NO. 189 COLOR PHOTOGRAPHY OF JUPITER

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ABSTRACT

Selected color photographs of Jupiter taken with the 154-cm Catalina reflector from October 1965 to September 1973 are presented. Eight oppositions are covered showing the developments in cloud belt structure and color distribution of the Jovian atmosphere.

Jupiter photography with color emulsions has been carried out regularly along with black-and-white filter photography in the continuing program of planetary photography with the NASA 154-cm reflector of the Catalina Observatory (Fountain and Larson 1973). The time coverage over eight oppositions provides a good base for study of the evolution of the cloud masses and their colors.

Although filter photography with black-and-white emulsions usually yields somewhat higher resolution (and is easier to calibrate photometrically), the color film offers several advantages. Its simultaneous recording in the three broad wavelength bands produces an image with higher information content than a single black-and-white image can give. On a color photograph one can see more easily the precise spatial relationships between features of slightly different colors. This speeds up the identification of features shown on the black-and-white photographs. Although the effective bandpass and sensitivity of each emulsion layer in color film is difficult to determine precisely (and may vary from batch to batch), the great majority of the features recorded on Jupiter do not exhibit great changes in reflectivity over small wavelength intervals so that it is possible to correct for emulsion differences in succeeding copies and reconstruct the visual impression closely. The most obvious departure is that the color images reproduce the colors with higher contrast than that noted in the telescopic image. Virtually all reproduced photographs of Jupiter are subject to this, which in many cases is desirable since it produces greater visibility of features. A correlation may exist between color and composition or particle size, so that color photography may provide a convenient source of spatial distribution studies.

In the present program, Kodak Ektachrome-EF reversal film is most commonly used. Many color emulsions have been tried, and in the first few years, Kodak High Speed Ektachrome was used most often. It was found that the color fidelity in Ektachrome-EF was more consistent. Atmospheric dispersion was compensated for by the use of a non-deviating small-dispersion prism in the telescope beam.

Most of the processing was done by Kodak Laboratories since they provide more consistent results than local processing firms. In some cases, we found that an increase in resolution was obtained by reducing the exposure by as much as a factor of 4 and extending in our darkroom the development time of the first developer. The increase in contrast makes copying more difficult and the color balance may be affected so that normally processed film, even at reduced resolution, is always needed for verification.

The plates reproduced here were made by copying the original images on Kodak Ektachrome-X, normalizing density and color with a standard whose color accuracy was verified at the telescope. The plates are reproduced with North up.

Acknowledgments: Dr. G. P. Kuiper, assisted by Mr. Dennis Milon, initiated the color photography of Jupiter with the 154-cm telescope. The two first authors continued it since late 1966, assisted by Charles Campbell, David McLean, and James Barrett. Mr. R. B. Minton has participated since late 1969. The work has been supported by NASA Grant No. NGL-03-002-002.

REFERENCE

Fountain, J.W. and Larson, S.M. 1973, "Multicolor Photography of Jupiter", *LPL Communication No. 175, 9.*

Editorial Note: The Laboratory intends to publish a 6-8 fold more extensive series of color photographs of the planet for the past eight oppositions, accompanied by a descriptive text.

LEGENDS FOR COLOR PLATES OF JUPITER

1. October 30, 1965; 8:21:58 UT. Red Spot (RS) prominent. Its Hollow seen by virtue of well-defined grey south component of the South Equatorial Belt (SEBs). White Equatorial Zone (EZ) is wide, with blue-festoon activity apparently originating in the North Equatorial Belt (NEB). The North Temperate Belt (NTeB) is faint, but distinctly orange.

2. January 10, 1966; 5:41:07 UT. RS has dark border. SEBs is deflected north by RS Hollow. Material appears to return to SEBs latitude in the disturbed area following RS. Dark spot is shadow of satellite Io.

