REPORT UAG – 40

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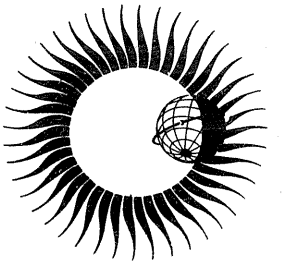
for
Solar-Terrestrial Physics

H–ALPHA SYNOPTIC CHARTS OF SOLAR ACTIVITY FOR THE PERIOD OF SKYLAB OBSERVATIONS

MAY, 1973 – MARCH, 1974



FEBRUARY 1975

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H–ALPHA SYNOPTIC CHARTS OF SOLAR ACTIVITY FOR THE PERIOD OF SKYLAB OBSERVATIONS

MAY, 1973 – MARCH, 1974

by

Patrick S. McIntosh

NOAA Environmental Research Laboratories
Boulder, Colorado, USA

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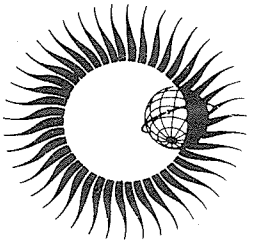

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H-ALPHA SYNOPTIC CHARTS OF SOLAR ACTIVITY FOR THE PERIOD OF SKYLAB OBSERVATIONS

May, 1973 - March, 1974

by

Patrick S. McIntosh
NOAA Environmental Research Laboratories
Boulder, Colorado U.S.A.

Special charts have been prepared of the slowly-varying large-scale features of chromospheric solar activity covering the period of the manned and unmanned Skylab observations, May 28, 1973 to February 3, 1974. They are intended as one of the background or reference data packages for study of the detailed Skylab observations and the complementary studies of corresponding phenomena from ground-based observations.

The charts are based on once-daily standard H-alpha observations which have been interpreted in terms of large-scale magnetic field regions according to a technique previously described [McIntosh, 1972a, 1972b]. The data are given on the synoptic time scale of a solar rotation, much like those in the Carte Synoptique prepared by the Meudon Observatory. Here, however, the features are shown as they appeared when each longitude zone was 40°W of the sun's Central Meridian, with the exceptions noted below.

There are a pair of charts for each solar rotation in the period May 3, 1973 to March 3, 1974 (Carrington rotations 1601 to 1611). The two charts are identical except one has the regions of negative magnetic polarity shaded for emphasis, although it may be misleading to so emphasize the polarities in regions where the boundaries or neutral lines are indistinct. Each chart is a map of the solar globe built up from the daily observations. The latitude range is ± 70°. The Carrington longitudes are indicated at the bottom and the date of central meridian passage at the top, both by calendar date and the ordinal day of the year (DOY). Each chart includes an overlap of 60° with the preceding and following chart. The date in the lower right corner, e.g., 8/9/74, is the date of preparation of this final version of the synoptic chart to distinguish it from preliminary versions.

The data shown on the charts are:

(1) distinct neutral lines (solid lines)
(2) estimated neutral lines (dashed lines)
(3) filaments (cross-hatched areas)
(4) major sunspots (large solid dots)
(5) H-alpha plage (stipple, density roughly representing brightness)

The distinct neutral lines, indicating magnetic polarity reversals [McIntosh, 1972a, 1972b], are mapped from various H-alpha structures: filaments, filament channels, plage corridors, "iron-filing" patterns of fibrils adjacent to active centers, and arch-filament systems. There are several criteria for drawing in "estimated" neutral lines. Basically, they connect segments of distinct neutral lines, but consideration is also given to the gross distribution of inferred polarities in adjacent regions and, more importantly, on the expected continuity with previous or following solar rotations when a distinct pattern may have been more recognizable in the same general area.

The signs of the magnetic polarities are inferred from Hale's law: leader sunspots in opposite solar hemispheres have opposite polarities. Northern leader spots possess negative polarity during even-numbered solar cycles, while southern leader spots are positive. Active regions from both Cycle 20 and Cycle 21 are present during this period, distinguished by their appearance at low and high latitudes, respectively. The polarities of all areas on the sun are inferred by beginning with a leader sunspot, or the leading portion of a bipolar plage, and alternating polarities with each successive neutral line. Patterns persisting from previous solar rotations are assumed to maintain the same polarity. Magnetic polarities are verified by comparison with solar magnetograms made with photospheric spectral lines whenever magnetogram data are available. Corrections to the inferred polarities are usually necessary only in areas of complex patterns outlined by estimated neutral lines.

The patterns are mapped by accumulating the positions of features on H-alpha filtergrams from several consecutive days. Seldom does a single photograph show the patterns in their complete form, owing to the transient nature of the filaments and the variable observing conditions. Structures and positions marked on the charts are a representation of the location and appearance of the features during their entire disk passage. Whenever possible, the H-alpha patterns mapped are the forms seen when the particular features were near W40° on the visible solar hemisphere. This bias toward the West enables a more realistic comparison with energetic particle data measured near the earth. Whenever a pattern undergoes a conspicuous change from the time of first visibility near the East limb to the time when at W40°, the former neutral-line position is depicted as a line crossed with hachures (e.g., see equatorial region, longitude 250°, on page 8).

For two of the solar rotations we have constructed additional charts with a bias for the form of the patterns when near East limb. These are for Rotations 1605 (see pages 12-13) and 1607 (see pages 18-19). Such charts are useful for comparisons with other types of solar data taken at the East limb of the sun and could be constructed for other rotations. These additional charts also permit study of the evolution of solar regions on a time scale shorter than the usual 27-day synoptic interval, as illustrated on pages 30-31 where these East limb charts are reprinted with the corresponding preceding and following regular charts which have the deliberate bias for the Western hemisphere.

The systematic evolution of large-scale features of solar activity throughout this 10-month period can be studied from the composite figure on page 32. Shown are small-scale reprints of each of the regular synoptic charts, with the one for Rotation 1606 repeated for continuity. Proper motions are readily apparent; e.g., the movement of cells of negative polarity along the equator and at about N30° leads to a general convergence of features in the central longitudes. Examples of fission and fusion of elements in the patterns can also be seen.

The charts for this series were constructed from photographic prints made from daily surveys taken at the NOAA Boulder Solar Observatory and at the solar observatory at Ramey Air Force Base, Puerto Rico. The solar diameter on the prints was usually 12 cm, but some at 18 cm were also used. Filaments and other clues as to the presence of a change in magnetic polarity were measured from all the available photographs, using a Stonyhurst grid overlay. Positions can be determined to within $\sim$1° using this method.

These charts have been extensively revised since they first appeared in preliminary form in *Solar-Geophysical Data* (Parts I and II), NOAA, EDS, Boulder, Colorado, 80302, U.S.A., and in the weekly "Preliminary Report and Forecast of Solar Geophysical Data", NOAA, ERL, Boulder, Colorado, 80302, U.S.A.

Charts of this same kind appear in Report UAG-41 for the early part of Solar Cycle 20, covering the period October 1964 to August 1965. Other examples of this type of data presentation for other times during this solar cycle have been provided for studies of solar cosmic rays [Roelof and Krimigis, 1973; Roelof, 1974; Shea and Smart, 1974].

Acknowledgments

Numerous members of the NOAA Space Environment Services Center at Boulder contributed to the construction of the preliminary versions of these charts as part of real-time support to the NASA Skylab mission. We acknowledge with thanks Dr. Robert Howard of the Hale Observatories for providing synoptic versions of solar magnetograms ahead of publication, Susan Andrews and Janice Leighton for editing and assisting with graphics, and Dean Eicher for his careful attention to detail in maintaining a uniform style in the final stages of the graphics work. This work was performed under NASA Contract H42710-A.

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ROELOF, E. C. 1974 Coronal Structure and the Solar Wind, in *Solar Wind Three*, edited by C. T. Russell, Institute of Geophysics and Planetary Physics, University of California.

ROELOF, E. C. and S. M. KRIMIGIS 1973 Analysis and Synthesis of Coronal and Interplanetary Energetic Particle, Plasma and Magnetic Field Observations over Three Solar Rotations, *J. Geophys. Res.*, *78*, 5375-5410.

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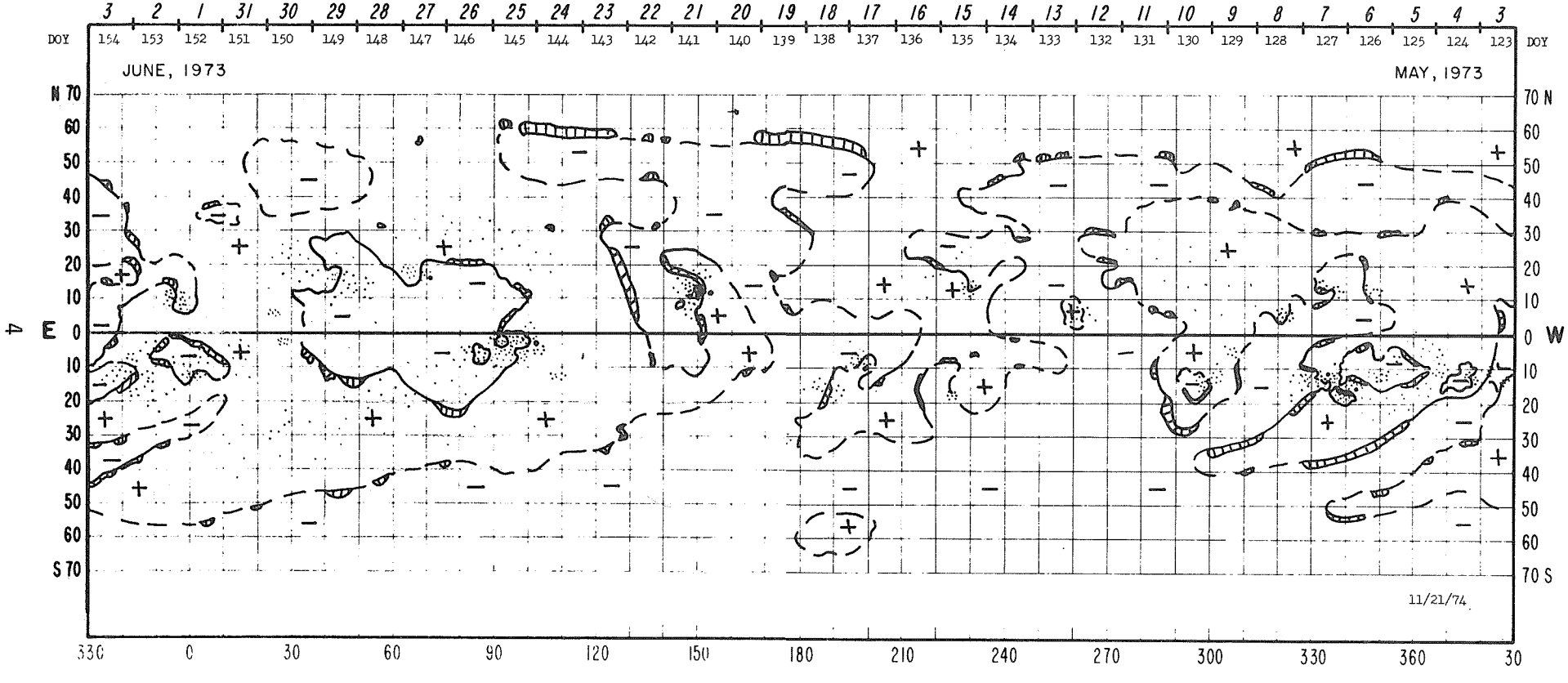
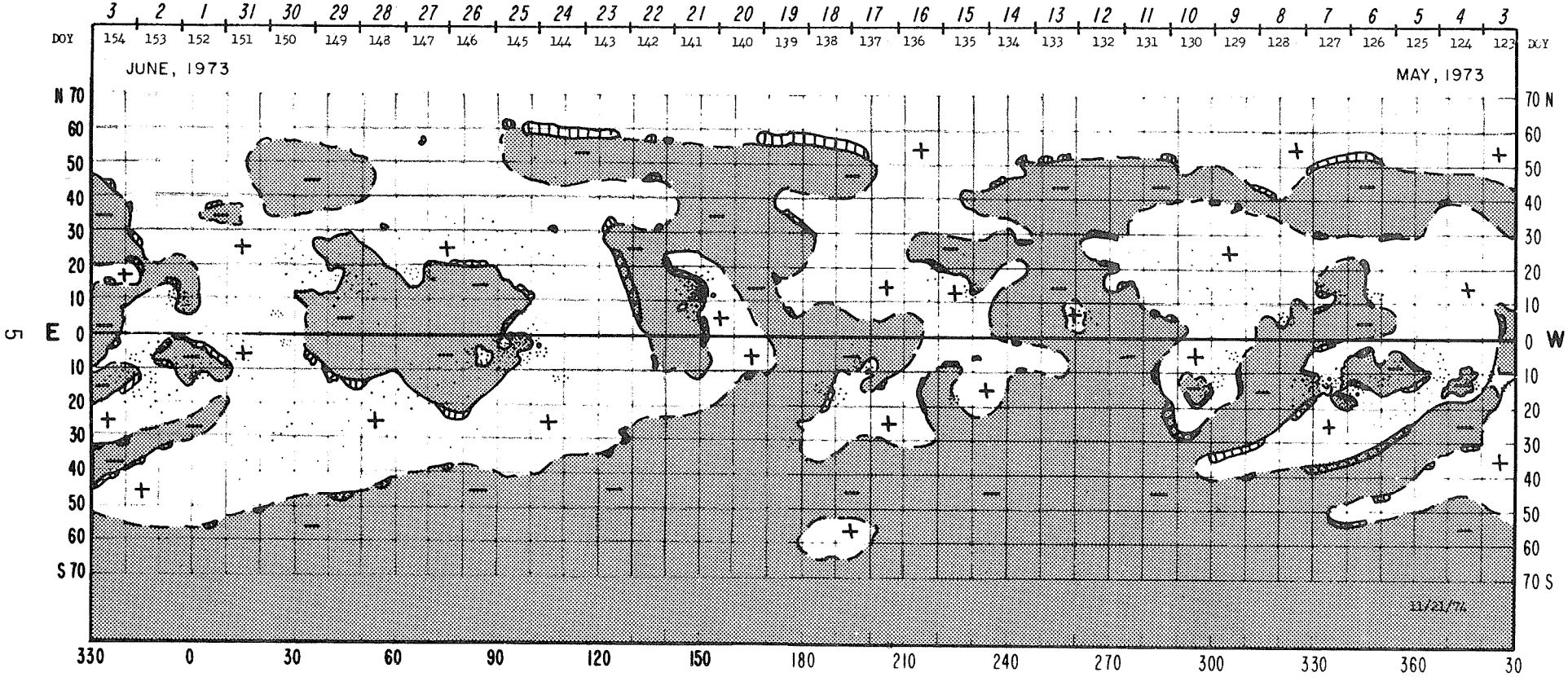
Hα SYNOPTIC CHART

