# The Jourrial of The Asssciation Oi Lumar And Planctary Observers 

## The Strolling Astronomer

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Drawing of Jupiter on September 14, 1975 at 3hrs., 58mins., Universal Time by Phillip W. Budine. 4-inch Unitron refractor, 214X and 250X. Seeing 9 (excellent), transparency 6 (very clear). C.M. (I) $=\mathbf{2 5 ^ { \circ }}$. C.M. (II) $=$ $41^{\circ}$. Simply inverted view with south at the top. The dark Red Spot with pointed ends is prominent and is surrounded by the Hollow. South Temperate Zone oval FA is near the left limb; oval BC follows the Red Spot. The festoons and bright spots of South Equatorial Belt Disturbance No. 1 extend from the Red Spot longitude to the right limb. See also text on pages 257 and 258.

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As described in a recent notice ('Observing Olympus Mons in 1975," JALPO, 25, Nos. 7-8 (June, 1975), pp. 129-130), the Martian volcano Olympus Mons should be visible as a relief feature with amateur-sized telescopes during the 1975-76 apparition. That report gave the Universal Times of sunset at Olympus Mons for each day in 1975 when its expected shadow length exceeded 0.'30.

The table below continues that ephemeris of Olympus Mons terminator transits into 1976 (for the dates January 8 - March 16, when its expected shadow length exceeds 0!'30). Since this period is after opposition, this table refers to the sunrise terminator. The summit of Olympus Mons should be illuminated by the rising sun about $33-35$ minutes before the tabulated time, while the tip of Olympus Mons' shadow should emerge from the terminator about the same time interval after terminator transit.

## Olympus Mons Terminator Transit Ephemeris (Sunrise): 1976

| U.T. Date | U.T. | Shadow Length | U.T. Date |  | U.T. | Shadow <br> Length | U.T. Date |  | U.T. | Shadow Length |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| JAN 08 | 03:54 | $0!31$ | JAN | 31 | 18:51 | $0!38$ | FEB | 23 | 09:10 | 0:35 |
| 09 | 04:33 | 0.31 | FEB | 01 | 19:30 | 0.38 |  | 24 | 09:49 | 0.35 |
| 10 | 05:11 | 0.32 |  | 02 | 20:10 | 0.38 |  | 25 | 10:28 | 0.35 |
| 11 | 05:51 | 0.33 |  | 03 | 20:48 | 0.38 |  | 26 | 11:07 | 0.35 |
| 12 | 06:30 | 0.33 |  | 04 | 21:28 | 0.38 |  | 27 | 11:46 | 0.34 |
| Jan 13 | 07:09 | 0:34 | FEB | 05 | 22:07 | 0.38 | FEB | 28 | 12:26 | $0 \because 34$ |
| 14 | 07:48 | 0.34 |  | 06 | 22:46 | 0.38 |  | 29 | 13:04 | 0.34 |
| 15 | 08:27 | 0.35 |  | 07 | 23:25 | 0.38 | MAR | 01 | 13:44 | 0.34 |
| 16 | 09:06 | 0.35 |  | 08 |  | 0.38 |  | 02 | 14:23 | 0.33 |
| 17 | 09:45 | 0.36 |  | 09 | 00:03 | 0.38 |  | 03 | 15:02 | 0.33 |
| JAN 18 | 10:24 | 0!36 | FEB | 10 | 00:43 | 0.37 | MAR | 04 | 15:41 | $0: 33$ |
| 19 | 11:03 | 0.36 |  | 11 | 01:21 | 0.37 |  | 05 | 16:20 | 0.33 |
| 20 | 11:42 | 0.37 |  | 12 | 02:01 | 0.37 |  | 06 | 16:59 | 0.33 |
| 21 | 12:21 | 0.37 |  | 13 | 02:39 | 0.37 |  | 07 | 17:38 | 0.32 |
| 22 | 13:00 | 0.37 |  | 14 | 03:18 | 0.37 |  | 08 | 18:17 | 0.32 |
| JAN 23 | 13:39 | 0.37 | FEB | 15 | 03:57 | 0.37 | MAR | 09 | 18:57 | 0'32 |
| 24 | 14:17 | 0.38 |  | 16 | 04:37 | 0.37 |  | 10 | 19:35 | 0.32 |
| 25 | 14:58 | 0.38 |  | 17 | 05:16 | 0.36 |  | 11 | 20:15 | 0.31 |
| 26 | 15:36 | 0.38 |  | 18 | 05:55 | 0.36 |  | 12 | 20:53 | 0.31 |
| 27 | 16:15 | 0.38 |  | 19 | 06:34 | 0.36 |  | 13 | 21:33 | 0.31 |
| Jan 28 | 16:55 | 0:38 | FEB | 20 | 07:13 | 0:36 | MAR | 14 | 22:12 | $0!31$ |
| 29 | 17:33 | 0.38 |  | 21 | 07:52 | 0.36 |  | 15 | 22:51 | 0.30 |
| 30 | 18:13 | 0.38 |  | 22 | 08:32 | 0.35 |  | 16 | 23:30 | 0.30 |

## SATURN CENTRAL MERIDIAN EPHEMERIS: 1976

By: John E. Westfall
The two tables on pages 218 and 219 give the longitude of Saturn's geocentric central meridian (C.M.) for the illuminated (apparent) disk at $0^{\mathrm{h}}$ U.T. for each day in 1976. These tables are a continuation of those for 1969-75, previously published in the JALPO, and incorporate corrections for phase, light-time, and the Saturnicentric longitude of the Earth.
"System I" assumes a sidereal rotation rate of 844.00 /day (period $=10^{\mathrm{h}_{1}} 4^{\mathrm{m}} \mathrm{m}_{3} \mathrm{~S}_{1}$ ), intended for use with features in the NEB, EZ, and SEB. "System II", intended for the rest of the ball, assumes a sidereal rotation rate of $812.00 /$ day (period $=10^{\mathrm{h}} 38^{\mathrm{m}}$ $25 S_{4}$ ). These rates are only approximations because latitude-dependent rotation rates for Saturn are more uncertain than, say, for Jupiter; but longitudes calculated from the following tables should give conveniently small drift rates for most features. (In order to convert such drift rates to rotation periods, see the following article, "Saturnian Drift Rates and Periods.") A.L.P.O. Saturn observers are urged to make central meridian timings, combined with latitude measures (or at least estimates) whenever possible, so that these rotation rates, and any future C.M. tables, can be made more accurate.

LONGITUDE OF CENTRAL MERIDIAN OF ILLUMINATED DISK

| SYSTEM I -- $0^{\text {h }}$ U.T. |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Day | JAN. | FEB. | MAR. | ADR. | MAY | JUNE | JULY | AUG | SED. | OCT. | NOV . | DEC. |
| 1 | 4183 | 28789 | 284:7 | $167 \% 1$ | 283.5 | 162:9 | 278.1 | 157:8 | 38.6 | 157:2 | 41.4 | 153.1 |
| 2 | 165.4 | 52.3 | 48.6 | 291.0 | 47.5 | 286.7 | 42.0 | 281.7 | 152.6 | 281.1 | 165.4 | 287.1 |
| 3 | 289.5 | 176.0 | 172.6 | 54.9 | 171.3 | 50.6 | 155.8 | 45.5 | 285.5 | 45.1 | 289.4 | 51.2 |
| 4 | 53.6 | 300.1 | 296.6 | 178.8 | 295.2 | 174.4 | 289.7 | 159.4 | 50.4 | 159.1 | 53.5 | 175.3 |
| 5 | 177.7 | 64.1 | 60.6 | 352.7 | 59.0 | 298.2 | 53.5 | 293.3 | 174.4 | 293.1 | 177.5 | 299.4 |
| 6 | 301.8 | 188.2 | 184.6 | 56.6 | 182.9 | 62.1 | 177.4 | 57.2 | 298.3 | 57.1 | 3J1.5 | 53.5 |
| 7 | 65.9 | 312.2 | 308.5 | 190.5 | 306.7 | 185.9 | 331.2 | 181.1 | 52.2 | 181.1 | 65.6 | 187.5 |
| 8 | 193.0 | 76.3 | 72.5 | 314.4 | 70.6 | 309.8 | 55.1 | 305.0 | 186.2 | 335.1 | 189.6 | 311.6 |
| 9 | 314.0 | 200.3 | 196.5 | 78.3 | 194.5 | 73.6 | 188.9 | 68.8 | 310.1 | 59.3 | 313.7 | 75.7 |
| 10 | 78.1 | 324.4 | 320.5 | 202.2 | 318.3 | 197.4 | 312.8 | 192.7 | 74.3 | 193.0 | 77.7 | 199.8 |
| 11 | 202.2 | 88.4 | 84.4 | 326.1 | 82.2 | 321.3 | 76.6 | 316.6 | 198.3 | 317.3 | 231. | 323.9 |
| 12 | 326.3 | 212.4 | 238.4 | 90.0 | 206.0 | 85.1 | 203.5 | 83.5 | 321.9 | 81.3 | 325.8 | 88.0 |
| 13 | 93.4 | 336.5 | 332.3 | 213.9 | 329.9 | 239.0 | 324.4 | 204.4 | 85.9 | 295.0 | 89.9 | 212.1 |
| 14 | 214.5 | $100 \cdot 5$ | 96.3 | 337.8 | 93.7 | 332.8 | 88.2 | 328.3 | 209.8 | 329.0 | 213.9 | 335.1 |
| 15 | 338.6 | 224.5 | 220.2 | 101.6 | 217.5 | 96.7 | 212.1 | 92.2 | 333.8 | 93.0 | 338.0 | 103.2 |
| 16 | 102.7 | 348.6 | 344.2 | 225.5 | 341.4 | 223.5 | 335.9 | 216.1 | 97.7 | 217.3 | 132.0 | 224.3 |
| 17 | 226.8 | 112.6 | 108.1 | 349.4 | 105.2 | 344.3 | 99.8 | 340.3 | 221.7 | 341.1 | 226.1 | 348.4 |
| 18 | 350.9 | 236.6 | 232.1 | 113.3 | 229.1 | 108.2 | 223.6 | 103.9 | 345.6 | 135.1 | 350.2 | 112.5 |
| 19 | 115.0 | 0.6 | 356.0 | 237.2 | 352.9 | 232.0 | 347.5 | 227.8 | 109.6 | 229.1 | 114.2 | 236.6 |
| 20 | 239.0 | 124.6 | 120.0 | 1.3 | 116.8 | 355.9 | 111.4 | 351.7 | 233.5 | 353.1 | 238.3 | 3.7 |
| 21 | 3.1 | 248.7 | 243.9 | 124.9 | 240.6 | 119.7 | 235.2 | 115.5 | 357.5 | 117.1 | 2.3 | 124.8 |
| 22 | 127.2 | 12.7 | 7.8 | 248.8 | 4.5 | 243.5 | 359.1 | 239.5 | 121.4 | 241.1 | 125.4 | 248.9 |
| 23 | 251.3 | 136.7 | 131.8 | 12.7 | 128.3 | 7.4 | 123.0 | 3.4 | 245.4 | 5.1 | 250.5 | 13.0 |
| 24 | 15.4 | 260.7 | 255.7 | 136.5 | 252.2 | 131.2 | 246.8 | 127.3 | 9.4 | 129.1 | 14.5 | 137.1 |
| 25 | 139.4 | 24.7 | 19.5 | 260.4 | 16.0 | 255.1 | 13.7 | 251.2 | 133.3 | 253.2 | 138.6 | 261.2 |
| 26 | 263.5 | 148.7 | 143.6 | 24.3 | 139.8 | 18.9 | 134.6 | 15.1 | 257.3 | 17.2 | 252.7 | 25.3 |
| 27 | 27.6 | 272.7 | 267.5 | 148.1 | 263.7 | 142.8 | 258.4 | 139.1 | 21.3 | 141.2 | 25.8 | 149.4 |
| 28 | 151.6 | 36.7 | 31.4 | 272.0 | 27.5 | 256.6 | 22.3 | 263.0 | 145.2 | 265.2 | 150.8 | 273.5 |
| 29 | 275.7 | $160 \cdot 7$ | 155.3 | 35.9 | 151.4 | 30.4 | 146.2 | 25.9 | 269.2 | 29.3 | 274.9 | 37.6 |
| 30 | 39.8 |  | 279.2 | 159.7 | 275.2 | 154.3 | 270.0 | 153.8 | 33.2 | 153.3 | 39.3 | 161.7 |
| 31 | 163.8 |  | 43.2 |  | 39.0 |  | 33.9 | 274.7 |  | 277.3 |  | 285.8 |

motion of the central meridian

| $01^{\mathrm{h}}--035^{\circ} .2$ | $09^{\mathrm{h}}-\mathrm{-a} 36^{\circ} .5$ | $17^{\mathrm{h}}--237.8$ | $10^{\mathrm{m}}--005^{\circ} .9$ | $01^{\mathrm{m}}--000.6$ |
| :--- | :--- | :--- | :--- | :--- | :--- |
| $02--070.3$ | $10--351.7$ | $18--273.0$ | $20-0011.7$ | $02-001.2$ |
| $03--105.5$ | $11--026.8$ | $19--308.2$ | $30--017.6$ | $03-001.8$ |
| $04--140.7$ | $12--062.0$ | $20--343.3$ | $40--023.4$ | $04-002.3$ |
| $05--175.8$ | $13--097.2$ | $21--018.5$ | $50--029.3$ | $05-002.9$ |
| $06--211.0$ | $14--132.3$ | $22--053.7$ |  | $06-003.5$ |
| $07--246.2$ | $15--167.5$ | $23--088.8$ |  | $07-004.1$ |
| $08--281.3$ | $16--202.7$ | $24--124.0$ |  | $08-004.7$ |
|  |  |  |  | $09-005.3$ |

Figure 1. Longitude of Central Meridian of Saturn in System I in 1976. Prepared and contributed by John E. Westfall. See text on page 217 et seq.

To find the central meridian at any time, find the $0^{\mathrm{h}}$ U.T. central meridian for the appropriate date and system, and then add the hours and minutes corrections from the related table, "Motion of the Central Meridian," as shown in the example below:

Example. - A festoon in the EZ transits the central meridian at $07^{\mathrm{h}} 23^{m}$ on February 7, 1976 U.T. (EZ is in System I).

SATURN, 1976
longitude of central meridian of illuminated disk

| SYSTEM II -- $0^{\text {h }}$ U.T. |  |  |  |  |  |  |  |  |  |  |  |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Day | JAN. | FEB. | MAR. | ADR. | MAY | JUNE | JULY | AUG. | SED. | ост. | NOV. | DEC. |
| 1 | 32981 | 30387 | 9285 | 6380 | 29906 | 26780 | 14293 | 11080 | 7888 | 31783 | 28994 | 17183 |
| 2 | 61.2 | 35.8 | 184.5 | 154.9 | 31.5 | 358.8 | 234.2 | 201.8 | 173.7 | 49.2 | 21.4 | 253.1 |
| 3 | 153.3 | 127.8 | 276.5 | 245.8 | 123.3 | 90.7 | 326.0 | 293.7 | 262.7 | 141.2 | 113.4 | 355.1 |
| 4 | 245.4 | 219.9 | 8.5 | 338.7 | 215.2 | 182.5 | 57.9 | 25.6 | 354.6 | 233.2 | 235.5 | 87.2 |
| 5 | 337.5 | 311.9 | 100.5 | 70.6 | 307.1 | 274.4 | 149.7 | 117.5 | 85.5 | 325.2 | 297.5 | 179.3 |
| 6 | 69.5 | 44.0 | 192.4 | 162.6 | 38.9 | 6.2 | 241.6 | 209:4 | 178.4 | 57.2 | 29.5 | 271.4 |
| 7 | 161.7 | 136.0 | 284.4 | 254.5 | 130.8 | 98.1 | 333.4 | 301.3 | 273.4 | 149.2 | 121.6 | 3.4 |
| 8 | 253.8 | 228.1 | 16.4 | 346.4 | 222.6 | 189.9 | 65.3 | 33.1 | 2.3 | 241.1 | 213.6 | 95.5 |
| 9 | 345.9 | 320.1 | 108.4 | 78.3 | 314.5 | 281.7 | 157.1 | 125.0 | 94.2 | 333.1 | 335.7 | 187.5 |
| 10 | 78.0 | 52.2 | 200.3 | 170.2 | 46.4 | 13.6 | 249.0 | 216.9 | 186.2 | 65.1 | 37.7 | 279.7 |
| 11 | 170.1 | 144.2 | 292.3 | 262.1 | 138.2 | 105.4 | 343.8 | 308.8 | 278.1 | 157.1 | 129.8 | 11.8 |
| 12 | 262.1 | 236.3 | 24.3 | 354.0 | 230.1 | 197.3 | 72.7 | 40.7 | 10.1 | 249.1 | 221.8 | 103.9 |
| 13 | 354.2 | 328.3 | 116.2 | 85.8 | 321.9 | 289.1 | 164.5 | 132.6 | 132.0 | 341.1 | 313.9 | 195.9 |
| 14 | 86.3 | 60.3 | 208.2 | 177.7 | 53.8 | 21.0 | 255.4 | 224.5 | 193.9 | 73.1 | 45.9 | 288.0 |
| 15 | 178.4 | 152.4 | 300.1 | 269.6 | 145.6 | 112.8 | 348.2 | 316.4 | 285.9 | 165.1 | 138.3 | 20.1 |
| 16 | 270.5 | 244.4 | 32.1 | 1.5 | 237.5 | 204.6 | 80.1 | 48.3 | 17.8 | 257.1 | 233.1 | 112.2 |
| 17 | 2.6 | 336.4 | 124.0 | 93.4 | 329.3 | 296.5 | 172.0 | 140.2 | 109.8 | 349.1 | 322.1 | 294.3 |
| 18 | 94.7 | 68.4 | 216.0 | 185.3 | 61.2 | 28.3 | 263.8 | 232.0 | 231.7 | 81.1 | 54.1 | 296.4 |
| 19 | 186.8 | 160.5 | 307.9 | 277.1 | 153.0 | 120.2 | 355.7 | 324.0 | 293.7 | 173.1 | 146.2 | 28.5 |
| 20 | 278.8 | 252.5 | 39.9 | 9.0 | 244.9 | 212.0 | 87.5 | 55.9 | 25.6 | 265.1 | 238.2 | 123.6 |
| 21 | 10.9 | 344.5 | 131.8 | 100.9 | 336.7 | 303.9 | 179.4 | 147.8 | 117.5 | 357.1 | 330.3 | 212.7 |
| 22 | 103.0 | 76.5 | 223.7 | 192.8 | 68.6 | 35.7 | 271.3 | 239.7 | 209.6 | 89.2 | 62.4 | 334.8 |
| 23 | 195.1 | 168.5 | 315.7 | 284.7 | 160.4 | 127.5 | 3.1 | 331.6 | 301.5 | 181.2 | 154.4 | 35.8 |
| 24 | 287.2 | 260.5 | 47.6 | 16.5 | 252.2 | 219.4 | 95.0 | 63.5 | 33.5 | 273.2 | 246.5 | 128.9 |
| 25 | 19.2 | 352.5 | 139.5 | 108.4 | 344.1 | 311.2 | 186.9 | 155.4 | 125.4 | 5.2 | 338.6 | 221.0 |
| 26 | 111.3 | 84.5 | 231.5 | 200.3 | 75.9 | 43.1 | 278.7 | 247.3 | 217.4 | 97.2 | 73.6 | 313.1 |
| 27 | 203.4 | 176.5 | 323.4 | 292.2 | 167.8 | 134.9 | 10.6 | 339.2 | 339.4 | 189.2 | 162.7 | 45.2 |
| 28 | 295.5 | 268.5 | 55.3 | 24.0 | 259.6 | 236.8 | 102.5 | 71.1 | 41.3 | 281.3 | 254.8 | 137.3 |
| 29 | 27.5 | 0.5 | 147.3 | 115.9 | 351.5 | 318.6 | 194.4 | 163.0 | 133.3 | 13.3 | 346.8 | 229.4 |
| 30 | 119.6 |  | 239.2 | 207.8 | 83.3 | 50.5 | 286.2 | 255.0 | 225.3 | 105.3 | 78.9 | 321.5 |
| 31 | 211.7 |  | 331.1 |  | 175.2 |  | 18.1 | 346.9 |  | 197.3 |  | 53.6 |

MOTION OF THE CENTRAL MERIDIAN

| $01^{\mathrm{h}}-033.8$ | 09 ${ }^{\text {h }}-\mathrm{-}$ 304.5 | $17^{\text {h }}-2215^{\circ}$. 2 | $10^{\text {m}}-005.6$ | $01^{\text {m }}--000: 6$ |
| :---: | :---: | :---: | :---: | :---: |
| $02-067.7$ | $10-338.3$ | 18 -- 249.0 | $20-011.3$ | $02-001.1$ |
| 03 -- 101.5 | 11 -- 012.7 | 19 -- 282.8 | $30-016.9$ | 03 -- 001.7 |
| 04-- 135.3 | 12 -- 046.0 | $20-316.7$ | $40-022.6$ | $04-002.3$ |
| 05 -- 169.2 | 13--079.8 | 21 -- 350.5 | $50-028.2$ | $05-002.8$ |
| 06 -- 203.0 | $14 \therefore 113.7$ | $22-024.3$ |  | 06 -- 003.4 |
| 07 -- 236.8 | $15-147.5$ | $23-058.2$ |  | 07 -- 003.9 |
| 08-- 270.7 | 16--181.3 | $24-092.0$ |  | $\begin{array}{ll} 08 & - \\ 09 & 004.5 \\ -- & 005.1 \end{array}$ |

Figure 2. Longitude of Central Meridian of Saturn in System II in 1976. Prepared and contributed by John E. Westfall. See text on page 217 et seq.