3. January 20, 1967; 5:58:31 UT. Many high-latitude light and dark spots in the South Temperate Belt (STeB) region are seen as well as much detail in the SEBs. The grey NTB appears wedge-shaped and in some parts double. Note elongated grey spot near central meridian in NTeZ.

4. March 17, 1967; 3:43:43 UT. Rift in NTB. Large white spot in brown NEB.

5. April 16, 1968; 4:56:15 UT. Single blue festoon still prominent in NEB.

6. May 9, 1968; 3:47:19 UT. Large blue festoon; part of NEB also blue. STB nearly absent at these longitudes.

7. April 5, 1969; 6:12:59 UT. The SEBs had brightened. SEBn is a well-defined grey belt bordering the yellow EZ which itself is filled with many festoons. The STrZ is slightly bluish, and the region around the STZ has much spot activity. NTB is very weak.

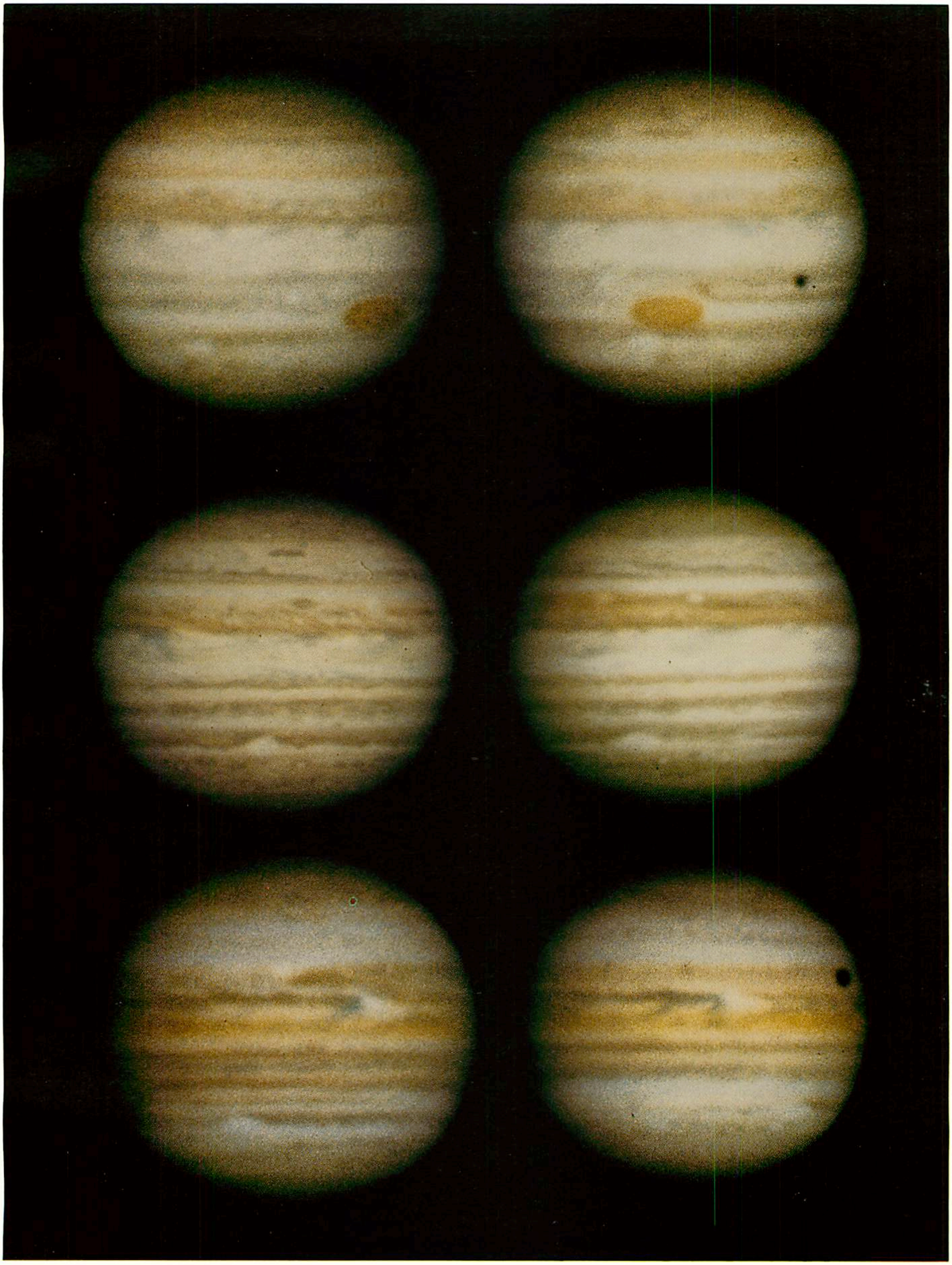
8. May 30, 1969; 4:05:38 UT. High-latitude spots shown in and S of STrZ. Note bright spot near central meridian on north edge of NEB.