1973 – ROTATION 1601



Hα SYNOPTIC CHART

1973 – ROTATION 1601



Hα SYNOPTIC CHART

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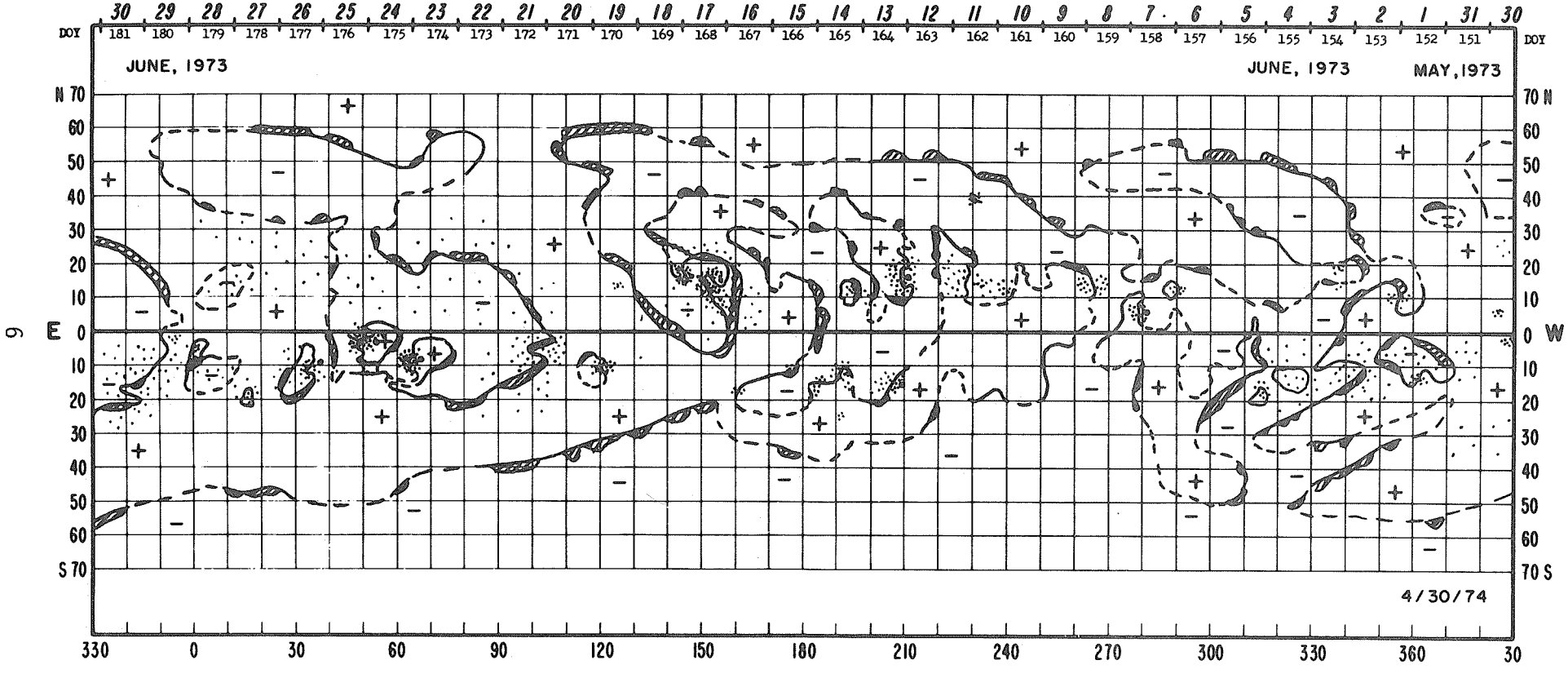
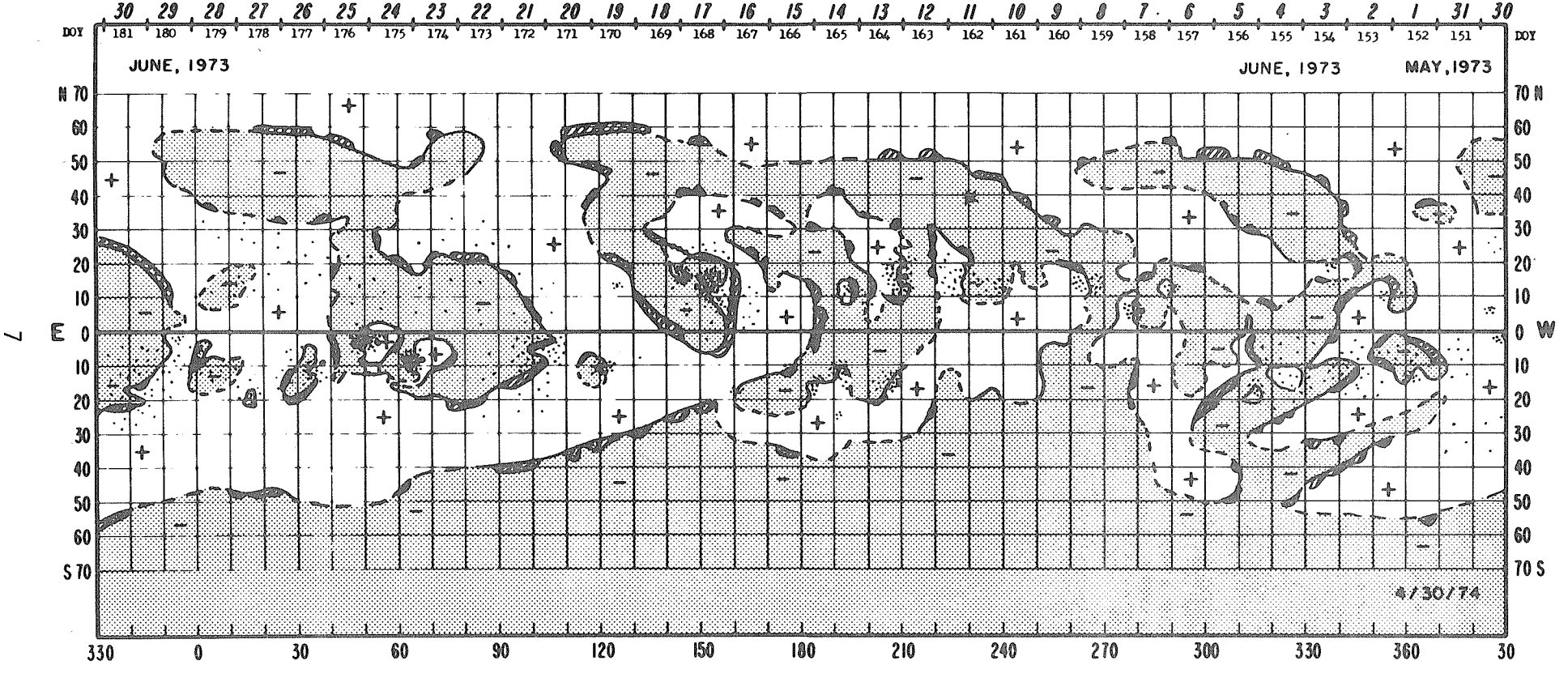
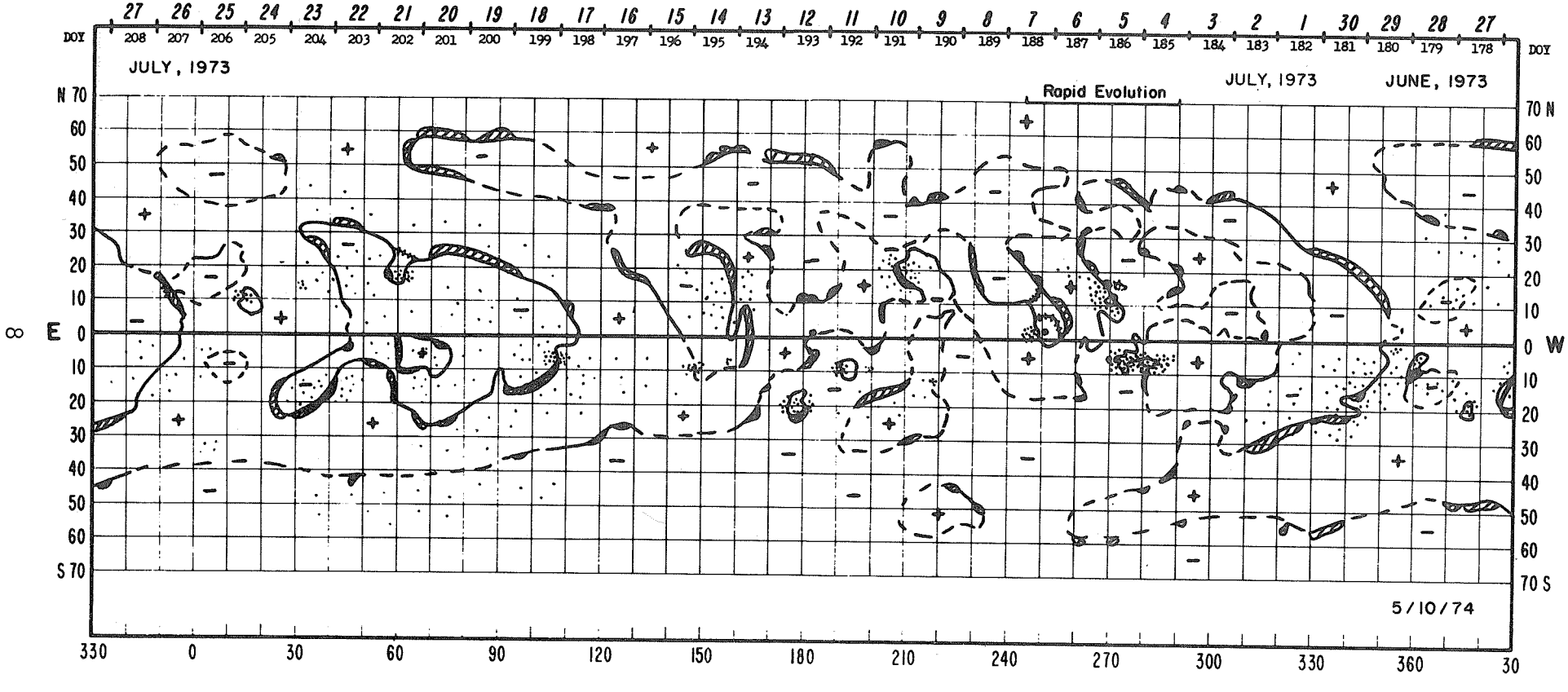


