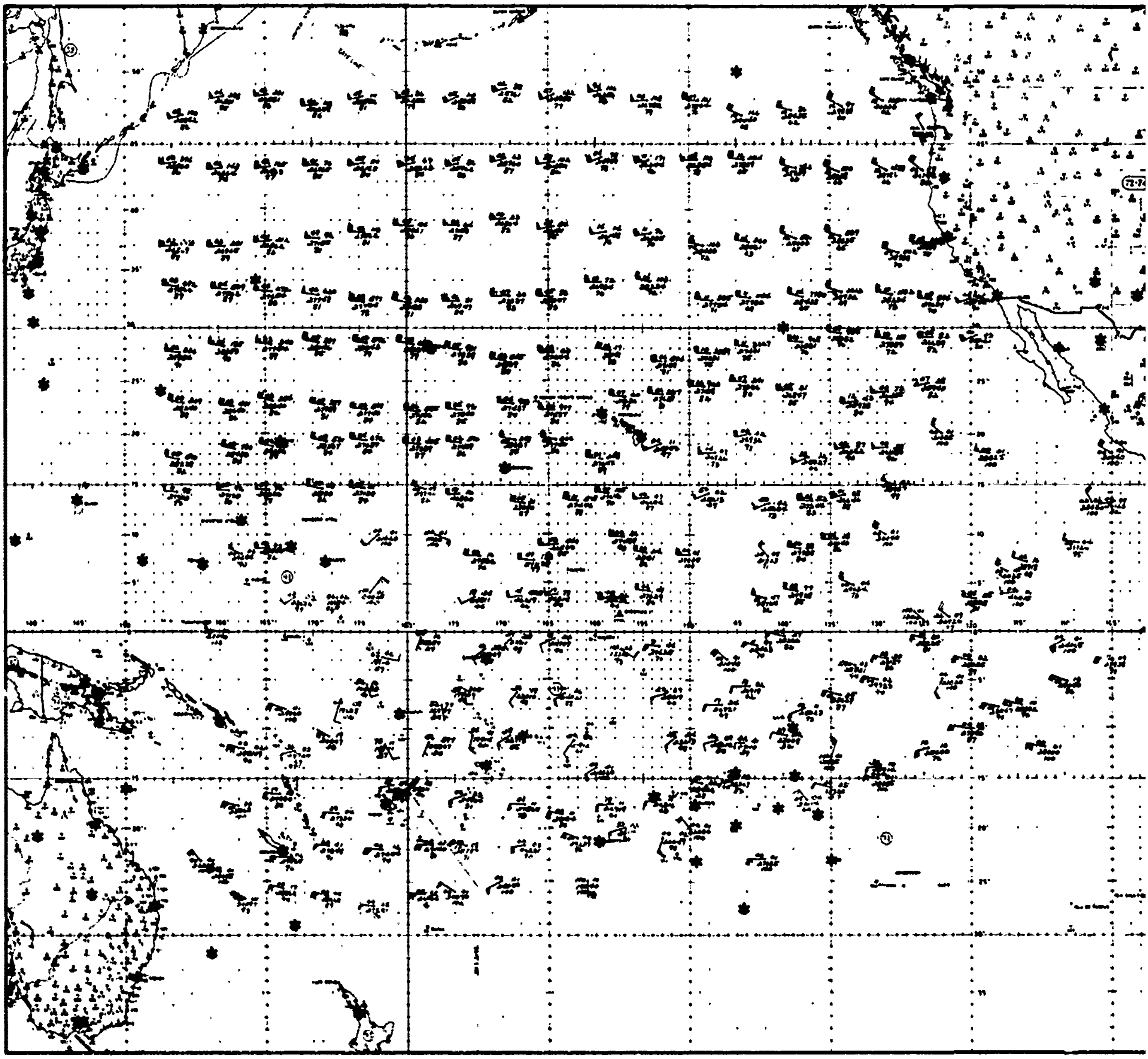

Figure 1. Typical monthly composite of aircraft reports. Asterisk symbol denotes location of rawin s

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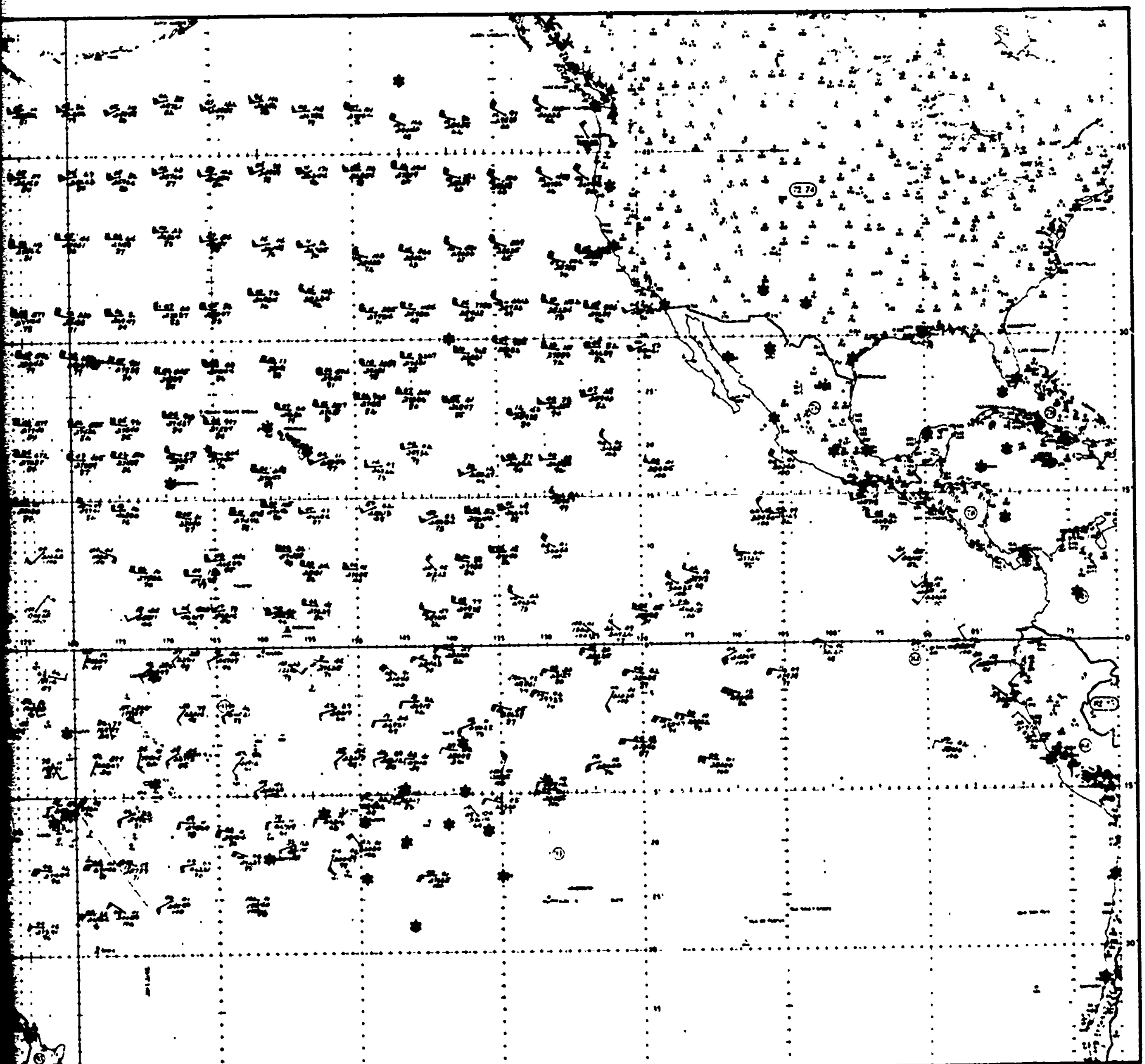
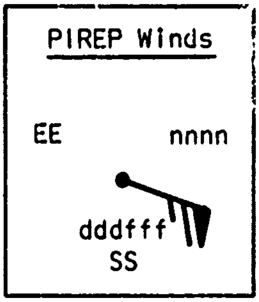
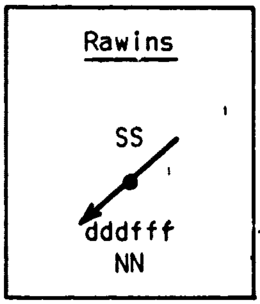


osite of aircraft reports. Asterisk symbol denotes location of rawin stations.

2.3 Plotting Models





EE -percentage of winds with an east component
nnnn -number of observations
ddd -mean resultant wind direction
fff -mean resultant wind speed in knots (flag = 50 knots, long barb = 10 knots, short barb = 5 knots)
SS -steadiness of winds in percent
NN -number of years of record

3. TERMINOLOGY

3.1 Systems

Since flow patterns are rather complex during the Northern Hemisphere summer, discussion is aided if major circulation features are labelled. In Figure
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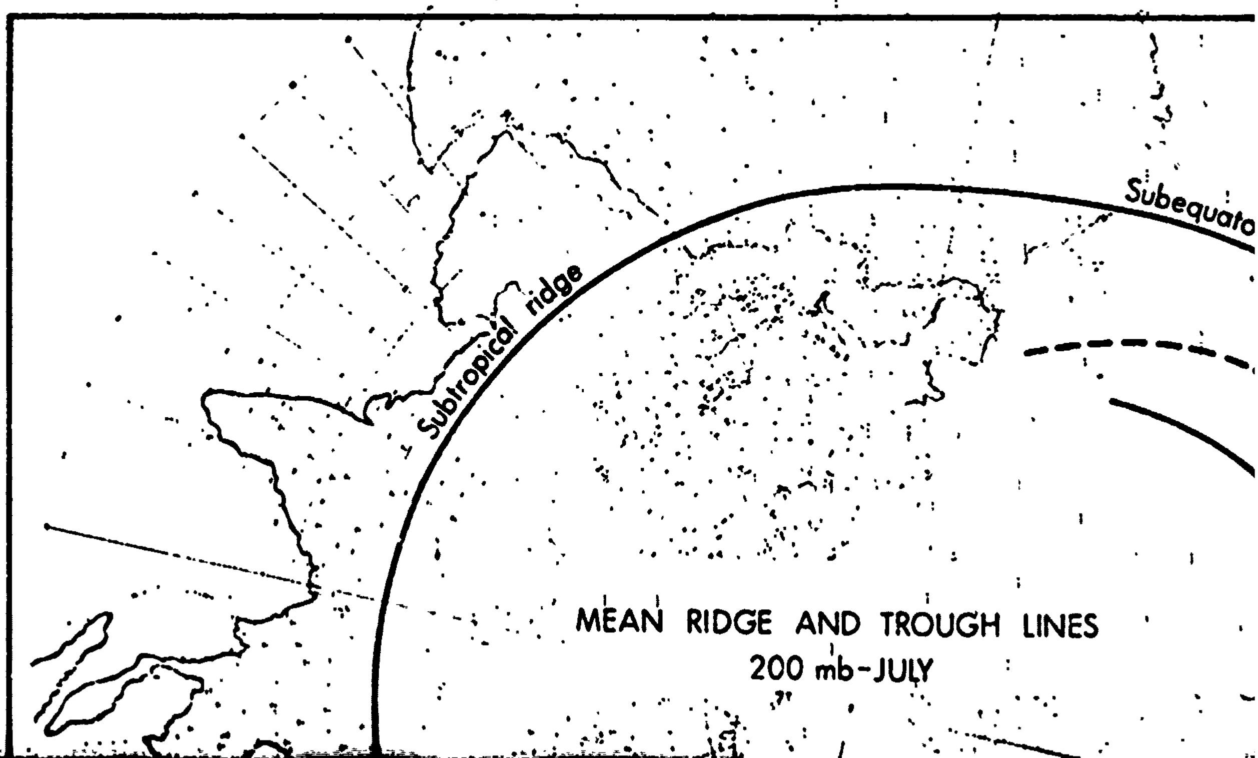
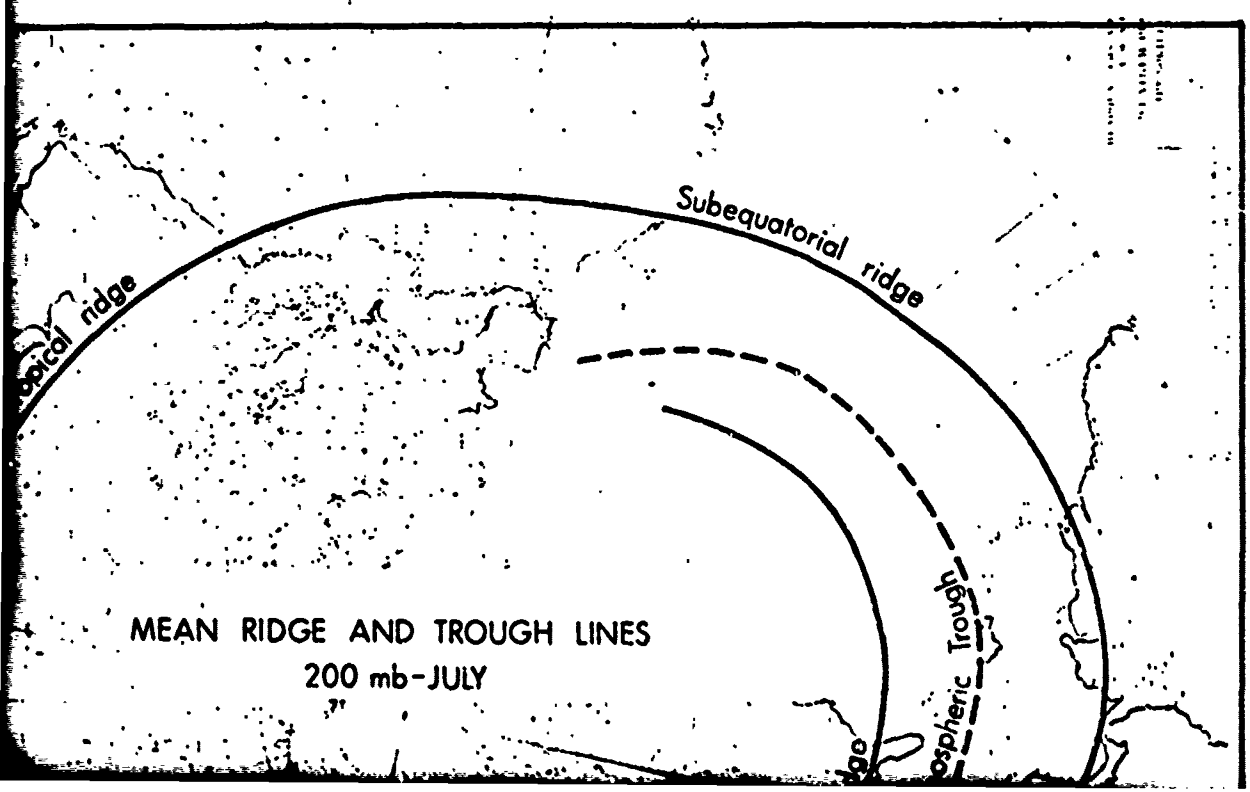


are labelled. In Figure 2, the ridge system has a spiral configuration and double ridges exist over the oceans. When only a single ridge exists in a hemisphere or portions of a hemisphere, it will be referred to as the subtropical ridge. When a double ridge system exists, the equatorward ridge will be referred to as the subequatorial ridge and the poleward one as the subtropical ridge. Note that the subequatorial ridge of the western and central North Pacific becomes the subtropical ridge across the United States and the North Atlantic. The subequatorial ridge of the eastern North Pacific, northern South America and the North Atlantic becomes the subtropical ridge over Africa, Asia, and the North Pacific.

The trough between the subequatorial and subtropical ridge will, in general, be referred to as the Tropical Upper-Tropospheric Trough (TUTT). It is commonly called the Mid-Pacific Trough (MPT) in the central Pacific and the Mid-Atlantic Trough (MAT) in the central Atlantic. The term "Tropical Upper-Tropospheric Trough" is preferred since similar troughs exist during summer in the Southern Hemisphere, eastern North Pacific, Central America, and the Gulf of Mexico. On occasion for shorter periods it is observed as a continuous feature extending westward from the Mediterranean Sea to Asia (Sadler, 1963).

Another near-equatorial system which needs defining results from the development and existence of a dynamic system in one hemisphere without a counterpart in the opposite hemisphere. The evolution is depicted in Figure 3 by sketches of the changing 200-mb features from January to August. In January [Figure 3(a)], westerly flow covers the equatorial region east of 170W in the absence of a ridge system in either hemisphere. In May, a ridge forms over the eastern North Pacific between 10N and 15N, and by June [Figure 3(b)], it extends



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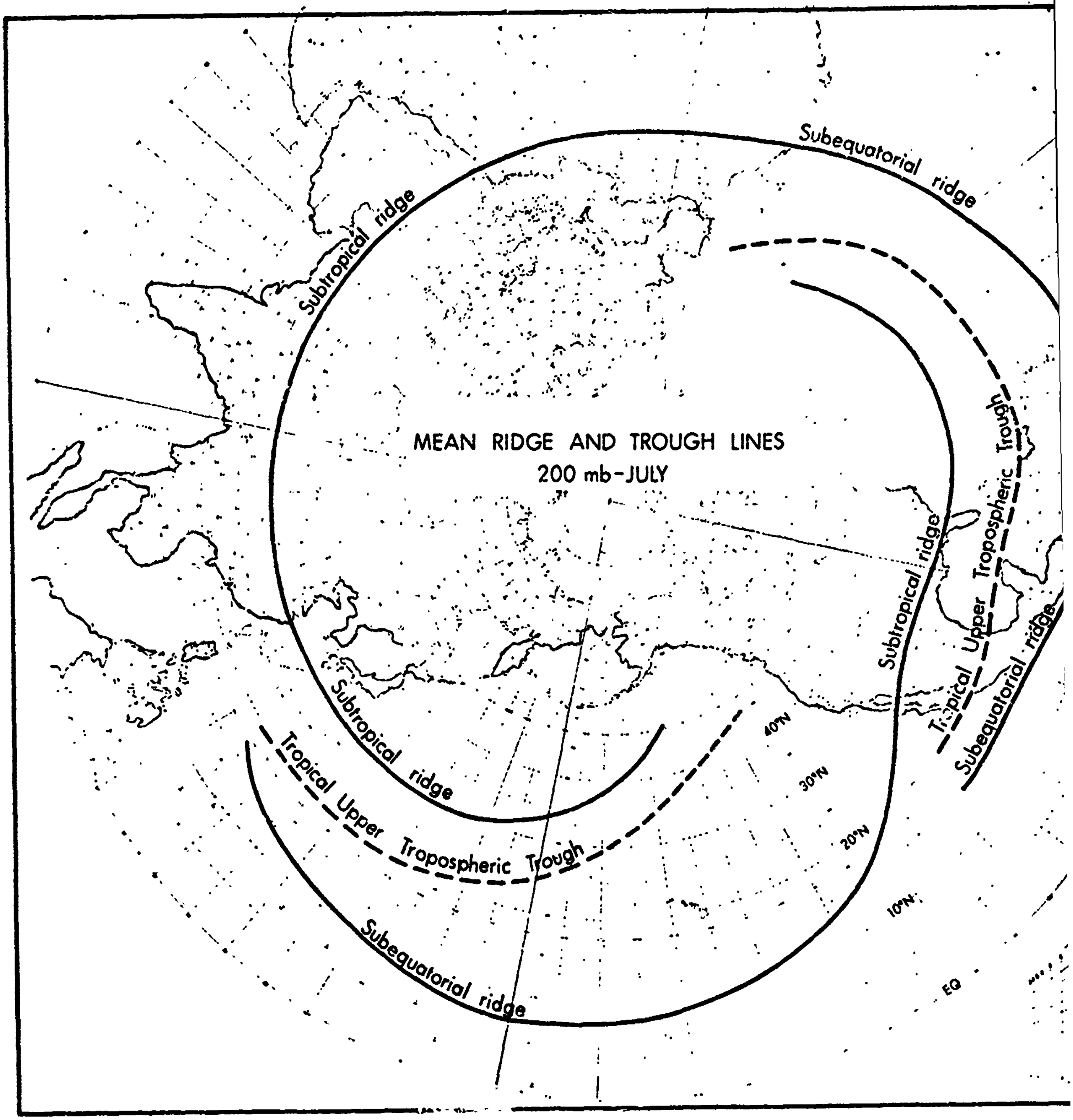
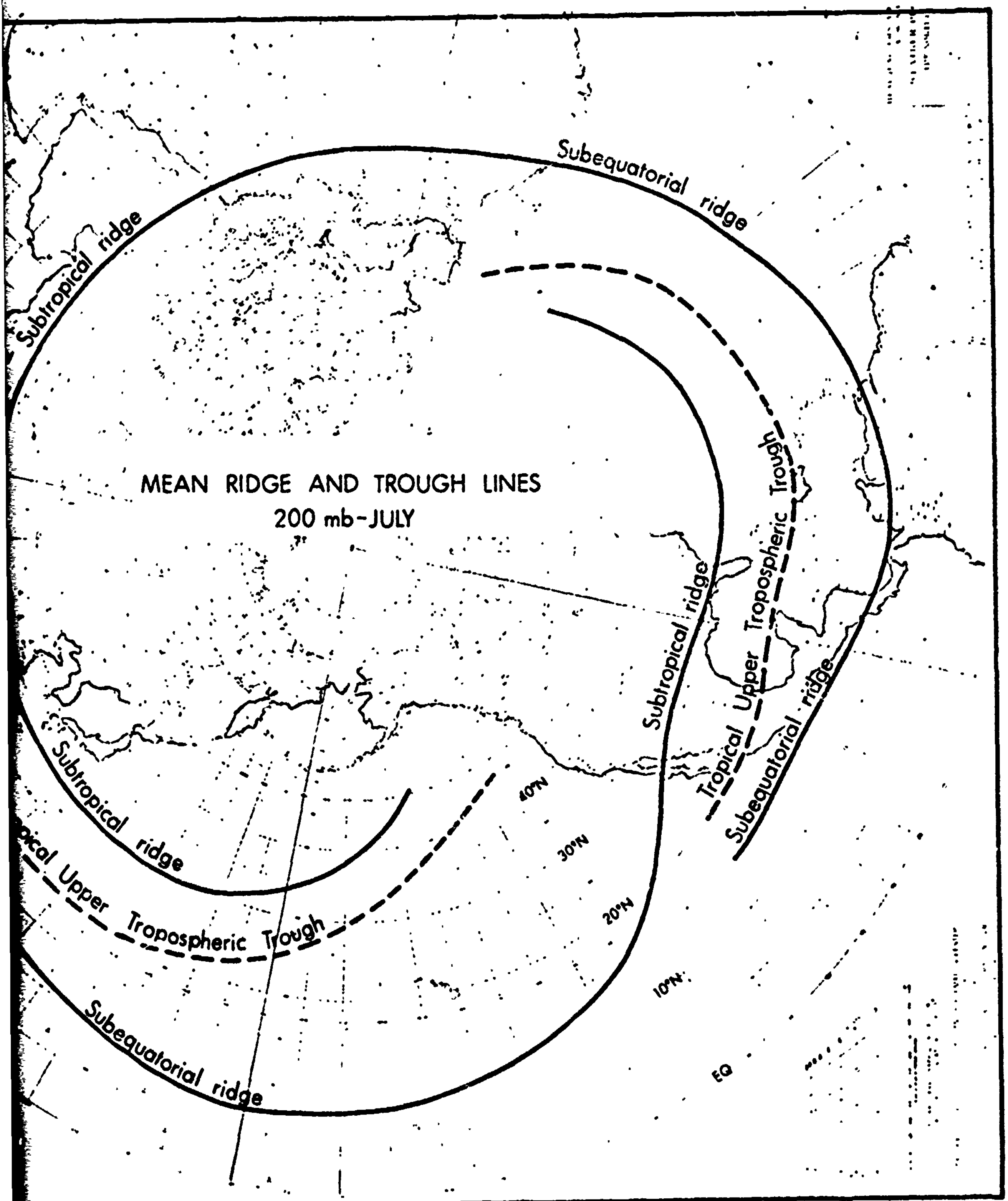


Figure 2. Mean July positions of ridges and troughs at 200 mb.



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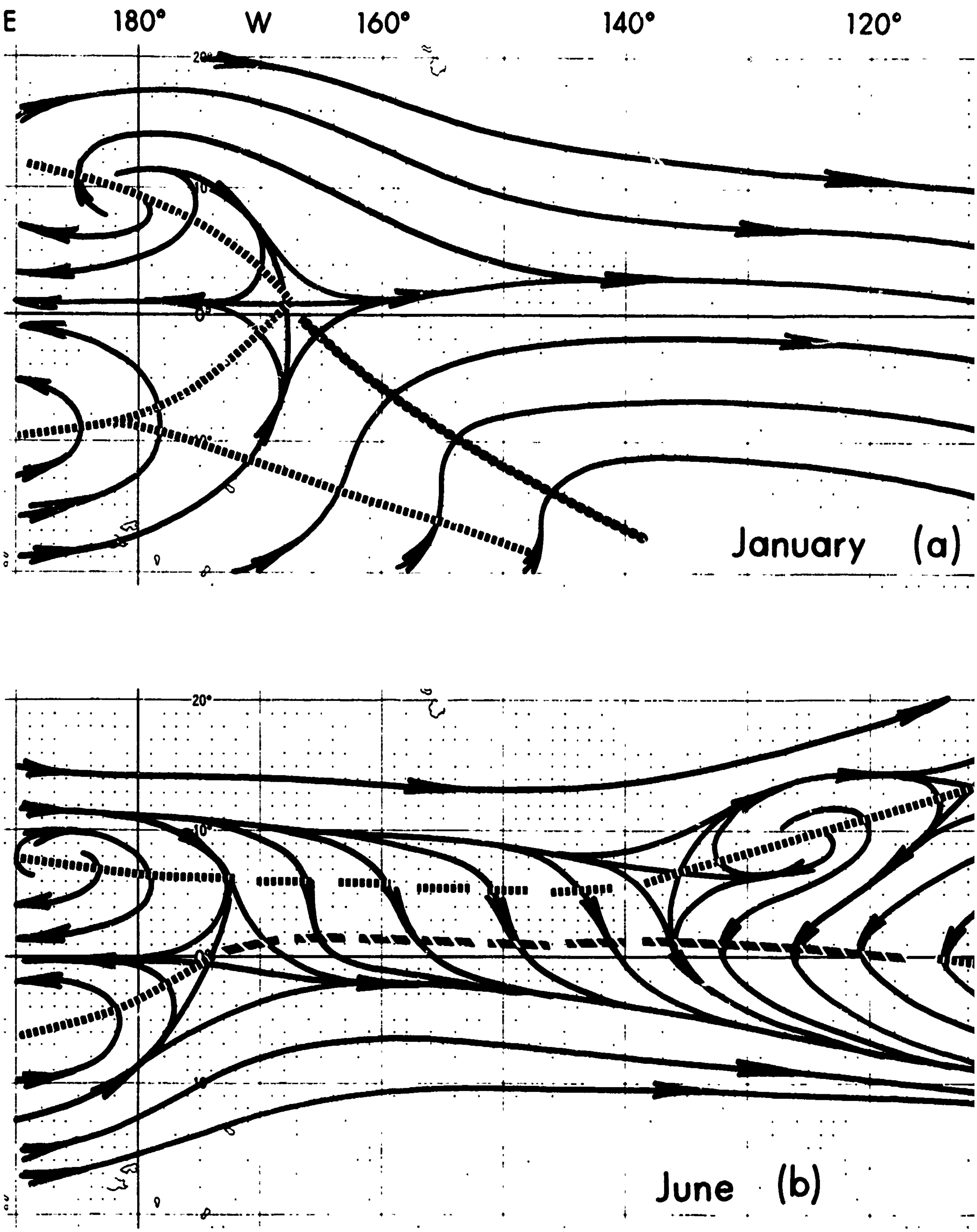
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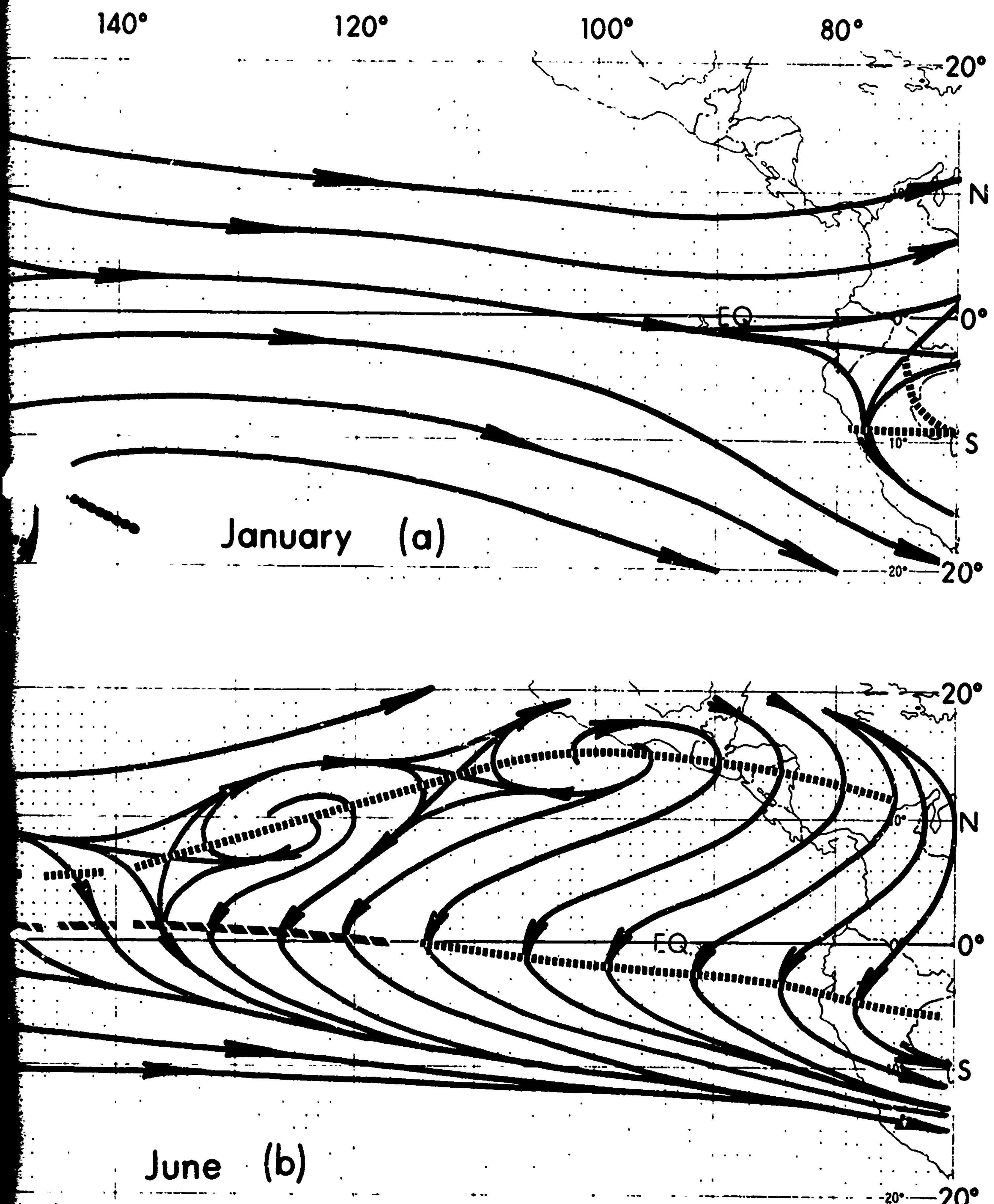

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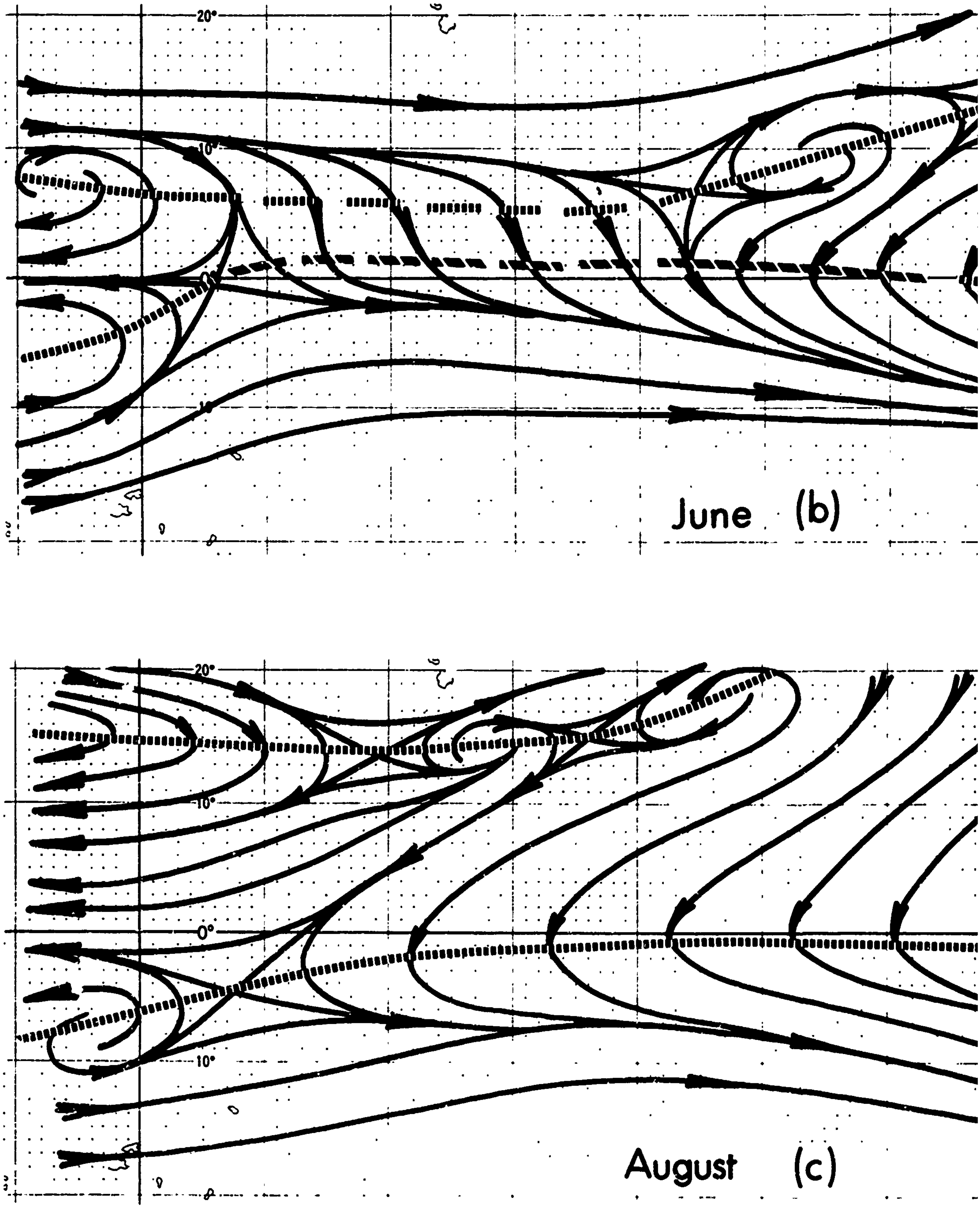
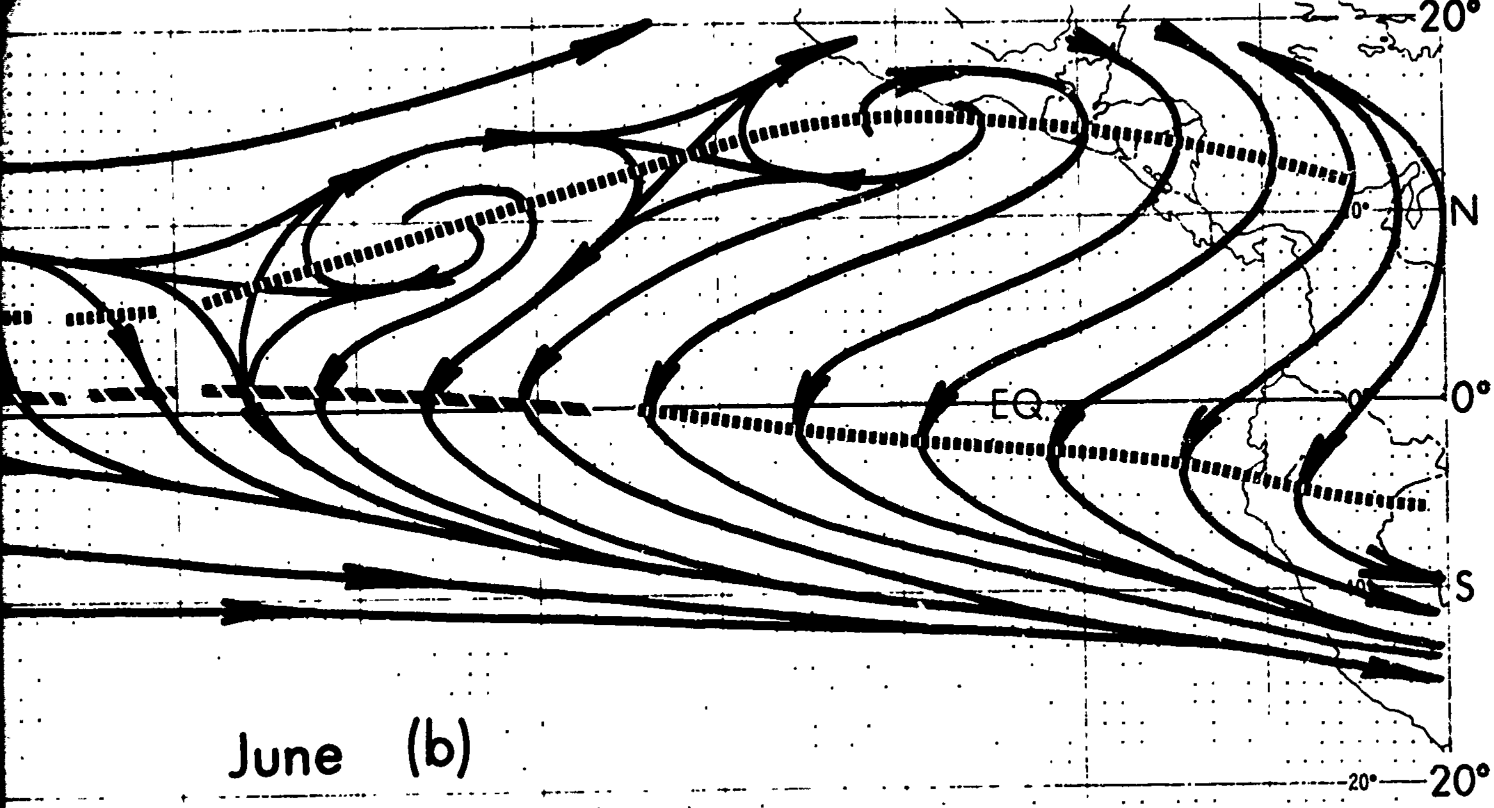
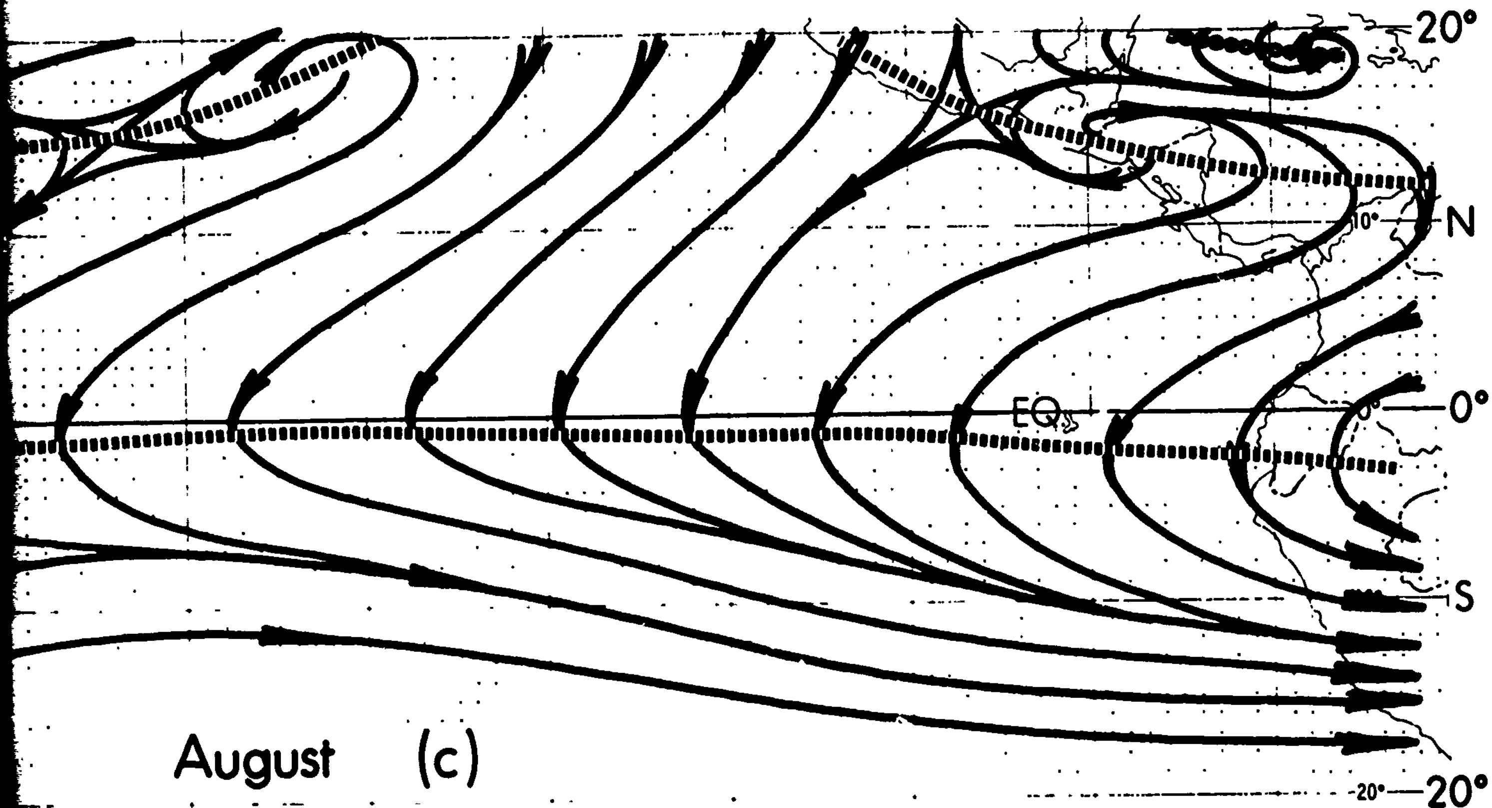


Figure 3. Schematic of 200 mb ridge development in the Northern Hemisphere over the eastern P
and the concurrent establishment of a buffer system in an equatorial region.





n the Northern Hemisphere over the eastern Pacific
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westward to near 140W. Easterly winds are established south of the ridge line. No counterpart ridge forms in the Southern Hemisphere and westerlies exist from the equator southward. A counterclockwise turning wind system is therefore established between the westerlies of the Southern Hemisphere and the easterly flow south of the ridge line. The ridge continues to strengthen and move northward, and by August [figure 3(c)], mean easterly flow is established across the North Pacific south of the ridge line. The axis of the counterclockwise system between the easterlies and the Southern Hemisphere westerlies lies very near the equator. This axis can move back and forth across the equator and even slope with height across the equator (see July and September plates). The sense of rotation is cyclonic when north of the equator and anticyclonic when south of the equator. Similar circulation systems in the lower troposphere over the western Pacific and Indian Ocean have been referred to as buffer systems (Sadler and Harris, 1970), implying only a wind-turning zone between two independently driven wind systems of opposite directions. The same nomenclature of buffer system will be used herein.

3.2 Major Currents

(a) Westerlies. The westerly currents of the mid- or temperate latitudes are persistent features throughout the year and will be referred to as the temperate westerlies, or the temperate jets if the mean speeds exceed 80 kt.

The westerly currents of tropical latitude origin separated from the temperate westerlies will be referred to as the subtropical westerlies. These currents normally exist equatorward of the tropical upper-tropospheric troughs.

The westerly currents of the equatorial region appear to be a mix or extension of the temperate westerlies and/or the subtropical westerlies and will be referred to in these terms as appropriate.

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6. ACKNOWLEDGEMENTS

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6. ACKNOWLEDGEMENTS

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(b) Easterlies. The easterly current between the tropical upper-tropospheric trough and the subtropical ridge will be referred to as the tropical easterlies. The easterly current of the equatorial or near-equatorial region between the subtropical ridges of the two hemispheres or between the subtropical ridge of the Southern Hemisphere and the subequatorial ridge of the Northern Hemisphere will be referred to as the equatorial easterlies.

4. ANALYSIS

The maximum data composite PIREP chart was analyzed first and used as an underlying control for analyses of the 300-, 250-, and 200-mb charts to assure vertical consistency. The analyses for the previous and following months were also used as underlays, and adjustments back and forth were made to assure time continuity.

The quality of the PIREP data was remarkably good. Very little smoothing was required in the streamline analyses to mesh the PIREP winds and rawins. More smoothing was necessary in analyzing the wind speed, particularly where data were sparse and the number of aircraft observations highly variable.

5. PLATE DISCUSSION

The monthly discussions dwell on the major circulation systems, and their changes from the previous month. The reference level for discussion is 200 mb unless noted otherwise.

Differences between the circulation patterns at the three levels are minor. The major differences are in wind speeds which generally increase with altitude.

7. REFERENCES

Aspliden, C. I., G. A. Dean, and H. Landers, 1966: Satellite study, tropical North Atlantic, 1963. Florida State University Rept. No. 66-4. 16 pp. 124 charts.

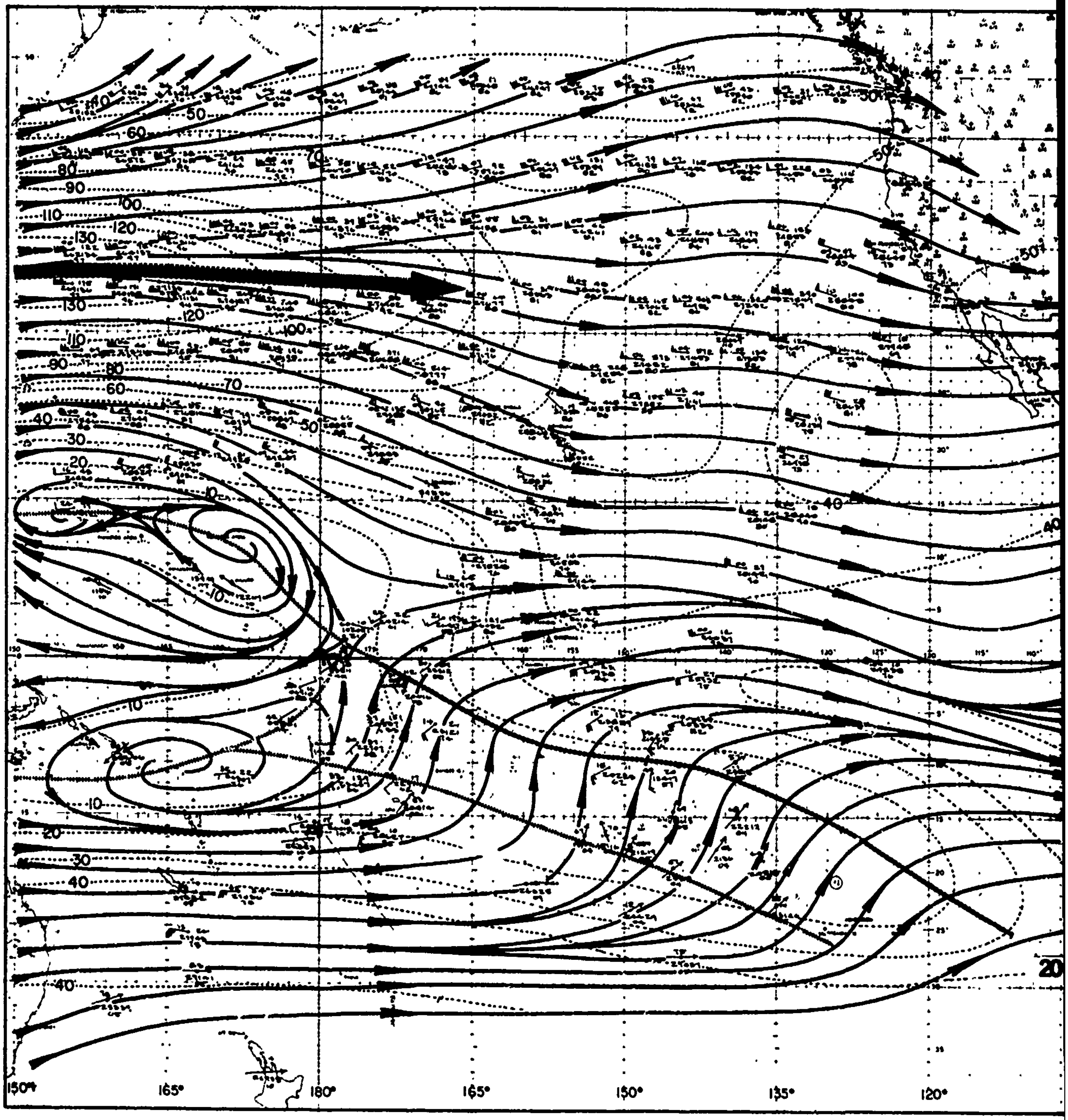
Pearson, A. D., 1968: The upper tropospheric wind and weather patterns of the tropical eastern Pacific. Masters Thesis, Geosciences Dept., University of Hawaii. 55 pp.

Ramage, C. S. and C. R. V. Raman, 1972: International Indian Ocean Expedition Meteorological Atlas. Vol. 2, Upper-Air. National Science Foundation. (in press)

Sadler, J. C., 1963: Utilization of meteorological satellite cloud data in tropical meteorology. Proc. First Internat. Symp. on Rocket and Satellite Meteorology. North-Holland Publishing Co., Amsterdam, 33-356.

Sadler, J. C. and B. E. Harris, 1970: The mean tropospheric circulation and cloudiness over Southeast Asia and neighboring areas. Hawaii Institute of Geophysics, Scientific Report No. 1, AFCRL-70-0489 and HIG-70-26, University of Hawaii, 37 pp.

Note: For those who may make frequent use of the charts it is suggested that the speed fields be color-shaded for ease in determining the position and intensity of the major wind systems.



JANUARY

Northern Hemisphere

A steady, persistent temperate jet stream with a core speed of near 135 kt enters the area along 35N. Speed decreases rather rapidly eastward, and there is a "fanning" in direction downstream from the core center with an apparent splitting into two branches. The northernmost branch enters the United States near 46N as an anticyclonic turning current of near 50 kt maximum speed. The southern branch passes just north of Hawaii and enters the American coast over Baja

Southern Hemisphere

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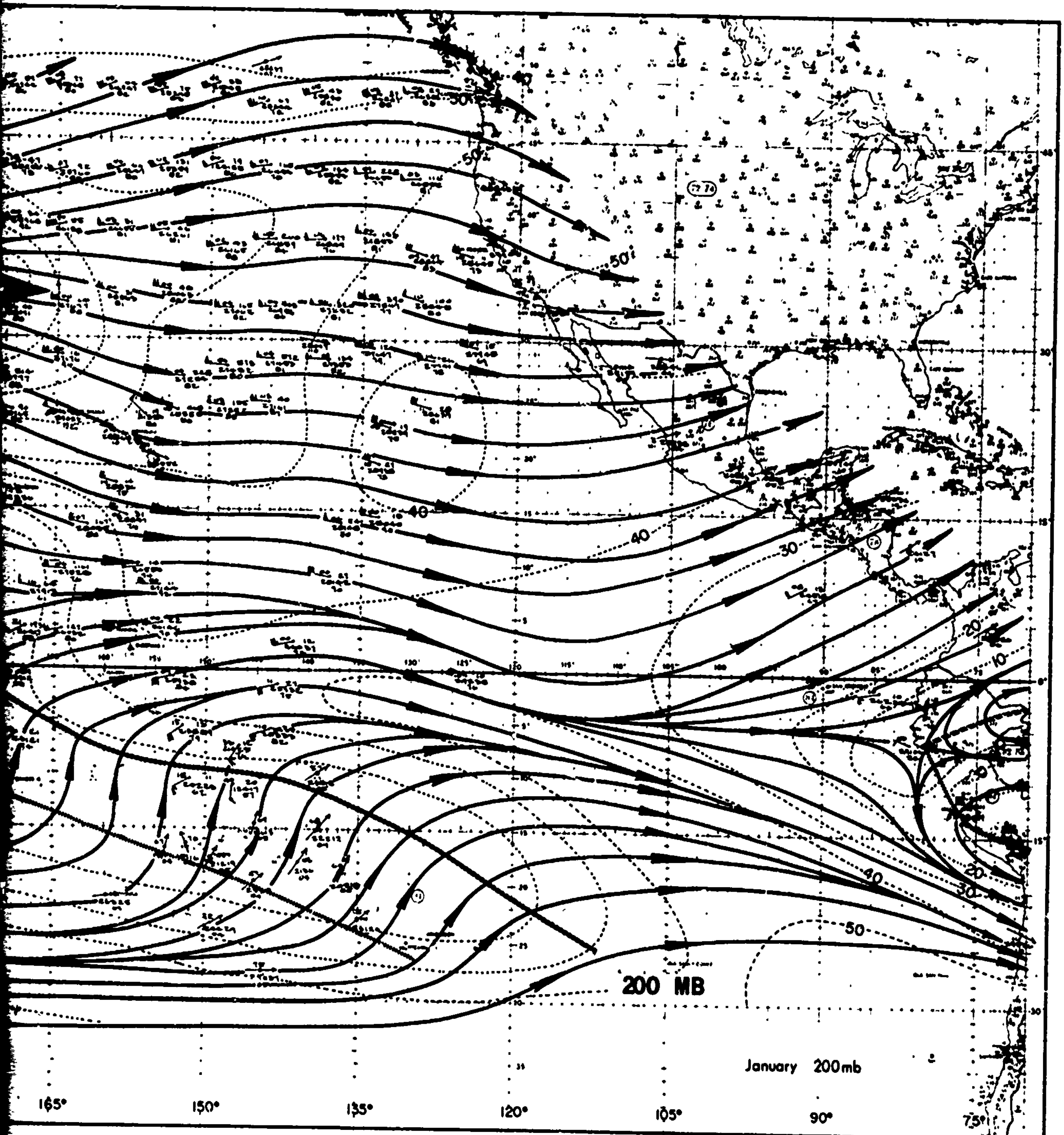

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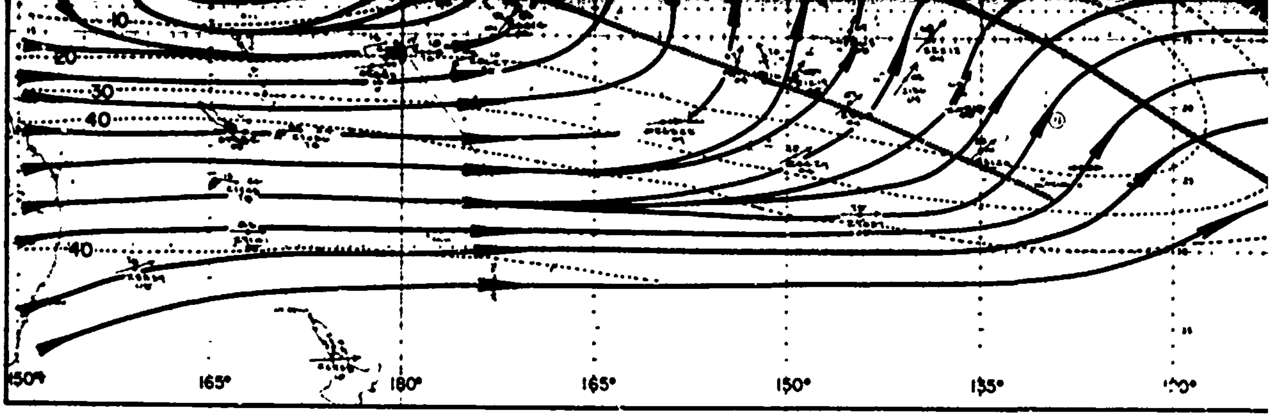
Southern Hemisphere

The subtropical ridge, near 12S at 155E, branches near 170E with the equatorward branch terminating near 177W at the juncture with the northern hemisphere subtropical ridge and the poleward branch extending east-southeast some 10 degrees south of and paralleling the tropical upper tropospheric trough (TUTT).

The core of temperate westerlies with a maximum speed of approx-



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Northern Hemisphere

A steady, persistent temperate jet stream with a core speed of near 135 kt enters the area along 35N. Speed decreases rather rapidly eastward, and there is a "fanning" in direction downstream from the core center with an apparent splitting into two branches. The northernmost branch enters the United States near 46N as an anticyclonic turning current of near 50 kt maximum speed. The southern branch passes just north of Hawaii and enters the American coast over Baja California as a cyclonic turning current. The maximum speed decreases to less than 50 kt east of Hawaii and increases again to 50 kt on the west coast. Between the two branches there is an area of minimum speed over the eastern Pacific.

Note that no winds with an easterly component are observed in the high steadiness (95 + %) region of the temperate jet west of 165W. This indicates that no deep westerly troughs with cut-off lows occur in this region as opposed to the eastern North Pacific which is a region of cut-off lows and blocking highs with omega patterns.

The subtropical ridge, near 14N at 155E, terminates near 177W, and westerly flow covers the tropical region eastward of 177W through Central America and northwestern South America.

Southern Hemisphere

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Equatorial Region

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PIREP Winds

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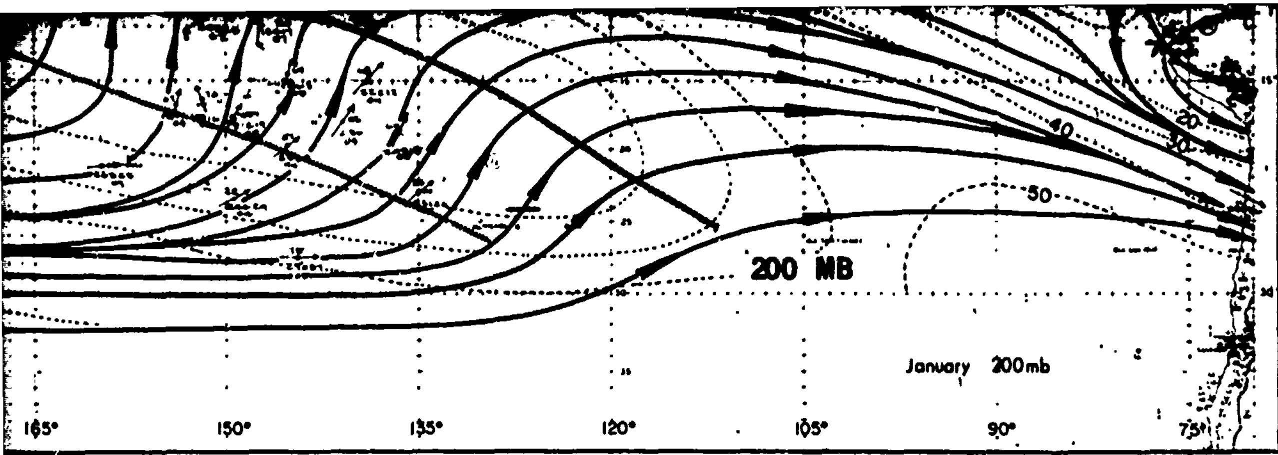
EE	-percentage of winds with an east comp	
nnnn	-number of observations	
ddd	-mean resultant wind direction	
fff	-mean resultant wind speed in knots (f 50 knots, long barb = 10 knots, short barb = 5 knots)	
SS	-steadiness of winds in percent	
NN	-number of years of record	



JANUARY

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Southern Hemisphere

The subtropical ridge, near 12S at 155E, branches near 170E with the equatorward branch terminating near 177W at the juncture with the northern hemisphere subtropical ridge and the poleward branch extending east-southeast some 10 degrees south of and paralleling the tropical upper tropospheric trough (TUTT).

The core of temperate westerlies with a maximum speed of approximately 45 kt lies near 25S over eastern Australia. Speeds decrease eastward to the subtropical ridge--TUTT systems between 110W and 130W, and then increase to greater than 50 kt over western South America where the northwesterly stream of subtropical westerlies from the equatorial region merges with the temperate westerlies.

Equatorial Region

Equatorial easterlies exist from near 177W westward, between the two subtropical ridges. Westerlies cover the equatorial region from near 177W eastward to South America.