Note that, if the calculated longitude exceeds $360^{\circ}$, one subtracts $360^{\circ}$. Also, in general it is more realistic to round calculated longitudes to the nearest whole degree.

## SATURNIAN DRIFT RATES AND PERIODS

By: John E. Westfall

The table on page 221, conbined with the "Saturn Central Meridian Ephemeris" published annually in the JALPO, allows observers of Saturn to determine the rotation periods of features for which they make central meridian timings.

To determine the rotation period of a Saturnian feature, it is necessary to time its central meridian passage, and then to determine its longitude (System I or System II, as appropriate), on at least two successive dates. The daily drift rate, for the longitude system used, is found by:
daily drift rate $=\frac{\text { latest longitude }- \text { earliest longitude }}{\text { interval in terrestrial days }}$
Given this drift rate, the period may be found directly from the accompanying table on page 221. If the drift rate falls between two different rates in the table, the period is found by interpolation, using the column "Diff. per Deg." (This will give periods accurate to $\approx \pm 1^{S}$ for the range $10: 50-11: 38$, and to $\approx \pm \pm 0 \leqslant 1$ for the remainder of the table. The longer rotation periods refer to infrequentlyobserved features in high latitudes.)

As an aid in recovering the same feature on successive days, the following relationship is useful:

7 System I rotations $=3$ terrestrial days minus 20 minutes.
9 System II rotations $=4$ terrestrial days minus 14 minutes.
In practice, more accurate rotation periods are found by a series of longitude determinations, so that a time versus longitude graph may be drawn. Then, a bestfitting line may be drawn (or calculated by regression) through the observed longitudes, and a mean drift rate then found. (Note: Even for the same feature, a rotation rate may change with time.)

Example: Determination of the rotation period of a theoretical dark spot observed in the South Equatorial Belt, south component.

Central Meridian Timings:

> 1976 FEB. $20,04: 23$ U.T. (FEB. 20 d 1826 ) 1976 FEB. $26,05: 11$ U.T. (FEB. 26 d 2160 )

Systen I Longitudes (see Figure 1 on page 218):

| 1976 FEB. 20 ( 124.9 | 1976 FEB. 26148.7 |
| :---: | :---: |
| $+4^{\text {h }} 140.7$ | +5h 175.8 |
| $+20^{\mathrm{m}} 011.7$ | $+10^{\mathrm{m}} 005.9$ |
| $+3^{m} 001.8$ | $+1^{\text {m }} 0000.6$ |
| 27898 | 331.0 |

Then, using the formula given at the beginning of this paper:

$$
\begin{aligned}
\text { daily drift rate } & =\frac{33190-278.8}{\left(\text { FFB. } 26^{\mathrm{d}} 2160-20.1826\right)}=\frac{+52.2}{6 \mathrm{~d}_{0334}^{\mathrm{d}}} \\
& =+8965 / \text { day }
\end{aligned}
$$

The actual period is found by interpolation from the table as follows:

$$
\begin{aligned}
& \text { System I drift rate }+8.00 / \text { day, period } \\
& \begin{aligned}
&=10: 20: 05.7 \\
&+0.65 \mathrm{X}+4456 / \mathrm{Deg} .= \\
& 10: 20: 34.0
\end{aligned}
\end{aligned}
$$

Realistically, this result would be rounded to $10: 20: 35$ or even 10:20:36.

| Sys.I | Sys.II | Daily <br> Rotn. <br> Rate | $\begin{gathered} \text { Rotation } \\ \text { Period } \\ \mathrm{h}: \mathrm{m}: \mathbf{8} \\ \hline \end{gathered}$ | Diff. per Deg. | Sys.I | Sys.II | Daily Rotn. Rate | $\begin{gathered} \text { Rotation } \\ \text { Period } \\ \mathrm{h}: \mathrm{m}: \mathrm{s} \\ \hline \end{gathered}$ | $\begin{gathered} \text { Diff. } \\ \text { per } \\ \text { Deg. } \end{gathered}$ |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| $+102^{\circ}$ | $+70^{\circ}$ | $742^{\circ}$ | 11:38:39.1 | $+56.1$ | $+10^{\circ}$ | - $22^{\circ}$ | $834^{\circ}$ | 10:21:35.0 |  |
| +97 | $+65$ | 747 | 11:33:58.6 | +56.1 | + 9 | - 23 | 835 | 10:20:50.3 |  |
| +92 | + 60 | 752 | 11:29:21.7 |  | + 8 | - 24 | 836 | 10:20:05.7 | +44.6 |
| $+87$ | + 55 | 757 | 11:24:48.5 |  |  | - 25 | 837 | 10:19:21.3 | +44.4 |
| $+82$ | + 50 | 762 | 11:20:18.9 |  |  | - 26 | 838 | 10:18:36.9 |  |
| $+77$ | + 45 | 767 | 11:15:52.8 | +52.5 | + $5^{\circ}$ | $-27^{\circ}$ | $839^{\circ}$ |  |  |
| + 72 | + 40 | 772 | 11:11:30.1 | +52.5 | +5 $+\quad 4$ | - 28 | 840 | $10: 17: 08.6$ | $+44^{8} .1$ |
| $+67$ | + 35 | 777 | 11:07:10.9 | +51.8 |  | -28 -29 | 841 | 10:16:24.5 | +44.1 |
| + 62 | + 30 | 782 | 11:02:54.9 | +50.5 |  | -29 $-\quad 30$ | 842 | 10:16:24.5 | +43.9 |
| + 57 | + 25 | 787 | 10:58:42.2 | +59 |  |  |  |  | +43.8 |
| + 52 | + 20 | 792 | 10:54:32.7 |  |  | 1 | 843 | 10:14:56.8 | +43.7 |
| +47 | $+15$ | 797 | 10:50:26.3 | +49.3 +48.7 | $0^{\circ}$ | - $32^{\circ}$ | $844^{\circ}$ | 10:14:13.1 | +43.6 |
| $+42^{\circ}$ | $+10^{\circ}$ | $802{ }^{\circ}$ | 10:46:23.0 |  | - 1 | - 33 | 845 | 10:13:29.5 | +43.5 |
| $+$ | +9 | 803 | 10:45:34.7 | +4 | - | - 34 | 846 | 10:12:46.0 | +43.5 |
| + 40 | + 8 | 804 | 10:44:46.6 | $+48.1$ |  | -35 -36 | 847 | 10:12:02.5 | +43.3 |
| + 39 | + 7 | 805 | 10:43:58.5 | +47.9 |  |  | 888 | . | +43.2 |
| $+38$ | $+6$ | 806 | 10:43:10.6 | +47.9 | $-5^{\circ}$ | - $37^{\circ}$ | $849^{\circ}$ | 10:10:36.0 |  |
| $+37^{\circ}$ | $+5^{\circ}$ | $807{ }^{\circ}$ | 10:42:22.7 |  | - 6 | - 38 | 850 | 10:09:52.9 | $+43.0$ |
| +36 | + 4 | 808 | 10:41:35.0 |  | - 7 | - 39 | 851 | 10:09:09.9 | +42.9 |
| + | + 3 | 809 | 10:40:47.5 |  | - 8 | - 40 | 852 | 10:08:27.0 | +42.8 |
| + 34 | + 2 | 810 | 10:40:00.0 |  |  |  |  | :4 | +42.7 |
| + 33 | + 1 | 811 | 10:39:12.6 |  | - $10^{\circ}$ | $-42^{\circ}$ | $854{ }^{\circ}$ | 10:07:01.5 |  |
| $+32^{\circ}$ | $0^{\circ}$ | $812^{\circ}$ | 10:38:25.4 |  | - 11 | 43 | 855 | 10:06:18.9 | +42.6 |
| + 31 | - 1 | 813 | 10:37:38.3 |  | 12 | 44 | 856 | 10:05:36.4 | +42.4 |
| + 30 | - 2 | 814 | 10:36:51.3 |  |  |  | 857 | 10:04:54.0 | +42.3 |
| + 29 | - 3 | 815 | 10:36:04.4 | +46. |  |  |  | 10:04:11.7 | +42.2 |
| + 28 | - 4 | 816 | 10:35:17.6 | +46. | - $15^{\circ}$ | $-47^{\circ}$ | $859{ }^{\circ}$ | 10:03:29.5 |  |
| $+27^{\circ}$ | - $5^{\circ}$ | $817^{\circ}$ | :34:3 |  | - 16 | -48 | 860 | 10:02:47.4 | 42.0 |
| +27 +26 | - 6 | 818 | 10:33:44.4 | +4 | - 17 | - 49 | 861 | 10:02:05.4 | +41.9 |
| + 25 | -7 | 819 | 10:32:58.0 | +46 | -18 | - 50 | 862 | 10:01:23.5 | +41.8 |
| + 24 | - 8 | 820 | 10:32:11.7 | 46. |  | - 5 | 863 | 10:00:41.7 | +41.7 |
| + 23 | - 9 | 821 | 10:31:25.5 |  | $-20^{\circ}$ | $-52^{\circ}$ | $864{ }^{\circ}$ | 10:00:00.0 |  |
| $+22^{\circ}$ | $-10^{\circ}$ | $822^{\circ}$ | 10:30:39.4 |  | - 21 | - 53 | 865 | 09:59:18.4 | +41.6 |
| + 21 | - 11 | 823 | 10:29:53.4 |  | - 22 | - 54 | 866 | 09:58:36.9 | +41.5 |
| + 20 | - 12 | 824 | 10:29:07.6 | 45.8 | - 23 | - 55 | 867 | 09:57:55.4 | +41.3 |
| +19 | - 13 | 825 | 10:28:21.8 |  | - 24 |  | 868 | 09:57:14.1 | +41.2 |
| $+18$ | - 14 | 826 | 10:27:36.2 |  | - $25^{\circ}$ | - $57^{\circ}$ | $869{ }^{\circ}$ | 09:56:32.9 |  |
| $+17^{\circ}$ | - $15^{\circ}$ | $827^{\circ}$ | 10:26:50.6 |  | 26 | - 58 | 870 | 09:55:51.7 | +41.0 |
| $+16$ | - 16 | 828 | 10:26:05.2 | +45.4 | - 27 | - 59 | 871 | 09:55:10.7 | +41.0 |
| $+15^{\circ}$ | $-17^{\circ}$ | $829{ }^{\circ}$ | 10:25:19.9 | $+45.3$ | -28 -29 | - 60 | 873 | 09:54:29.7 $09: 53: 48.9$ | +40.8 |
| +14 | - 18 | 830 | 10:24:34.7 | $+45.2$ |  |  | 873 | 09:53:40.9 | +40.8 |
| +13 | - 19 | 831 | 10:23:49.6 | +45.1 | - 30 | - $62^{\circ}$ | $874^{\circ}$ | 09:53:08.1 | $+40^{8} 7$ |
| + 12 | - 20 | 832 | 10:23:04.6 | +4 |  | - 63 | 875 | 09:52:27 | +40.6 |
| +11 | - 21 | 833 | 10:22:19.7 | +44.9 +44.7 | -32 -33 | -64 -65 | 876 877 | $\begin{aligned} & 09: 51: 46.8 \\ & 09: 51: 06.4 \end{aligned}$ | +40.4 |

Figure 3. Table relating daily drift rates and rotation periods for features on Saturn, System I or System II. Prepared and contributed by John E. Westfall. See text on page 220.

## JUPITER IN 1973-74: ROTATION PERIODS*

By: Phillip W. Budine, A.L.P.O. Jupiter Recorder
The highlights of the 1973-74 apparition were: a return of the abnormally slow current in the northern part of the Equatorial Zone; a new record for the period of the North Tropical Current B; and observations of the North Temperate Current A and the North North Temperate Current A.
*See text on page 232 for references to previously published Jupiter drawings which can helpfully illustrate this report.

Date of Opposition: 1973, July 30.
Dates of Quadrature: 1973, May 1; October 27.
Declination of Jupiter: $19^{\circ} \mathrm{S}$ (at opposition).
Equatorial Diameter: 48.3 seconds (at opposition).
Zenocentric Declination of Earth: -0.3 (at opposition).
Magnitude of Jupiter: -2.4 (at opposition).
This report is based on 987 visual central meridian transit observations submitted by 25 observers of the A.L.P.O. When plotted on graph paper, 903 transits form usuable drifts for 86 Jovian spots distributed in 9 different atmospheric currents. The contributing observers are listed below by name and number of transits submitted, along with the station of observation and telescope(s) employed.

Budine, Phillip W.
Carlino, L. M.
Doel, Ron E. Gordon, Rodger W.
Haas, Walter H.
Heath, Alan W.
Hevesi, Zoltan, A.A.C.
Mackal, Paul K.
Mayer, Ernst H.
Osawa, T.
Papp, Janos, A.A.C.
Peterson, B. M.
Porter, Alain
Sherrod, Clay \& Valentine,

Smith, J. Russell
Sopper, Reinhard
Szoboszlai, Zoltan, A.A.C.
Toth, Imre, A.A.C.
Toth, Saudor, A.A.C.
Travnik, Nelson, Dr. Ufvarosy, Autal, A.A.C.
Wacker, Wynn K.
Weier, David D.
Wessling, Richard J.

| Masonville, N.Y. | $4-$ in. refr. | $460 t$ |
| :--- | ---: | ---: |
| Buffalo, N.Y. | $10-i n . ~ r e f l . ~$ | $3 t$ |
| Willingboro, N.J. | $8-i n . ~ r e f l$. | $100 t$. |
| Nazareth, PA | $3 \frac{1}{2}-i n . ~ r e f l . ~(c a t) ~$. | $2 t$. |

azareth, PA
Las Cruces, N.M.
12 $\frac{1}{2}$-in. refl.
12-in. refl. 6t.
2.4-in. refr. $2 t$.
6 -in. refl. 67 t .

6-in. refl. 1t.
8 -in. refl. 13 t.
6-in. refl. 7t.
6 -in. refl. 11t.
6 -in. refl. 11 t . W. Palm Beach, Fla. $24 t$.
8 -in. \& $12 \frac{1}{2}-i n$. refls.
$8-i n . \& 16-i n . r e f l s * 23 t$.
Burgsolms, W. Germany 16-in. refl. 8t.
Hafdunanas, Hungary 6-in. refl. 3t.
Szolnok, Hungary
Hafdunanas, Hungary
3-in. refr.\&10-in.refl.13t.
6 -in. refl. $2 t$.
6-in. refr.** $20 t$.
3-in. refr.86-in.refl. 1t.
15年-in. refr.*** 15 t .
15 $\frac{1}{2}$-in. refr.*** $78 t$.
12立-in. refl. $1 t$.

Minas, Brasil
Szolnok, Hungary
Madison, Wisc.
Madison, Wisc.
Milford, Ohio
*Skyview Observatory
**Flanmarion Observatory
***Washburn Observatory

The distribution of transit observations by months is as follows:

| 1973, | May | 17 |
| :--- | :--- | ---: |
| June | 66 |  |
| July | 160 |  |

1973, August | 303 |  |
| :--- | :--- |
| September | 283 |
| October | 135 |

| 1973, | Novenber |
| :--- | ---: |
| December | 20 |
| 1974, | January |

In the tables which follow the first colum gives an identifying number or letter to each object; and the second column indicates whether the object was dark (D) or bright ( $W$ ) and whether the preceding end ( $p$ ), center (c), or following end ( $f$ ) was being observed. The third column gives the first and last dates of observation; the fourth colum, the longitudes on those dates. The fifth column gives (when meaningful) the longitude at opposition, July 30, 1973. The sixth colum gives the number of transits. The seventh column indicates the number of degrees in longitude that the marking drifted in 30 days, negative when the longitude decreased with time. The eighth column shows the rotation period in hours, minutes, and seconds.

South Temperate Current (S. edge STB, STeZ), System II.


| No. | Mark. | Limiting Dates. |  | Limiting L. |  | L. |  | Transits |  | Drift |
| :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | :--- | Period

The three long-enduring white ovals of the STeZ ${ }_{n}$ continued to be observed as prominent features of the South Temperate Zone. They remained stable in length during the apparition, and compare well with the 1972 lengths. In 1973 all of the ovals were $14^{\circ}$ in length. Oval DE was considerably preceding FA and BC, while FA and $B C$ were quite close together; and $B C$ continued to gain on FA during the apparition. Observers often recorded a white rift between FA and BC. This type of feature is usually observed when any two long-enduring ovals approach close together as they were beginning to do in 1973. In August, 1973 the rift was observed well. The center of oval DE was in conjunction with the center of the Red Spot on May 6, 1973 at $4^{\circ}$ (II). Extrapolation of the FA drift curve indicates that the oval FA was near conjunction with the Red Spot on February 2, 1974 at $5^{\circ}$ (II).