Hα SYNOPTIC CHART

1973 – ROTATION 1602



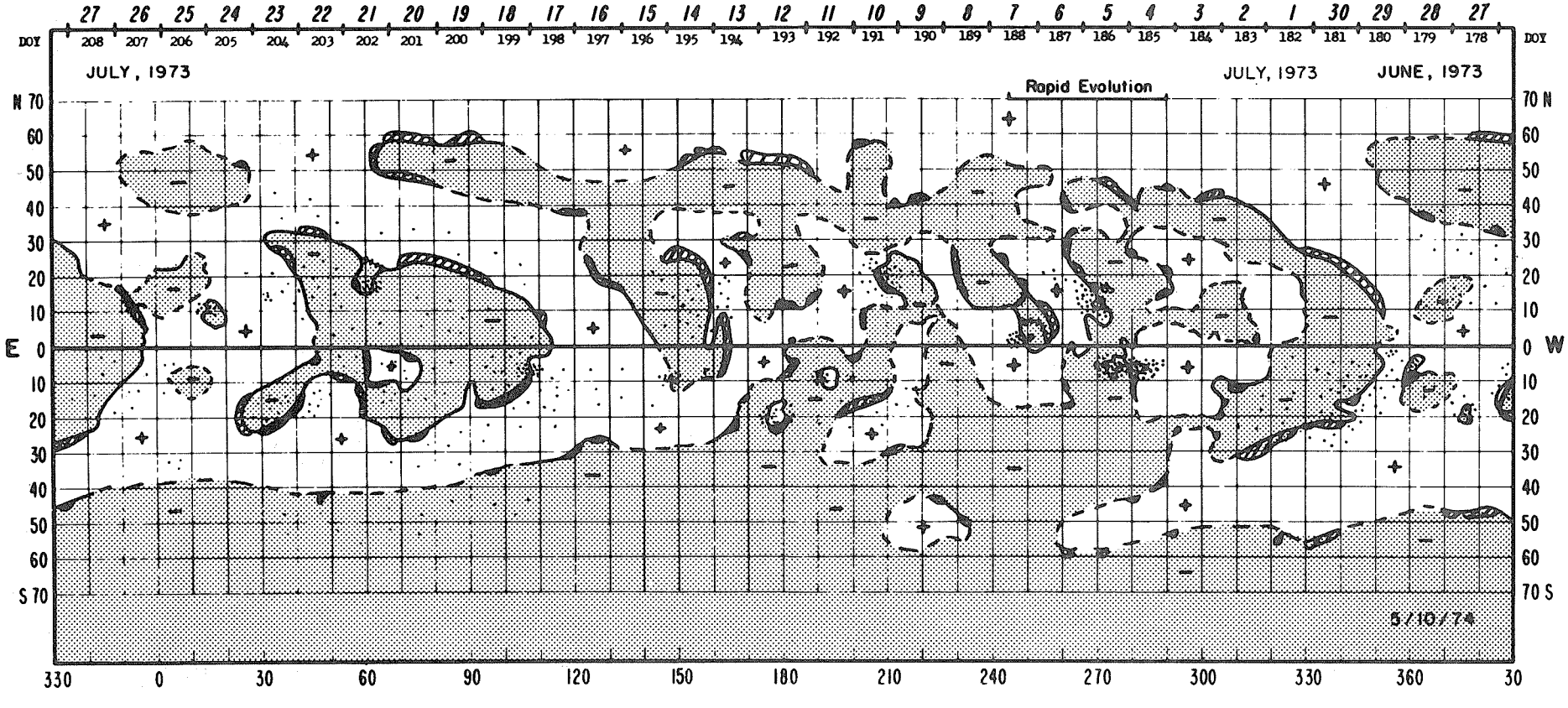
Hα SYNOPTIC CHART
1973 – ROTATION 1603



8

Hα SYNOPTIC CHART

1973 – ROTATION 1603



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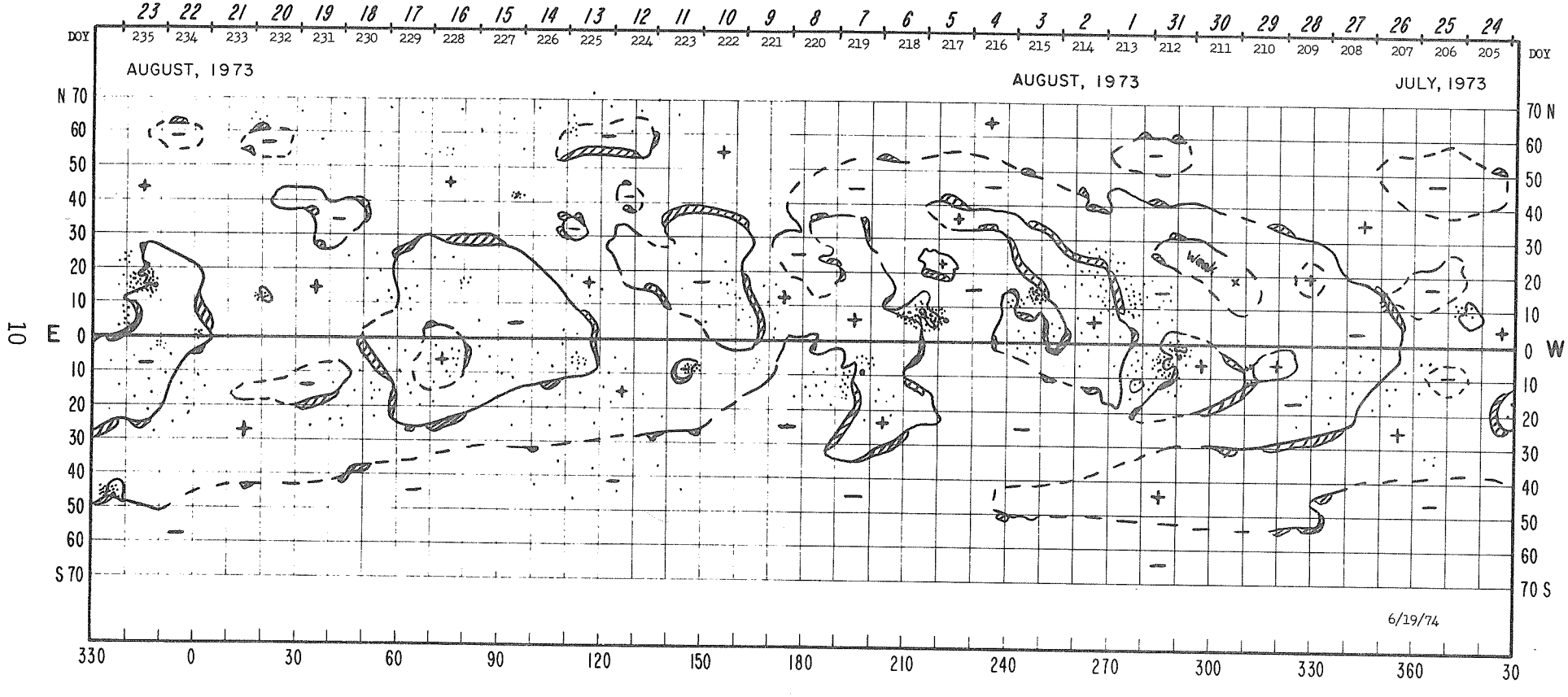
1973 - ROTATION 1604



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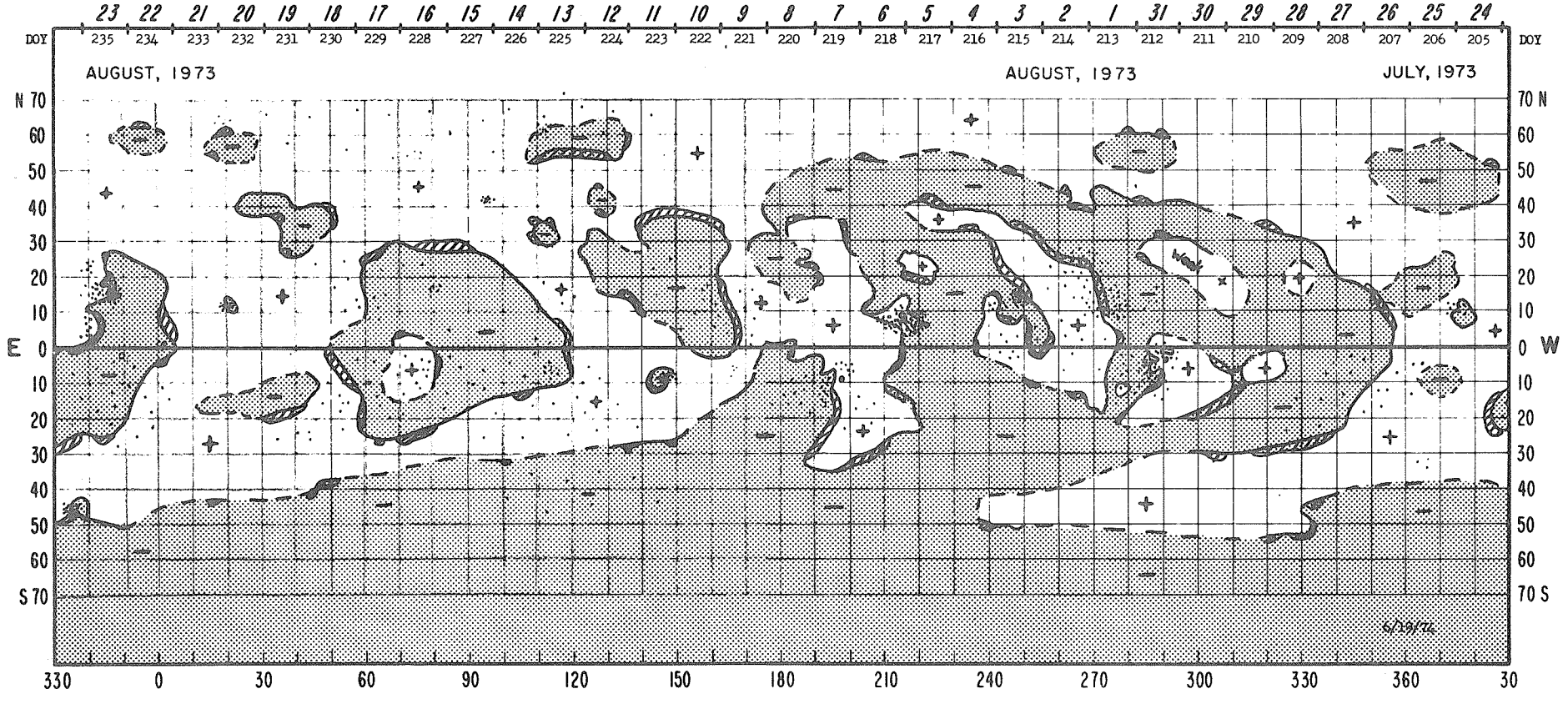
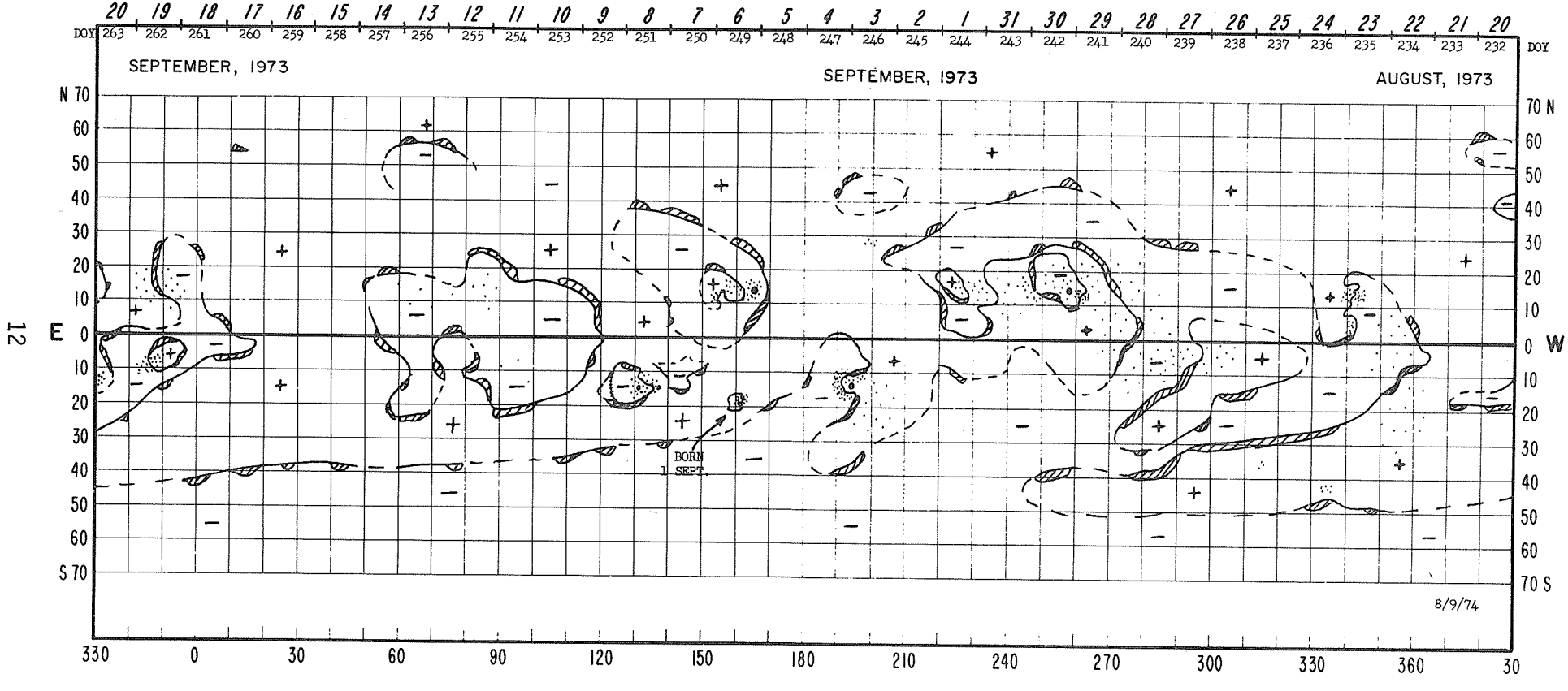
1973 - ROTATION 1604



Hα SYNOPTIC CHART

1973 - ROTATION 1605 (East Limb)



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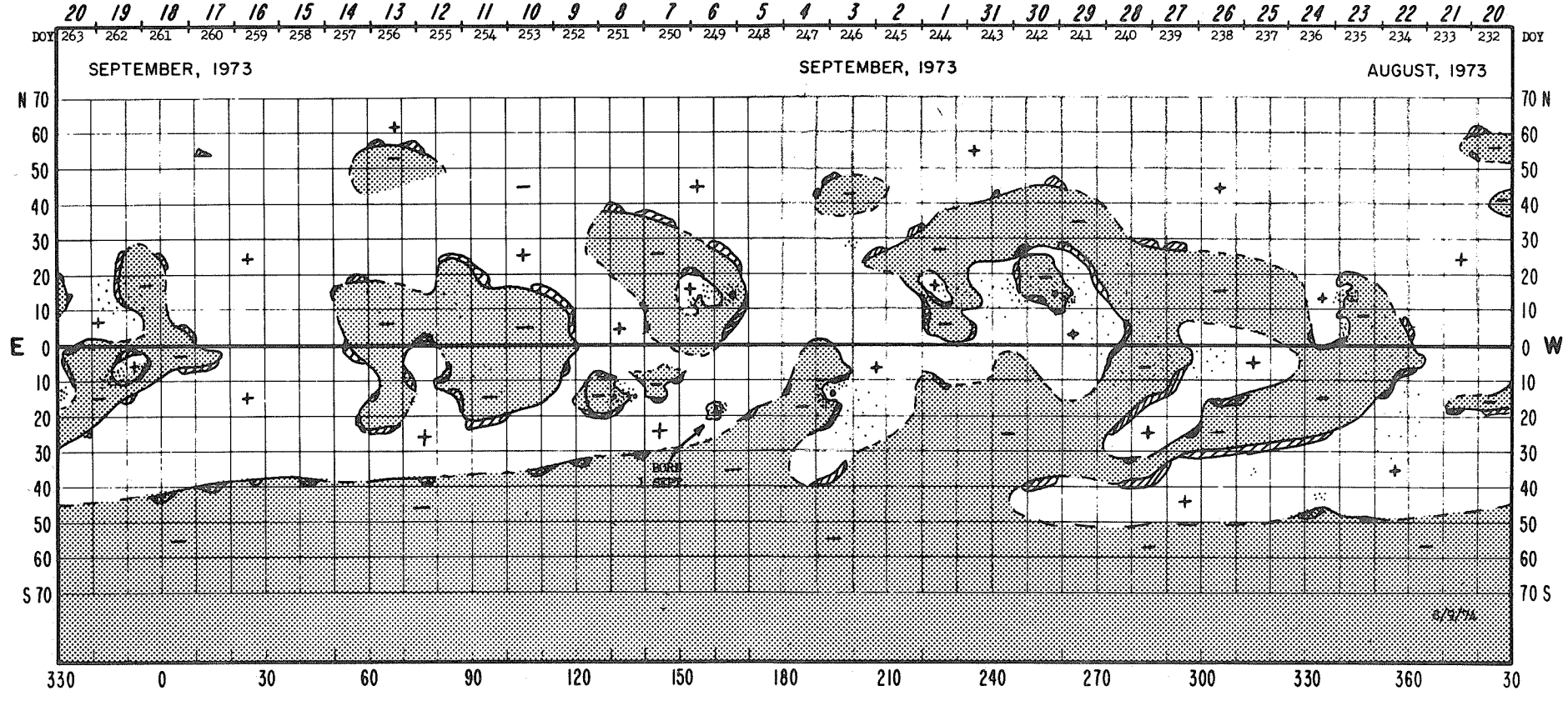
1973 - ROTATION 1605 (East Limb)



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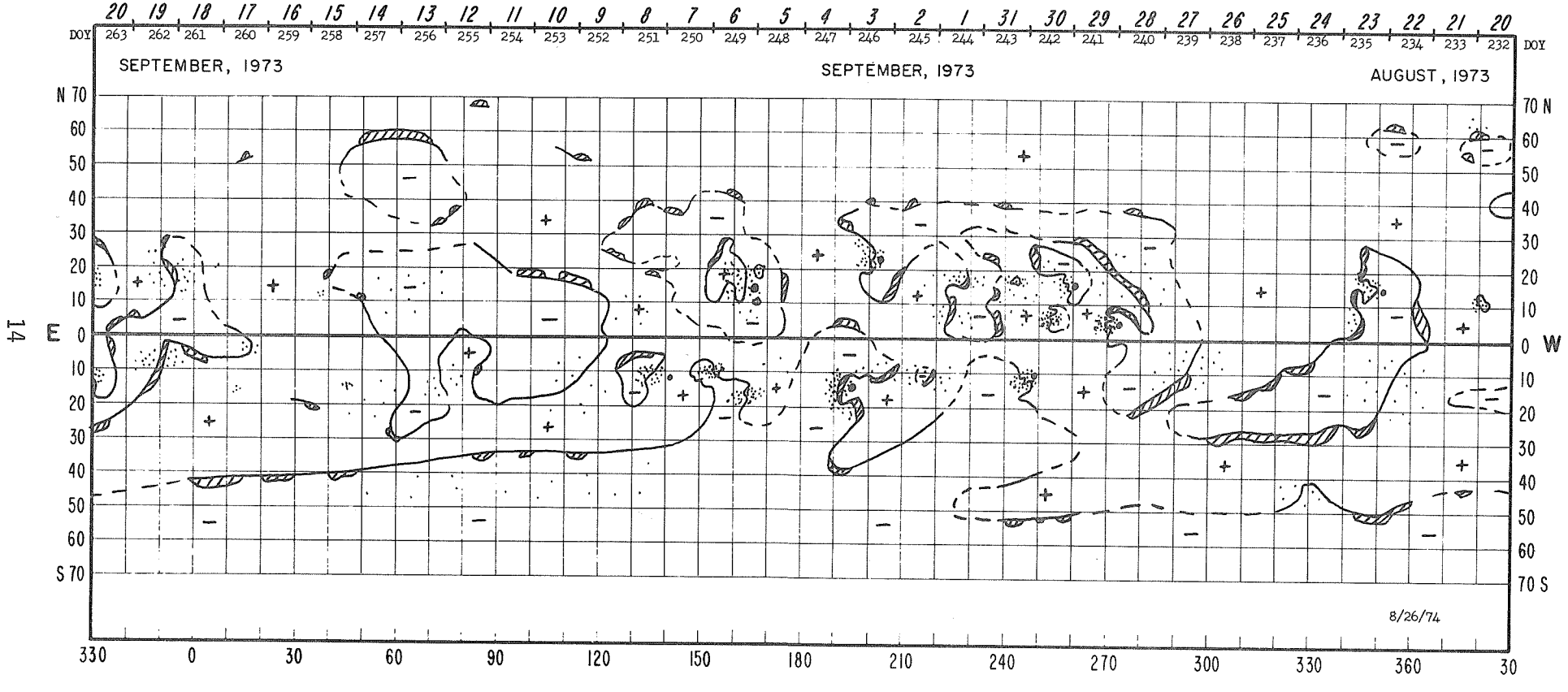
1973 - ROTATION 1605



