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The Rotation Period of Jupiter.

By *W. F. Denning.*

On 1831 Sept. 5 9^h 45^m p. m. Heinrich Schwabe at Dessau observed Jupiter with a 6 foot Fraunhofer telescope power 216 and drew the planet with a remarkable depression or hollow in the S. side of the great southern equatorial belt. The particular object referred to was then situated between the middle of the disc and the west limb. Schwabe frequently delineated the same feature in subsequent years and his manuscript books of observation in the possession of the Royal Astronomical Society contain some well marked representations of it down to 1856. It is shown under a precisely similar aspect to that of the hollow in the southern belt which has during the last 20 years, maintained a prominent appearance in the immediate region of the red spot. The latter, if it has no physical connection with the hollow has no doubt greatly influenced its shape for it seems due to the bending northwards of the S-side of the S-equatorial belt just outside the NE and NW boundaries of the spot.

On 1901 Sept. 5 (exactly 70 years after Schwabe's first observation of this marking) I observed Jupiter with my 10 inch reflector powers 150 and 312 and estimated that the hollow in the belt was at mid-transit at 5^h 59^m. The sun had not nearly set and the planet's image was very faint in the light and somewhat hazy sky but the observation was regarded as pretty accurate.

This remarkably durable feature of Jupiter can be traced on a large number of drawings made during the long interval which has elapsed since Schwabe detected it in 1831. I gave a summary of many of the observations made by Schwabe, Baxendell, Huggins, Gledhill, Noble, Jacob, Lord Rosse, Copeland, Russell and others, in the Monthly Notices of the R. A. S. vol. LIX p. 574 to 584. From a comparison and combination of all these it was found possible to determine the rotation period and variable motion of the object between 1831 and 1899.

My present purpose is to compare the two observations made in the evenings of Sept. 5 in 1831 and 1901. From the position of the marking delineated by Schwabe it must have been central at about 8^h 21^m Gr. M. T. so that the whole interval comprised 25566 days 21 hours 38 minutes, during which time Jupiter performed

61813 rotations

with a mean period of

9^h 55^m 36^s 56.

The rate during the 70 years has varied from about 9^h 55^m 33^s 5 in 1831-2 and 1876-8 to 9^h 55^m 38^s 3 in 1859

and 9^h 55^m 41^s 7 in 1899-1900. During the present year, and indeed since 1900 September, the hollow has been running level with the rate 9^h 55^m 40^s 6 adopted for system II by the late Mr. Marth and more recently followed by Mr. Crommelin, in the annual ephemerides for physical observations of Jupiter published in the Monthly Notices.

I have lately secured a considerable number of observations of this feature as it crossed the central meridian but the planet having been in S-declination 23°, definition has generally been very imperfect; the disc has been moulding and seething in the vapours near the horizon. I give below a selected few of the estimated transit times and the computed longitudes of the object on the various nights, adding the last observations made here in 1900 for comparison:

	Transit Time	Longitude
1900 Sept. 3	7 ^h 10 ^s	44° 4
1901 Febr. 13	17 37	43.5
May 23	14 24	43.6
28	13 35	45.9
June 24	10 46	44.7
July 8	12 17	45.2
28	8 49	46.5
Aug. 9	8 38	43.5
21	8 35	44.6
Sept. 5	5 59	43.5

The figures show that during the last 12 months there has been no perceptible change in the longitude other than that introduced by small errors of observation. The motion of the object has therefore exhibited a very decided acceleration during the interval embraced by the above observations. Its rotation period was in fact about one second less than in 1899 and 1900 (to September).

During the present opposition of the planet the dark and white equatorial spots have been both numerous and conspicuous. I have accumulated a considerable number of transits of 27 of these objects and their mean motion indicates that the velocity of this current has slackened this year to the extent of several seconds as compared with the mean rate it exhibited in the three years 1898, 1899 and 1900 when it was 9^h 50^m 24^s 1. Recent observations have shown that the rotation period varied very little from 9^h 50^m 30^s so that it conforms with the adopted rate of system I in Marth-Crommelin's ephemerides. It may be noted as a singular coincidence that during the present opposition the rotation periods of the red spot with its

adjoining hollow in the belt and of the equatorial spots have conformed very closely with the rates upon which systems I and II are based in the ephemerides alluded to.

The dark spot in the N-tropical zone of Jupiter mentioned by J. Comas Solá, *Astr. Nachr.* 3719, and by the Rev. T. E. R. Phillips, *Astr. Nachr.* 3724, was of very temporary character for it rapidly grew faint and disappeared altogether.