No. 4 was a dark condensation on the south edge of the SIB preceding the oval BC. No. 7 was a very brilliant white spot located near the center of the SIB. It was observed about one-third of the distance from BC to DE . This bright spot was well observed by A.L.P.O. observers. Its period was 9:55:12. No. 8 was a darker section of the STB. No. 9 was a dark projection located on the south edge of the SIB. This projection was moving at 9:55:08.

## Red Spot Region, System II

| Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| RSp | May 2 - Dec. 27 | $357^{\circ}-358^{\circ}$ | $358{ }^{\circ}$ | 41 | $+0.04$ | 9:55:41.0 |
| RSC | May 2 - Dec. 27 | 4-5 | 5 | 48 | +0.04 | 9:55:41.0 |
| RSf | May 2 - Dec. 27 | $11-12$ | 12 | 48 | +0.04 | 9:55:41.0 |

The Red Spot continued to be a dark prominent ellipse in Jupiter's South Tropical Zone. Now we have a total of eleven consecutive apparitions in which the Red Spot has been a dark, striking feature, dominating the Giant Planet. The mean length for the RS was $22^{\circ}$, the same as for the apparition of 1972. The period for the RS was back to the period observed in 1966-67, namely, 9:55:41.0. The RS shifted $-3^{\circ}$ in longitude when the oval DE was attracting the RS while they were near conjunction between May 6-20, 1973.

South Equatorial Current A (N. edge SEB $_{n}$, S. part EZ), System I.
Table I

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Dc | Aug. 27 - Sep. 23 | $17^{\circ}-10^{\circ}$ | -- | 9 | $-7.7$ | 9:50:20 |
| 2 | Dc | Jun. 3 - Aug. 26 | 307-293 | $296{ }^{\circ}$ | 7 | -4.8 | 9:50:24 |
| 3 | Wc | Sep. 5 - Sep. 21 | 323-322 | -- | 5 | -1.7 | 9:50:28 |

Table II

| 1 | Wc | Sep. 8 - Sep. 30 | $30^{\circ}-39^{\circ}$ | --- | 5 | $+11.1$ | 9:50:45 |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | Wc | Sep. 8 - Sep. 30 | $45-49$ | - | 5 | +4.9 | 9:50:37 |
| 3 | Dc | Sep. 8 - Sep. 30 | $55-56$ | --- | 7 | +1.3 | 9:50:32 |
| 4 | Dc | Sep. 7 - Oct. 15 | 250-254 | -- | 9 | +3.8 | 9:50:35 |
|  | Mean Rotation Period |  |  |  |  |  | 9:50:37 |

In table II No. 1 was a bright oval on the north edge of the SER $_{n}$, projecting into the southern part of the EZ. No. 2 was another bright oval similar in appearance to oval No. 1, and it also was located on the north edge of the $\mathrm{SEB}_{\mathrm{n}}$. Oval No. 2 was following oval No. 1 at the same latitude. Following both white ovals was a dark section of the $\mathrm{SEB}_{\mathrm{n}}$ which is marking No. 3. Note that oval No. 1 was moving more rapidly in the increasing longitude direction and almost caught up to oval No. 2, being within $10^{\circ}$ of oval No. 2 by September 30, 1973. No, 4 was a dark section of the $\mathrm{SEB}_{\mathrm{n}}$.

North Equatorial Current (abnormally slow portion), System I.

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | De | Jul. 19 - Sep. 10 | $25^{\circ}-58^{\circ}$ | $32^{\circ}$ | 5 | +17? ${ }^{\text {\% }}$ | 9:50:53 |
| 2 | Wc | Jul. 19 - Sep. 10 | $30-63$ | 37 | 6 | +17.4 | 9:50:53 |
| 3 | Dc | Jun. 23 - Oct. 8 | 48-121 | 74 | 26 | +19.7 | 9:50:57 |
| 4 | Wp | Jun. 23 - Oct. 8 | 55-128 | 83 | 16 | +19.7 | 9:50:57 |
| 5 | Wf | Jun. 23 - Oct. 8 | 76-149 | 102 | 12 | +19.7 | 9:50:57 |
| 6 | Dc | Aug. 4 - Oct. 6 | $106^{\circ}-141^{\circ}$ | -- | 7 | +15.9 | 9:50:51 |
| 7 | Dc | Jun. 25 - Aug. 5 | 205-225 | 223 | 5 | +13.3 | 9:50:48 |
| 8 | Dc | Jul. 6 - Oct. 24 | 233-285 | 251 | 6 | +14.3 | 9:50:49 |
| 9 | Wc | Jul. 6 - Oct. 24 | 250-302 | 263 | 5 | +14.3 | 9:50:49 |

The abnormally slow portion of the North Equatorial Current has returned again! The first time that this current was observed was in 1963-64 when 11 spots had a period of $9: 50: 48$. In 1964-65 the current was again observed, with only 4 spots giving a rotation period of 9:50:45. In 1965-66 there were 3 spots in the current, which yielded a period of 9:50:53. In 1973 the mean period for this slow current was 9:50:53, the same as in 1965-66. The current was active in 1973 with 9 spots. Since the current was first observed in 1963, and now in 1973, does this fact indicate a 10 year period for each initial eruption of activity for this slow current? Studies are being performed now by both of your Recorders to determine the nature of this current. No. 8 was the outstanding feature in this current; it was a "Great Festoon", which was later the source of the EB. It had a very wide dark base on the south edge of the NEB and extended as a very dark festoon in the following direction. The base of the festoon was moving rapidly in the direction of increasing longitude at a rate of +14.3 in thirty days, giving a rotation period of $9: 50: 49$. A similar feature was observed in $1965-66$, which had a period of $9: 50: 58$. The "Great Festoon" of 1973 was followed by a very large bright elongated oval located on the south edge of the NEB and extending into the north part of the EZ. This feature is No. 9 in the table. This large oval was also moving at 9:50:49. Nos. 3,4 , and 5 represent the slowest-moving features of this current. No. 8 was a prominent very dark festoon located on the south edge of the NEB and extended to the north edge of the $\mathrm{SEB}_{\mathrm{n}}$. Following No. 8 was a bright oval in the $E Z_{n}$, which is marking No. 9 in the table.

North Equatorial Current (S. edge NEB, N. part EZ), System I.

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Wp | Jun. 2 - Oct. 23 | $312^{\circ}-299^{\circ}$ | $308{ }^{\circ}$ | 24 | $-2.7$ | 9:50:26 |
| 2 | Wc | Jun. 2 - Oct. 23 | 317 - 304 | 313 | 31 | -2.7 | 9:50:26 |
| 3 | Wf | Jun. 2 - Oct. 23 | 322-309 | 318 | 20 | -2.7 | 9:50:26 |
| 4 | We | Aug. 23 - Sep. 23 | 324-325 | -- | 9 | +1.0 | 9:50:31 |
| 5 | Dc | Aug. 29 - Sep. 21 | 336-336 | -- | 7 | 0.0 | 9:50:30 |
| 6 | Dc | Aug. 15 - Sep. 23 | 356-354 | - | 7 | -1.4 | 9:50:28 |
| 7 | Dp | Aug. 28 - Sep. 21 | $17-14$ | - | 9 | -3.3 | 9:50:26 |
| 8 | Wc | Aug. 6 - Sep 10 | 27-24 | -- | 8 | -2.5 | 9:50:27 |
| 9 | Dc | Jul. 12 - Sep. 30 | $49-48$ | 50 | 6 | -0.4 | 9:50:29 |
| 10 | Wc | Aug. 23 - Oct. 23 | 63-63 | - | 10 | 0.0 | 9:50:30 |
| 11 | De | Jul. 5 - Sep. 13 | 132-134 | 133 | 5 | +0. 8 | 9:50:31 |
| 12 | Wp | Jul. 5 - Sep. 26 | 137-136 | 137 | 9 | -0.4 | 9:50:29 |
| 13 | Wc | Jul. 5 - Sep. 26 | 140-139 | 140 | 8 | -0.4 | 9:50:29 |
| 14 | Wf | Jul. 5 - Sep. 26 | 144-143 | 144 | 5 | -0.4 | 9:50:29 |
| 15 | Dc | Jul. 29 - Oct. 22 | 162-157 | 162 | 7 | -1.7 | 9:50:28 |



Figure 4. Drift-curves of the Red Spot and the South Temperate Zone ovals on Jupiter in 1973, as recorded by A.L.P.O. Jupiter Section observers. Graph prepared and contributed by Phillip W. Budine. The longitude (II) is plotted against time. See also text.

North Equatorial Current (S. edge NEB, N. part EZ), System I. (cont.)

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 16 | Wc | Jul. 29 - Sep. 27 | $165^{\circ}-166^{\circ}$ | $165^{\circ}$ | 6 | $+0.5$ | 9:50:31 |
| 17 | Wp | Jul. 6 - Sep. 27 | 181-181 | 181 | 5 | 0.0 | 9:50:30 |
| 18 | Wc | Jul. 6 - Sep. 27 | 185-185 | 185 | 8 | 0.0 | 9:50:30 |
| 19 | Wf | Jul. 6 - Sep. 27 | 189-189 | 189 | 6 | 0.0 | 9:50:30 |
| 20 | Dc | Jul. 25 - Aug. 26 | 212-210 | 212 | 7 | -1.8 | 9:50:28 |
| 21 | Wp | May 5 - Sep. 7 | 233-225 | 227 | 18 | -2.0 | 9:50:27 |
| 22 | Wc | May 5 - Sep. 7 | 241-234 | 236 | 24 | -1.7 | 9:50:28 |
| 23 | Wf | May 5 - Sep. 7 | 250-244 | 246 | 15 | -1.5 | 9:50:28 |
| 24 | Dc | Jul. 5 - Aug. 29 | 272-273 | 272 | 7 | +0.E | 9:50:31 |
| 25 | Dc | Jun. 18 - Aug. 26 | 279-279 | 279 | 9 | 0.0 | 9:50:30 |

North Equatorial Current (S. edge NEB, N. part EZ), System I. (cont.)

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 26 | Dc | May 2 - Jun. 18 | $290^{\circ}-286^{\circ}$ | --- | 7 | $-2.5$ | 9:50:27 |
| 27 | Wp | May 2 - Jun. 18 | 296-290 | -- | 8 | -3.8 | 9:50:25 |
| 28 | Wc | May 2 - Jun. 18 | 301-295 | -- | 6 | -3.8 | 9:50:25 |
| 29 | Wf | May 2 - Jun. 18 | 307-301 |  | 5 | -3.8 | 9:50:25 |
| 30 | Wc | Jul. 3 - Aug. 31 | 290-290 | $290{ }^{\circ}$ | 6 | 0.0 | 9:50:30 |
| 31 | Dc | Jul. 12 - Sep. 21 | 298-297 | 298 | 8 | -0.4 | 9:50:29 |

Nos. 1-3 were a very large bright oval located on the south edge of the NEB and projecting into the $E Z_{n}$. No. 8 was a very bright oval on the south edge of the North Equatorial Belt. No. 9 was a very dark festoon with its base on the south edge of the NEB and with the festoon connecting to the EB. No. 10 was a large bright patch in the $E Z_{n}$, which was following the dark festoon marking No. 9. No. 5 was a low dark projection preceding a large oval, Nos. 12-14. The projection was on the south edge of the NEB. Nos. 12-14 was a large white oval on the $\mathrm{NEB}_{\mathrm{S}}$. No. 15 was a dark tall projection on the $\mathrm{NEB}_{\mathrm{S}}$. No. 16 was a bright oval in the north part of the EZ and following object No. 15. Nos. 17-19 were an elongated bright oval in the $\mathrm{EZ}_{\mathrm{n}}$. The oval increased in length during September. No. 20 was a very dark festoon on the south edge of the NEB, which connected with the north edge of the SEB ${ }_{\mathrm{n}}$. Nos. 24-26 were all dark festcons connecting the $\mathrm{NEB}_{\mathrm{S}}$ with the $\mathrm{SEB}_{\mathrm{n}}$. No. 30 was a large white oval on the south edge of the NEB. No. 31 was a very dark festoon on the NEB ${ }_{S}$, which also connected to the north edge of the $\mathrm{SEB}_{\mathrm{n}}$.

North Tropical Current A (N. edge NEB, NTrZ), System II.

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Dc | Sep. 10 - Sep. 27 | $295{ }^{\circ}-273^{\circ}$ | --- | 5 | $-11.5$ | 9:55:25 |
| 2 | Dc | Aug. 17 - Sep. 5 | 308-294 | --- | 7 | -19.7 | 9:55:14 |
| Mean Rotation Period |  |  |  |  |  |  | 9:55:20 |

No. 2 in the table above was a large, red, 'barge"-like object in the northern portion of the North Tropical Zone. The feature was observed best by L. M. Carlino.

North Tropical Current B (N. edge NEB, NTrZ), System II.
Table I

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Wc | Jul. 20 - Sep. 24 | $97^{\circ}-2^{\circ}$ | $86^{\circ}$ | 8 | $-41.3$ | 9:54:44 |
| 2 | Dc | Aug. 26 - Sep. 30 | 163-133 | - | 7 | -32.8 | 9:54:56 |
| 3 | Dc | Aug. 31 - Oct. 1 | 176-133 | - | 5 | -39.1 | 9:54:47 |
| 4 | Dc | Aug. 29 - Oct. 6 | 233-172 | -- | 6 | -43.6 | 9:54:41 |
| 5 | Wc | Jul. 19 - Aug. 29 | 289-240 | 277 | 9 | -35.0 | 9:54:53 |
| 6 | Dc | Aug. 17 - Sep. 10 | 276-239 | -- | 7 | -40.6 | 9:54:45 |
| 7 | Wc | Aug. 17 - Sep. 27 | 295-238 | --- | 8 | -37.9 | 9:54:49 |
| 8 | Dc | Aug. 23 - Sep. 27 | 306-257 | -- | 5 | -40.8 | 9:54:45 |

Table II

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Wc | Aug. 26 - Oct. 1 | $144^{\circ}-117^{\circ}$ | -- | 7 | $-20.8$ | 9:55:12 |
| 2 | Dc | Jul. 5 - Oct. 1 | 190-113 | $172^{\circ}$ | 9 | -25.6 | 9:55:06 |
| 3 | Wc | Aug. 6 - Sep. 21 | 163-129 | -- | 5 | -21.2 | 9:55:12 |
| 4 | Wc | Aug. 29 - Oct. 11 | 240-205 |  | 8 | -23.4 | 9:55:09 |
| Mean Rotation Period 9:55:10 |  |  |  |  |  |  |  |

In the North Tropical Current B, Table I object No. 4 was a dark elongated projection on the north edge of the NEB with a festoon curving northward and
attaching to the south edge of the NIB. No. 5 was a large bright oval with its major axis running NW to SE and touching the NEB $_{\mathrm{n}}$ and the NIB. No. 6 was a dark section of the $\mathrm{NEB}_{\mathrm{n}}$.

In Table II of the North Tropical Current B marking No. 1 was a small brilliant white spot in the $\mathrm{NEB}_{\mathrm{n}}$. No. 4 was also originally a small white spot, but later during September it became a notch in the north edge of the NEB.

| No. | Mark | Limiting Dates | Limiting L. | L. | Transits | Drift | Period |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 1 | Wc | Aug. 10 - Sep. 21 | $41^{\circ}-73^{\circ}$ | - | 7 | $+21.4$ | 9:56:10 |

The above marking was a bright white spot located on the north edge of the NIB and was moving in the North Temperate Current A. This bright spot was in conjunction with the NNTB Disturbance (see below) on August 10, 1973 at $41^{\circ}$ (II). The spot was moving in the direction of increasing longitude and was observed passing the NNIB Disturbance from August $10-16,1973$. The NIB $n$ white spot was observed by the Washburn Observatory team of David Weier, Wynn Wacker, Eric Thiede, John Hansen, and Jeff Stewart. They were employing the $15 \frac{1}{2}$-inch Clark Refractor of the Washburn Observatory. The North Temperate Current A had been observed previously in 1968-69 with a period of 9:53:50 and in 1967-68 with a rotation period of 9:56:09.


Marking No. 1 represents the following end of a wide dark feature which consisted of white spots and complex structure including dark spots, giving an appearance of a Disturbance region as far as classification is concerned. Therefore, I prefer to call it the NNIB Disturbance. The Washburn Observatory team (named above) observed it carefully. Their observations cover the period July 29-August 15, 1973. The feature was also observed by L. M. Carlino on August 2, 1973. The NNIB Disturbance is the most prominent dark active feature ever observed in this far northern latitude. The preceding end was not well timed but the following end was. The period was 9:55:34, and the mean length for the Disturbance was $35^{\circ}$. The marking extended to the $\mathrm{NIB}_{\mathrm{n}}$ and was very elongated in shape. Our congratulations to the Washburn Observatory team for their fine studies of this feature.

## LUNA INCOGNITA IN 1976

By: John E. Westfall, A.L.P.O. Lunar Recorder

## Program Summary

The A.L.P.O. Lunar Section's "Luna Incognita" Program, begun in 1972, is concerned with mapping that portion of the Moon which was not adequately photographed by the Lamar Orbiter and Apollo Missions (Refs.: JALPO, 23 (1972), 118-122, 134136; 24 (1973), 20-22, 184-187; 25 (1974), 60-63). "Luna Incognita" includes the south polar zone (approximately $\overline{82^{\circ}}-90{ }^{\circ} \mathrm{S}$ ) and the "marginal zone" of the (IAU) southwest limb (from latitudes $52^{\circ}-82^{\circ} \mathrm{S}$, and approximately from longitudes $95{ }^{\circ} \mathrm{W}$ to the limits of terrestrial visibility).

During the last year, three observers have made contributions to this program:
James H. Fox (10-in. R1.) . . . . . . . . . 3 photographs
Richard J. Wessling (121 ${ }^{\left.\frac{1}{2}-i n . ~ R 1 .\right) ~ . ~ . ~ . ~ . ~ . ~} 6$ photographs
John E. Westfall (10-in. R1.) . . . . . . . 6 photographs.

The accompanying illustration (Figure 5) consists of three of the photographs submitted by Mr. Wessling and shows the general appearance of Luna Incognita near full phase with moderately favorable conditions of libration.

Interested ALPO observers are invited to submit, to the writer, photographs of Luna Incognita similar to those illustrated, taken under favorable conditions of lighting and libration. From such photographs, outline charts will be prepared for the visual sketching of details in this area.

## Luna Incognita Observing Schedule, 1976

The table which follows gives those dates in 1976 when at least part of "Luna Incognita" will be visible, with favorable lighting and libration. The south polar zone ("SPZ") is readily visible (i.e., with the South Pole tilted at least $5^{\circ}$ toward Earth) for a certain period in every lunation. Because the solar altitude is always low for this region, best viewing occurs when the solar latitude is negative (i.e., south, as in May - October, 1976).

The area "beyond" the southwest limb is less often visible than is the SPZ because a combination of southerly (negative) and westerly (also negative) libration is desirable and also because this region is illuminated only after full phase. Unfortunately, during 1976 latitude and longitude librations will be "out of phase"; and Luna Incognita will not be so well presented as in 1974 or 1977, for example.