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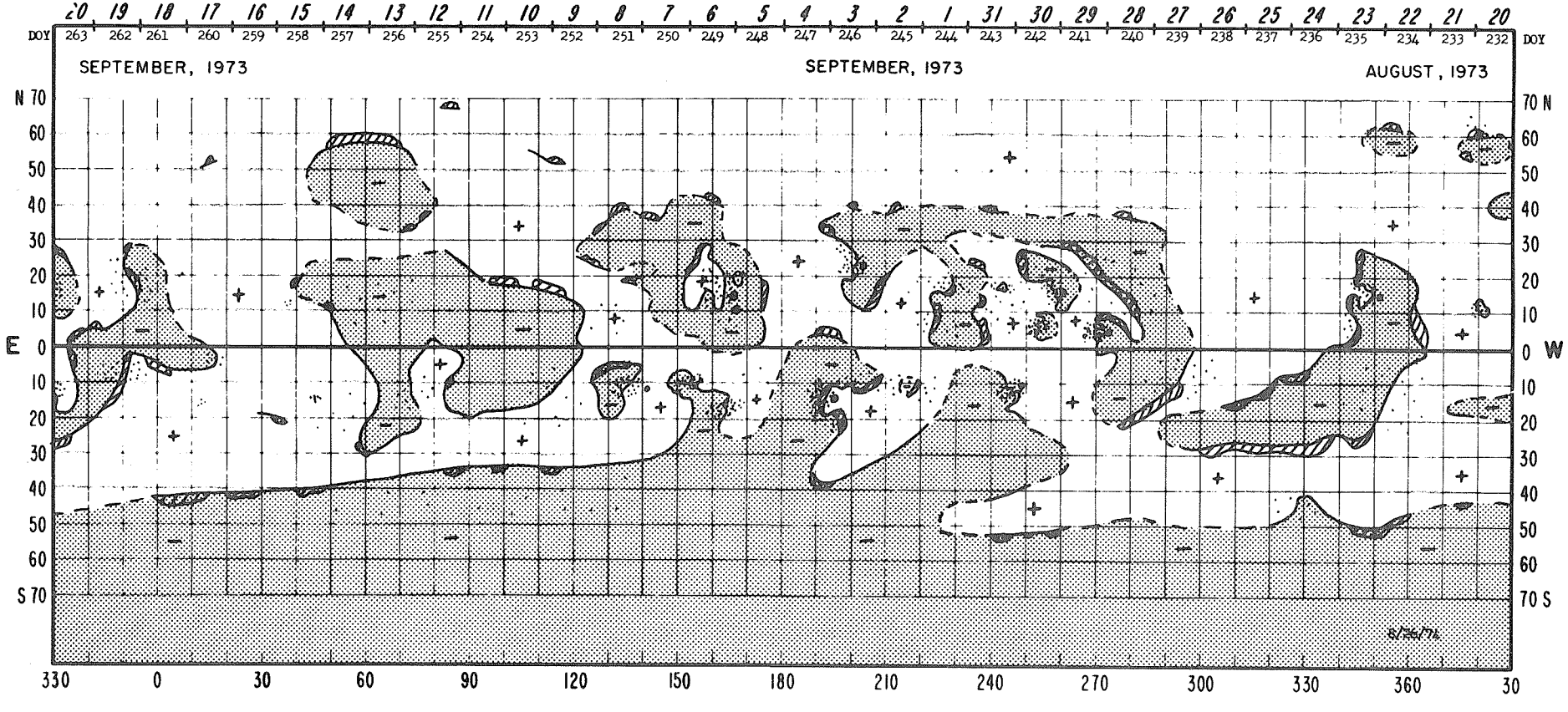
1973 - ROTATION 1605



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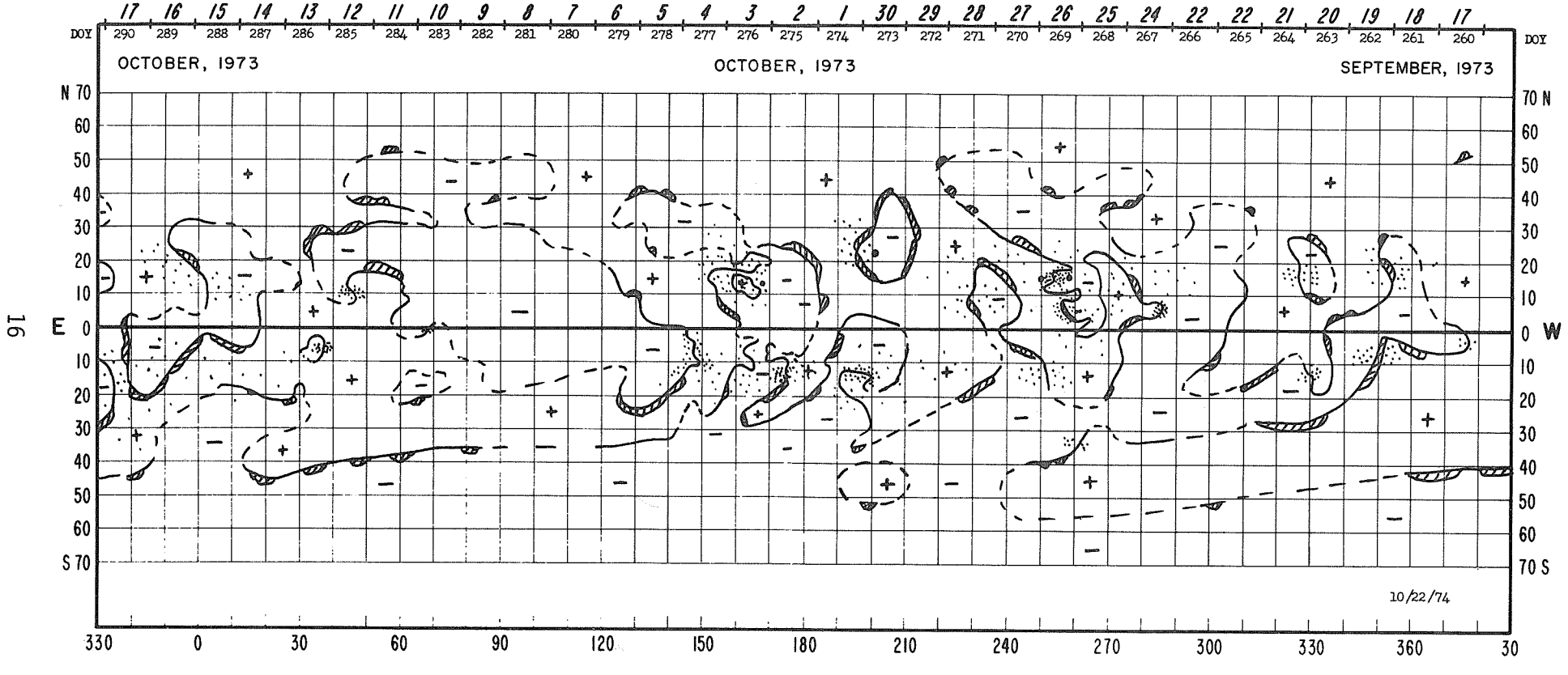
1973 - ROTATION 1606



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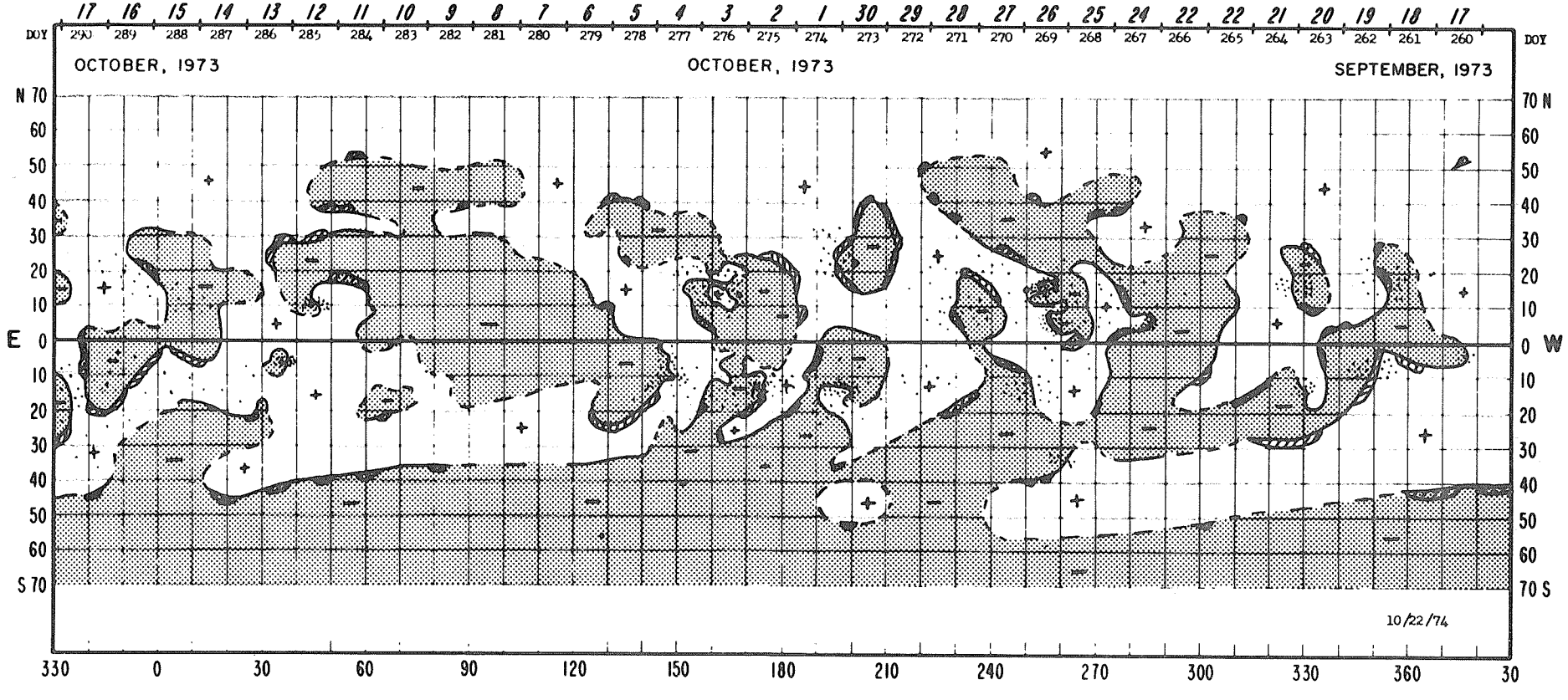

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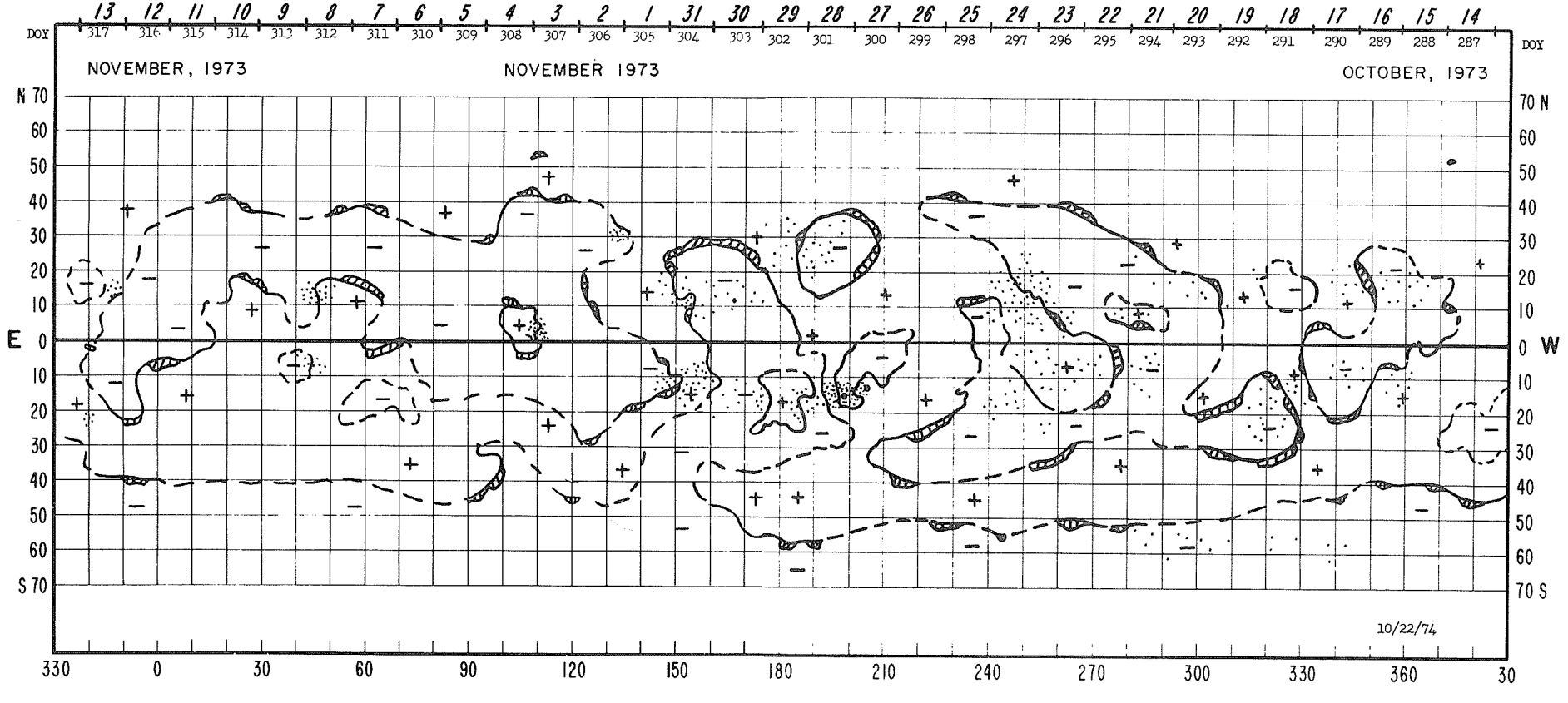
Hα SYNOPTIC CHART

