

End of Apparition Report: Jupiter in 2015-2016

Paul G. Abel

Start of observations: 2016 January 15th Finish: 2016 June 05th

Opposition date: 2016 March 08 Conjunction: 2016 September 26

Number of observations: 14 (19 disk drawings)

Instruments used:

- 203mm Newtonian reflector (Leicester UK)
- 508mm Planewave DK (University of Leicester Observatory, UK)
- 203mm OG (Stefanik Observatory, Prague)

$L_s = 164^\circ$ to 175°

Largest observed disk size: 44.4"

1 Introduction

This is a short report summarising observations made by the author of the planet Jupiter during the 2015-2016 apparition. Jupiter was once again reasonably well placed for UK observers residing in the constellation of Leo. Unfortunately the planet is heading south and will pass into the constellation of Virgo in early August of 2016 where the planet will spend the 2016-17 apparition.

Although reasonably well placed, poor weather meant that observations were not started until 2016 January 15th. Cloudy conditions continued to persist and as a result, only 14 observations were made of the planet. The planet and satellites presented a wide variety of phenomena for visual observers to see and record, and the author had a number of good views of the planet over the apparition.

Observations were made visually using the instruments listed at the top of this report. All observations made at the telescope were recorded in *Field Observations* (Vol V). Drawings made at the telescope were done in black and white using pencils, with notes regarding intensity and colour made after the sketches were completed. Colour drawings and a summary of observations were then produced indoors and can be found in the author's Jupiter log book (Vol 3). The notes made at the telescope were used to create the colour drawings and it was these observations which were sent to the BAA Jupiter Section, the ALPO Japan and other interested parties.

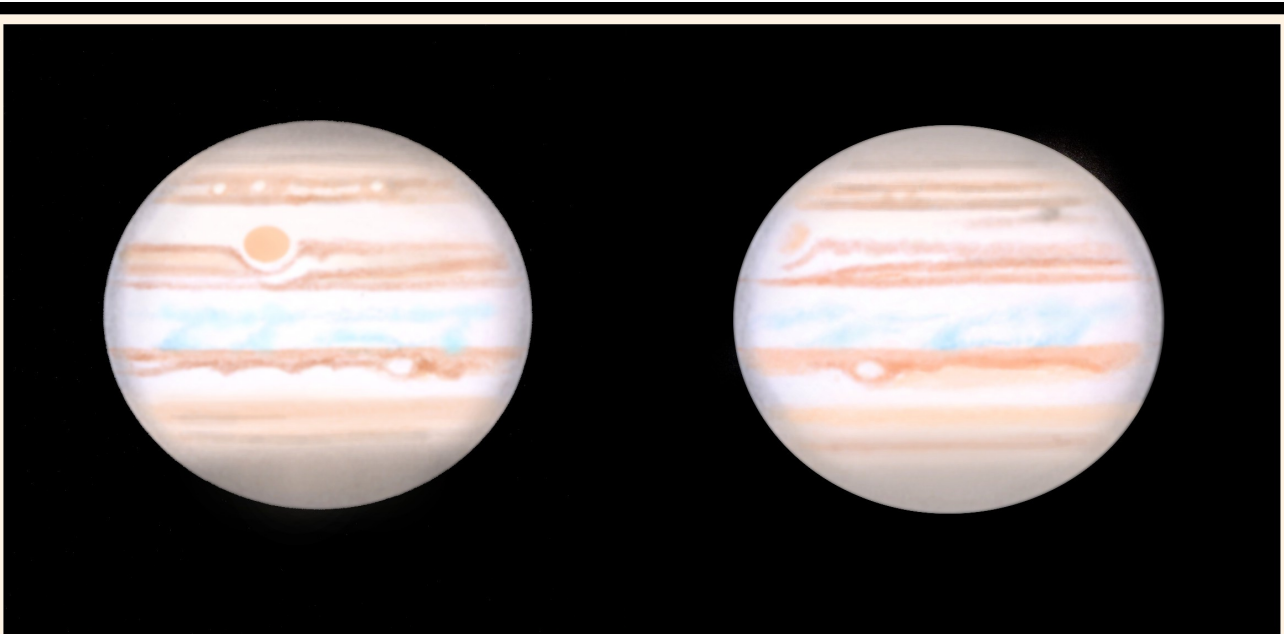
All observational data- for example CM longitudes, disk size etc were obtained from the WINJUPOS software. In all drawings, north is located at the bottom and south is at the top. A star diagonal was never employed thus in all observations the following side is located on the right hand side of the disk, the preceding meanwhile is found on the left hand side. We now proceed to summarise the features observed on the disk during the apparition.

