

## A Paper on Jupiter.

BY REV. J. MITCHELL, M.A., F.R.A.S.

IN my lecture on Jupiter in the Town Hall on the 12th February 1914, I referred in some detail to the work which Mr. Raman and I were engaged in last year on the planet. To night I fear I shall have to go over much of the same ground again, though perhaps in slightly greater detail, but with the advantage that there will be an opportunity for discussion on the points raised at the end of the paper.

My observations began in May and continued well into November when the planet was too near the Sun for further work. As the observations will be continued during the present year as soon as the planet is in a favourable position, my report to-night will be more or less a preliminary to further reports which I hope to be able to send in future. Being a somewhat inexperienced observer of Jupiter, at any rate with the telescope, the 5" Cooke Refractor, I am now using, the early observations cannot have the same value as the later ones. To a new observer I may say that it takes some days, probably weeks, before one becomes familiar with the more or less permanent markings of the planet, in other words with its General Geography (to use an Earthly Expression), with the rate of Revolution, and to know when to expect certain prominent markings. When this experience is gained then the observations become valuable.

For the purpose of determining the exact revolution of any spot or belt ending or beginning, my observation lack value to some extent because their exact time of transit over the Central meridian was not taken, though in November I did take a few definite transits of the Great Red Spot and the preceding end of the S. T. D. All I did last year was to take two or three drawings each night and to note the exact Standard time. In future whenever possible, I shall, in addition to taking drawings, note the time when certain spots or prominent features transit and then the rotation periods can be worked out with the greatest accuracy specially if taken over a long period of several weeks or months. However, even as it is by taking two drawings, with the same spot in the same position with reference to the Central meridian, and over a period of two or three months it has been possible to calculate the rotation periods of end spots with a degree of accuracy quite surprising. Errors of time and position become almost eliminated when taken over such periods and

already it has been possible to work out the rotation period of several spots to within one or two seconds.

Many of the spots, some black, some white, appear only once. They are not present when next the same portion of the planet presents itself. Some spots persist for days, even weeks or months, though they may change in appearance and size and even colour during that period. The general appearance of the belts and zones are more permanent though these also are subject to change. The most permanent object in the planet is the Great Red Spot. This with periods of faintness and brightness has maintained its size and general appearance since 1878 when it was discovered and it is possible it was visible many years previous to this date.

It is impossible to refer to all the detail on the planet as seen with a good telescope from night to night. On an exceptionally good night the detail is enormous and the markings are so delicate and elusive that it is impossible to reproduce them on paper and still more impossible to photograph them. Jupiter is essentially the planet of the amateur.

The best that photography can yet do is but feeble compared with the wealth of detail a good telescope of 4" or even 3" aperture reveals.

The following is a list of the most striking of the isolated spots seen during the period under observation :—

Date.	St. time.	Nature and number.	Position.	General remarks.
17-5-18	10-45 P.M.	4 black, rectangular	S. Edge of N. E. B.	Second spot on central meridian.
...	11-30 P.M.	3 black, rectangular	Ditto	Second spot in transit.
...	1-30 A.M.	3 Ditto	Ditto	P. end of second spot in transit.
...	1-30 A.M.	2 Ditto	S. Edge of S. E. B.	F. end of first spot in transit.
19-6-18	9-30 P.M.	3 black, rectangular	S. Edge of N. E. B.	P. end of third spot in transit.
21-6-18	9-30 P.M.	2 black, rectangular	S. Edge of N. E. B.	
26-7-18	10-0 P.M.	1 black	Within N. E. B.	
28-7-18	10-15 P.M.	7 faint, black	S. Edge of N. E. B.	
1-8-18	9-0 P.M.	1 white, round	Within N. E. B.	
3-8-18	10-45 P.M.	2 faint, white round	Within N. E. B.	Just passed C. Mer.
12-8-18	10-30 P.M.	1 long, thin black	Within N. E. B.	In transit.
22-8-18	8-30 P.M.	1 large, white	Within E. Z. under F. End of S. T. D.	In transit.
25-8-18	8-40 P.M.	1 white-circular	Within N. E. B.	Just passed, C. M.
3-9-18	9-15 P.M.	1 black, rectangular	Under F. End of S. T. D.	
5-9-18	10-15 P.M.	Same spot	.....	On C. Merid.
11 10-18	5-30 P.M.	1 black, rectangular	S. Edge of N. E. B.	Approaching C. M.

It will be noticed that nearly all these isolated black spots occur in the N. E. B. The few isolated white spots noticed were also seen in the same belt and these are about the only definite markings seen in this region; the more active disturbances were all in the Sportion of the planet.

*Great Red Spot.*—This was the most striking feature on the planet. It is found on the red S. E. B. It is elliptical (or somewhat pear-shaped to be more accurate, the pointed portion being towards the direction of revolution) in shape and of enormous dimensions, being some 24,000 miles long from E. to W. and some 7,000 miles broad from N. to S. It has been regularly observed since it was discovered by Pritchett of Glasgow Missions, U. S. A., in July 1878. In 1879 it attracted much attention and again it was brilliant in 1892. It seems to have periods of brightness and faintness, but whether there is any regularity in these periods or not, has not yet been determined. Last year, however, it was easily seen in small telescopes and in my 5" was a striking object.