1973 - ROTATION 1607 (East Limb)



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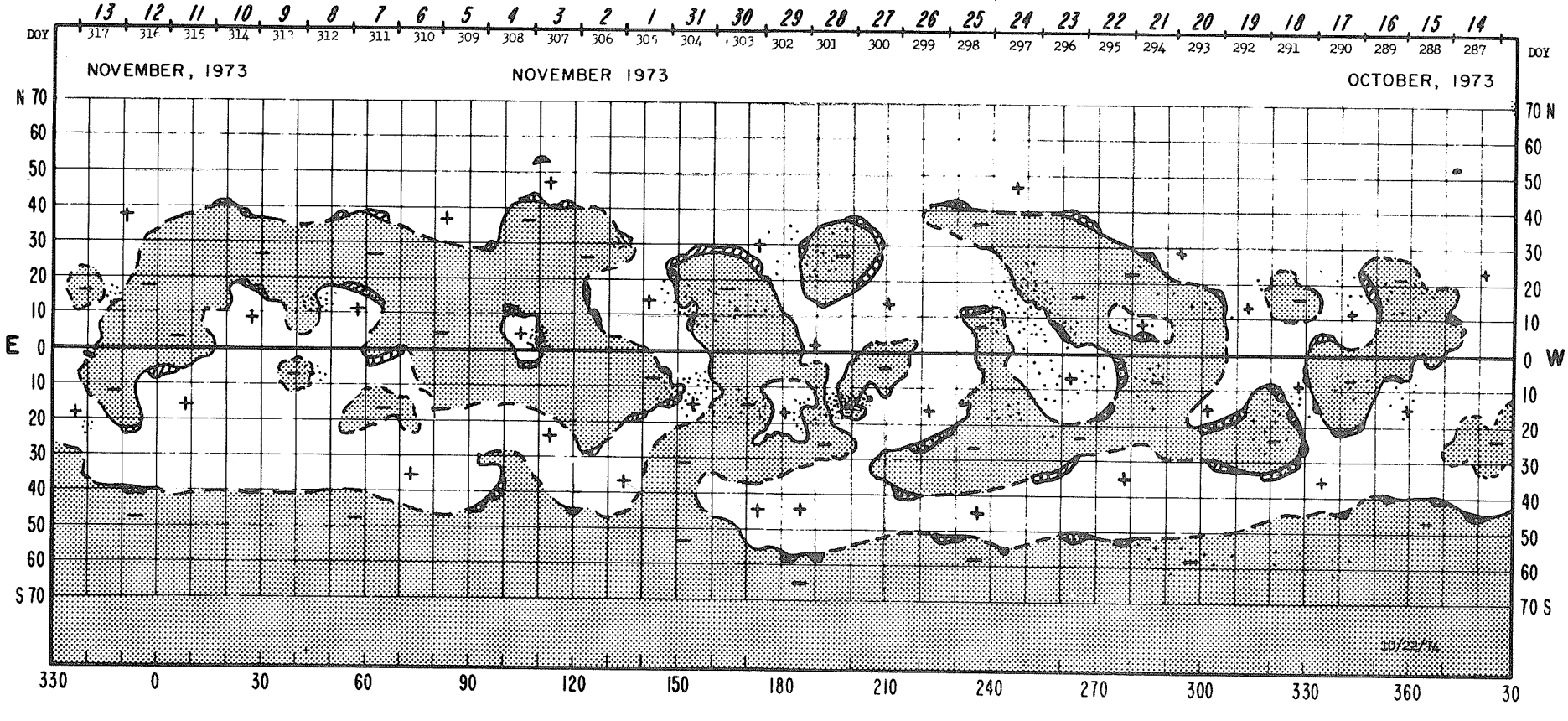
1973 - ROTATION 1607 (East Limb)



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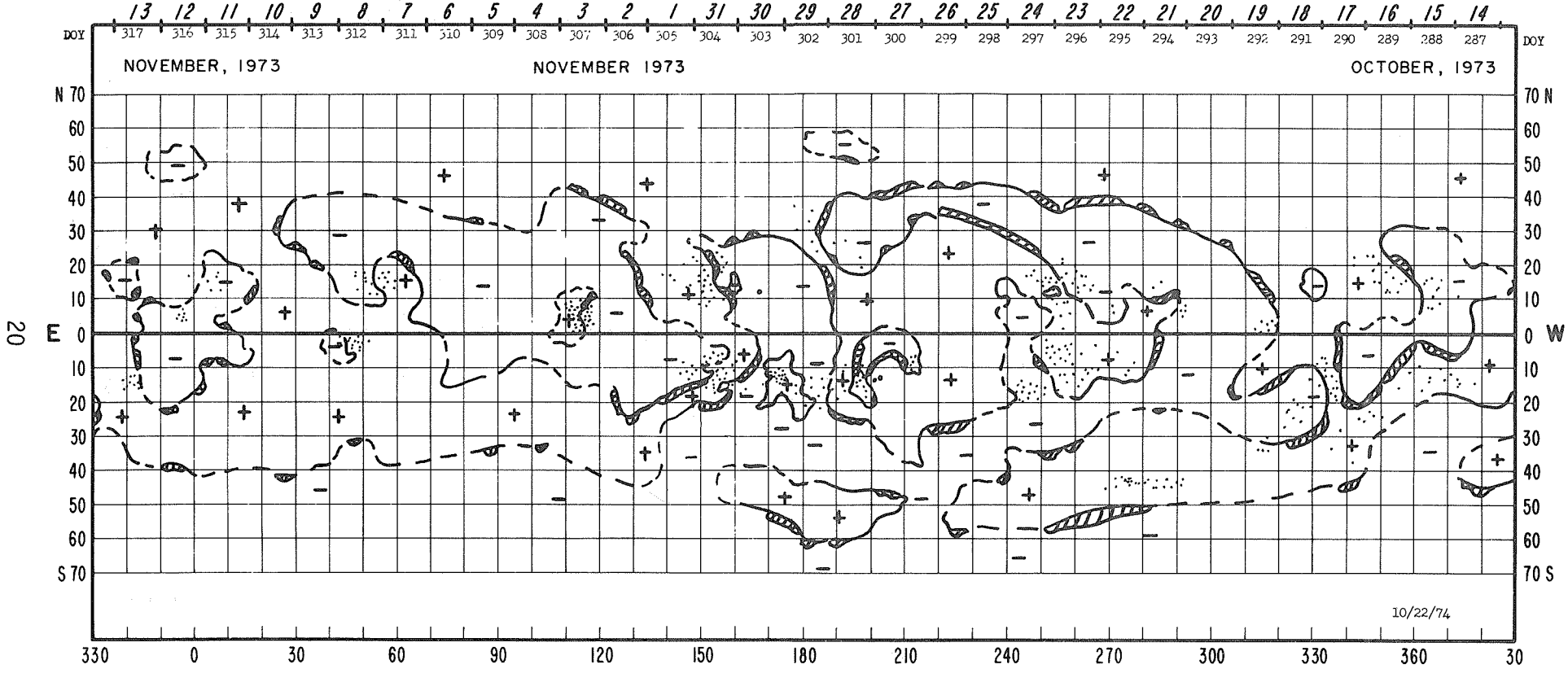
1973 – ROTATION 1607



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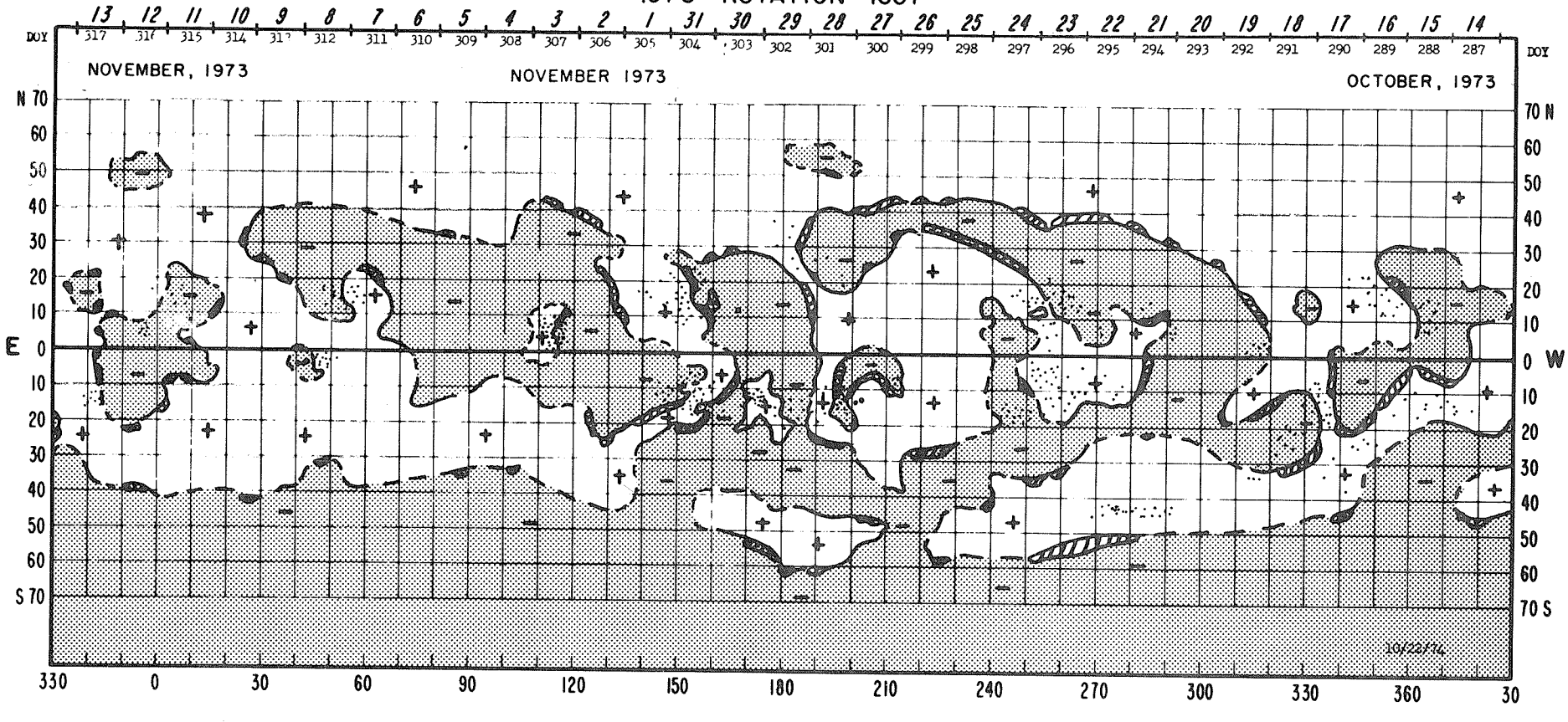
Hα SYNOPTIC CHART

1973 – ROTATION 1607



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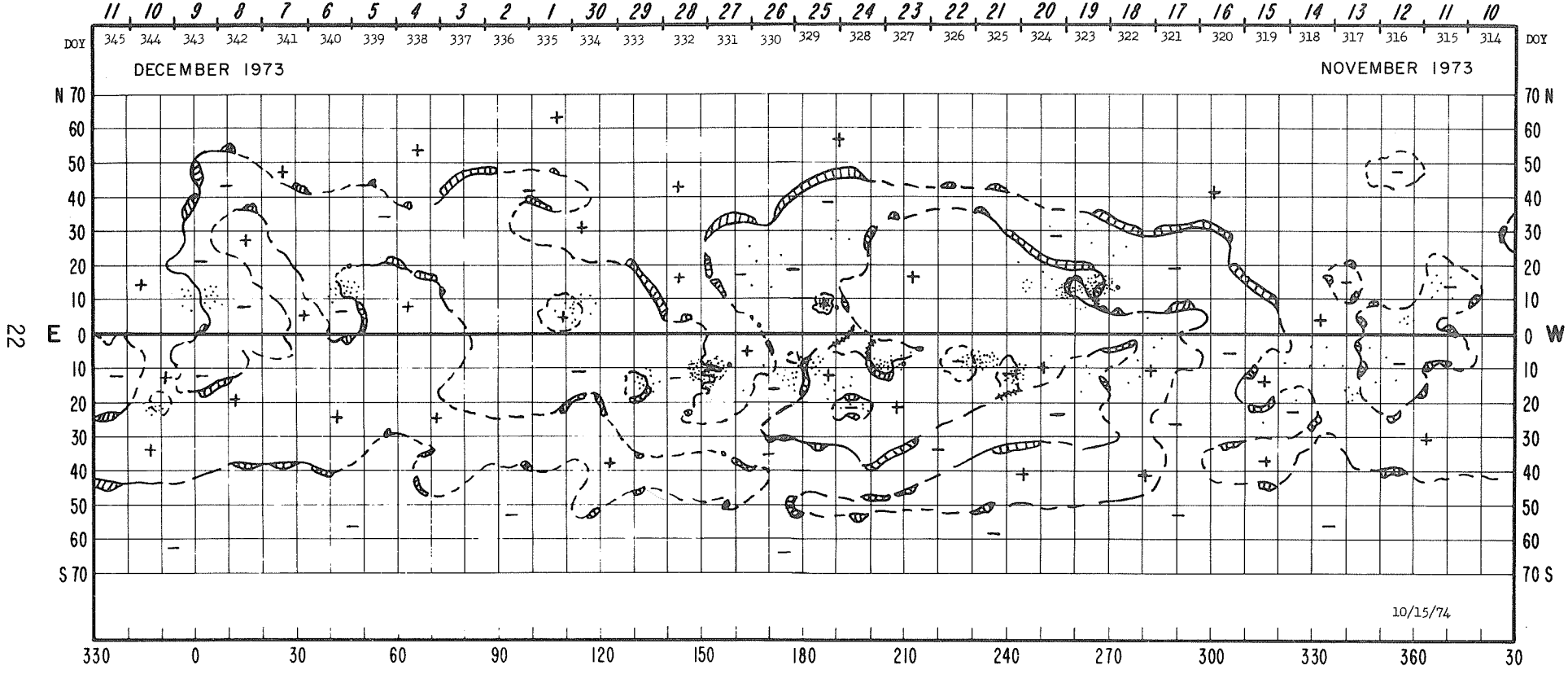
1973 - ROTATION 1608