In the following table:

1. All data are for $0^{h}$ U.T.
2. Asterisked (*) colongitudes indicate a low- to medium-Sun angle for the southwest marginal zone. (The Sun is always low for the SPZ,)
3. The Earth's selenographic longitude/latitude (librations) are geocentric.
4. "Latitude Zone" indicates the approximate range of south latitudes visible in Luna Incognita. "SPZ" refers to the south polar zone.

| U.T. <br> 1976 <br> Date |  | Solar |  | Earth's <br> Selenographic |  | Latitude Zone (all Lats. South) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Colong. | Lat. | Longitude | Latitude |  |
| JAN. | 00 | 246 ${ }^{\text {\% }}$ | +1.2 | $+4^{0}$ | $-3^{\circ}$ | $65^{\circ}-\mathrm{SPZ}$ |
| JAN. | 04 | $294{ }^{\circ}$ | $+1.3$ | $+4^{\circ}$ | $-7^{\circ}$ | SPZ |
|  | 05 | 306 | +1.3 | +4 | -7 | SPZ |
|  | 06 | 319 | +1.3 | +3 | -6 | SPZ |
|  | 07 | 331 | +1.3 | +2 | -6 | SPZ |
|  | 08 | 343 | +1.3 | +1 | -5 | SPZ |
| JAN. | 28 | $226^{\circ}$ | +1.5 | $+5^{\circ}$ | - ${ }^{0}$ | $70^{\circ}-80^{\circ}$ |
|  | 29 | 238 * | +1.5 | +5 | -5 | $65^{\circ}$ - SPZ |
|  | 30 | 250 * | +1.5 | $+5$ | -6 | $60^{\circ}$ - SPZ |
| FEB. | 03 | $299{ }^{\circ}$ | $+1.9$ | $+2^{\circ}$ | $-6^{\circ}$ | SPZ |
|  | 04 | 311 | +1.6 | +1 | -5 | SPZ |
| FEB. | 23 | $182^{\circ}$ | $+1.4$ | $+6^{\circ}$ | $-3^{\circ}$ | $75^{\circ}-80^{\circ}$ |
|  | 24 | 194 | +1.4 | $+6$ | -4 | $70^{\circ}-80^{\circ}$ |
|  | 25 | 206 | +1.4 | +6 | -5 | $65^{\circ}-$ SPZ |
|  | 26 | 219 | +1.4 | $+6$ | -6 | $65^{\circ}-\mathrm{SPZ}$ |
|  | 27 | 231 * | +1.4 | +5 | -6 | $60^{\circ}-\mathrm{SPZ}$ |
|  | 28 | 243 * | +1.4 | +5 | -7 | $60^{\circ}-\mathrm{SPZ}$ |
| MAR. | 21 | $151{ }^{\circ}$ | $+1.0$ | $+6^{\circ}$ | $-3^{0}$ | $75^{\circ}-80^{\circ}$ |
|  | 22 | 163 | +1.0 | +7 | -4 | $75^{\circ}-80^{\circ}$ |
|  | 23 | 175 | +1.0 | +7 | -5 | $70^{\circ}$ - SPZ |
|  | 24 | 187 | +1.0 | +7 | -6 | $65^{\circ}$ - SPZ |
|  | 25 | 200 | +1.0 | +7 | -7 | $65^{\circ}$ - SPZ |
|  | 26 | 212 | +1.0 | $+6$ | -7 | $60^{\circ}$ - SPZ |
|  | 27 | 224 | +0.9 | +5 | -7 | $60^{\circ}$ - SPZ |
|  | 28 | 236 * | +0.9 | +4 | -6 | $60^{\circ}$ - SPZ |
|  | 29 | 248 * | +0.9 | +3 | -5 | $60^{\circ}$ - SPZ |




Figure 5. Three-photograph panorama of Luna Incognita, taken by Richard J. Wessling with a $12 \frac{1}{2}$-inch reflector on Plux-X film, June 24, 1975, 11:44-11:50 U.T. Colongitude $=09499$, solar latitude $=-099$; libration $=+494$ in longitude and -495 in latitude. South at top; the top photograph is the leftmost view, and the bottam photograph is the rightmost. The names and latitudes of major features on the limb are indicated below those features.

| $\begin{aligned} & \text { U.T. } \\ & 1976 \\ & \text { Date } \end{aligned}$ |  | Solar |  | Earth's |  | Latitude Zone (all Lats. South) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Colong. | Lat. | Longitude | Latitude |  |
| APR. | 18 | $132^{\circ}$ * | $+0.4$ | $+6^{\circ}$ | $-4^{\circ}$ | $70^{\circ}-80^{\circ}$ |
|  | 19 | 144 | +0.3 | +7 | -5 | $65^{\circ}-\mathrm{SPZ}$ |
|  | 20 | 157 | +0.3 | +7 | -6 | $65^{\circ}$ - SPZ |
|  | 21 | 169 | +0.3 | +7 | -7 | $60^{\circ}$ - SPZ |
|  | 22 | 181 | +0.3 | +7 | -7 | $60^{\circ}$ - SPZ |
|  | 23 | 193 | +0.2 | $+6$ | -7 | $60^{\circ}$ - SPZ |
|  | 24 | 205 | +0.2 | +5 | -6 | $60^{\circ}$ - SPZ |
|  | 25 | 218 | +0.2 | +4 | -6 | $60^{\circ}$ - SPZ |
|  | 26 | 230 * | +0.2 | +3 | -5 | $60^{\circ}$ - SPZ |
|  | 27 | 242 * | +0.2 | +2 | -4 | $60^{\circ}-80^{\circ}$ |
| MAY | 15 | $102^{\circ}$ * | -0. 4 | $+4^{\circ}$ | $-3^{\circ}$ | $70^{\circ}-80^{\circ}$ |
|  | 16 | 114 * | -0.4 | +5 | -5 | $65^{\circ}-80^{\circ}$ |
|  | 17 | 126 * | -0.4 | $+6$ | -6 | $65^{\circ}-\mathrm{SPZ}$ |
|  | 18 | 138 | -0.4 | +7 | -6 | $65^{\circ}$ - SPZ |
|  | 19 | 151 | -0.5 | +7 | -7 | $65^{\circ}-\mathrm{SPZ}$ |
|  | 20 | 163 | -0.5 | +7 | -7 | $65^{\circ}-\mathrm{SPZ}$ |
|  | 21 | 175 | -0.5 | +6 | -6 | $65^{\circ}$ - SPZ |
|  | 22 | 187 | -0.5 | +5 | -6 | $65^{\circ}$ - SPZ |
|  | 23 | 200 | -0.6 | +4 | -5 | $65^{\circ}-80^{\circ}$ |
|  | 24 | 212 | -0.6 | +3 | -4 | $65^{\circ}-80^{\circ}$ |
|  | 25 | 224 | -0.6 | +1 | -3 | $65^{\circ}-80^{\circ}$ |
| JUNE | 13 | $096{ }^{\circ}$ | -190 | $+5^{\circ}$ | $-5^{\circ}$ | $65^{\circ}$ - SPZ |
|  | 14 | 108 * | -1.1 | +6 | -6 | $65^{\circ}$ - SPZ |
|  | 15 | 121 * | -1.1 | +6 | -7 | $60^{\circ}-\mathrm{SPZ}$ |
|  | 16 | 133 * | -1.1 | +6 | -7 | $60^{\circ}-\mathrm{SPZ}$ |
|  | 17 | 145 | -1.1 | $+6$ | -6 | $65^{\circ}$ - SPZ |
|  | 18 | 157 | -1.2 | $+5$ | -6 | $60^{\circ}$ - SPZ |
|  | 19 | 169 | -1.2 | +4 | -5 | $65^{\circ}-\mathrm{SPZ}$ |
|  | 20 | 182 | -1.2 | +3 | -4 | $65^{\circ}-80^{\circ}$ |
|  | 21 | 194 | -1.2 | +2 | -3 | $70^{\circ}-80^{\circ}$ |
|  | 22 | 206 | -1.2 | 0 | -2 | $65^{\circ}-80^{\circ}$ |
| JULY | 11 | $079{ }^{\circ}$ | -1.5 | $+4^{\circ}$ | $-6^{\circ}$ | SPZ |
|  | 12 | 091 | -1.5 | +5 | -6 | SPZ |
|  | 13 | 103 * | -1.5 | +5 | -7 | $60^{\circ}-\mathrm{SPZ}$ |
|  | 14 | 115 * | -1.5 | +5 | -6 | $60^{\circ}-\mathrm{SPZ}$ |
|  | 15 | 127 * | -1.5 | +5 | -6 | $60^{\circ}-\mathrm{SPZ}$ |
|  | 16 | 139 | -1.5 | +4 | -5 | $65^{\circ}$ - SPZ |
|  | 17 | 152 | -1.5 | +3 | -4 | $65^{\circ}-80^{\circ}$ |
|  | 18 | 164 | -1.5 | +2 | -3 | $70^{\circ}-80^{\circ}$ |
|  | 19 | 176 | -1.5 | +1 | -2 | $70^{\circ}-80^{\circ}$ |
| AUG. | 07 | $049{ }^{\circ}$ | -1. ${ }^{\circ}$ | $+4^{\circ}$ | $-6^{\circ}$ | SPZ |
|  | 08 | 061 | -1.5 | +5 | -6 | SPZ |
|  | 09 | 073 | -1.5 | $+5$ | -7 | SPZ |
|  | 10 | 085 | -1.5 | +5 | -6 | SPZ |
|  | 11 | 097 * | -1.5 | +5 | -6 | $60^{\circ}$ - SPZ |
|  | 12 | 109 * | -1.5 | +4 | -5 | $65^{\circ}$ - SPZ |
|  | 13 | 122 * | -1.5 | +3 | -4 | $65^{\circ}-80^{\circ}$ |
|  | 14 | 134 * | -1.5 | +2 | -3 | $70^{\circ}-80^{\circ}$ |
|  | 15 | 146 | -1.5 | +1 | -2 | $70^{\circ}-80^{\circ}$ |
| SEP. | 03 | $018{ }^{\circ}$ | $-1.3$ | +5 ${ }^{\circ}$ | $-6^{\circ}$ | SPZ |
|  | 04 | 031 | -1.2 | $+6$ | -6 | SPZ |
|  | 05 | 043 | -1.2 | $+6$ | -7 | SPZ |
|  | 06 | 055 | -1.2 | $+6$ | -7 | SPZ |
|  | 07 | 067 | -1.2 | +5 | -6 | SPZ |
|  | 08 | 079 | -1.2 | +5 | -6 | SPZ |
| SEP. | 10 | $104{ }^{\circ}$ * | -1.2 | $+3^{\circ}$ | $-3^{\circ}$ | $70^{\circ}-80^{\circ}$ |
|  | 11 | 116 * | -1.1 | +2 | -2 | $70^{\circ}-75^{\circ}$ |
| SEP. | 30 | $348^{\circ}$ | -0.7 | $+6^{\circ}$ | $-6^{\circ}$ | SPZ |
| OCT. | 01 | 000 | -0.7 | +7 | -6 | SPZ |
|  | 02 | 012 | -0.7 | +7 | -7 | SPZ |
|  | 03 | 024 | $-0.6$ | +7 | -7 | SPZ |
|  | 04 | 036 | -0.6 | $+6$ | -6 | SPZ |
|  | 05 | 049 | -0.6 | $+6$ | $-6$ | SPZ |


| U.T. <br> 1976 <br> Date |  | Solar |  | Earth's |  | Latitude Zone (all Lats. South) |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
|  |  | Colong. | Lat. | Longitude | Latitude |  |
| OCT. | 27 | $317^{\circ}$ | 0.0 | $+6^{\circ}$ | $-5^{0}$ | SPZ |
|  | 28 | 329 | 0.0 | +7 | -6 | SPZ |
|  | 29 | 341 | +0.1 | +8 | -7 | SPZ |
|  | 30 | 353 | +0.1 | +8 | -7 | SPZ |
|  | 31 | 006 | +0.1 | +8 | -7 | SPZ |
| NOV. | 01 | 018 | +0.2 | +7 | -6 | SPZ |
|  | 02 | 030 | +0.2 | +6 | -5 | SPZ |
| NOV. | 24 | $298{ }^{\circ}$ | +0.8 | +50 | $-6^{\circ}$ | SPZ |
|  | 25 | 310 | +0.8 | +7 | -7 | SPZ |
|  | 26 | 322 | +0.8 | +8 | -7 | SPZ |
|  | 27 | 334 | +0.8 | +8 | -7 | SPZ |
|  | 28 | 346 | +0.9 | +8 | -6 | SPZ |
|  | 29 | 358 | +0.9 | +7 | -5 | SPZ |
| DEC. | 17 | $217^{\circ}$ | +192 | $4^{\circ}$ | $0^{\circ}$ | $65^{\circ}-75^{\circ}$ |
|  | 18 | 229 * | +1.2 | -2 | -1 | $70^{\circ}-75^{\circ}$ |
|  | 19 | 241 * | +1.3 | -1 | -3 | $65^{\circ}-75^{\circ}$ |
| DEC. | 23 | $290{ }^{\circ}$ | $+1.3$ | $+6^{\circ}$ | -7 | SPZ |
|  | 24 | 302 | +1.3 | +7 | -7 | SPZ |
|  | 25 | 315 | +1.4 | +7 | -6 | SPZ |
|  | 26 | 327 | +1.4 | +7 | -5 | SPZ |

Note: A range of high peaks in the Leibnitz Mountains often casts shadows over much of the SPZ. Observers are requested to photograph or sketch the SPZ on May 22 and September 30, 1976, when this area will be "back1ighted" as seen from Earth.

## FURTHER NOTES ON JUPITER IN 1973-74: NEASURED LATITUDES,

A SATELLITE ECRESS, AND REFERENCFD ILLUSTRATIONS
By: Phillip W. Budine, A.L.P.O. Jupiter Recorder
The table below presents averages of measured zenographic latitudes of Jovian belts as determined by Mr. Reinhard Sopper from observations on August 10, 1973. He employed a micrometer on a 16 -inch Newtonian reflector, and he estimated the accuracy of his measures to be $\pm 1$ degree. The table also shows zenographic latitudes measured on New Mexico State University Observatory blue light photographs with a 24 -inch reflector. These range in date from June 26 to October 16, 1973; the number of measures of each tabulated latitude and its standard deviation are also given. The New Mexico State University Observatory latitude data were kindly made available by Mr. Elmer J. Reese of their staff. Latitudes are negative when south, positive when north. Finally, the table gives differences of latitude in the sense Sopper minus NMSUO.

Zenographic Latitudes of Jovian Belts in 1973

| Position | Sopper Lat. | $\begin{aligned} & \text { NusuO } \\ & \text { Lat. } \end{aligned}$ | Standard Deviation | No. Measures | Difference in Lat. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| center SPB |  | -64.9 | ${ }^{+}{ }_{0}{ }_{2}$ | 4 |  |
| center SSSTB | -59.8 | -55.4 | $\pm 0.2$ | 3 | -494 |
| center SSTB | -49.1 | -44.6 | $\pm 0.9$ | 4 | -4.5 |
| center STeZB |  | -37.3 | $\pm 0.7$ | 3 |  |
| $S$ edge STB |  | -32.8 | $\pm 0.2$ | 7 |  |
| center STB | -34.5 |  |  |  | (-5.1) |
| $N$ edge STB |  | -25.9 | $\pm 0.2$ | 7 |  |
| $S$ edge $\mathrm{SEB}_{\mathrm{S}}$ center SEB $_{S}$ | -22.3 | -20.3 | $\pm 0.2$ | 7 |  |
| $N$ edge $\mathrm{SEB}_{S}$ |  | -16.1 | $\pm 0.2$ | 7 | (-4.1) |
| $S$ edge $\mathrm{SEB}_{\mathrm{n}}$ | -11.4 | -10.7 | $\pm 0.1$ | 7 | -0.7 |
| $N$ edge $\mathrm{SEB}_{\mathrm{n}}$ | -4.2 | -6.8 | $\pm 0.2$ | 7 | +2.6 |
| $S$ edge EB |  | -3.2 | $\pm 0.1$ | 6 |  |
| $N$ edge EB |  | +0.7 | $\pm 0.1$ | 6 |  |
| $S$ edge NEB | +10.6 | +7.5 | $\pm 0.2$ | 7 | +3.1 |
|  |  |  |  |  |  |


| Pasition | Sopper Lat. | NMSUO <br> Lat. | Standard Deviation | No. Measures | Difference in Lat. |
| :---: | :---: | :---: | :---: | :---: | :---: |
| N edge NEB | +2094 | +1894 | $\pm 0.2$ | 7 | +290 |
| S edge NTB |  | +23.8 | $\pm 0.1$ | 7 |  |
| center NIB | +32.3 |  |  |  | (+4.4) |
| N edge NIB |  | +32.0 | $\pm 0.3$ | 7 |  |
| center NNIB | +39.3 | +37.5 | $\pm 0.6$ | 7 | +1.8 |
| center NNNTB |  | +44.7 | $\pm 0.3$ | 3 |  |
| center NPB |  | +53.9 |  | 1 |  |

[^0]Many of the features cited in my report on rotation periods in 1973-74 are present on illustrations in Mr. Paul Mackal's report for the same Jovian apparition, namely "The Appearance of Jupiter in 1973 - An Interim Report", Journal ALPD, Vol. 25 , Nos. $9-10, \mathrm{pp} .173-182,1975$. It will be helpful to the reader to point out where some of the objects in tables in my present report can be found on published drawings in Mr. Mackal's report.

South Temperate Current: Oval DE is in conjunction with the Red Spot in Figure 1. It may also be found on Figures 3, 10, 15, 17, 21, 29, and 36. Oval BC may be observed on Figures 2, 6, 9, 13, 16, 27, and 33. Oval FA can be seen on Figures $7,9,30$, and 34 . No. 6 in the table is shown on Figure 33. No. 7 can be found on Figures 3, 15, 21, 29, and 36. No. 8 is illustrated on Figures 15, 21, 29, and 36.

South Equatorial Current A (Table II): No. 1 in the table is located on Figure 26. No. 2 is seen on Figures 21 and 26. No. 4 is illustrated on Figure 33.

North Equatorial Current (Abnormally Slow Portion): No. 8, the Great Festoon, is seen on Figures 6, 33, and 34. No. 9 is located on Figures 6, 33, and 34.

North Tropical Current B (Table I): No. 1 may be seen on Figure 5. No. 5 is shown on Figure 6. No. 8 is well illustrated on Figure 29.
(Table II): No. 1 is visible on Figure 34, and No. 4 is shown on Figure 36.
North North Temperate Current A: No. 1 is illustrated on Figure 12. No. 2 is seen on Figure 30; No. 3 is on Figure 34; No. 5 is on Figure 33; and No. 6 shows on Figure 36.

## THE 1966-67 APPARITION OF SATURN

By: Julius L. Benton, Jr., A.L.P.O. Saturn Recorder

Foreword by Editor. We are very sorry for the extremely late appearance of this report on the last edgewise presentation of the rings of Saturn, that which occurred during the 1966-67 apparition. Our Saturn Recorder at that time was unable to analyze and to publish the observational data submitted to him for a number of reasons. After Dr. Benton took charge of the Saturn Section, he did carry out this task, a major job in view of the heavy observational coverage. Further delays in publication occurred because of the length of this Saturn Report. The original version has been considerably shortened, perhaps beyond the point which would be really ideal. It appeared best to both the Editor and the Saturn Recorder to avoid publication in two or more parts.