2 Observations of the Disk

In this section we summarise the various features observed on the disk. We start in the far south and move northwards:

South Polar Regions [SPR]: A vague yellowish grey region. Sometimes in very good seeing the far south took on a slightly mottled appearance.

South South Temperate Belt [SSTB]: A fascinating feature, the SSTB was well defined over all longitudes of the planet. Visually it appeared to be quite broad and was usually brownish in colour. At some longitudes it appeared fairly uniform, while at others it showed considerable structure. The belt was resident to the white ovals AO-A8, and many of the larger ones were visible visually. The SSTB also appeared to contain a number of lighter sections, some of them quite long and yellowish grey in colour.



Disk Drawing 1: 2206UT, x200 Seeing: All-III
CM1: 309.6 CM2: 250.5 CM3: 266

Disk Drawing 2: 2322UT, x200 Seeing: All-IV
CM1: 355.9 CM2: 296.5 CM3: 311.9

2016 February 28th Start: 2148UT Finish: 2331UT, Seeing: All-IV, Transparency: Very good
203 mm NEWtonian Reflector, x200 & x250. Filter(s): None.

B= -1.9, Ds= -1.6, Disk Diameter= 44.3", Ls= 168

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Drawing 1: Jupiter on 2016 February 28th made by the author with his 203mm Newtonian Reflector. The drawing at 2206UT shows white spots in the SSTB along with a bright irregular region.

South Temperate Zone [STZ]: Generally the STZ appeared to be a bright white zone although when conditions were less favourable it did appear to take on a yellowish hue.

South Temperate Belt [STB]: Still absent from the disk, although at some longitudes there was a faint greyish streak where the STB would normally be. The strip map in drawing 5 illustrates how this appeared visually.

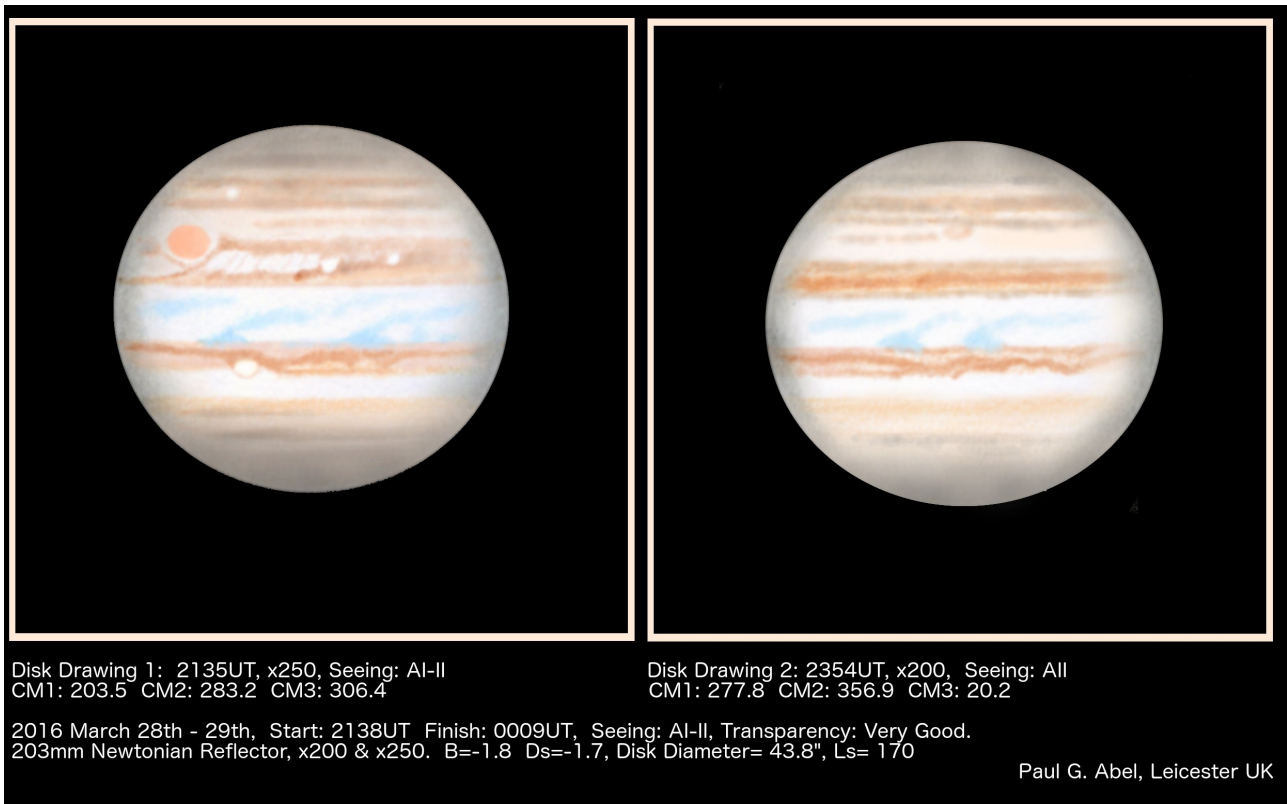
Oval BA: This is a small storm at a similar latitude to the STB. High resolution images show that oval BA has a reddish colouration to it, however this was entirely absent when viewed visually whereby BA took on the appearance of a light greyish patch (see drawings 1, 2 and 5). Drawing 2 shows oval BA very close to the CM.