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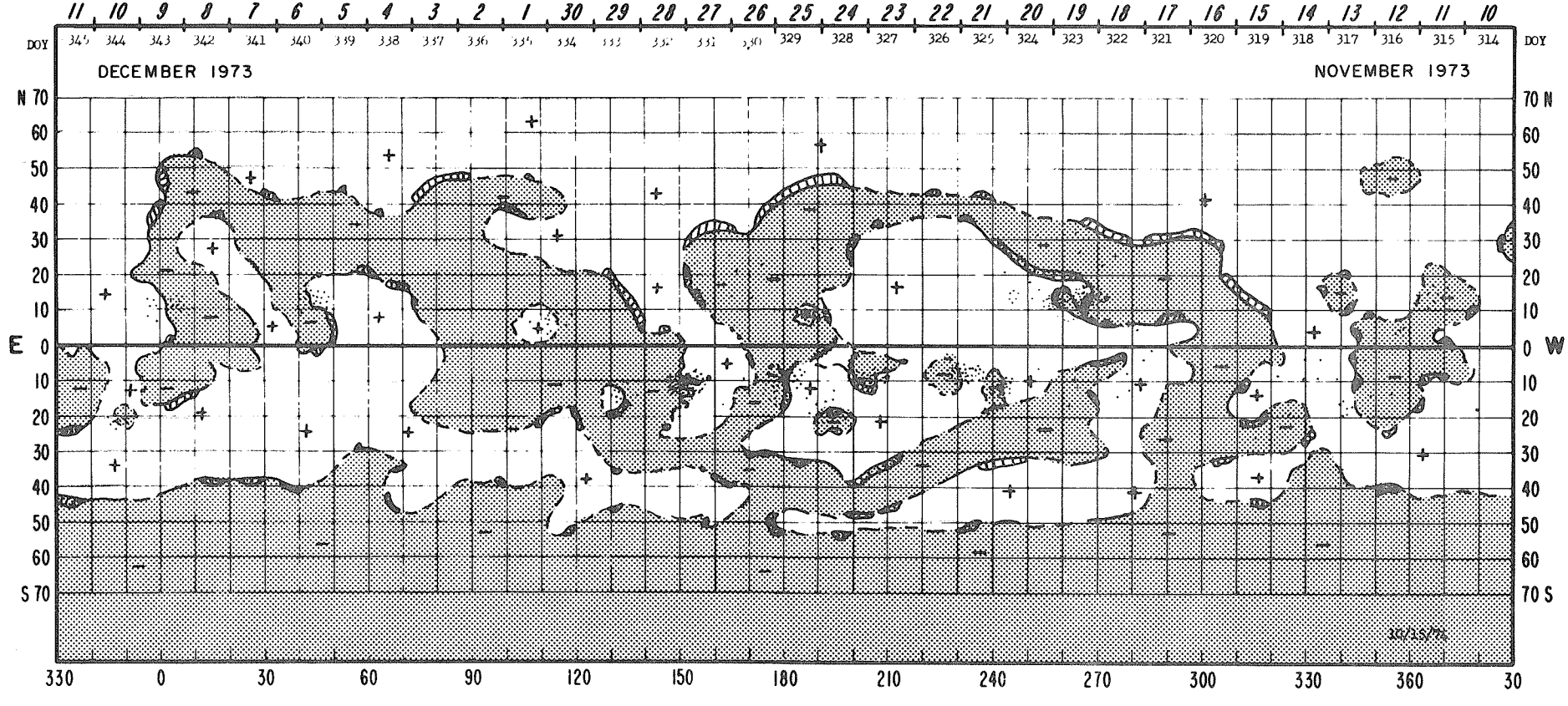

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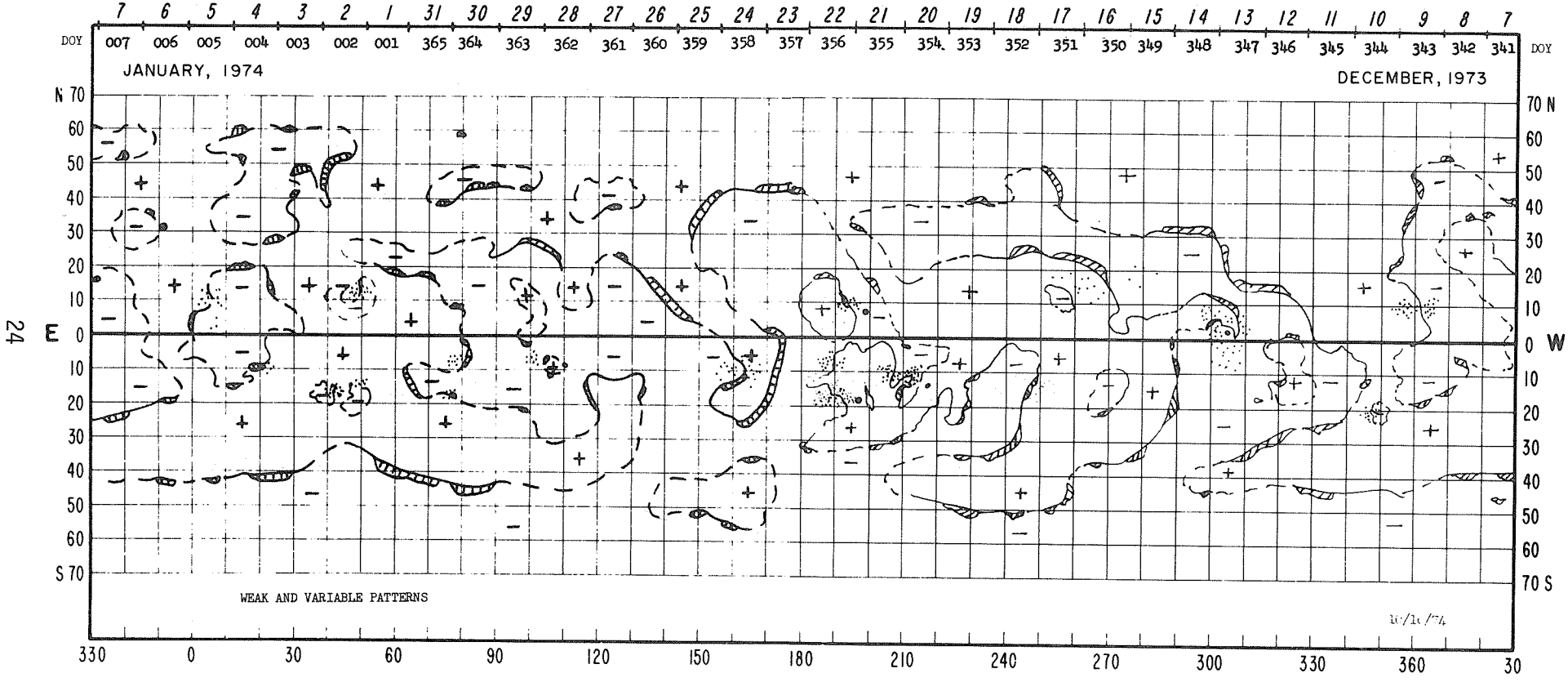

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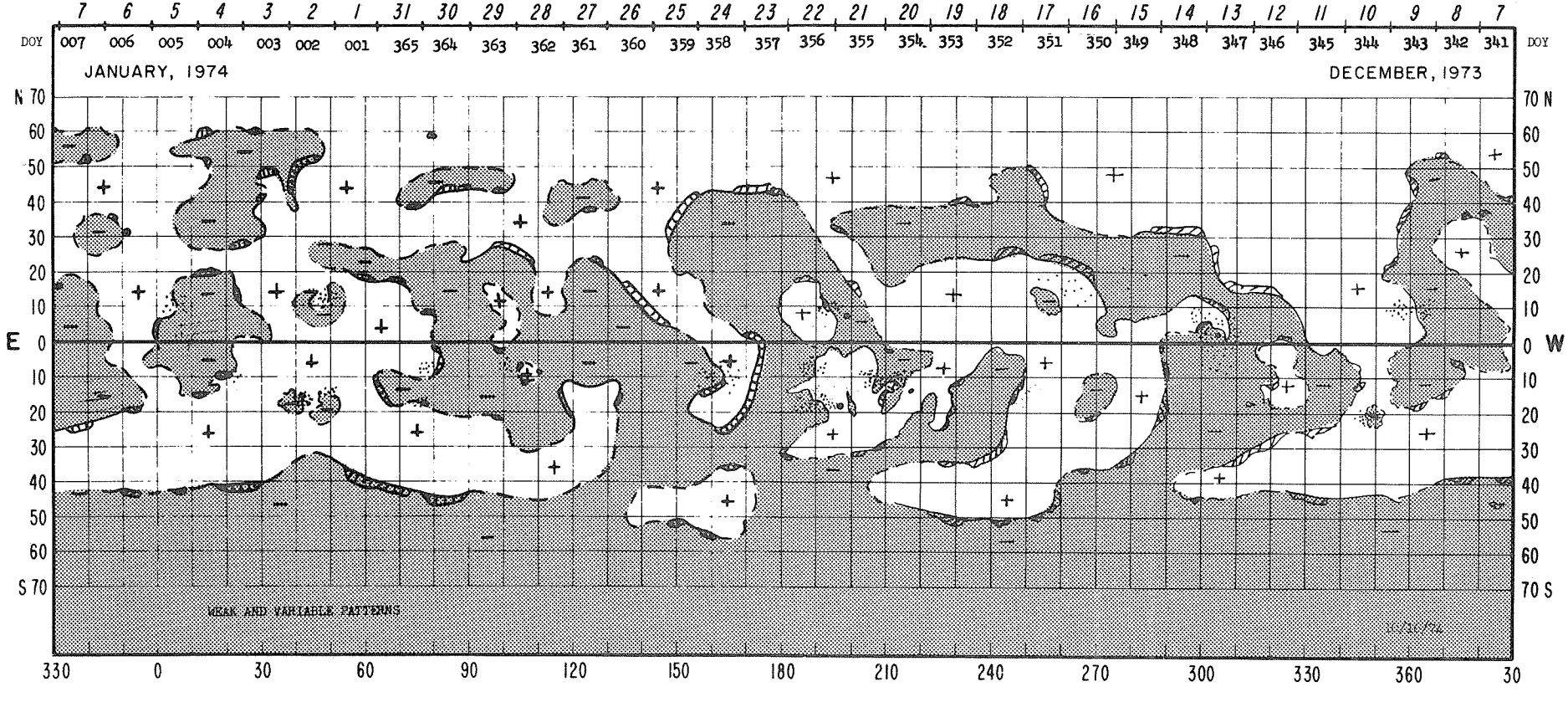

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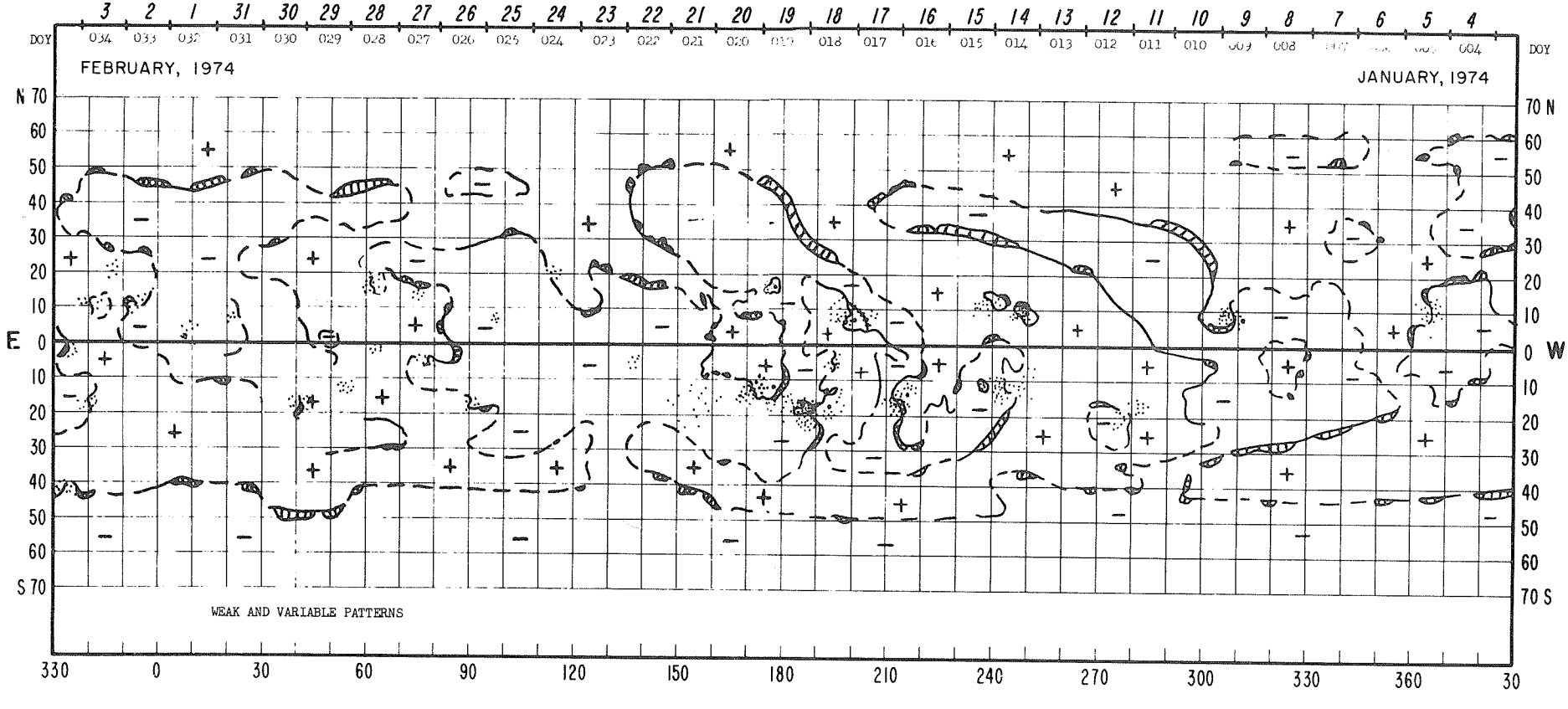
1974 - ROTATION 1610