Dr. John E. Westfall has prepared for publication here the illustrative material selected by Dr. Benton. We are much indebted to Dr. Westfall for this really major assistance-we assure the reader that the original drawings were submitted in a great variety of formats!

The report which follows covers the observing period from April 2, 1966 to February 15, 1967, the first apparition since 1936 in which the ring system of Saturn could be observed when presented edgewise to our line of sight. The next edge-on presentation of the rings will not occur until about 1981, and up to that time the southern portions of the globe and the ring system will remain visible to observers.

Of perhaps equal importance during the 1966-67 apparition was the unexpected discovery of a tenth satellite of Saturn, later named Janus, by Dr. Audouin Dollfus of the Meudon Observatory in Paris.

Throughout 1966 there were three separate passages of the Earth through the plane of the rings:

1. April 2, 1966: Earth passing from north to south.
2. October 29, 1966: Earth moving from south to north.
3. December 17, 1966: Earth again moving southward.

The value of $B$, the Saturnicentric latitude of the Earth referred to the plane of the rings and positive when north, varied according to the following table:


Both the northern and southern hemispheres of the planet were readily observable during 1966-67, the visibility of the associated ring system varying in accordance with the relative geometric orientation of the Earth and the Sun with respect to the plane of the rings. Opposition occurred on September 19th, 1966, Saturn then having a distance from the Earth of about 796 million miles. On opposition date the first magnitude planet, located in southern Pisces, exhibited an equatorial diameter of $19^{\prime \prime} .1$, a polar diameter of $17^{\prime \prime} .0$, and a major axis of the ring system extending some $44^{\prime \prime} .0$.

The following thirty-six individuals contributed observational data to the Section during 1966-67:

| Observer | Location |  | Number of <br> Observations | Instrumentation |
| :--- | :--- | :--- | :--- | :--- |



A total of 228 reports was received from the persons listed above, and the following distribution of submitted reports by month is noted:

| 1966, April | 10 | 1966, Septenber | 26 |
| :--- | ---: | :---: | ---: |
| May | 8 | October | 82 |
| June | 21 | November | 5 |
| July | 26 | December | 12 |
| August | 28 | 1967, | January |

The bulk of the observational material was accumulated for the period beginning in June and ending in October, quite a number of individuals beginning their programs early in the apparition. Saturn was in conjunction with the Sun on March 23, 1967, terminating useful observations about a month earlier.

The writer would like to thank all of the individuals who contributed observational data to the Section during the 1966-67 apparition. Interest was obviously stimulated by the edge-on presentation of the rings of Saturn, but it is hoped that such interest will not be limited to just these rare occurrences. A detailed and consistent observational record is needed for every year, regardless of the inclination of the rings.

## The Globe

Since the ring plane of Saturn was inclined only very slightly to our line of sight during the 1966-67 apparition, it is obvious that both hemispheres of


Figure 6. Selected drawings and photographs of Saturn by ALPO members during the 1966-67 apparition, when the rings were nearly on edge to both the Earth and the Sun. Figures 6-10 were prepared for publication here by John E. Westfall. All views are simply inverted ones with south at the top and west (as a direction in the Earth's sky) at the left. See also discussion in text of Saturn Report by Dr. Benton on page 232 et seq. $\underline{S}$ is the seeing on a scale of 0 to 10 , with 10 best; $T$ is the transparency of the sky as a limiting stellar magnitude; and $B$ is the tilt of the rings toward the Earth, negative when the Earth is south of the plane of the rings.
the planet were in view. The observations described here are presented in accordance with what is normally the case when Saturn is viewed through any astronomical telescope; south is usually at the top and west toward the left (as west appears in the sky and not in the IAU sense). As a consequence, our discussion begins at the south end of the planet's disc and proceeds northward.

South Polar Region (SPR). The majority of contributing observers agreed that the SPR was almost without exception a little darker than the NPR. In general, the SPR was not detected very often before opposition, but following that date the diffuse area apparently increased in conspicuousness. Delano remarked that the SPR was usually continuous with the darker SEB, while Osawa noted non-uniformity in the form of whitish spots on several occasions. Heath described the SPR as a greyish, evenly-shaded feature, often blending in well with the SEB; no detail was apparent at any time. A contrary view is expressed by Budine, who reported that the SPR. was not so dark as the NPR throughout the apparition. No other individuals held this opinion. Haas observed a diffuse, greyish SPB (South Polar Band) on several evenings of good seeing; it was reported to be slightly brighter than the NPB on occasion.

South South Temperate Belt (SSTeB). This uncertain feature was only rarely suspected during the apparition. The best seeing conditions were needed to catch even fleeting glimpses of the elusive belt, according to most observers.

South Temperate Zone (STeZ). Virtually everyone noted that this zone was slightly darker than the NTeZ or the more closely associated STrZ (South Tropical Zone). Budine recorded that the STeZ was darker than the NTeZ fairly consistently. The same observer noted that the NTrZ (North Tropical Zone) was brighter than the STeZ on August 6th; the STeZ and NTrZ were about the same estimated numerical intensity during October; and the STeZ and STrZ were, on the average, of about the same brightness. Budine noted no activity in the STeZ during the 1966-67 period. Heath confirmed the view that the STeZ was darker than the NTeZ at times of good seeing.

South Temperate Belt (STeB). Prior to July this feature was not reported, but the STeB increased in intensity (became darker) in October. It began to fade later in the same month, remaining visible in December. Most observers recorded that the NTeB was a great deal darker than the STeB. Budine noted that the STeB was greyish, showed little variation in form, usually appearing as a thin, rather featureless line, and was usually brighter than its northern counterpart, the NTeB.

South Tropical Zone (STrZ). This zone was visible only at times when the SEB, the STeB, and the STeZ were all well seen, usually being reported by observers as a brighter feature than the $S T e Z$. Most individuals agreed that the $S T r Z$ was distinctly dimmer than the NTrZ or the NTeZ. According to Budine, the STrZ was brighter than the NTrZ on only one occasion in August; but at all other times the $\operatorname{STr} Z$ was much dimmer than the NTrZ. No activity was suspected by the same individual at any time during the apparition. Weis confirms these impressions, noting that the STrZ was more dusky than the corresponding zone in the north.

South Equatorial Belt (SEB). The SEB was reported by nearly every observer, most of them confirming its double nature, separated into the SEB $_{n}$ and $\mathrm{SEB}_{\mathrm{S}}$ by a somewhat brighter SEB Z. Taken as a whole, the SEB was not so dark as the NEB, here also considered as a single feature. When one refers to the specific belt components, however, it is noted that the $\mathrm{SEB}_{\mathrm{S}}$ was not so dark as the $\mathrm{SEB}_{\mathrm{n}}$, on the average; and the $\mathrm{NEB}_{S}$ was much darker than either of the two SEB components or the $\mathrm{NEB}_{\mathrm{n}}$. In general, the $\mathrm{NEB}_{\mathrm{n}}$ had an assigned numerical intensity about midway between the values noted for the $\mathrm{SEB}_{\mathrm{S}}$ and $\mathrm{SEB}_{\mathrm{n}}$. The SEB Z (South Equatorial Belt Zone) was also observed throughout the apparition, clearly separating the components of the SEB and always appearing a little brighter than the NEB Z. Budine noted only limited activity in the SEB during the observing period, while no other observers reported any specific phenomena. Haas described the color of the SEB from May to August as brownish grey, but in September and October the SEB appeared reddish brown. The SEB was again brownish grey by late October, remaining so until the end of the apparition, according to Haas. Heath detected slight variations in the color of the SEB from grey to brownish grey throughout mast of the apparition. Lonak and Delano consistently reported that the SEB was double, but they agreed that the southern edge of the belt was continuous and blended in with the general polar shading and the SPR.

Equatorial Zone (EZ). Everyone who contributed observations to the Section plainly indicated that the EZ was the brightest feature seen on Saturn's globe. It was separated into the $E Z_{\mathrm{n}}$ and $\mathrm{EZ}_{\mathrm{S}}$ by the thin line of the rings where they passed in front of the ball, and it was apparent that the $E Z_{\mathrm{s}}$ was usually brighter

P. Budine

1966 AUG 29
04:30 U.T.
61 in. RL.
$550 \mathrm{X}, 750 \mathrm{X}$.
$S=7, T=5$.
$B=-1.976$

P. Budine

1966 SEP 12
03:25 U.T.
8 in. RL.
200 X.
$S=6, T=5$.
$B=-1.480$
Shadow of Titan on northwest of ball.

P. Budine

1966 OCT 08
02:30 U.T.
10 in. RL.
250 X.
$\mathrm{S}=8, \mathrm{~T}=5$.
$B=-0.559$


Figure 7. Selected drawings of Saturn by ALPO members during the 1966-67 apparition. See also text of Dr. Benton's Saturn Report.
than the $E Z_{n}$. The elusive $E B$ was noted on a few occasions as well. Visual estimates of color produced an impression that the EZ was usually pale yellow throughout the apparition. Budine detected several whitish spots in the EZ during the apparition, but they were too vague to allow accurate transit timings. Capen was the only other individual to report activity on the globe of Saturn in the vicinity of the EZ. He detected two bright limb patches in the region of the $\mathrm{EZ} \mathrm{Z}_{\mathrm{n}}$ on October 29th, 1966. Delano, remarking that the FB was the darkest belt on the planet, indicated that there may have been a possible confusion between the true EB and either the shadow or the dusky band of the rings where they passed in front of Saturn's disc in the region of the EZ.

Shadow of the Rings on the Globe. During most of the apparition individuals were in apparent disagreement as to the actual color and numerical intensity of the shadow of the rings on the globe of Saturn. It is not at all uncommon to have reports of anomalous shadow phenomena on Saturn; but many such reports have been attributed variously to effects of differential refraction, contrast, and seeing. Throughout the months of April, May, and June virtually everyone agreed that the shadow was a thin, black line crossing the planet's equatorial region to the immediate south of the ring-band. Haas described the color of the shadow on July 5th as brownish red, noting in addition that this feature might actually be the projected rings rather than the true shadow. The same individual detected a possible deviation from a true black intensity again on September 18th, indicating that the shadow bordering the south edge of the rings was not nearly so dark as in May and August. The shadow of the rings on the ball was straight, very thin, and consistently dark up until December, when it appeared to brighten slightly. On December 29th Heath reported a charcoal grey color for the shadow, although the planet was observed against a twilight sky. Delano noted that a jet black northern border to the ring-band, presumably the shadow of the rings on the ball, was seen from early October to mid-November.

By reference to Figure 11 it is possible to determine with some accuracy just when the shadow of the rings was visible and in which hemisphere the shadow would have been projected, either north or south of the ring-band which passed in front of the planet. In general, from April 2nd to June 15th the Earth was to the south of the ring plane and the Sun was to the north, the two being thus located on oppasite sides of the ring plane. Consequently, the shadow of the rings would have been projected to the south of the projected ring-band. From October 29th to December 17th, when the Earth was north of the ring plane and the Sun on the opposite side, the shadow would have been present north of the ring-band projected on the globe. Observations submitted to the Section are in general agreement with the theoretical considerations presented here.

Shadow of the Globe on the Rings. The only observer to report having seen the shadow of Saturn's globe on the rings was Heath, who described it as a black shadow very apparent on the eastern side of the planet in January.

North Equatorial Belt (NEB). A fair number of observers noted that the NEB appeared as a single belt during most of the 1966-67 apparition. A much smaller percentage of observers described the NEB as being divided into the $\mathrm{NEB}_{\mathrm{n}}$ and the $\mathrm{NEB}_{\mathrm{S}}$ by a vague NEB $Z$. It is apparent upon an examination of the observational evidence that the $\mathrm{NEB}_{\mathrm{S}}$ was usually darker than the $\mathrm{NEB}_{n}$, the latter lying about midway between the $\mathrm{SEB}_{\mathrm{S}}$ and the $\mathrm{SEB}_{\mathrm{n}}$ in overall conspicuousness. The NEB Z was not so bright as the SEB Z, according to the average intensity estimates. Delano described the color of the NEB as "noticeably red" in mid-October and December, while at other times it was seen to be greyish to brownish grey by Heath and Haas. On one occasion in September Hass described the color of the NEB as reddish brown, but no one else detected any color variations from the usual grey tone during the apparition. Budine noticed that the $\mathrm{NEB}_{\mathrm{S}}$ showed a variety of dark features off and on during the observing season, but unfortunately no transits were attempted for these apparently obvious features. No other observers described any activity in the NEB.

North Tropical Zone (NIrZ). The NTYZ was second only to the $E Z_{n}$ in brightness throughout the apparition, appearing almost always a little more obvious than the NTeZ and STeZ in overall brightness. With the exception of one report in August, the NTrZ was also brighter than the STrZ, according to Budine. Color estimates indicate that the NTrZ appeared yellowish. No activity was reported at any time in this region during the apparition, although it was apparent that this zone had begun to brighten a little since 1965.

North Temperate Belt (NTeB). Observers saw the NTeB only with difficulty throughout the apparition, the belt appearing a little darker than the STeB. Haas described the NTeB as a faint and broken line, while Heath indicated that its color was grey and fairly even in shade. Budine noted that the NTeB was usually equal to, or slightly brighter than, the more northern and less conspicuous $\mathrm{N} N \mathrm{TeB}$.

North Temperate Zone (NTeZ). The NTeZ was not usually so conspicuous as the NTrZ, but it did appear brighter than the STeZ and the STrZ on most occasions. Heath indicated that the NTeZ had no definite northern border during the last part of the apparition, blending in gradually with the dusky NPR. Budine pointed out that he could detect no activity in this region during the 1966-67 apparition, which was in keeping with the findings of other observers.

C. Pollak

1966 OCT 23
01:00 U.T.
8 in. RL.
200 x.
$S=7-8, T=3$.
$B=-0.133$


## P. Budine

1966 OCT 25
02:40 U.T.
10 in. RL.
$300 \mathrm{X}, 350 \mathrm{x}$.
$S=8-9, T=3$.
$B=-0.084$

P. Budine

1966 OCT 27
01:40 U.T.
10 in . RL.
300 X.
$S=6-7, T=3$ 。
$B=-0.041$
Tethys to east.


Figure 8. Selected drawings of Saturn by observers in the A.L.P.O. Saturn Section during the edgewise 1966-67 apparition. See also text of article by Julius L. Benton in this issue.

North North Temperate Belt (NNTeB). Budine was the only observer to report this belt during the apparition, noting that it was seen with only a fair amount of difficulty. The NNTEB was apparently about the same intensity as the SSTeB, and there is some chance that this belt may have been confused with the NPB or vice versa on several occasions.

North Polar Region (NPR). The evenly shaded NPR was almost without exception a little brighter than the SPR. Budine was the only individual to remark that the NPR was darker than the SPR consistently throughout 1966-67. Heath described the color of the NPR as an evenly shaded grey, while Haas on occasion detected a bluish grey color for the region.


Figure 9. Selected drawings of Saturn by observers in the A.L.P.O. Saturn Section during the edgewise 1966-67 apparition. See also text.

Haas was able to see the NPB on several evenings with difficulty, noting that the NPB was only slightly brighter than the SPB. It is possible that other individuals saw this belt, but confused it with the NNTeB. No specific activity was observed in this region during the apparition.

## Intensities of Features on Saturn

The table on pages 241 and 242 gives the observed average numerical intensity of various features on a scale of zero (black shadows) to ten (most brilliant marks).


Figure 10. Selected drawings of Saturn by observers in the A.L.P.O. Saturn Section during the edgewise 1966-67 apparition. See also text.

Visual Numerical Intensity Estimates of Saturnian Belts and Zones and of the
Rings for the 1966-67 Apparition

| Feature |  | Number of Estimates | Average Derived Intensity |
| :---: | :---: | :---: | :---: |
| Zones: | $E Z_{S}$ | 75 | 8.46 |
|  | $E Z_{n}$ | 66 | 7.52 |
|  | NTrZ | 45 | 5.73 |
|  | NPR | 68 | 5.45 |
|  | NTeZ | 33 | 5.38 |
|  | STrZ | 42 | 5.31 |
|  | STeZ | 34 | 5.29 |
|  | SPR | 65 | 5.16 |
|  | SEB Z | 16 | 5.00 |
|  | NEB Z | 7 | 4.40 |
| Belts: | NPB | 16 | 3.85 |
|  | STeB | 13 | 3.75 |
|  | SPB | 14 | 3.67 |
|  | NTeB | 14 | 3.58 |
|  | NNTeB | 10 | 3.53 |
|  | SSTeB | 3 | 3.50 |
|  | $\mathrm{SEB}_{S}$ | 22 | 3.20 |
|  | SEB ${ }^{\text {S }}$ | 66 | 3.15 |
|  | $N E B_{n}$ | 16 | 3.10 |
|  | SEB ${ }_{\text {n }}$ | 21 | 2.93 |
|  | NEB | 68 | 2.84 |
|  | $\mathrm{NEB}_{S}$ | 16 | 2.81 |
|  | EB | 31 | 1.08* |
| Rings: | Ring $B$ | 26 | 5.51 |
|  | Ring C (on ball) | 18 | 5.10 |
|  | Ring A | 24 | 4.52 |

*This very low intensity for what is normally a very faint belt may result from confusion during 1966-67 between the actual EB and the closely adjacent projected rings and/or their shadow.--Editor


Figure 11. The geometry of the rings of Saturn from February 8, 1966 to January 2, 1967. Dates appear on the left margin. The Saturnicentric latitude of the Earth, $B$ ( $\oplus$ ), is in degrees, positive when north; the Saturnicentric latitude of the Sum B (O), follows the same format. The Earth was in the plane of the rings on April 2, October 29, and December 17, 1966. The Sun passed fram the north to the south side of the plane of the rings on June 15, 1966. See also discussion in accompanying text. Graph prepared and contributed by Saturn Recorder Julius L. Benton. The black areas denote intervals of time when the Sun and the Earth were on opposite sides of the plane of the rings.
Feature
Number of Estimates
Shadow of Ball on Rings Shadow of Rings on Ball
4
0.96
60
0.95
B10 (Cassini's)
3
2.00
Intensity Minima:

Average Derived Intensity

The standard practice of the ALPO Saturn Section is normally to make intensity estimates of features on the globe and in the rings by assigning an intensity of 8.0 to the outer part of Ring B. Since B was never more than $\pm 390$ during 1966-67, we were without a suitable bright reference standard. The intensity estimates consequently have a lower confidence level for this apparition.

## Latitudes of Belts and Zones

Haas was the only observer to submit a series of visual estimates of belt latitudes during the apparition. Utilizing the technique he developed several years before 1966, Haas estimated the fraction of the polar semi-diameter of the planet's disc subtended on the CM (central meridian) by the belt whose latitude was desired. The application of the Crommelin formulae enables us to determine the latitude values from the raw data.