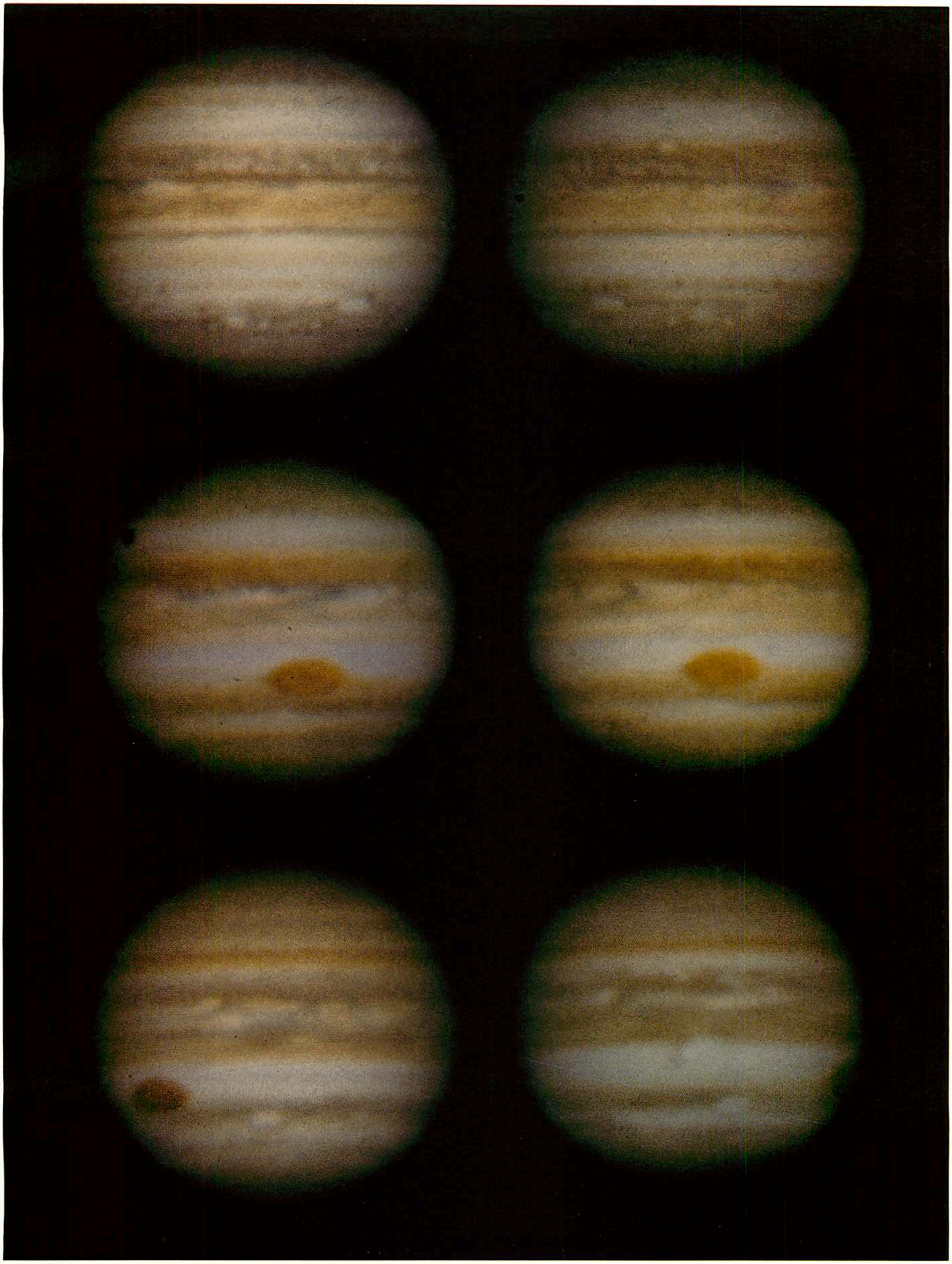
9. May 16, 1970; 6:03:21 UT. RS is prominent with interior detail. The NTB has faded away. The NEB has changed from grey to yellow-brown, bordered on south by very blue festoons. With the absence of SEBs, STrZ and SEBZ combine to be brightest area on planet. STB is much wider than No. 8.