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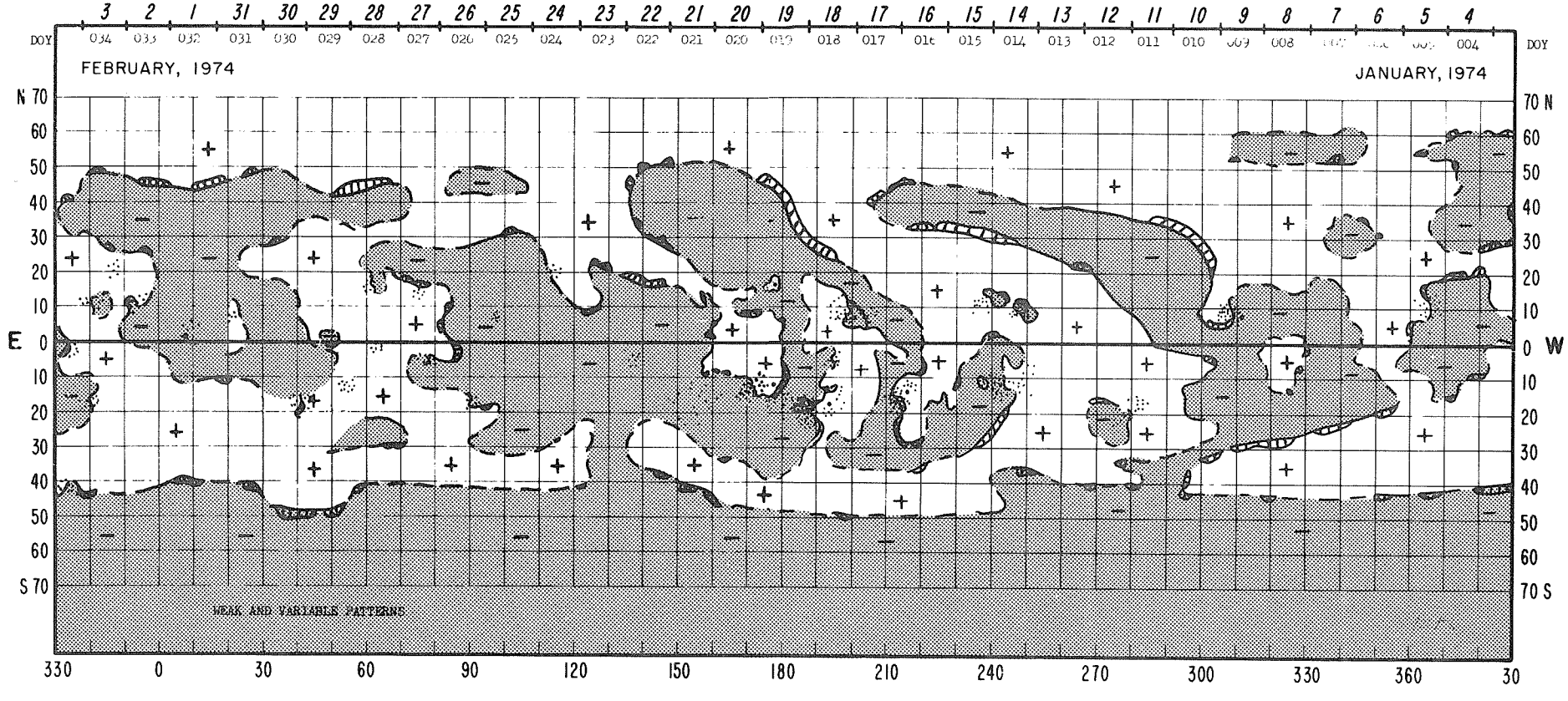
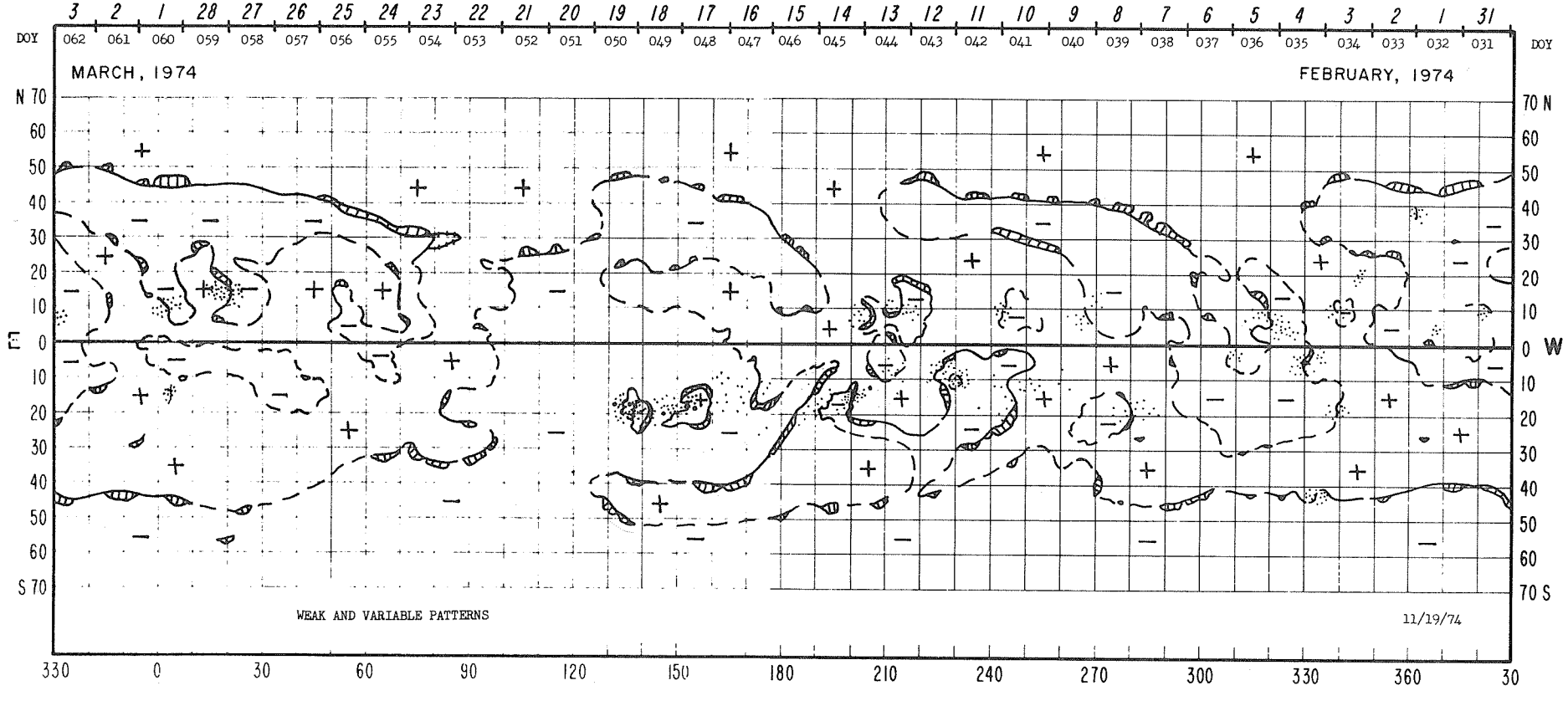


Hα SYNOPTIC CHART

1974 - ROTATION 1611



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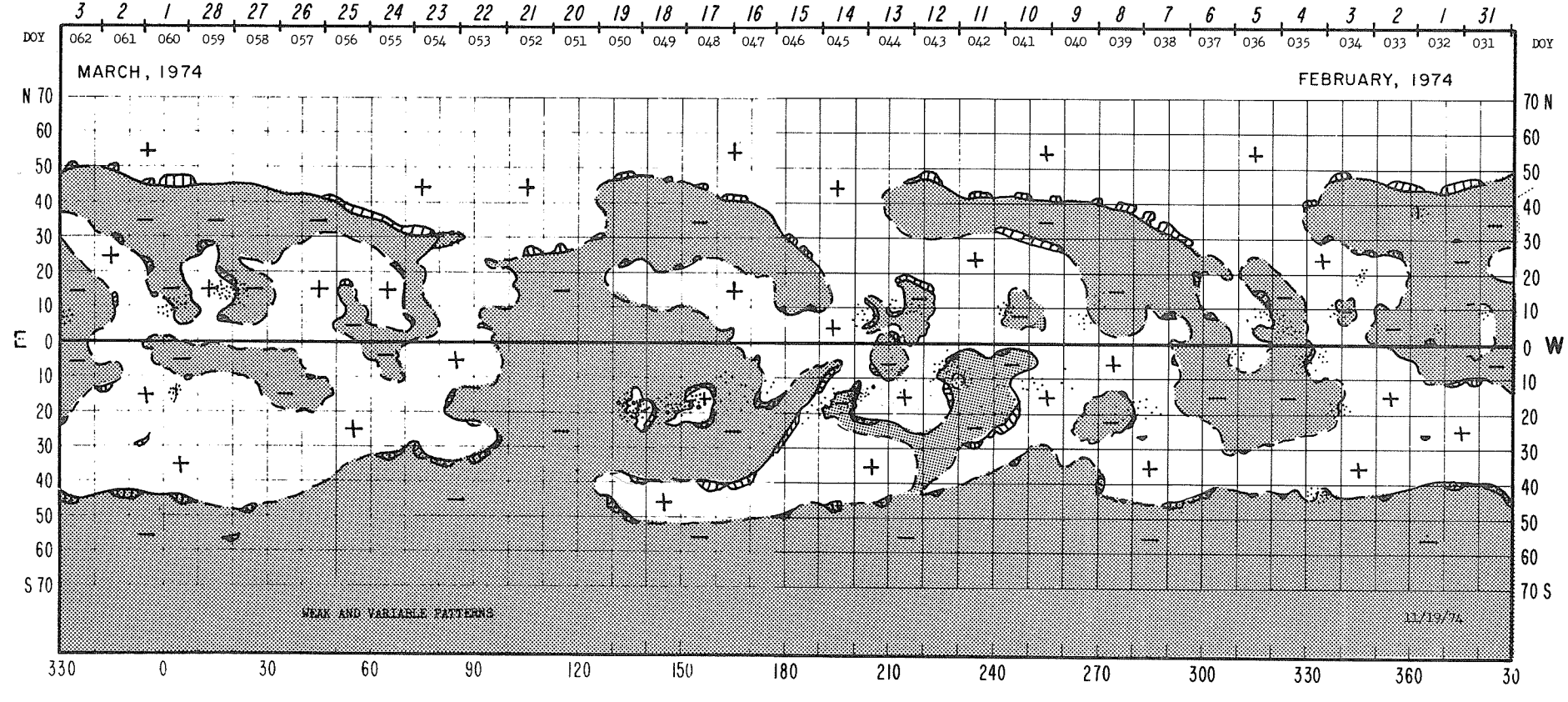

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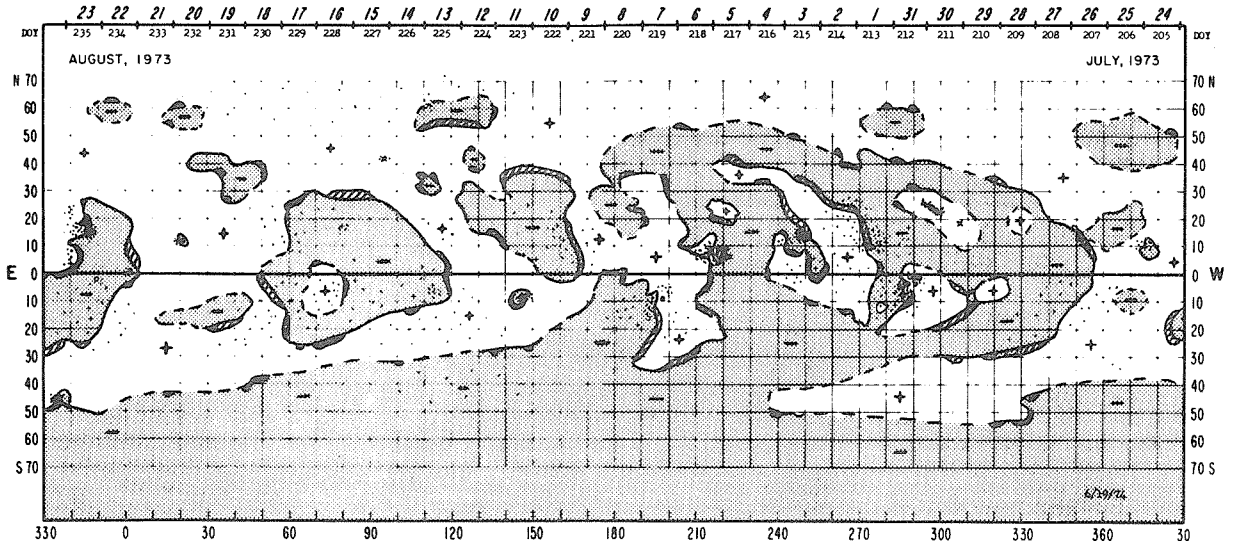
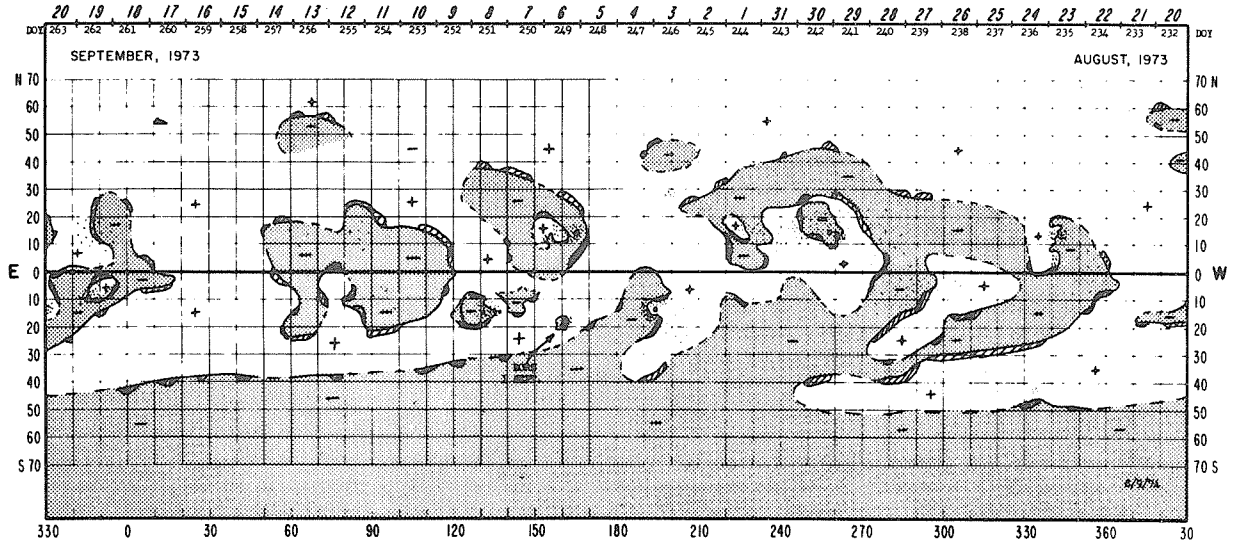


1973 - ROTATION 1605 (East Limb)



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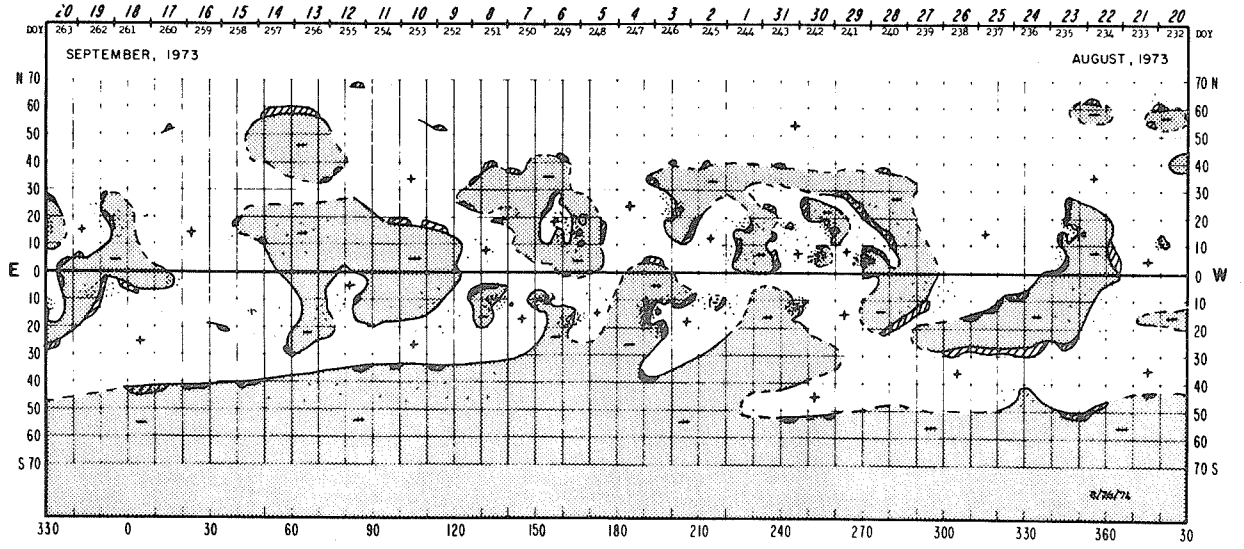