Latitudes of Saturnian Features During the 1966-67 Apparition

| Feature | Latitude: Eccentric (Mean) | Latitude: <br> Planetocentric | Latitude: <br> Planetographic |
| :---: | :---: | :---: | :---: |
| $N$ edge NEB | +10.44 | +9934 | +11966 |
| $S$ edge NEB | + 5.79 | + 5.17 | + 6.47 |
| $N$ edge SEB | -24.63 | -22.26 | -27.18 |
| $S$ edge SEB | -34.36 | -31.40 | -37.45 |
| $N$ edge $\mathrm{NEB}_{\mathrm{n}}$ | +11.03 | +9.87 | +12.31 |
| $S$ edge $\mathrm{NEB}_{5}$ | + 4.64 | + 4.14 | + 5.44 |
| $N$ edge SEB ${ }_{\text {n }}$ | -14.98 | -13.43 | -16.65 |
| $S$ edge SEB $_{\text {n }}$ | -20.34 | -18.31 | -22.55 |
| $N$ edge $\mathrm{SEB}_{5}$ | -25.26 | -22.84 | -27.85 |
| $S$ edge SEB $_{\text {S }}$ | -32.34 | -29.48 | -35.34 |
| $N$ edge SPB | -62.32 | -60.64 | -64.00 |
| $S$ edge NPB | +58.28 | +55.83 | $+60.75$ |

## The Rings

During 1966 the planet Saturn moved from heliocentric longitude $348^{\circ}$ in January to $360^{\circ}$ by late December, yielding passages of the Earth through the plane of the rings on the three dates noted earlier in this report. (A detailed discussion of the necessary geometric conditions for edgewise presentations of Saturn's ring system is given in A.F. O'D. Alexander's The Planet Saturn, pp. 303-313.)

Up to April 2nd, when the rings first appeared edge-on to the Earth, the northern face of the ring system was visible; but afterwards the southern surface of the rings came into view, the northern face still being in sunlight. It is possible to determine which face of the ring system is visible at any given time, and consequently the inclination of the plane to our line of sight, by making reference to values of B , the planetocentric latitude of the Earth referred to the plane of the rings, in a suitable ephemeris. Northern portions of Saturn's globe and the rings are seen when B is positive, while southern regions are visible when $B$ is negative. On April 2nd, the value of $B$ was 090 , but thereafter $B$ began to decrease to a minimu value for this apparition of -390 by July 7 th. From about July 7 th on, the rings began to close up again until by October 29th the numerical value of $B$ was again 09. After October 29th, the values of B were positive, the northern surface of the rings being inclined slightly to our line of sight. B , however, did not exceed 093 before the rings closed up again for the third and final passage of the Earth through the ring plane on December 17th. From that date on, the southern face of the ring system was visible to observers.

It is of additional importance to note that throughout this sequence of events, the ring plane passed through the Sun on June 15th. Before that event occurred, the northern portions of the rings were illuminated; but afterwards the southern face became sunlit. As can be seen from these positional changes of the Earth and Sun, the two were on opposite sides of the ring plane from April 2nd to June 15th and from October 29th to December 17th. Brightness estimates of the theoretically invisible rings are then of great value.

The Visibility of Saturn's Ring System. Throughout the interval from April 2nd to June 15 th and from October 29 th to December 17 th, the ring system of Saturn was theoretically supposed to have been invisible, regardless of the size of the telescope employed. Observational data, however, from past edgewise presentations of the ring system indicate that the rings do remain visible to persons using moderate apertures. As a result, the only time when the rings are completely absent from view occurs when they are precisely edge-on to our line of sight.

A complete report on the visibility of the ring system with regard to date and aperture of telescope used is presented in graphical form in Figures 13 and 14 for the period
beginning on April 2, 1966 and ending on January 29, 1967. There was a total of 303 possible observing dates between the two limits noted above; but when taken as a whole, there were only 228 observations received. Out of these 228 observations, only 126 dates were found where there was at least one attempt to detect the rings of Saturn, leaving some 177 days for which there were apparently no reports. Seven observations, the greatest number of observations for any one date, were made on October 21st and on October 23rd.

The distribution of telescope aperture in relation to the visibility or invisibility of the rings for the 126 days is presented below:

| Aperture (cms.) | Rings Visible | Rings Invisible | No Attermt to Observe Rings |
| :---: | :---: | :---: | :---: |
| 6.0 | 0 | 1 | 125 |
| 7.5 | 11 | 0 | 115 |
| 10.0 | 8 | 0 | 118 |
| 11.0 | 15 | 0 | 111 |
| 15.0 | 31 | 2 | 93 |
| 20.0 | 29 | 2 | 95 |
| 25.0 | 60 | 3 | 63 |
| 30.0 | 45 | 10 | 71 |
| 40.0 | 10 | 0 | 116 |
| 155.0 | 1 | 0 | 125 |
|  | $210$ | $18$ |  |

The distribution of observations and observing dates by month from April 2 to January 29 is presented in the following analysis:


Specific Detail in the Rings. As a result of the exceedingly small values of B during the apparition, observations of the individual ring components were extremely difficult. Nonetheless, at those times when the numerical value of B was between -190 and -3.0 , as was the case from April 21st to September 24th, a few individuals were able to notice that Ring B was the brightest part of all the rings. Observers agreed that Ring B exhibited a grey to yellowish grey color. Ring C was reportedly much brighter than Ring A, the two being described as having a greyish tone throughout. Intensity minimu B10, or Cassini's Division, was detected with difficulty on a few occasions; but Encke's Complex was never seen.

The face of the ring system which was not illuminated often displayed a variety of non-uniformity in overall brightness, exhibiting bright condensations or spots on several occasions. These areas appeared to vary in number and size throughout the apparition.

Some brief descriptions by individual observers are summarized here:

| 1966, April 13 | Brighter spots noted in the dusky E arm of the rings (Haas). <br> April 16 |
| :--- | :--- |
| Bright spots along the E arm of the rings suspected, one near position <br> of Ring C (Haas). |  |
| July 23 | Bright dots along E arm of rings suspected (Haas). |
| Condensations at region of Cassini's Division on E side of rings |  |



Figure 12. Photographs of Saturn and its rings with the 61-inch NASA Catalina reflector of the Lunar and Planetary Laboratory, University of Arizona. Those between November 1 and December 15, 1966 show bright condensations in the rings, 3000 ASA, $\mathrm{f} / 45$. Photographs by Daniel H. Harris, observing with Alika K. Herring and Dennis Milon.

1966, August 16 August 21 October 28 October 29 November 16

Two bright spots noted near position of Ring B in each ansa (Heath). Anomalous darkening on E side of rings (Anderson). Bright spots in each ansa at the positions of Ring A and B (Budine). Bright condensations in W ansa (Budine).
Bright spot on W arm where Ring C would lie; another spot suspected near position of Cassini's (Haas).

November 21
November 27
December 29
December 31

Spot detected at W ansa (Haas).
Spot at approximate position of Cassini's Division in each ansa (Haas). Bright spots in each ansa; one in E brightest (Haas).
Bright spots in each ansa at about position of Ring B; spot in E most obvious (Heath).


Figure 13. The observed visibility of Saturn's rings, April 2 - September 6, 1966. Prepared by Julius L. Benton from ALPO observations. See also text.


Figure 14. The observed visibility of Saturn's rings, September 7, 1966 - January 29, 1967. Prepared by Julius L. Benton from ALPO observations. See also text. Symbols and rest of format same as for Figure 13. The totals ( $T$ ) at the bottom refer to all observations in Figures 13 and 14.

1967, January 21 Light area about Ring B; no condensations seen (Heath).
February 12 Ring B has two bright portions at each ansa (Heath).

No observers reported any evidence of the elusive Ring D, situated supposedly external to Ring A. In addition, searches for extra-planar particles, which would appear as a faint 'haze", were without success.

Very few persons submitted visual estimates of the brightness of the dark side of the rings at various distances from the planet. It has been pointed out that if the intensity of the ring at various positions is related to the particle density, then the intensity of the dark side should be opposite to that of the bright side. Observations which were received only suggested that such was the case; Ring B, as it was observed, was the brightest of the ring components. This ring should have been the darkest, if such speculation is meaningful. Of course, one cannot assume too much from only isolated observations, and it would be good if a great number of observers would pay close attention to such work at future edge-on ring presentations.

A very important series of observations was received from Delano, who estimated the magnitude of the ansae when near exact edge-on presentation by comparing them with the brightness of the individual satellites of Saturn. Delano has been an observer of Saturn's satellites for many years; and most of his estimates are usually accurate, at least as accurate as one can estimate the magnitude of a satellite amid the glare of the planet. For what they are worth, then, the following data from Delano are presented:
1966, Jume 21

Ansae equal to magnitude 10.3 (Tethys).
Ansae almost equal to magnitude 10.4 (Dione).
Ansae about as bright as 9.8 (Rhea).
Ansae about as bright as 9.8 (Rhea).
Ansae about 0.5 magnitudes fainter than 10.1 (Tethys).
October 23
Ansae as bright as magnitude 11.2 (Tethys).
Ansae about 0.5 magnitudes fainter than 10.7 (Dione).
Ansae very faint, fainter than magnitude 11.2 (Dione).
deab
Ansae not seen at all.

December 23 Ansae about three times brighter than on December 19; magnitude would be about 9.7.

From the above data, it would appear that the ansae recovered their brightness more slowly in June than in December. The comparison stellar magnitudes of the satellites used above are mean opposition ones.

Bicolored Aspect of the Rings. Despite the very small angle of inclination of the rings of Saturn, individuals continued to report this curious phenomenon throughout the apparition. The observational technique involves estimating visually the brightness of each ansa in comparison with the other, using red and blue filters of known transmission and also observing without filters. At various times the rings were invisible or too faint to be seen with filters. Bartlett, Haas, and Delano used Wratten Filter 25 (red) and Wratten 47 (blue) for their work; Heath used the Dufay Tricolor red and blue filters. The following is a full report of the data submitted by the four individuals mentioned above:

| Date of Observation | Red Filter | Blue Filter | No Filter | Observer |
| :---: | :---: | :---: | :---: | :---: |
| 1966, April 11 | -- | -- | E suspected | Haas |
| April 13 | -- | -- | E seen | Haas |
| April 16 | -- | - | E seen, W suspected | Haas |
| April 23 | -- | -- | E seen, W difficult | Haas |
| April 27 | - | - | E seen | Haas |
| May 14 | -- | - | E seen | Haas |
| May 30 | -- | - | E glimpsed, W uncertai | n Haas |
| June 13 | -- | -- | Neither seen | Haas |
| June 15 | - | -- | E dusky, W seen | Haas |
| June 21 | - | - | Both seen, W>E | Delano |
| June 23 | -- | - | Both seen, W>E | Delano |
| June 24 | -- | -- | Both seen, $\mathrm{E}>\mathrm{W}$ suspected | Hass |
| July 1 | -- | -- | $\mathrm{W}=\mathrm{E}$ | Delano |
| July 5 | $E>W$ | W $>\mathrm{E}$ | $W=E$ | Haas |
| July 10 | - | -- | $\mathrm{W}=\mathrm{E}$ | Delano |


| Date | of Observation Red | Red Filter | Blue Filter | No Filter | Observer |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1966 | July 23 | $\mathrm{W}=\mathrm{E}$ | $\mathrm{W}=\mathrm{E}$ | $W=E$ | Heath |
|  | July 26 | $\mathrm{W}=\mathrm{E}$ | $\mathrm{W}=\mathrm{E}$ | $W=E$ | Heath |
|  | August $10{ }^{\text {d }} 23{ }^{\text {h }}$ |  |  |  |  |
|  | 45m, U.T. | . | -- | $\mathrm{W}=\mathrm{E}$ | Heath |
|  | August 11do0h |  |  |  |  |
|  | $30^{\mathrm{m}}, \mathrm{U} . \mathrm{T}$. | . $W=E$ | W>E (?) | $W=E$ | Heath |
|  | August 14 | $\mathrm{W}=\mathrm{E}$ | W $\boldsymbol{\prime} \mathrm{E}$ (? | $W=E$ | Hass |
|  | August 15 | $\mathrm{W}=\mathrm{E}$ | $E>W$ | W>E (?) | Haas |
|  | August 16 | $\mathrm{W}=\mathrm{E}$ | $\mathrm{W}=\mathrm{E}$ | $W=E$ | Heath |
|  | August 27 | - | -- | $W=E$ | Heath |
|  | Septenber 8 | $\mathrm{W}=\mathrm{E}$ | $W=E$ | $\mathrm{W}=\mathrm{E}$ | Heath |
|  | September 10 | W > E | $w>E$ | $W>E$ (?) | Haas |
|  | September 12 | -- | -- | $W=E$ | Delano |
|  | September 15 | $\mathrm{W}=\mathrm{E}$ | W>E (?) | $W=E$ | Heath |
|  | September 18 | $\mathrm{W}=\mathrm{E}$ | W> E | $W=E$ | Haas |
|  | September 19 | $\mathrm{W}=\mathrm{E}$ | W seen, E not seen | $\mathrm{W}=\mathrm{E}$ | Heath |
|  | September 20 | $\mathrm{W}=\mathrm{E}$ | W > E | $\mathrm{W}=\mathrm{E}$ | Heath |
|  | September 27 | $\mathrm{W}=\mathrm{E}$ | W seen, E not seen | $t W=E$ | Heath |
|  | October 3 | $\mathrm{W}=\mathrm{E}$ | W $>\mathrm{E}$ | $W=E$ | Delano |
|  | October 4 | -- | -- | $W=E$ | Delano |
|  | October 7 | - | - | $\mathrm{W}=\mathrm{E}$ | Delano |
|  | October 8 | - | -- | $W=E$ | Heath |
|  | October 10 | - | -- | $W=E$ | Delano |
|  | October 11 | - | -- | $W=E$ | Heath |
|  | October 13 | - | -- | $W=E$ | Delano |
|  | October 14 | -- | W > E | $W=E$ | Delano |
|  | October 15 | $\mathrm{W}=\mathrm{E}$ | Neither seen | $\mathrm{W}=\mathrm{E}$ | Heath |
|  | October 18 | $\mathrm{W}=\mathrm{E}$ | w seen on occasion | $\mathrm{W}=\mathrm{E}$ | Haas |
|  | October 21 | -- | -- | $E>W$ | Delano |
|  | October 22 | -- | -- | $W=E$ | Delano |
|  | October $23{ }^{\text {d }} 20 \mathrm{~h}$ | Neither Neither seen |  | $\mathrm{W}=\mathrm{E}$ ( weak) | Heath |
|  | October $\stackrel{33^{\mathrm{d}} \mathrm{don}_{1} \mathrm{~h}}{\mathrm{~W}} \mathrm{~T}$ | T. seen |  |  |  |
|  | $30^{\mathrm{m}}$, U.T. | T. $W=E$ | $W>E$ | $W=E$ | Delano |
|  | October $23{ }^{\text {dod }}{ }^{\text {a }}$ |  |  |  |  |
|  | $\begin{aligned} & 15^{\mathrm{m}}, \mathrm{U} \cdot \mathrm{~T} . \\ & 24^{\mathrm{d}} \mathrm{O}^{2} \end{aligned}$ | T. E2W <br> Neither | W seen | $E>W$ | Haas |
|  | October $30^{\mathrm{m}}$, U.T | T. seen | Neither seen | $W=E$ | Heath |
|  | October $244^{\text {d }} 5^{\text {h }}$ |  |  |  |  |
|  | $40^{\mathrm{m}}, \mathrm{U} . \mathrm{T}$ | T. W $>$ E (? | ) E>W (?) | suspected | Haas |
|  | October 25 | (?) | (?) | $\mathrm{W}=\mathrm{E}$ | Delano |
|  | October 26 | - | - | W $\boldsymbol{L E}_{\mathrm{E}}$ (?) | Haas |
|  | October 27d05 |  |  |  |  |
|  | $50^{\mathrm{m}}$, U.T. | T. | - | W seen, E difficult | Haas |
|  | October $27 \mathrm{~d} 1^{\text {h }}$ |  |  |  |  |
|  | $00^{m}$, U.T. | T. | - | $\mathrm{W}=\mathrm{E}$ | Delano |
|  | October $29 \mathrm{~d} 3^{\text {h }}$ |  |  |  |  |
|  | $20^{\mathrm{m}}$, U.T | T. | -- | neither seen | Haas |
|  | October 29dish |  |  |  |  |
|  | $45^{\text {m, }}$ U.T | T. | -- | neither seen | Heath |
|  | October 31 | -- | - | W suspected; E difficult, suspected | Haas |
|  | November 2 | -- | -- | suspected | Heath |
|  | November 3 | -- | -- | W difficult, E not seen | Haas |
|  | November 5 | -- | -- | neither seen | Heath |
|  | November 6 | - | - | neither seen | Haas |
|  | November 6 | -- | -- | neither seen | Heath |
|  | November 9 | - | -- | suspected | Heath |
|  | Novenber 10 | -- | - | uncertain | Heath |
|  | November 13 | -- | -- | both glimpsed; W easier | Haas |


| Date of | of Observation | Red Filter | Blue Filter | No Filter | Observer |
| :---: | :---: | :---: | :---: | :---: | :---: |
| 1966, | November $14^{\mathrm{d}}$ $06^{\mathrm{h}} 00^{\mathrm{m}}$, U.T. |  |  |  |  |
|  |  | -- | - | both seen with more certainty | Hass |
|  | Novenber $14^{\mathrm{d}}$$22^{\mathrm{h}} 00^{\mathrm{m}}, \mathrm{U} . \mathrm{T}$. |  |  |  |  |
|  |  | -- | - | $W=E$ | Heath |
|  | Novenber ${ }^{16}$ November 21 d | -- | -- | W $>\mathrm{E}$ | Haas |
|  |  |  |  |  |  |
|  | $00^{\mathrm{h}} 50^{\mathrm{m}}$, U.T. November 21 d | -- | - | W $>\mathrm{E}$ | Haas |
|  | $22^{\mathrm{h}} 0 \mathrm{O}^{\mathrm{m}}$, U.T. November 27 d | -- | - | E $>\mathrm{W}$ | Heath |
|  | $01^{\mathrm{h}_{2} 0^{\mathrm{m}}, \mathrm{U} . \mathrm{T}}$ $\text { Novenber } 27 \mathrm{~d}$ | -- | - | E > W | Haas |
|  | $21^{\mathrm{h}} 15^{\mathrm{m}}$, U.T. | -- | - | E seen; W uncertain | Heath |
|  | December 4 | -- | - | Both suspected, W plainer | Haas |
|  | December 6 | -- | - | Short "stub" on E and W sides of planet | Heath |
|  | December 10 Decenber 18d | -- | -- | neither seen | Heath |
|  |  |  |  |  |  |
|  | o3hoom, U.T. | -- | -- | suspected | Haas |
|  | December 18 $05^{\mathrm{h}} 00^{\text {m }}$, U.T. | -- | - | suspected with more confidence | Haas |
|  | December 18 d |  |  |  |  |
|  | $17^{\mathrm{h}} 00^{\mathrm{m}}$, U.T. | - | -- | neither seen | Heath |
|  | December 20 | W = E | not seen | $W=E$ | Heath |
|  |  | (limit of v | vision) |  |  |
|  | December 25 | -- | - | $W=E$ | Heath |
|  | December 29 | - | - | E $>$ W | Heath |
|  | December 31 | $W=E$ | $\begin{gathered} W=E \\ \text { (limit of vis } \end{gathered}$ | E easy; W more diffision) cult | Heath |
|  | December 31 | - | -- | $\mathrm{W}=\mathrm{E}$ | Bartlett |
| 1967, | January 1 | $W=E$ | $W$ dimly seen, $W=E$E not seen |  | Haas |
|  |  |  |  |  |  |
|  | January 2 | $\mathrm{W}=\mathrm{E}$ | W = E | $\mathrm{W}=\mathrm{E}$ | Heath |
|  | January 2 | - | - | both seen | Bartlett |
|  | January 3 | -- | -- | both seen | Bartlett |
|  | January 3 | $W=E$ | $\mathrm{W}=\mathrm{E}$ | W = E | Heath |
|  | January 5 | $\mathrm{W}=\mathrm{E}$ | $\mathrm{W}=\mathrm{E}$ | $\mathrm{W}=\mathrm{E}$ | Heath |
|  | January 5 | - | - | both seen | Bartlett |
|  | January 8 | W = E | uncertain | W = E | Heath |
|  | January 9 | - | - | both seen | Bartlett |
|  | January 9 | W>E | E>W (?) | $W=E$ | Haas |
|  | January 11 | -- |  | E $>$ W | Bartlett |
|  | January 12 | W>E | $E>W$ | W $=\mathrm{E}$ | Bartlett |
|  | January 12 | W $>$ E (?) | E > | $W=E$ | Haas |
|  | January 16 | E $>$ W | W $>\mathrm{E}$ | $E>W$ | Bartlett |
|  | January 18 | $E>W$ | W>E | $\mathrm{E}>\mathrm{W}$ | Bartlett |
|  | January 19 | $W=E$ | W>E | $W=E$ | Heath |
|  | January 21 |  | - | $W=E$ | Heath |
|  | January 22 | $W=E$ | W>E | $W=$ E | Heath |
|  | January 24 | $W=E$ | $W=E$ | $W=E$ | Bartlett |
|  | January 26 | $\mathrm{W}=\mathrm{E}$ | $\mathrm{W}=\mathrm{E}$ | E) W | Bartlett |
|  | January 29 | $W=E$ | $W=E$ | $W=E$ | Bartlett |
|  | February 5 | - | -- | $\mathrm{W}=\mathrm{E}$ | Heath |

When we compare the brightness of each ansa throughout the whole apparition, it is easily noted that the E ansa was more easily visible than the $W$ ansa. Comparing the bicolored aspect of the rings, we note that the $W$ ansa was often the brighter with the use of red and blue filters. The reader is reminded that east and west have been used as directions in the Earth's sky throughout this whole discussion. Thus west is to the left when Saturn is viewed in a simply inverting telescope with south at the top.