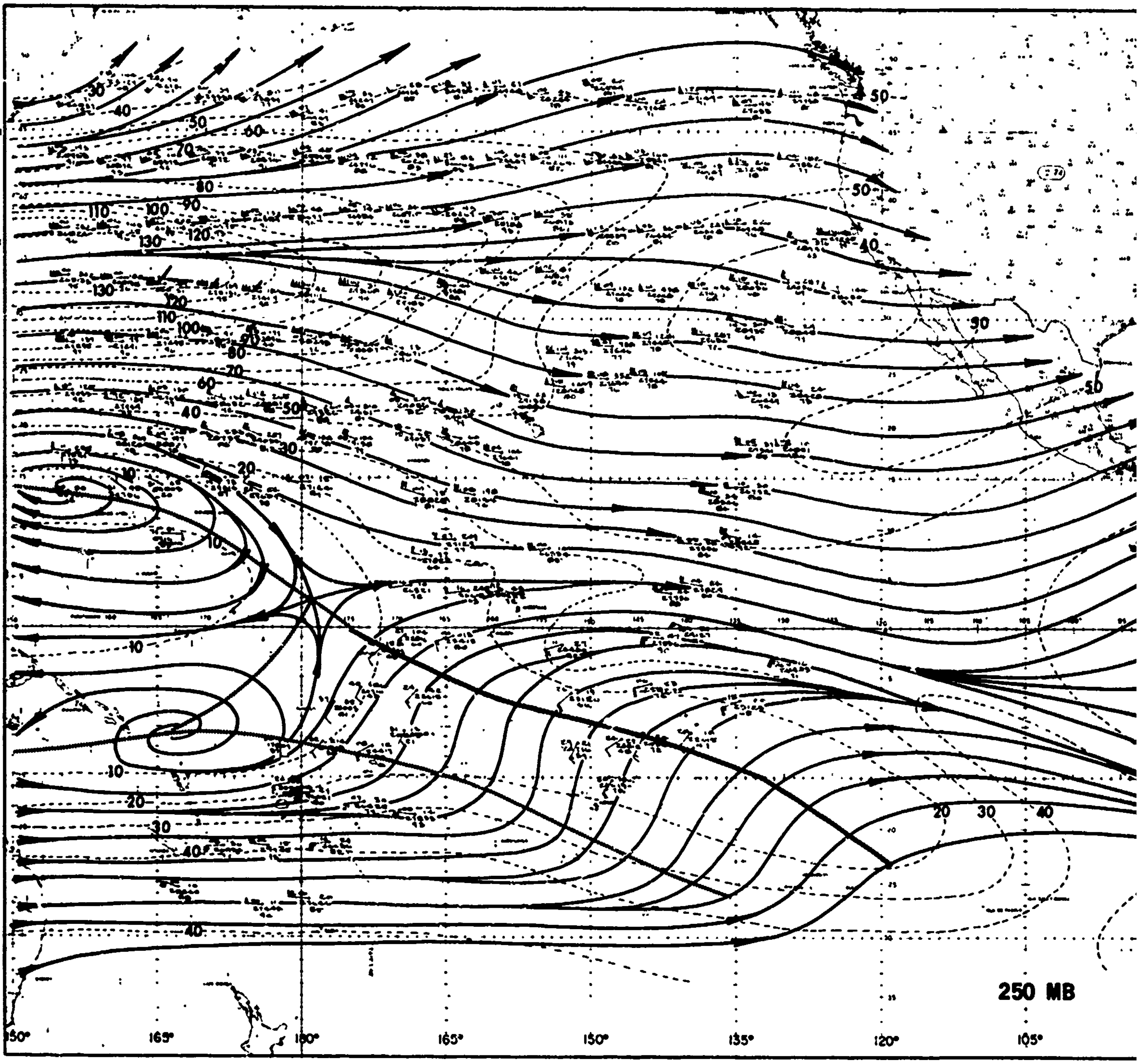
EE	-percentage of winds with an east component
nnnn	-number of observations
ddd	-mean resultant wind direction
fff	-mean resultant wind speed in knots (flag = 50 knots, long barb = 10 knots, short barb = 5 knots)
SS	-steadiness of winds in percent
NN	-number of years of record

Rawins

SS

dddfff

NN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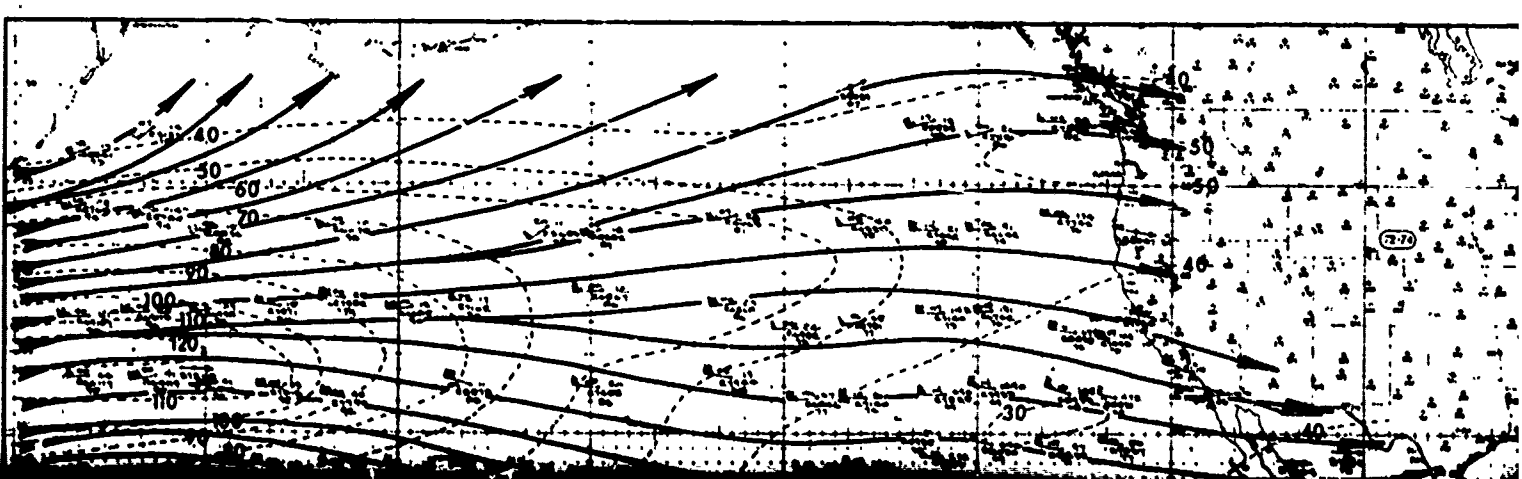

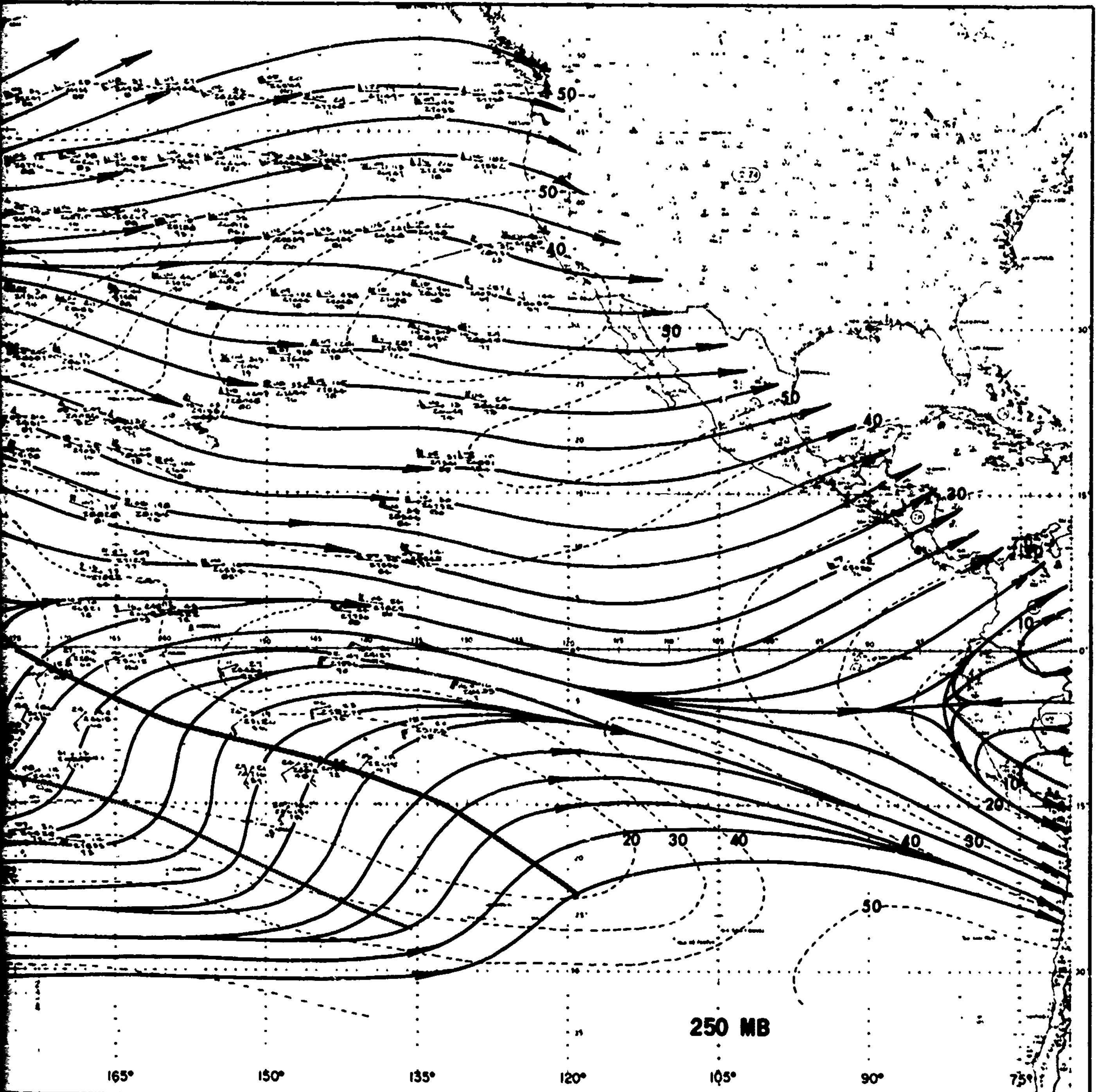
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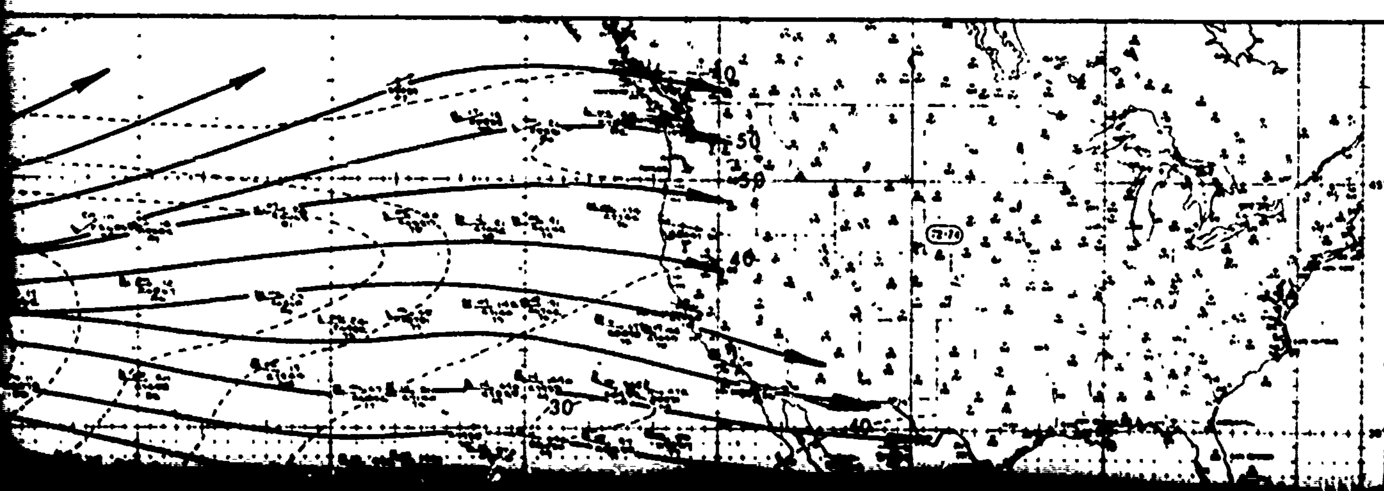

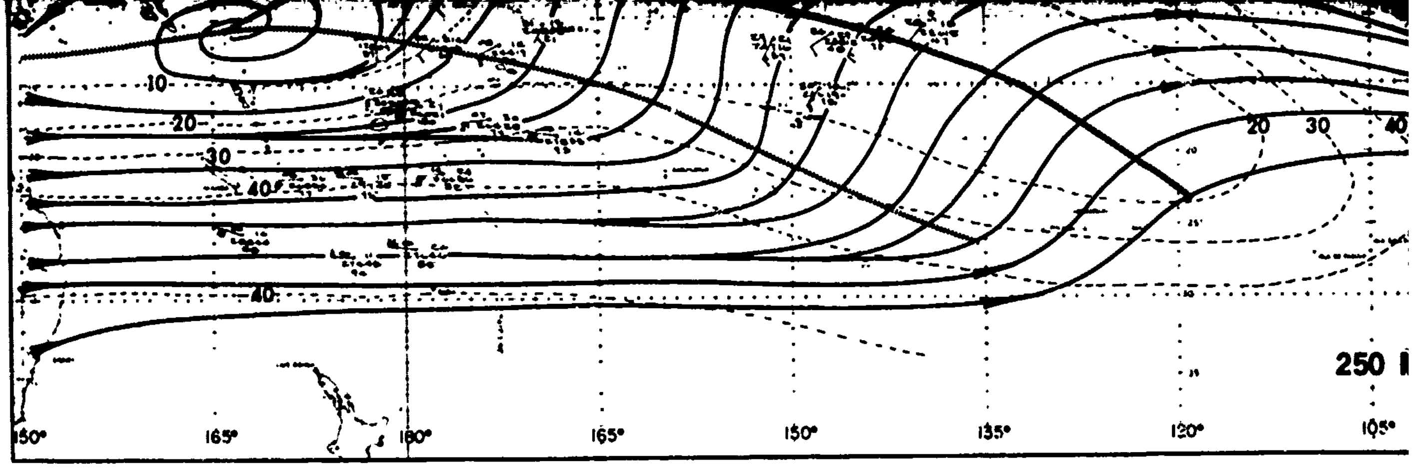

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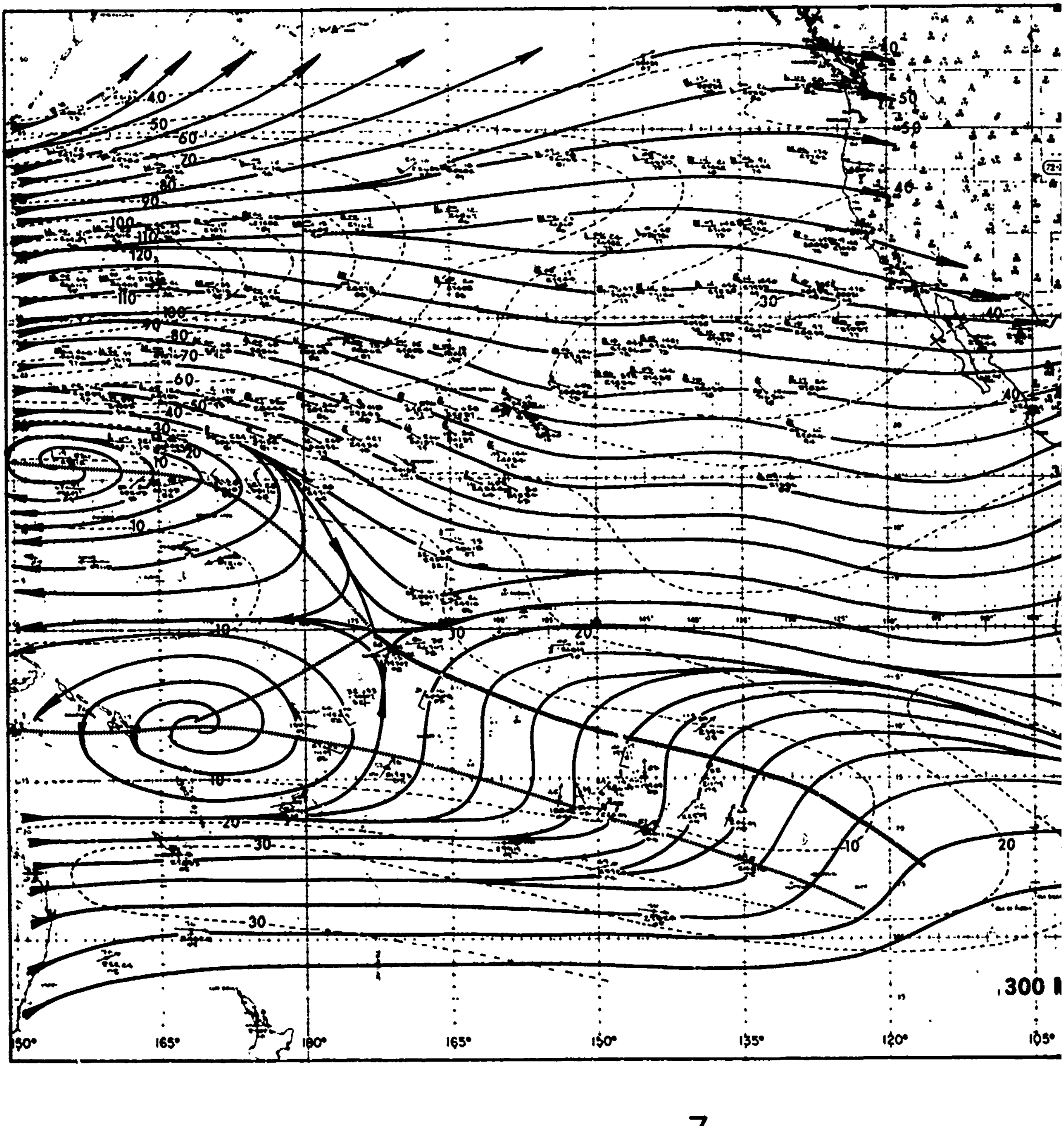

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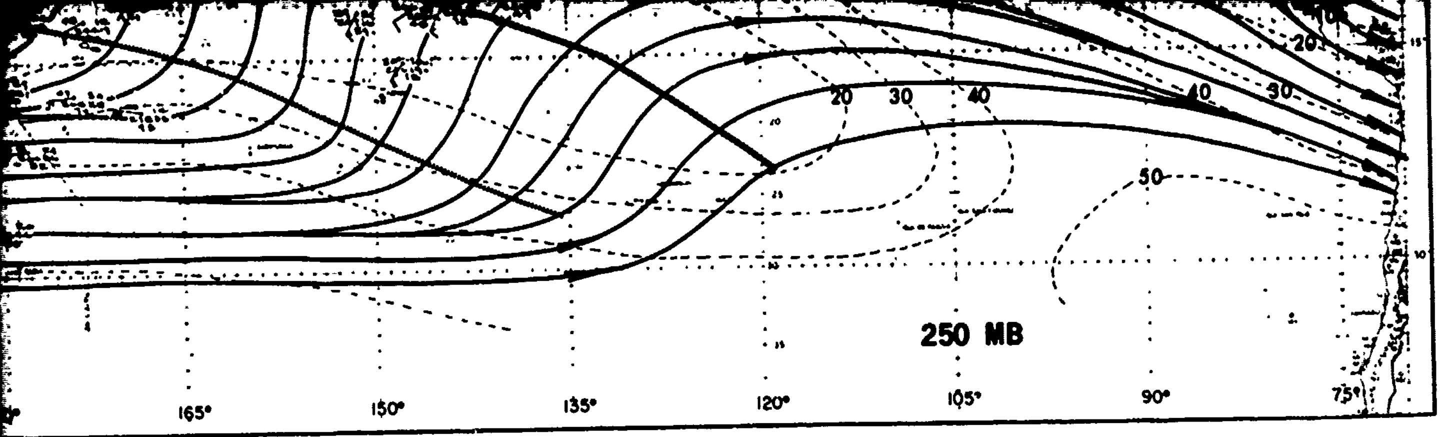

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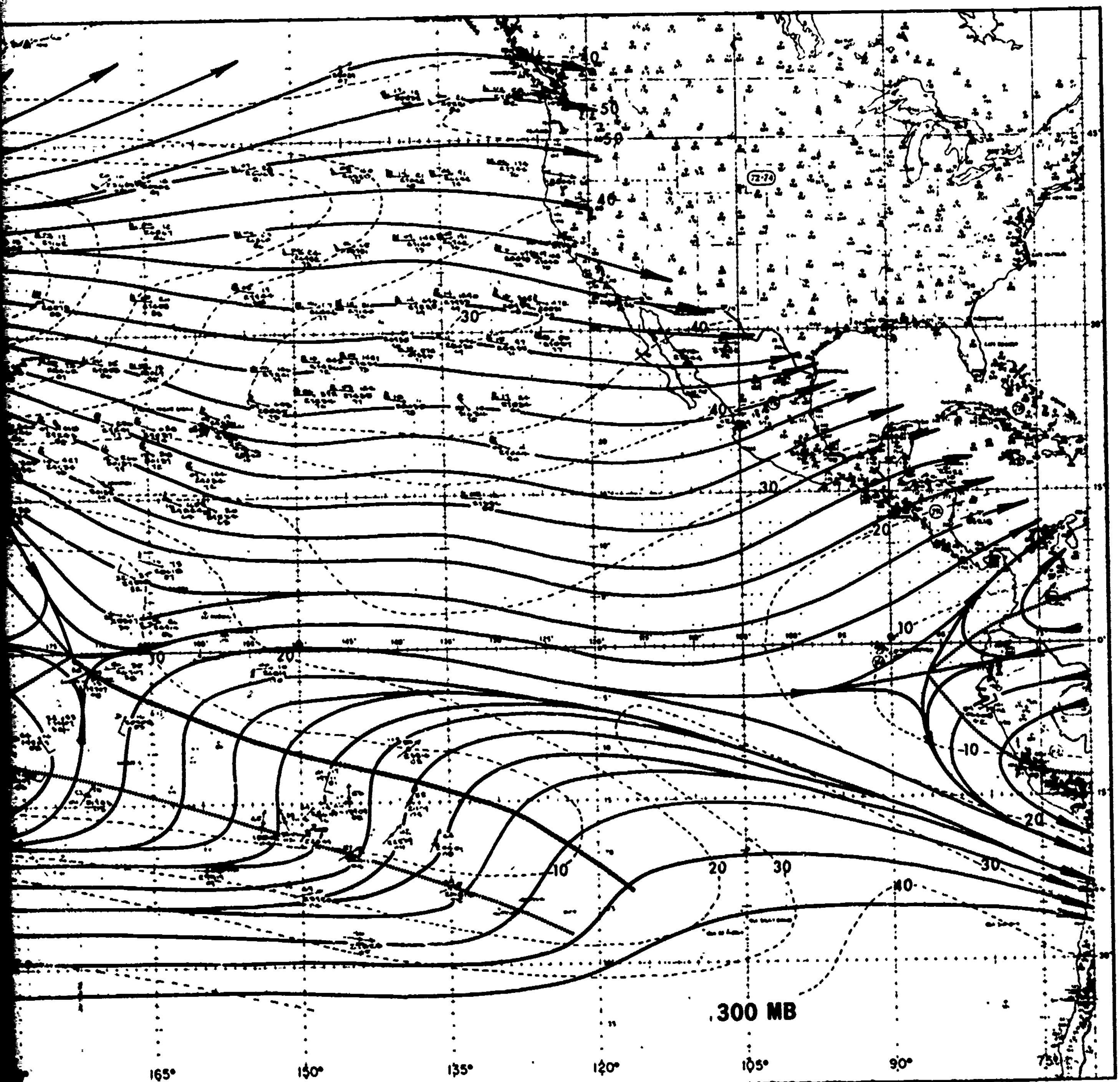

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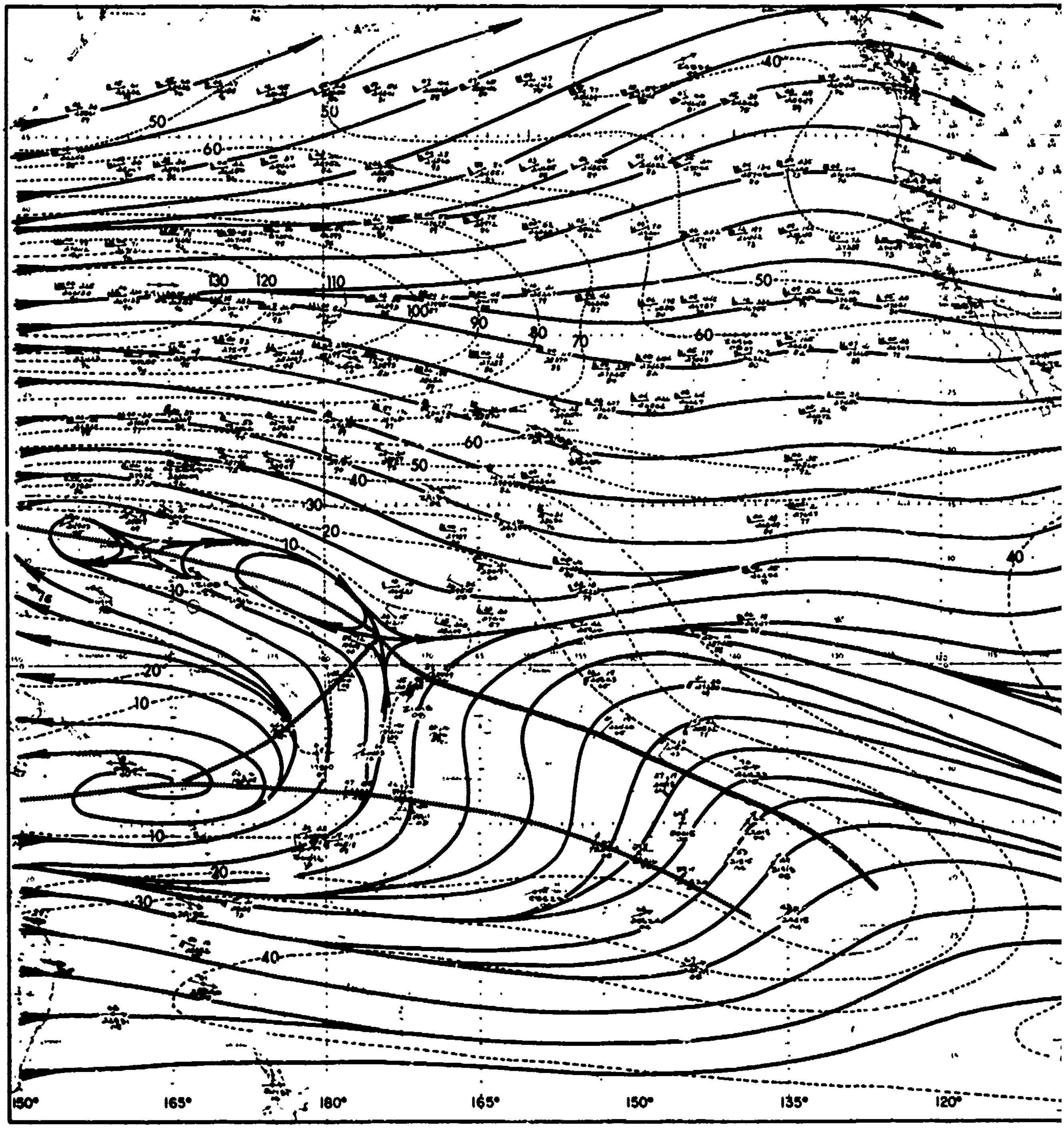

FEBRUARY

Northern Hemisphere

The temperate jet, with a core speed of near 135 kt, enters the area along 33N or slightly south of the January position. The downstream "fanning" of the direction field is very similar to January, but there is a definite change in the speed field. The southernmost branch is dominant with speeds of greater than 60 kt from just north of Hawaii through Baja California. The northernmost branch is not as apparent as in January, and the speeds are less than 40 kt off the

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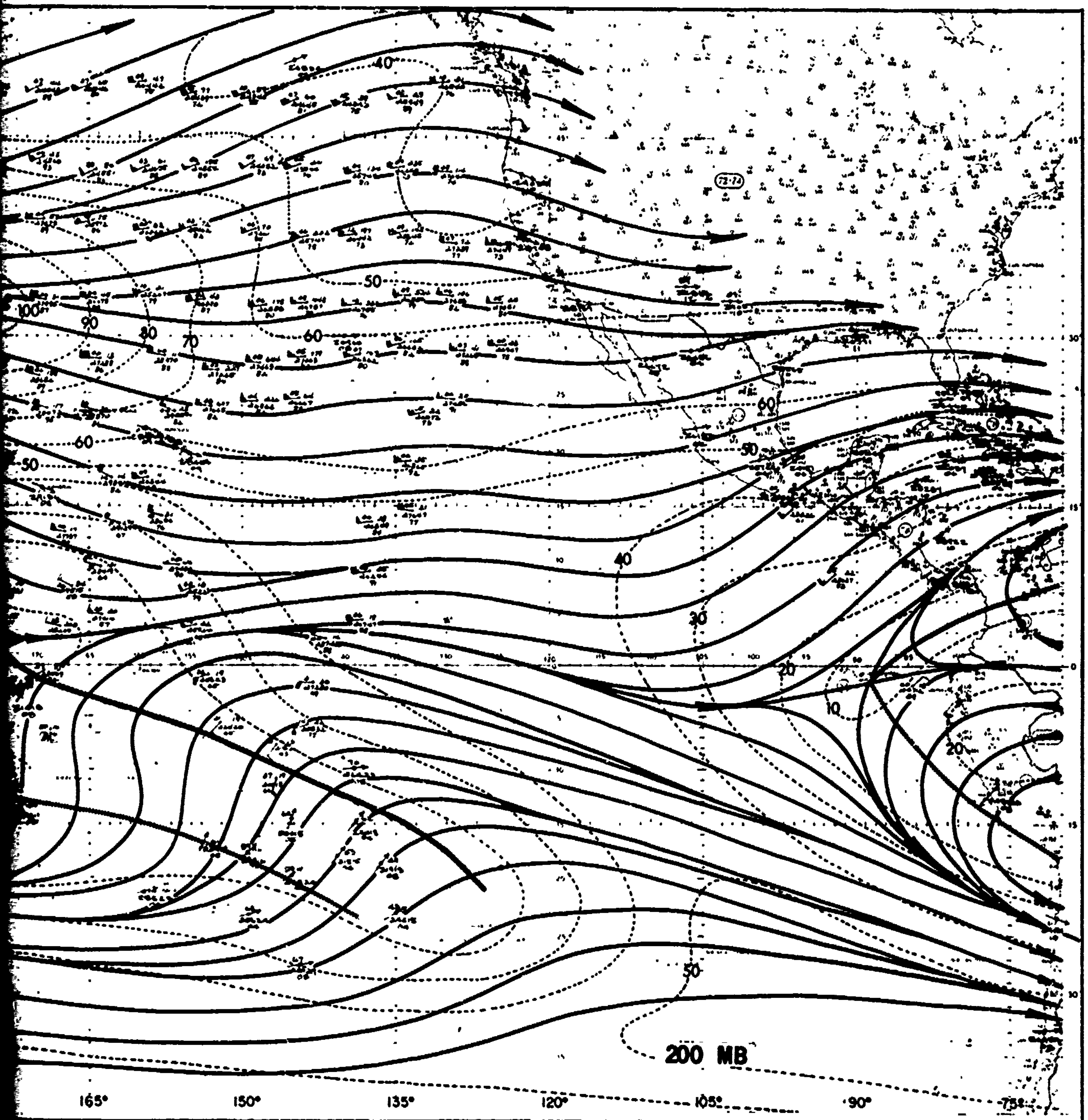

FEBRUARY

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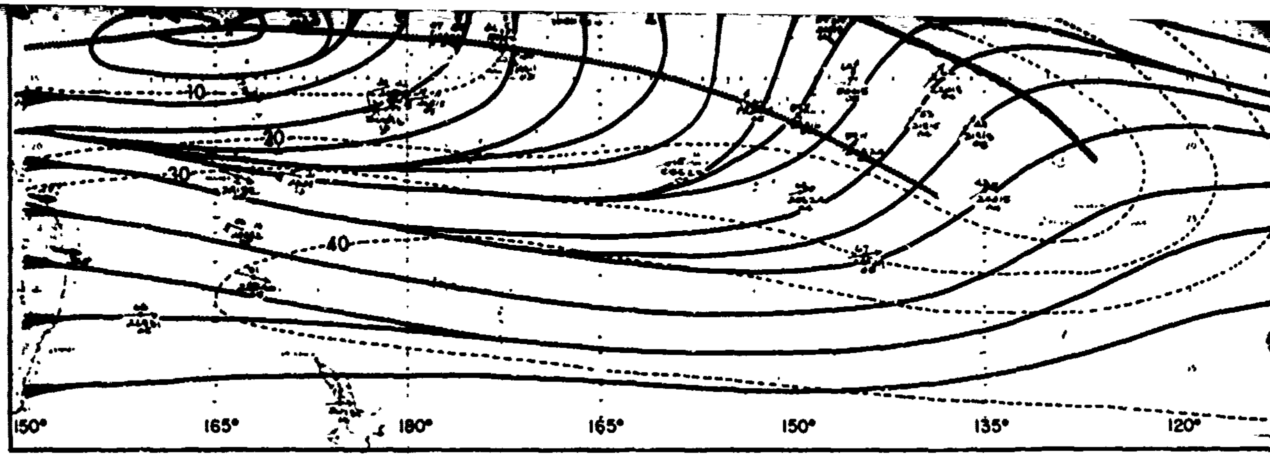
The temperate westerlies over eastern Australia have decreased slightly from January to less than 40 kt. The speeds remain greater than 50 kt over western South America near 35S.

The TUTT is a little poleward of the January position and perhaps more "active" as indicated by the decrease in wind speeds and steadiness at the French Polynesian stations south of 14S.

<u>Equatorial Region</u>



FEBRUARY

Northern Hemisphere

The temperate jet, with a core speed of near 135 kt, enters the area along 33N or slightly south of the January position. The downstream "fanning" of the direction field is very similar to January, but there is a definite change in the speed field. The southernmost branch is dominant with speeds of greater than 60 kt from just north of Hawaii through Baja California. The northernmost branch is not as apparent as in January, and the speeds are less than 40 kt off the northwest coast of the United States.

The subtropical ridge is essentially unchanged from January.

Southern Hemisphere

The direction and the speed fields are quite similar to those of January.

The subtropical ridge is near the January position of 12S at 155E. Eastward of 155E it is slightly south of the January position.

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PIREP Winds

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EE	-percentage of winds with an east comp
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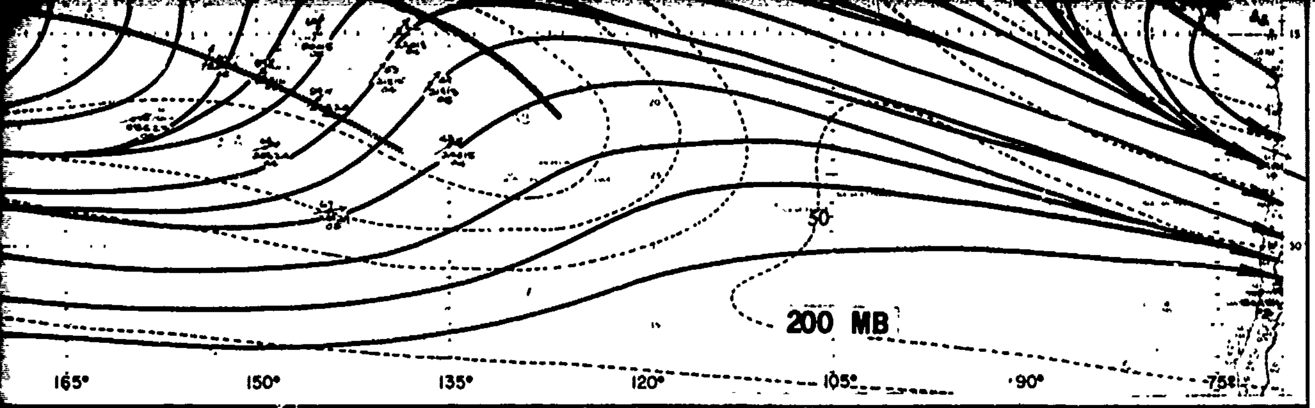

FEBRUARY

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The TUTT is a little poleward of the January position and perhaps more "active" as indicated by the decrease in wind speeds and steadiness at the French Polynesian stations south of 14S.

Equatorial Region

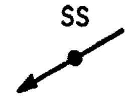
The boundary between equatorial easterlies to westerlies occurs near 175W, little different from January.

The anticyclonic cell south of the equator over South America has expanded northward, and equatorial easterlies have replaced the westerlies of January along the equator westward to near 85W.

EE	-percentage of winds with an east component
nnnn	-number of observations
ddd	-mean resultant wind direction
fff	-mean resultant wind speed in knots (flag = 50 knots, long barb = 10 knots, short barb = 5 knots)
SS	-steadiness of winds in percent
NN	-number of years of record

Rawins

SS



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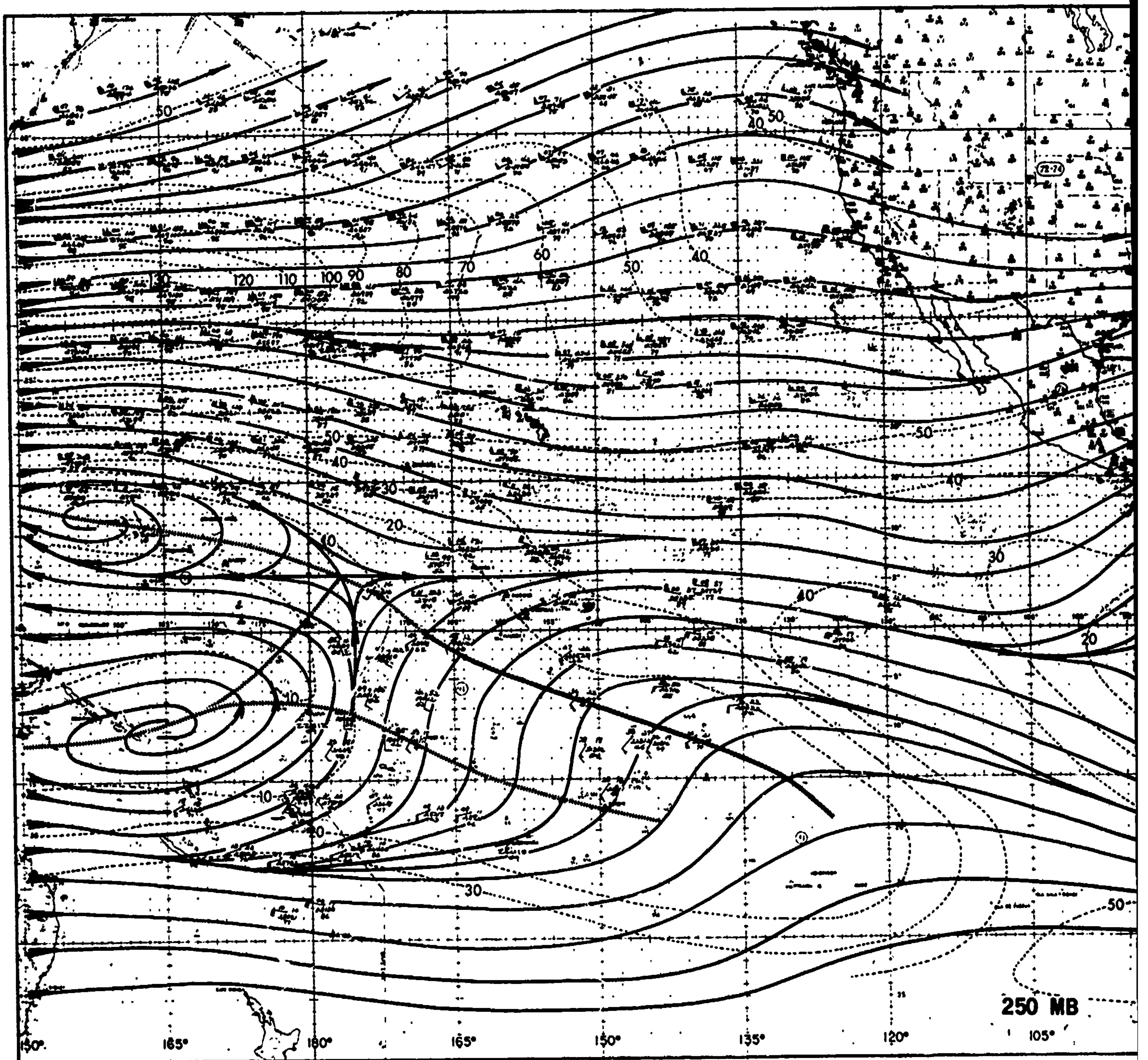
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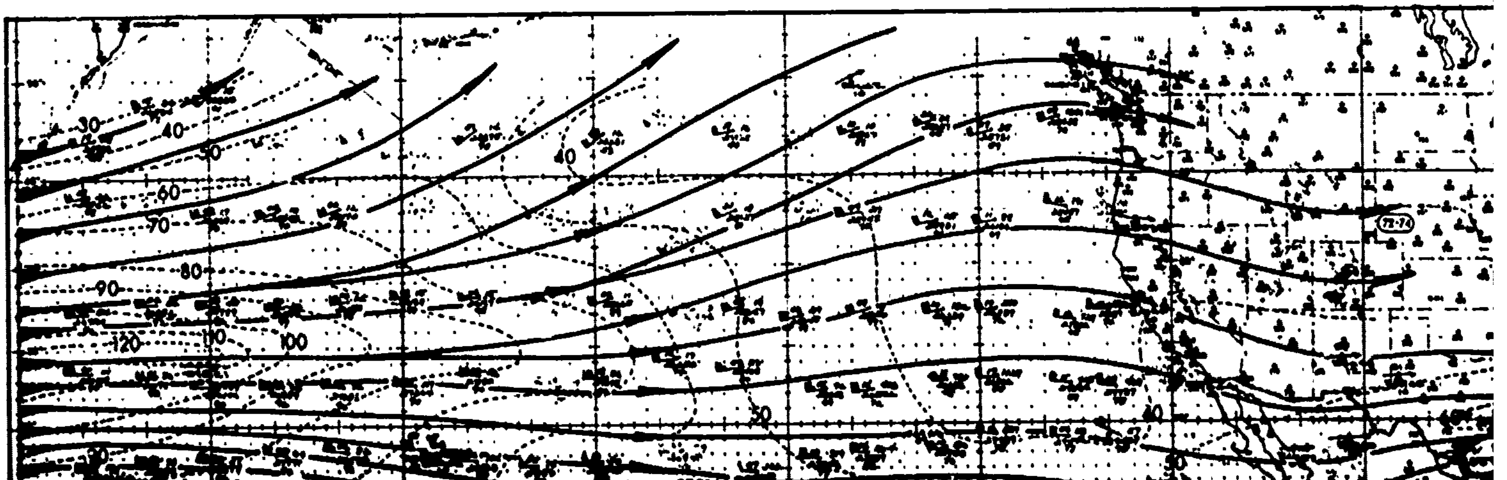

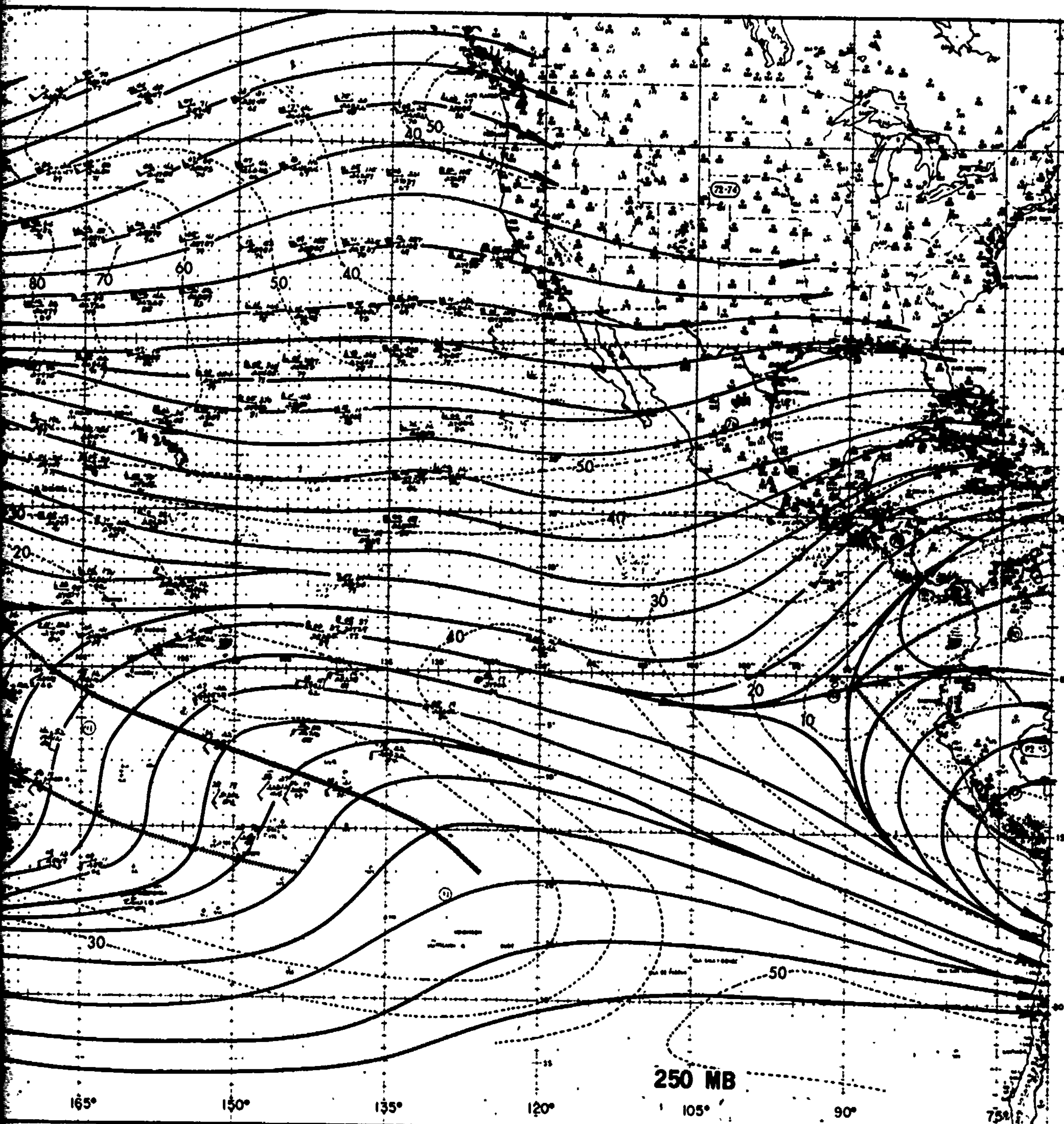

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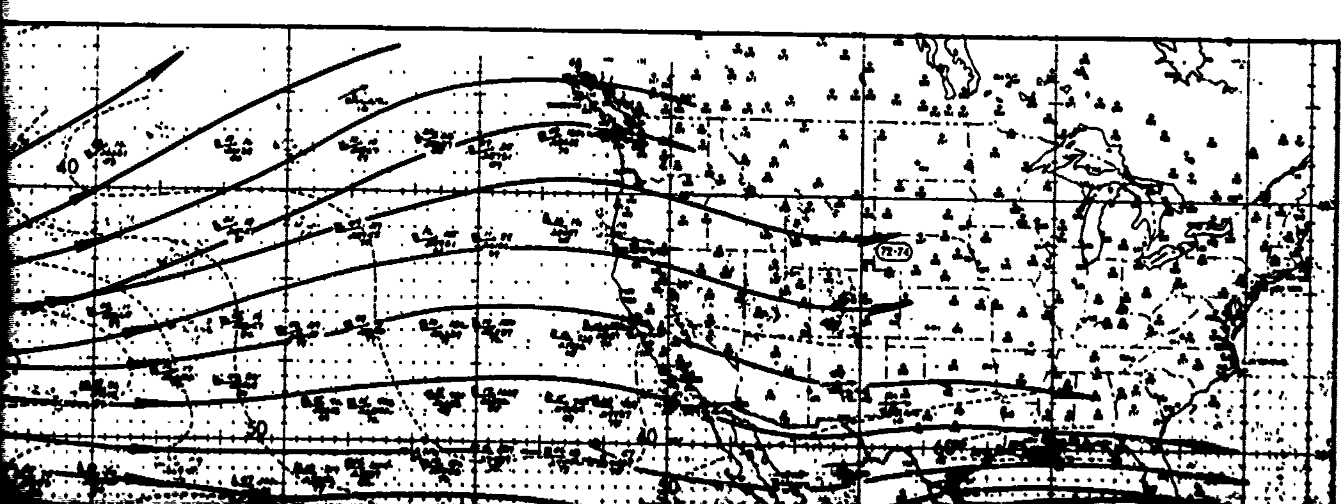

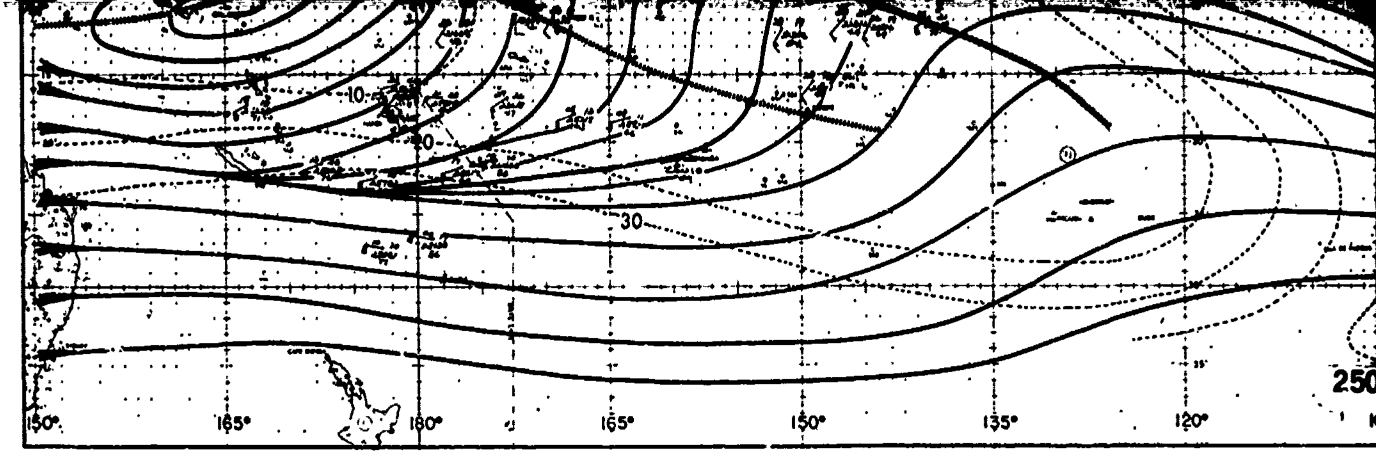
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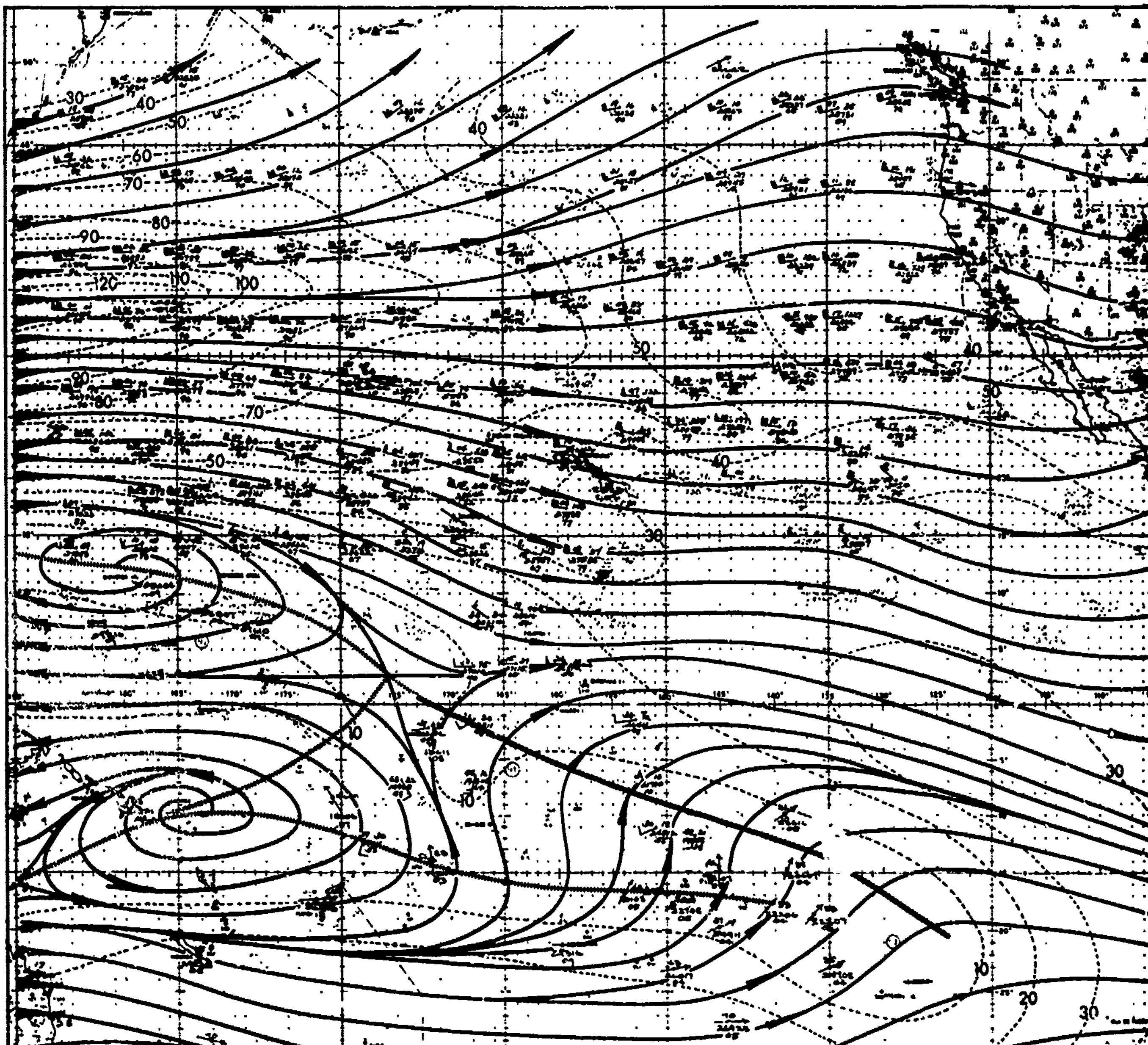
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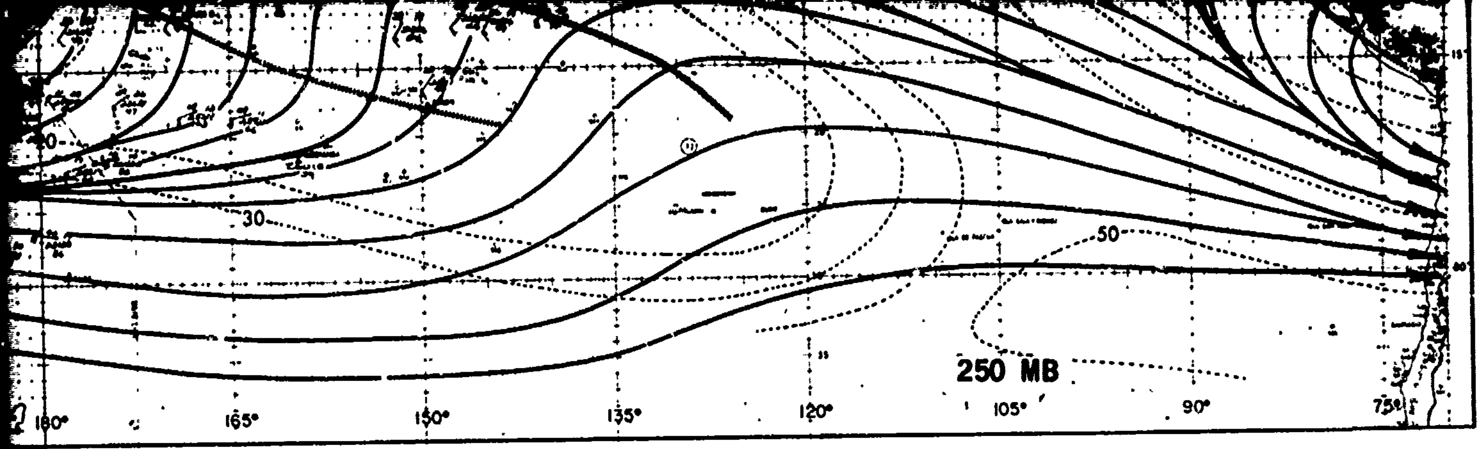
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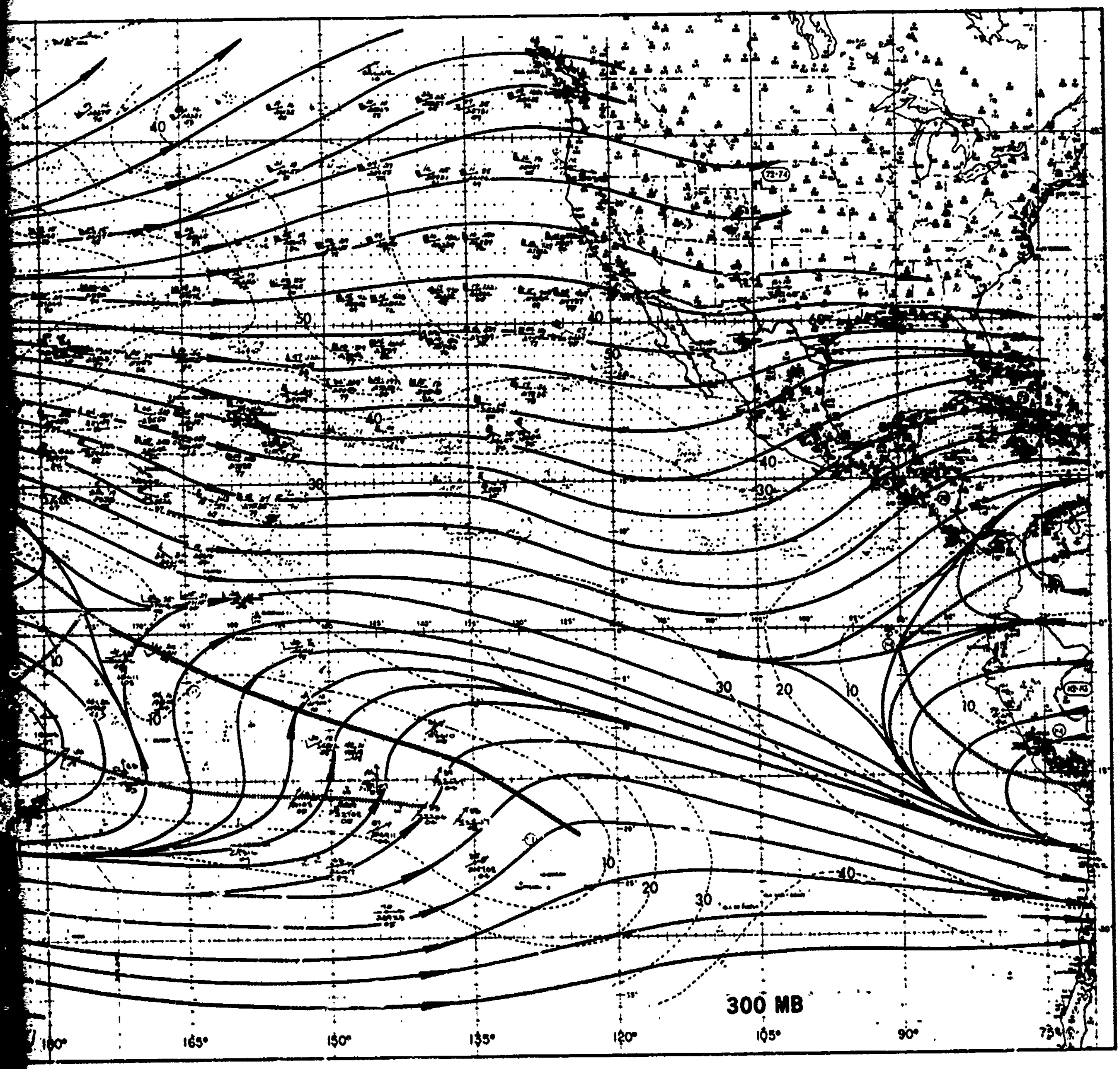
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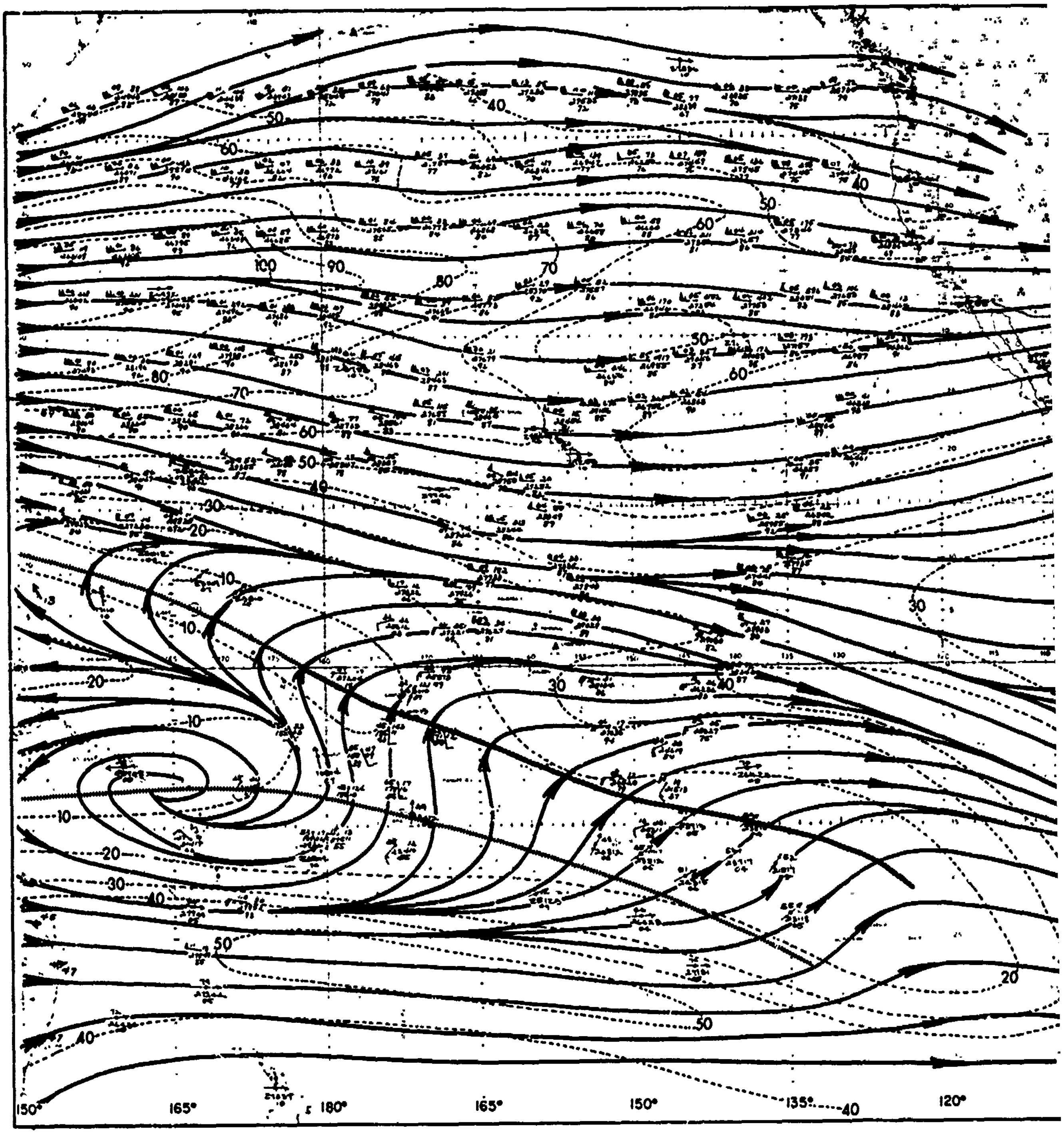

MARCH

Northern Hemisphere

Considerable changes occur in the temperate westerlies from February to March. As from January to February the major changes are in the speed field. The jet core along 155E has moved northward to near 36N, and the speed has decreased to about 110 kt. There is a more pronounced separation between the northern branch extending east-northeast from the jet core and the southern branch from Hawaii to Baja California. Even though the jet core has moved northward and

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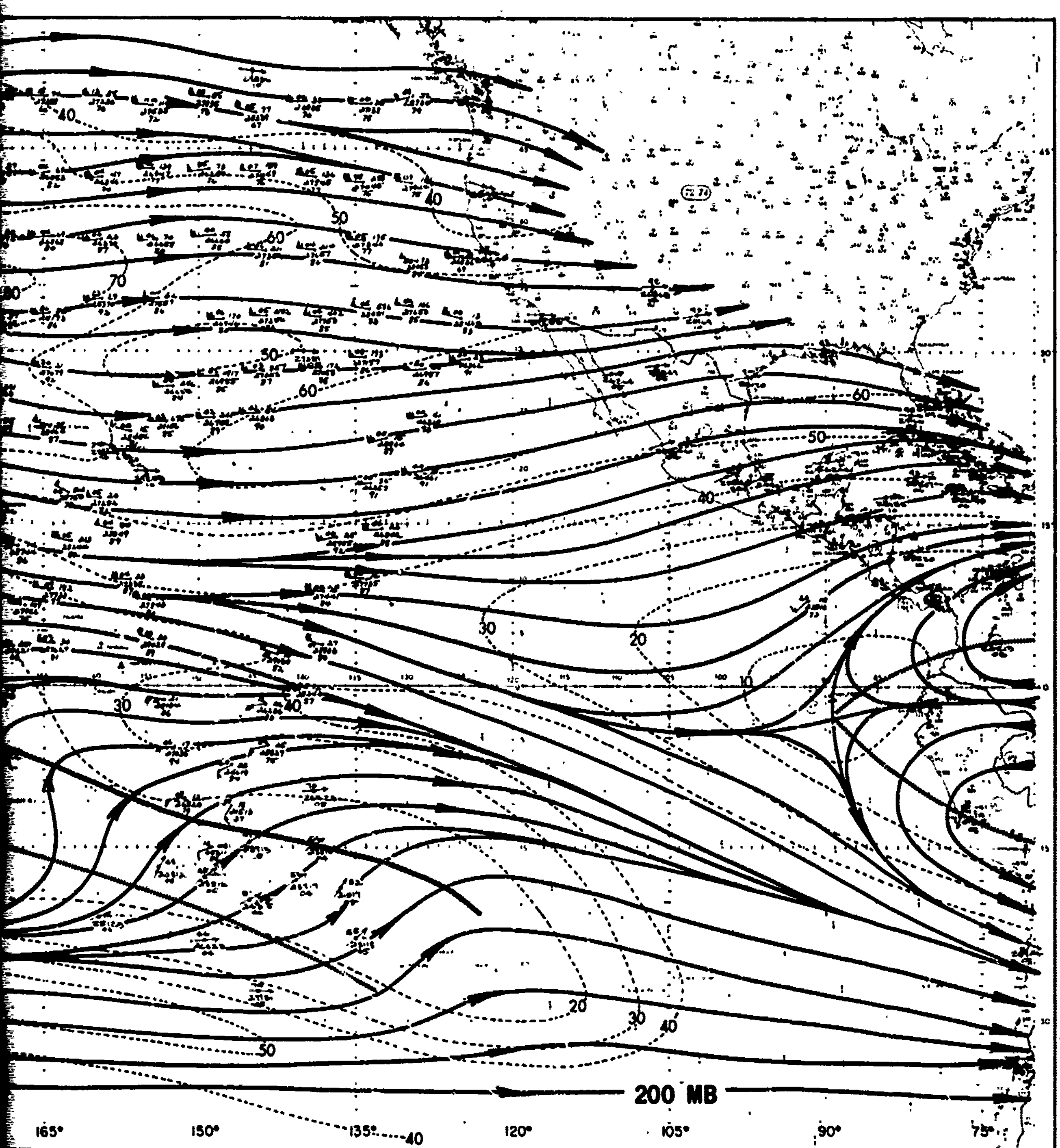

MARCH

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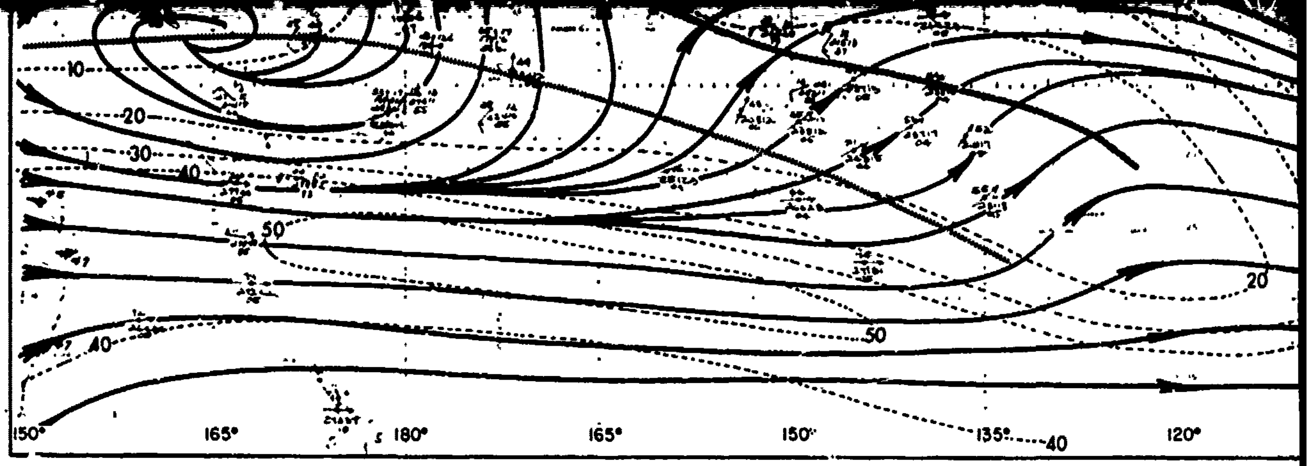
The subtropical ridge is near 10N at 155E, or some three degrees farther south than in February. It joins with the Southern Hemisphere TUTT west of 180, or about 10 degrees farther west than in February.