South Tropical Zone [STropZ]: In general one of the brightest zones on the planet and usually a white colour.

Great Red Spot [GRS]: Once again the GRS was quite dark and a strong orange colour. A W#80A (light blue) filter helped to enhance it further. On nights of good seeing the GRS seemed to have both a darker boundary and core. The spot sometimes seemed to have some faint greyish material very close by to it in the STropZ (see drawing 3).

Using WINJUPOS one can estimate the size of the GRS. Uploading the drawing from 2016 May 05 (see drawing 3) into WINJUPOS and measuring the width of the GRS gives an estimated width of 15400km.

Red Spot Hollow [RSH]: A bright white region below the GRS separating the GRS from the SEB. The RSH was always visible and well defined.



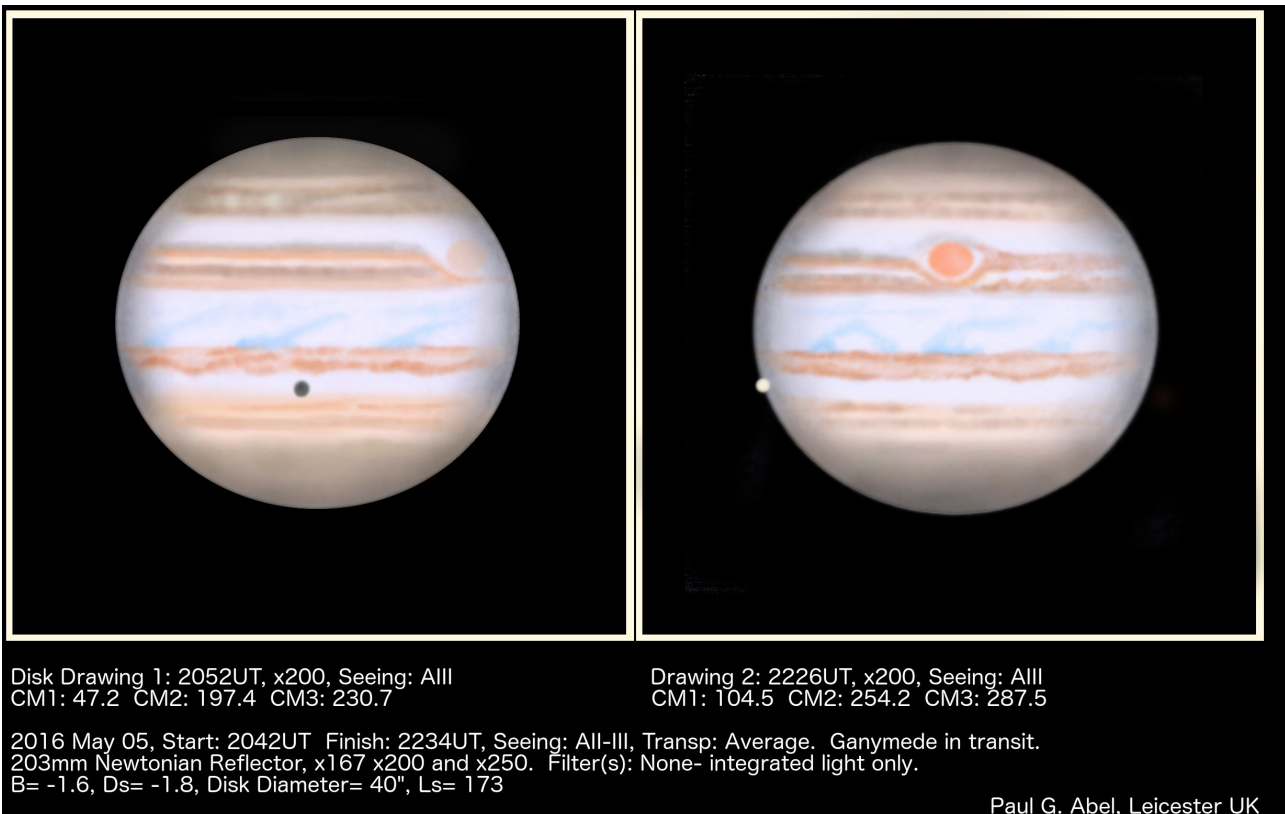
Drawing 2: Two drawings of Jupiter made on 2016 March 28th-29th using a 203mm Newtonian reflector. In the left hand drawing the GRS and WSZ are visible. On the right, oval BA is shown and there is considerable activity in the NEB.