During the 1966-67 apparition, when the plane of the ring system passed through the Earth and the Sun, observers were presented with an opportunity to view transits, shadow transits, occultations, and eclipses of Saturn's satellites. These various phenomena can easily be observed for Titan with small to moderate apertures, but it has always been interesting to note just what can be done with similar instmments on the other satellites. This apparition also provided enthusiasts with an excellent opportunity for estimating the brightness of each satellite since the glare from the rings was very much reduced.

The following is a summary of observations subnitted by various individuals throughout the 1966-67 period:

1966, June 24
July 7
August 11

August 19
August 26
August 27
September 12
September 19

September 20

September 27

October 12
October 13
October 21
October 23
October 26

October 27
October 28
October 29

Titan noted about $1!0$ from the N limb (Haas).
Tethys 2:0 from Dione to the E-NE (Lonak).
Shadow of Titan seen on the globe, exactly on the NEB. The shadow was about the same width as the belt, first seen when very close to the limb; the intensity was a complete black only when the shadow was farther on to the globe. The shadow was predicted to have gone on to the disc at August $10 \mathrm{~d}_{23} \mathrm{~h}_{10} \mathrm{~m}$, U.T., and on August $11 \mathrm{~d}_{0} 0^{\mathrm{h}}$ $40^{\mathrm{m}}$, U.T. it was $1 / 5$ of an equatorial diameter on to the disc. Comparison of the size of Titan's shadow with Titan, as seen off the disc, gave a little larger size to the shadow, the difference being only slight (Heath).
Titan and its shadow cast on the NEB were detected (Cyrus). Dione noted in W ring arm (Lonak).
Rhea seen at center of $E$ arm and distinctly $S$ of the rings (Ionak).
Shadow of Titan detected on the NEB between the CM and the W limb at $02^{\mathrm{h}} 30^{\mathrm{m}}$ U.T. (Heath).
Shadow of Titan visible on ball (Budine).
Observed transit of Rhea and its shadow. The shadow was seen at times of good seeing on the NEB, close to the CM at $21 \mathrm{~h} 20^{\mathrm{m}}$, U.T., "flashing" as the seeing fluctuated. A fainter spot just east of the shadow was Rhea itself. At $21^{\mathrm{h}} 55^{\mathrm{m}}$ the shadow was well past the CM; the shadow was darker than Rhea but presented a charcoal grey hue rather than black (Heath).
Shadow of Dione was noted on the NEB about midway between the $E$ limb and the CM at $21 \mathrm{~h} 20^{\mathrm{m}}$, U.T. Seeing was very good, the shadow being detected very easily. At $21^{\mathrm{h}} 45^{\mathrm{m}}$ the shadow was near the CM but was still on the E side. Dione was only suspected on the globe (Heath).
Transit ingress of Titan was predicted for $20 \mathrm{~h} 04^{\mathrm{m}}$, U.T. and for its shadow at $21 \mathrm{~h}_{1} \mathrm{~m}^{\mathrm{m}}$.
At 19 h 5 m Titan was close to the E limb, parallel with the NEB, while at $19 h 56^{m}$ it was in contact with the limb. Titan was on the globe of the planet at $20^{h} 00^{m}$, not becoming visible until $21^{\mathrm{h}} 00^{\mathrm{m}}$. Titan was extremely dark but not black in transit. The shadow of Titan was suspected on the extreme limb at $21 \mathrm{~h} 40^{\mathrm{m}}$, and a moment later it was certain. The shadow was located farther north than Titan, just about midway between the north edge of the NEB and the pole (in the region of the NTeZ). At $22 \mathrm{~h}_{15 \mathrm{~m}}$ both Titan and its shadow were visible in transit, both appearing black; the shadow may have been slightly the larger (Heath).

Mutual phenomenon noted; Rhea lay in front of Tethys. Images merged but did not occult (Lonak).
Shadow of Titan seen (Gordon).
Titan and Tethys seen $4^{\prime \prime}$ apart at $W$ edge of ring (Lonak).
Possible shadow of Mimas (?) observed (Delano).
Rhea and Tethys seen on $W$ arm of rings, the former to the outside. It is possible that the bicolored aspect noted on this date was due to the presence of Rhea. Dione seen on E arm. Dione was more difficult than Tethys (Haas).
The satellite Rhea was seen on the W side of the rings (Lonak).
Tethys at E edge of rings "moving away" (Lonak).
Rhea going behind planet at $3^{h} 55^{m}$ (Lonak).
Titan and shadow in transit, both intensely black and about halfway between W limb and the CM at 19 h 5 m , U.T. Titan was predicted to come off the disc at $21^{2} 23^{m}$, U.T., but was still visible on the globe at $21^{h} 30^{m}$; its shadow lay near the $N$ pole of the planet. At $21^{\mathrm{h}} 42^{\mathrm{m}}$ Titan was visible off the globe, cloud interfering; the estimated time of egress was $21^{h} 40^{m}$. Titan's shadow was slightly

November 13

November $14 \quad$ Dione reappeared from eclipse at $02^{\mathrm{h}} 44^{\mathrm{m}}$, brightening 0.3 stellar magnitudes in 0.9 minutes (Haas).
November 14 Titan's shadow was noticed $W$ of the $C M$ and in contact with the N pole of the planet; Titan was in line with the ring shadow, off the globe (Heath).
November $30 \quad$ Titan noted just off the limb at $18{ }^{\mathrm{h}} 50^{\mathrm{m}}$, a fraction S of the ring shadow (Heath).
December 3 A faint spot was seen near W limb at $21^{h} 05^{m}$; this object was the termination of the transit of Dione (Heath).
December 3 A faint spot detected in parallel with the ring shadow at $21^{\mathrm{h}}$ $23^{m}$, presumably Tethys (Heath).

December 19 Rhea was not detected on or off the globe at the time of predicted transit of the satellite (Hass).

Very few individuals submitted observations in which estimates were made of the brightness of the satellites. Delano estimated the magnitude of the satellites when trying to ascertain the brightness of the ansae, and these numerical values are presented elsewhere in this report. There were not enough estimates made to produce suitable amplitudes for the satellites, which have been known to exhibit marked variations in brightness.

As was noted earlier in this paper, a tenth satellite of Saturn was discovered on December 15, 1966 at precisely $18^{h} 50^{m}$, U.T. by Dr. Audouin Dollfus in Paris. Janus, as the new satellite was later named, was located at eastern elongation at the time of discovery. The satellite was detected upon examination of photographic plates as a 14.0 magnitude object situated some $13,000 \mathrm{miles}$ off the edge of the outermost ring. The estimated revolution period of Janus is $17 \mathrm{~h} 58^{\mathrm{m}}$, traveling in a nearly circular orbit.

On only one occasion was there any possible observation of Janus by ALPO observers. C. F. Capen, using a $16^{\prime \prime}$ Cassegrain at 360 X (no filter), observed a few bright condensations in the rings on December 19, 1966 at $03^{h} 38^{\mathrm{m}}-55^{\mathrm{m}}$, U.T. He speculated that at least one of the bright objects might have indeed been Janus, which was nearly in the position of the outer bright condensation in line with the E ansa. A drawing is presented here by Capen to indicate the position of the object (Figure 10, upper drawing).

## ON SPURIOUS GREEN COLORS ON MARS AND SATURN

By: Paul K. Mackal, A.L.P.O. Jupiter Recorder
Visual observations of both Mars and Saturn have been made by members of both the B.A.A. and the A.L.P.O. over the last fifty years and more. Observers of both organizations have been struck by green colors on Mars. I have been struck by green colors on Saturn as well. The green patches of Mars are now known to be fictitious; i.e., they only appear to be green and are in reality dark brown regions. It is very likely that green tones in Saturn's temperate belts (north or south) are also spurious! Why is this so? Martian seasonal changes involving green areas may be interpreted as brown areas exposed to view by redistribution of red dust, as hypothesized by R. S. Richardson (EXPLORING MARS, McGraw-Hill Book Co., Inc., N.Y.C., 1954.) Syrtis Major, a dark area on Mars shaped something like a triangle, appears to be greenish, due to the color contrast of Syrtis with the brighter red background of the surrounding regions. Observations were made of this region of Mars by the author in July and August, 1975, using a 6-inch reflector with a magnification of 318 X . I was able to rule out the cause to be due to refraction of light, the "green-flash" phenomenon, or optical aberration. I conclude, therefore, that brown appears greenish against a lighter colored background, be it red or any other light color. This conclusion is wholly consistent with existing physiological theory.

Appertaining to Mars, we now know that green there is not a real color at all so that this hypothesis appears to be confirmed. In short, we may accept the above conclusion at face value. In extending this proposition to cover Saturn, we are making a new supposition to the same effect. Observations were made of the NTB [NEB?-Editor] on Saturn by the writer in 1962, using a 6 -inch reflector with a magnification of 212 X . The belt appeared to be greenish to me. It may or may not have appeared greenish to other observers, but

I would tend to suppose so. I conclude, therefore, that brown appears greenish against a lighter colored background, be it yellowish-white.

All suspected green colors on Jupiter may be the same kind of spurious contrast effect. A very thin SSSTB or NNNIB ought to appear green if flanked by yellow-white zones. In this connection a zone may also appear greenish, if we may assume this to be due to irradiation in conjunction with color contrast of the flanking belt. An observation of Ron Doel's made on July 6, 1973, of the SSSTeZ at $222^{\circ}$ II is probably a good example of this event (J.A.L.P.O., 24: pg. 215, 1974.)

## BOOK REVIEWS

The Amateur Astronomer's Handbook, Revised Edition, by James Muirden. Thomas Y. Crowell Co., New York, N.Y., 1974. 404 pages. Price $\$ 9.95$.

## Reviewed by Rodger W. Gordon

Most of the new material in this revised edition consists of two "add on" chapters-"Optical Work for Amateurs" and "Advanced Optical Work". The author's description of the process of grinding, polishing, and figuring a mirror is very easy to understand; and the diagrams are very explicit. There are many books on telescope making, but Muirden's section on this topic is one of the best this reviewer has seen considering the total space (pps. 319-367) devoted to it. It was good to see the author go into the mystique of lens making and point out that it is not too difficult to make an object glass after all.

In examining the rest of the book, it appears to me that Muirden has "left well enough alone", thereby keeping revision to a minimu. However, at times the book seems a little uneven. An error of fact is noted on page 153 where the author states that the 1973 apparition of Mars "was relatively free from obscuration" whereas in actuality the dust storm of 1973 on Mars was inferior only to the great storms of 1956 and 1971.

The objects of the Solar System, nebulae, stars (doubles and variables), comet hunting telescopes, accessories, atmosphere, and the observer are discussed with great clarity. The section on "learning to see" is by far the most important for the beginning planetary and lunar observer. However, some criticism can be directed to the use of the Pickering and Antoniadi scales of seeing, especially since the latter is the reverse of most normal scales. American planetary observers have, generally speaking, settled on the 1-10 scale in use by the A.L.P.O. The chapters on solar work, astrophotography, and lunar and planetary photography are somewhat briefer than I had expected, considering the everincreasing interest in these areas.

I was amused to read the following statement on page 186: "In the United States, in particular, it is probably true to say that the brighter planets are photographed at least as frequently as they are drawn! In some ways this is a pity when one considers the amount of planetary detail that is being lost". I concur wholeheartedly with Mr. Muirden.

Chapters on meteors and meteor showers and the constellations, together with revised lists of solar, lunar, and planetary phenomena through the $1980^{\prime} \mathrm{s}$, are included. A glossary and an excellent bibliography round out the book.
"The Amateur Astronomer's Handbook" is just that. It should whet the appetite of the beginner as well as the maker of a telescope who is thinking about what to do next. The author is realistic in his approach as to what the amateur can do as far as scientific research is concerned. However, the amateur is still the visual monitor of the night skies, and in a limited way he can still do his part.

From Stonehenge to Modern Casmology, by Fred Hoyle. W. H. Freeman and Co., San Francisco, CA, 1972. 93 pages, illustrated, hardcover. Price $\$ 6.00$.

## Reviewed by Bruce M. Frank

From Stonehenge to Modern Cosmology is a compendium of four lectures delivered by Fred Hoyle at the State University of New York-Buffalo in 1971. Intended for a wide audience, the subject matter of the lectures deals with three major themes. The first theme (lecture No. 1) is an exposé of the role of science, as viewed by society and acting on society, in modern times. An interesting point in this section is Dr . Hoyle's theory that a definite relationship exists between the amount of scientific advance and the degree of permissiveness evident in the political structure of a country. The most recent example is the spectacular technological and industrial growth occurring in Japan and Germany following the downfall of their repressive political systems at the end of World War II.

The second theme moves from the realm of philosophy of science to a detailed discussion of major theories about the astronomical significance of Stonehenge. Focusing on the theory proposed by Gerald Hawkins that Stonehenge is a prehistoric astronomical calculator of solar eclipses, summer and winter solstices, etc., Dr. Hoyle summarizes evidence in support of parts of the theory as well as pointing out certain shortcomings. One example is a mathematical method developed by Dr. Hoyle to explain how ancient Britons may have used the Aubrey or counter holes, a method which allows less room for mistakes than does the Hawkins explanation of their use.

The third area of discussion (lectures 3 and 4) concerns recent developments in cosmology. Dr. Hoyle begins with the key question of how the structure of the universe correlates with the laws of physics. He discusses Hubble's red-shift theory and radio galaxies in some detail. The last section of this discussion concems methods of estimating the age of the Earth, composition of the stars, and the interstellar medium. This last section is quite mathematical and may require a second reading by those not possessing familiarity with advanced mathematics.

In summary, the book is short, but it is very informative. Ideas are clearly stated and are well supported through abundant use of photographs, diagrams, and many examples. Parts of the discussion require some prior knowledge of physics and mathematics on the part of the reader if he is to get the most out of what is being said. Nevertheless, the information to be gained from this book is well worth the time spent in reading it; and the small volume should be a welcome addition to anyone's personal library.

Earth, Moon and Planets, Fourth Printing, Third Edition, by Fred L. Whipple. Harvard University Press, Cambridge, Mass. 1971. 279 pages, paperbound. Price $\$ 2.75$.

Reviewed by Jan Van der Stucken
This book is an update of an earlier classic introduction to the satellites of our Sun and some sub-satellites. The book is well written in terms conprehensible to the interested layman and covers many phenomena not usually considered by the beginner. The presentation is through the expedient of superb photography and excellent diagrams, supported by clear understandable text. The coverages of the individual planets and the Moon vary in depth with the greatest concentration on the Earth and its satellite, the Moon.

The author drifts into some effects due to the complexities of the human brain; for example, why does the Moon appear larger on the horizon than it does overhead? The size difference is explained by the observer's mental association with a distant horizon. The size variation on the horizon due to the peculiarities of atmospheric thermohygroscopic stratification is ignored.

The remainder of the planets are considered in a concise manner, utilizing the data from NASA and Russian research. The new data provide a modemization of a text of proven worth. Several earlier theories of the origin of the Solar System and its evolution are presented in the plainest possible terms. The objections to these earlier theories are explained; and the reader is oriented on a theoretical plane which is more compatible with the latest observational data.

The strongest point of this book is the straightforward manner in which many of the basic principles of astronony are explained. It will provide a valuable addition to the library of any student or beginning hobbyist.

The Physics of Stellar Interiors, by V. C. Reddish: Crane, Russak \& Company, New York, 1975. 107 + vii pages. Price $\$ 8.75$.

## Reviewed by Fred J. Lazor

This text is the summary of a course given to graduate students at Case Western Reserve University in 1969. The book is divided into two sections. The first section deals with the structure and energy generation processes in stable stars. The second section deals with nuclear synthesis and instability with regard to supernovae and supermassive objects. The various processes described are developed mathematically. Dr. Reddish does an excellent job in describing the processes and the mathematics.

For a reader with a good working knowledge of calculus and thermodynamics, this little volume should not only be fascinating but will be a valuable reference.

Equilibrium Configurations of Degenerate Gaseous Masses, by G. S. Saakyan. John Wiley and Sons, Inc., New York, N. Y. 1974. 294 pages. Price $\$ 36.00$.

Reviewed by Julius L. Benton, Jr.
Professor G. S. Saakyan, Corresponding Member of the Acadeny of Sciences of the Armenian SSR, presents an authoritative monograph discussing systematically the theory of stellar configurations consisting of degenerate gaseous masses, essentially white dwarf and baryon stars. Although many of the foundations in this field appeared during the 1930 's, contemporary work has been possible following the discovery of hyperons and a number of other particles. Baryon or neutron stars, until very recently, were chiefly theoretical models; as direct or indirect observational data have become available, new interest in superdense celestial bodies has been stimulated. As an additional note, in fact, the theoretical considerations of white dwarf and baryon stars constitute a most interesting and rapidly developing field of modern astrophysics.