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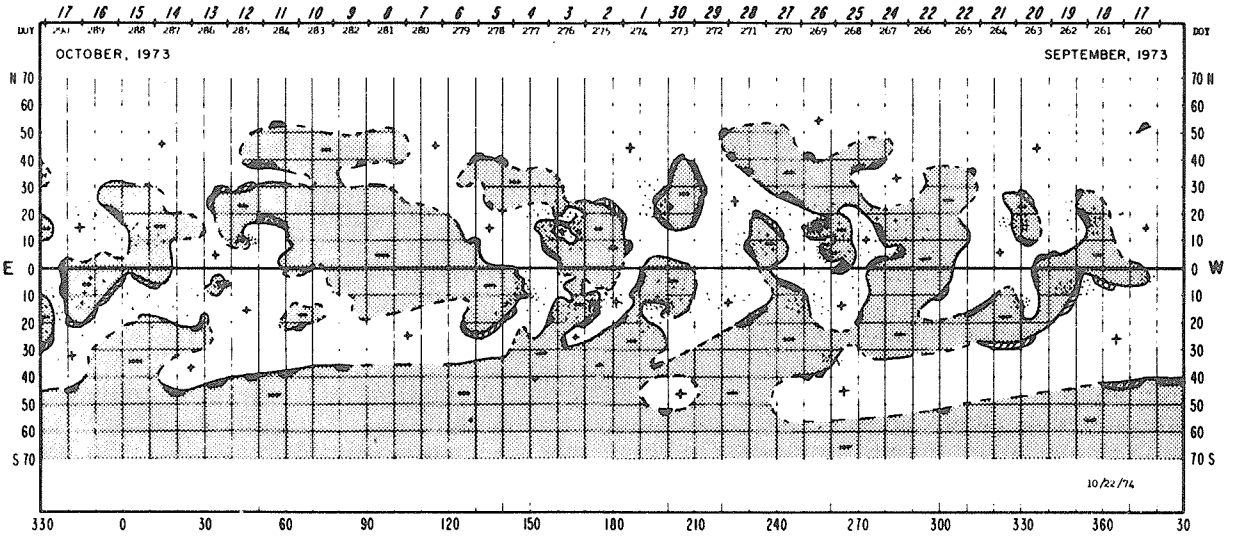

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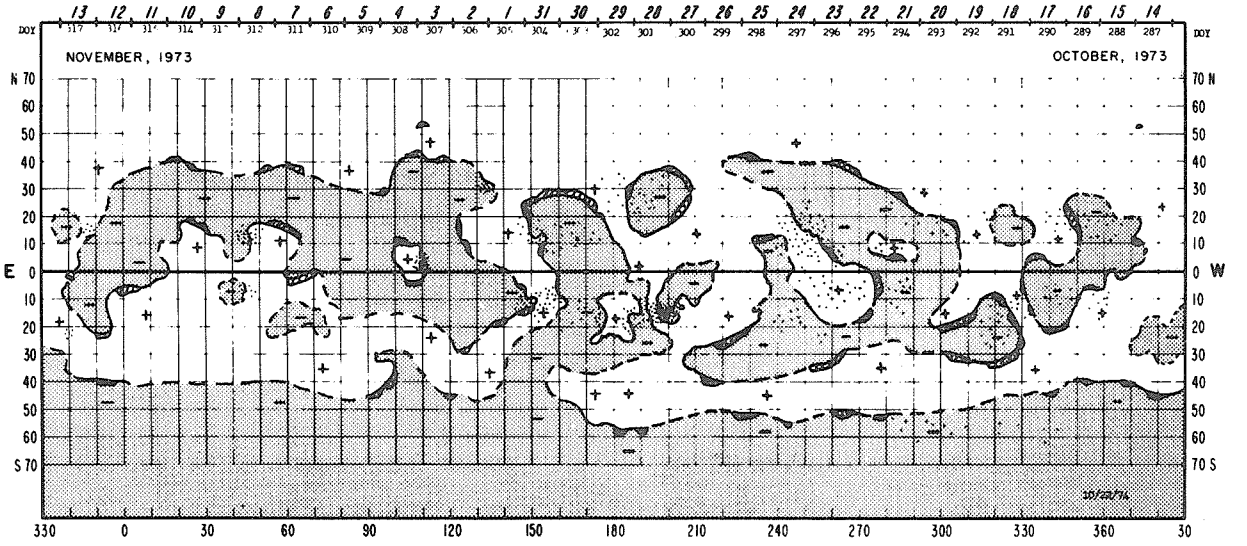

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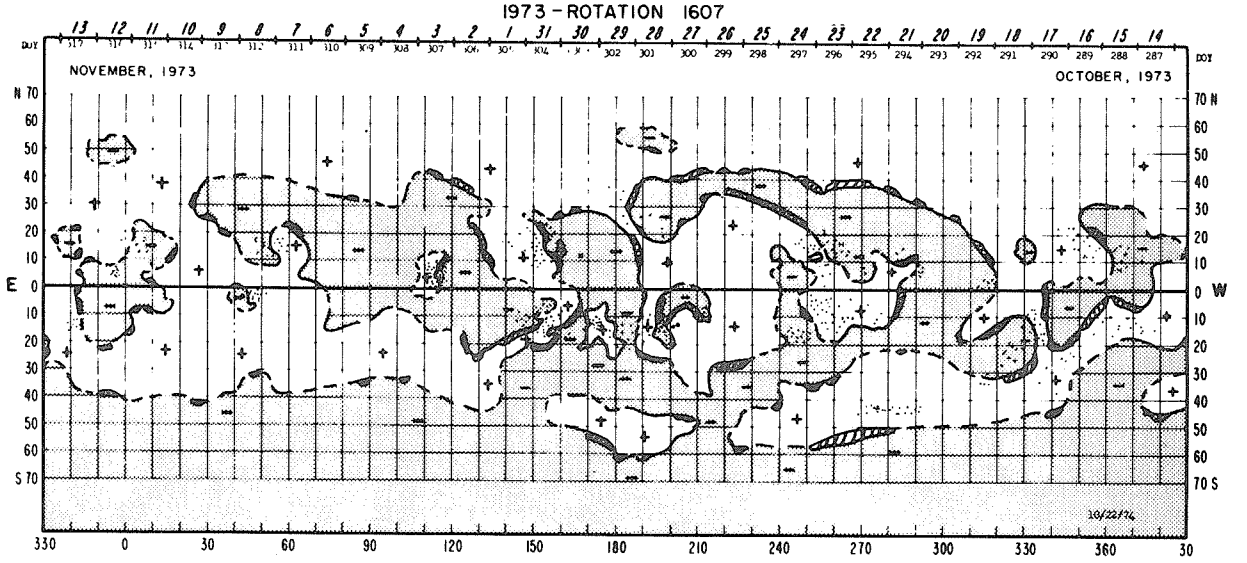
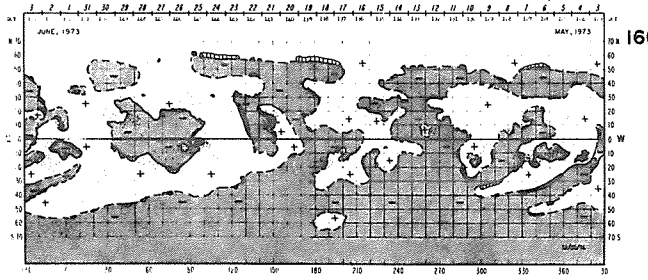


Hα SYNOPTIC CHARTS FOR ROTATIONS 1601-1611



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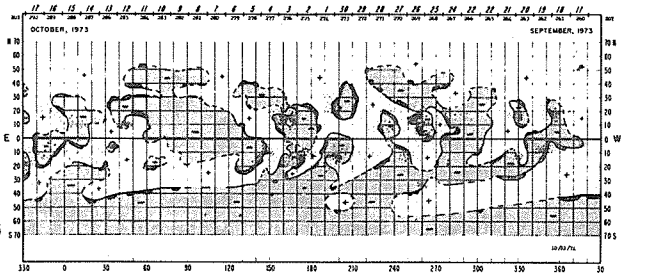

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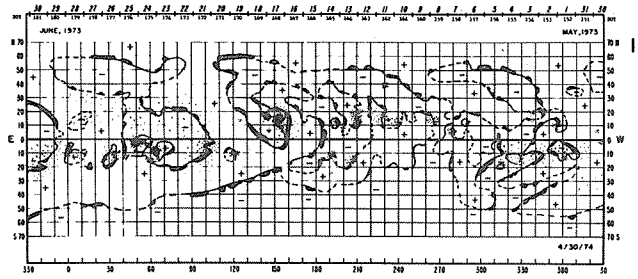

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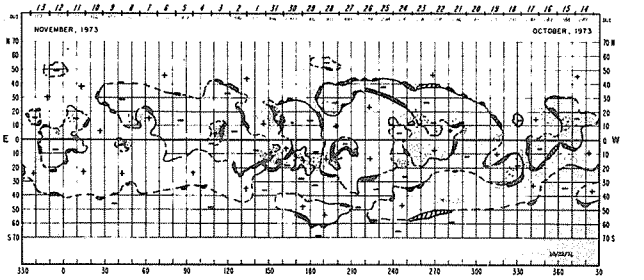

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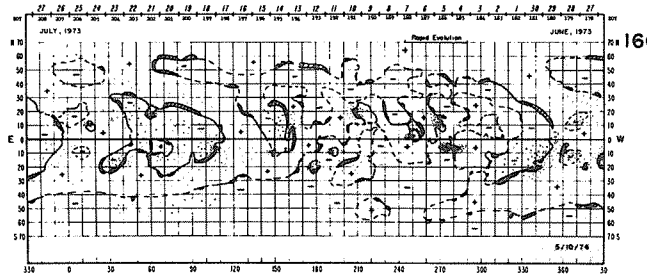

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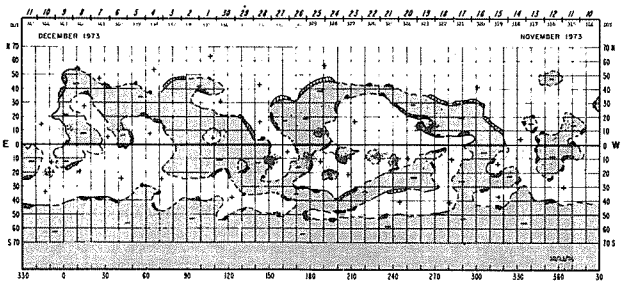

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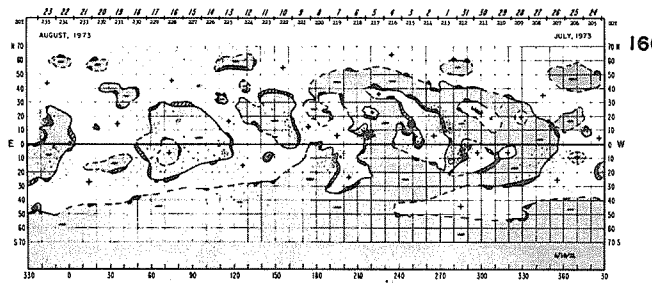

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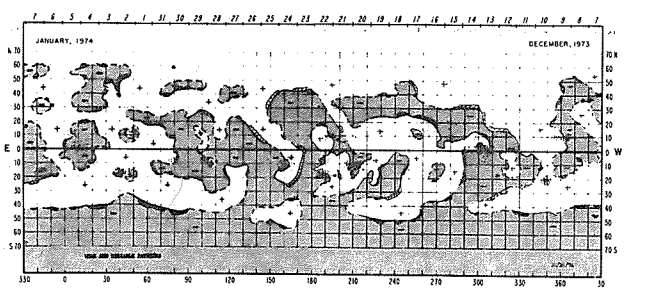

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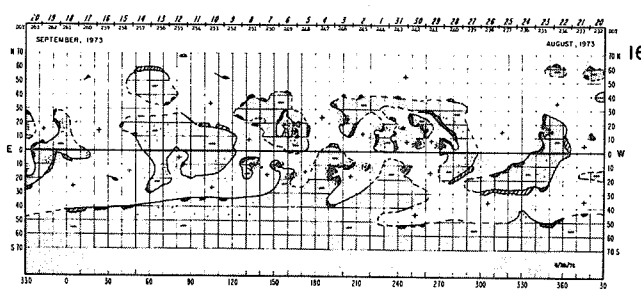

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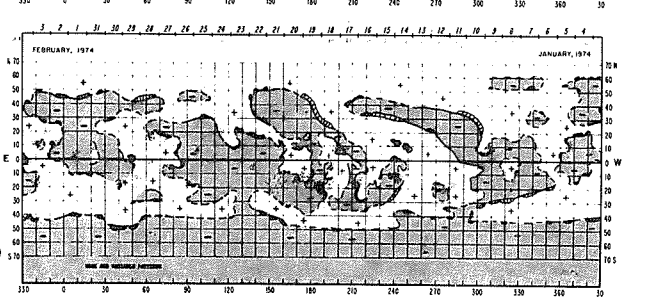

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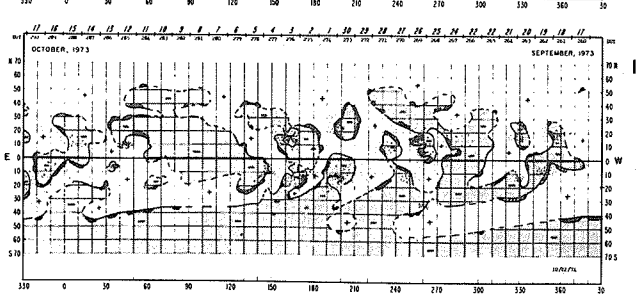

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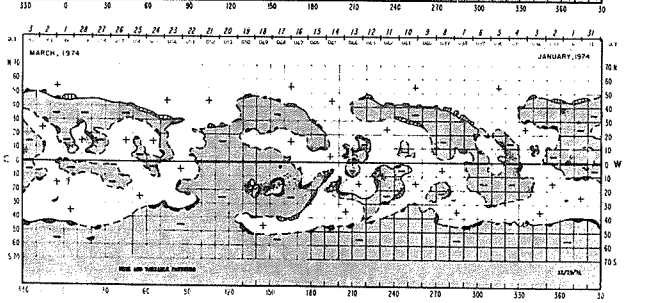

1611

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