South Equatorial Belt [SEB]: The broadest of the two main equatorial belts. Visually the SEB appeared to have a dark southern component (SEBs) and dark north component (SEBn)- both components being separated by a zone which contained both light and dark sections. Considerable structure could be seen in the belt on nights of good seeing.

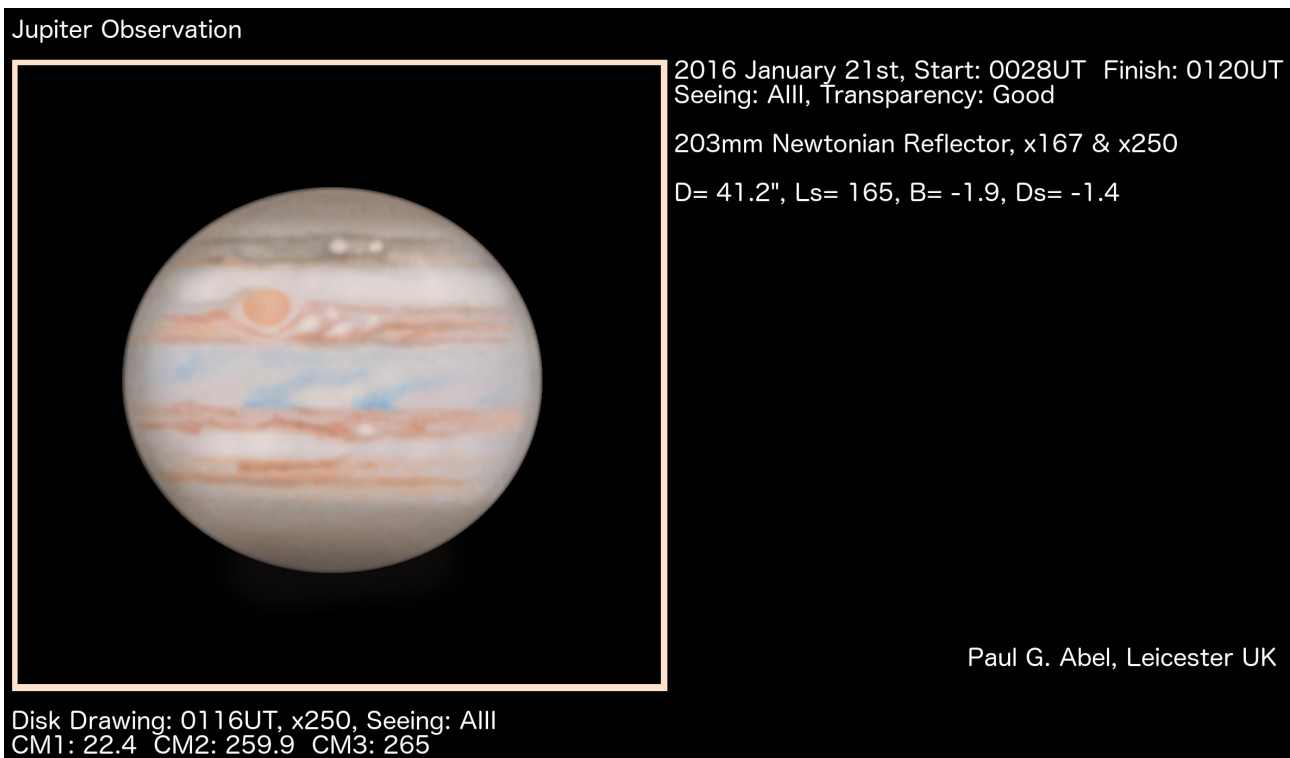
The most active part of the SEB was the environs near to where the GRS was situated. Along the prec. side of the GRS, the SEBs would move northwards and 'under' the GRS, before moving back southwards on the following side of the spot. The region following the GRS would show a great deal of turbulence (drawings 1 to 5). The turbulence following the GRS was normally quite pronounced and unmistakable in even moderate seeing. In good seeing definite delicate structures and subtle hues could be made out in the white irregular regions. Usually the turbulence would slowly become compressed at larger distances away from the GRS until it joined a the SEBz and the belt then resumed its normal appearance.