Many observers will probably have remarked a dark mass or irregular group of spots lying on the southern borders of the great southern equatorial belt. This has recently formed a prominent feature and was situated in longitude $232^{\circ}8$ (system II) on Aug. 3 and in $217^{\circ}0$ on Sept. 1 so that its rotation period is about $9^h 55^m 20^s$. There was a somewhat similar outbreak of spots in the same zone

in the early part of June 1889 seen by Mr. A. S. Williams and they formed the subject of an interesting contribution from his pen in *Monthly Notices* Vol. L, p. 520 to 522. The more rapid velocity of these objects caused them to overtake the ellipse of the red spot in July 1890 when they were immediately diverted to the south and drifted along the southern edge of the ellipse. — It remains to be seen whether the present outbreak will retain a visible form until its swifter motion enables it to overtake the red spot in about 9 months from the present time viz in 1902 June and whether the experiences of 1890 will be repeated. It is curious that these disturbances occurred at intervals of 12 years and suggestive that if they are recurrent the period is coincident with that of a revolution of Jupiter round the sun.

Bishopston, Bristol, 1901 Sept. 6.

W. F. Denning.

Observations of meteors in July and August 1901.

By *W. F. Denning.*

Between July 15 and 24 during 14 hours of watching 95 meteors were seen of which the paths of 72 were registered. Between Aug. 10 and 22, when fortunately there occurred a series of very clear nights, during 34 hours of watching 401 meteors were observed of which 242 were registered. The Perseids furnished a display perhaps a little stronger than the average and decidedly more of its meteors were noticed on Aug. 11 than on Aug. 10 while the maxi-

mum was probably attained on the morning of Aug. 13 but at that time the sky was much clouded at Bristol and fair comparisons could not be made. The first Perseids were recognized on July 21 and the last on Aug. 21; the radiant point exhibited the usual movement of about 1° per day to the ENE. There were a great number of minor showers among them being the following:

July 18-24	$2^{\circ} + 43\frac{1}{2}^{\circ}$	5	Rapid	Aug. 10-22	$310^{\circ} + 61^{\circ}$	11	Slow
" 15-21	23 +44	4	Rapid, streaks	July 15-21	311 +13	5	"
Aug. 15-21	24 +43	5		Aug. 11-13	312 +13	5	
" 10-19	63 +30	6		July 15-20	317 +31	5	
" 10-20	106 +52	5	" "	Aug. 10-22	335 + 1	15	Slowish, faint
" 11-20	263 +62	7	Slow	" 10-20	335 +73	13	Rapid, white
" 10-15	269 +47	7	"	" 15-21	345 0	7	Rapid
" 10-20	280 +81	5	Rapid, short paths	" 15-19	349 +48	5	"
" 10-21	290 +53	10	Slow	" 10-21	350 -14	10	Slowish
July 19-24	290 +24	8	"	" 10-21	353 +31	6	"
" 15-24	304 - 8	6	"				

There were other radiants in July at $29^{\circ} + 36^{\circ}$ and $20^{\circ} + 5^{\circ}$ and in August at $14^{\circ} + 7^{\circ}$, $33^{\circ} + 18^{\circ}$, $42^{\circ} + 12^{\circ}$, $47^{\circ} + 43^{\circ}$, $57^{\circ} + 9^{\circ}$, $71^{\circ} + 52^{\circ}$ &c.

A large number of interesting meteors were doubly observed in England during the period from Aug. 10 to 21 and I have computed the following real paths:

No.	Date 1901	Gr. M. T.	Mags.	Height at beginning miles	Height at ending miles	Length of Path miles	Velocity in miles per sec.	Radiant	Observers
1	Aug. 10	$10^h 41^m$	3-2	88	68	21	25	$278^{\circ} + 67^{\circ}$	A. S. H., W. F. D.
2	"	10 58	3-2-2	57	52	25	15	$352 - 14$	A. S. H., J. H. B., W. F. D.
3	"	12 0 $\frac{1}{2}$	1-1	76	51	36	50	$44 + 58\frac{1}{2}$	A. S. H., W. F. D.
4	"	12 16	2-1	69	50	27	39	$42 + 57$	A. S. H., W. F. D.
5	"	12 19	3-2	72	60	33	25	$149 + 60$	A. S. H., W. F. D.
6	"	13 18	1-24	70	47	31	31	$45 + 56$	O. A. Le Bean, W. F. D.
7	"	13 34	1->1	63	29	48	16	$269 + 47$	O. A. Le Bean, W. F. D.
8	Aug. 11	11 2	$2 \times \varphi - \equiv \gg$	95	56	64	v. rapid	$45 + 58$	D. E. Packer, W. F. D.
9	"	11 33 $\frac{1}{2}$	2-24	94	59	55	42	$45 + 57$	D. E. Packer, W. F. D.