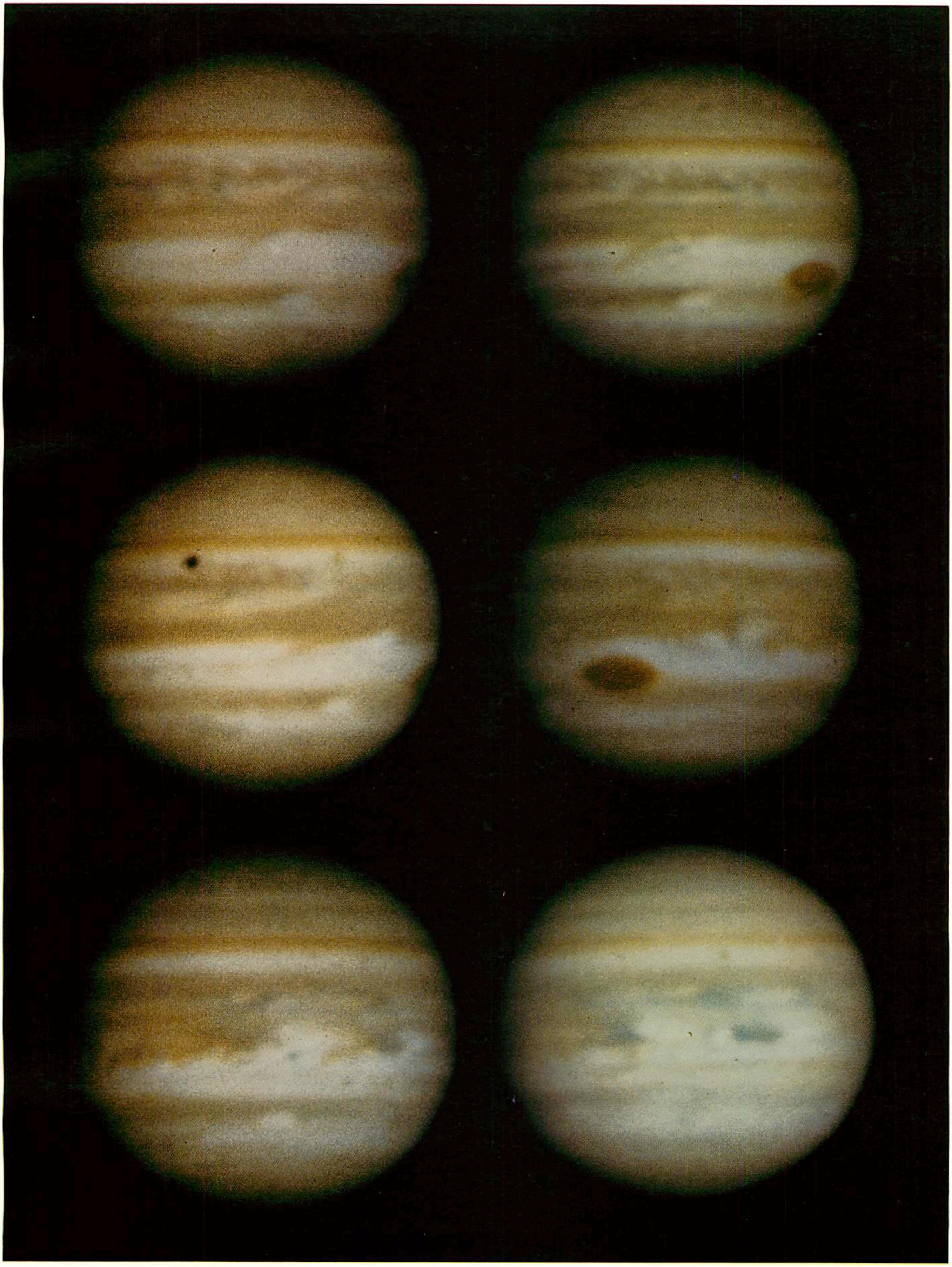
10. June 19, 1970; 4:09:05 UT. RS prominent showing structure. Festoon activity.