Equatorial Zone [EZ]: The bright equatorial zone was the brightest zone on the planet and usually appeared to be white in colour. A number of dark blue festoons were frequently observed in the region- usually they started from triangular shaped regions on/in the NEBs and then streaked into the zone. On occasions, the region enclosed by a festoon appeared notably brighter.

North Equatorial Belt [NEB]: A striking belt, just north of the Equatorial Zone. Over the course of the apparition, the belt manifested all manner of interesting and dynamic features. In general, the NEB seems to have broadened now and in some places, it was almost as broad as the SEB. Usually the northern boundary was dark and had a somewhat jagged-irregular look to it, while the southern edge usually appeared more uniform.



Drawing 3: The drawing made at 2226UT is used to estimate the width of the GRS in WINJUPOS.



Drawing 4: Drawing of Jupiter made on 2016 January 21st showing the author's first view of the white object in the NEBn designated WSZ.

It was not uncommon to see large bright sections within the NEB. On the night of 2016 January 21st the author observed a bright white oval designated WSZ (drawing 5). The feature became quite prominent over the course of the apparition- growing larger and brighter. However, it seemed to fade a little towards the end of the apparition (Drawings 1,2, 4, and 5). WSZ normally appeared white in colour and could usually be observed even in moderate seeing conditions.

On 2016 March 17 at 0008 UT Austrian observer Gerrit Kernbauer[1] reported a fireball detected on his video lasting about a second in the NEB- other observers had also recorded it. No visual impact mark was left behind however.

North Tropical Zone [NTropZ]: A bright zone, usually white in colour. Very little in the way of other features, except occasionally when, some features in the NEBn would extend down northwards into the NTropZ.

North Temperate Belt [NTB]: A rather vague belt, yellowish in colour. At some longitudes darker brown sections could be made out.