Southern Hemisphere

The subtropical ridge is near the February position of 12S at 155E. From 175E to 165W it is more pronounced than in February as indicated by the increased easterly component of the tropical easter-



MARCH

Northern Hemisphere

Considerable changes occur in the temperate westerlies from February to March. As from January to February the major changes are in the speed field. The jet core along 155E has moved northward to near 36N, and the speed has decreased to about 110 kt. There is a more pronounced separation between the northern branch extending east-northeast from the jet core and the southern branch from Hawaii to Baja California. Even though the jet core has moved northward and weakened some 25 kt from February, the speeds in the latitudes of 15N to 20N from Wake Island through Johnston Island to south of Hawaii have increased some 10 kt.

There are subtle changes in the direction field from February; i.e., the backing of more than 10 degrees in the Johnston-Hawaiian Island region; however, there are no pronounced troughs or ridges. The ridging in higher latitudes which was prominent in January and February off the west coast of North America has moved westward of weather ship Papa (50N, 145W) and become less pronounced.

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Equatorial Region

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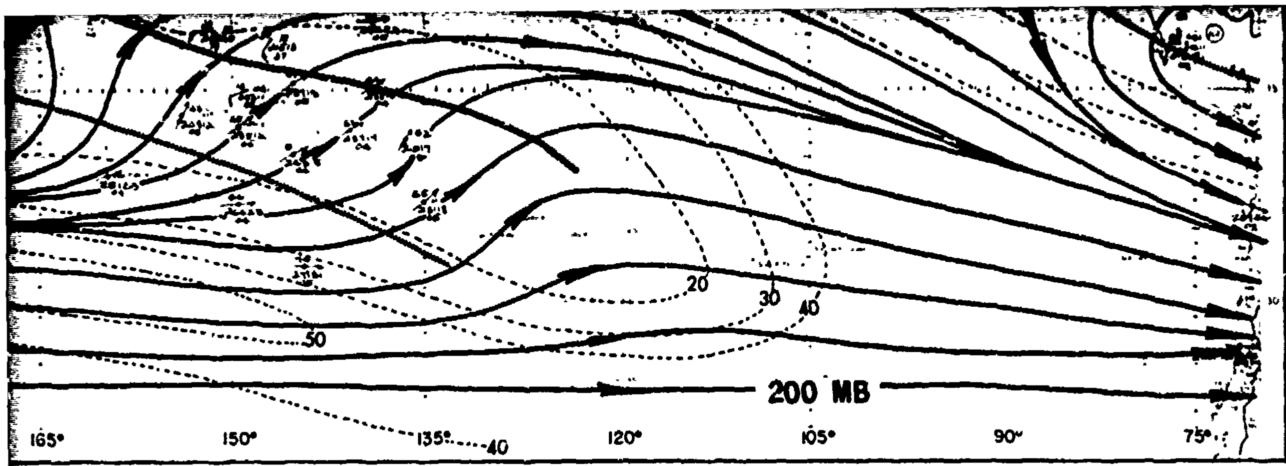

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The subtropical ridge is near 10N at 155E, or some three degrees farther south than in February. It joins with the Southern Hemisphere TUTT west of 180, or about 10 degrees farther west than in February.

Southern Hemisphere

The subtropical ridge is near the February position of 12S at 155E. From 175E to 165W it is more pronounced than in February as indicated by the increased easterly component of the tropical easterlies between the ridge and the TUTT.

The temperate westerlies over eastern Australia have increased from February to greater than 45 kit. The core lies near 30S as in February. Over western South America the westerly maximum near 35S has decreased to less than 50 kt.

Equatorial Region

The change from equatorial easterlies to westerlies occurs near 177E or some 10 degrees farther west than in February. The anticyclonic cell over South America south of the equator has decreased in intensity from February, and the equatorial easterlies have decreased in intensity and latitudinal extent.

EE	-percentage of winds with an east component
nnnn	-number of observations
ddd	-mean resultant wind direction
fff	-mean resultant wind speed in knots (flag= 50 knots, long barb = 10 knots, short barb = 5 knots)
SS	-steadiness of winds in percent
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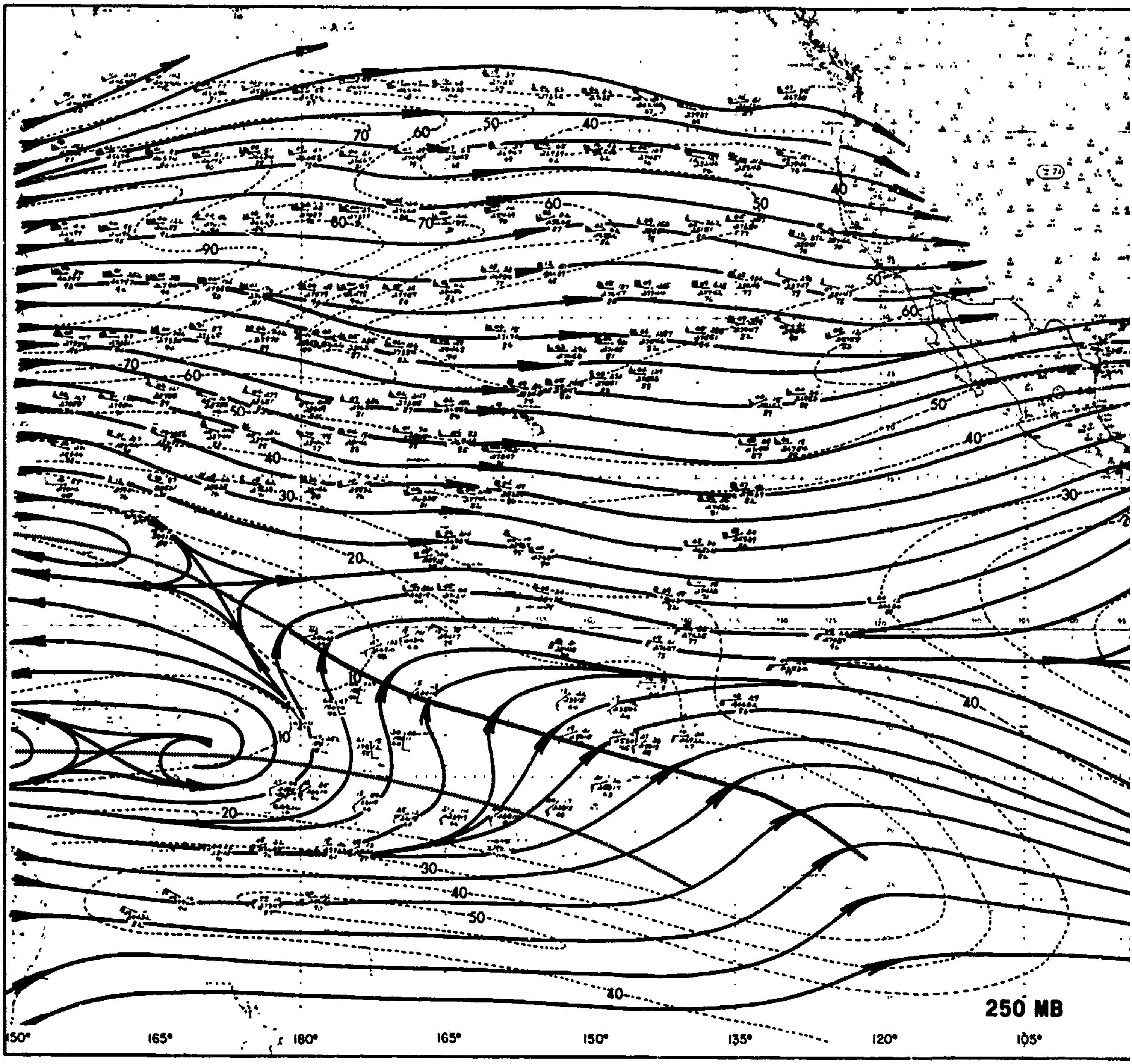
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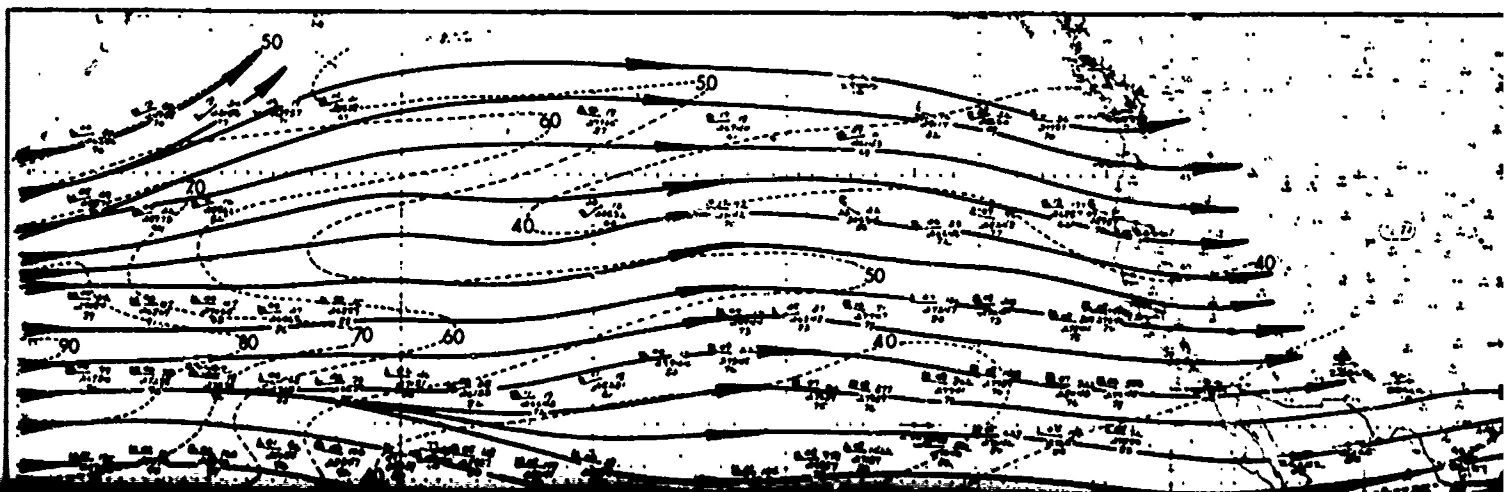

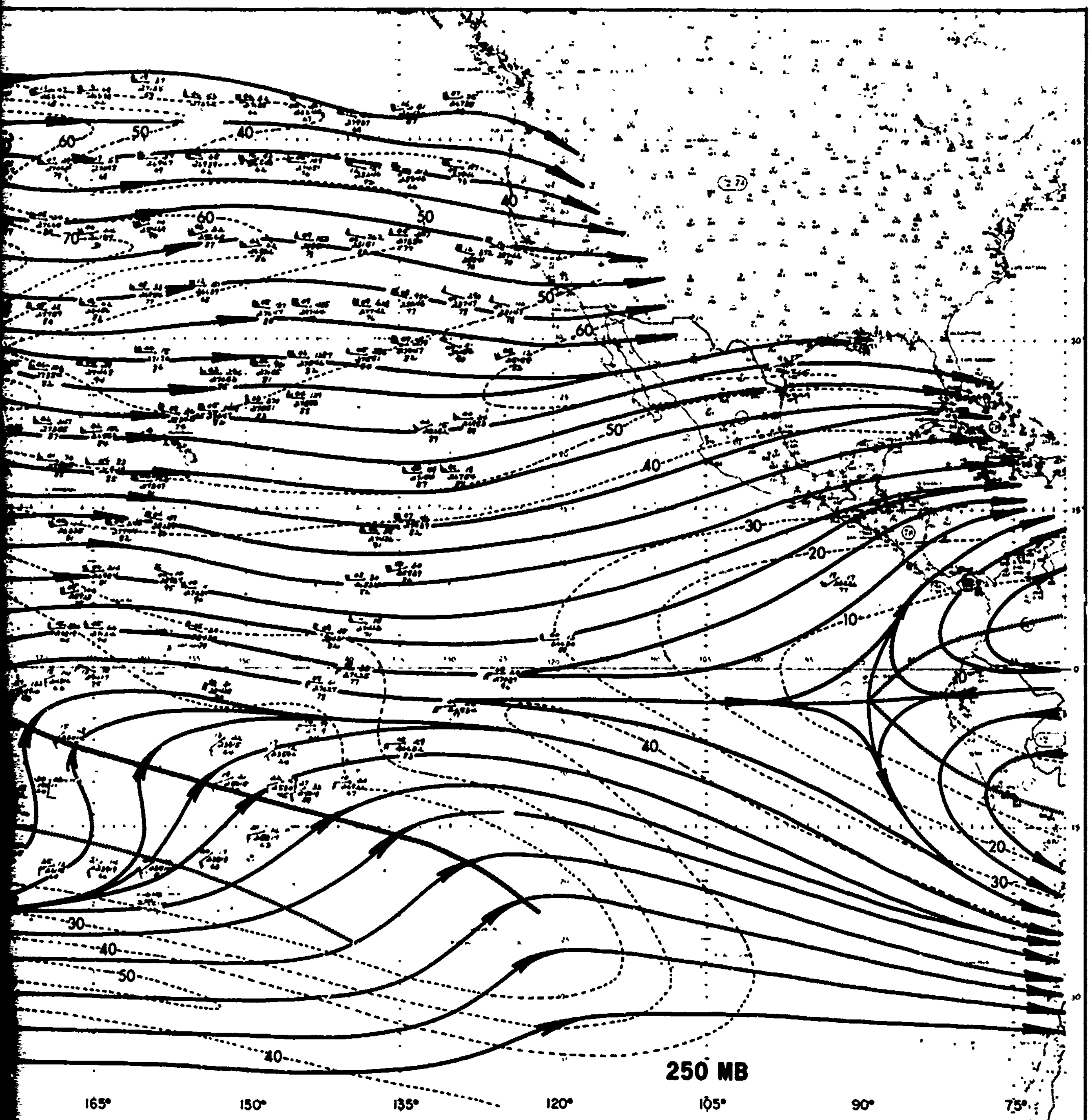
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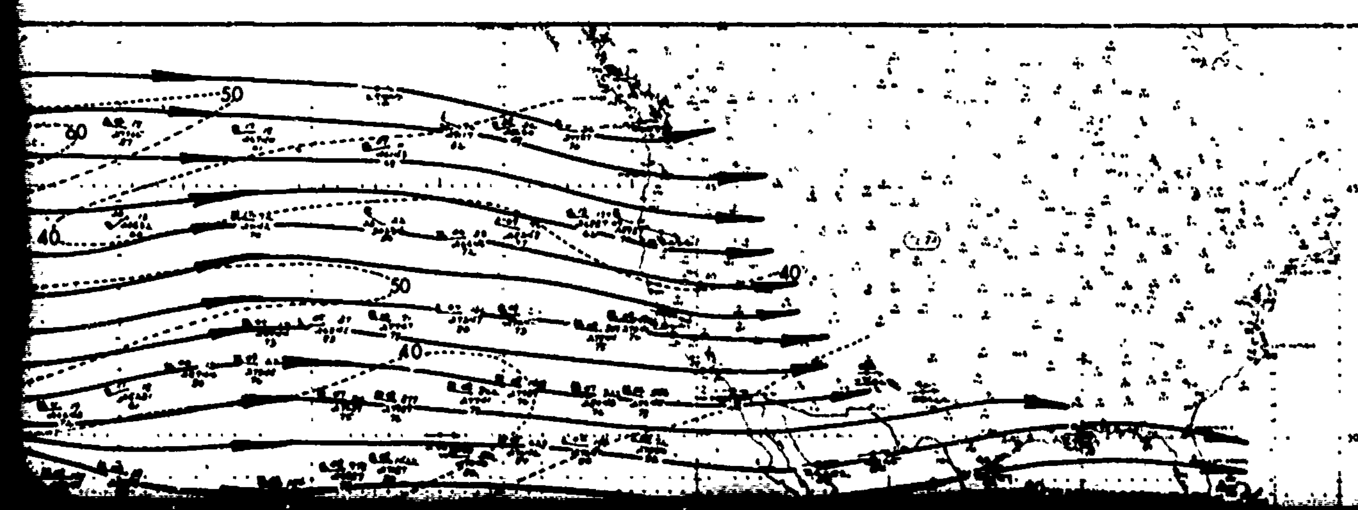

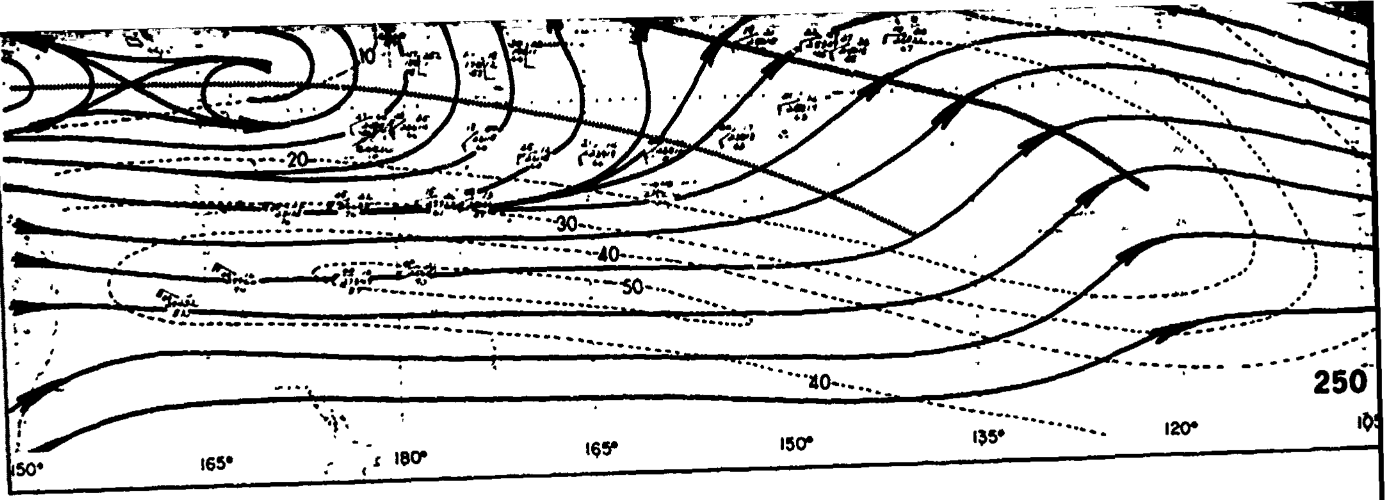
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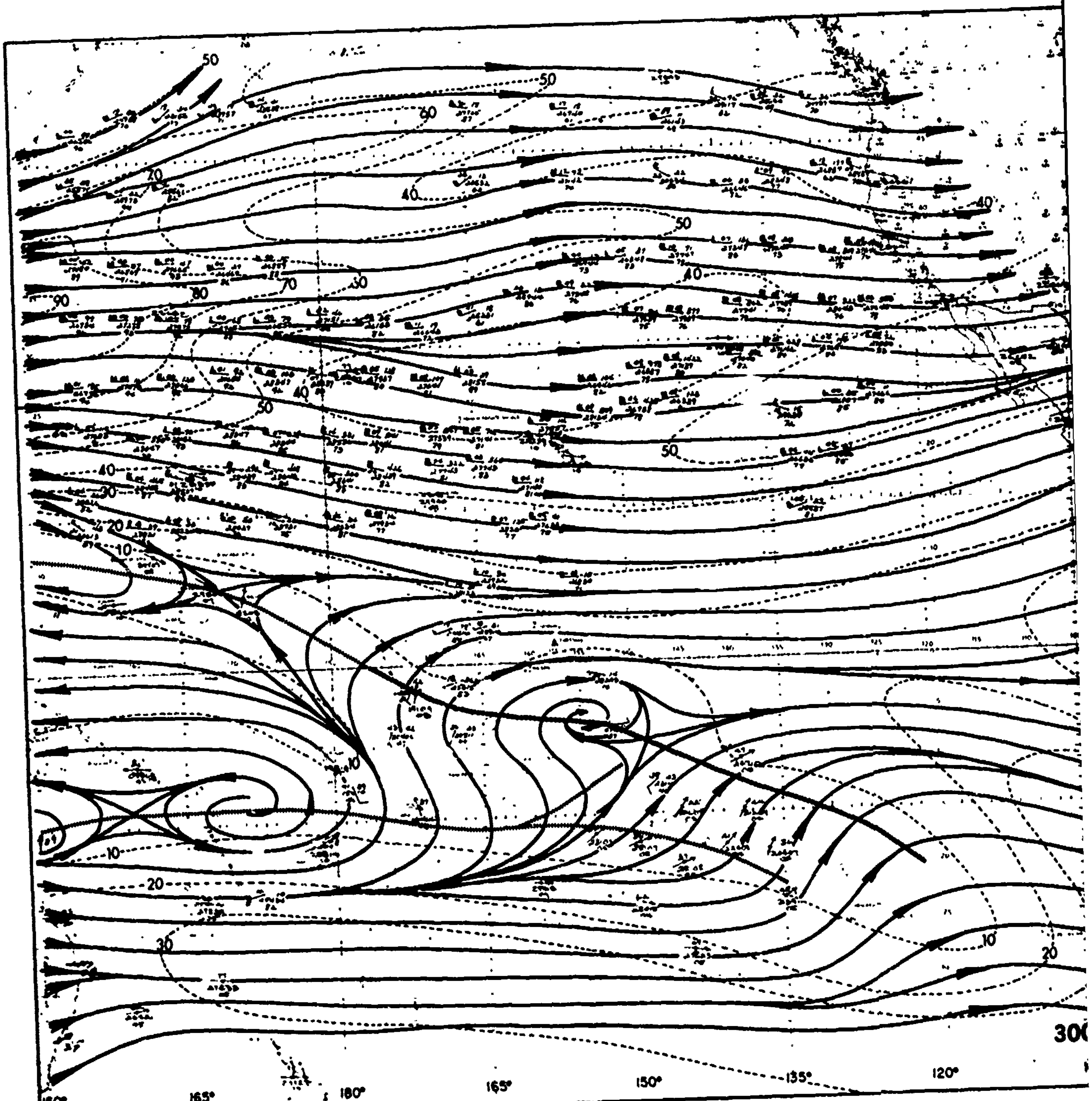
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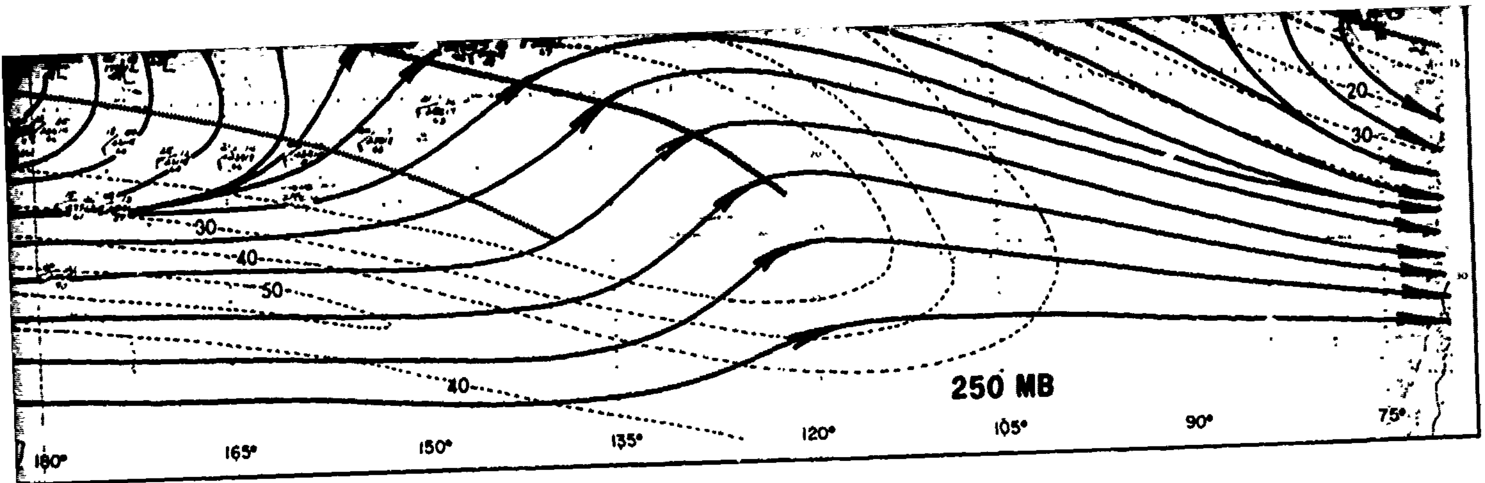
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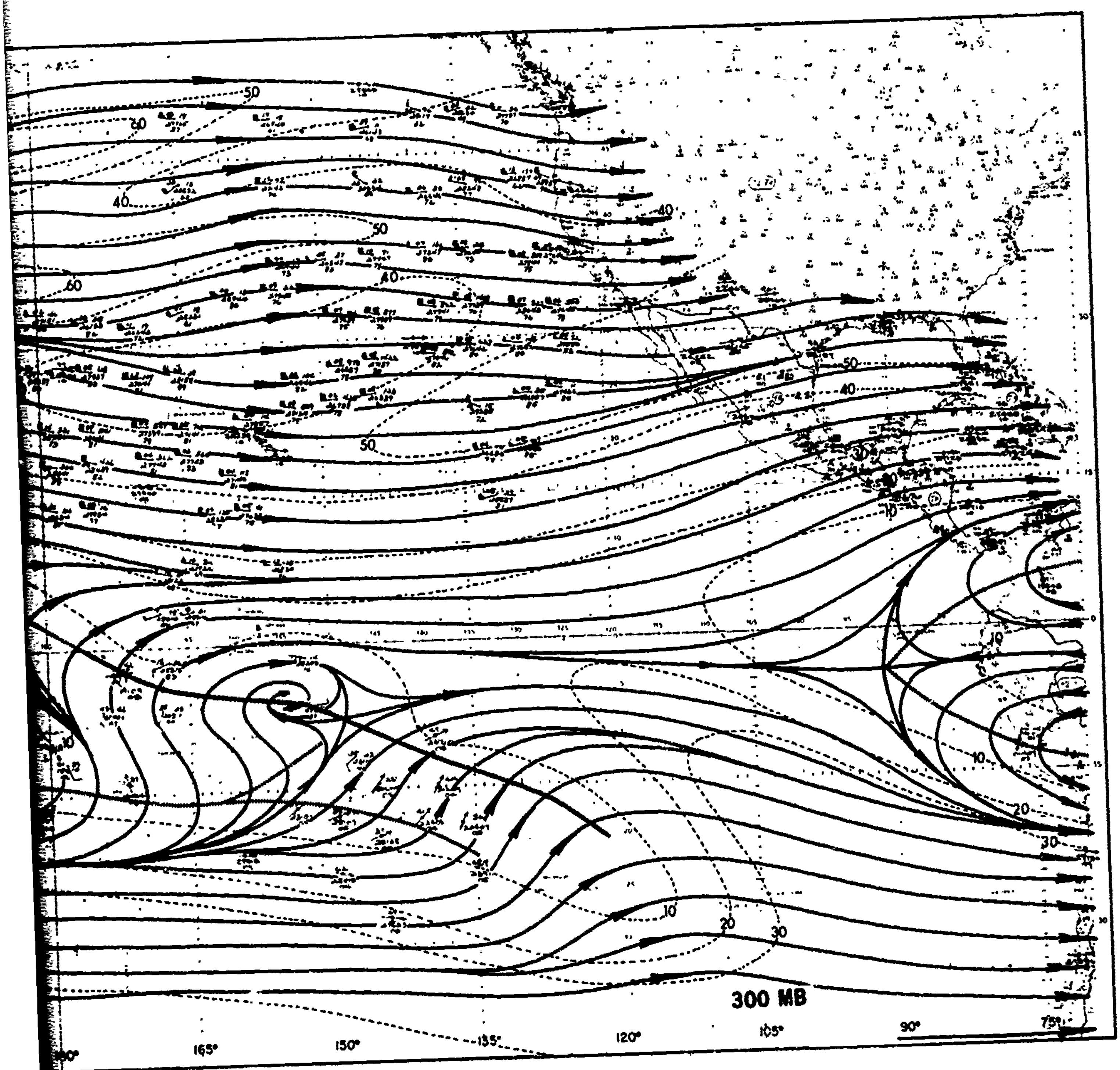
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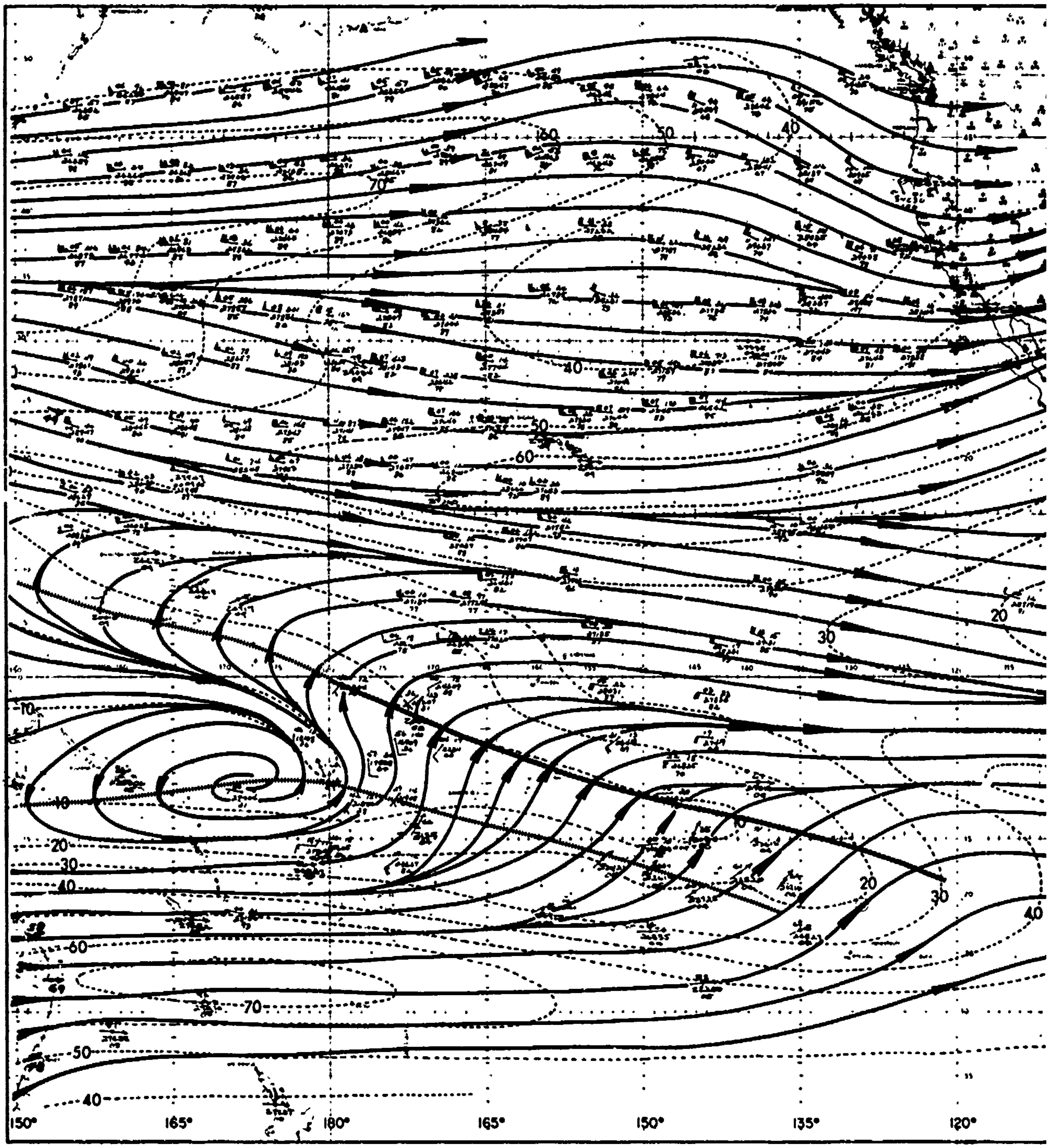


APRIL

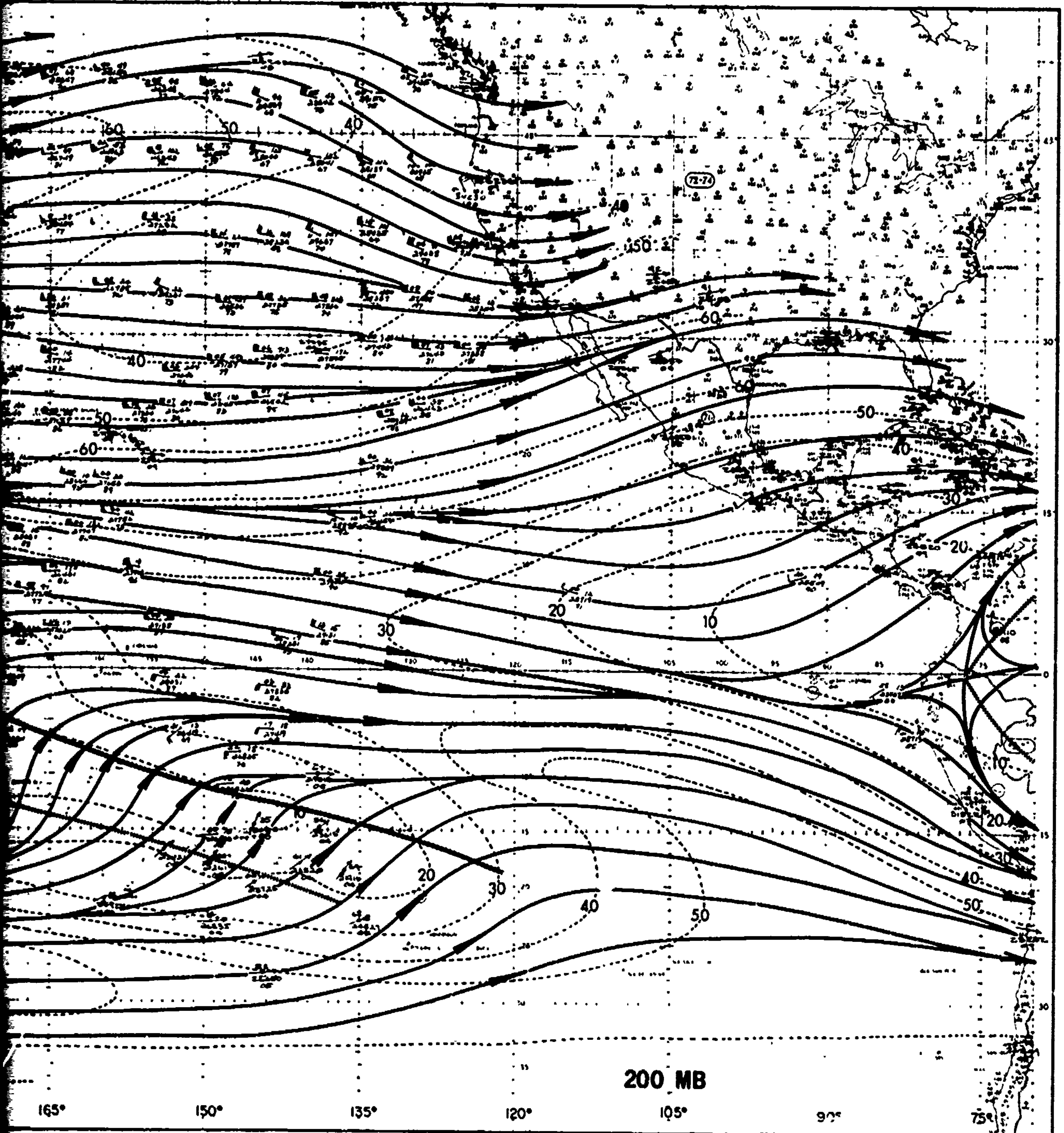
Northern Hemisphere

The separation trend between the two main streams of the westerlies, which is quite apparent from February to March, continues from March to April. The maximum core of the temperate westerlies has continued its northward movement to 38N at 155E; and the speed has decreased to about 75 kt. The southern current has continued to move southward in the Johnston-Hawaii region to near 18N. The current

The subtropical
at 155E. It joins t
March.

Southern Hemisphere

The subtropical
position of 12S at



APRIL

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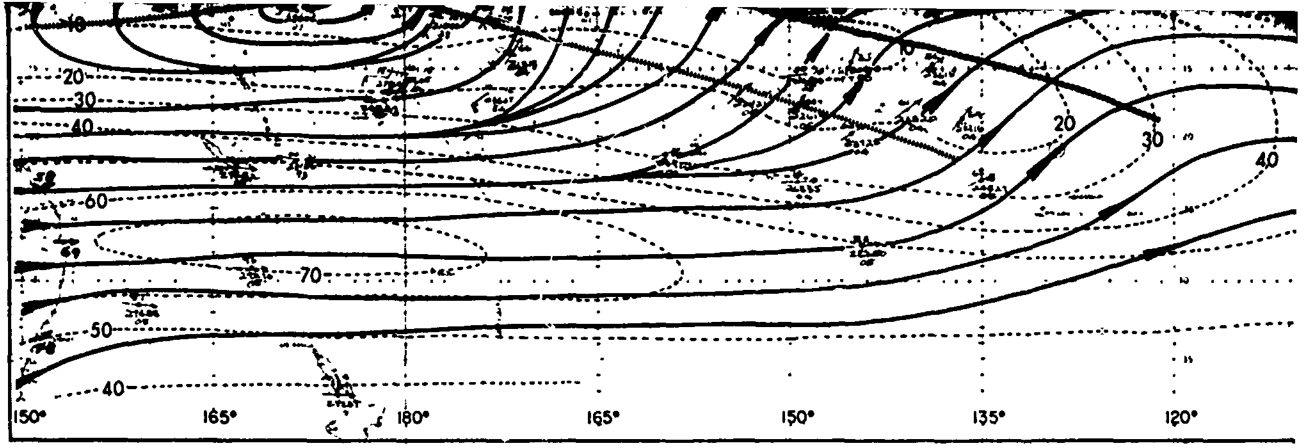
The subtropical ridge has continued to move southward to near 8N at 155E. It joins the Southern Hemisphere TUTT just west of 180 as in March.

Southern Hemisphere

The subtropical ridge remains near the January through March position of 12S at 155E. The ridge has weakened east of 180 in conjunction with apparent weakening of the TUTT.



APRIL

Northern Hemisphere

The separation trend between the two main streams of the westerlies, which is quite apparent from February to March, continues from March to April. The maximum core of the temperate westerlies has continued its northward movement to 38N at 155E; and the speed has decreased to about 75 kt. The southern current has continued to move southward in the Johnston-Hawaii region to near 18N. The current crosses Baja California at about the same latitude as in January, February and March. The speed of the current has also continued to increase in the Johnston-Hawaii region such that both Johnston Island and Hilo, Hawaii record their greatest mean monthly speed in April. The wind minimum area between the two currents has continued to expand over the eastern Pacific and is much more pronounced than in March. The separation of the southern current from the temperate westerlies is sufficient to justify labelling it "subtropical westerlies."

The ridge in the northern latitudes has moved back eastward to just east of weather ship Papa (50N, 145W) and the pronounced veering of the winds off the Oregon and Washington coasts indicates a deeper trough over the western United States than in the previous month.

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Southern Hemisphere

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Equatorial Region

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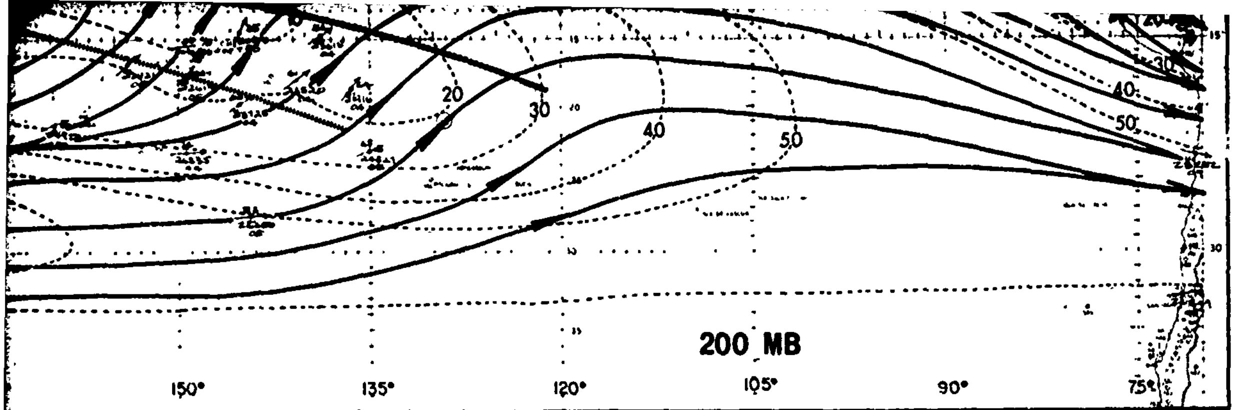
PIREP Winds

EE nnnn

dddfff

SS

EE	-percentage of winds with an east compon
nnnn	-number of observations
ddd	-mean resultant wind direction
fff	-mean resultant wind speed in knots (fla 50 knots, long barb = 10 knots, short barb = 5 knots)
SS	-steadiness of winds in percent
NN	-number of years of record



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The subtropical ridge has continued to move southward to near 8N at 155E. It joins the Southern Hemisphere TUTT just west of 180 as in March.

Southern Hemisphere

The subtropical ridge remains near the January through March position of 12S at 155E. The ridge has weakened east of 180 in conjunction with apparent weakening of the TUTT.

The temperate westerlies have increased in core speed to some 70 kt just east of Australia and have shifted slightly equatorward from March to near 28S. The temperate westerlies over western South America have moved north of 30S and increased to greater than 50 kt.

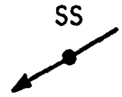
Equatorial Region

The direction pattern is very similar to that of March. Speeds over the eastern Pacific have decreased. The anticyclonic cell over South America south of the equator has shrunk and moved equatorward of 10S thereby reducing the extent and speed of the equatorial easterlies.

-percentage of winds with an east component
nn -number of observations
d -mean resultant wind direction
f -mean resultant wind speed in knots (flag = 50 knots, long barb = 10 knots, short barb = 5 knots)
-steadiness of winds in percent
-number of years of record

Rawins

SS



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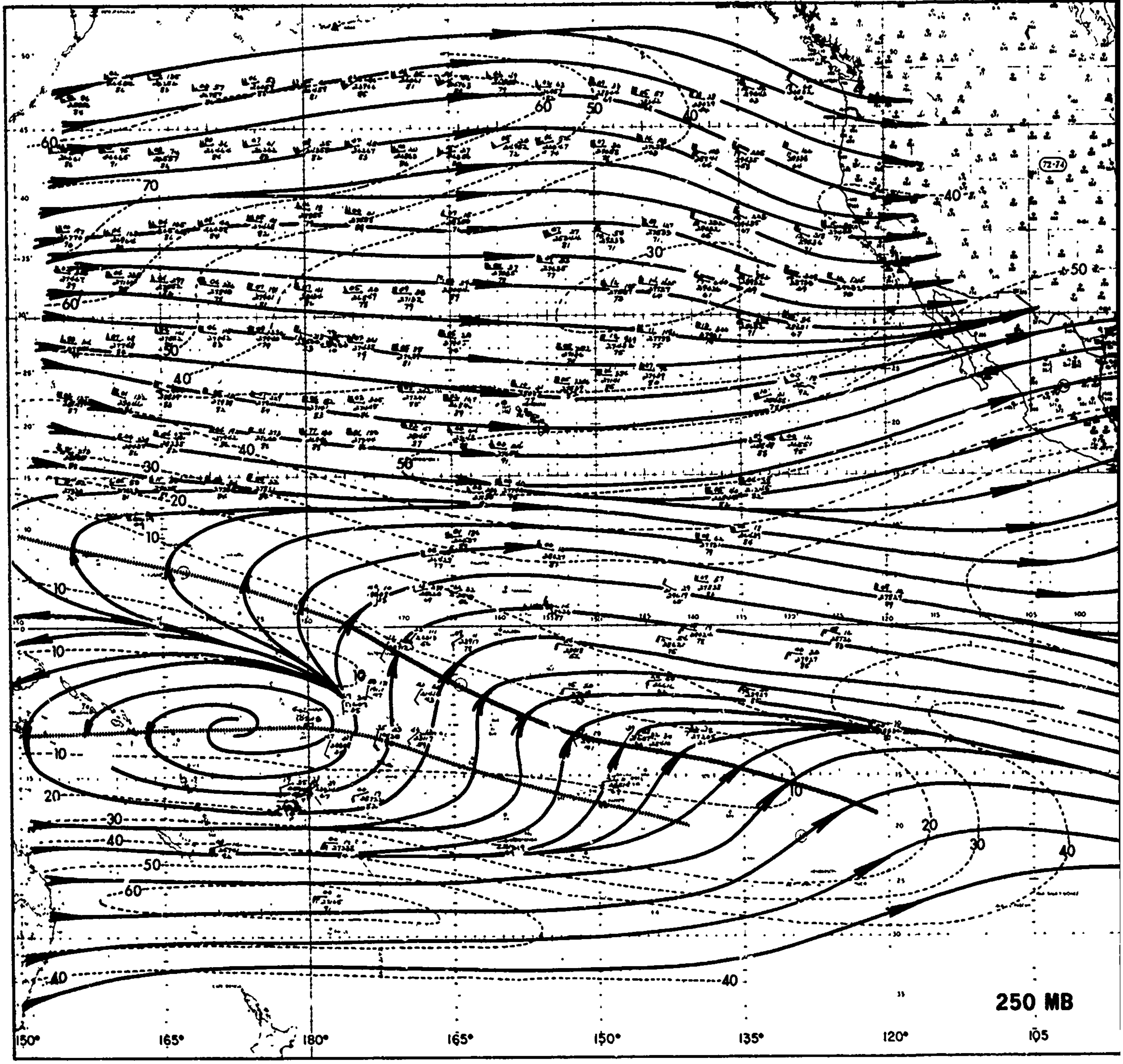
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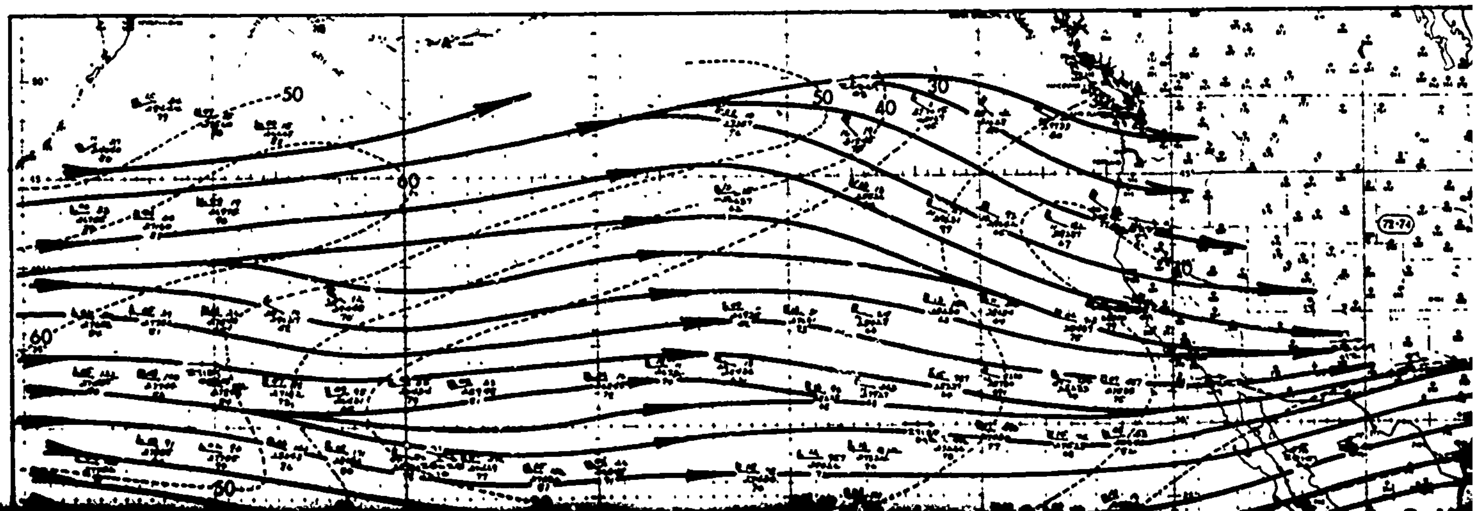

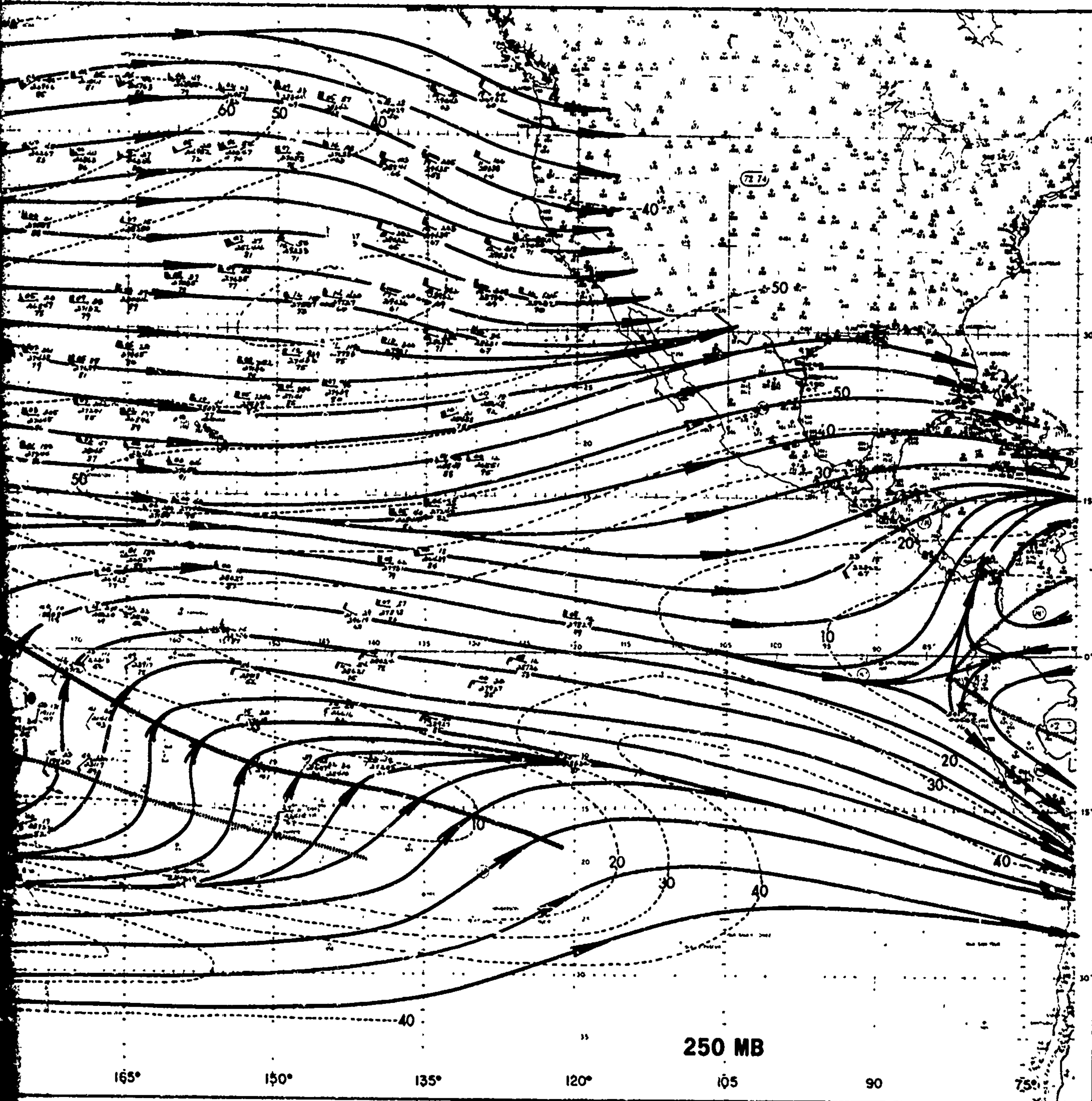
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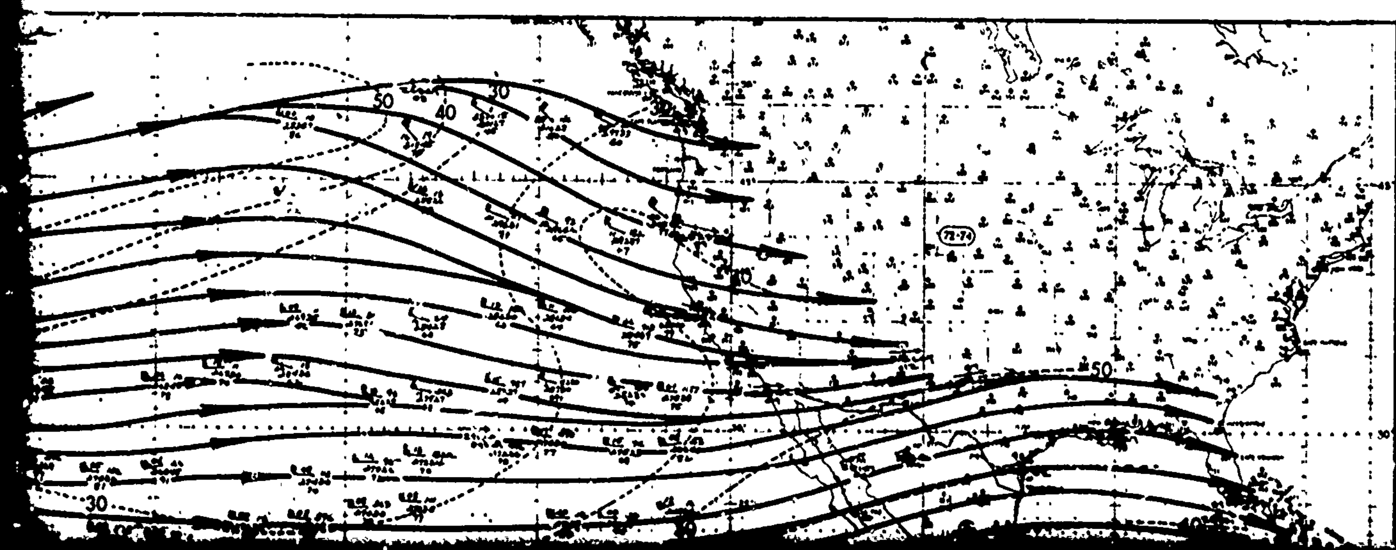