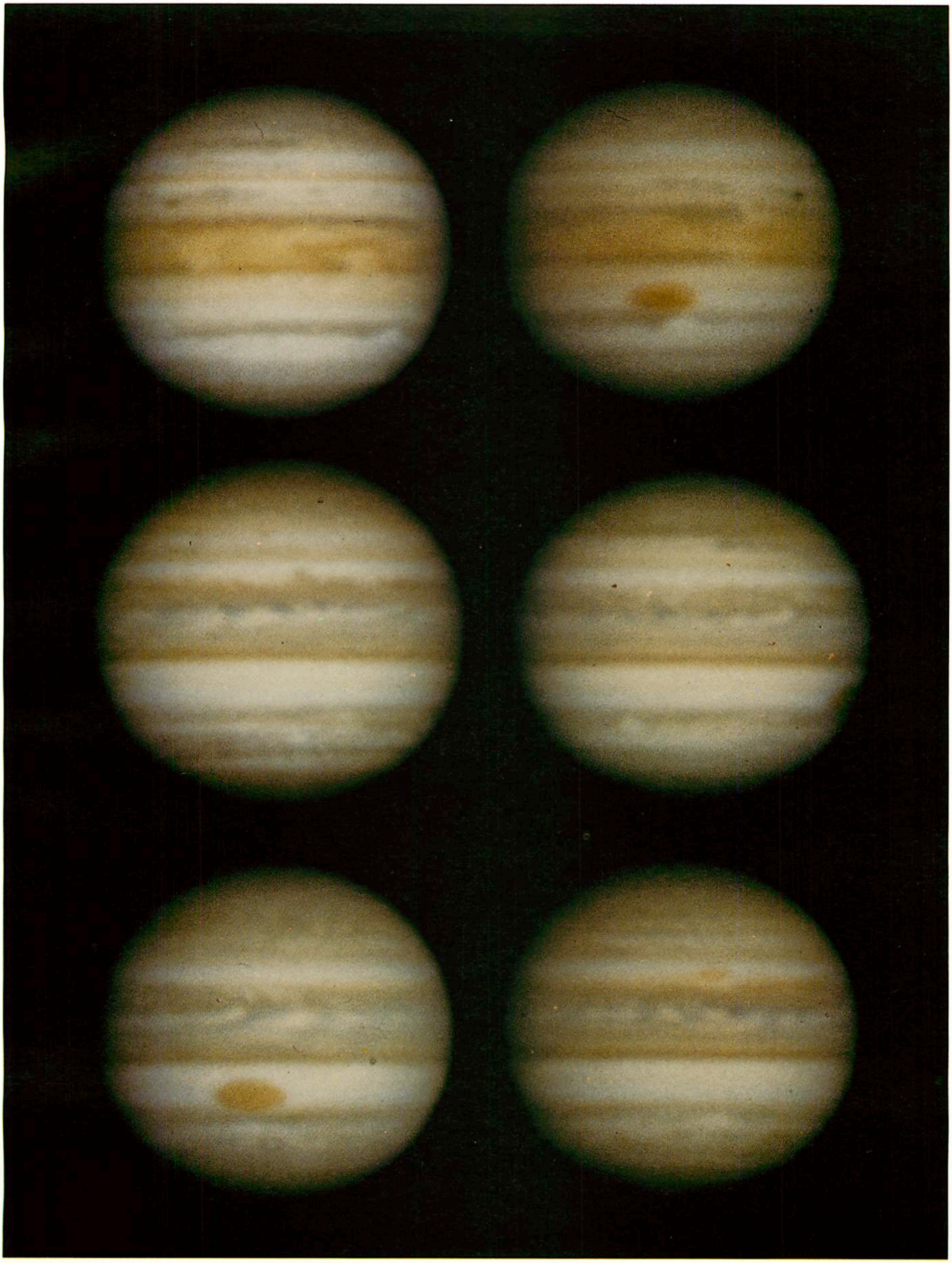
11. May 2, 1971; 10:03:47 UT. More than a month *before* the onset of the SEB disturbance, RS is very pronounced. The SEBs is weak, and SEBZ and STZ show no detail. Colors of festoons in EZ now appear grey.