*Its backward drift.*—This is an undoubted fact. To determine this we must compare it with some permanent spot or feature. There is fortunately a permanent bright band in the S. E. B. known as the S. Tropical Disturbance. This band does not entirely surround the planet and between the two ends, the G. S. is situated. Now it is a fairly easy matter to compare the position of the spot between these two ends.

I have 35 drawings in which this spot figures and from an examination of these it is easy to see the spot has drifted backwards through any considerable distance. Take the two drawings 19th June and 8th November. The p. end of the S. T. D. is in the same position in both cases. In the former drawing, however, the spot is only partly visible, while in the latter the outline is easily in the picture. But proof of the drift does not depend on two drawings, all the drawings from the same phenomenon.

*Its Repulsive force.*—Invariably I have noticed that immediately round the spot there is a sort of white border (difficult to sketch) and that the darkness of the belt shades off in the neighbourhood. As far back as 1879 Barnard called attention to this repulsive force in the E. M. He noticed that the belts on the N. and S. sides of the ellipse bulged out and there was a sea of light almost completely round the spot. My drawings confirm his observations.

*Its attractive force. The Black spot in the S. E. B.*

*Spot slides.*—This spot, black, long and rectangular in shape, possesses great interest. On the 1st August it was near the F. end of the S. T. D. Altogether I have 16 drawings of this particular spot, and these prove without doubt that it travelled backwards in the direction of the Red Spot in which it was finally absorbed. It preserved its length until it was almost in contact with the ellipse, then it gradually shortened, became fainter and fainter, until it entirely disappeared. On the 12th October the spot was close to the ellipse apparently touching it. On the 17th October it had disappeared. Later observations confirm this. From the 1st August up to 30th September when it was seen practically in contact with the ellipse, it had drifted backward some 17,000 miles, or at the rate of 300 miles a day. That it was attracted and not merely drifted, appears to be shown by the fact that when it reached the G. R. S., there it stuck, became fainter and fainter and at last disappeared. It appears therefore certain that the lesser black spot was entirely swallowed up by the greater.

*Notch (1).*—With reference to this notch seen on the S. edge of the S. E. B. on the 17th July, 11-30 P.M., and followed until 1-30 A.M. the same night, Mr. Raman and I have tried to identify it with the notch or swelling to be described presently, but we have failed. It was evidently a separate phenomenon. Unfortunately the weather was bad in late May and early June and further observations were impossible here. It would be interesting to know if any other member observed Jupiter at this time and under better conditions.

*Swelling and Gap.*—On the 23rd August I noticed a curious swelling in the same narrow band as the notch previously described. My observations may be summarised thus—

Date.	St. time.	Description.	Remarks.	Position with reference to C. Meridian.
23-8-13	11-35 P.M.	Swelling ...	Sno. observer ...	Half way between E. Edge and C. M.
26-8-13	8-40 P.M.	Swelling ...	Sharp ...	On C. Merid.
4-9-13	10-10 P.M.	Swelling ...	Definition good, not very easy to see. Dark shadow above.	Approaching C. M.
5-9-13	6-35 P.M.	More like faint gap	Good Def. ...	Near C. M.
9-9-13	10-0 P.M.	Gap Square Ends ...	Def. fair ...	On C. M.
12-9-13	6-35 P.M.	Gap only faint ...	.....	Approaching C. M.
24-9-13	6-40 P.M.	Gap faint ...	Rectangular Def. not good. ...	Do.

Date.	St. time.	Description.	Remarks.	Position with reference to C. Meridian.
26-9-13	8-30 P.M.	Gap rect. in shape	.....	Approaching C. M.
13-10-13	7-20 P.M.	Gap widening ...	Def. good ...	Do.
18-10-13	6-5 P.M.	Gap wider ...	Def. good ...	Do.
21-10-13	5-30 P.M.	Gap ...	Def. good ...	Approaching W. Edge.
23-10-13	5-30 P.M.	Gap widening slowly	Clear. Easy to see ...	Approaching C. M.
25-10-13	7-0 P.M.	Gap much wider ...	Fair def. ...	E. of C. M.
30-10-13	6-5 P.M.	Gap very wide— Double 23-8.	Def. very good ...	Approaching C. M.
4-11-13	5-45 P.M.	Gap quite double 23-8	Def. good ...	On C. Merid.

The gap is quite twice as wide as on 23rd August. It will be well to remember this when we deal with the question of the condition of Jupiter's surface.

*Notch (2)*—Position on S. edge of S. E. B. immediately preceding p. end of S. T. D.