A wealth of information has been introduced which is in need of critical examination and analysis. Not all aspects, therefore, of superdense configurations have been treated in the rather sparse literature. The present book does some justice to this obvious gap.

Without question, Saakyan is an eminent authority in the field, and it goes without saying that a great deal of the research supporting the theoretical considerations in the book are due to his painstaking work.

The first few chapters of the book deal with some of the fundamental supporting physical concepts. For example, the basics of the relativistic theory of gravitation and the properties of matter at low temperatures and high densities are outlined in the first two entries. Following this discussion is a rather technical consideration of the nonrelativistic and relativistic baryon configurations, which leads into an immensely interesting treatment of pulsars. The last two chapters in the book are extrapolatory in nature, giving emphasis to the possible consequences of varying the equations or constants introduced earlier. As many of the assumptions in the latter portion of the book are as yet unsubstantiated by experimental evidence, the results presented are debatable. The development of the theory, however, appears to this writer to be at least palatable.

Clearly, this monograph is not intended for the non-specialist, and thus it probably has a limited audience. It might be useful, however, to have the volume available for reference purposes. The book undoubtedly does contribute considerably toward somehow systematizing the informational chaos existing in the field, and the reader with sufficient background in physics and mathematics should find the presentation enlightening.

Black Holes, Gravitational Waves, and Cosmology, by Martin Rees, Remo Ruffini, and John Archibald Wheeler. Gordon and Breach, Science Publishers, New York, N. Y., 1974. 331 pages. Price $\$ 29.50$.

## Reviewed by Ron Doel

The authors preface this book as an "Introduction . . . on a level comprehensible to beginning graduate students".

The "Introduction" covers such topics as spacetime vs. space, curvature and density, and Einstein's equations connecting the latter. There is seemingly less text in the first few chapters than equations. Pulsars, black holes, quasars, and gravitational radiation are covered in a largely mathematical discussion which suffers in narration.

Beginning with Chapter Ten, "Relativistic Effects in Lunar and Planetary Motions", the narration reads like a breath of fresh air. An excellent blend of well-worded text and precise mathematics yields the best treatment of the 'Expanding and Evolving Universe", "Microwave Radiation", "Galaxy Formation", "Contents of the Universe", and "Cosmic Background Radiation" that I have found. "Beyond the End of Time", adapted from Wheeler's Marchon Lecture at Cambridge University, can be described as fascinating. This exciting frontier unfolds in a unique and interesting style.

The book provides a thorough appendix which is filled with reprints from outstanding contemporary physicists and astronomers. This part is a refresher course in advanced astronomy and particle physics in its own right. Footnotes are frequent and helpful. While the topics themselves are introduced by a Table of Contents in crisp outline form, there is no index. The clarity of the figures and diagrams is impressive, but don't purchase the book for the pictures -- the two views it provides of the Apollo laser reflector and Partridge's radiometers won't catch any awards.

This book undoubtedly interests only a select circle of our readers, and to them I recommend the text for the current insight it provides.

Astronomy: A Handbook, edited by Gïnter D. Roth. Springer-Verlag Publishers, New York, N. Y. 1975. 567 pages. Translated by Arthur Beer. Price $\$ 21.40$, hardcover; \$14.80, paperback.

## Reviewed by Rodger W. Gordon

This volume is not designed for the person who just purchased a telescope as many handbooks are. It is intended for the amateur who knows the basic fundamentals or the specializing amateur who wants a reference manual of the topics which interest him most. Fifteen different authors have combined their talents into the best one-volume handbook on astronony available today. There are twenty-one different sections with a large appendix, a very complete bibliography, and an excellent index. One is surprised at the amount of information given on each topic, which makes this work an excellent handbook as well as an authoritative book for amateur observing projects. The volume is copiously referenced with footnotes, and many of them refer to past articles in The Journal of the Association of Lunar and Planetary Observers.

It is inevitable that there will be comparisons of this work to the two well-known Sidgwick volumes, Amateur Astronomer's Handbook and Observational Astronomy for Amateurs. The two Sidgwick volumes have almost double the number of pages; and therefore, in most cases they treat the same topics somewhat more in depth. As a result, the Roth volume in many ways supplements the Sidgwick work and is more up-to-date in many areas. For example, even though Sidgwick's books were reprinted a few years ago, the only extensive revision then done was to the material on astrophotography. Therefore, the Roth book is more timely.

One topic of fundamental importance (and which incidentally makes extensive use of the A.L.P.O. materials) is the section on 'Photometry of Stars and Planets' relating to contrast of planetary image details. This topic is poorly covered in most other books; and in general, the topic of resolution is adequately covered at the expense of contrast. Yet, both are of equal importance; and I would prefer a telescope of $20 \%$ greater contrast over one with $20 \%$ greater resolution but $20 \%$ less contrast. Resolution is important in the observing of planetary details, but it is far from being the most desirable quantity. The relation of optimum contrast to objective diameter and magnification per inch should be studied and restudied by every planetary observer. This care is necessary since the quantities can vary greatly from planet to planet or even upon the same planet, depending upon observing conditions.

Criticisms of the book are, for the most part, minor. Some areas could have been expanded, particularly the section devoted to planetary observations. Fifty-four pages are all that are devoted to this section. While it is true that some other chapters give related information, it appears unreasonable to devote just fifty-four pages to this engrossing topic in which almost all amateurs have a great interest. Almost the same number of pages (combined) are devoted to 'Radio Astronomy for Amateurs' and 'Fundamentals of Spherical Astronomy'. These topics, to be sure, are of great interest to many; but they are unlikely to have a lasting interest to more than a handful of readers. Also the section on the terrestrial atmosphere is only seven pages long; and of that, only two pages are devoted to seeing and scintillation, despite the fundamental importance of these topics to the observer. This is the weakest section of the book, and the subject is more adequately covered in Sidgwick's Amateur Astronomer's Handbook.

In some instances, our appetites are whetted for more information on a topic; but there is no reference listed for more detail. For example, on page 16 we read that E. Lau stated, in 1937, that the resolving power of a telescope can be changed by attaching a limiting diaphragm in a thin glass plate in front of the image plane; but there is no source listed for anyone who wishes to pursue the matter further.

In another case, erroneous references are given with an all-sweeping statement; and only the reference is cited. For example, the fundamental and critical objections to compound telescopes mentioned on page 54 and referenced by the article of Cross, "Objections to Compound Telescopes" in Strolling Astronomer, Vol. 21, p. 70, 1968, do not in reality exist. This has been pointed out by Robert Fischer of Itek Corporation in "Wavefront Errors in Cassegrain Systems and Other Optical Oddities" and also by R. A. Buchroeder of the Optical Science Center of the University of Arizona. On the whole, however, the book is remarkably free from errors, including typographical ones. The translator, Arthur Beer, has done a cormendable job.

There is no question that the book is expensive, even in the paperback version. However, now that the Sidgwick volumes are sold out, the Roth book is the best one-volume source of information currently available; and it can take the place of several general volumes on the same topics.

With these thoughts in mind, I can enthusiastically recormend this book for the amateur's bookshelf; and it is beside the Sidgwick volumes on my own shelf.

Man's Relation to the Universe, by Bernard Lovell. W. H. Freeman and Company, San Francisco, CA, 1975. 118 pages. Illustrated, price $\$ 5.95$.

Reviewed by Bruce M. Frank

Man's Relation to the Universe is an extension of four lectures delivered by Bernard Lovel at SUNY-Buffalo in 1973. The subject matter covered represents a broad range of topics in current astronomical research. Dr. Lovell first reviews the progress in observational astronomy from Galileo to the Large Space Telescope. The author then covers a little discussed topic-the costs of astronomical investigation. One interesting fact found in this section is that the U.S. expenditures on astronamical research account for only $1 \%$ of the total annual amount spent on scientific study in this country.

The narrative then turns to a discussion on our present understanding of the Solar System, the Milky Way galaxy, extragalactic systems, and cosmology. Where appropriate, Dr. Lovell has included new discoveries obtained since the lectures were delivered. This is particularly true in discussing current information on the observable features of Mercury, Venus, and Jupiter as reported by unmanned spacecraft since 1973. Information is also provided about the latest theories concerning formation of black holes and about how the heavier elements may have arisen in the universe. One section of particular interest concerns theoretical models on the formation of the universe. They make, in common, a prediction that the radius of curvature and mean density of the universe vary with time. Within this generality, it appears that wide variations are theoretically possible. For example, the 'Big Bang" model predicts that the universe will reach a maximum size and then contract as time increases. However, observational tests have yet to lend definite empirical support to any particular model.

In sum, Dr. Lovell provides us with a factual, nonmathematical account on mankind's continual striving to understand the interrelation between time and space. Illustrations are few in number, but they are well chosen to provide visual support which highlights key concepts throughout the book. Man's Relation to the Universe is a good investment for anyone wanting a concise overview of current astronomical research.

Planetary Geology, by Nicholas M. Short. Prentice-Hall, Inc., Englewood, N. J., 1975. 361 pages. Price $\$ 17.95$.

## Reviewed by Charles S. Morris

Planetary Geology is the first college level textbook to be devoted solely to the field of astrogeology. This book does not concentrate on the geology of the Earth. Instead, it is aimed at extending the principles of geology to the other planetary bodies in the Solar System. In doing this, the author relies heavily on data gathered by the various space probes.

The first two chapters of Planetary Geology review man's quest to the stars and basic facts about the Solar System respectively. Chapter Three discusses the information obtained from meteorites, and Chapter Four introduces the reader to the various theories of planetary formation. The greatest emphasis of the book is placed on limar geology since more data are available for the Moon than for the planets (excluding Earth). Chapters Five through Eleven deal with many aspects of lunar geology, including impact cratering, lunar igneous processes, and the information obtained from lunar samples. Chapter Twelve discusses the data collected by space probes concerning Mercury, Venus, and Mars. Future missions to the planets are also commented upon. Finally, the last chapter uses the ideas presented in the previous chapters to summarize the probable geologic evolution of the Moon and the Earth.

This well written text with its large number of photographs and references should be considered an excellent source of information, particularly for the advanced amateur astrononer or college student. A background in geology is helpful, but not necessary. The major drawback of this book, as was pointed out by the author, is the fact that it will probably be outdated in a couple of years due to the rapid development of ideas and research within this field.

CURRENT EVENTS QN JUPITER AND JUPITER SECTION ACTIVITIES
The 1975-76 apparition of Jupiter is unique in our records for the outbreak of three major South Equatorial Belt Disturbances. The result has been a tremendous amount of detail in the two components of the S.E.B. and the bright zone separating them. The approximate dates and positions of the initial outbreaks are as follows: Disturbance No. 1, July 5, 1975, $58^{\circ}$ (II); Disturbance No. 2, August 2, $208^{\circ}$ (II); Disturbance No. 3, August

12, $120^{\circ}$ (II). Randy Tatum of the Richmond Astronomical Society obtained very early observations of all three Disturbances - our hearty congratulations!

Several rapid-moving spots have been observed at the south edge of the North Temperate Belt. This current, when observable, is the swiftest on the whole surface of Jupiter. Elmer Reese has made a preliminary determination of a rotation period of $9^{\mathrm{h}} 46^{\mathrm{m}} \mathrm{m}^{\mathrm{s}}$ for one of these spots, the shortest yet found for a feature on the Giant Planet.

The three long-enduring South Temperate Zone ovals still exist, but two of them are hard to see with small telescopes. Careful C.M. transits with larger instruments are definitely needed.

On November 1, 1975 the Great Red Spot was observed to be fading. It has been extremely dark and conspicuous since 1960. By November 22 the north half of the Spot was "quite faded". It is reasonable to expect the imminent return of the Red Spot Hollow aspect. Careful observations are needed.

In early October Budine and Hull reported what they call a 'North Tropical Zone Disturbance". It was dark, with festoons and small bright ovals. On October 4 the Disturbance


Figure 15. Drawing of Jupiter by Phillip W. Budine on October 23, 1975, 1 h 7 m , U.T. 4-inch Unitron refractor, 167X and 214X. Seeing 9 (excellent), transparency 6 (very clear). $\quad \mathrm{CM}(\mathrm{I})=3250$. $\mathrm{CM}(\mathrm{II})$ $=43^{\circ}$. Note the Red Spot with internal detail and South Temperate Zone oval BC to its south. There was a double North Temperate Belt, and the 'North Tropical Zone Disturbance and Oval" are right of the C.M. Note the prominent festoons in the Equatorial Zone.
covered about 40 degrees of longitude.
Figure 15 and the front cover drawing will exhibit many of these aspects. Readers are urged to observe Jupiter during the remaining weeks of an extremely active apparition. In truth, the Giant Planet may even give us some new surprises.

Since July, 1975 the A.L.P.O. has had a Jupiter Bulletin, jointly edited by Recorder Phillip W. Budine and Richard L. Hull of Richmond, Virginia. The bulletin is mailed at the first of each month without charge to persons actively participating in A.L.P.O. Jupiter Section studies. Each issue is one or two typed pages and briefly covers Jovian events of current interest. Longitudes of features of particular interest are given. Needed observations are described. The Bulletin is a most invaluable service to all serious students of Jupiter.

Mr. Budine requests that all 1974 observations not yet mailed to him be submitted without further delay. His address is on the back inside cover. He wishes to complete his report on Jovian rotation periods in 1974. And, of course, Recorders Budine and Mackal will appreciate also receiving your 1975-76 observations at your early convenience.

## ANNOUNCEMENTS

Availability of Material on Mars-Viking Missions. Any A.L.P.O. member desiring to be kept informed of the Mars-Viking missions via NASA educational publications is invited to send his name and address to John Marelli Meteorological Associates, 42 Chestnut St., Charlestown, Massachusetts 02129. There will be a nominal charge for postage, depending upon how many pamphlets will be issued during the mission. Five (5) issues of "The New Frontier" plus twelve (12) photos from the Mariner 10 mission to Venus and Mercury are available. The cost will be postage charges only.

In Memoriam: S\{ndor Toth. We have learned of the tragic death of Mr. Sandor Tóth of Hajdunanas, Hungary on July 3, 1975 at the age of 21 . He was an active observer of the planets Saturn, Mars, and Venus; and his enthusiasm prompted numerous other observers in Hungary to participate in ALPO programs. We extend our sympathy to his survivors and friends.

Invitation to Australia for Eclipse Observers. Aileen Schoeppe, Coo̊rdinator, Editorial Conferences International, 15 West 55 th St., New York, N.Y. 10019 wrote us on September 12, 1975 about forming a group to attend the Astronomical Conference being arranged
by the Eclipse Subcormittee of the Astronomical Society of Victoria. This meeting will be at Melbourne, Australia on October 21 to 25 , 1976, at the time of the total eclipse of the Sun in that area. The offering of group airfare allows a considerable financial saving to participants. Miss Simone Bassous, President of Editorial Conferences International, has worked for a number of years with professional groups and has arranged their travel to conferences and seminars. Although ALPO funds unfortunately rule out support for eclipse trips to Australia, we would certainly encourage interested readers to contact Ms. Schoeppe at the address above.

Old Issues of The Strolling Astronomer for Sale. Dr. Eugene E. Epstein, Radio Astrononty Program 120/2101, The Aerospace Corporation, P. O. Box 92957, Los Angeles, CA 90009 wishes to sell his very extensive collection of issues of this journal. It is complete from 1950 to 1974 and also includes many pre-1950 issues. Many of these old issues are extremely difficult to find and have long been out of stock on our own shelves. Interested persons should write Dr. Epstein promptly.

In Memoriam: Dr. Charles P. Olivier. All students of meteors will be saddened by the death of Dr. Olivier on August 14, 1975. Born in 1884 at Charlottesville, Virginia, he obtained his college degrees at the University of Virginia and the University of California. He was Director of the American Meteor Society from its beginning in 1911 to 1973. His professional career was spent at Agnes Scott College, the University of Virginia, and the University of Pennsylvania. His books Meteors (1924) and Comets (1930) were classics for many years.

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The 1976 ALPO Convention. We shall take part in the 1976 National Convention of the Astronomical League at Kutztown State College, between Allentown and Reading, PA. The dates are August 15 to 22; the hosts are the Astronomical Society of Harrisburg, the Lehigh Valley Amateur Astronomical Society, and the Rittenhouse Astronomical Society. A special package for food and lodging is being arranged; and it is now estimated that the total cost for the week, including the banquet, will be only fifty dollars ( $\$ 50$ ). Advance registration is always helpful; the price is $\$ 4$ for individuals or $\$ 5$ for family groups. Checks should be made payable to George Maurer, Treasurer, Bi-Centennial Convention Committee. His address is RD 3-Box 140, Coopersburg, PA 18036. Kutztown is in the heart of the scenic Pennsylvania Dutch country. In commemoration of the nation's bi-centennial year the theme of the convention is "Two Hundred Years of Amateur Astronomy'.

This meeting will include a number of unusual activities. There will be a photography contest; entries will be hung in the art gallery of Kutztown State College. Photographs may be entered either in the black-and-white class or the color class and will be judged for both astronomical interest and artistic merit. There will be a Telescope Fair on Saturday, August 21, intended to provide an opportunity for the display and recognition of ideas in amateur astronomical instrument making. Entries will be judged, and recognition will be in the form of certificates of merit. We can provide interested readers with more details on both the photography contest and the Telescope Fair. Dr. Gerald Soffen, Science Director of the Viking Project, has promised a telelecture hookup with all thirteen teams of scientists processing data on the Mars landing, i.e., a feedback show. Work seminars are planned on different amateur observing programs, and we would be glad to hear from qualified ALPO members who would be willing to lead seminars on such subjects as comets, Jupiter, Mars, minor planets, etc.

Undoubtedly, however, one of the major ways in which ALPO members can add to meetings of this kind is by contributing suitable amateur papers of good quality. We hence invite interested readers to decide upon a good subject for a paper and to inform us of their choice. A more formal invitation to selected members is planned for a little later. A

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Comet West 1975 n in the Morning Sky. A newly discovered comet is expected to provide an interesting sight in the morning sky, beginning the first week of March. Perihelion passage will occur on February 25, 1976 at a distance of 0.197 Astronomical Units from the Sun, and very tentative estimates suggest that the comet might then be as bright as zero magnitude. The earliest observations might be made when the comet's head is still

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    The differences in the rightmost column are perhaps larger than one would expect. There may exist systematic differences between photographs and micrometric measures. Perhaps also the blue light for these photographs differs from visual light so as to affect such latitude determinations.

    On October 22, 1973 Walter H. Haas observed a transit egress of Jupiter III with a 12.5 -inch reflector at 303 X , seeing $=2-3$ (poor) and transparency as a limiting stellar magnitude $=6$ (good). The American Ephemeris and Nautical Almanac prediction for mid-egress was $1 \mathrm{~h}_{13} \mathrm{~m}, \mathrm{U} . \mathrm{T}$. Haas recorded the middle of transit eg-
    