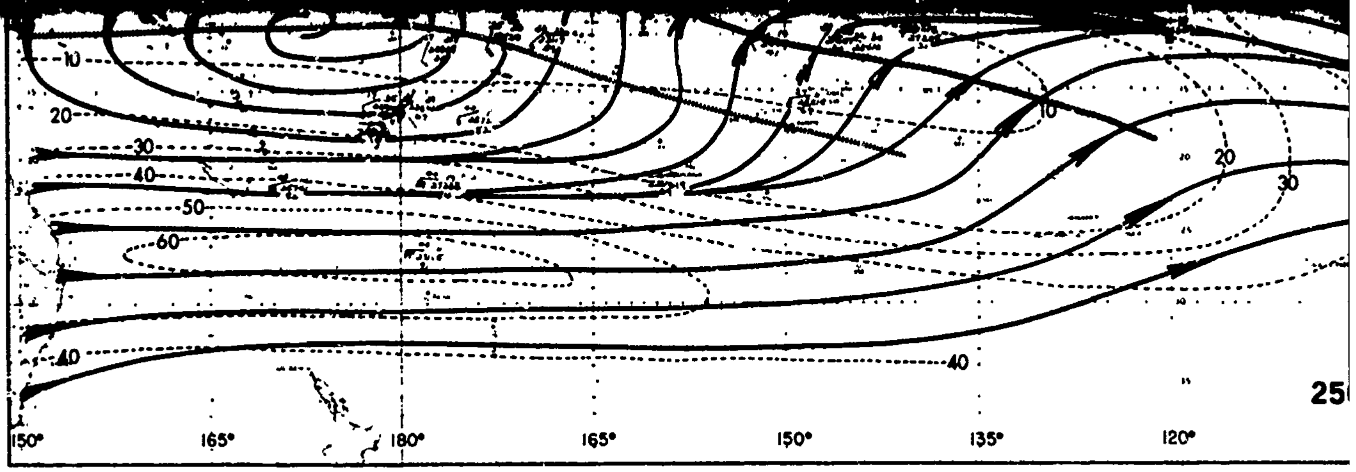

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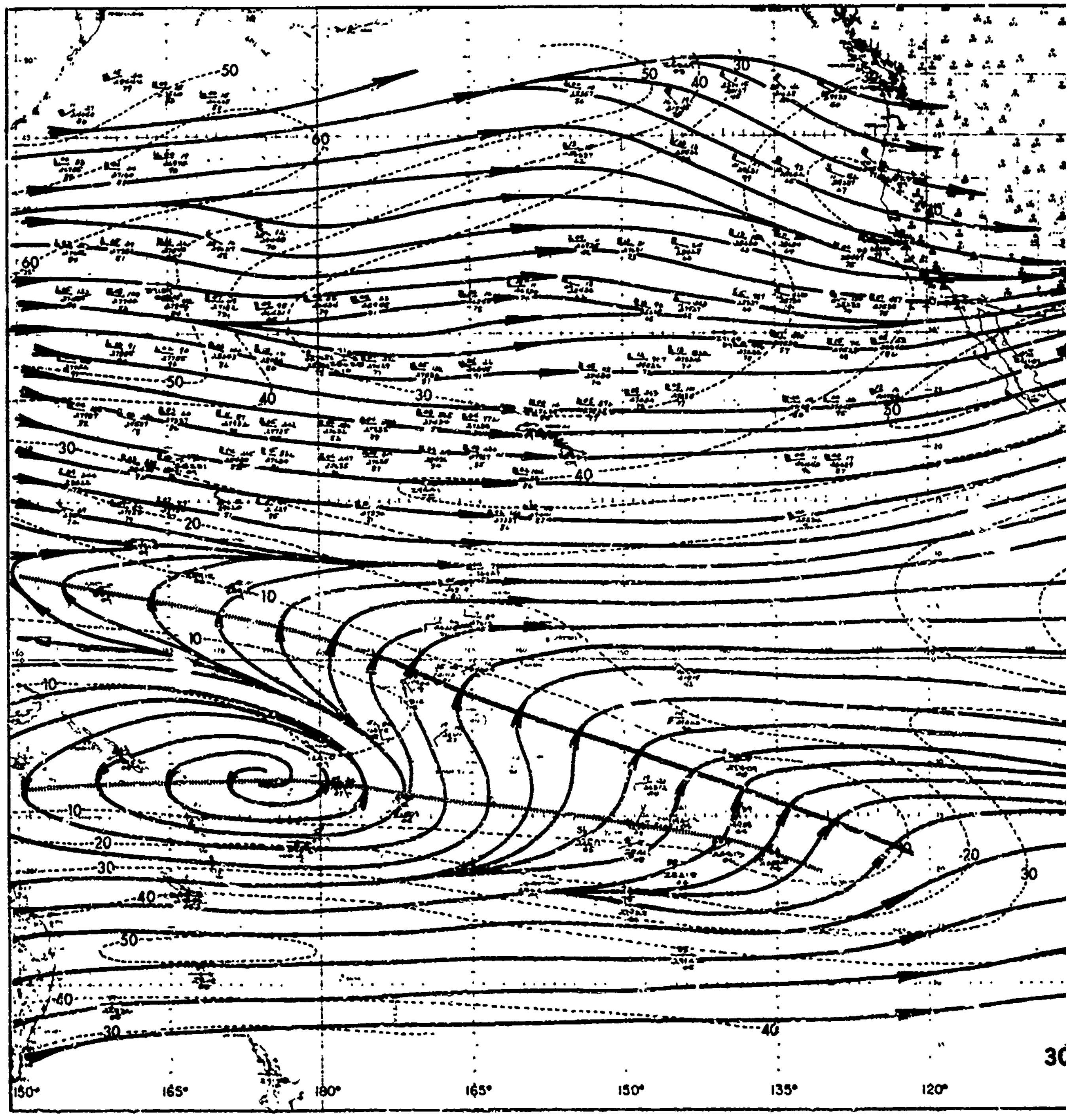

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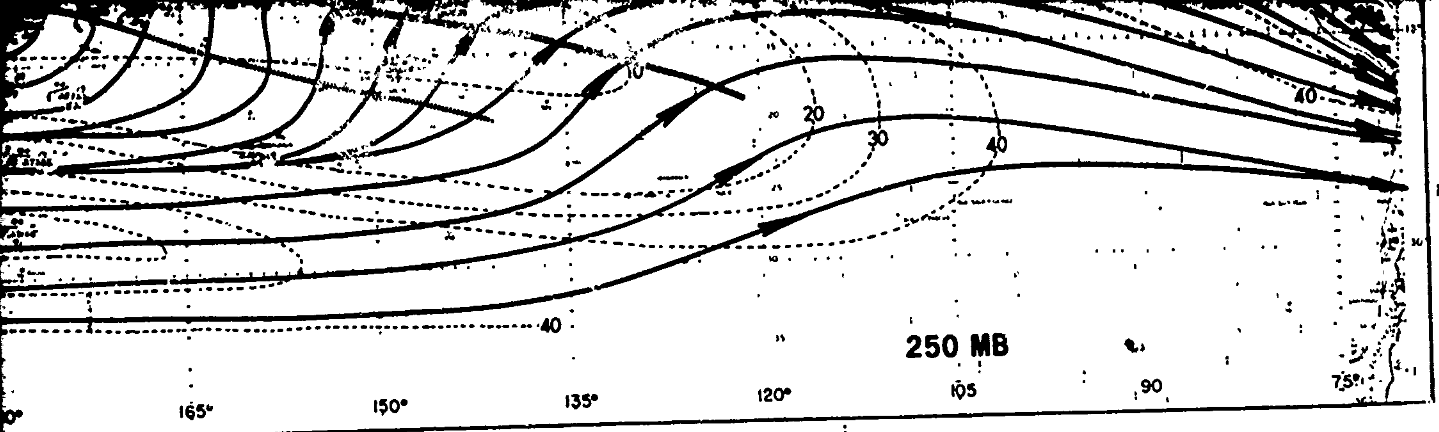
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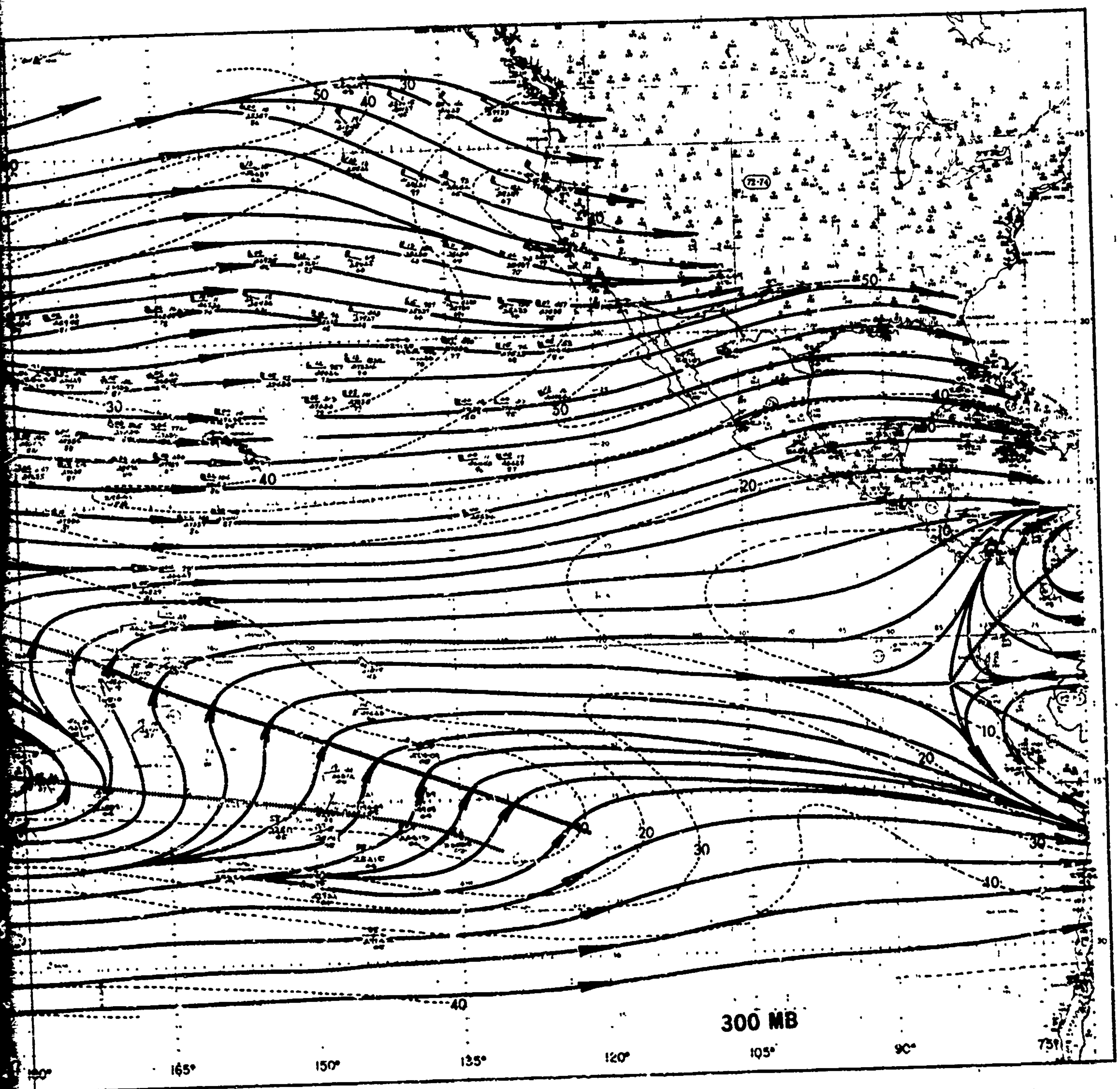
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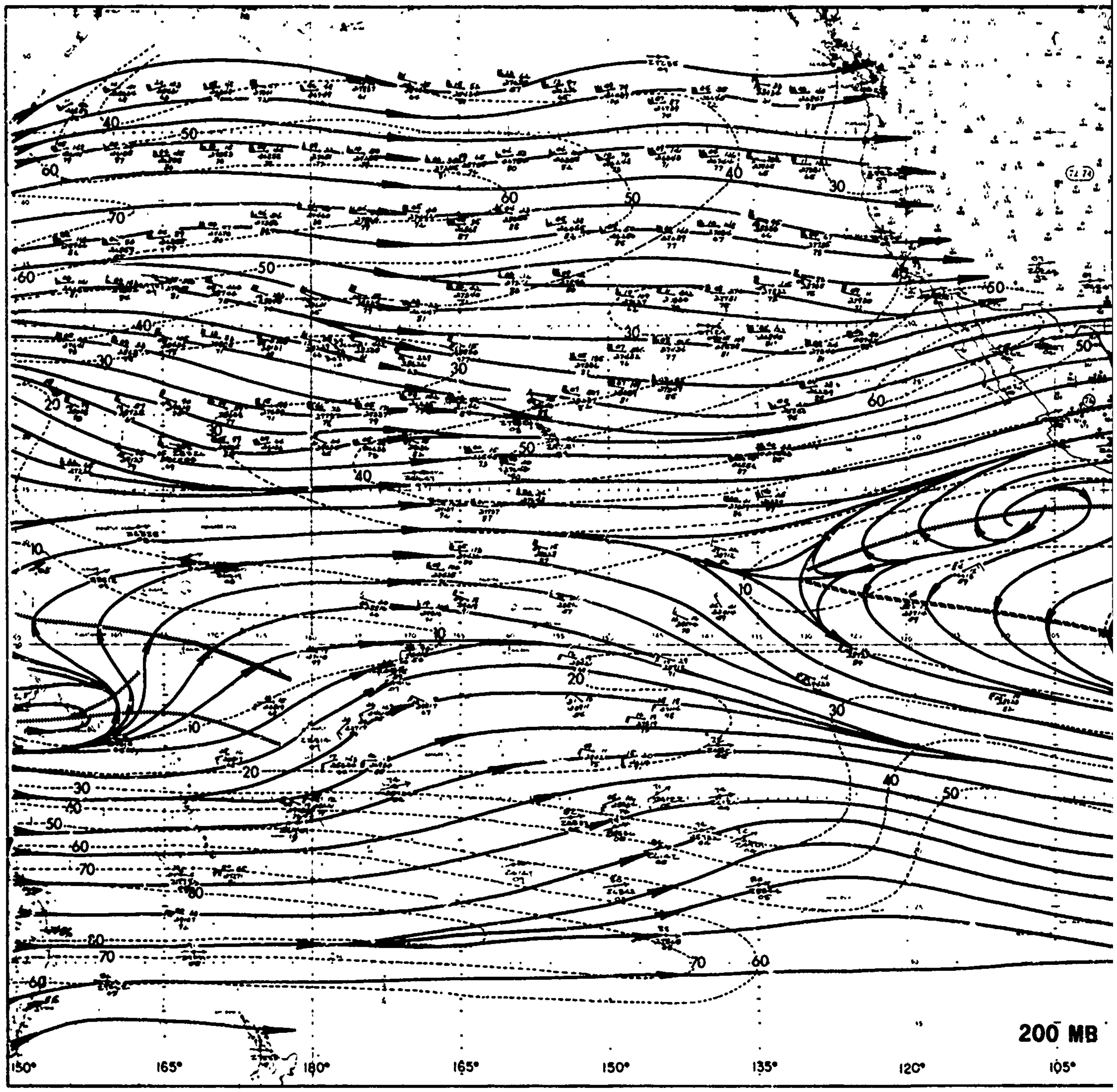

MAY

Northern Hemisphere

The temperate westerlies have continued to decrease in speed and extent. The core speed of near 70 kt is found near the April position of 38N at 155E.

The core of the subtropical westerlies is also near the April position. Th. - speed has decreased to near 50 kt in the Hawaiian region and 60 k over Baja California.

A segment of the subtropic
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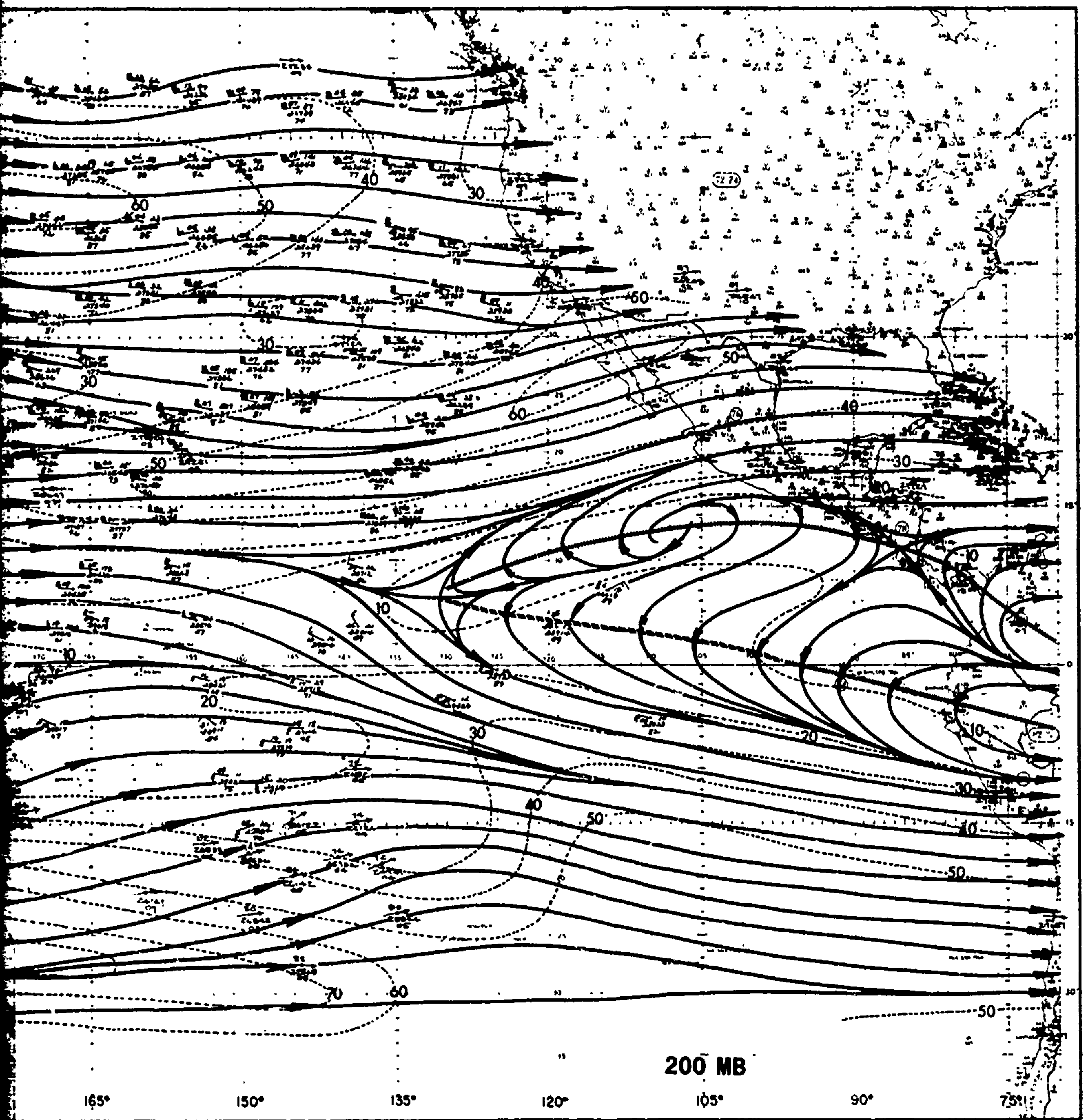
remained near 5N.

Southern Hemisphere

The subtropical ridge has
155E and has shrunk westward;



MAY

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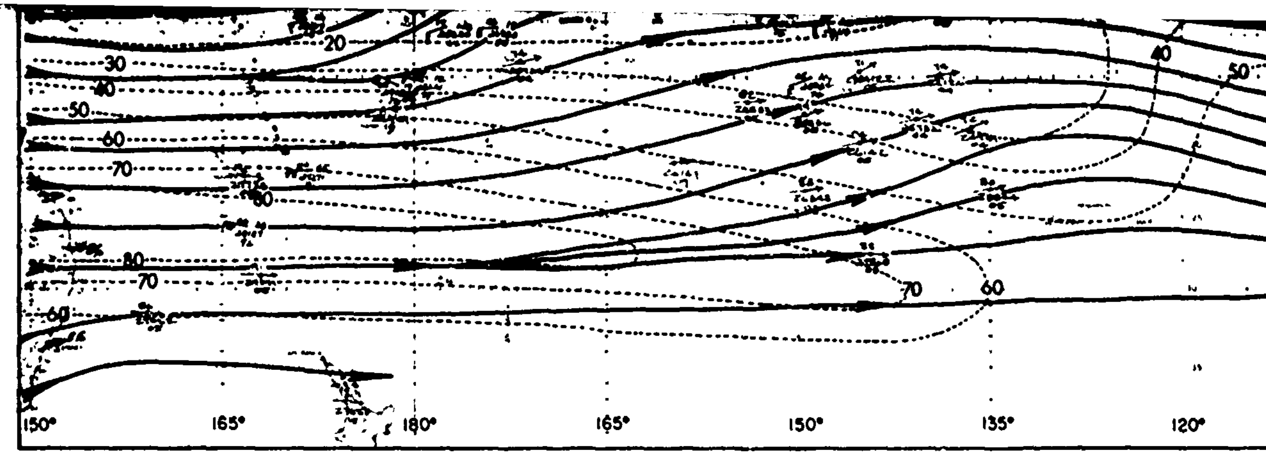
A segment of the subtropical ridge has formed over the eastern Pacific and extends westward to near 130W. The northernmost position is near 14N at 105W. The segment of the ridge over South America has remained near 5N.

Southern Hemisphere

The subtropical ridge has moved sharply equatorward to near 7N at 155E and has shrunk westward; it is only weakly apparent at 180.



MAY

Northern Hemisphere

The temperate westerlies have continued to decrease in speed and extent. The core speed of near 70 kt is found near the April position of 38N at 155E.

The core of the subtropical westerlies is also near the April position. Their speed has decreased to near 50 kt in the Hawaiian region and 60 kt over Baja California.

Speeds in the minimum zone between the temperate and subtropical westerlies have decreased to less than 30 kt.

The Mid-Pacific Trough (MPT) has become weakly apparent in the direction field. It appears as two segments. One extends from just east of Hawaii to the coast of southern California. The other segment extends from northeast of Midway Island southwestward to Wake Island and 18N, 155E.

The subtropical ridge has continued to move equatorward in the western Pacific to its annual southernmost position of 5N at 155E.

A segment of t
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remained near 5N.

Southern Hemisphere

The subtropica
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The TUTT has w
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The temperate
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Equatorial Region

Westward retre
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PIREP Winds

EE nnnn

dddfff

SS

EE	-percentage of winds with an east compo
nnnn	-number of observations
ddd	-mean resultant wind direction
fff	-mean resultant wind speed in knots (f 50 knots, long barb = 10 knots, short barb = 5 knots)
SS	-steadiness of winds in percent
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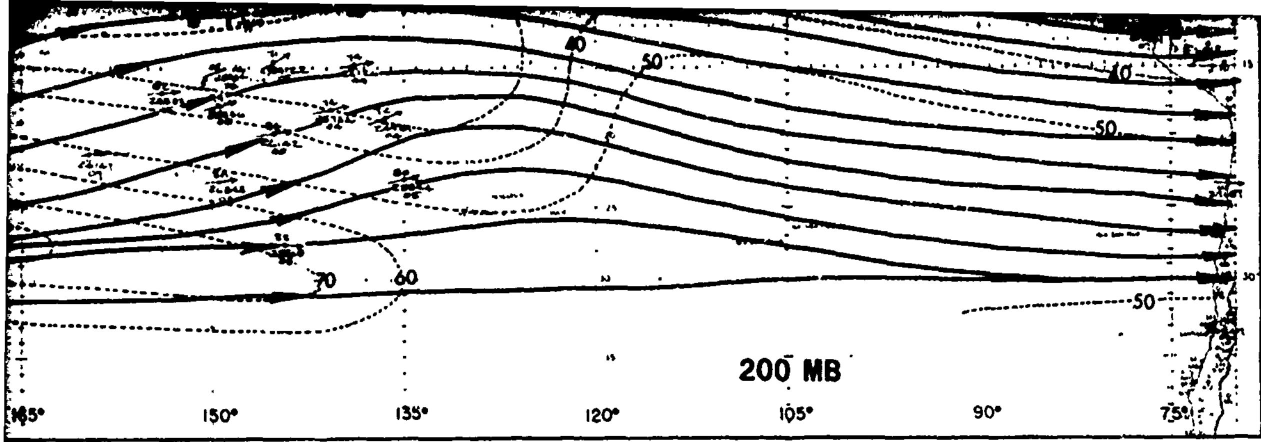

MAY

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A segment of the subtropical ridge has formed over the eastern Pacific and extends westward to near 130W. The northernmost position is near [illegible] 105W. The segment of the ridge over South America has remained n[illegible]N.

Southern Hemisphere

The subtropical ridge has moved sharply equatorward to near 7N at 155E and has shrunk westward; it is only weakly apparent at 180.

The TUTT has weakened considerably, and it is difficult to locate. A segment remains near 135W and is more apparent in the speed field than in the direction field (note the 250- and 300-mb charts).

The temperate westerlies have increased to greater than 85 kt over eastern Australia, and the core region has moved farther equatorward to 25S. Over western South America speeds have increased to greater than 55 kt, and the core region has moved equatorward to near 25S.

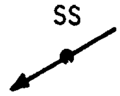
Equatorial Region

Westward retreat of the subtropical ridges in the western Pacific has moved the region of change from equatorial easterlies to westerlies westward to near 165E. Formation of the ridge in the eastern Pacific has extended the equatorial easterly wind belt westward to near 130W; the buffer system thus formed links with the Southern Hemisphere ridge near 95W.

EE -percentage of winds with an east component
nnnn -number of observations
ddd -mean resultant wind direction
fff -mean resultant wind speed in knots (flag = 50 knots, long barb = 10 knots, short barb = 5 knots)
SS -steadiness of winds in percent
NN -number of years of record

Rawins

SS



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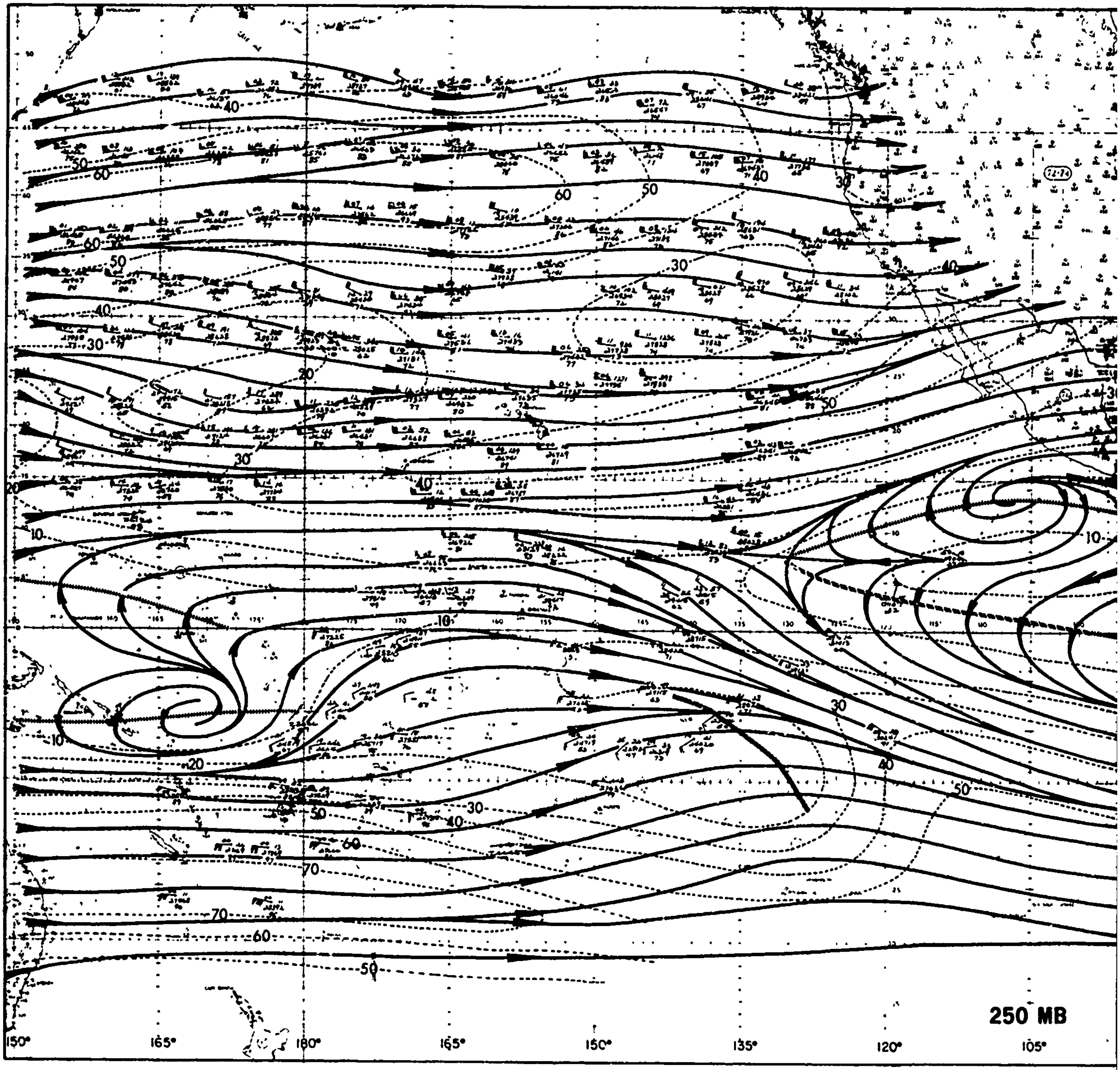
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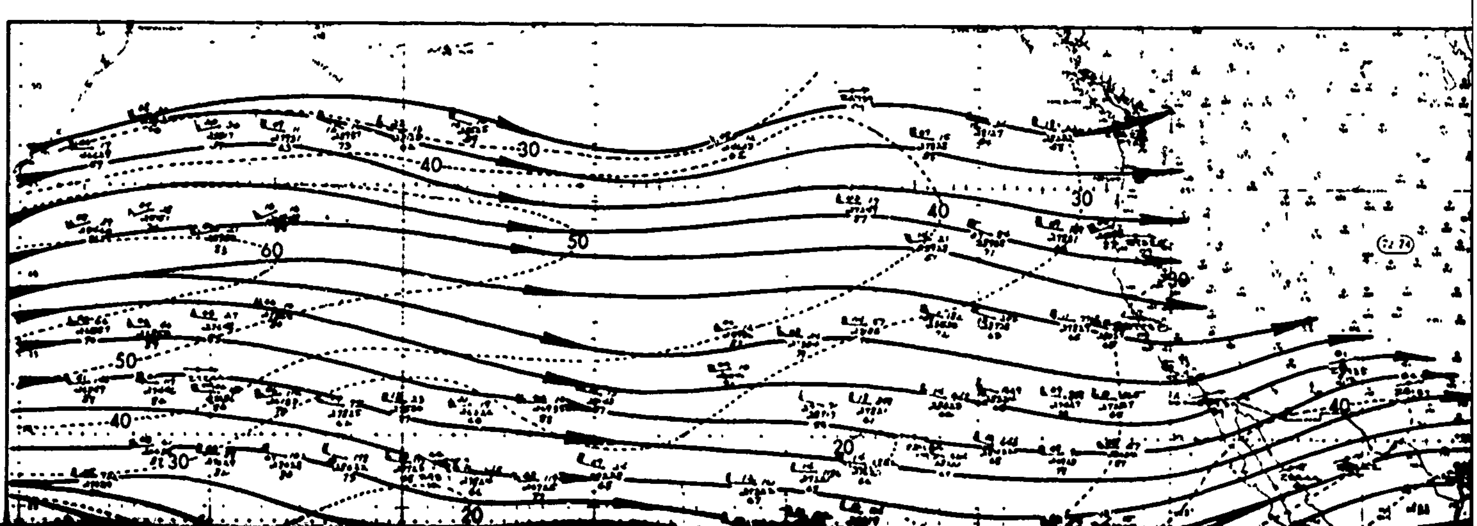

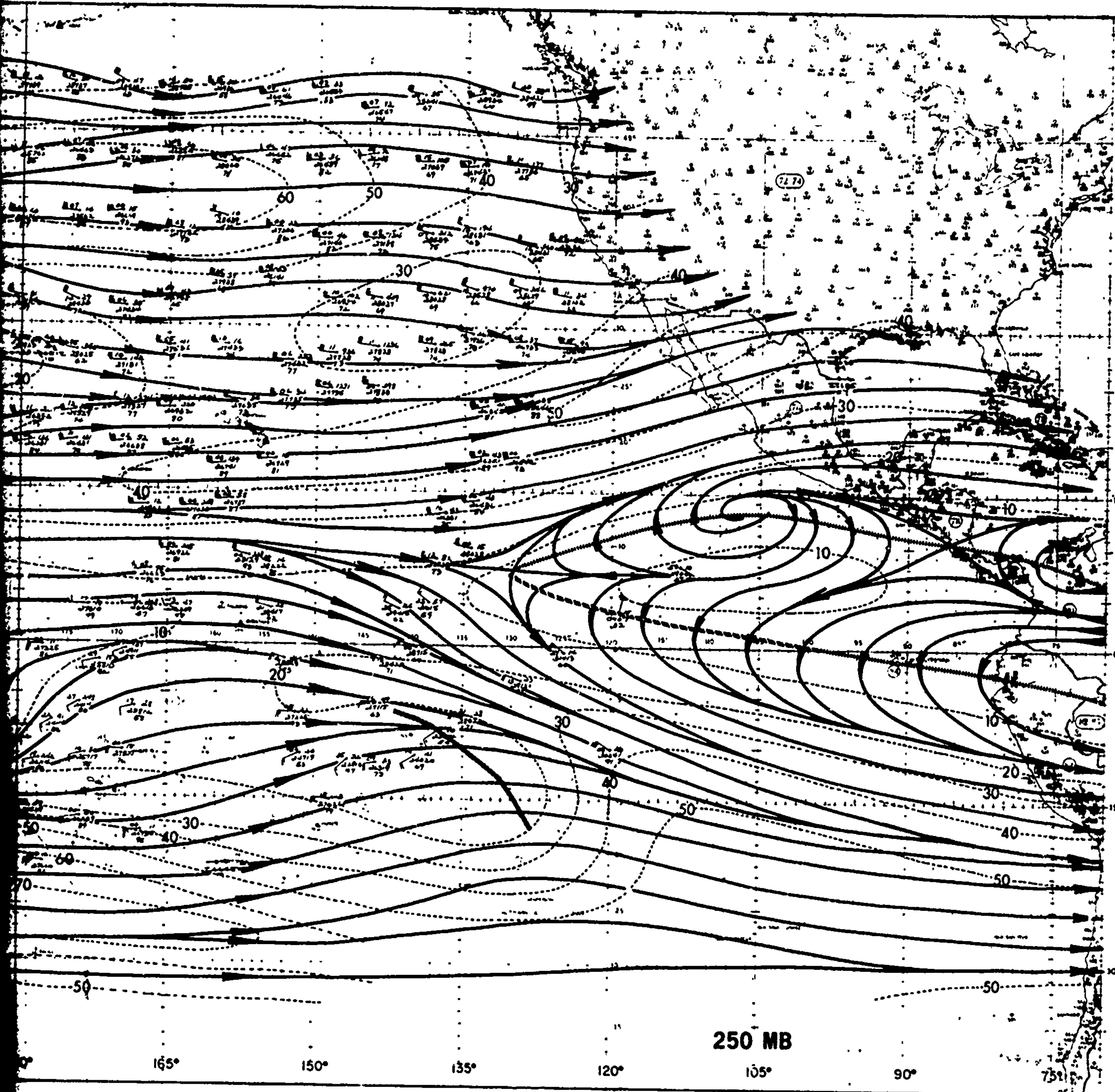
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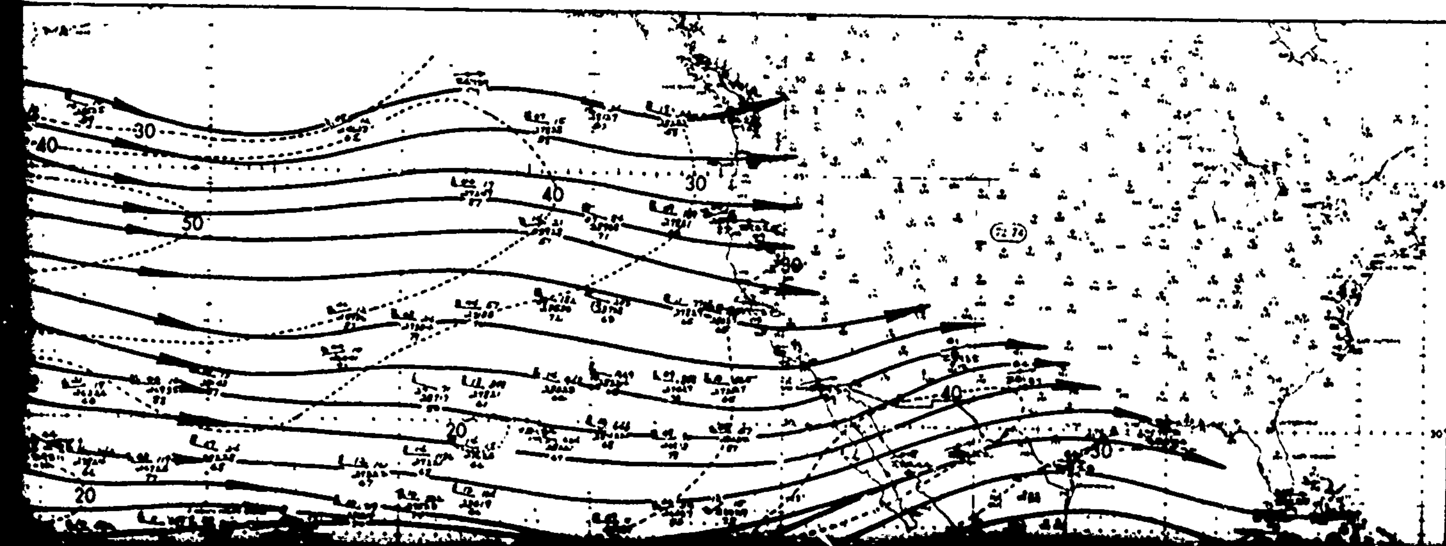

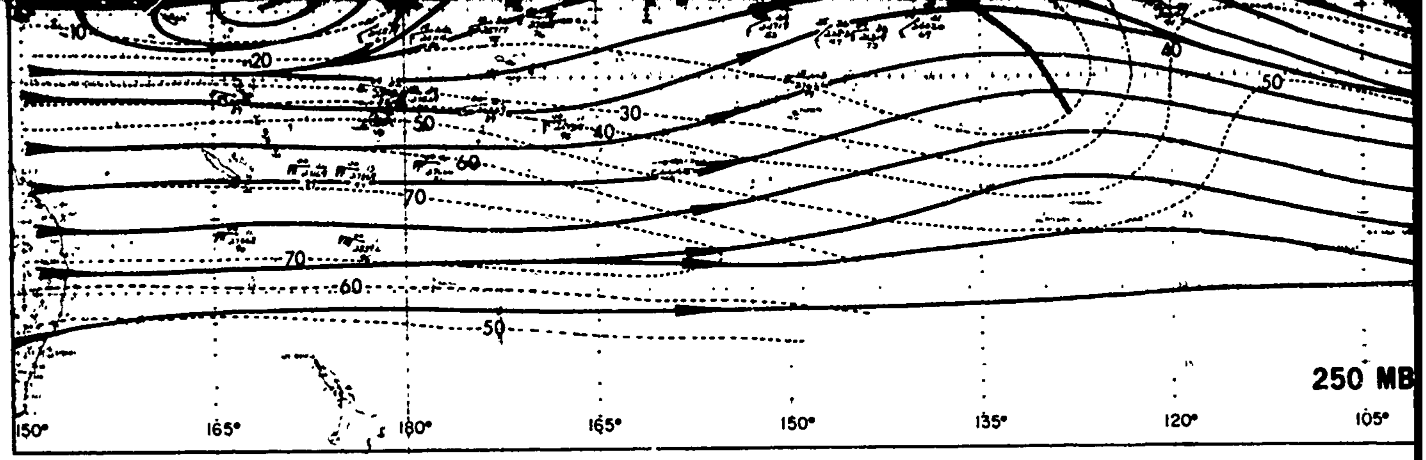

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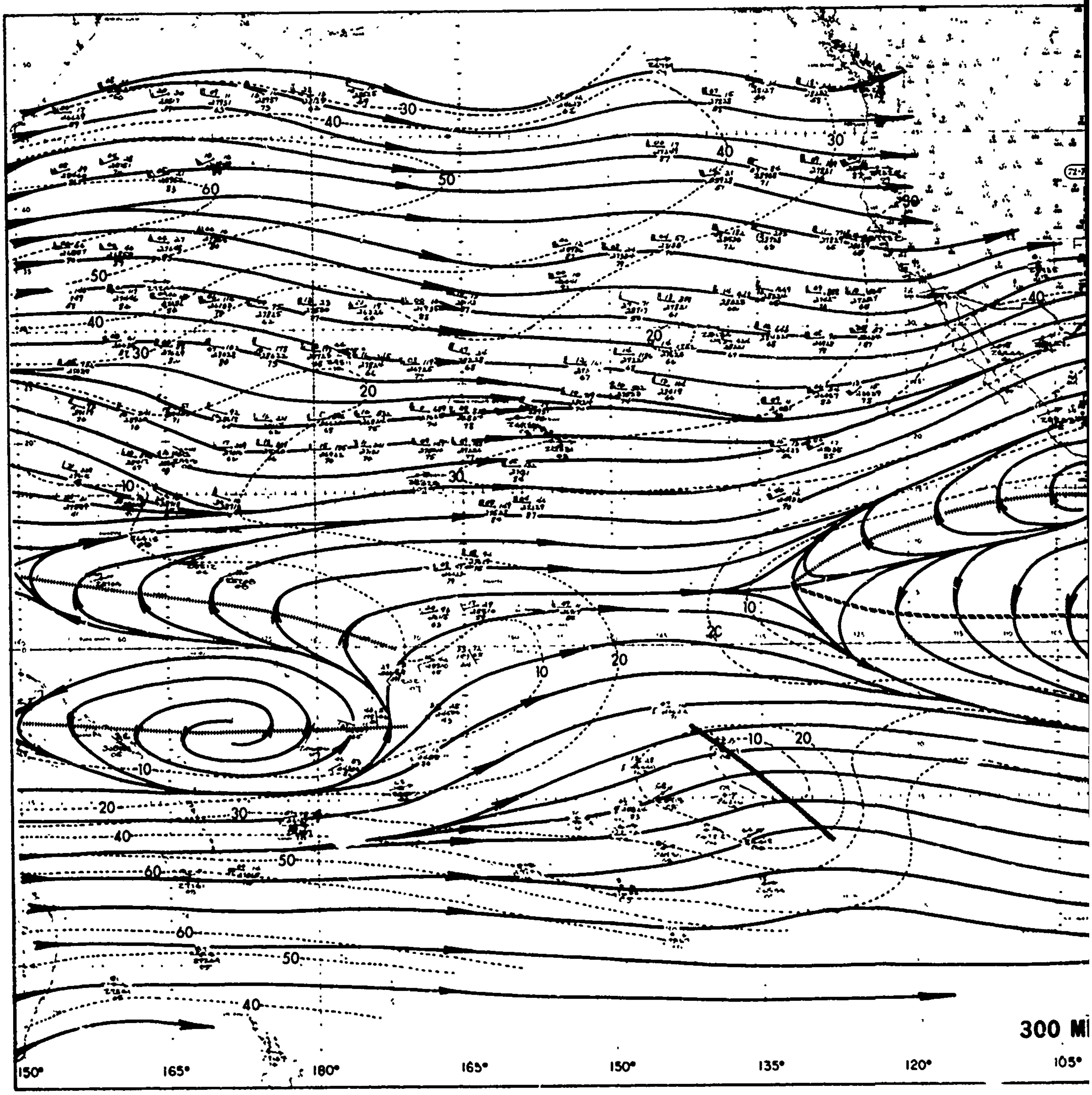

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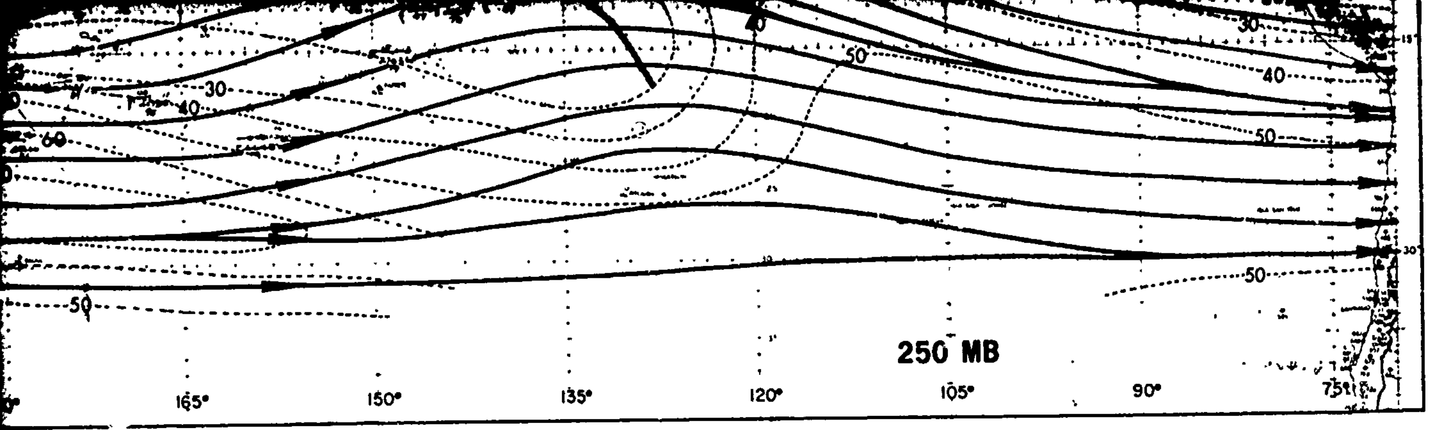
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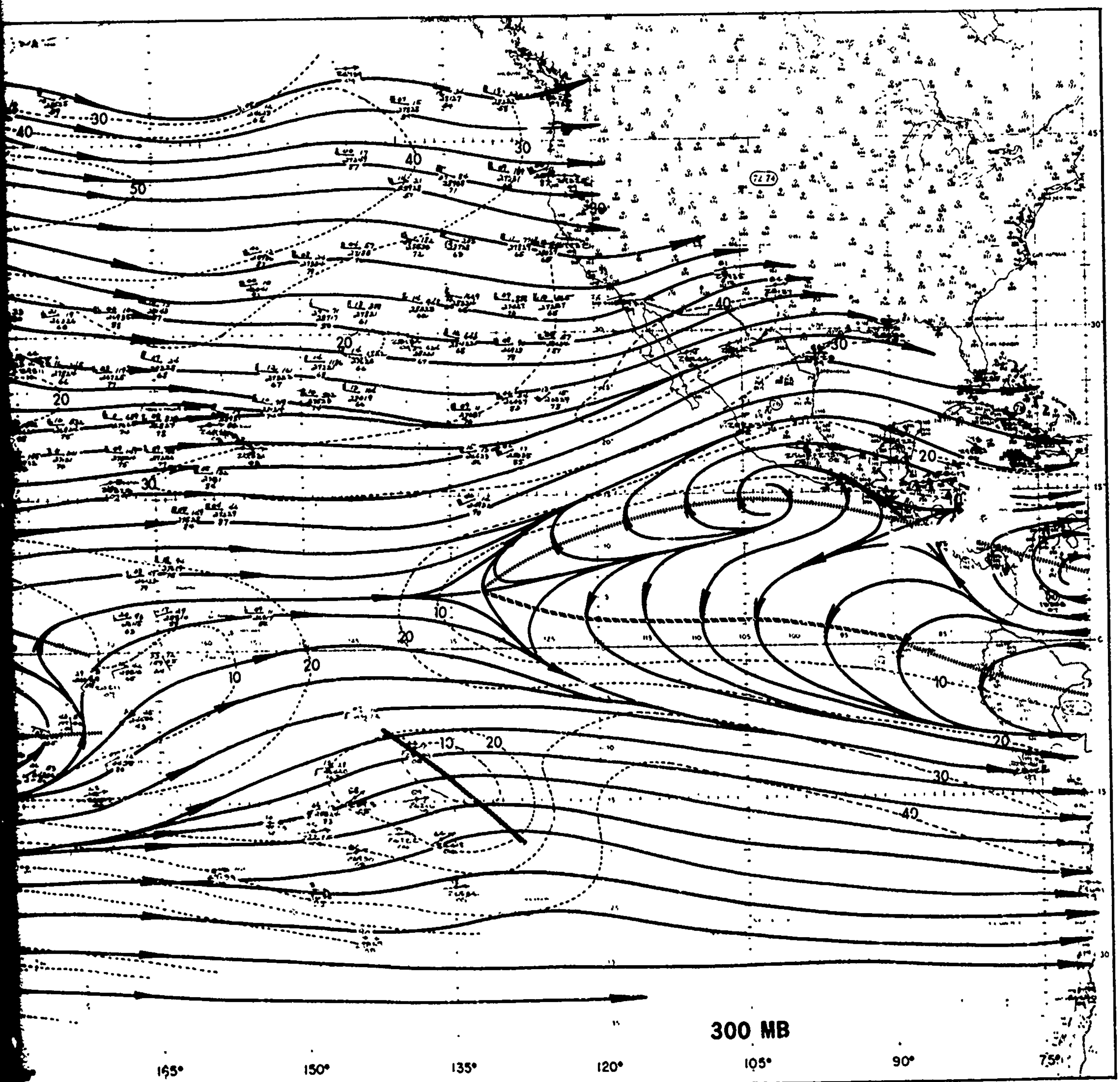
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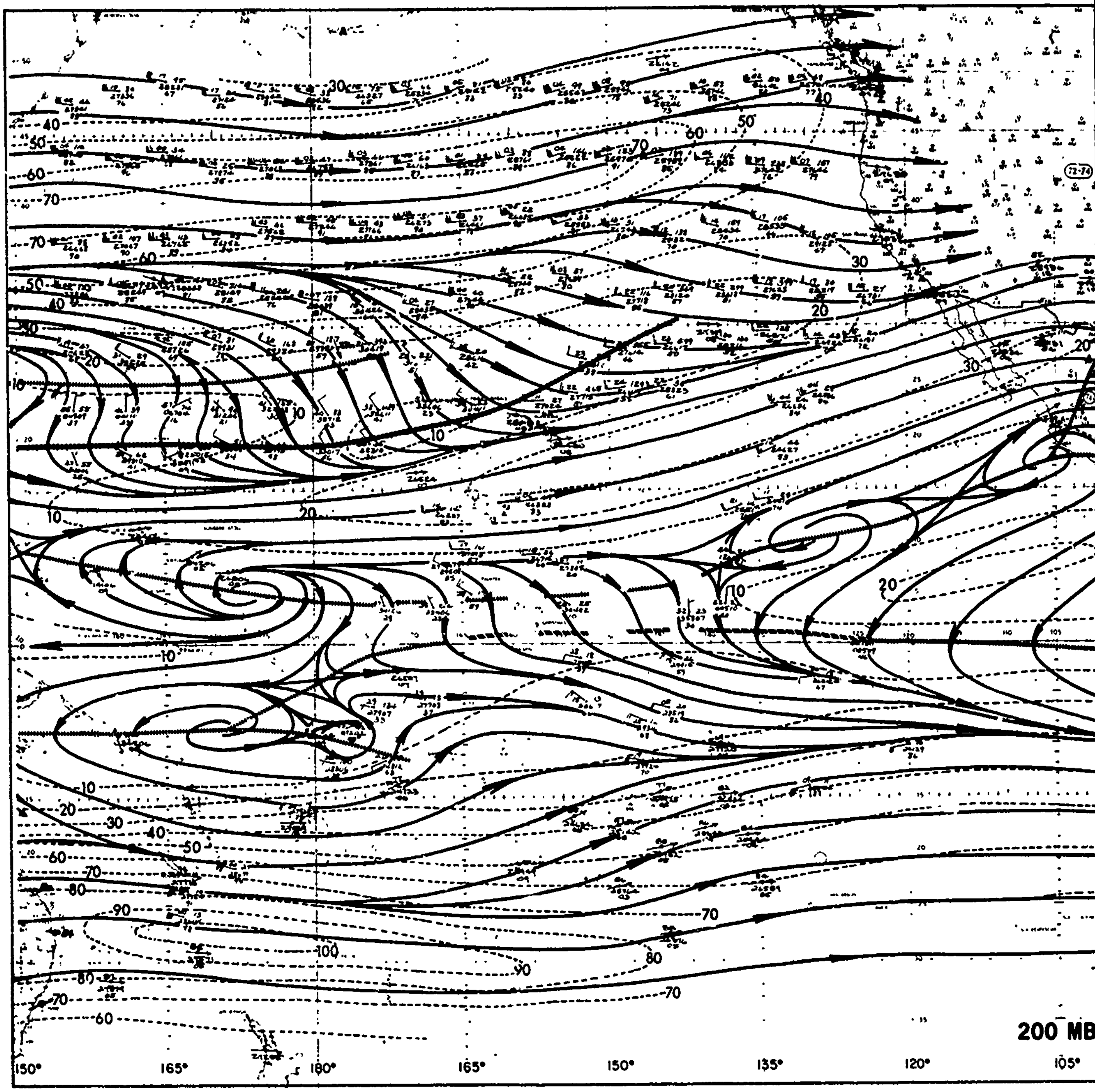

JUNE

Northern Hemisphere

The core of the temperate westerlies remains near the April and May position of 38N at 155E; however, the decreasing speed trend has reversed, and the speeds have increased slightly from May. Perhaps of greater significance is the eastward extension of the maximum core. The 70 kt ribbon reaches beyond 150W, a marked change from May.

The subtropical westerlies in the eastern Pacific have continued

A belt of tropical easter
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Southern Hemispnere

The subtropical ridge has
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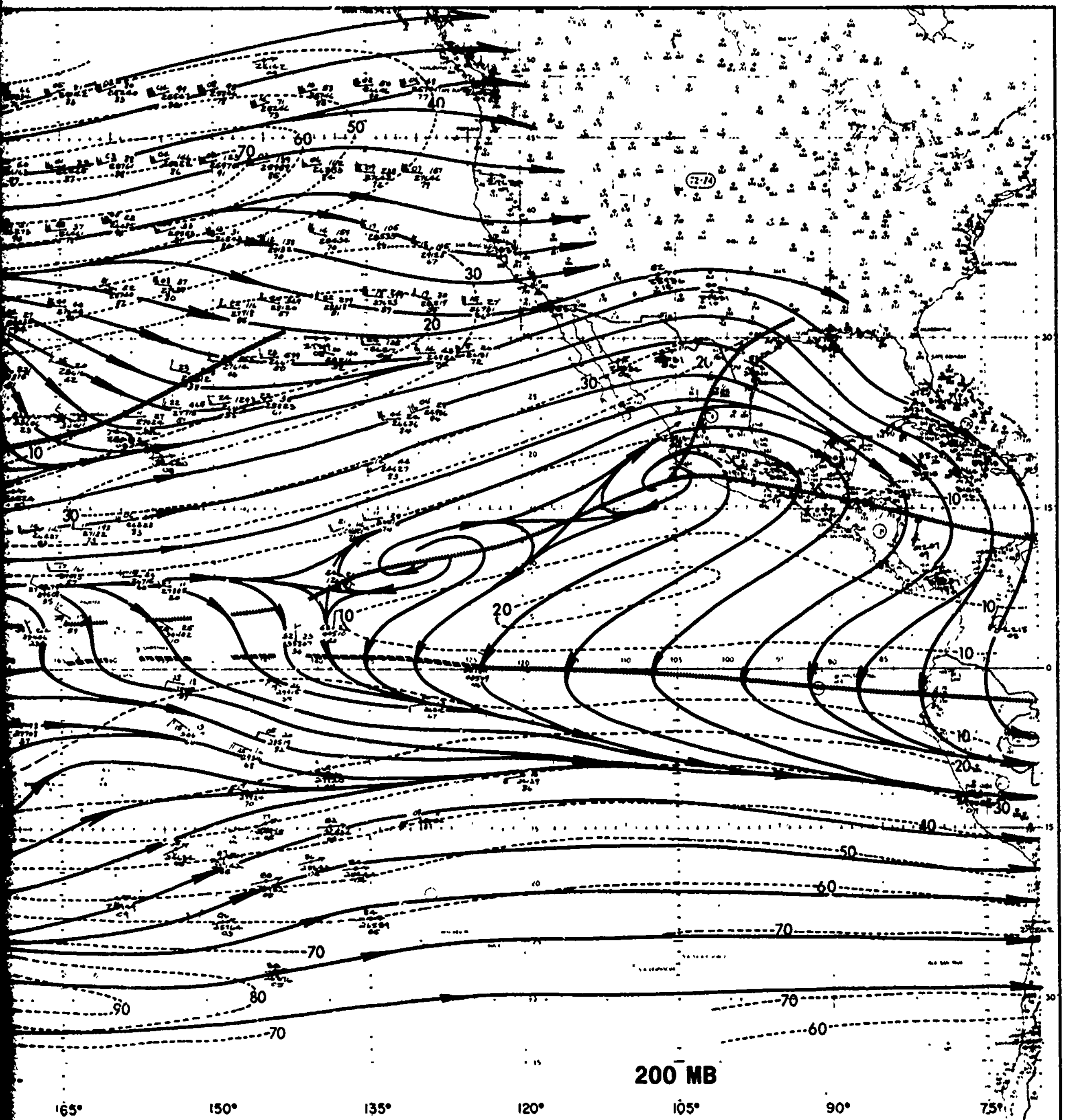

JUNE

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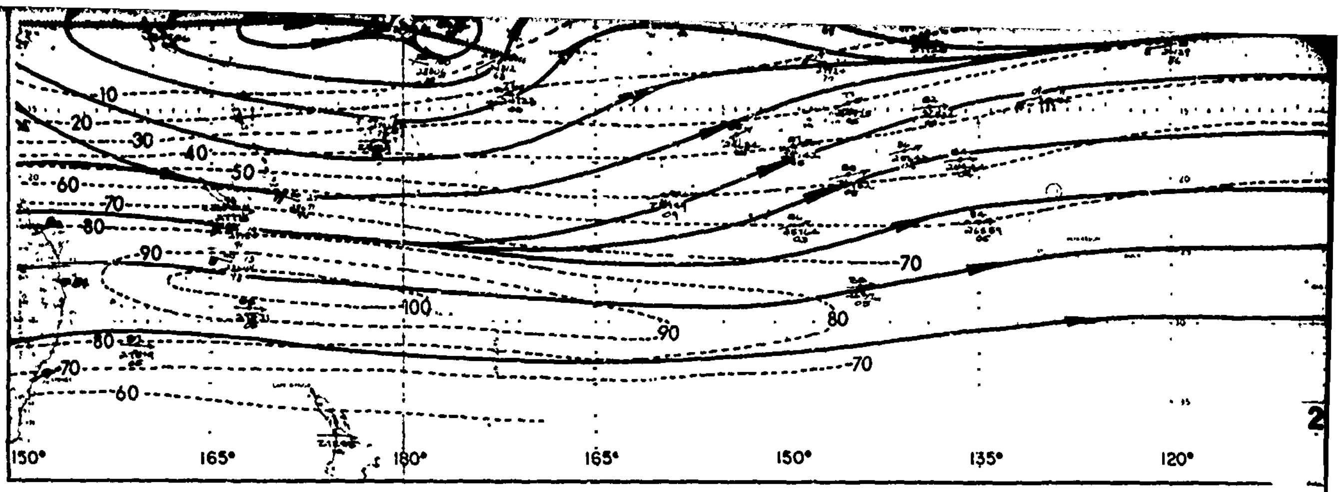
Pacific have continued

A belt of tropical easterlies has become established in the western Pacific north of 20N and westward of 170E between the MPT and the subtropical ridge.