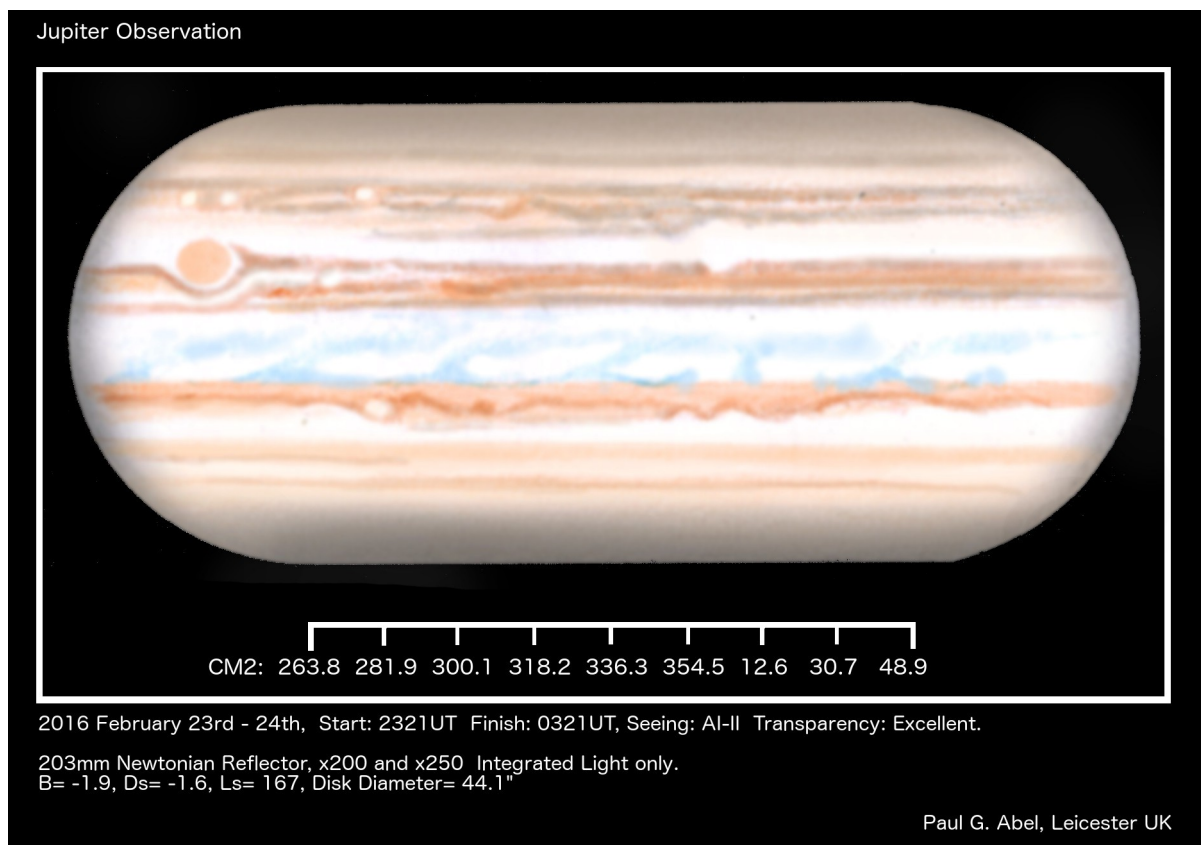
North Temperate Zone [NTZ]: A yellowish zone, separating the NTB and the NNTB.

North North Temperate Belt [NNTB]: On some occasions this belt appeared to be a little more conspicuous than the NTB. It too contained a number of interesting dark sections at certain longitudes.

North Polar Regions [NPR]: A vague greyish region which in moments of better seeing appeared somewhat mottled, suggesting the existence of fainter structures.

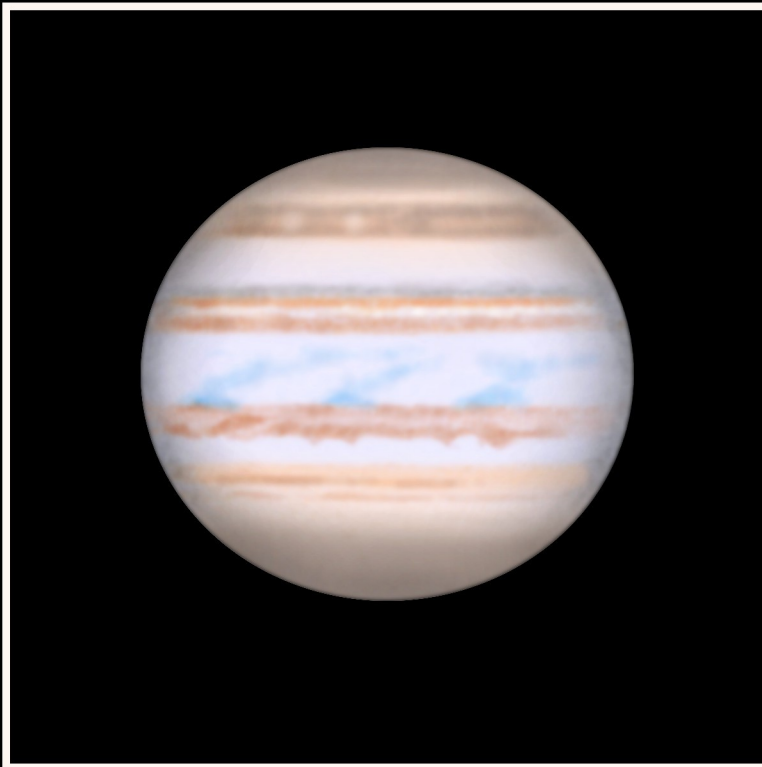
3 Half-Rotation Map

On the night of 2016 February 23-24, the author was able to obtain a half rotation map of Jupiter showing the many features mentioned here, and their place on the disk:



Drawing 5: Half-Rotation map of Jupiter made on 2016 February 23-24.