12. June 23, 1971; 5:57:36 UT. Five days *after* first observation of outbreak of SEB disturbance. The white spot that signaled the onset of the disturbance in the SEBZ is still the brightest feature on planet. A grey column has formed bridging the SEBs and SEBn. The "dent" in SEBn was formed by disturbance. NTZ is whiter than before. Reduced festoon activity.









13. June 28, 1971; 5:03:30 UT. The column of No. 12 is now well-developed. It slants in accord with differential rotation of the SEBs and SEBn. Material from the column is spreading out toward increasing longitude in the SEBs forming dark spots.

14. July 7, 1971; 6:56:11 UT. The area in which first spot occurred is now occupied by many spots. The column is now yellowish, and dark spots in SEBs are well-developed. Note detail in SEBn and NEB.

15. July 10, 1971; 5:05:49 UT. White spots have moved from SEBZ to SEBn, away from the disturbance toward decreasing longitudes. Column is more slanted. The SEBs spots are well shown, by now 70° from the outbreak of the disturbance.

16. August 5, 1971; 4:03:07 UT. Spectacular activity in SEBn. RS is still prominent.

17. August 7, 1971; 3:32:25 UT. The SEB, in complete turmoil, displays striking color differences, especially blues and dark oranges. The SEBs spots can be seen reaching 180° from the apparent source.

18. August 14, 1971; 2:54:53 UT. A large blue oval spot has developed in SEBn. Note the blending of blue and orange in SEBn, and the colorless SEBs.

19. July 20, 1971; 6:36:07 UT. SEB has returned to more normal appearance, except that the whole equatorial region is yellowish. Spots in NTrZ.

20. October 3, 1972; 1:18:56 UT. RS still prominent. Shadow of Europa is near W limb.

21. August 13, 1973; 7:49 UT. Most of yellow color has disappeared; whole equatorial region is dark. Most activity in NEB.

22. September 1, 1973; 4:03:59 UT. Detail in NEB.

23. September 22, 1973; 2:34:53 UT. RS prominent. Festoon activity in equatorial region. High-latitude spots in both hemispheres.

24. September 22, 1973; 4:26:51 UT. Detached orange spot N of NEB. Many belts at high latitudes at this longitude.