Southern Hemisphere

The subtropical ridge has retreated southward to 9S at 155E and has also been re-established eastward beyond 180.



JUNE

Northern Hemisphere

The core of the temperate westerlies remains near the April and May position of 38N at 155E; however, the decreasing speed trend has reversed, and the speeds have increased slightly from May. Perhaps of greater significance is the eastward extension of the maximum core. The 70 kt ribbon reaches beyond 150W, a marked change from May.

The subtropical westerlies in the eastern Pacific have continued to decrease to a core speed of about 35 kt. The position of this current has changed little from May.

The MPT has intensified and can be readily located in both the speed and direction analyses, from near 19N, 155E, through Wake Island, to just north of the Hawaiian Islands.

Two ridges now exist in the western Pacific. The northernmost (subtropical) extends eastward from 25N, 155E to near 29N, 170W. The southernmost (subequatorial), which was near 5N at 155E in May, has moved northward to near 8N at 155E. The subtropical ridge in the eastern Pacific has moved northward, intensified, and extended farther westward, running from 10N, 135W to 17N, 105W and then east-southeast through Central America to near 14N, 70W. The western Pacific and eastern Pacific segments of this ridge are weakly linked between 170W and 135W.

A belt of tropical
western Pacific north o
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Southern Hemisphere

The subtropical ri
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The TUTT has disap
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Equatorial Region

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PIREP Winds

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dddfff
SS

EE	-percentage of winds with an east componen
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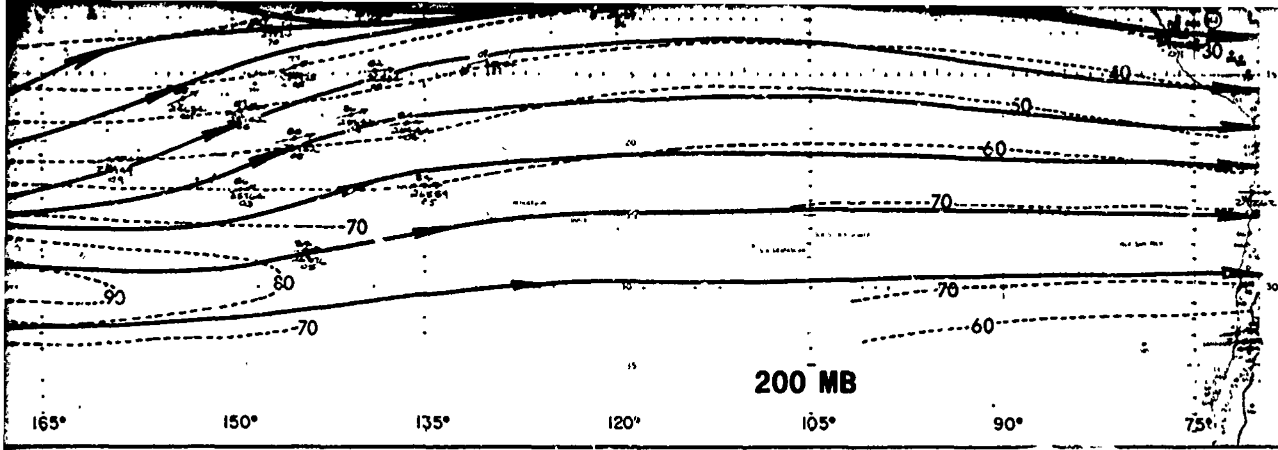

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A belt of tropical easterlies has become established in the western Pacific north of 20N and westward of 170E between the MPT and the subtropical ridge.

Southern Hemisphere

The subtropical ridge has retreated southward to 9S at 155E and has also been re-established eastward beyond 180.

The TUTT has disappeared, and the temperate westerlies have increased considerably. The jet is located near 25S over eastern Australia; meager aircraft data indicates a 100-kt core east of Australia. The maximum westerlies remain near 25S over western South America and have increased.

Equatorial Region

The belt of equatorial easterlies in the eastern Pacific has increased in area and speed as the ridge has moved northward. The easterlies are essentially confined to the Northern Hemisphere, and the buffer system is very near and parallel to the equator. The equatorial easterlies in the western Pacific have also expanded as the ridge in each hemisphere has moved poleward and expanded eastward. Equatorial easterlies have not yet become established between 170W and 140W.

EE	-percentage of winds with an east component
nnnn	-number of observations
ddd	-mean resultant wind direction
fff	-mean resultant wind speed in knots (flag = 50 knots, long barb = 10 knots, short barb = 5 knots)
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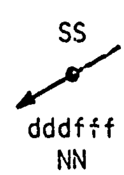

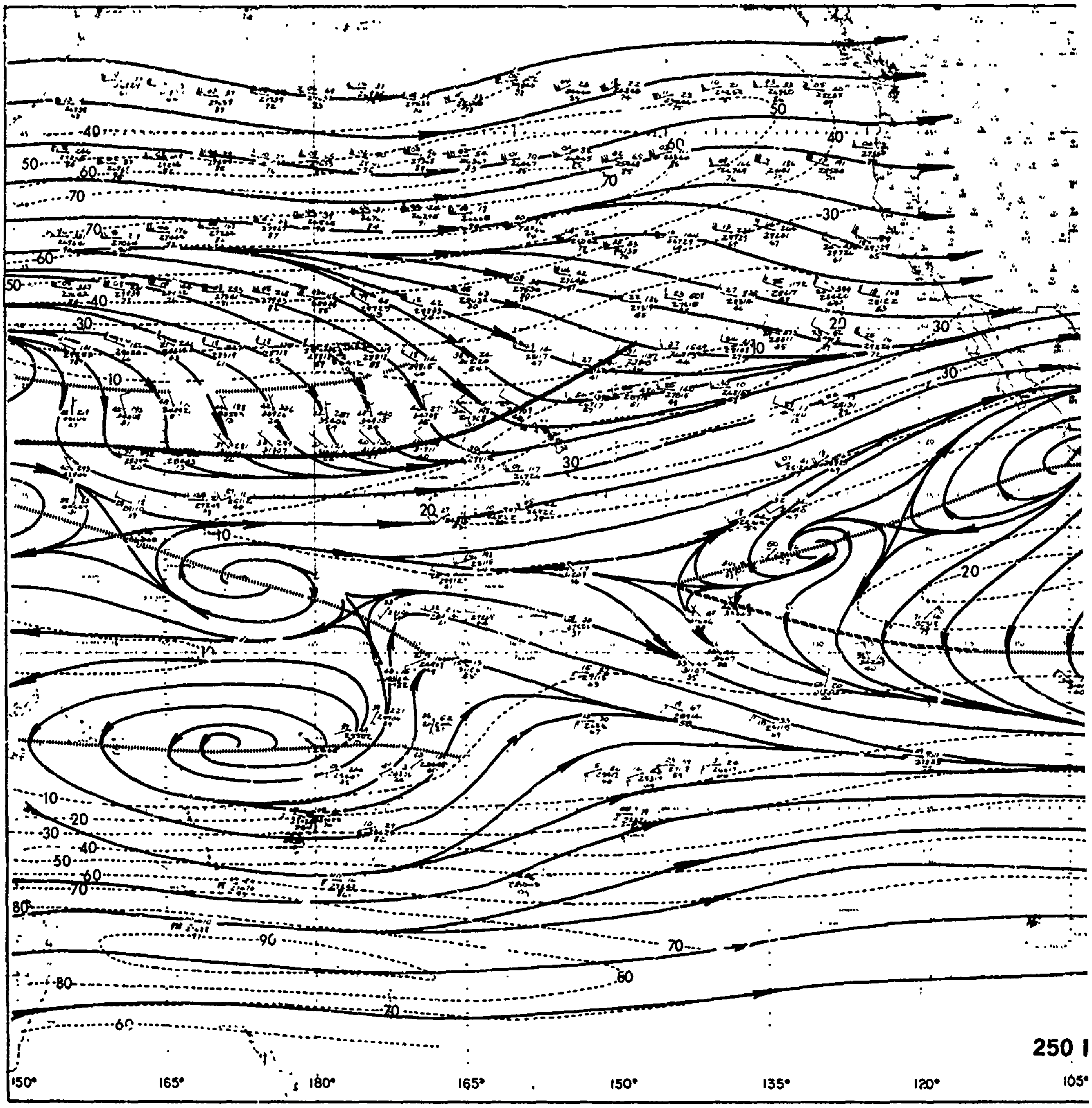
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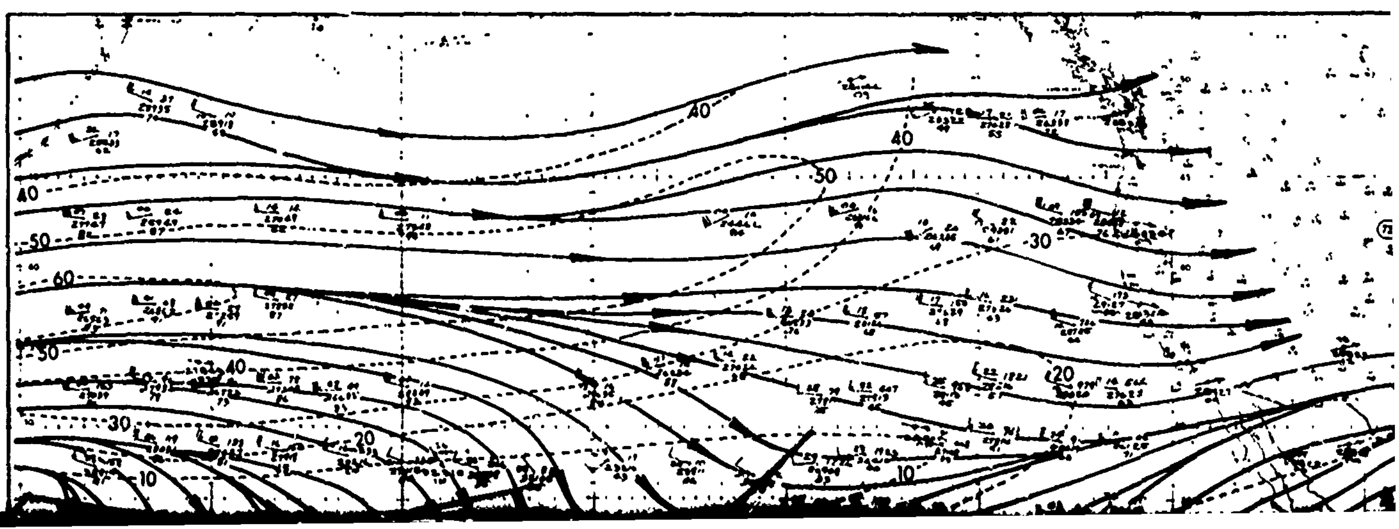

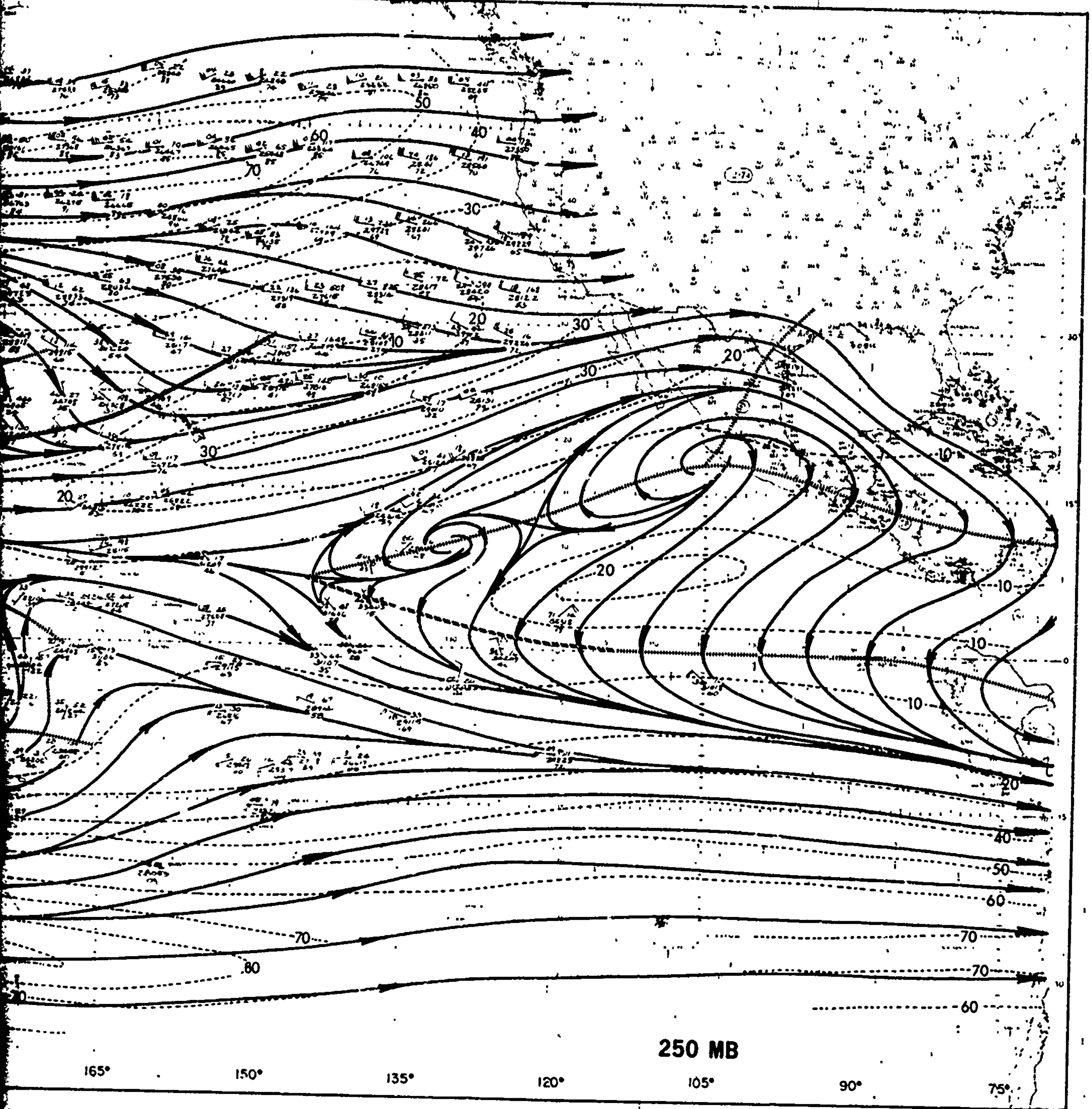
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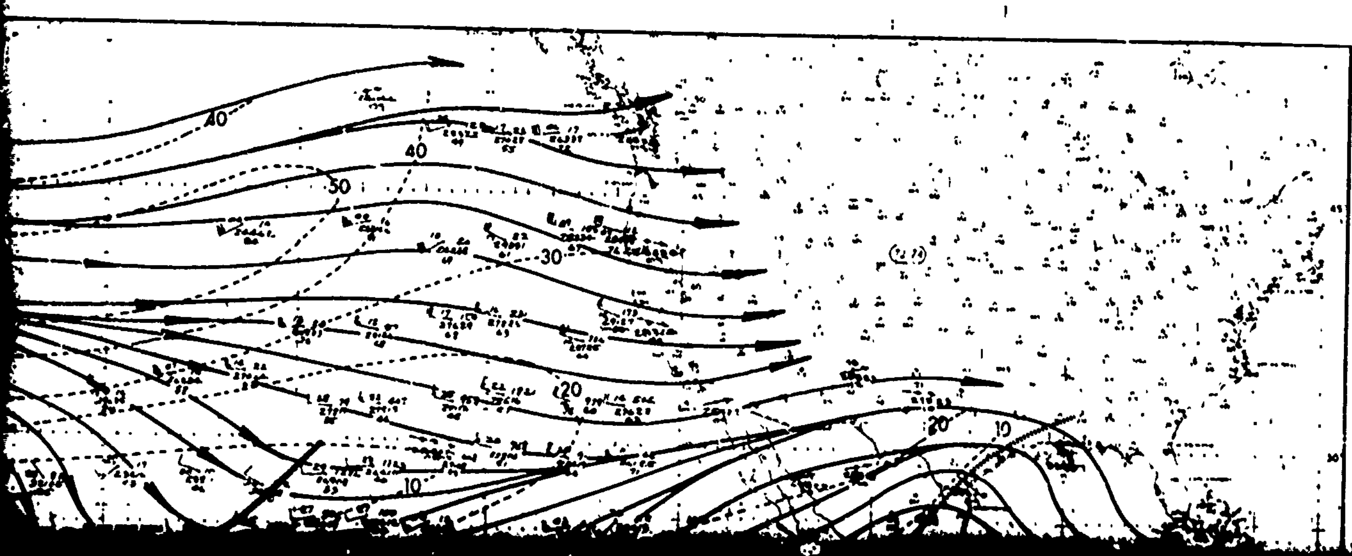

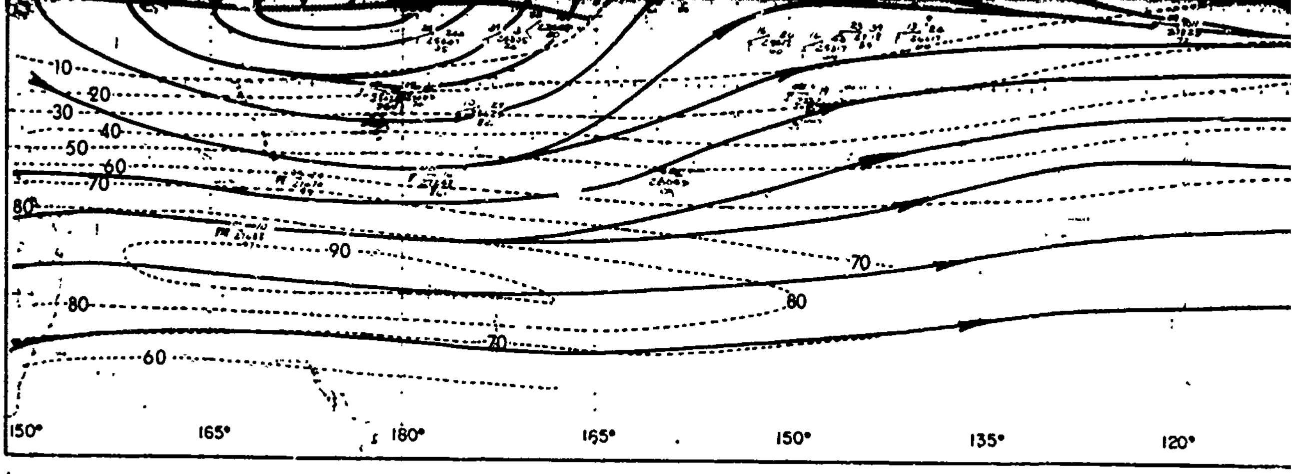
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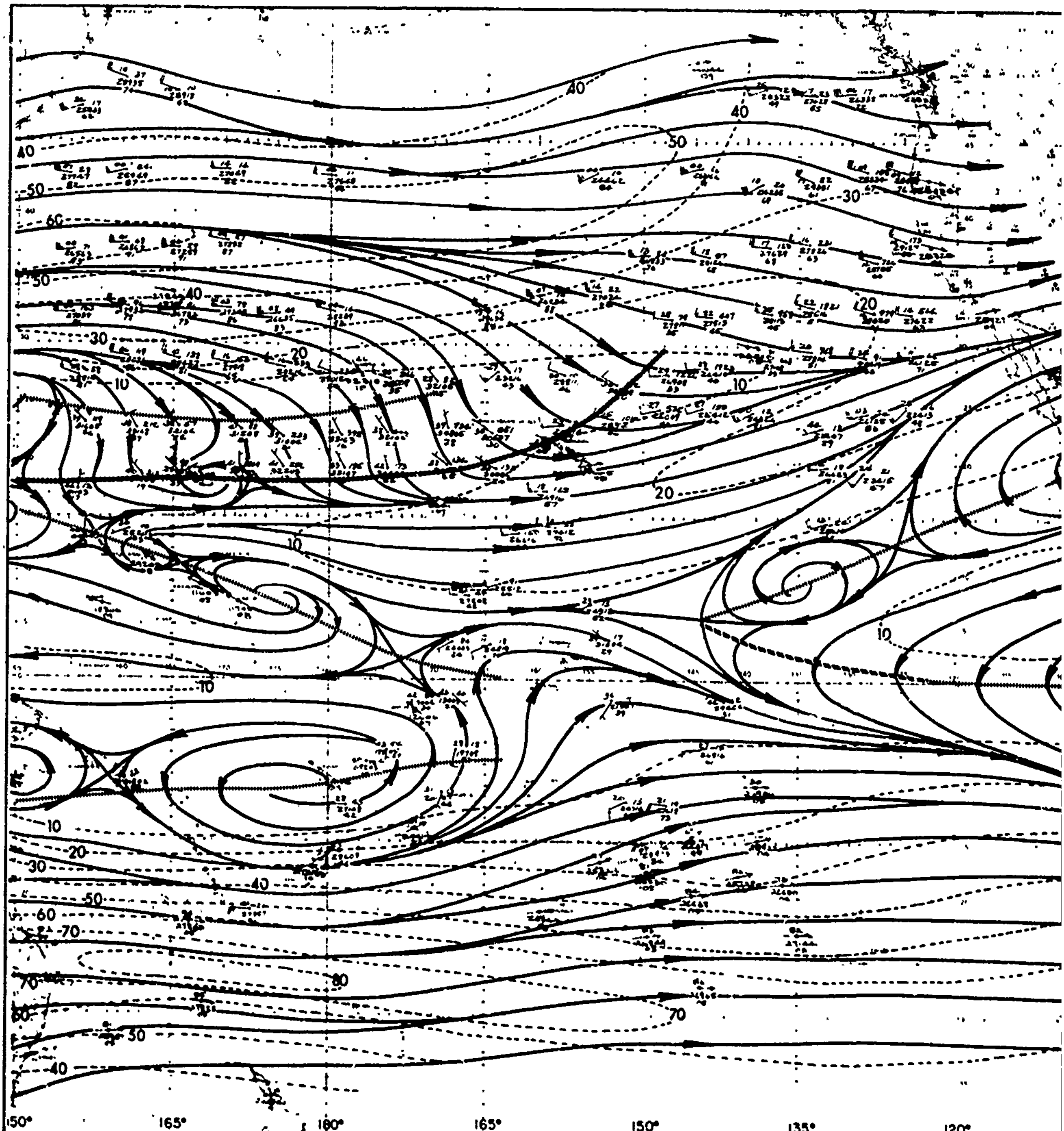
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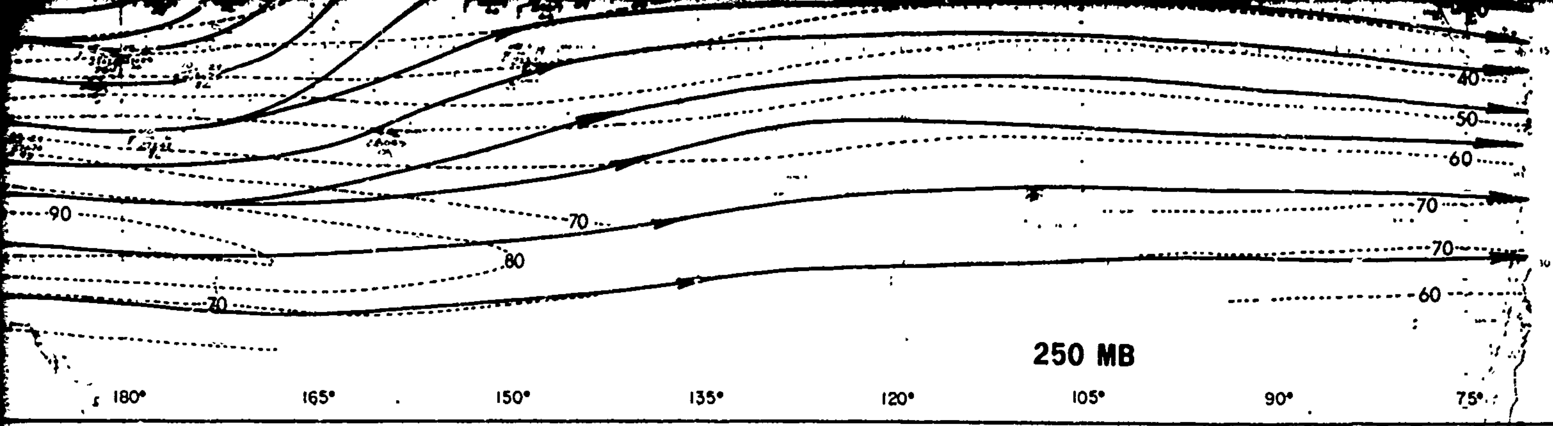
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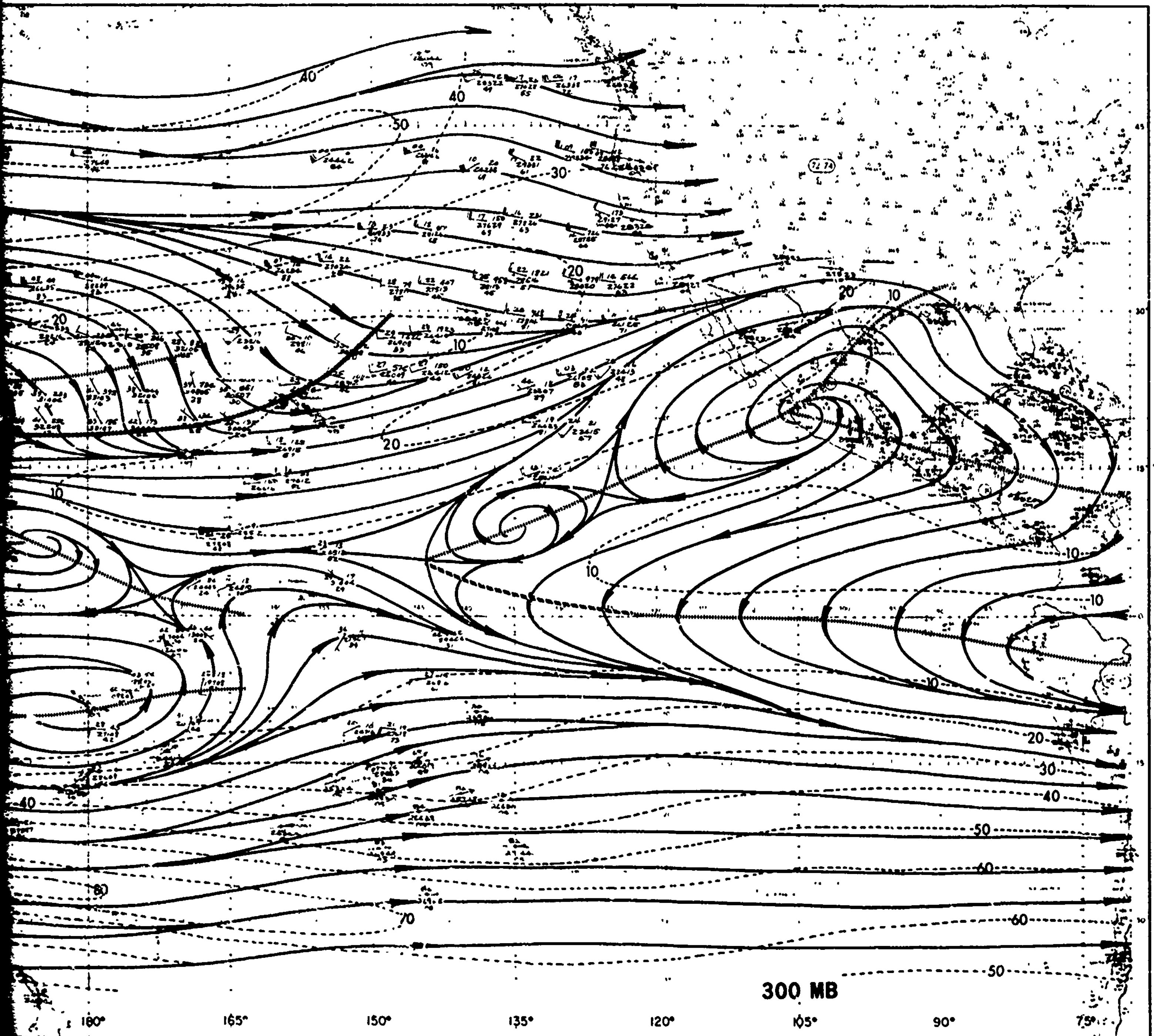
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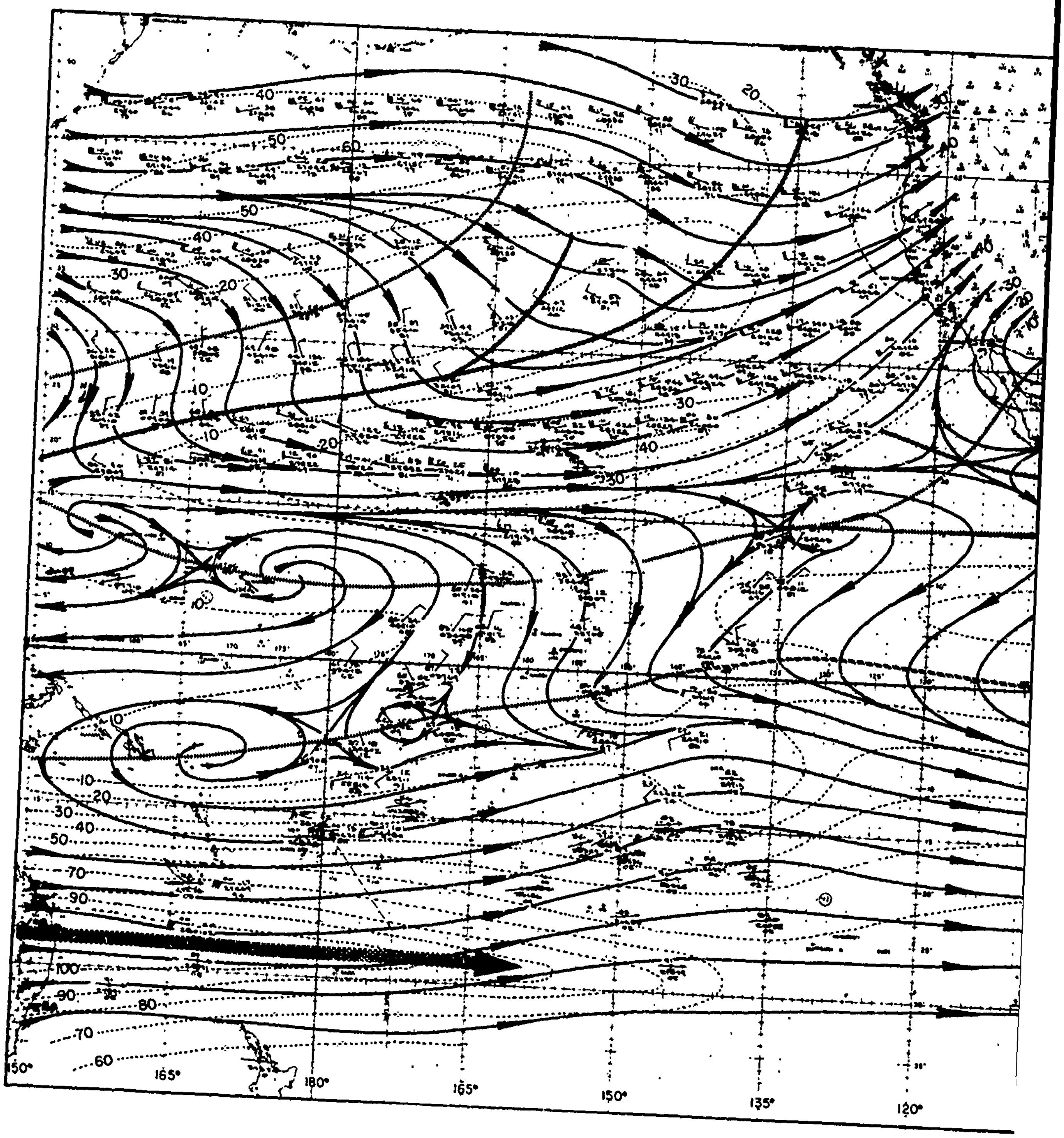


JULY

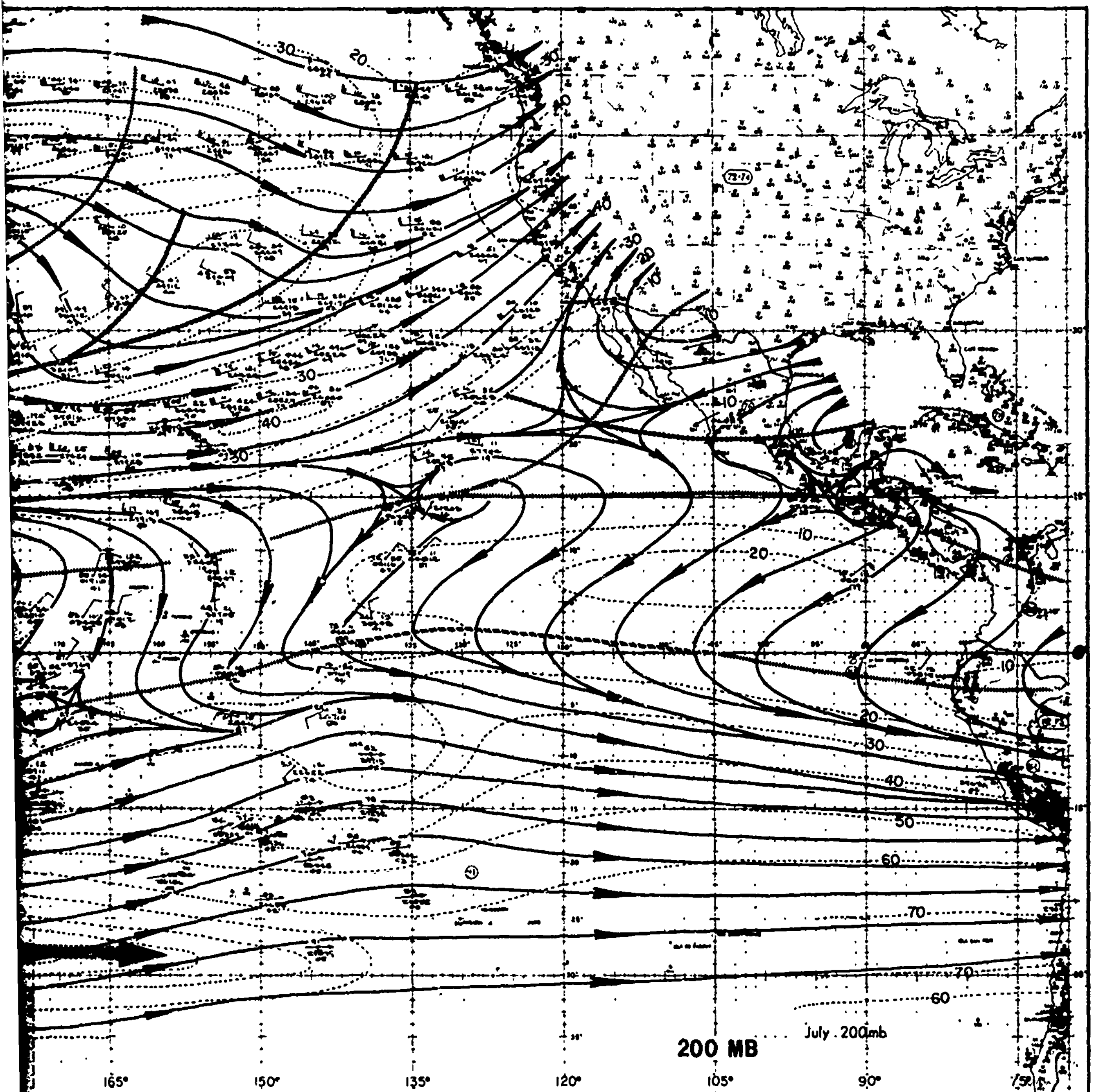
Northern Hemisphere

The subequatorial ridge has intensified and is essentially continuous across the area; however, a weakness remains in the ridge between 160W and 150W. The western portion has moved northward to near 12N at 155E. Flow in the extreme eastern Pacific has been complicated by formation of a ridge over the southern United States and appearance of the tropical upper-tropospheric trough across Central America near 20N.

The core of subtr
maximum speeds of near

Southern Hemisphere

The subtropical r
ridge east of 180. Th
(cyclonic) between 145



JULY

d and is essentially con-
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has moved northward to
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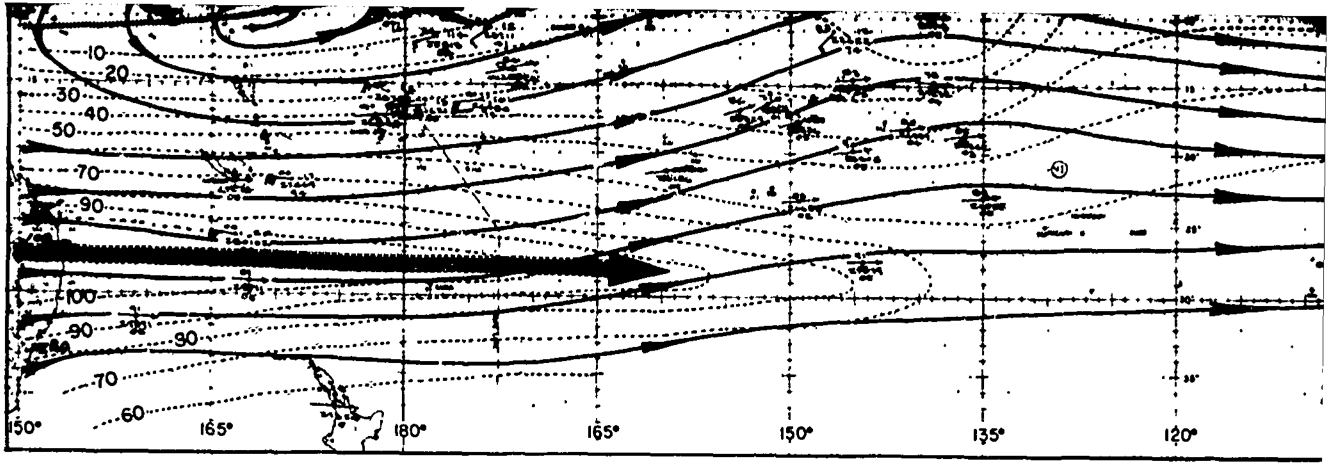
The core of subtropical westerlies has moved northward with maximum speeds of near 40 kt through the Hawaiian Islands.

Southern Hemisphere

The subtropical ridge remains near 9S at 155E. It joins the buffer ridge east of 180. The buffer system lies north of the equator (cyclonic) between 145W and 105W.



JULY

Northern Hemisphere

The subequatorial ridge has intensified and is essentially continuous across the area; however, a weakness remains in the ridge between 160W and 150W. The western portion has moved northward to near 12N at 155E. Flow in the extreme eastern Pacific has been complicated by formation of a ridge over the southern United States and appearance of the tropical upper-tropospheric trough across Central America near 20N.

The tropical upper-tropospheric trough in the Pacific has intensified and moved northward. It is a continuous feature from 20N, 155E northeastward to 50N, 135W.

The subtropical ridge in the northwestern Pacific is more pronounced than in June and extends from near 26N, 155E northeastward.

The temperate westerlies have shrunk considerably, and the core speed has decreased to near 60 kt. The greatest speeds are near 45N, 180. Previous to July this current comprised an eastward extension of stronger flow across Japan.

The core of subtr
maximum speeds of near

Southern Hemisphere

The subtropical r
ridge east of 180. Th
(cyclonic) between 145

The temperate jet
centered over eastern
have decreased, probab
a winter trough in the
South America have inc
near 25S.

Equatorial Region

The equatorial ea
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remain between 145W an
equator.

PIREP Winds

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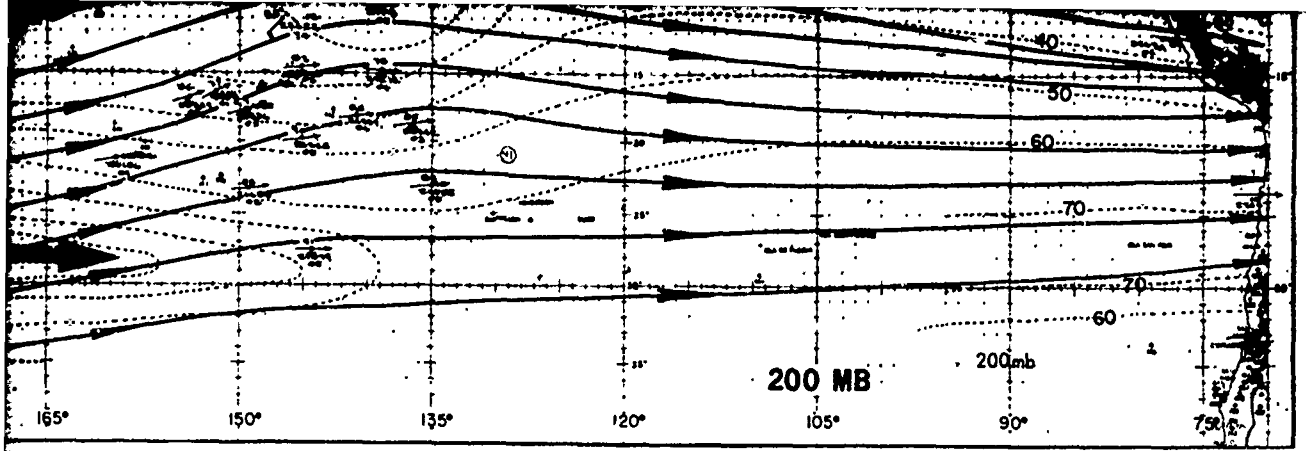
dddfff

SS

EE	-percentage of winds with an east compone
nnnn	-number of observations
ddd	-mean resultant wind direction
fff	-mean resultant wind speed in knots (fla 50 knots, long barb = 10 knots, short barb = 5 knots)
SS	-steadiness of winds in percen
NN	-number of years of record



JULY

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the Pacific has inten-
feature from 20N, 155E

Pacific is more pro-
155E northeastward.

derably, and the core
t speeds are near 45N,
n eastward extension of

The core of subtropical westerlies has moved northward with maximum speeds of near 40 kt through the Hawaiian Islands.

Southern Hemisphere

The subtropical ridge remains near 9S at 155E. It joins the buffer ridge east of 180. The buffer system lies north of the equator (cyclonic) between 145W and 105W.

The temperate jet has increased to greater than 100 kt and is centered over eastern Australia near 28S. Speeds over French Polynesia have decreased, probably indicating the formation or intensification of a winter trough in the westerlies near 135W. Speeds over western South America have increased slightly from June; the core remains near 25S.

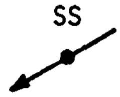
Equatorial Region

The equatorial easterlies have expanded in the Northern Hemisphere as the ridge has intensified and moved northward. Westerlies remain between 145W and 105W where the buffer system is north of the equator.

EE	-percentage of winds with an east component
nnnn	-number of observations
ddd	-mean resultant wind direction
fff	-mean resultant wind speed in knots (flag = 50 knots, long barb = 10 knots, short barb = 5 knots)
SS	-steadiness of winds in percent
NN	-number of years of record

Rawins

SS



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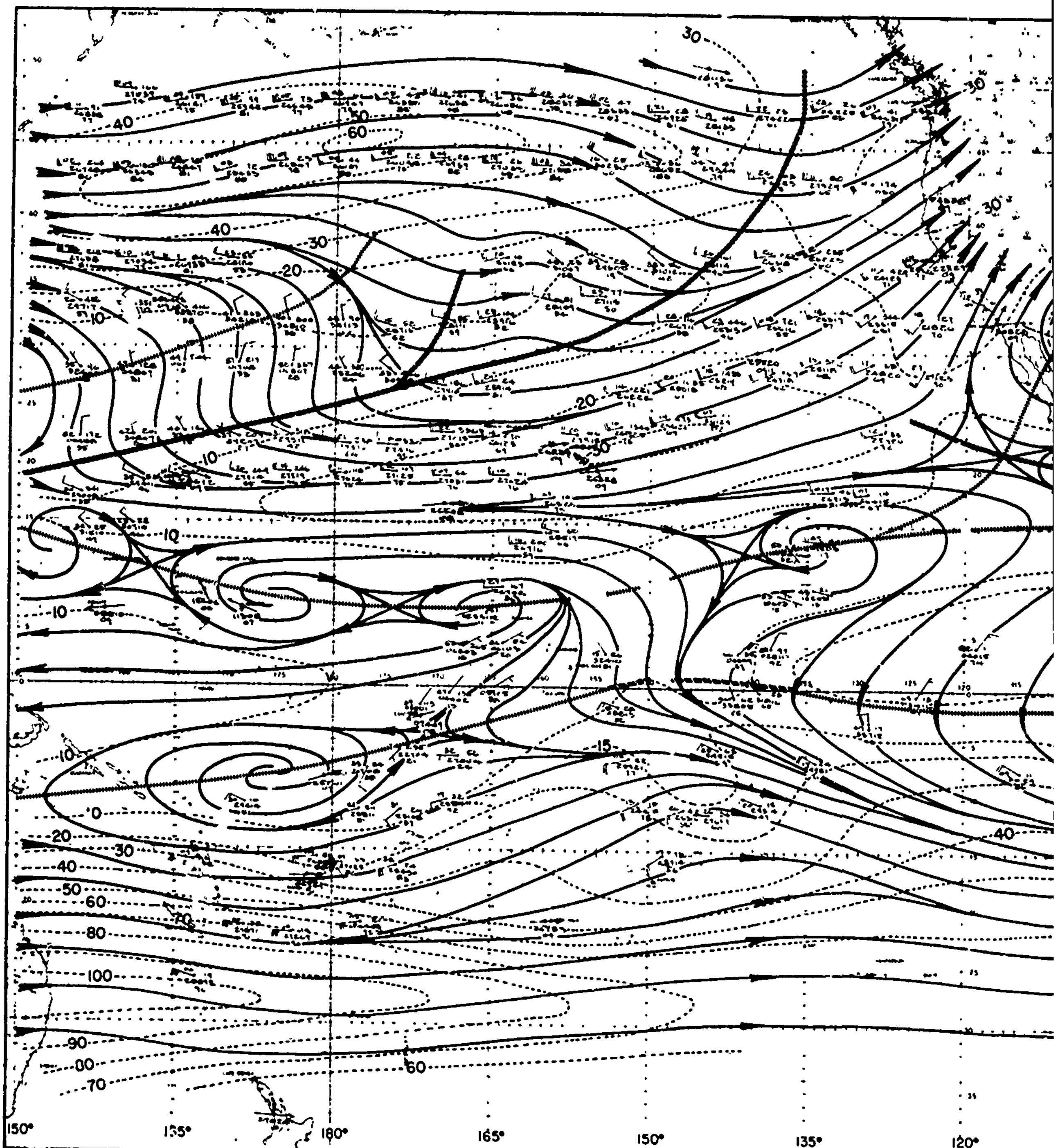
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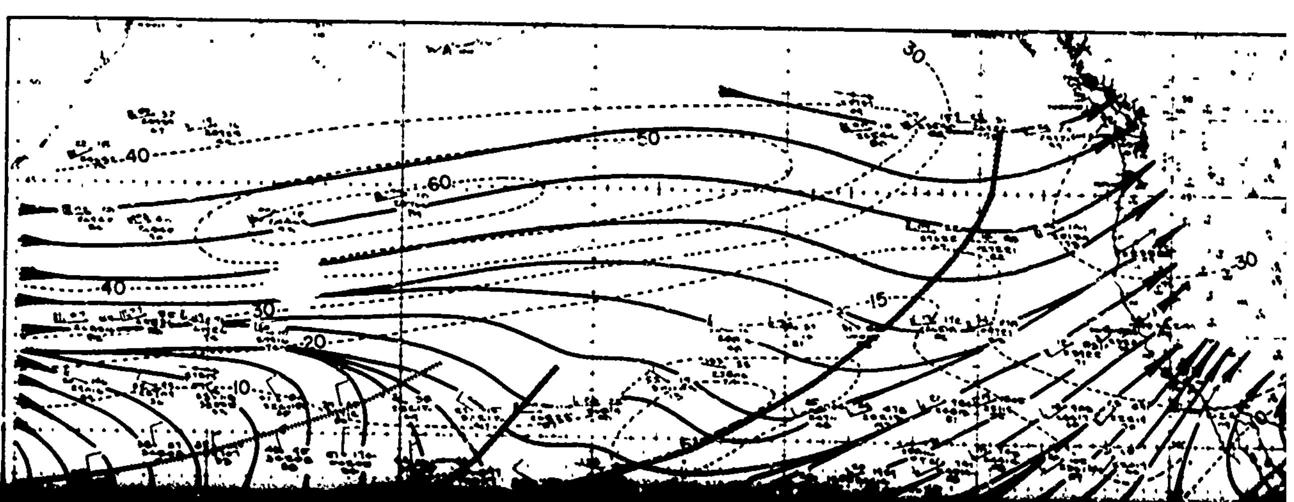

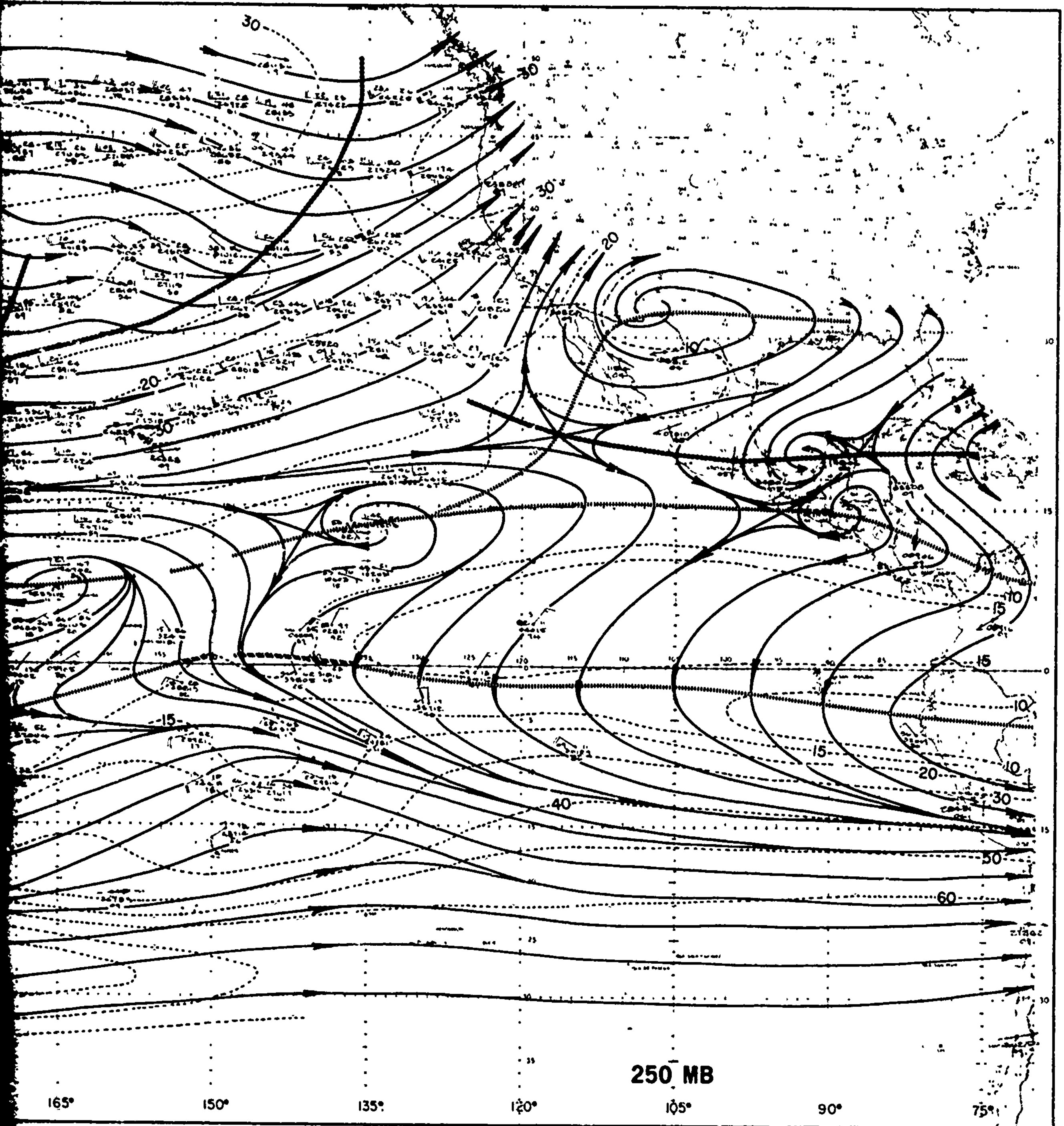
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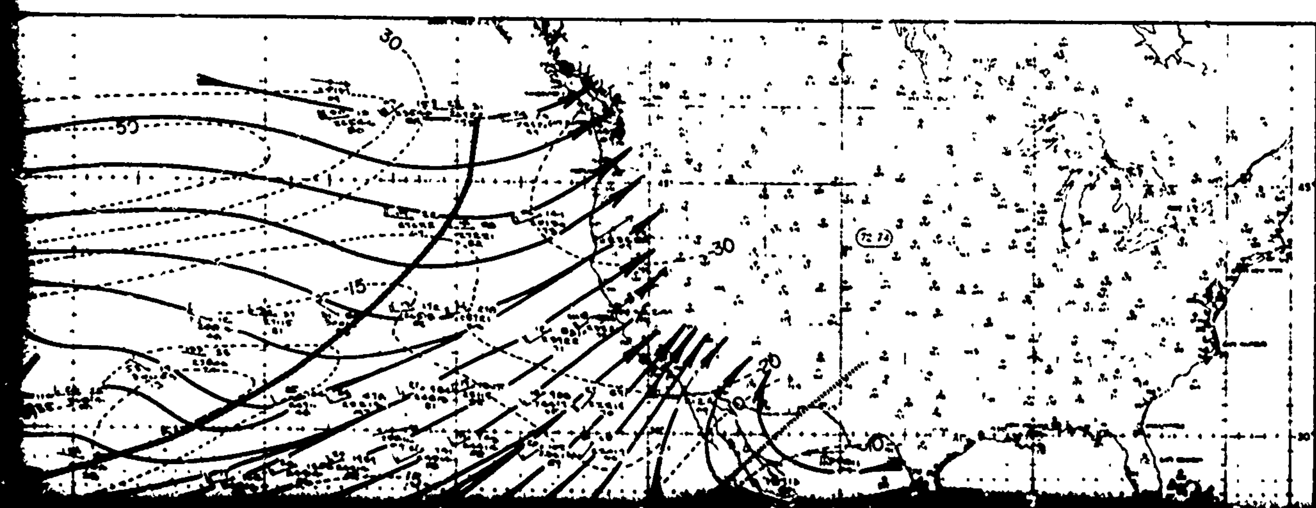