Jupiter Observation



Disk Drawing: 2056UT, x170, Seeing: All
CM1: 340.5 CM2: 168.7 CM3: 200.7

Observation of Jupiter at Štefánik Observatory, Prague, with Matthew Forman and Jaroslav Gabrovski.

2015 April 30th, Start: 2019UT Finish: 2100UT, Seeing: Initially AIV, then All, Transparency: Average
203mm OG, Double Zeiss Astrograph, X150 & x170. Integrated Light only.
B= -1.6, Ds= -1.8, Disk Diameter= 40.6", Ls= 172

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Drawing 6: Drawing mad by the author on 2016 April 30th at the Stefanik Observatory, Prague.

4 Visit to the Stefanik Observatory, Prague

On 2016 April 30th, the author was able to use the 203mm Zeiss Astrograph Refractor at the Stefanik Observatory in Prague with Dr Matthew Forman. We were assisted by Jaroslav Gabroski and the author was able to make a drawing of Jupiter in moderate seeing (Drawing 6).

A number of interesting details were present on the disk which included:

- Interesting brighter regions in the STZ
- SEB had two distinct components.
- A number of bluish festoons present in the EZ
- NEB rather active- its northern edge showed a number of irregular dark sections
- Dark sections apparent in both the NTB and the NNTB

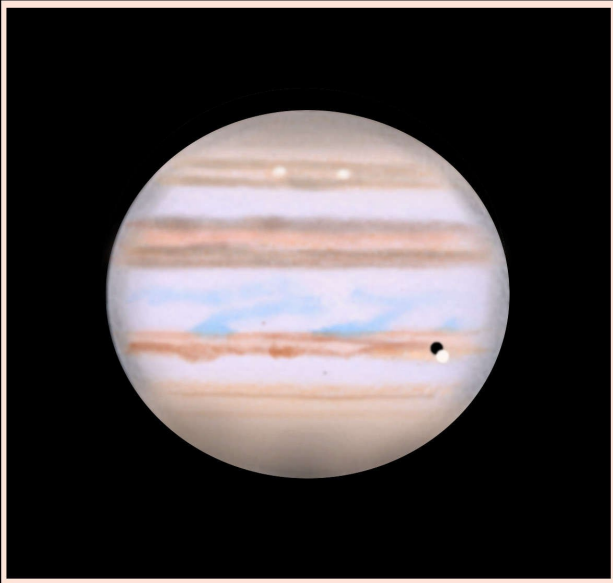
The observatory is an excellent public facility with solar (H-alpha and white light) observing during the day, and is open most evenings for night sky objects.

5 Observations of the Galilean Satellites

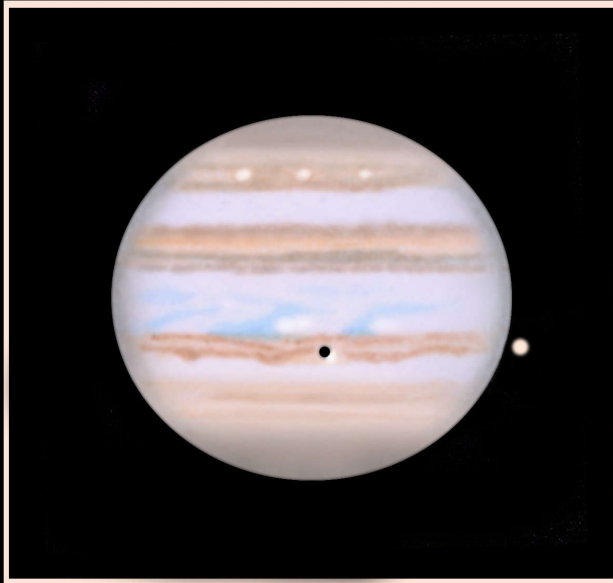
During the course of any Jupiter apparition, a number of interesting satellite events usually present themselves as the four main satellites of Jupiter shuttle back and forth across the disk and pass in and out of the planet's shadow. Perhaps the most interesting event occurred on 2016 March 07-08 when Jupiter was at opposition. During this time, both Io and Europa (along with their shadows) were due to transit the planet with the following timings:

- Europa Shadow: Transit Starts 2309 UT, 2016 March 7. Transit Ends 0157 UT 2016 March 8.
- Io Shadow: Transit Starts 0027 UT 2016 March 8. Transit Ends 0242 UT 2016 March 8.
- Multi Moon Shadow Event Length: 1h 30m


Jupiter Observation



Drawing 1: 2334UT, x200 & x250 Seeing: All
CM1: 187.5 CM2: 66.9 CM3: 84.6

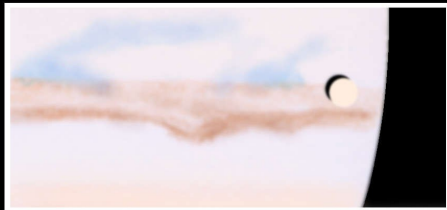


Drawing 2: 0022UT, x200 & x250 Seeing: All
CM1: 216.8 CM2: 96 CM3: 113.6



Europa and Shadow in Transit, 0034UT, x250 & x312

Europa and its shadow seen against the NEB. The darker, brownish NEB meant that Europa appeared as a white disk.



Io and Shadow on the Fol. Limb, 0035UT, x250

Io and its shadow just past the fol limb. The shadow of Io almost seems like a dark 'halo' to the left of Io.

2016 March 07-08, Start: 2317UT Finish: 0045UT, Seeing: All-III, then later III-IV. Transp: Very good
203mm Newtonian Reflector, x200 x250 and x312. Integrated light only.
B=-1.9, D_s= -1.6, Disk Size = 44.4", L_s= 168

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Drawing 7: Io and Europa (along with their respective satellites) in transit on opposition night.

Jupiter was at opposition on 2016 March 08 at 1046 UT, and so the satellites and their respective shadows would appear to to closely coincide. For once, clear skies prevailed in Leicester and the author was able to observe the event (Drawing 7).

6 Conclusions

Overall, the 2015-2016 apparition was a good one. Although cloudy skies and wet weather reduced the overall number of observations there were still a reasonable number of clear nights with stable seeing which allowed the author to monitor the many interesting features of the planet. Points of particular interest include:

- Continued observation of the White Ovals in the SSTB/STZ which seem to vary somewhat in size and brightness- a number of them were easier to observe during this apparition.
- Continued observation of the STB and its behaviour.
- The GRS continued to be a prominent feature- still notably smaller than in previous apparitions with a strong deep orange colour. Using WINJUPOS, the author estimated the size of the GRS to be 15400km in width.
- SEB still very dynamic- it has been some time since an SEB fading and revival however one is not expected in 2016-2017.
- Festoon activity in EZ continues although the EZ is still 'quieter' compared to a number of Previous apparitions.
- NEB continues to be active- the white spot WSZ seemed to become large and bright but towards the end of the apparition it had faded somewhat. The belt is rather broad now and it seems that a broadening process is underway.

It will be interesting to see what new developments occur during the next apparition. On 2015 March 31st, BAA Jupiter Section Director, Dr John Rogers made a three year weather prediction for the planet[2]. In particular Rogers predicted:

- A new NTBs jet stream breakout is likely to occur sometime between 2016-2017; most likely in the first half of 2017.
- A NEB broadening is probably in process- we are likely to see an increased number of dark barges and white ovals appearing.
- The current level of activity in the SEB is likely to remain the same- an SEB fading and revival is not likely.

Jupiter is continuing to head south and will spend all of the next apparition in the constellation of Virgo. As it starts to pass below the celestial equator we can expect the seeing conditions to become poorer, with much less favourable conditions over the next few years. However, even at low altitude there can be times of surprising calm and so the visual observer should continue to watch the planet and its dynamic weather systems.

References:

[1] "Report No 7: Fireball on Jupiter." Rogers J., 2016 March 29, 2310UT, BAA Jupiter Section Website: <https://www.britastro.org/node/7281>

[2] "Prospects for Jupiter 2015-2017." Rogers J., 2015 March, BAA Jupiter Section website: http://www.britastro.org/jupiter/2014_15/rep05/Jup-Prospectus_2015-2017_v2.pdf