Date.	St. time.	Definition.	Description.	Position as regards C. M.
23-8-13	9-50 P.M.	Good ...	Deep and narrow ...	Approaching C. M. (very near).
4-9-13	7-20 P.M.	Poor ...	Not well seen. Same position.	Approaching C. M.
6-9-13	9-45 P.M.	Fair ...	Sharp ...	Just passed C. M.
9-9-13	9-9 P.M.	Good ...	Sharp. Slightly longer	On C. M.
23-9-13	8-30 P.M.	Fair ...	Faint ...	Just passed C. M.
15-10-13	6-0 P.M.	Fair ...	Faint. Somewhat drawn out.	Approaching C. M.
20-10-13	6-5 P.M.	Good ...	Long drawn out hollow.	Near W. Edge.
22-10-13	7-0 P.M.	Good ...	Very long drawn out & shallow.	Approaching C. M.
27-10-13	5-30 P.M.	Poor ...	Very difficult to see. Only long shallow hollow.	Approaching C. M.
1-11-13	5-20 P.M.	Fair ...	Very long slight hollow.	
3-11-13	6-15 P.M.	Fair ...	Resembles 1st Nov.	
8-11-13	5-24 P.M.	Good ...	Very long hollow, practically original notch disappeared.	

*Belts and Bands.*—

As a rule the belts are fairly straight and parallel to each other, but several times I have noticed that the band above the Red Spot, or above the S. T. D. swells or bulges out. This fact has been referred to previously.

2-3-13 The E. S. caused the S. E. B. to bulge out.

25-8-13 The F. End of the S. T. D. caused the same belt to bulge.

3-9-13 The same occurs as on 25-8-13.

1-11-8 Resembles 3-8-13.

Again the fainter S. temperate band sometimes bulges.

8-11-13 Here this is very noticeable.

I have not given much attention to the Belts and Zones N. & S. of the S. E. and N. E. Belts as they are rather faint, but on good nights Belts and Zones can be seen N. and S. up to 75° latitude.

I have already referred to the fact that most of the isolated black and white spots are found in the N. E. Belt. I have nothing more to say with reference to this Belt.

*S. E. Belt.*—This is perhaps the most important Belt on the planet. It is dull red in colour and when seen side by side with the dazzlingly white Moon at a time of occultation it is strikingly ruddy. It is in this region that the great spot is situated and here also the S. T. D. occurs.

On the E. of the G. R. S. a bead like arrangement of small white spots has been seen, *e.g.*, 25-8, 26-8, 4-9, 9-9, 23-9, 13-10. But perfect nights are necessary. Mr. Raman has seen more details herewith his 7" merz. than I have with my refractor.

Further between the G. R. S. and the p. end of the S. T. D. I have invariably noticed a light band running up from the lower E. end of the R. S. to the S. T. D. This light area is a feature of almost every drawing where the R. S. comes in. A similar band though not so striking is seen between the F. end of the S. T. D. and the Red spot.

The S. T. D. is on the whole wonderfully stable being long and narrow with rounded meniscus-like ends resembling a thick column of Mercury. The band is, however, not quite stable. On the 20th October I noticed a notch in the N. side of the p. end and this notch persisted until October 30th when it disappeared. Occasionally also I have noticed that the N. edge is slightly jagged.

A rather striking feature of the S. E. Belt, but only the portion under the S. T. D. is that it is divided into two portions throughout its whole length by a light narrow band. This is a permanent division but not always easy to see.

*Widening of the S. E. Belt.*—

Up to 30th September the S. E. B. and the Eg. Zone were about equal in breadth, but after this a change set in; the S. E. B. gradually became wider until by the 20th October the upper half of the bright E. Zone was entirely absorbed into the S. E. B. The portion of the E. Zone thus taken in is not continuously black however, it is frequently seen to break up into long drawn out ellipses. These were a very striking feature of the planet in the latter part of October

and early November. These ellipses are very common but they vary with every revolution of the planet.

*Eq. Zone.*—This is a most active area for differential movements are going on here right the planet. The most striking feature is the fairly regular system of arches with their bases pointing N. This arrangement can be seen at any position of the planets in the course of its revolution. The pillars of the arches are generally vertical, but they are often tilted sometimes to the left and occasionally to the right. Sometimes two arches coalesce into one large arch though the middle base remains. At the lower part of each pillar is invariably a black rectangular spot or base. These arches were a most striking feature from July to November.

## A Note on Mira Ceti.

BY MISS M. C. FELINE.

It had long been my desire to see for myself Mira, the "wonderful," but not till this year have I been able to do so. Possibly this account of Mira (imperfect though it is) may be of some interest. The opportunity of watching it night after night was an exceptionally good one as our verandah faces West and gives an unbroken view to the horizon.

It was about the 1st or 2nd of February that I first discerned a very dim Star in the place where Mira should appear. Throughout the month I observed it slowly brightening till by the end of the month it was comparable in brightness to  $\gamma$  and  $\delta$  Ceti,—about the 4th magnitude.

From March 14th I kept a detailed account till the time when last visible on March 26th.

I had already watched it without intermission each night but hitherto had no thought it could possibly be of use till suggested to me by a friend.

From that time I noted each night's appearance (or non-appearance) thus :—

<i>March 14th. &amp; 15th</i>	... Obscured by clouds.
"  16th	... As bright as $\alpha$ Ceti. (3rd magnitude.)
"  17th	... Clouds again.