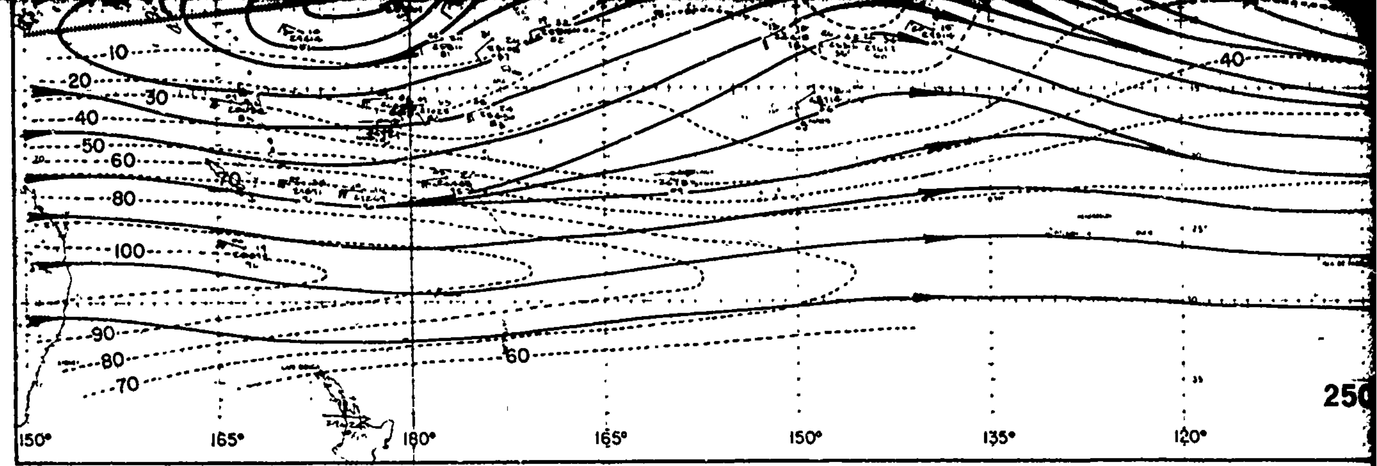

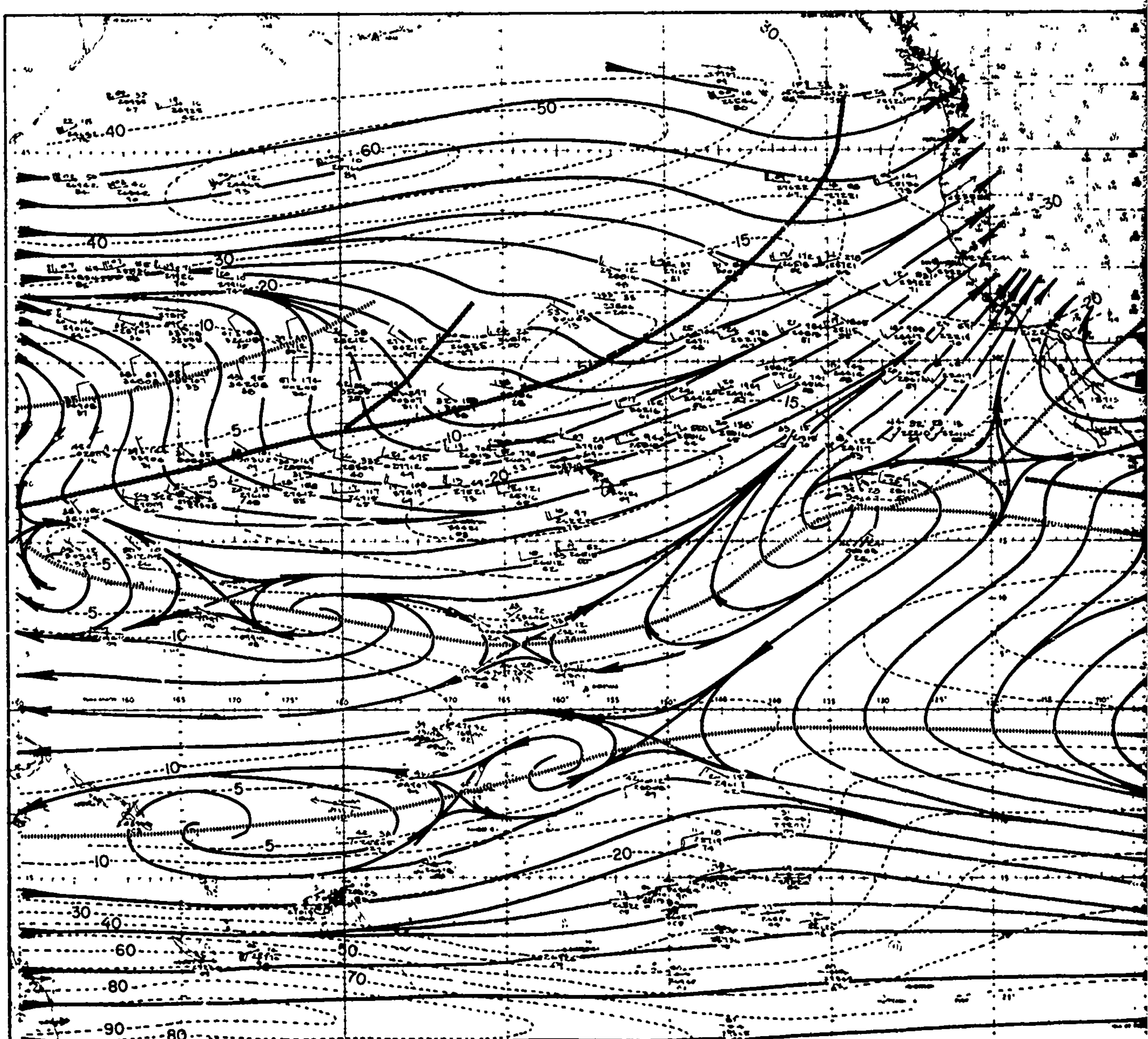

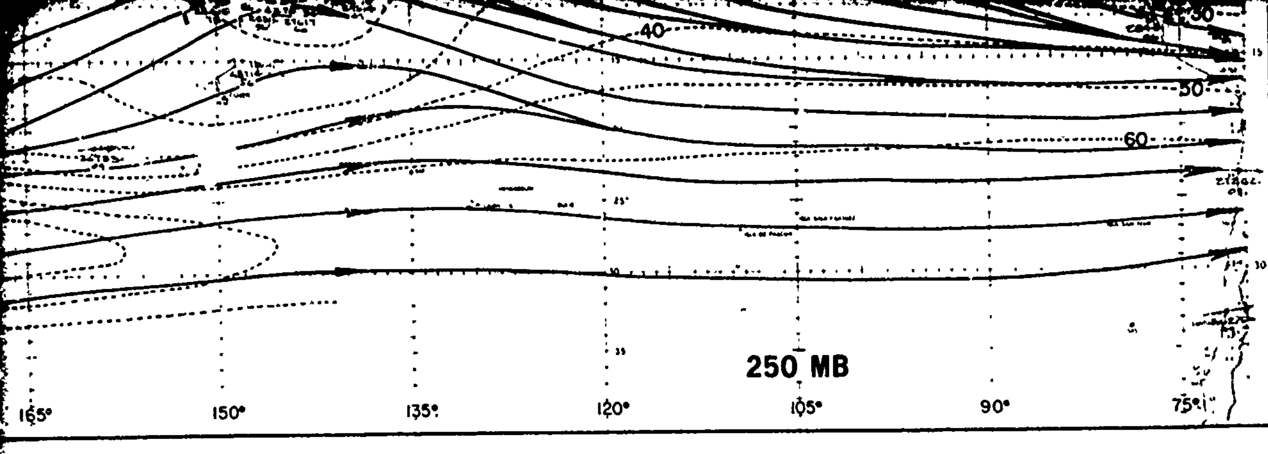
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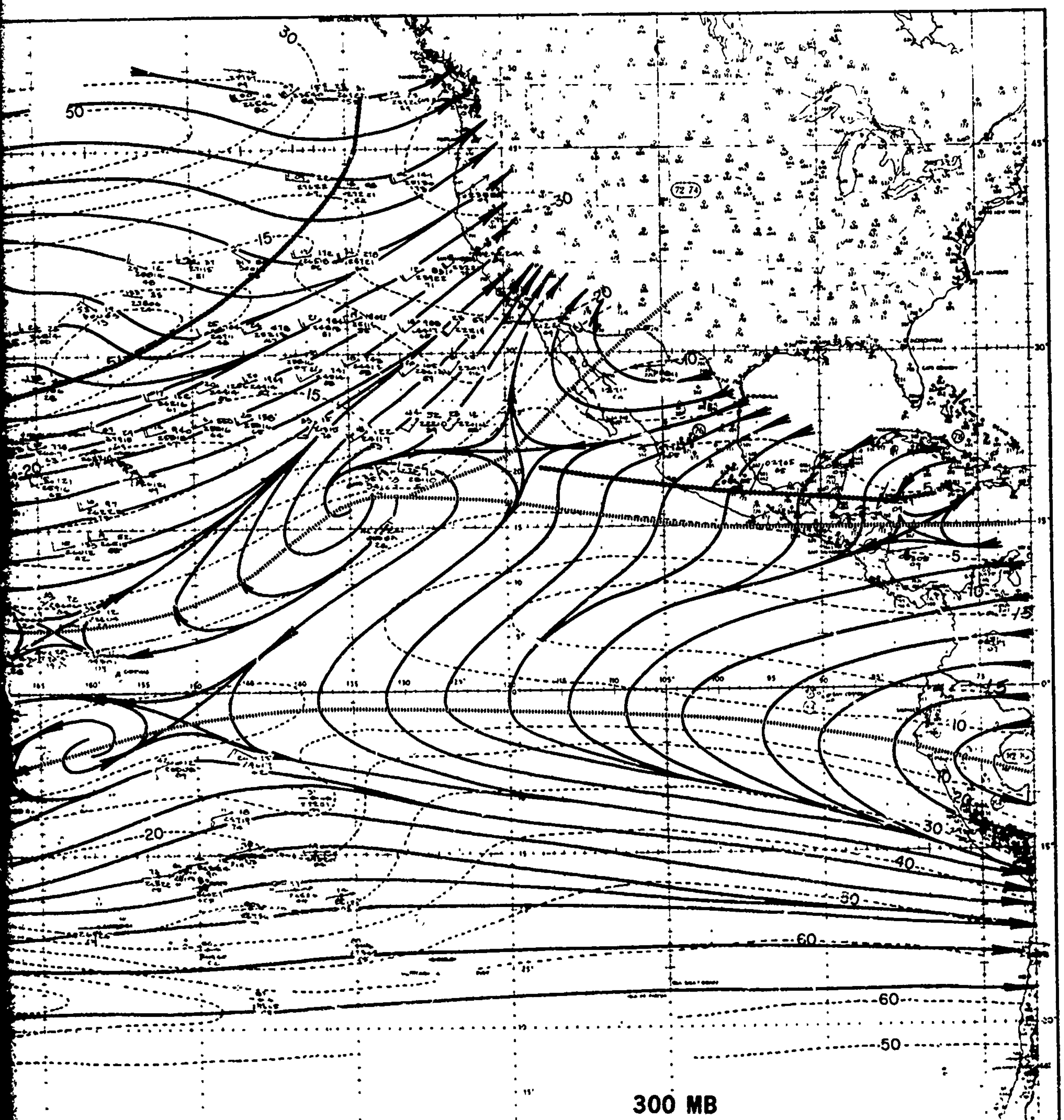
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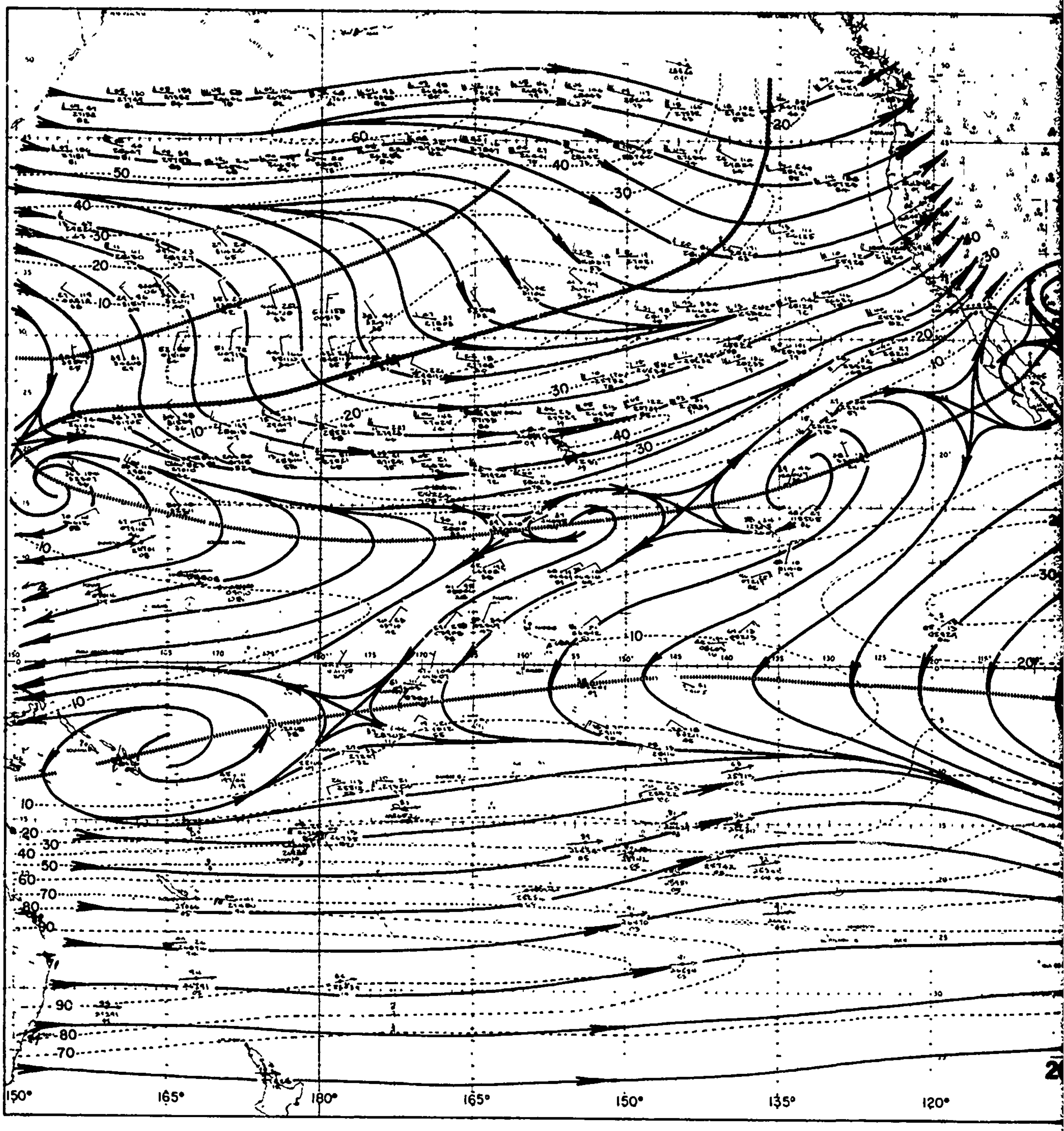
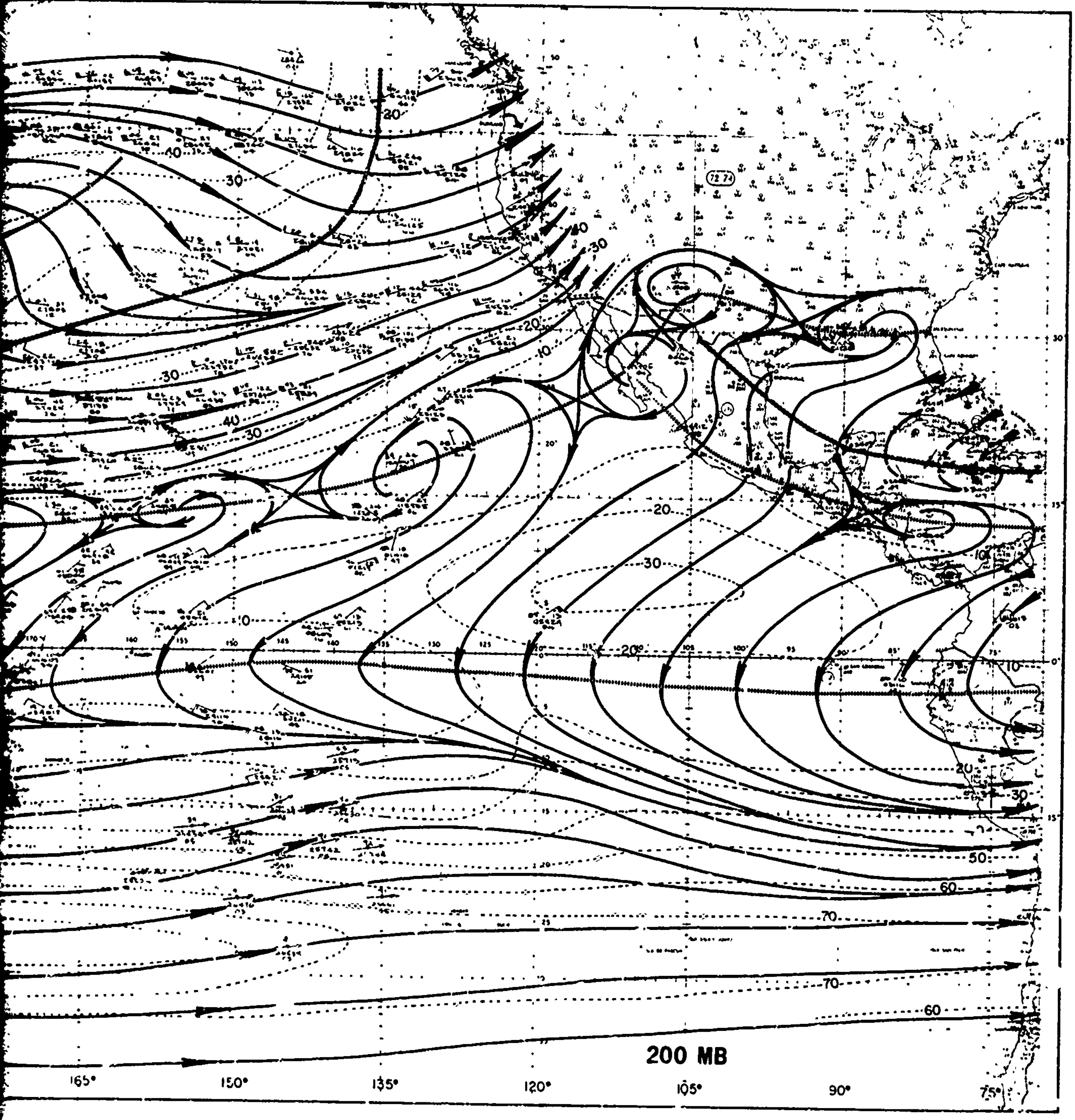


AUGUST

Northern Hemisphere

All systems have moved northward. The subequatorial ri[dge] intensified and is continuous from the western Pacific to So[uth] America. The circulation patterns and major current speeds [have] changed little from July.

Southern Hemisphere



AUGUST

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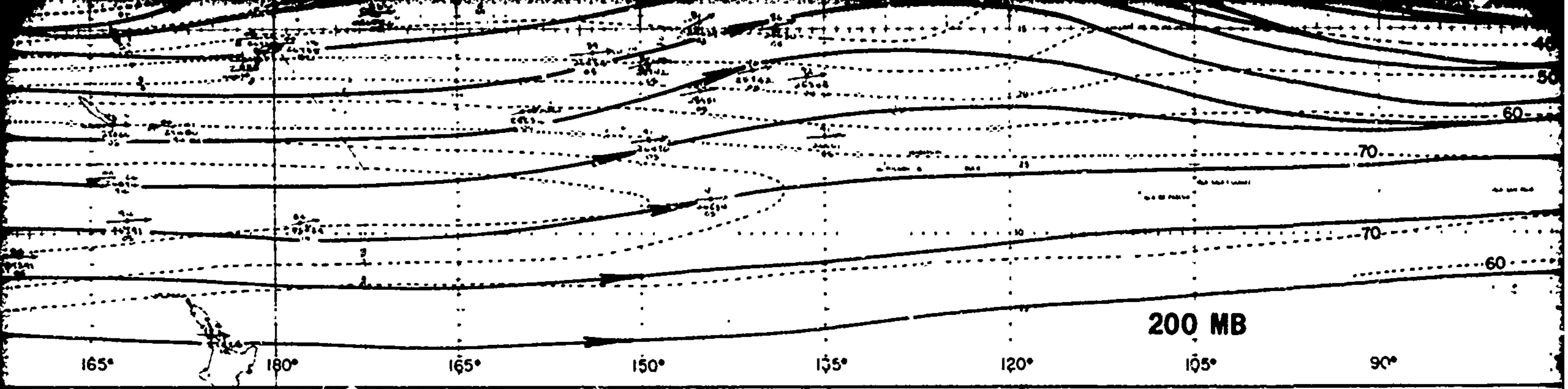


AUGUST

Northern Hemisphere

All systems have moved northward. The subequatorial ridge has intensified and is continuous from the western Pacific to South America. The circulation patterns and major current speeds have changed little from July.

Southern Hemisphere

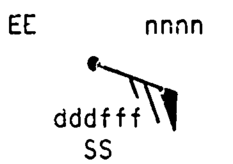
The subtropical ridge is near 10S at 155E and links with the buffer system which lies south of the equator across the entire eastern Pacific.

The temperate jet position and intensify have changed little from July. The trough in the westerlies has moved eastward of 135W.

Equatorial Region

This is the first month in the year that easterly winds are found on the equator at all longitudes. The speed of the northeast current outflowing from the eastern Pacific low-level monsoon has increased to near 30 kt.

PIREP Winds



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ddd	-mean resultant wind direction
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SS	-steadiness of winds in percent
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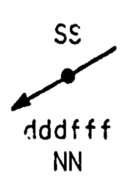
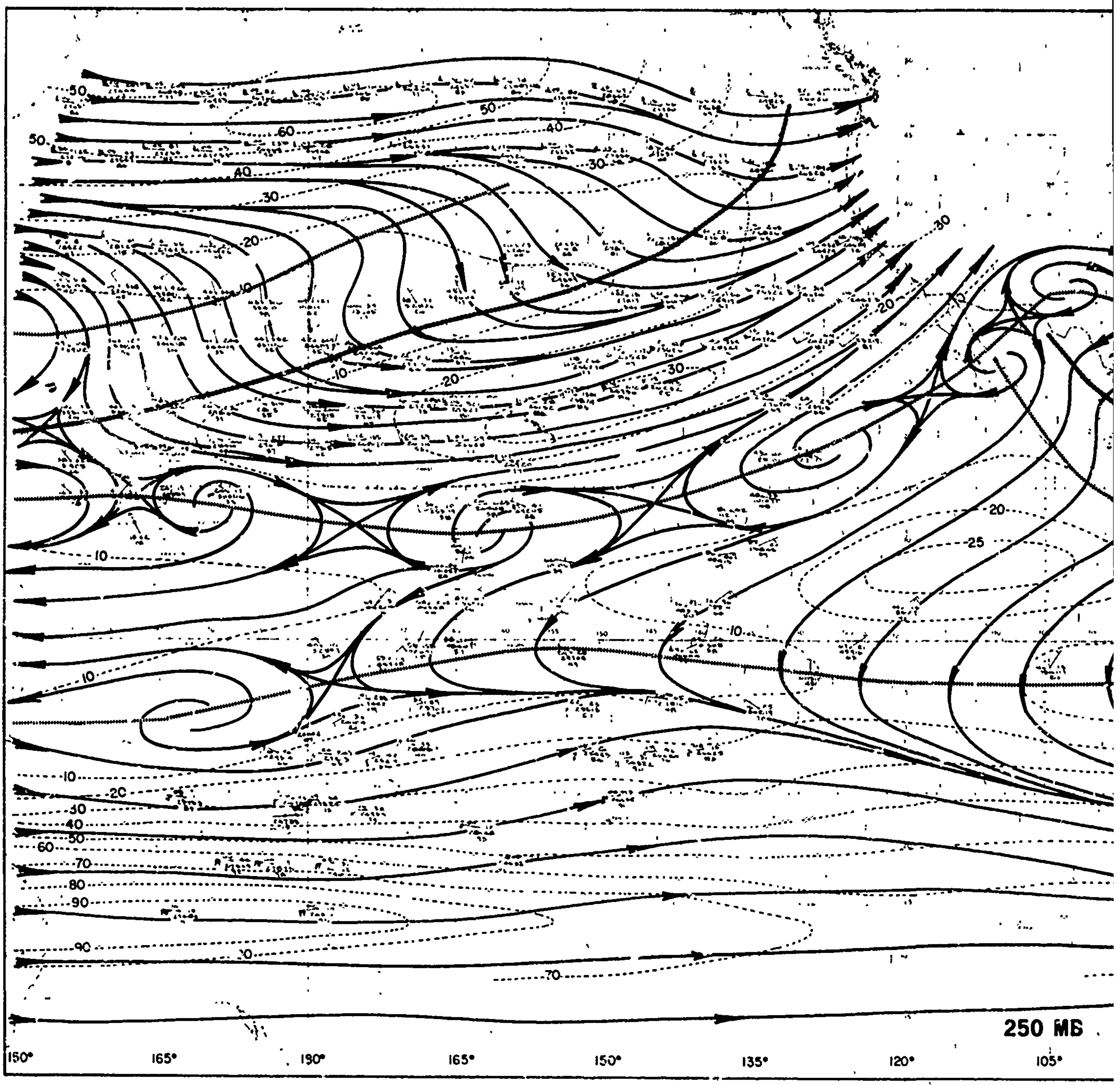
Rawins

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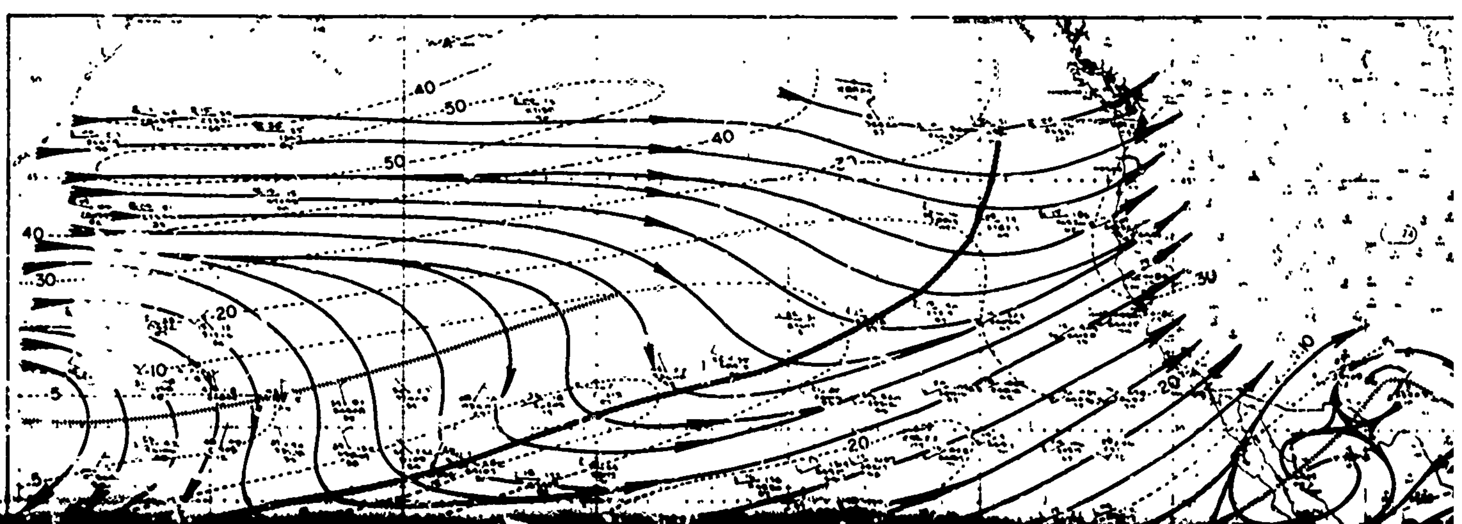

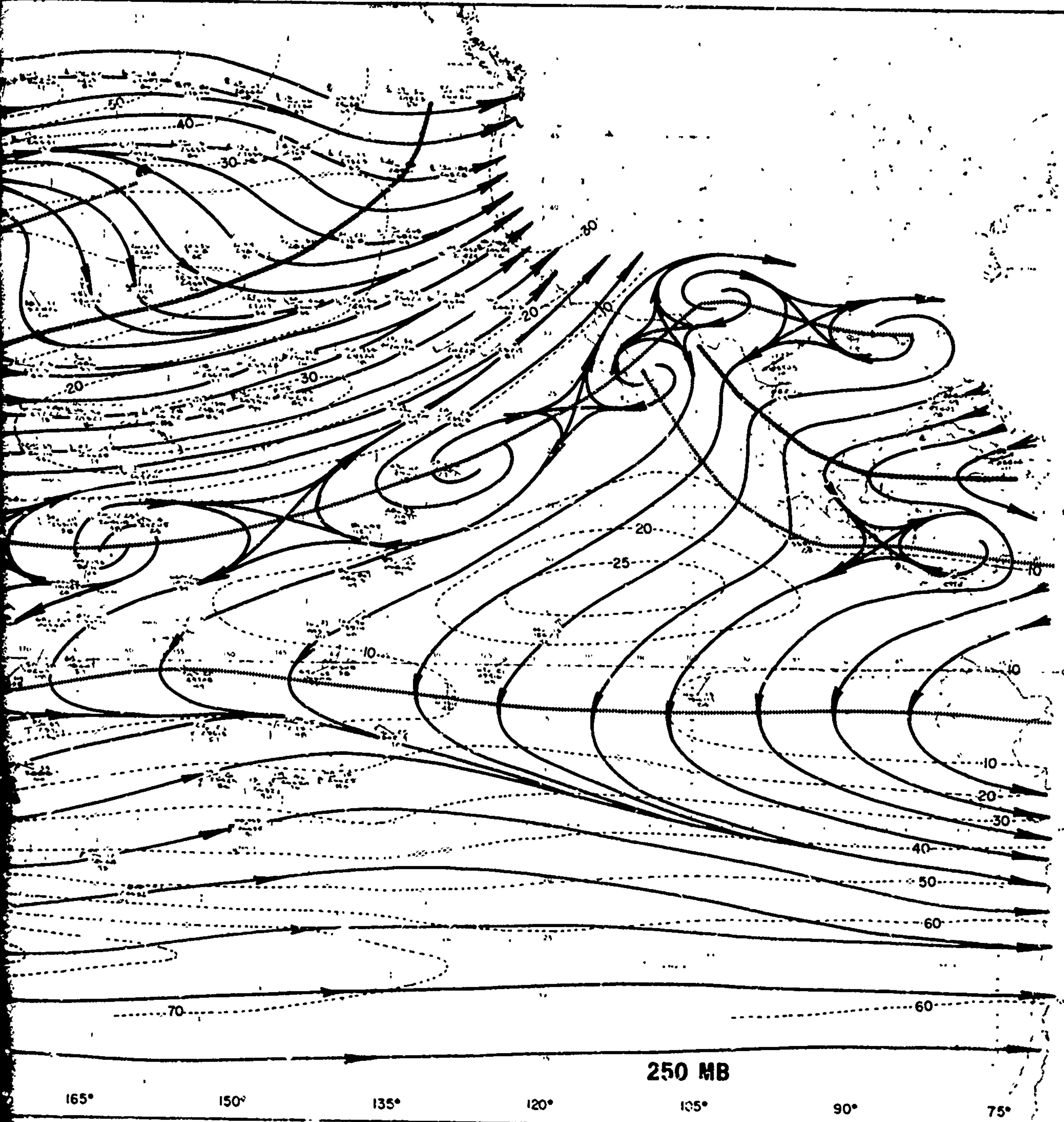

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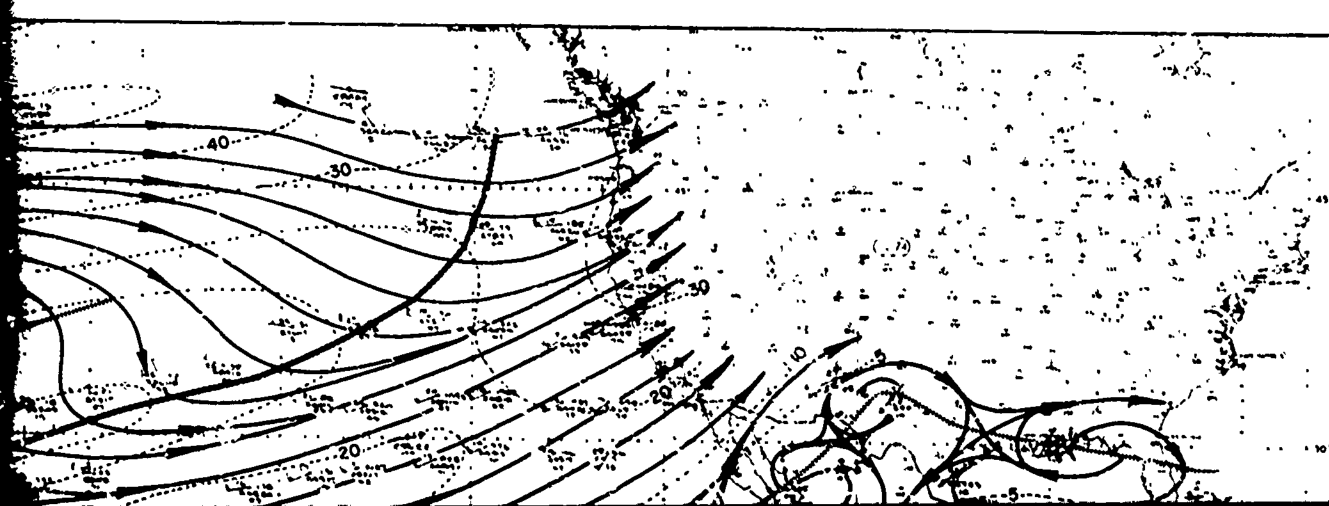

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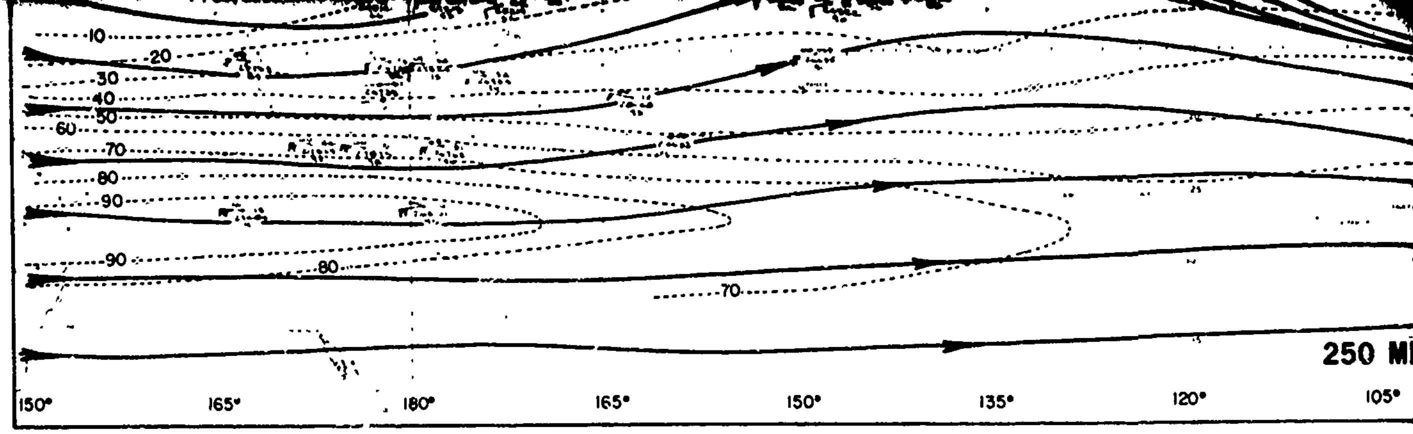
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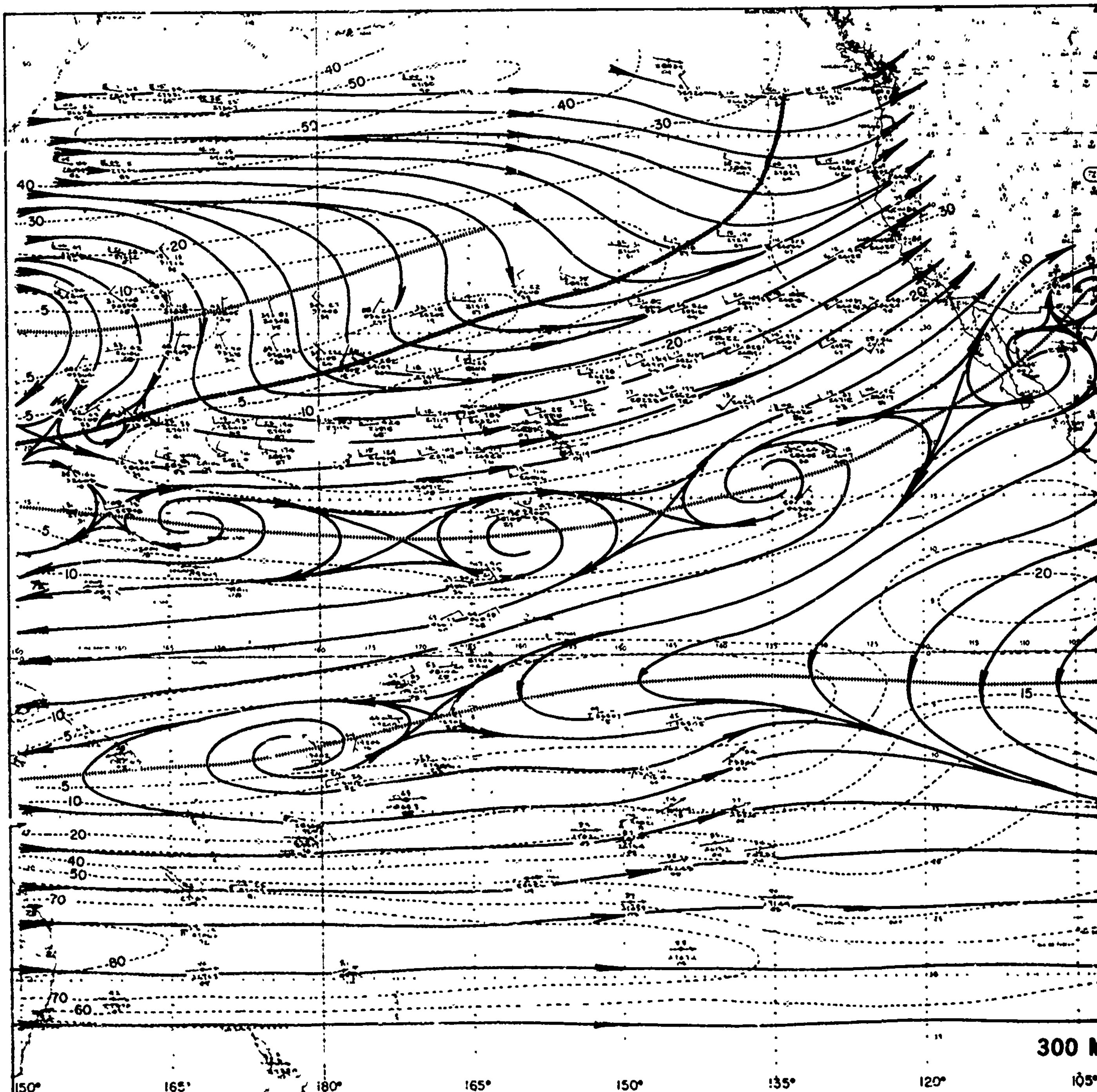
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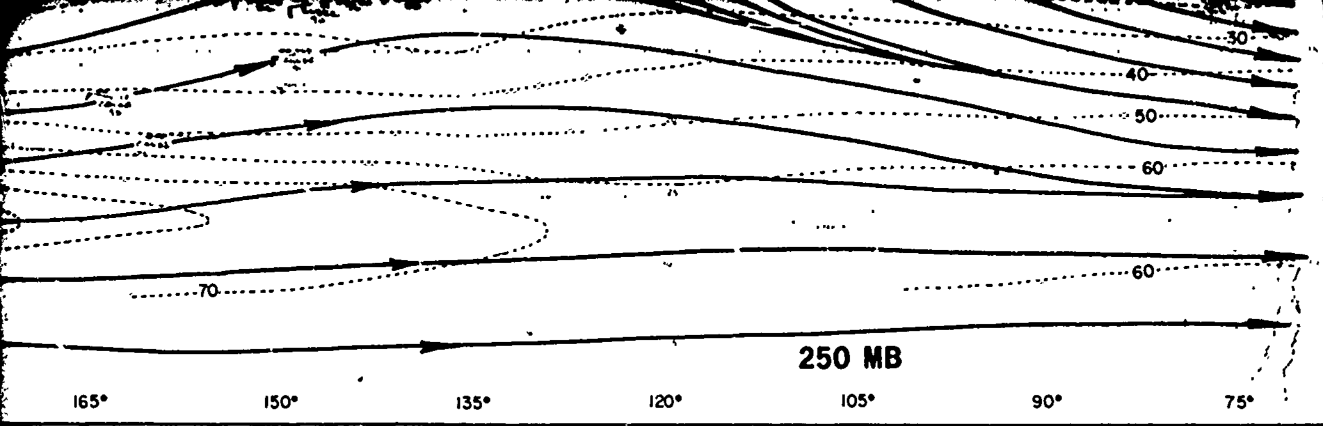
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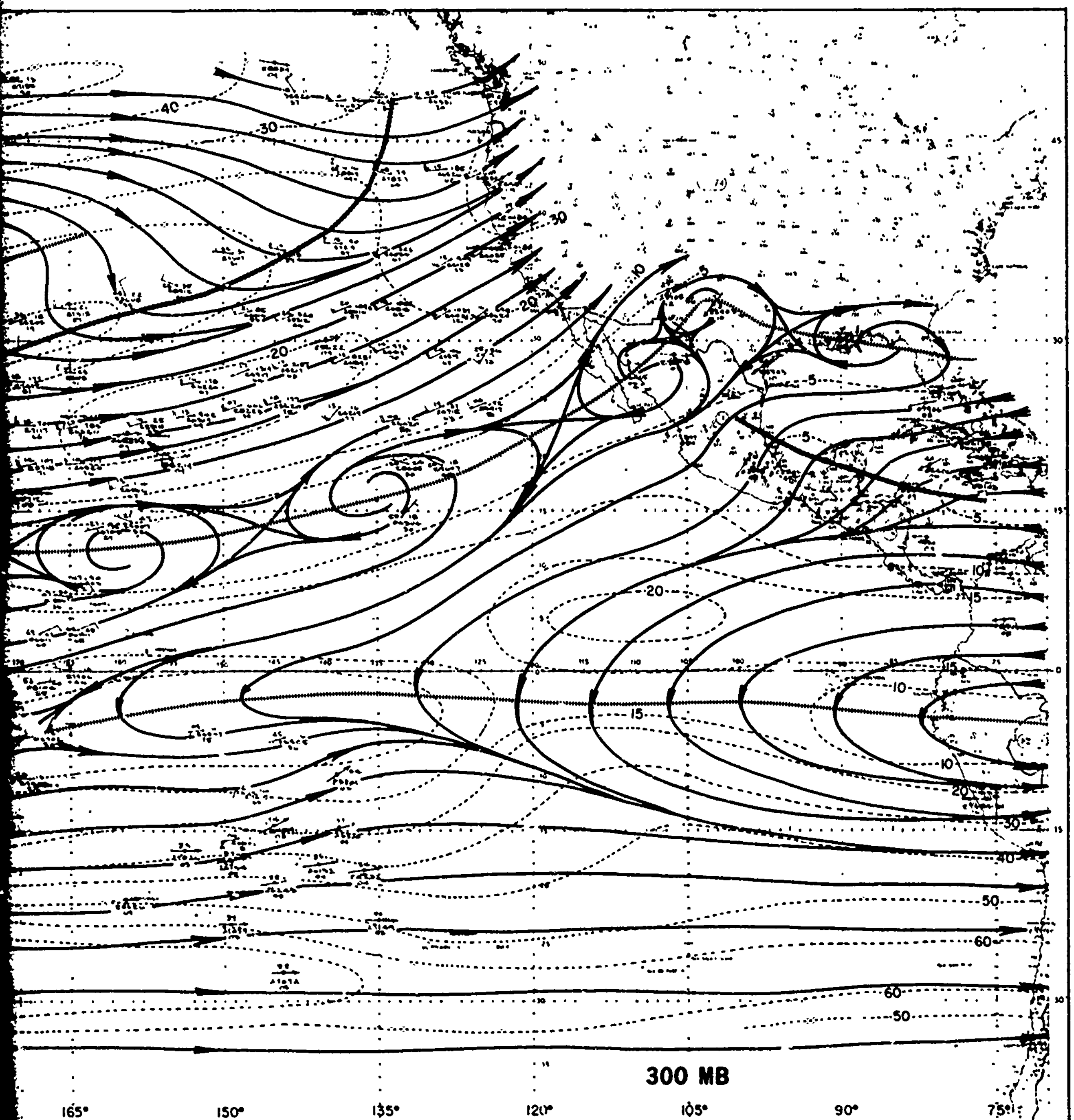
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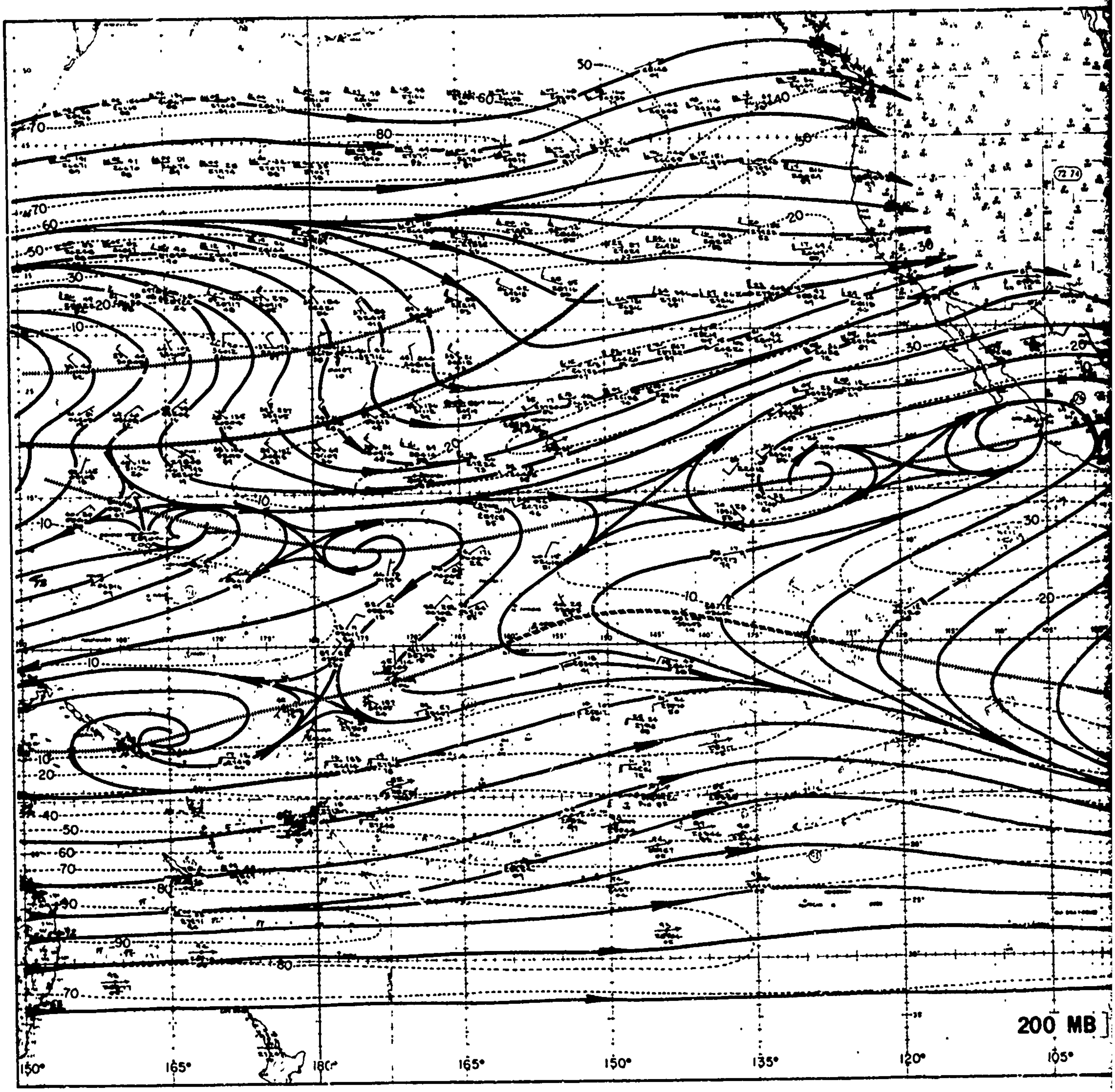

SEPTEMBER

Northern Hemisphere

Large changes occur between August and September.

The segment of the subtropical ridge over the southern United States has disappeared, and the TUTT is barely discernible over the Caribbean.

The MPT has moved southward and lost its link to higher latitudes ... to the eastern Pacific off the northwest coast of

The subequatorial ridge h
weakened between 165W and 130W
of the buffer system across th

Southern Hemisphere

The temperate jet has dec
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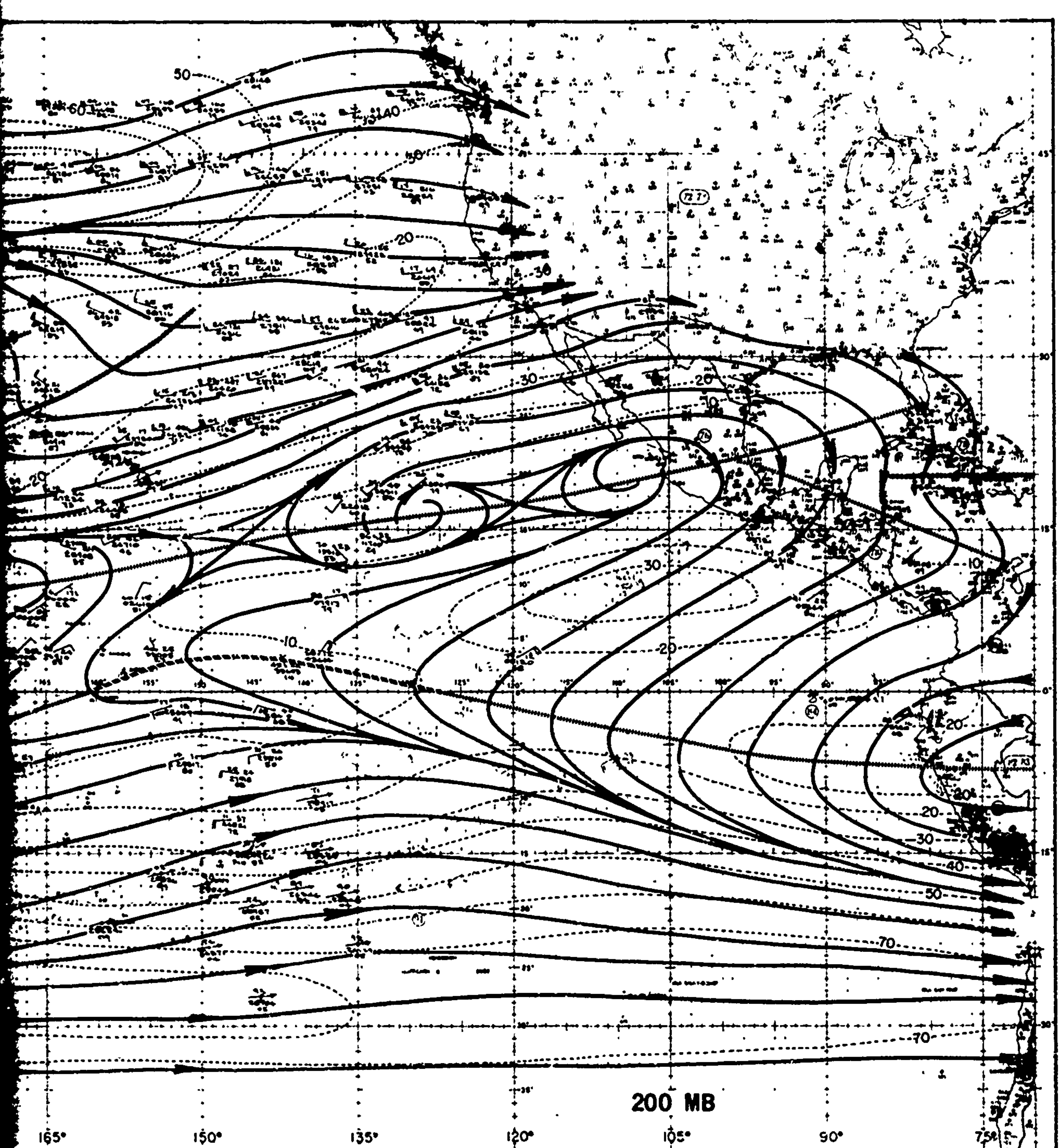
Equatorial Region



SEPTEMBER

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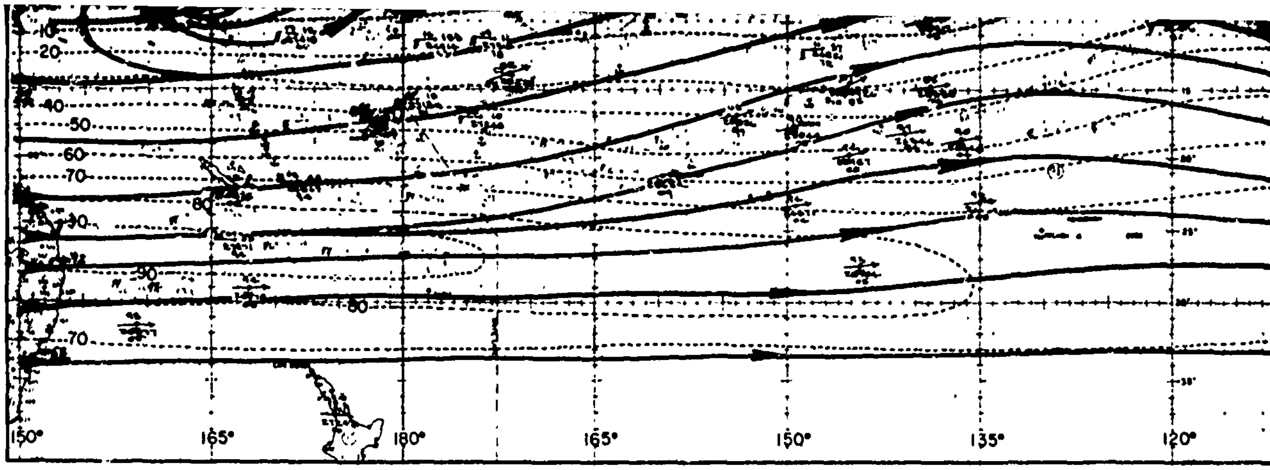
...the southern United ...discernible over the

...to higher latitudes

The subequatorial ridge has moved southward. It apparently has weakened between 165W and 130W as is indicated by northward movement of the buffer system across the equator.

Southern Hemisphere

The temperate jet has decreased to near 90 kt over and just east of Australia; however, speeds have increased slightly over French Polynesia and western South America.



SEPTEMBER

Northern Hemisphere

Large changes occur between August and September.

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The MPT has moved southward and lost its link to higher ides as ri ging returns to the eastern Pacific off the northwest coa of the United States.

The temperate westerlies have increased to 80 kt. The maximum core remains near 45N between 180 and 165W.

The subtropical westerli s have decreased to near 30 kt eastward of Hawaii.

The subequatori weakened between 165 of the buffer system

Southern Hemisphere

The temperate of Australia; howeve Polynesia and wester

Equatorial Region

Southern Hemisp region between 165W

The northeaster equator remains well

PIREP Winds

EE nnnn

dddfff
SS

EE	-percentage of winds with an east compo
nnnn	-number of observations
ddd	-mean resultant wind direction
fff	-mean resultant wind speed in knots (f 50 knots, long barb = 10 knots, short barb = 5 knots)
SS	-steadiness of winds in percent
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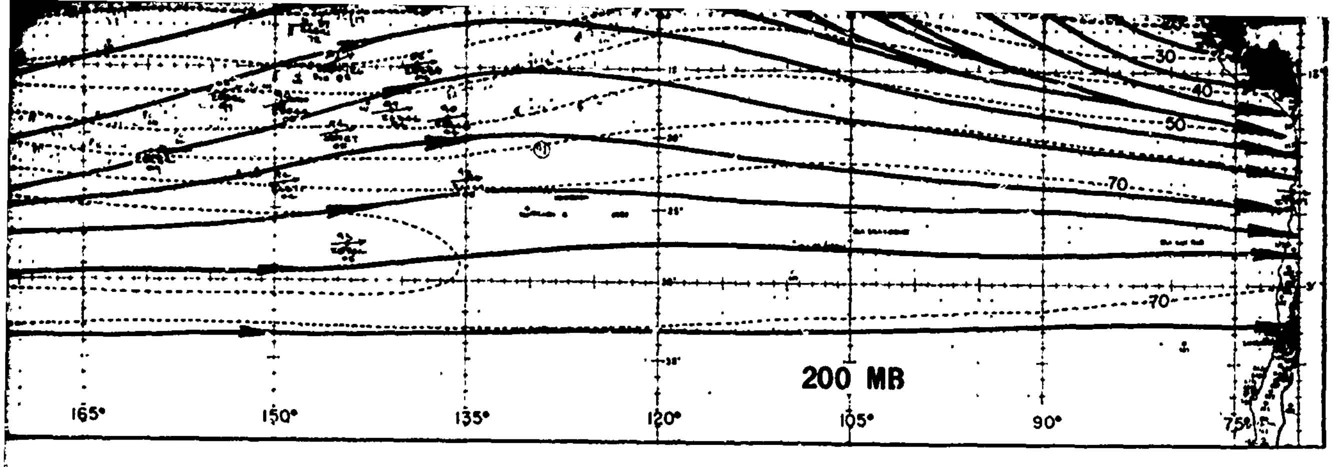

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Southern Hemisphere

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Equatorial Region

Southern Hemisphere westerlies have returned to the equatorial region between 165W and 130W.

The northeasterly current over the eastern Pacific north of the equator remains well organized with speeds of near 30 kt.

EE	-percentage of winds with an east component
nnnn	-number of observations
ddd	-mean resultant wind direction
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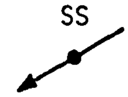
Rawins

SS



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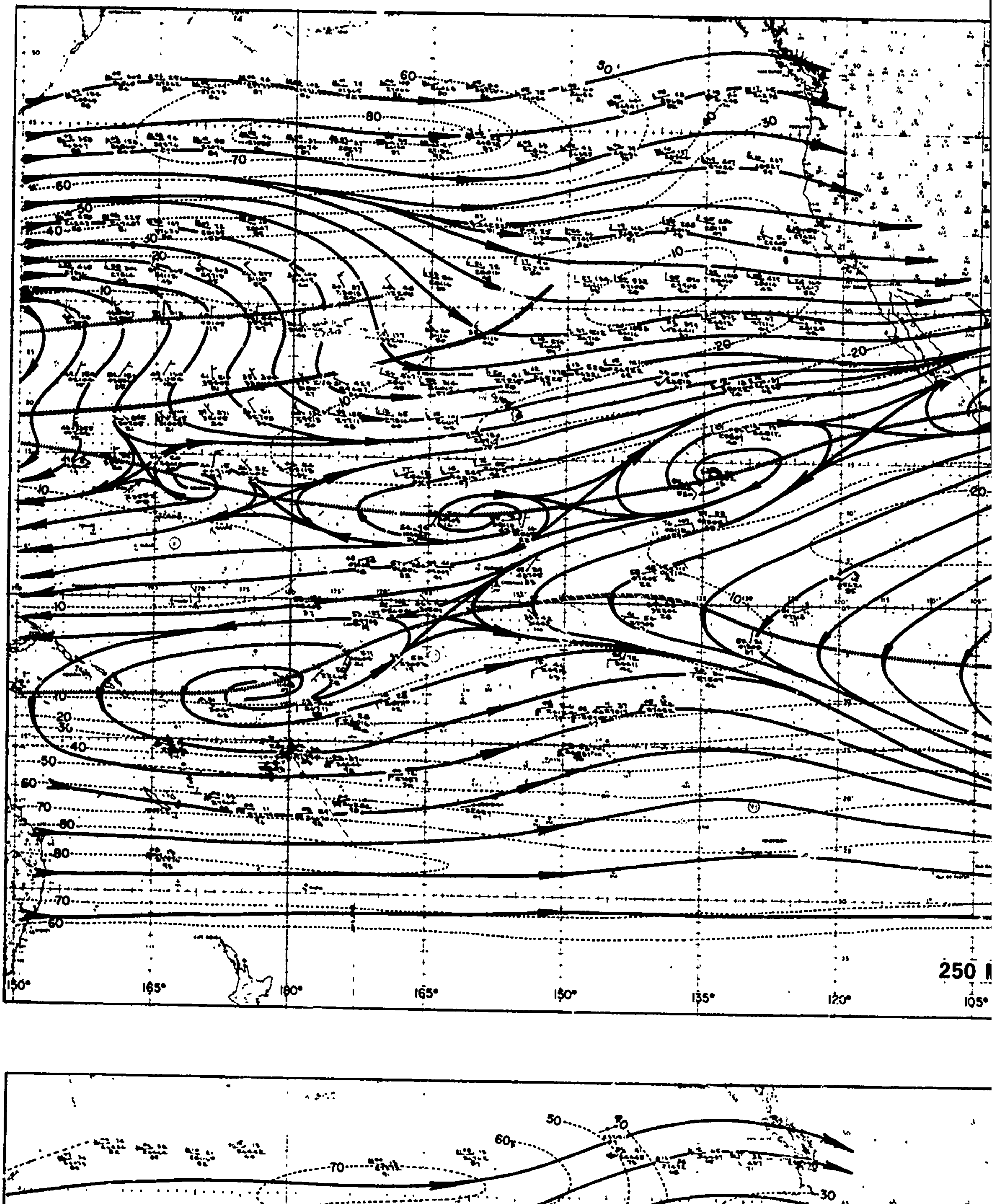
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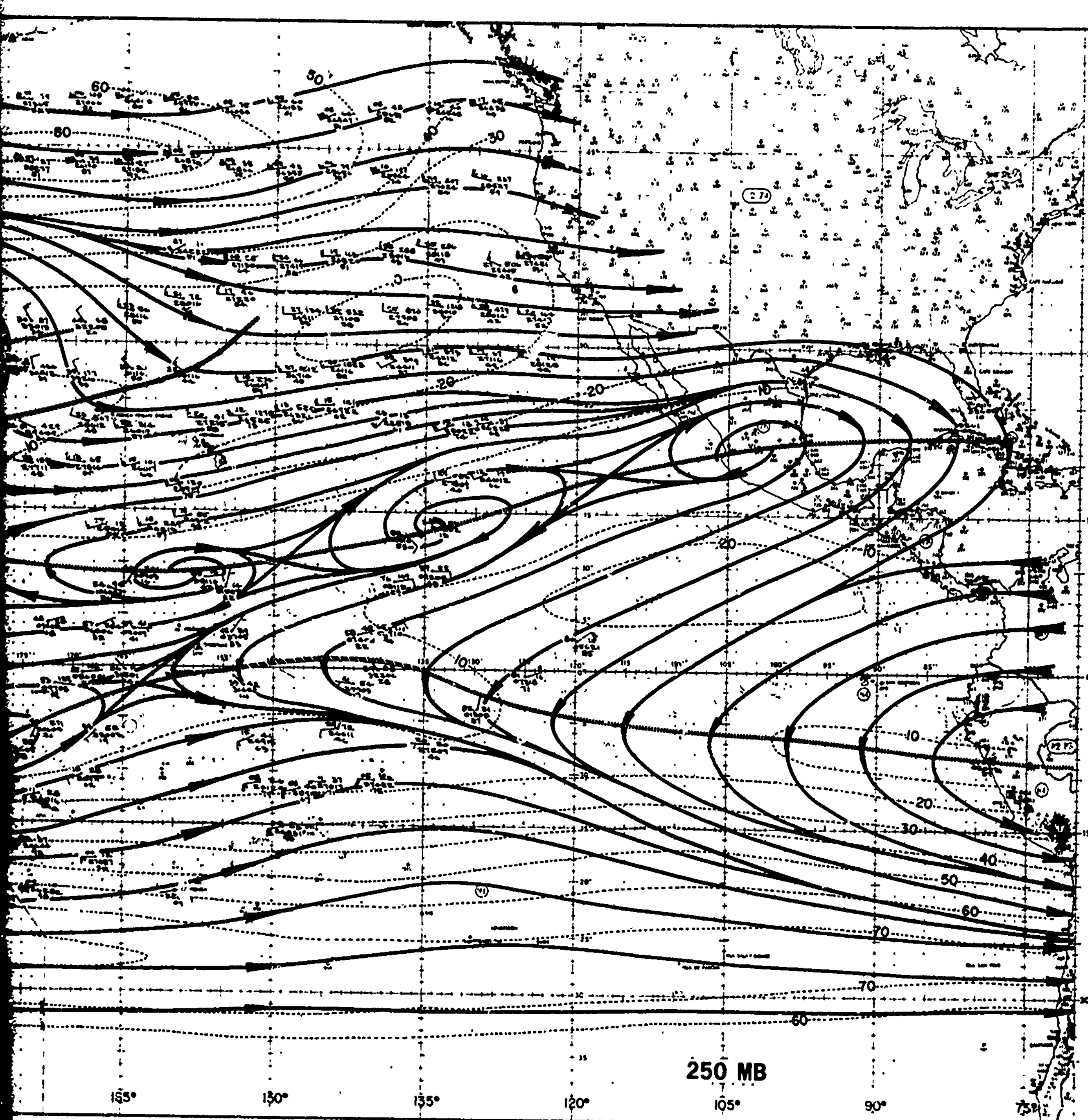
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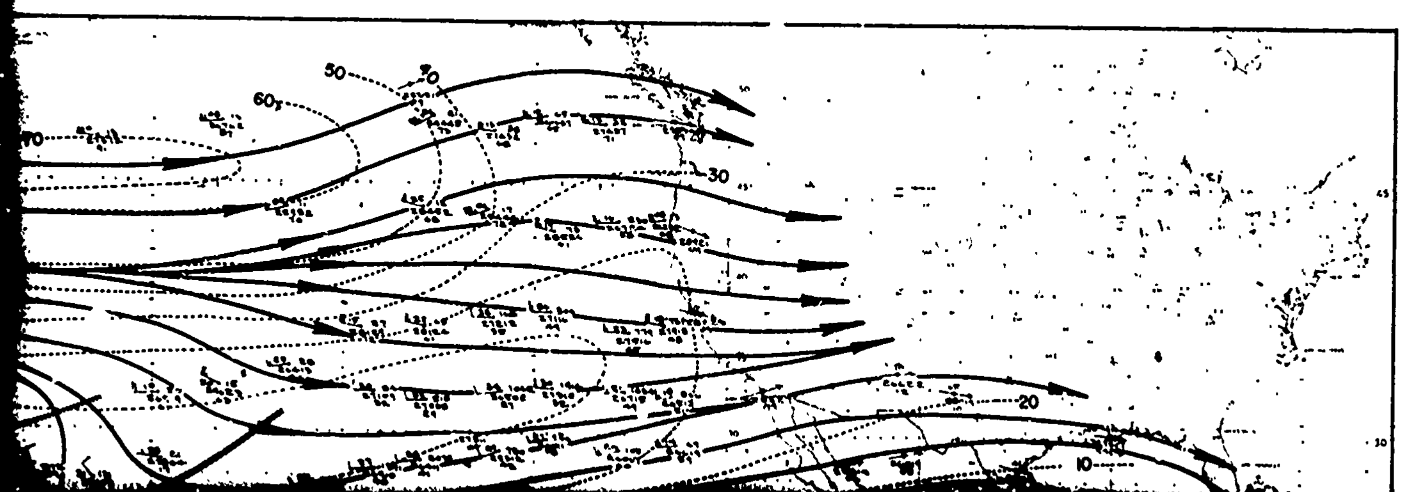

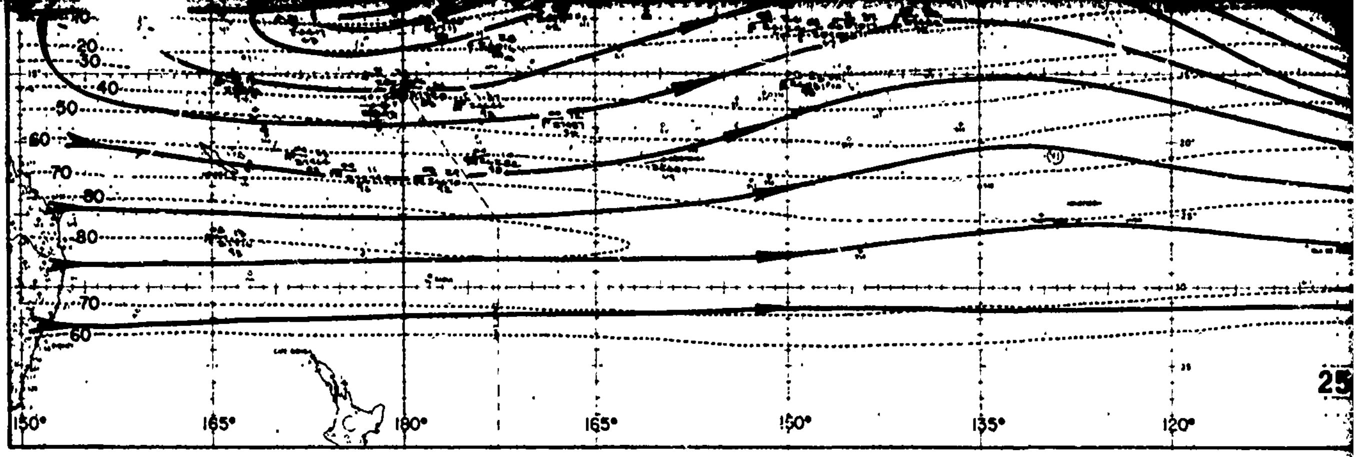
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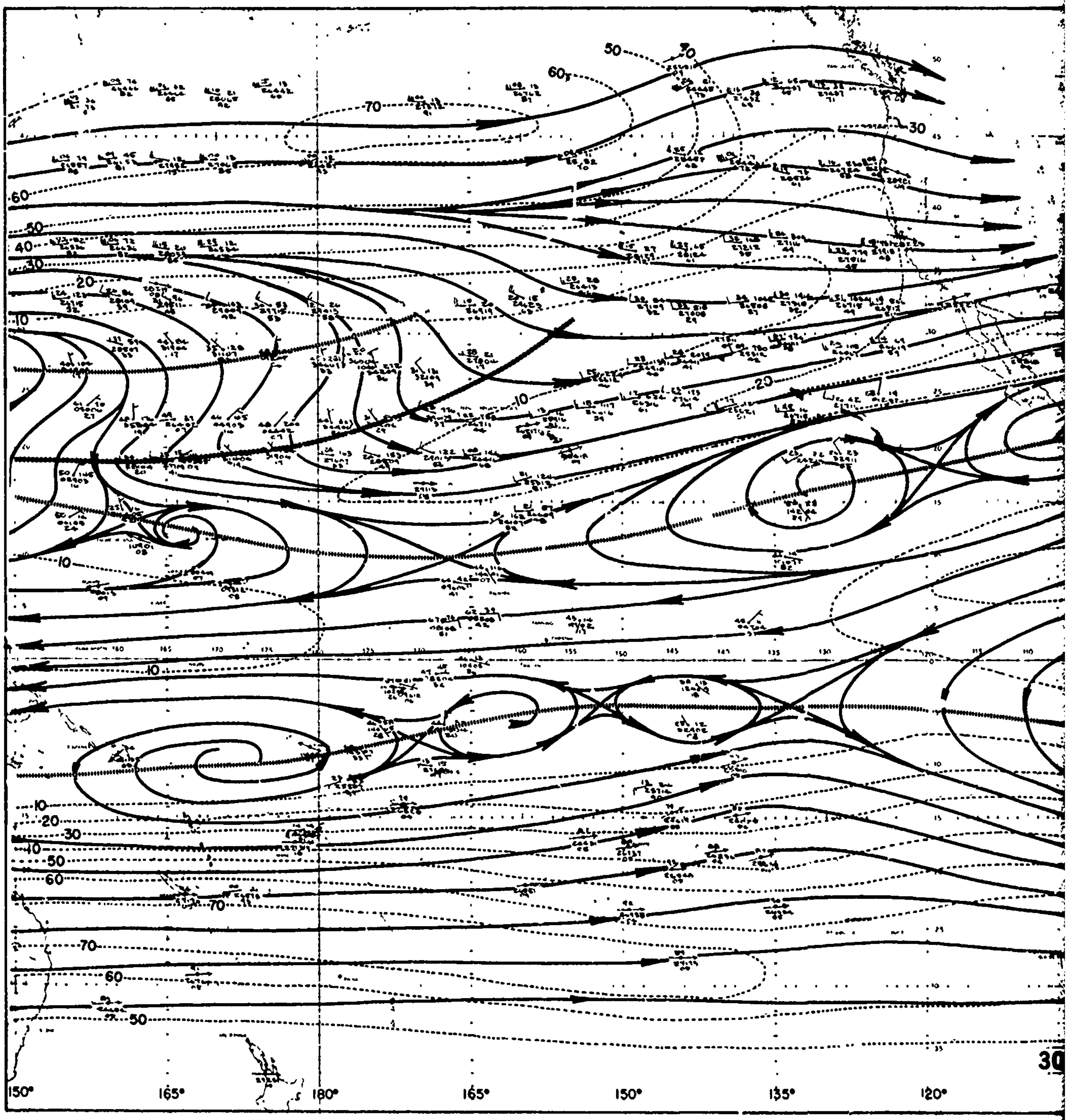
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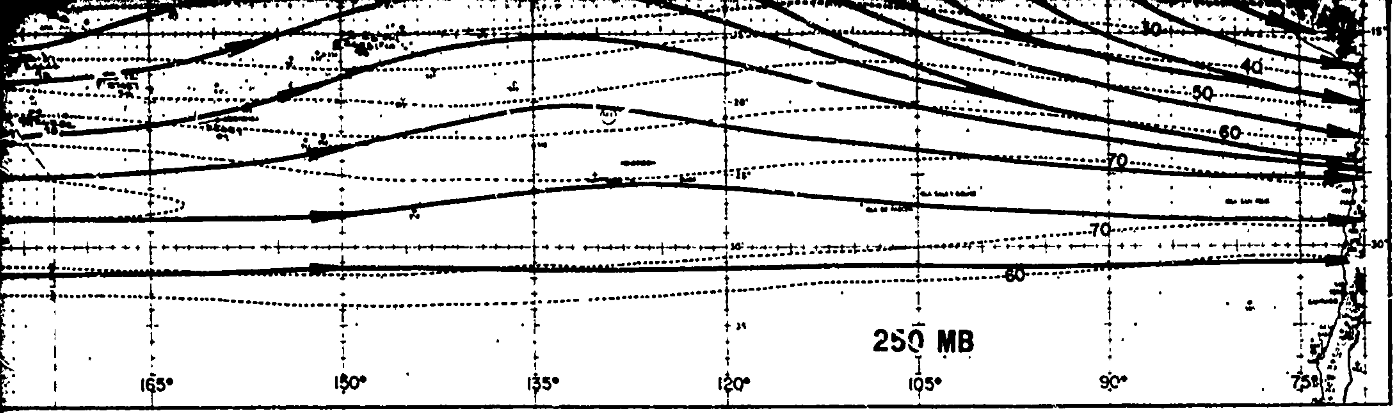
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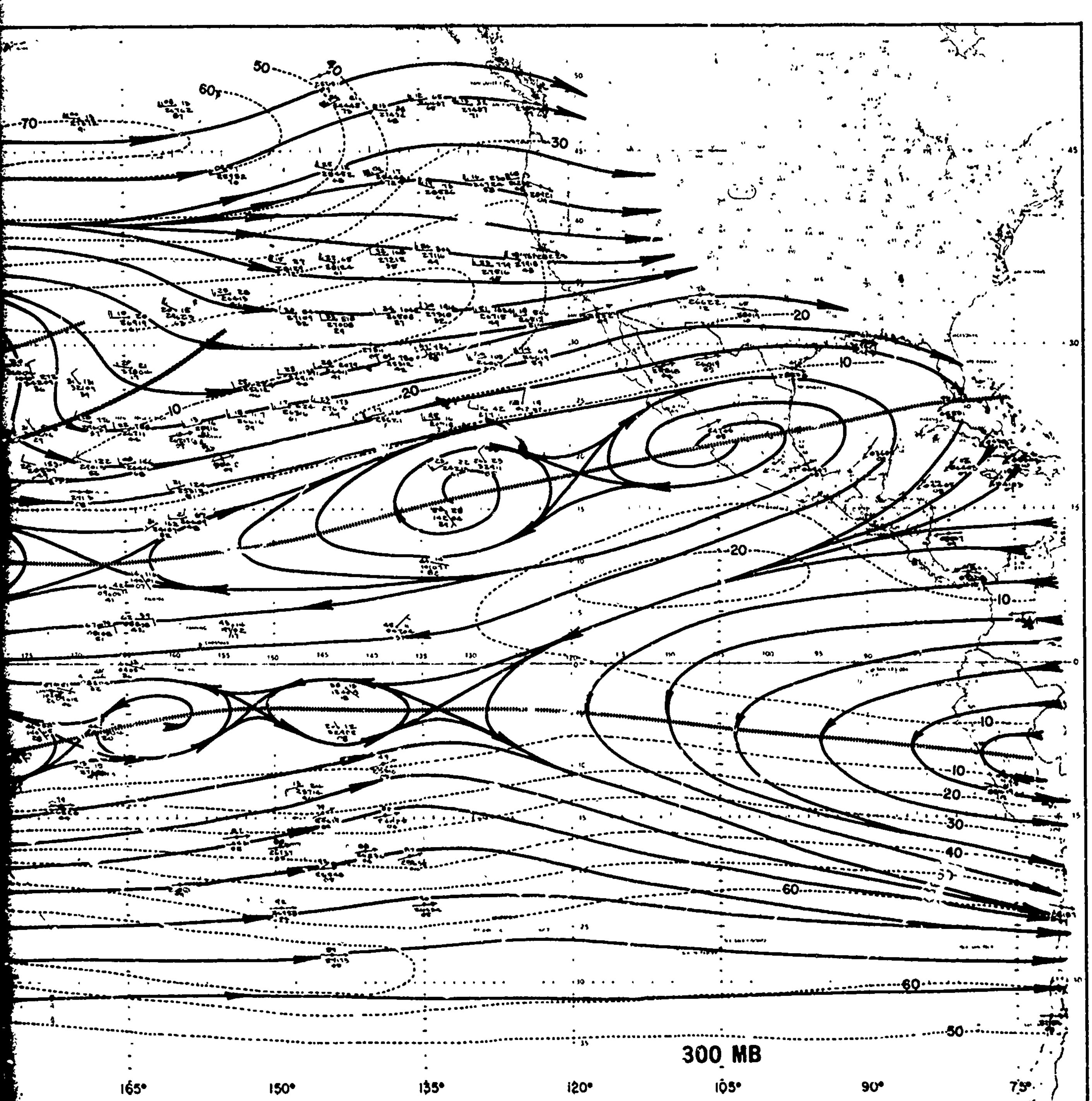
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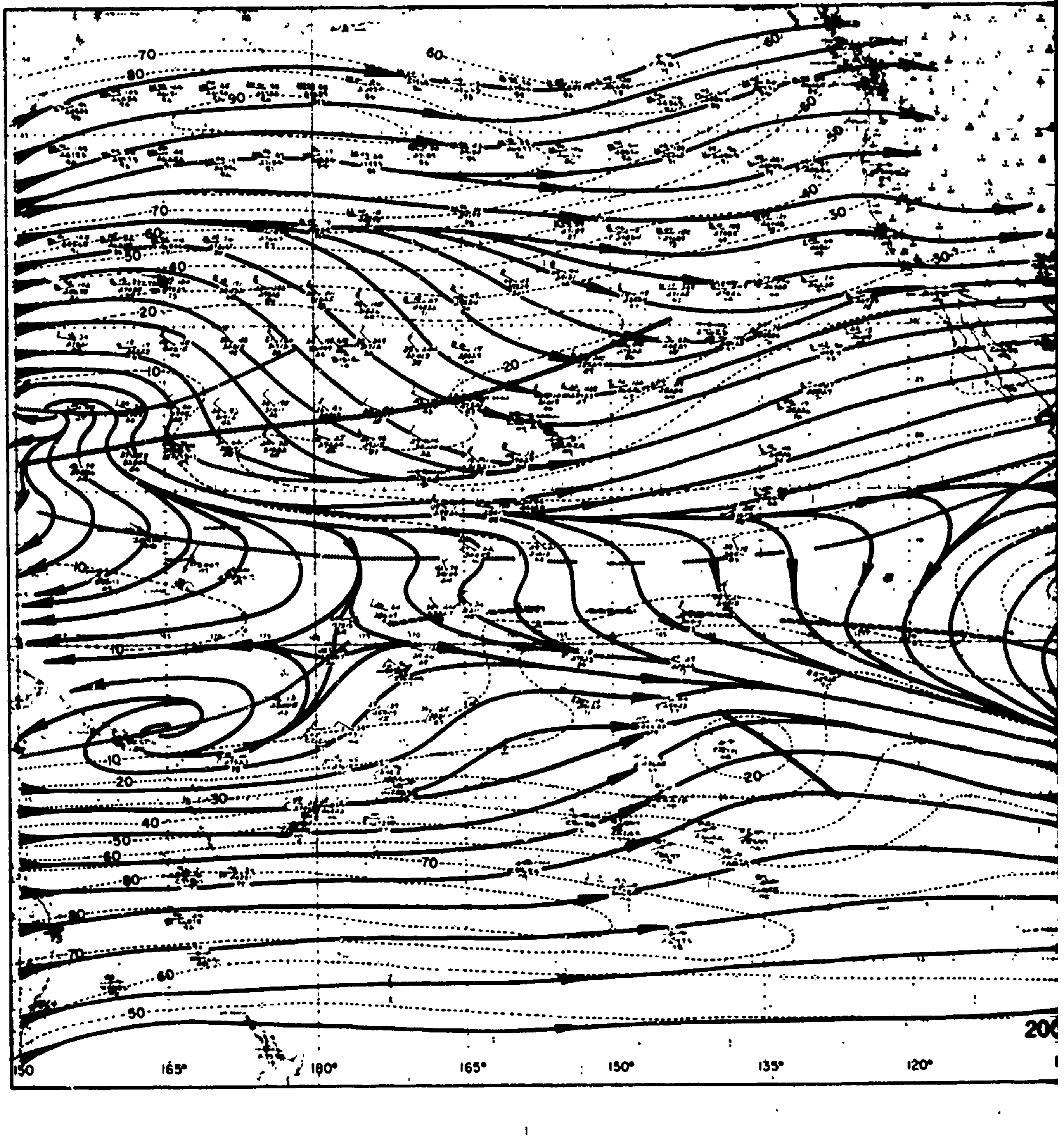

OCTOBER

Northern Hemisphere

The temperate westerlies have continued to increase. The maximum speed of near 90 kt remains near the dateline just north of 45N; however, there is a marked eastward extension of the high speed ribbon (similar to that of June), and a core of greater than 60 kt enters southwestern Canada.

The MPT has weakened considerably and moved southward.

Southern Hemisphere

The subtropical ridg
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Relatively strong w
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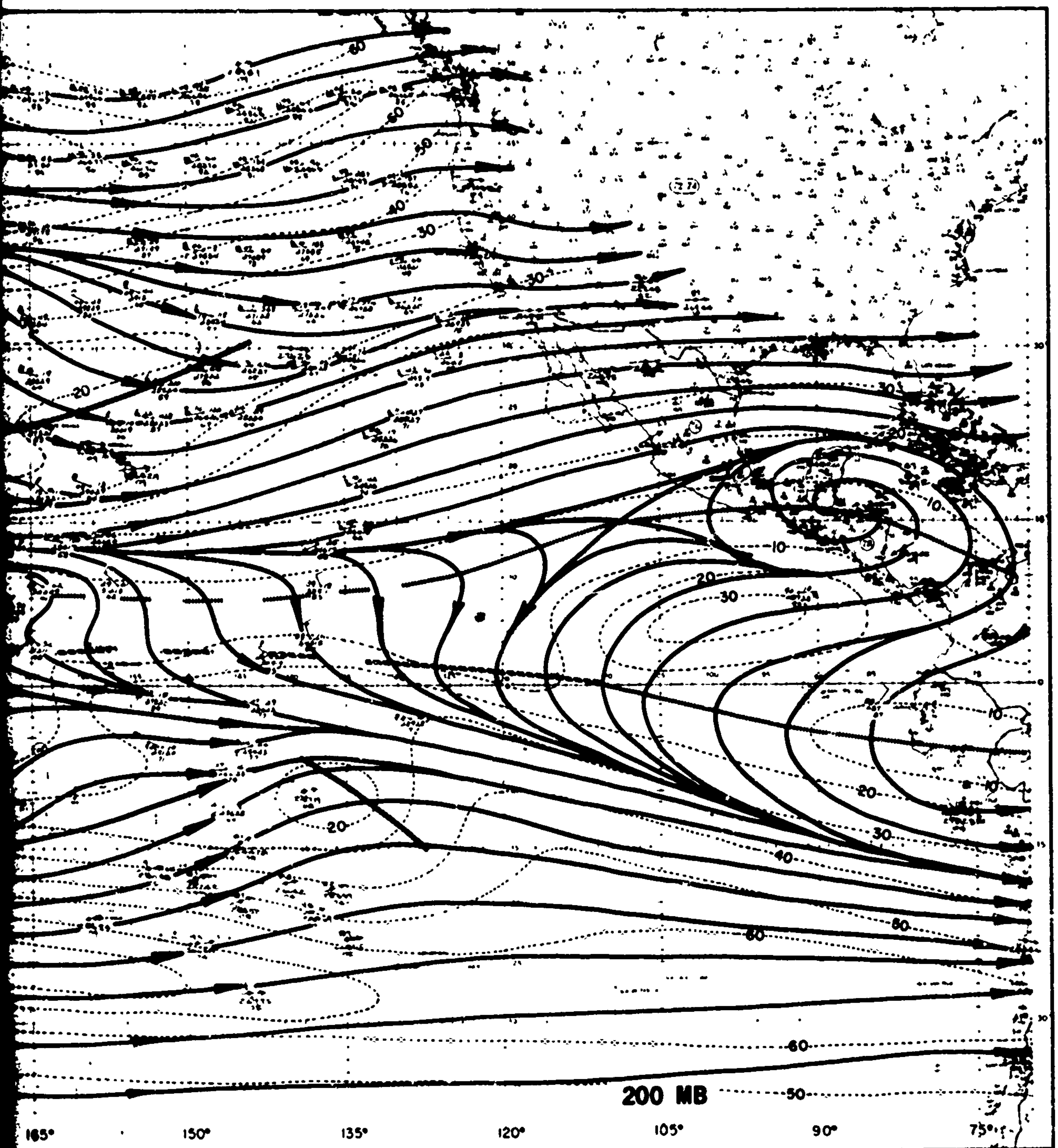

OCTOBER

Southern Hemisphere

The subtropical ridge is located near 10S at 155E and terminates near 180.

Relatively strong westerlies of 25 to 30 kt have returned to the equatorial region. The minimum speed over French Polynesia near 10S, between the re-established tropical westerlies and the stronger temperate westerlies to the south, indicates redevelopment of the TUTT.

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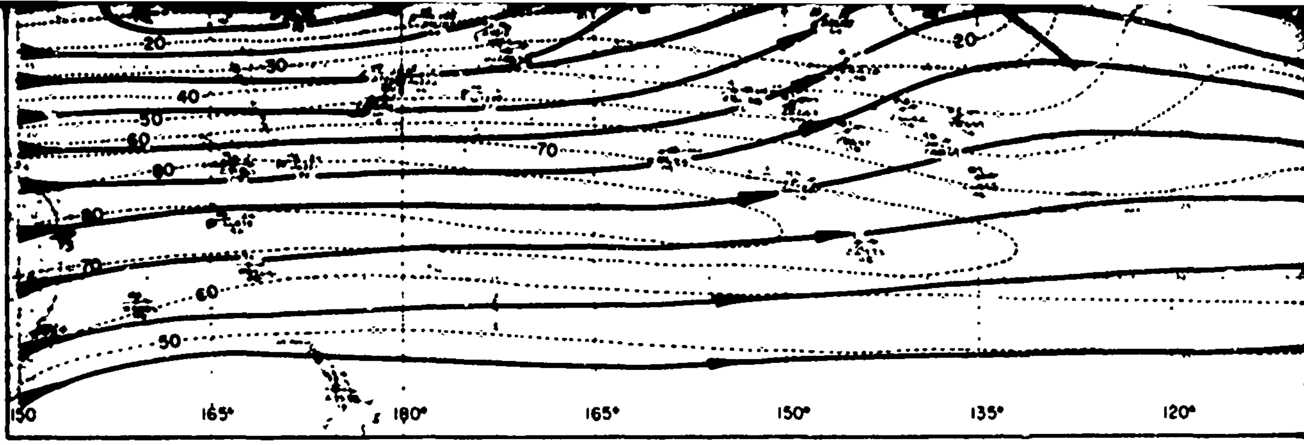

OCTOBER

Northern Hemisphere

The temperate westerlies have continued to increase. The maximum speed of near 90 kt remains near the dateline just north of 45N; however, there is a marked eastward extension of the high speed ribbon (similar to that of June), and a core of greater than 60 kt enters southwestern Canada.

The MPT has weakened considerably and moved southward.

A very thin ribbon of 30-kt subtropical westerlies extends from just south of Hawaii to the southern California coast.

The subtropical ridge has weakened markedly between 180 and 120W and moved southward. A strong anticyclonic cell remains north of 15N over Central America.

Southern Hemisphere

The subtropical r
near 180.

Relatively strong
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The temperate wes
core has moved equator
western South America.

Equatorial Region

Westerlies have r
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PIREP Winds

EE nnnn

dddfff
SS

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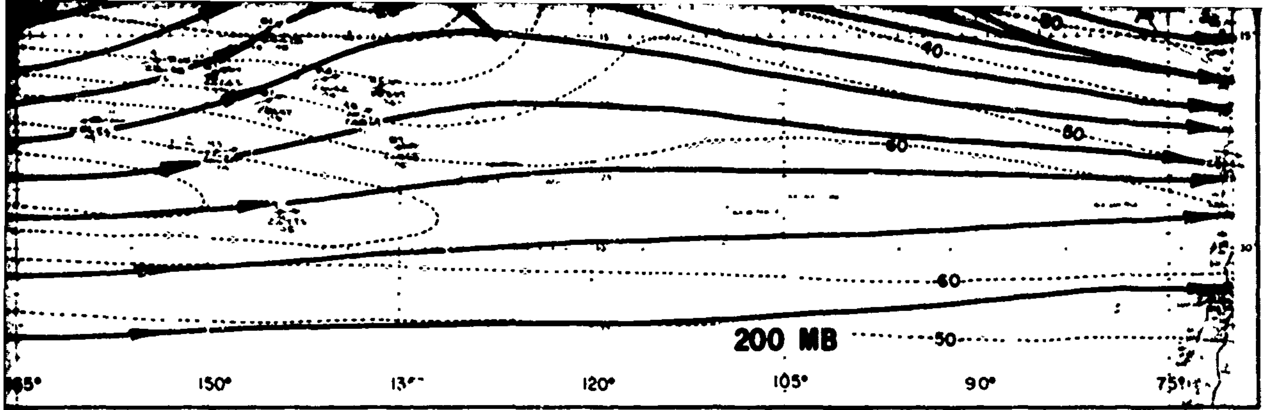

OCTOBER

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Southern Hemisphere

The subtropical ridge is located near 10S at 155E and terminates near 180.

Relatively strong westerlies of 25 to 30 kt have returned to the equatorial region. The minimum speed over French Polynesia near 10S, between the re-established tropical westerlies and the stronger temperate westerlies to the south, indicates redevelopment of the TUTT.

The temperate westerlies have decreased throughout. The maximum core has moved equatorward over the western Pacific and poleward over western South America.

Equatorial Region

Westerlies have returned to the equatorial region between 180W and 130W. The easterly current over the eastern Pacific north of the equator remains well organized with maximum speeds near 30 kt.

EE	-percentage of winds with an east component
nnnn	-number of observations
ddd	-mean resultant wind direction
fff	-mean resultant wind speed in knots (flag = 50 knots, long barb = 10 knots, short barb = 5 knots)
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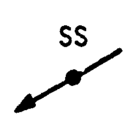
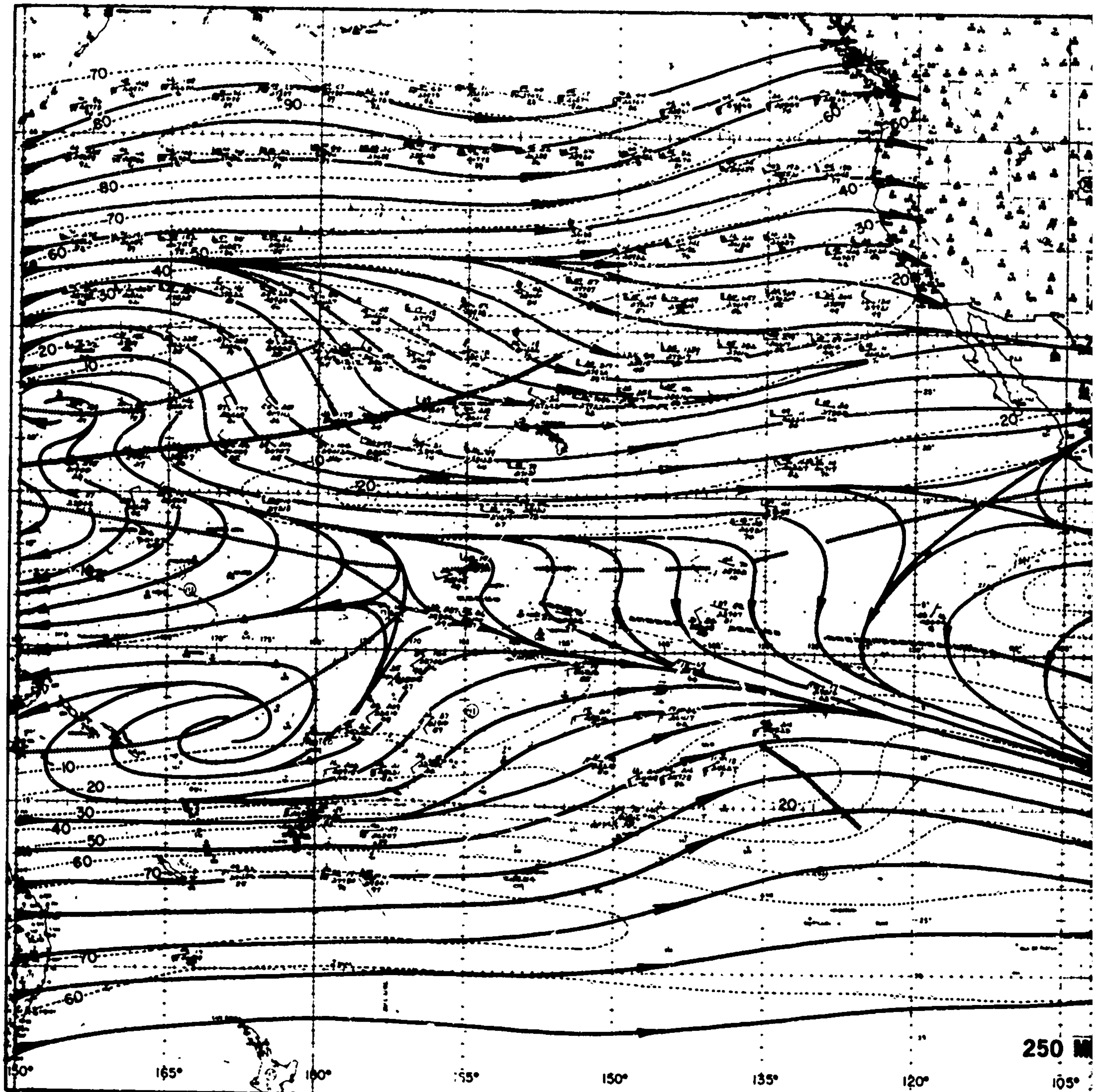
Rawins

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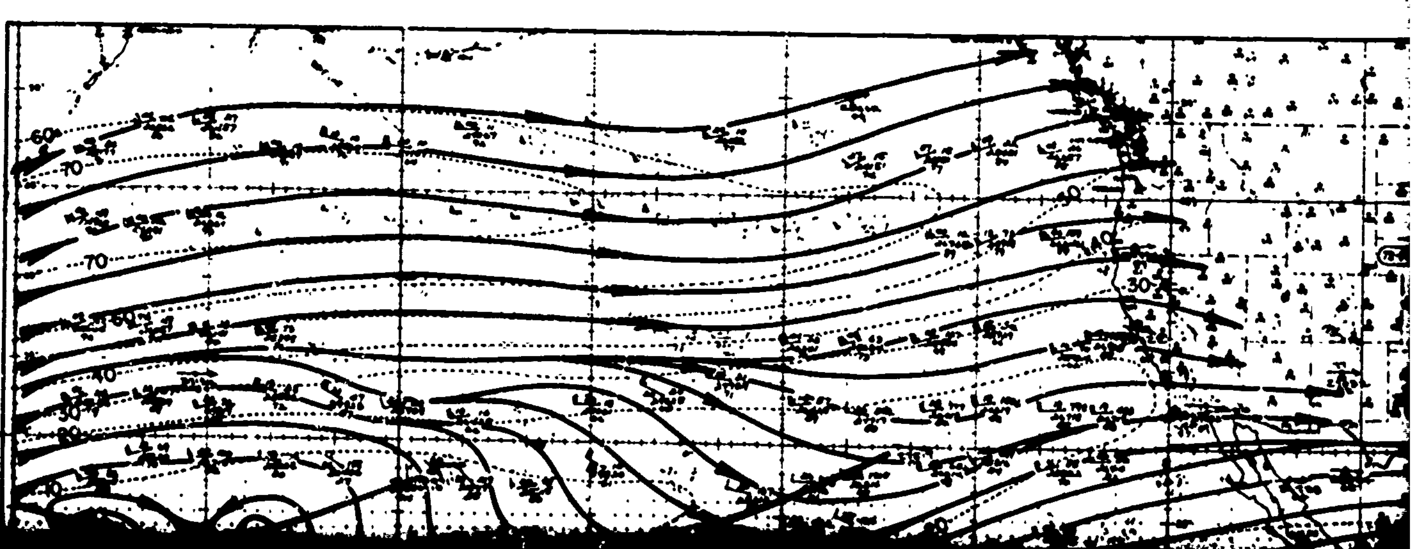

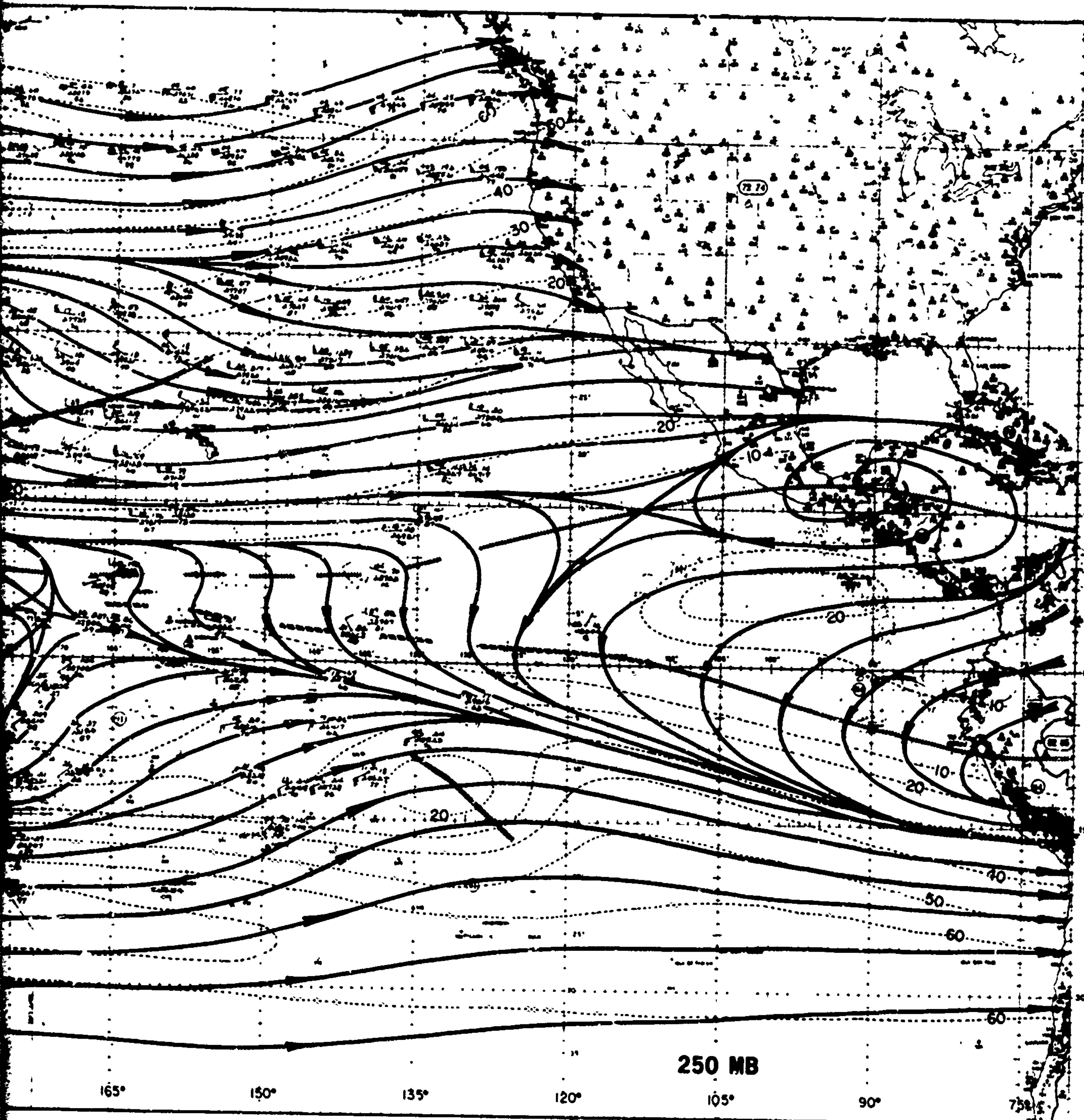
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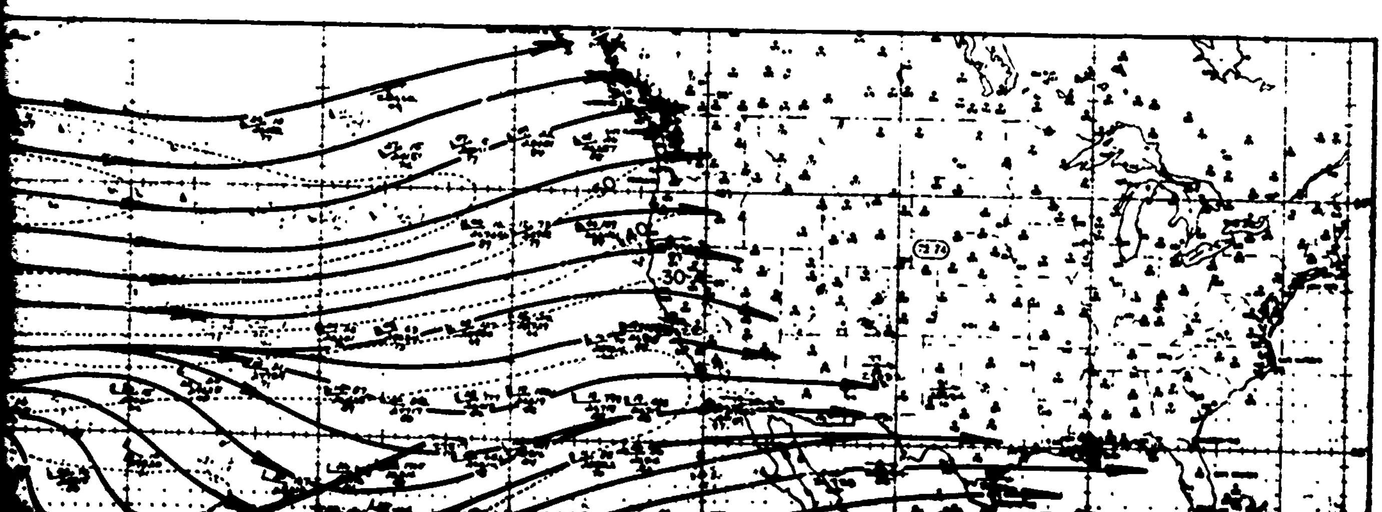

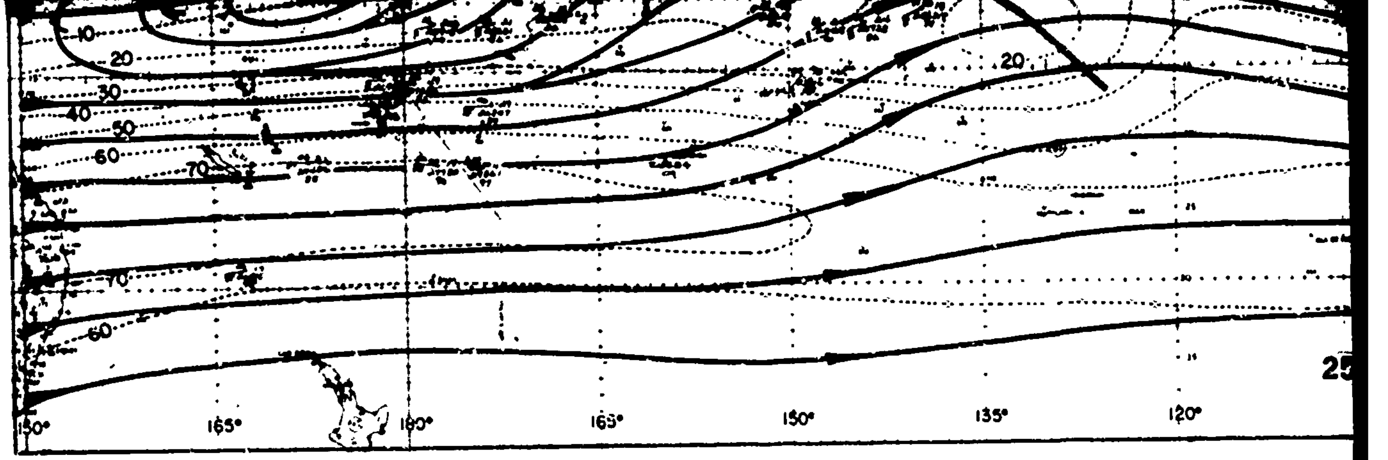
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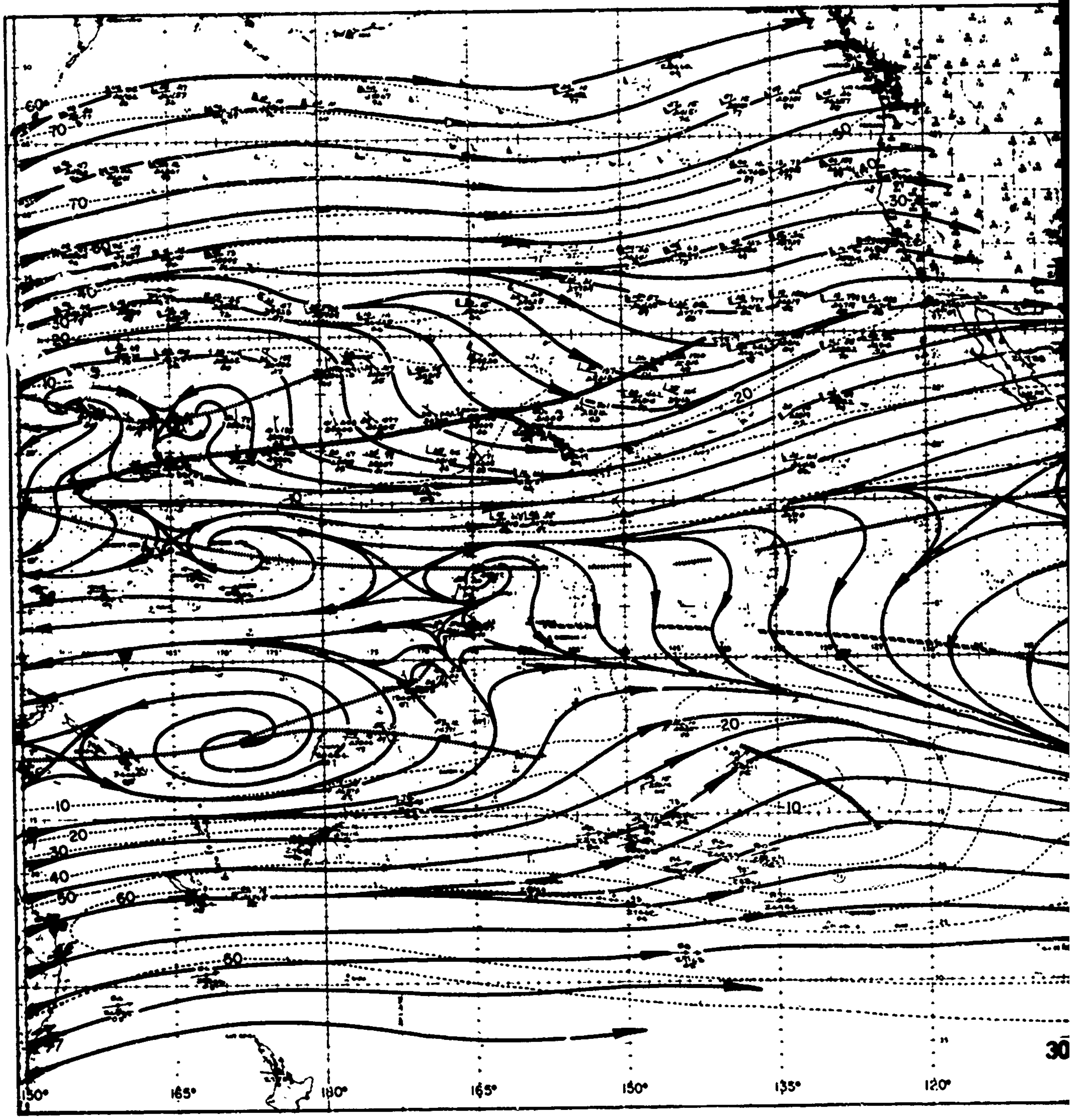
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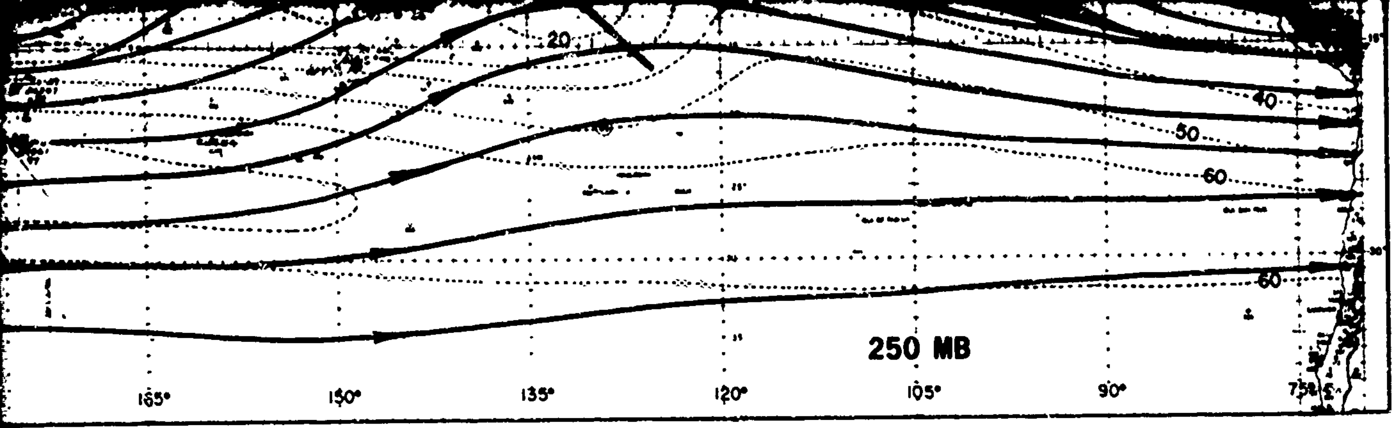
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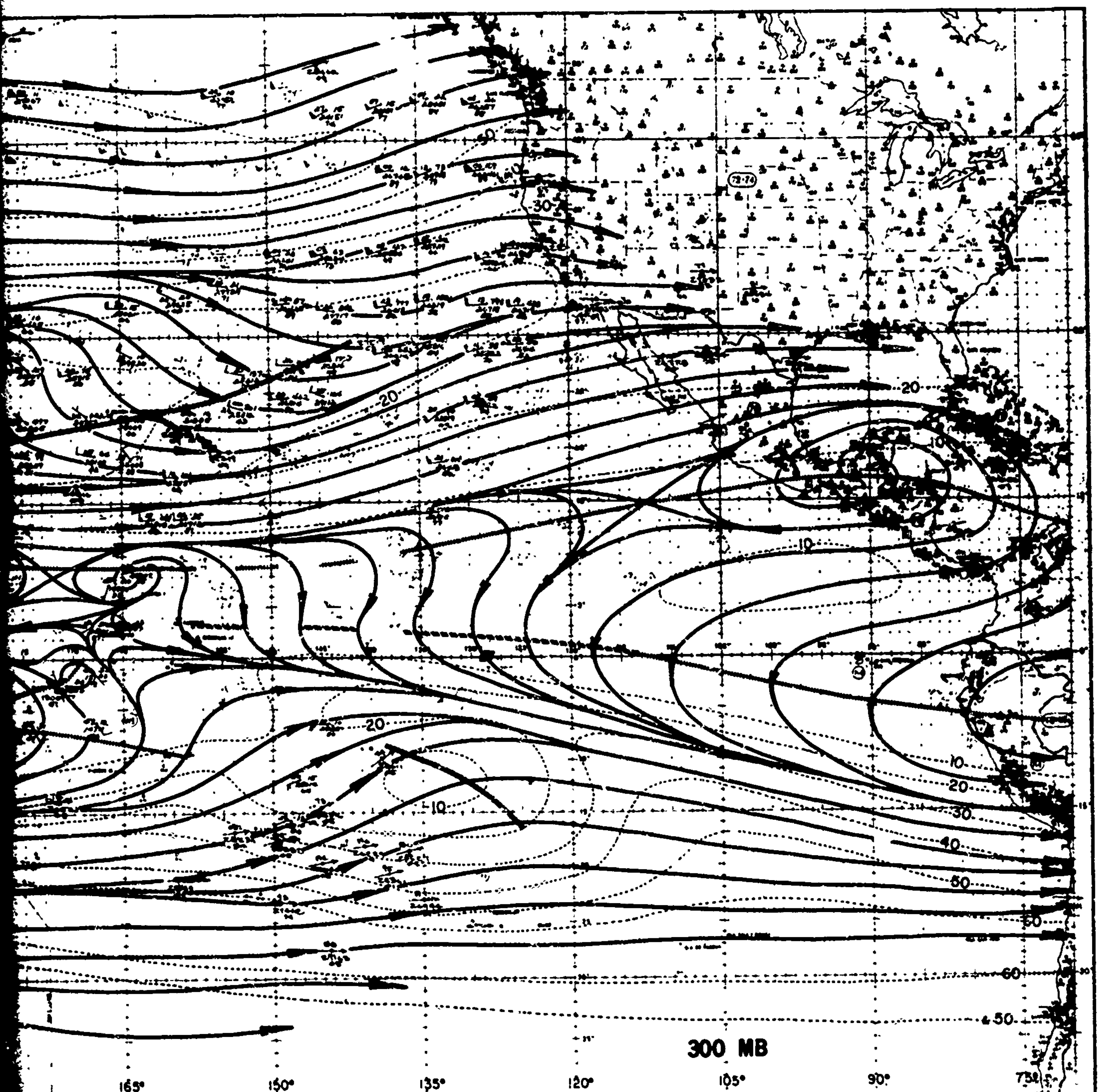
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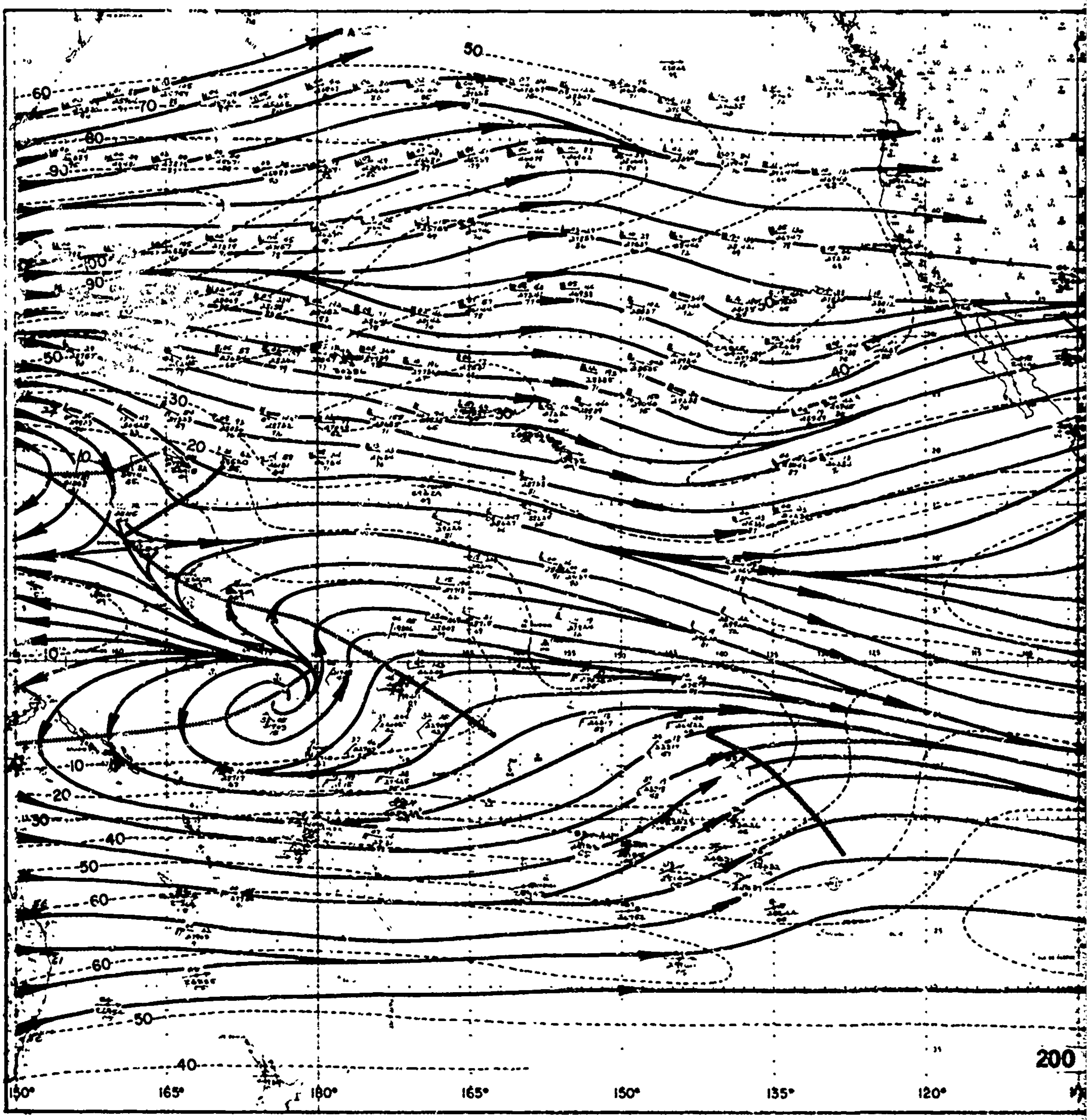


NOVEMBER

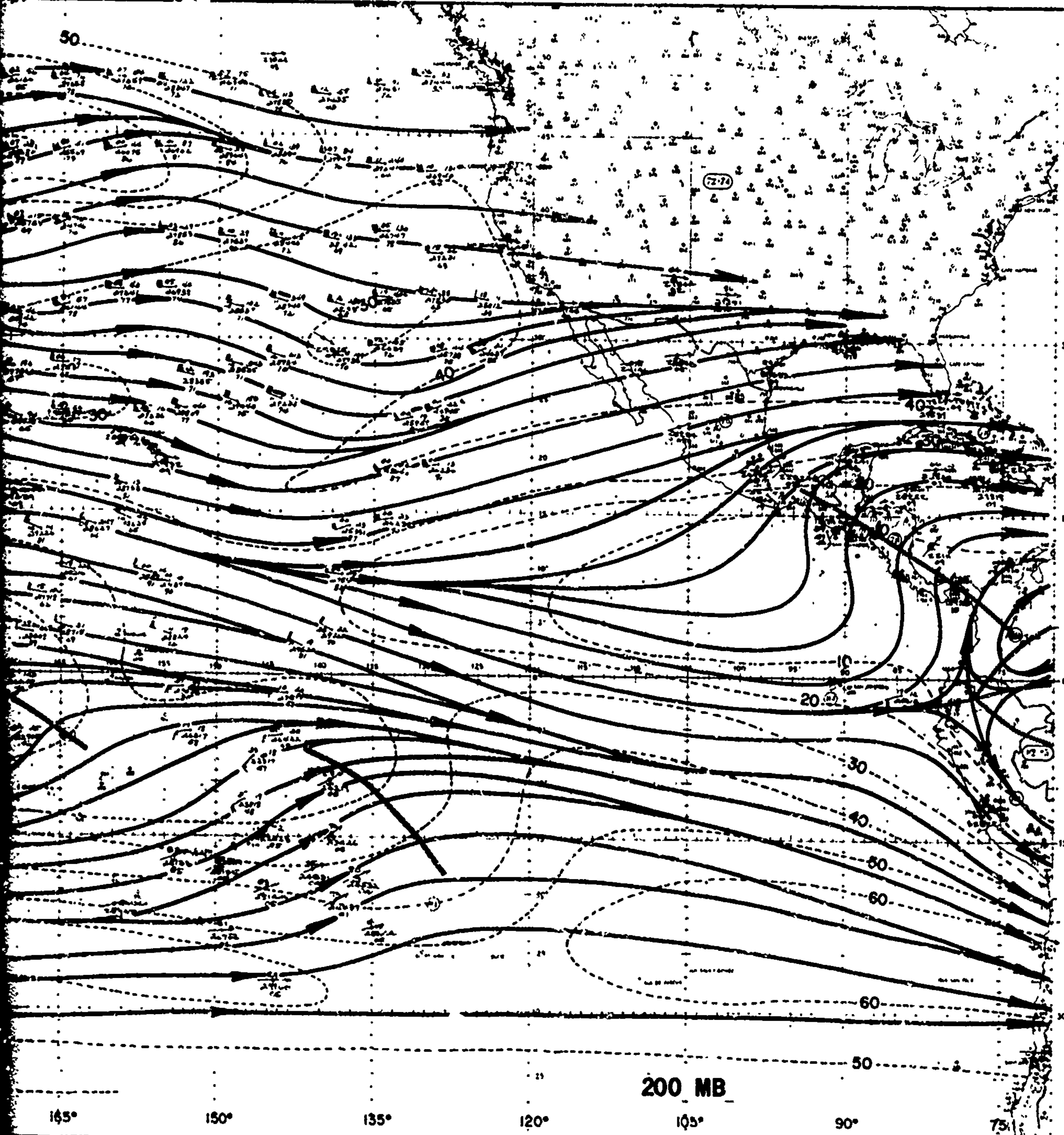
Northern Hemisphere

The temperate westerlies change considerably from October to November. The October maximum in the region of the dateline at 45N has disappeared, and the winter pattern of the highest speeds over Japan near 35N has been re-established. The eastward extension of the high speeds in October has disappeared, and relative minimum speeds exist off the western coast of North America.

The subtropical ridgo a weak ridge extends from n Central America.

Southern Hemisphere

The temperate westerl Pacific; however, they hav to the re-establishment of



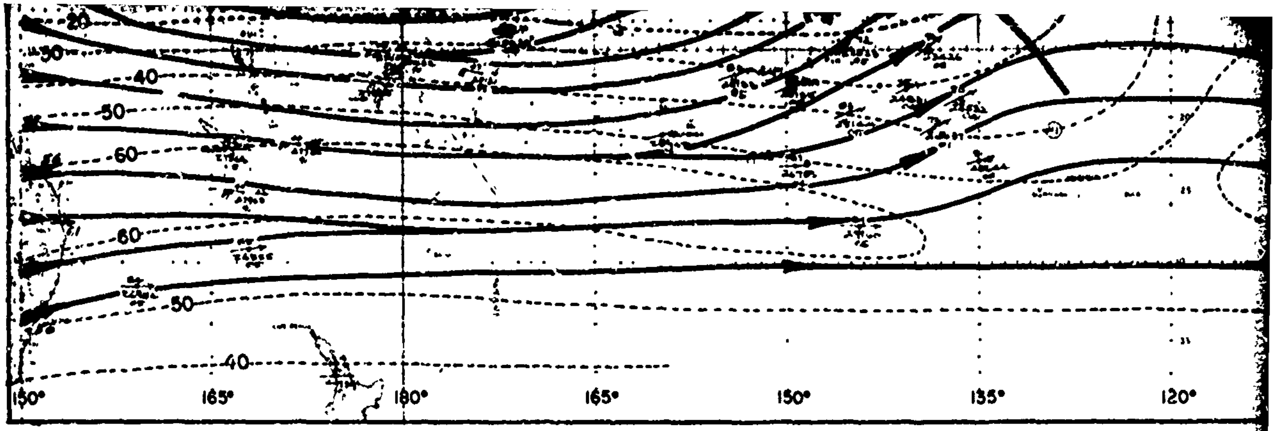
NOVEMBER

y from October to the dateline at 45N highest speeds over stward extension of relative minimum ica.

The subtropical ridge in the eastern Pacific has disappeared, and a weak ridge extends from northern South America northwestward over Central America.

Southern Hemisphere

The temperate westerlies have continued to decrease in the western Pacific; however, they have increased over western South America due



NOVEMBER

Northern Hemisphere

The temperate westerlies change considerably from October to November. The October maximum in the region of the dateline at 45N has disappeared, and the winter pattern of the highest speeds over Japan near 35N has been re-established. The eastward extension of the high speeds in October has disappeared, and relative minimum speeds exist off the western coast of North America.

The subtropical current has increased in the eastern Pacific. Core speeds of near 45 kt extend from 22N, 135W eastward across Baja California.

The MPT has essentially disappeared. It is split into two weak segments, one west of 180 and the other east of weather ship November (30N, 140W) and Hawaii.

The subtropica
a weak ridge extend
Central America.

Southern Hemisphere

The temperate
Pacific; however, t
to the re-establish
equatorward of the

Equatorial Region

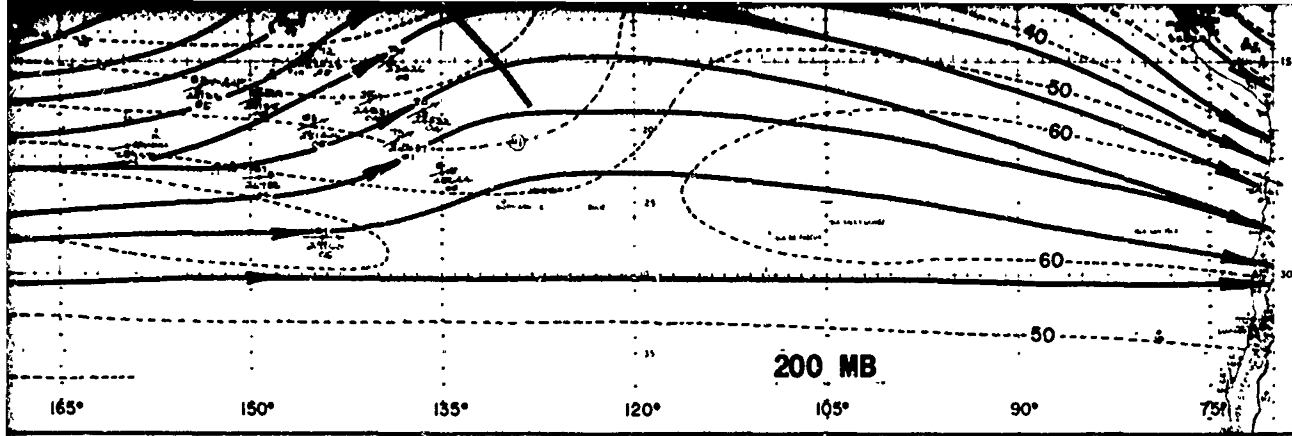
Westerlies hav
ward to South Amer
eastern Pacific nor
of summer has disap

PIREP Winds

EE nnnn

dddfff
SS

EE	-percentage of winds with an east comp	
nnnn	-number of observations	
ddd	-mean resultant wind direction	
fff	-mean resultant wind speed in knots (f 50 knots, long barb = 10 knots, short barb = 5 knots)	
SS	-steadiness of winds in percent	
NN	-number of years of record	



NOVEMBER

y from October to
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weather ship November

The subtropical ridge in the eastern Pacific has disappeared, and a weak ridge extends from northern South America northwestward over Central America.

Southern Hemisphere

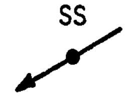
The temperate westerlies have continued to decrease in the western Pacific; however, they have increased over western South America due to the re-establishment of the subtropical northwesterly stream equatorward of the TUTT.

Equatorial Region

Westerlies have returned to the equatorial strip from 180 eastward to South America. The greatest change has occurred over the eastern Pacific north of the equator where the strong northeast current of summer has disappeared.

EE	-percentage of winds with an east component
nnnn	-number of observations
ddd	-mean resultant wind direction
fff	-mean resultant wind speed in knots (flag= 50 knots, long barb = 10 knots, short barb = 5 knots)
SS	-steadiness of winds in percent
NN	-number of years of record

Rawins

SS

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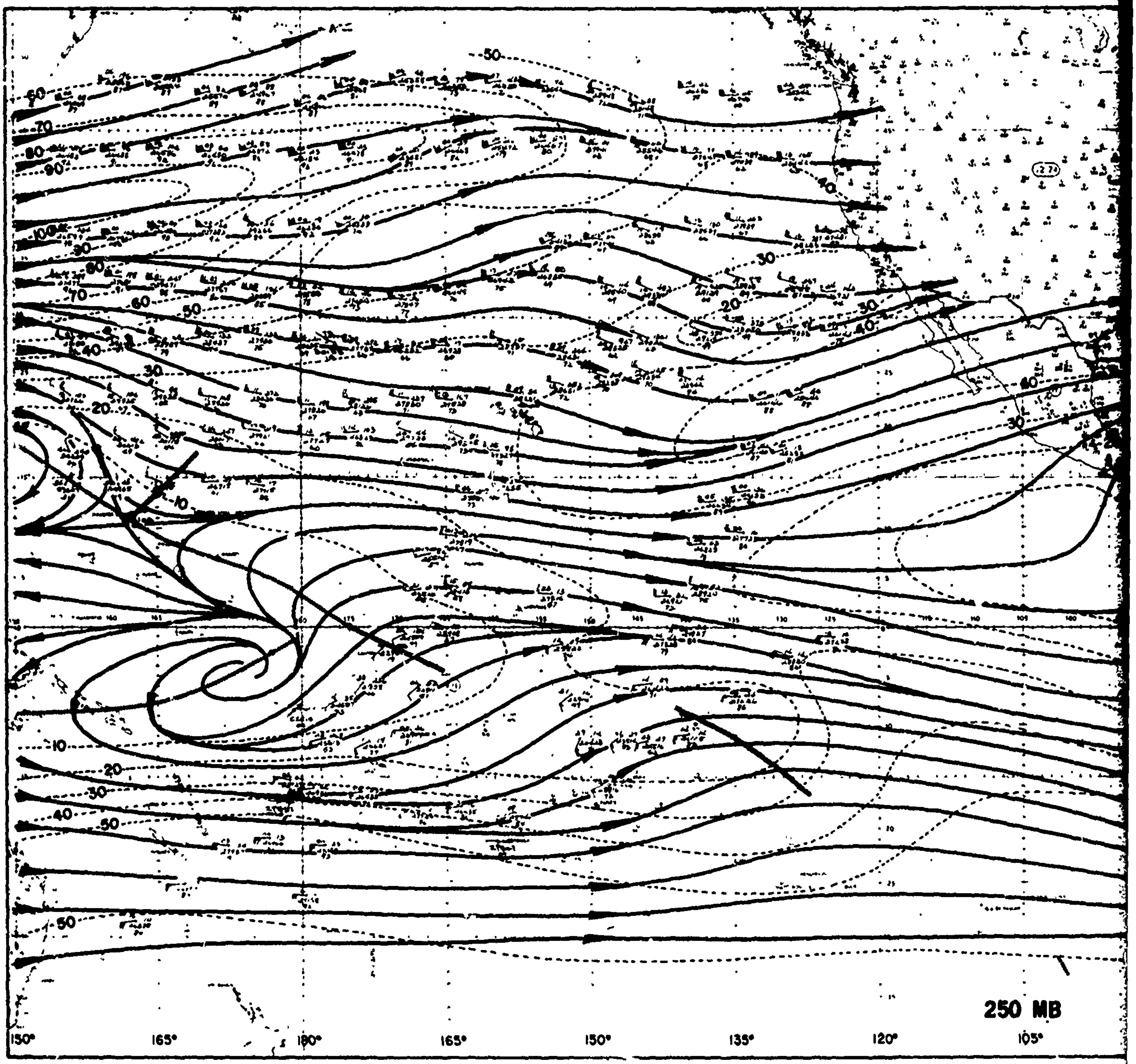
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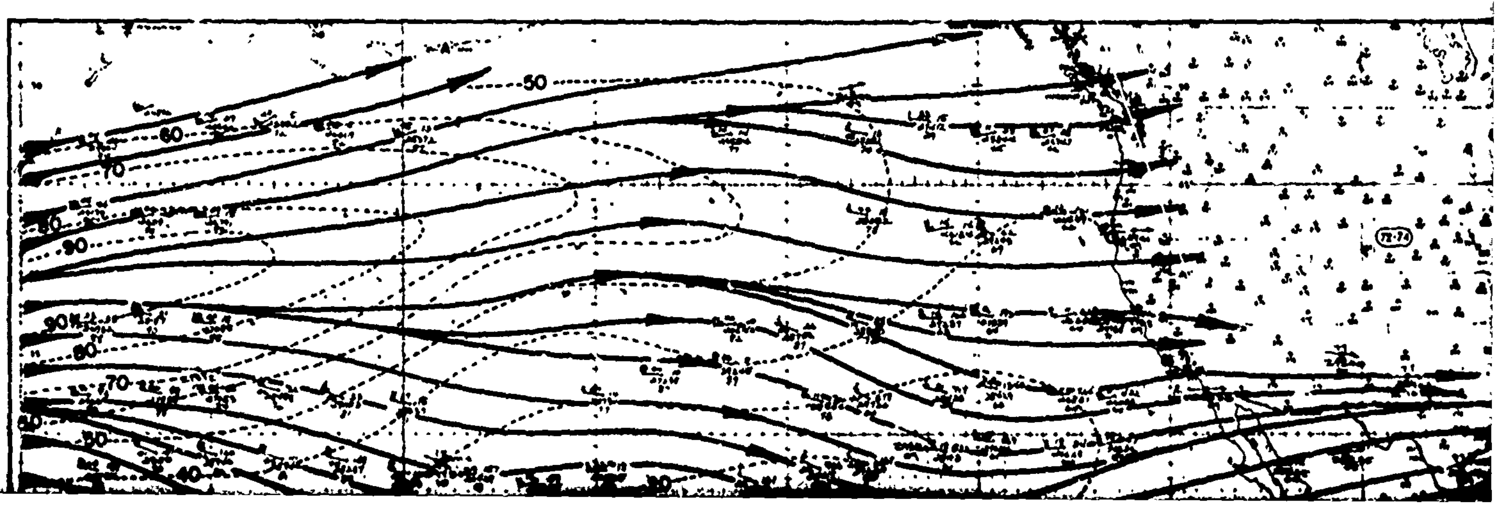

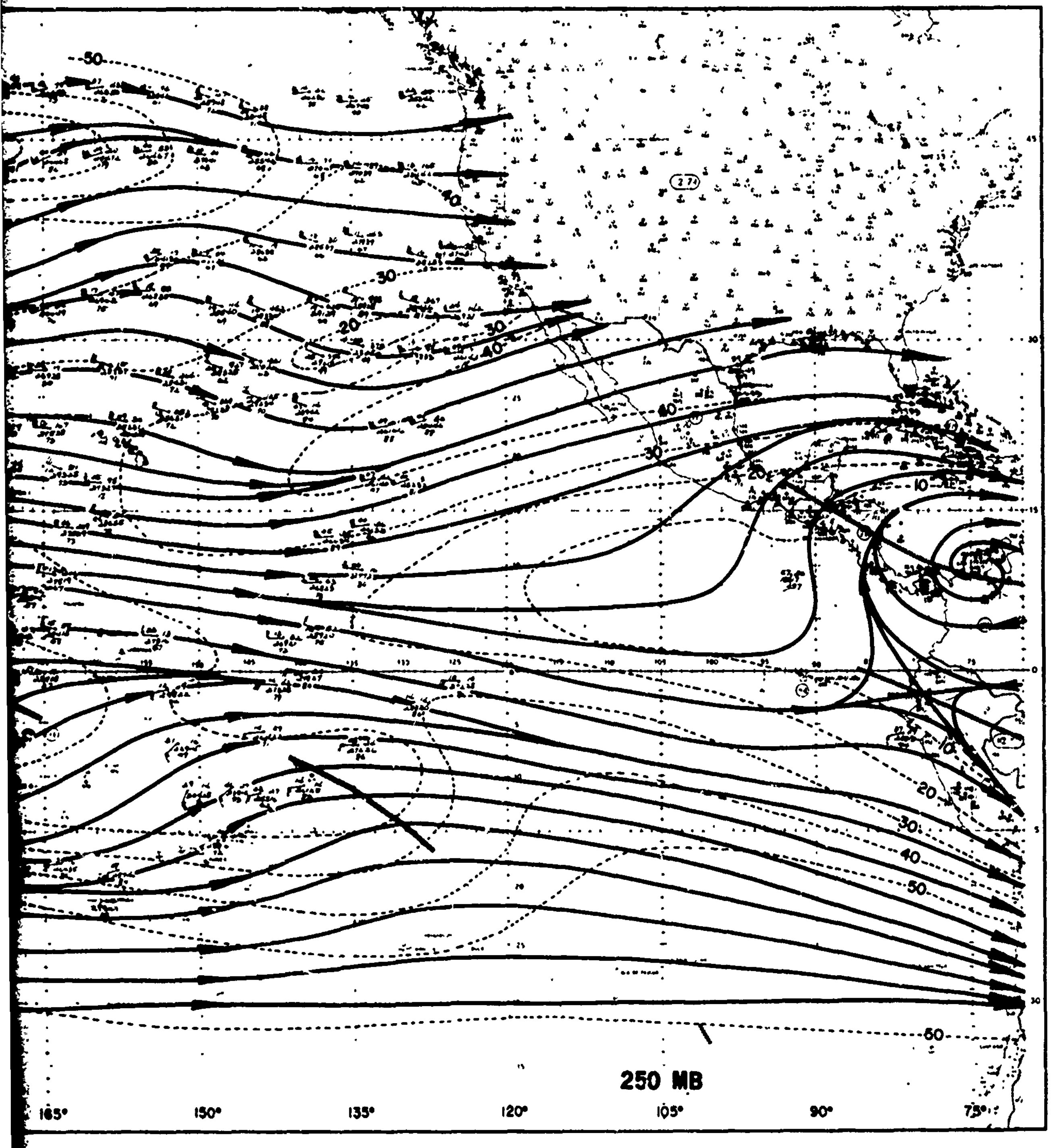
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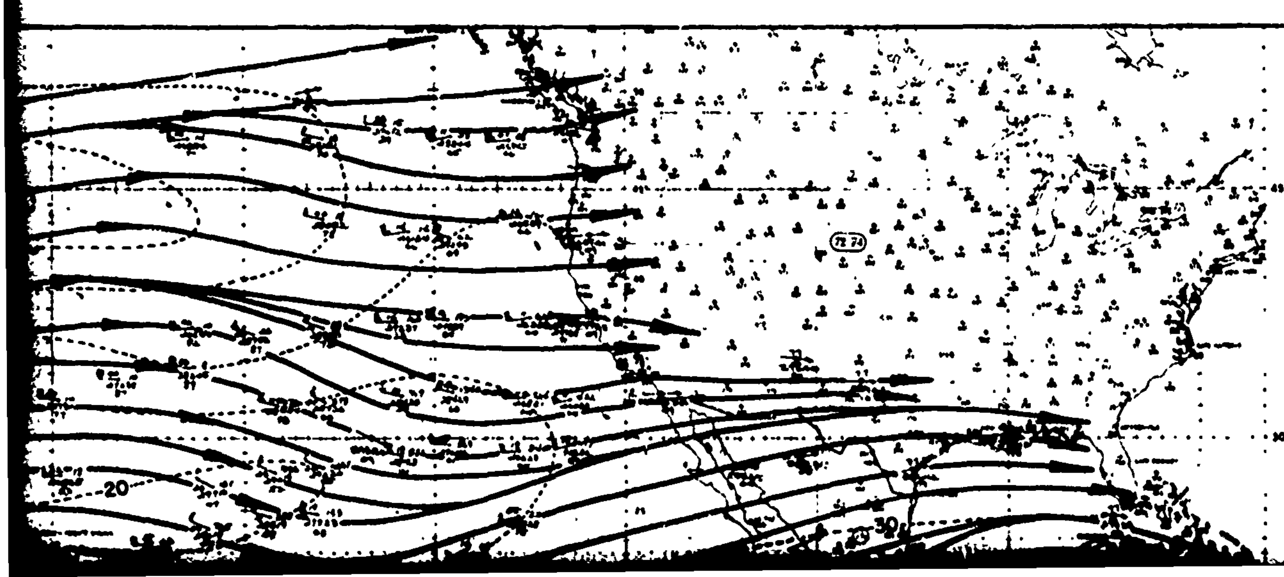
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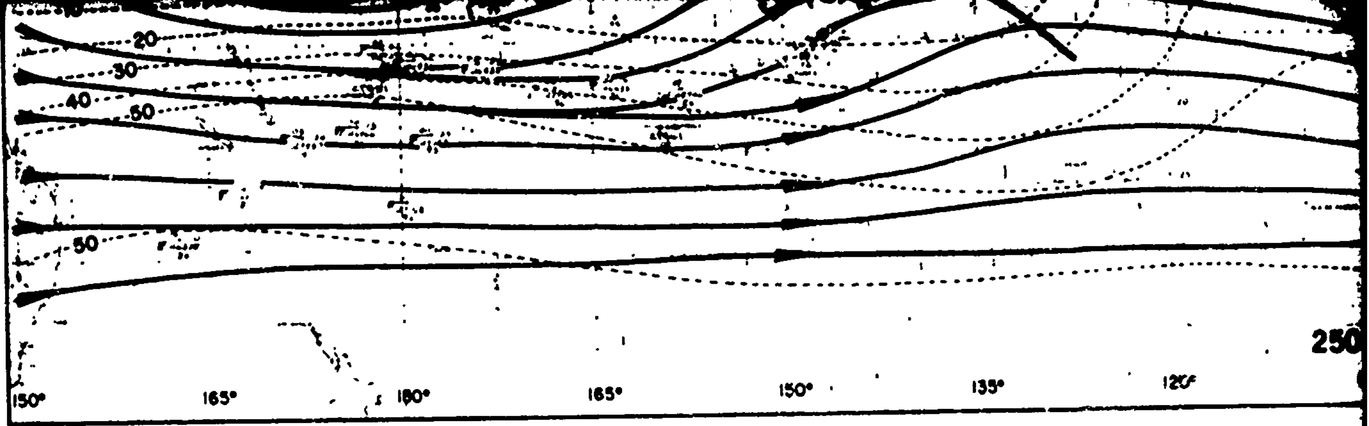
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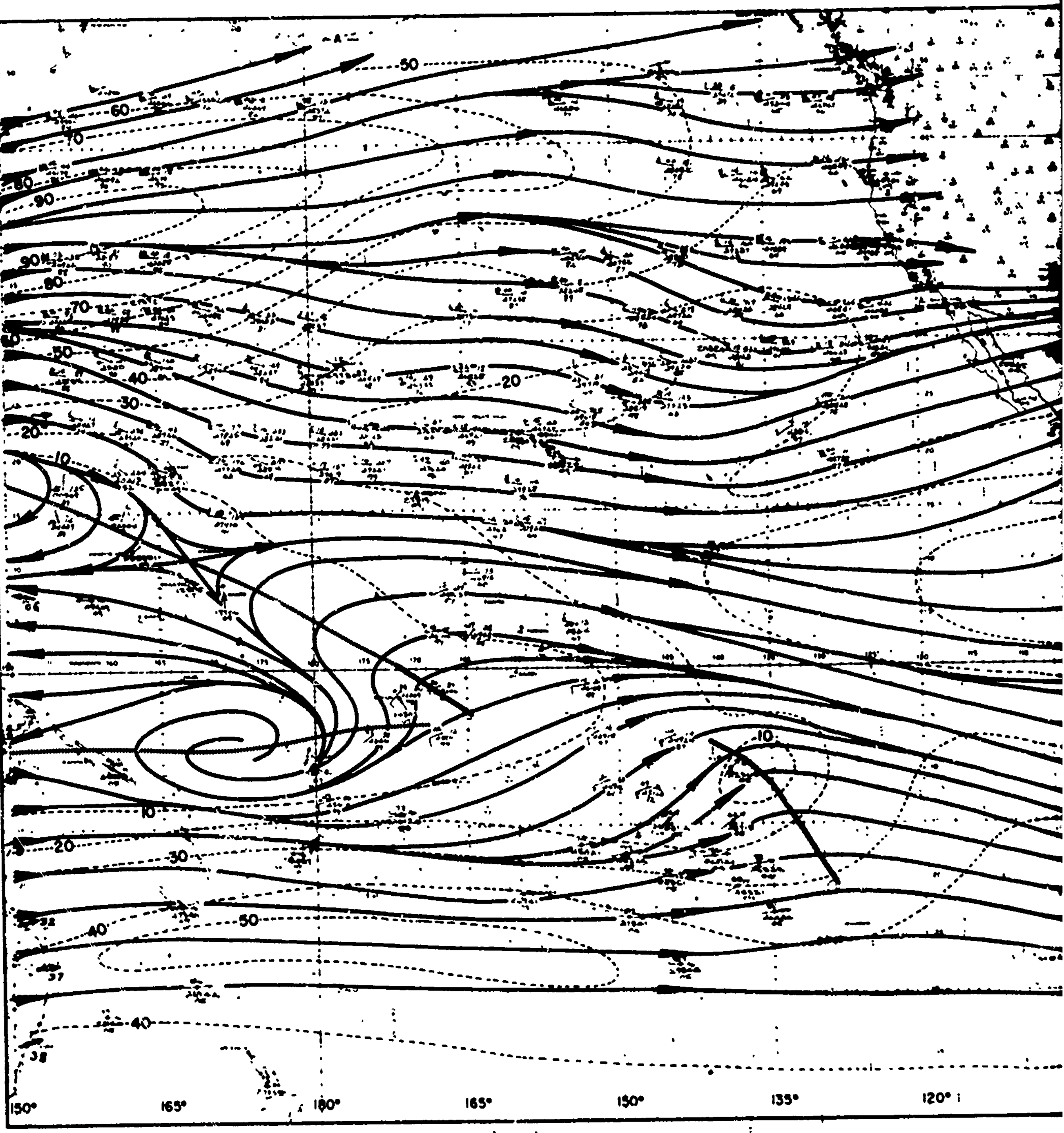
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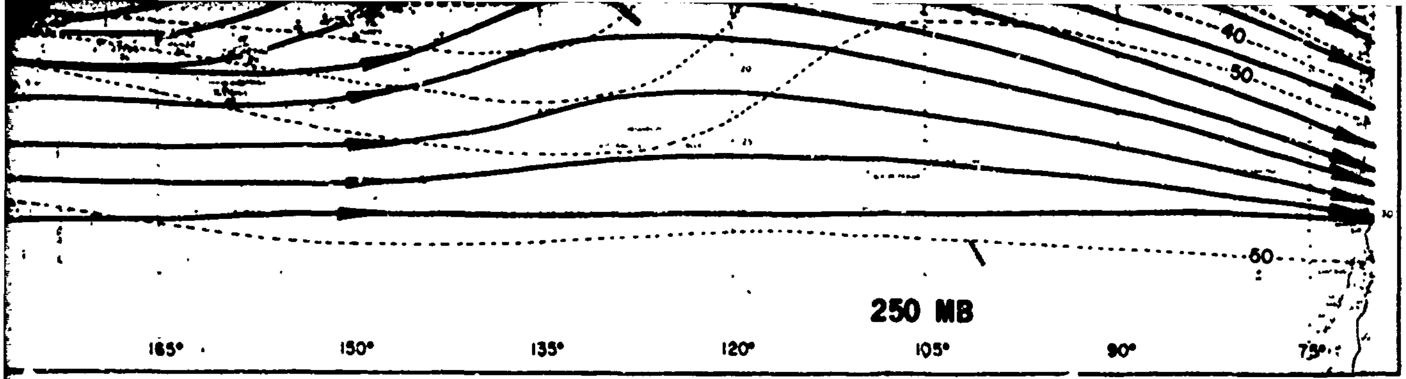

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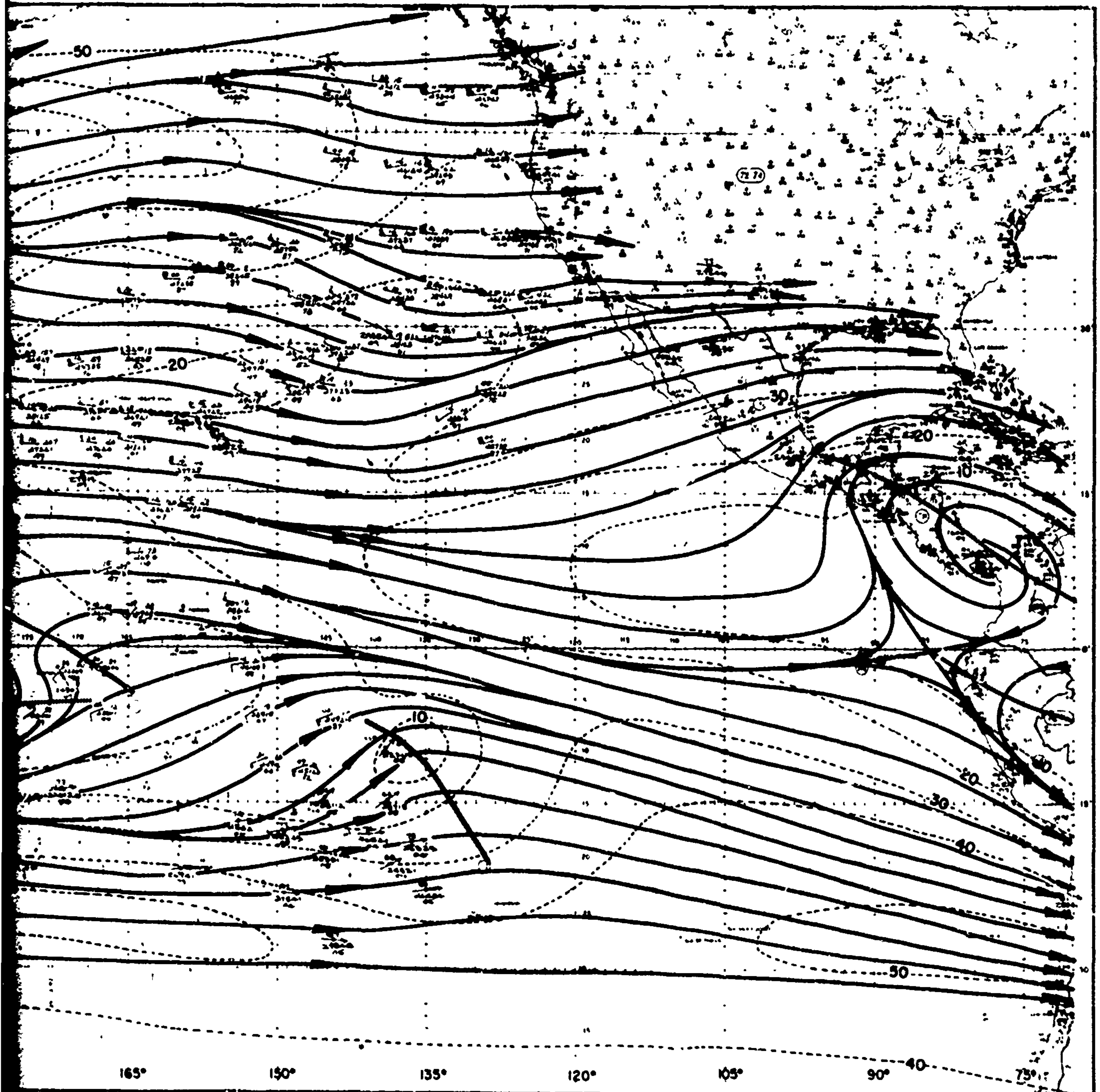

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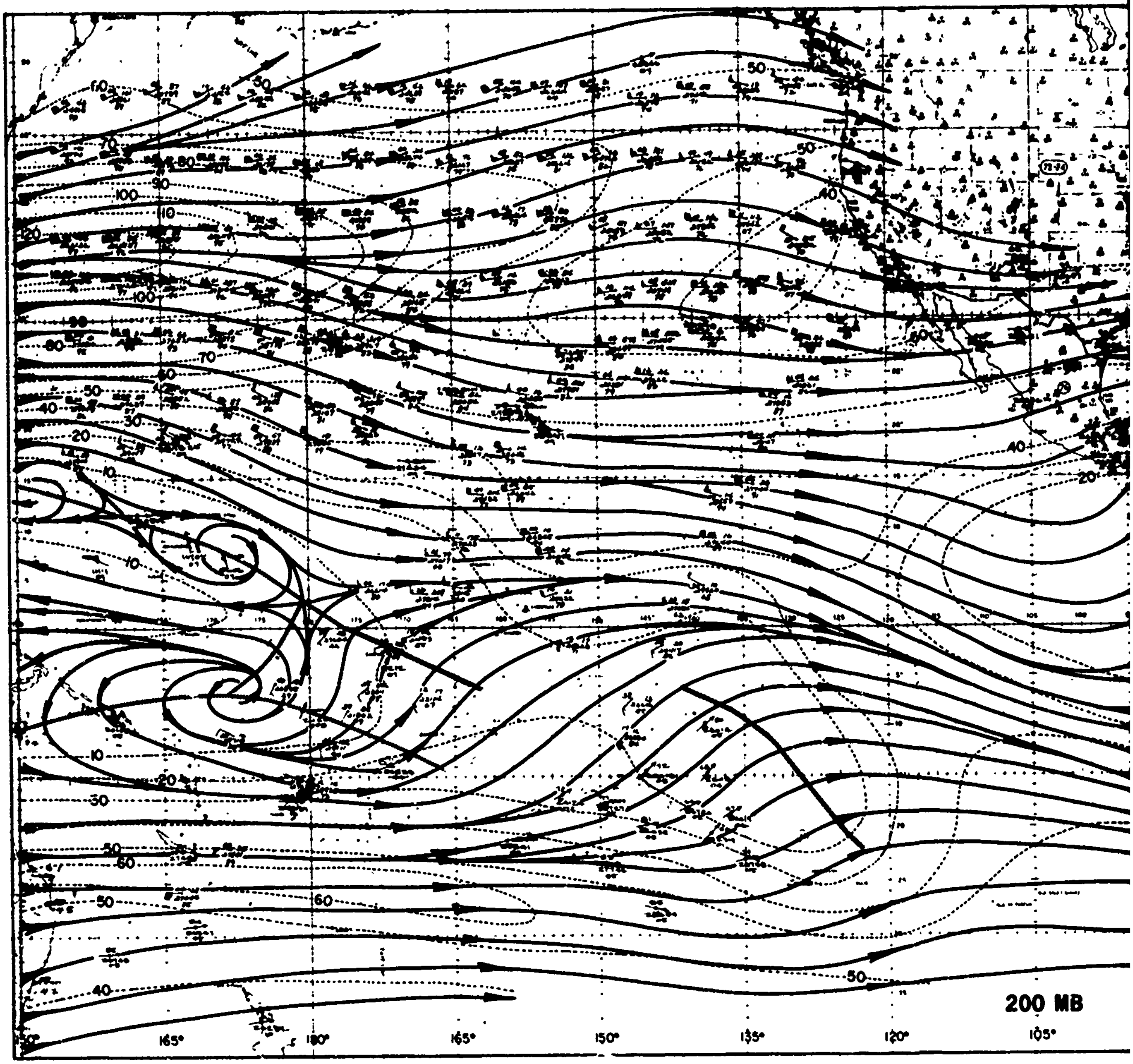
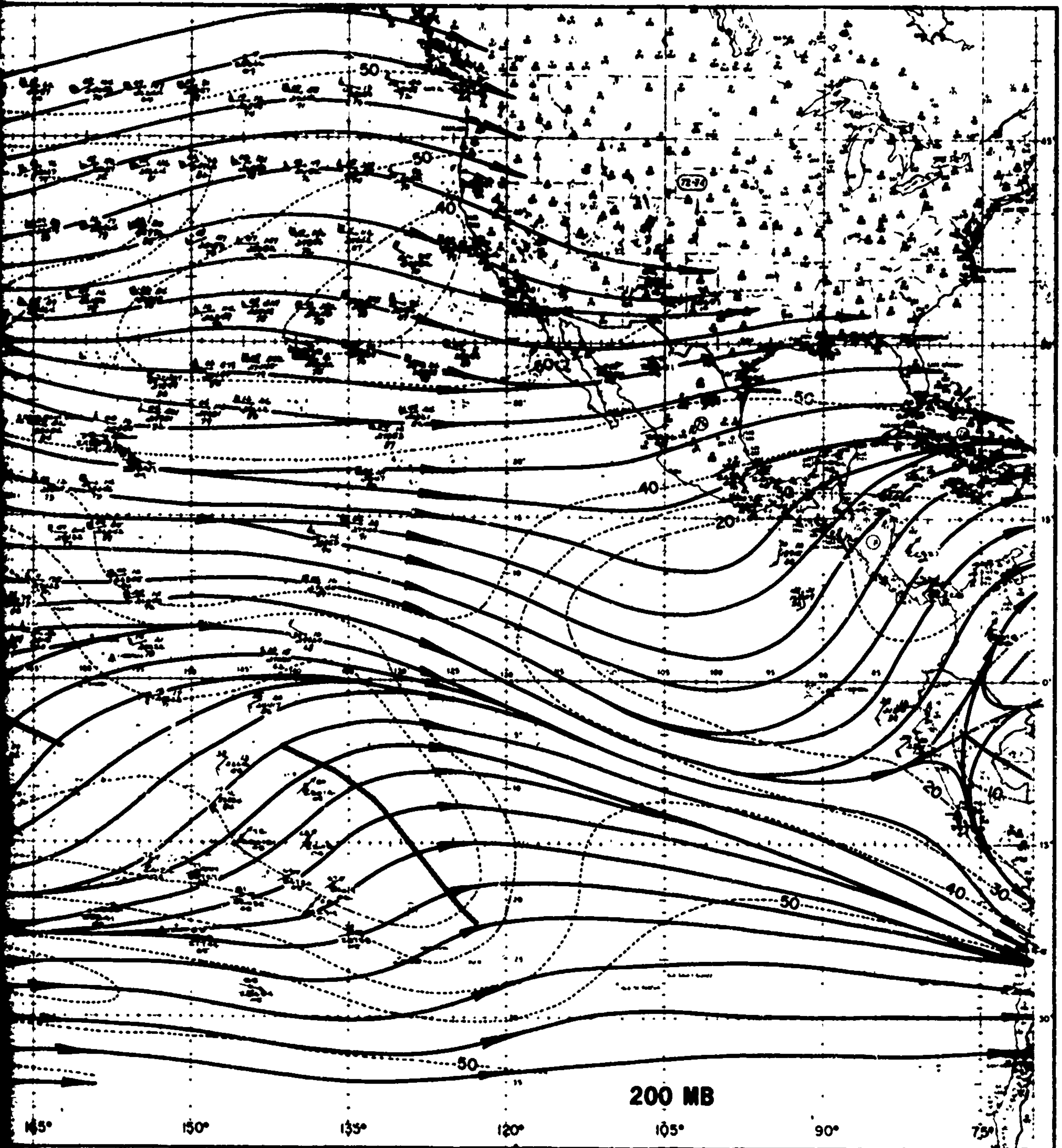


DECEMBER

Northern Hemisphere

The winter pattern has been established. The temperate jet core speeds are near 130 kt. The current branches downstream. The southernmost branch of greater than 50 kt passes north of Hawaii and across Baja California. The northern branch crosses the Washington coast north of 45N.

Southern Hemisphere



DECEMBER

<u>misphere</u>

nter pattern has been established. The temperate jet core near 130 kt. The current branches downstream. The south-nch of greater than 50 kt passes north of Hawaii and across rnia. The northern branch crosses the Washington coast N.

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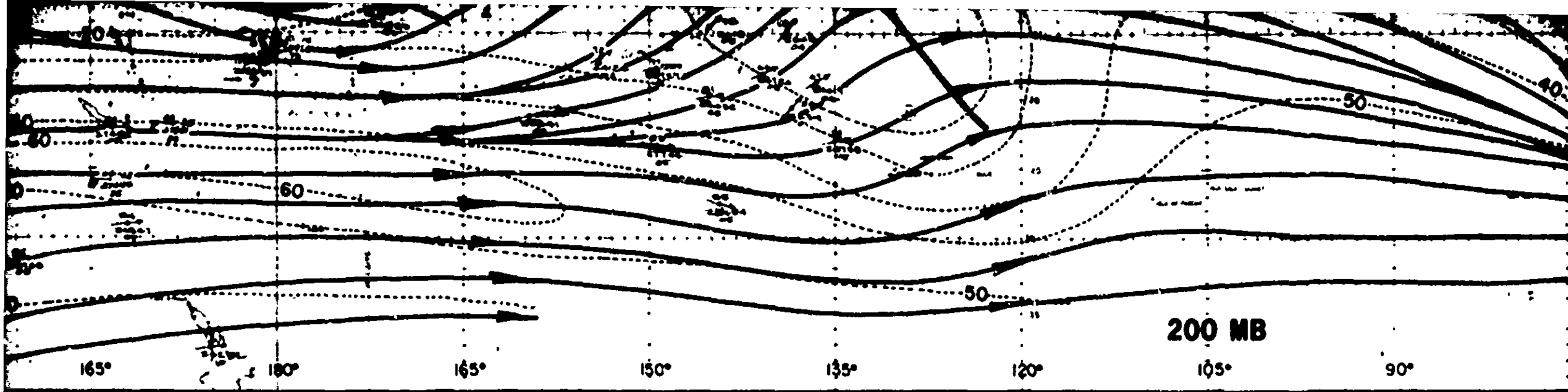


DECEMBER

Northern Hemisphere

The winter pattern has been established. The temperate jet core speeds are near 130 kt. The current branches downstream. The southernmost branch of greater than 50 kt passes north of Hawaii and across Baja California. The northern branch crosses the Washington coast north of 45N.

Southern Hemisphere

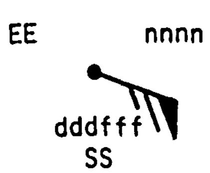
The temperate westerlies have decreased slightly from November.

The TUTT has intensified; however, it appears, from the very meager data between 150W and 165W, that it is still segmented.

Equatorial Region

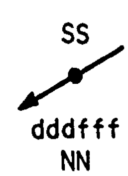
The westerlies have increased from November.

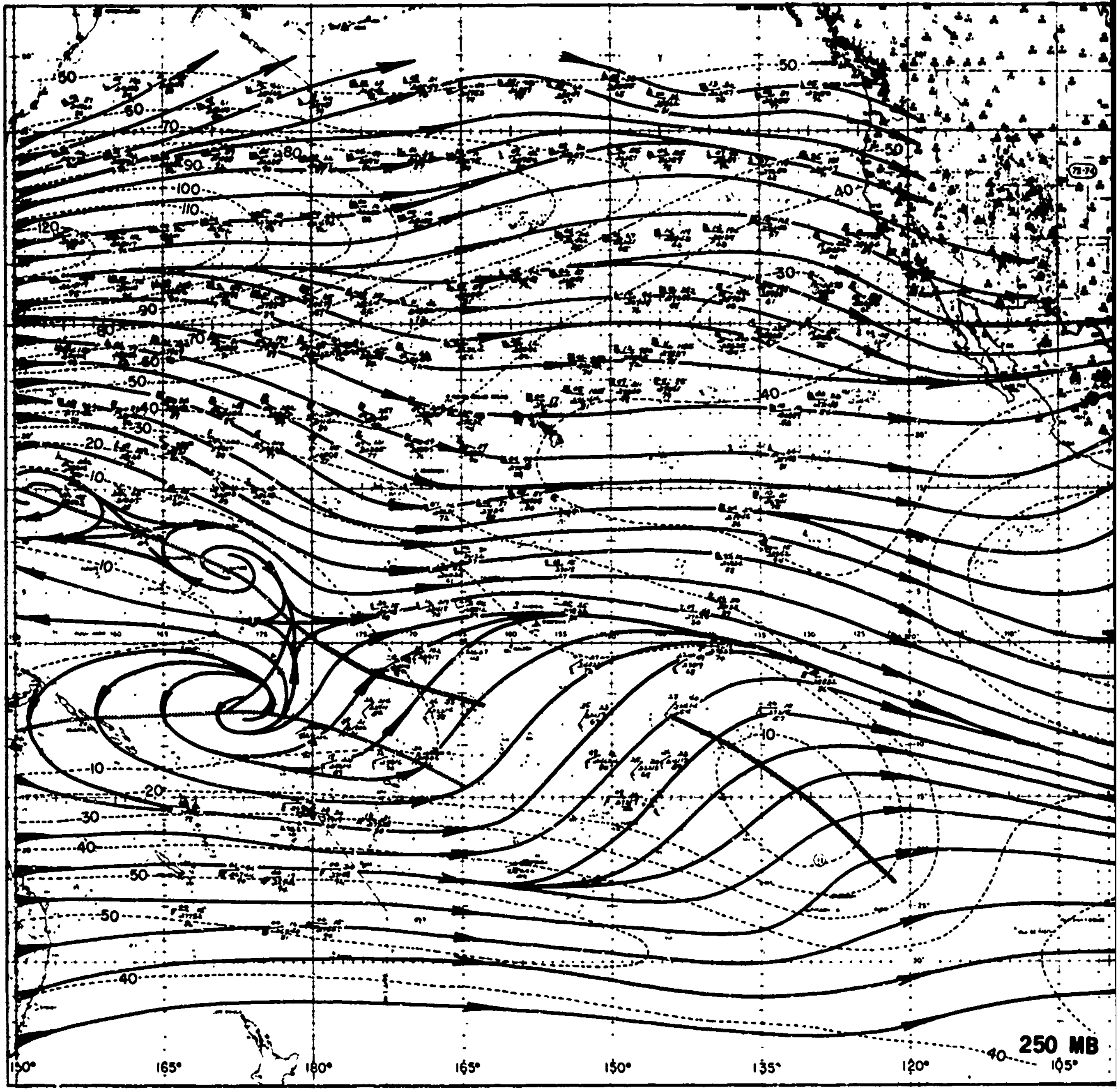
PIREP Winds



EE	-percentage of winds with an east component
nnnn	-number of observations
ddd	-mean resultant wind direction
fff	-mean resultant wind speed in knots (flag = 50 knots, long barb = 10 knots, short barb = 5 knots)
SS	-steadiness of winds in percent
NN	-number of years of record

Rawins

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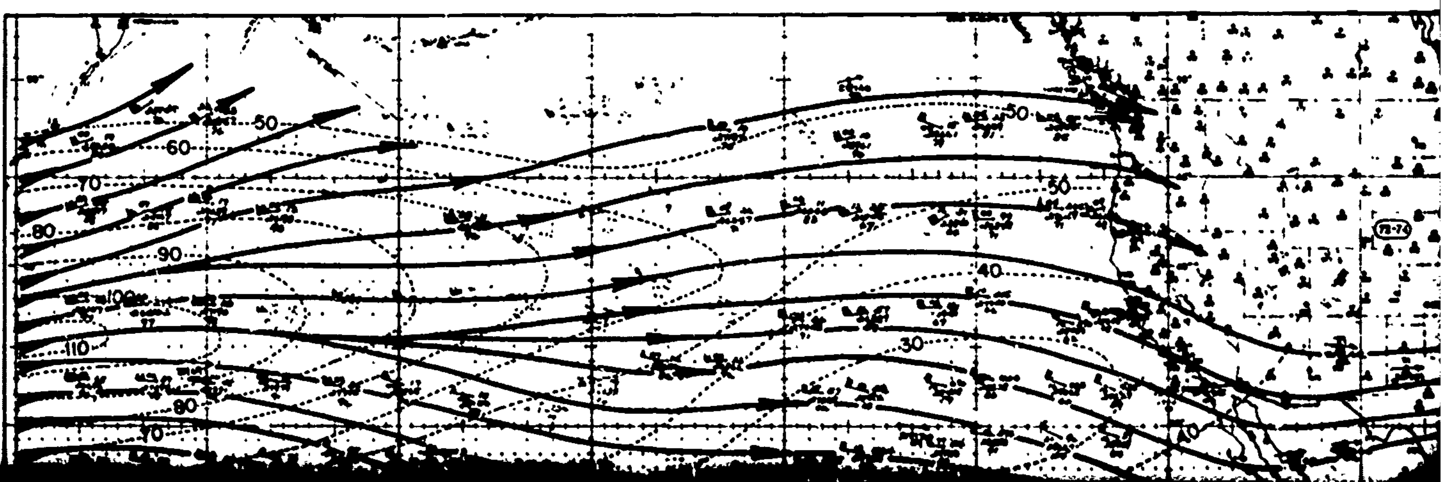

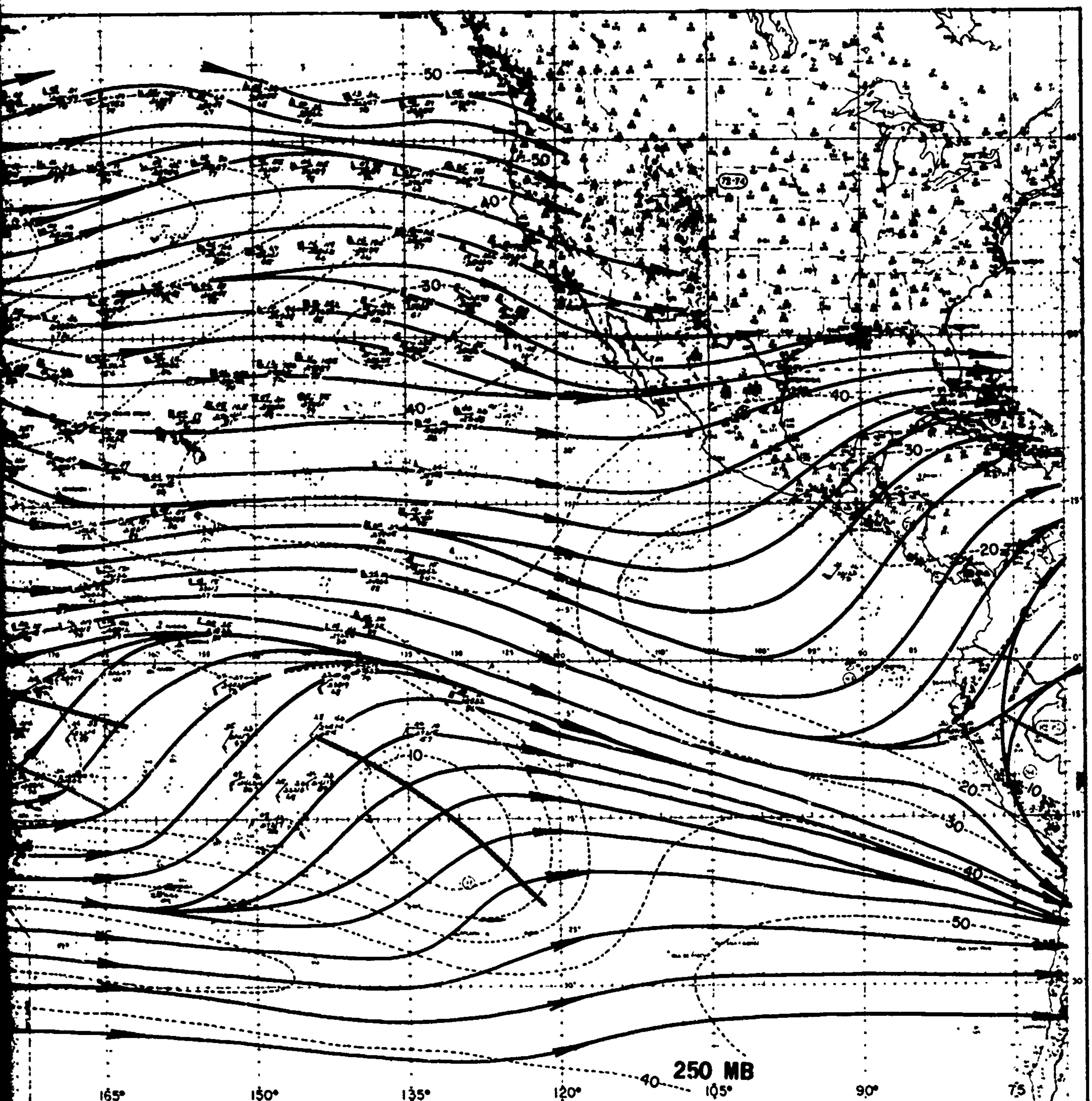
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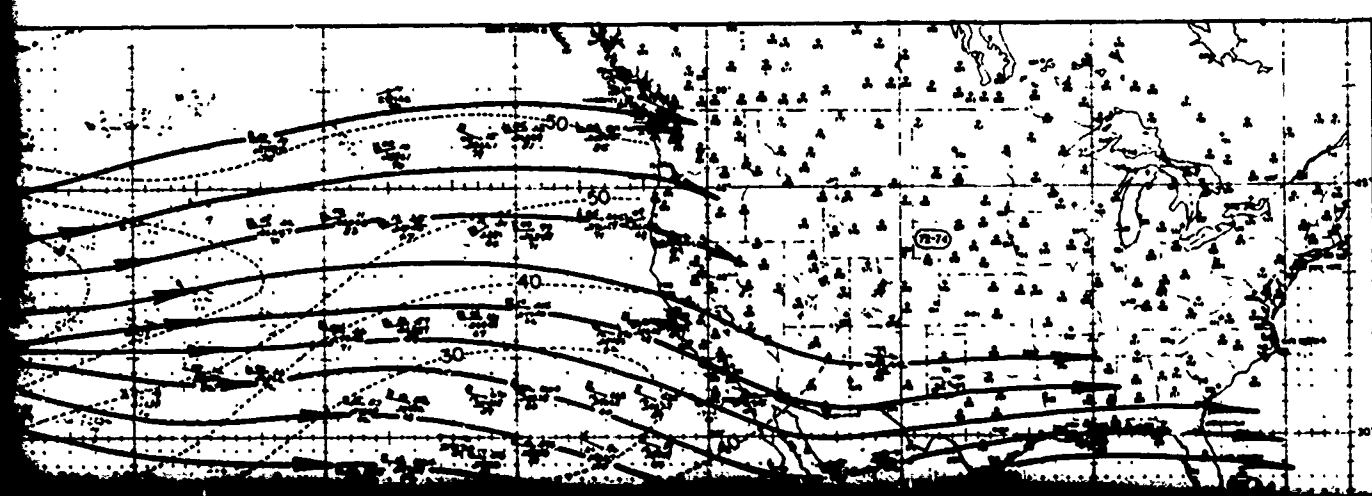

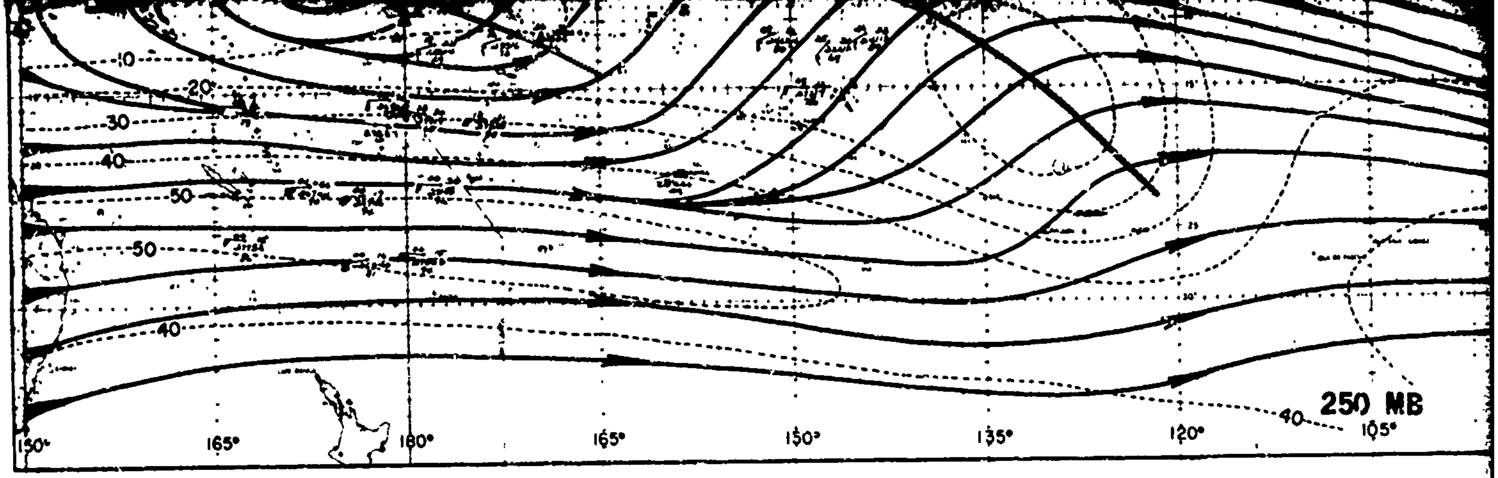

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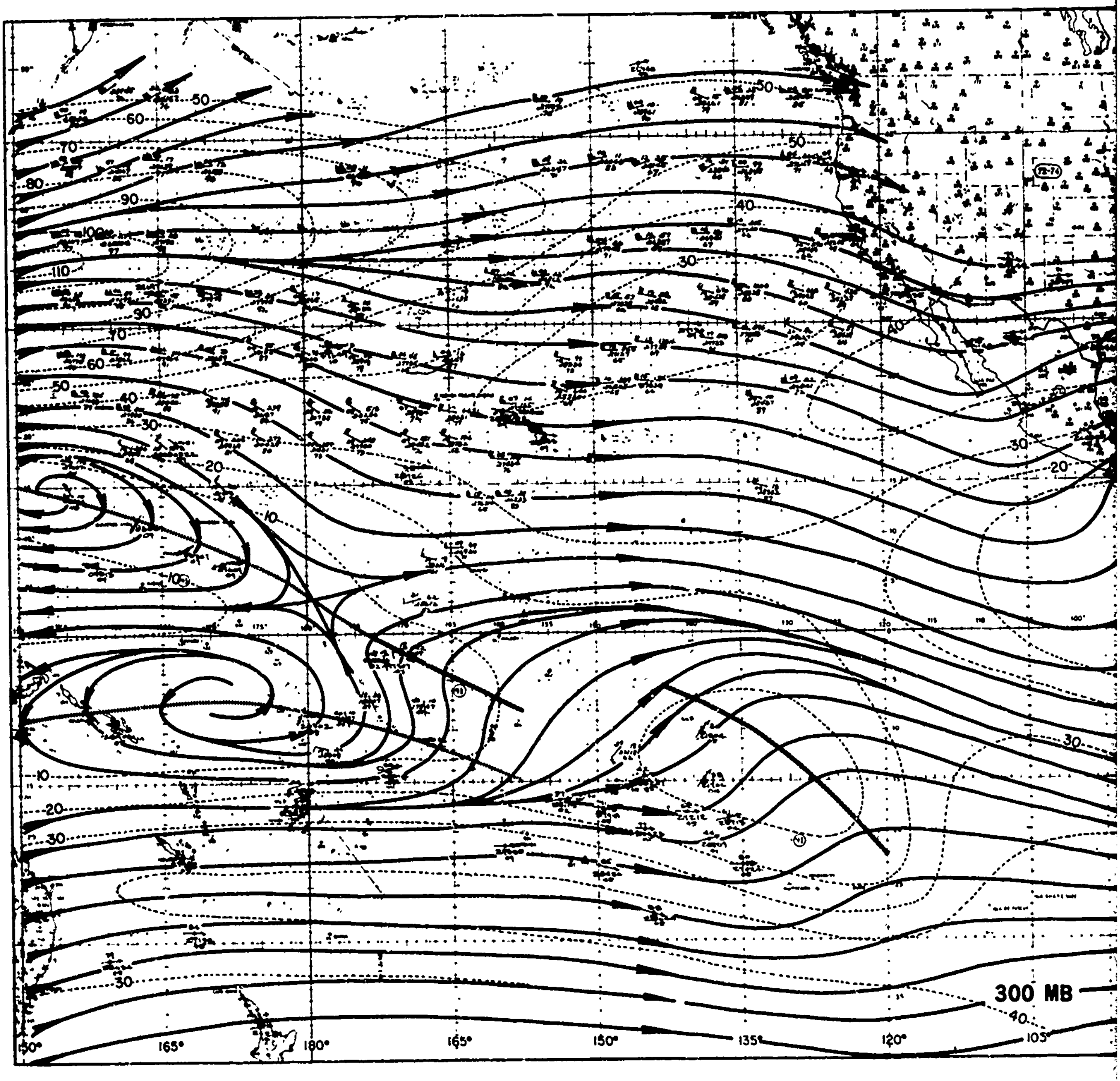

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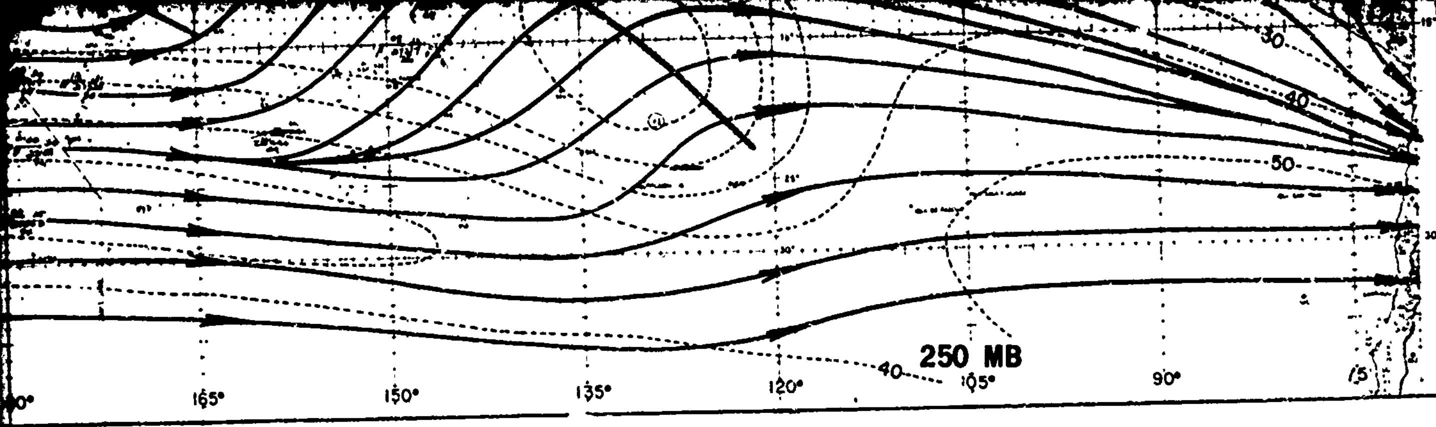
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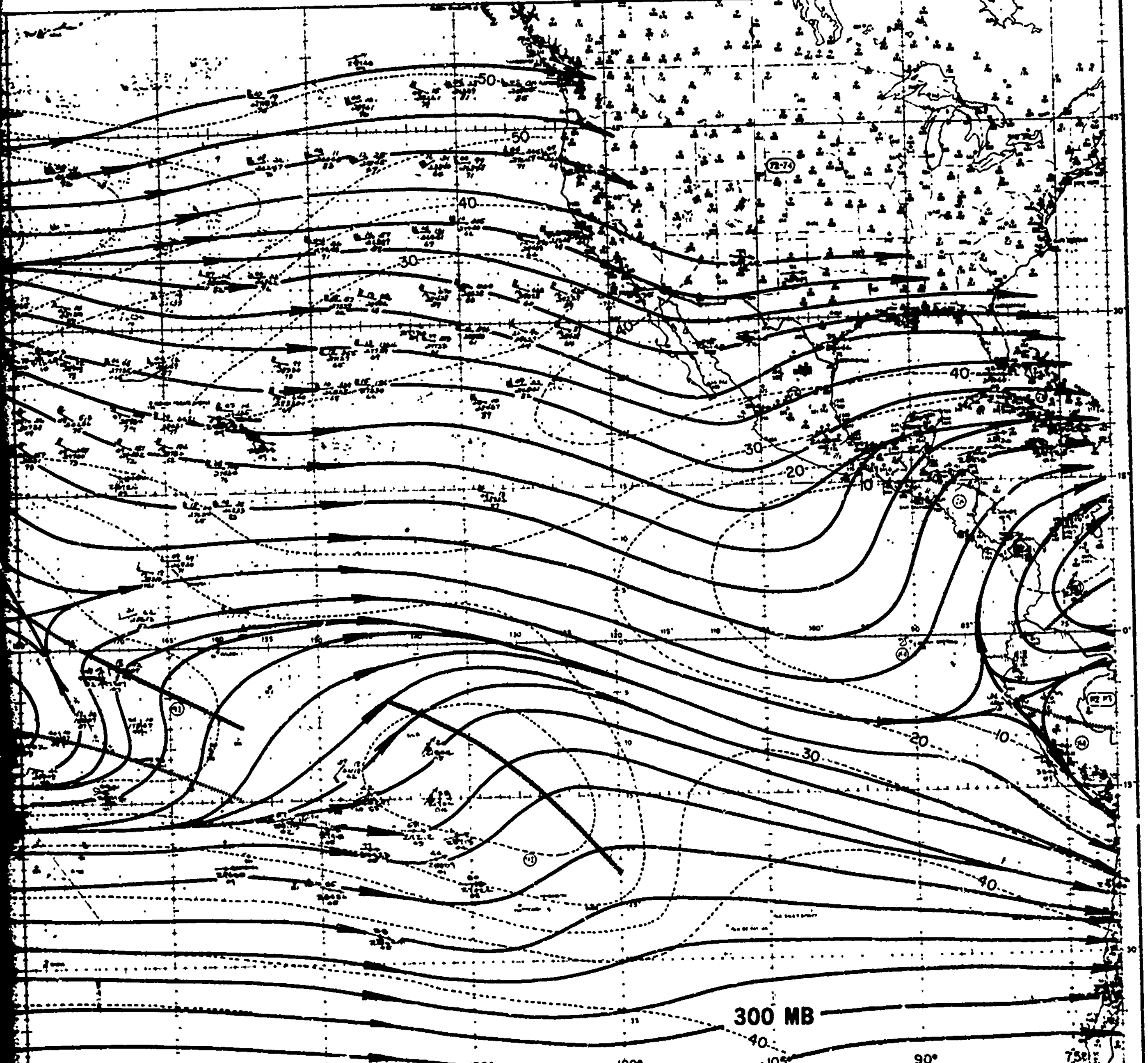
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