

# **End of Apparition Report: Jupiter 2014-2015**

**Paul G. Abel**

Start of Observations: 2014 October 05<sup>th</sup>      until: 2015 May 28<sup>th</sup>

Number of Observations: 14 (these include 15 drawings, 1 half-rotation map)

Opposition: 2015 February 6<sup>th</sup>

Instruments Used:

- 203mm Newtonian Reflector, Leicester UK
- 150mm OG, Hampstead Observatory UK

## **Abstract**

This end of apparition report summarises observations made by the author of Jupiter during 2014-15. In Section 1, we discuss preliminaries regarding the apparition. In Section 2, we summarise observations of all features from south to north. Section 3 gives a half-planet rotation map made in January 2015, while Section 4 gives an account of an observation made at Hampstead Observatory. Section 5 contains details of the mutual phenomena observed while in Section 6 the author's concluding remarks are give.

## **1. Introduction**

Presented here is a short report summarising observations made by the author of the planet Jupiter during the 2014-2015 apparition. Jupiter was well placed for northern hemisphere observers as the planet moved slowly from Cancer and into Leo, with opposition taking place on 2015 February 6<sup>th</sup> on the border of Cancer and Leo. Although the planet was well placed, weather conditions for this observer were rather poor for much of the end of 2014. This state of affairs continued well into the new year, and as a result only 19 observations were made of the planet.

Although a smaller number of observations were made, the planet demonstrated a variety of interesting phenomena for visual observers. In particular, this apparition was one whereby the Galilean satellites underwent 'mutual phenomena'- eclipsing and occulting each other as well as transiting the disk of Jupiter. There were a number of these splendid events, unfortunately due to the aforementioned weather conditions, this observer only managed to secure three such events.

All observations reported here were made visually. Black and white drawings were made at the eyepiece along with comments about brightness and colours (although no formal charts of colours and intensity estimates were made during this apparition). The raw data from the observations are recorded in the log book 'Field Observations Vol IV) and were subsequently used to generate the colour drawings made later. The colour drawings and observational notes were then recorded in the log book 'Jupiter Observations, Vol III.' All CM longitudes were obtained from WINJUPOS and all three systems are recorded.

We will now go on to examine some of the interesting features observed on the disk during the 2014-2015 apparition.

## **2 . Observations of the Disk**

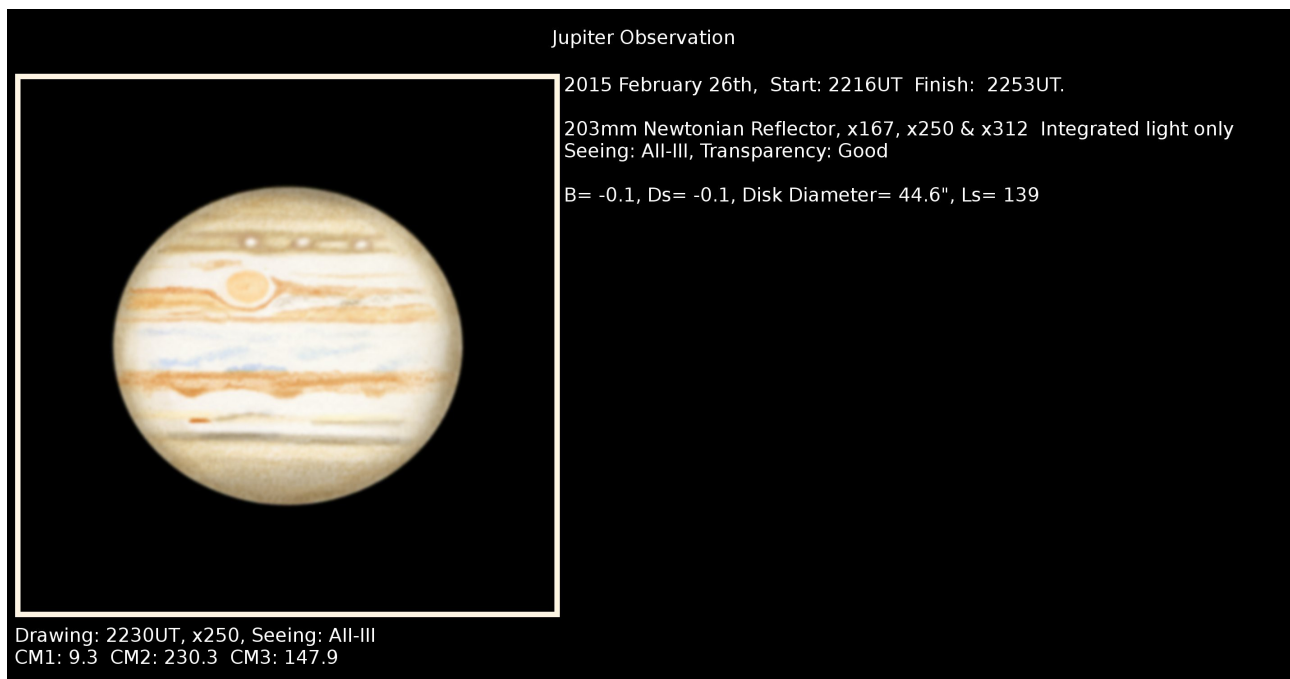
We summarise observations of various regions and features on the disk, starting in the far south and

working northwards. All drawings included here have the traditional visual observer convention with north at the bottom. Following is always to the left of the drawing and preceding is to the right.

**Southern Polar Region [SPR]:** A light greyish yellow-region at the extreme southern pole of the planet. Sometimes a vague SSSTB could be glimpsed in good conditions

**South South Temperate Belt [SSTB]:** Only visible in good to moderate conditions and did not seem to be present at all sections of longitude. At times it was a well defined greyish-brown belt, at other times it could be rather irregular and appearing only in certain sections.

**South Temperate Zone [STZ]:** A light greyish zone lying between the SSTB and STB. The zone is resident to a number of white ovals, some of which were visible under good conditions. In particular, the white ovals near the GRS were well seen on 2015 February 26<sup>th</sup> (see figure 1.)



*Figure 1: Drawing of Jupiter showing a number of white ovals in the STB. The drawing was made on 2015 February 26th at 2230UT with a 203mm Newtonian reflector in good conditions.*

**South Temperate Belt [STB]:** An interesting belt, normally always present but by no means uniform. At some sections of longitude, the belt appeared as a thin brownish-grey line, at other times it appeared to have somewhat thicker and irregular darker sections extending into the STZ.

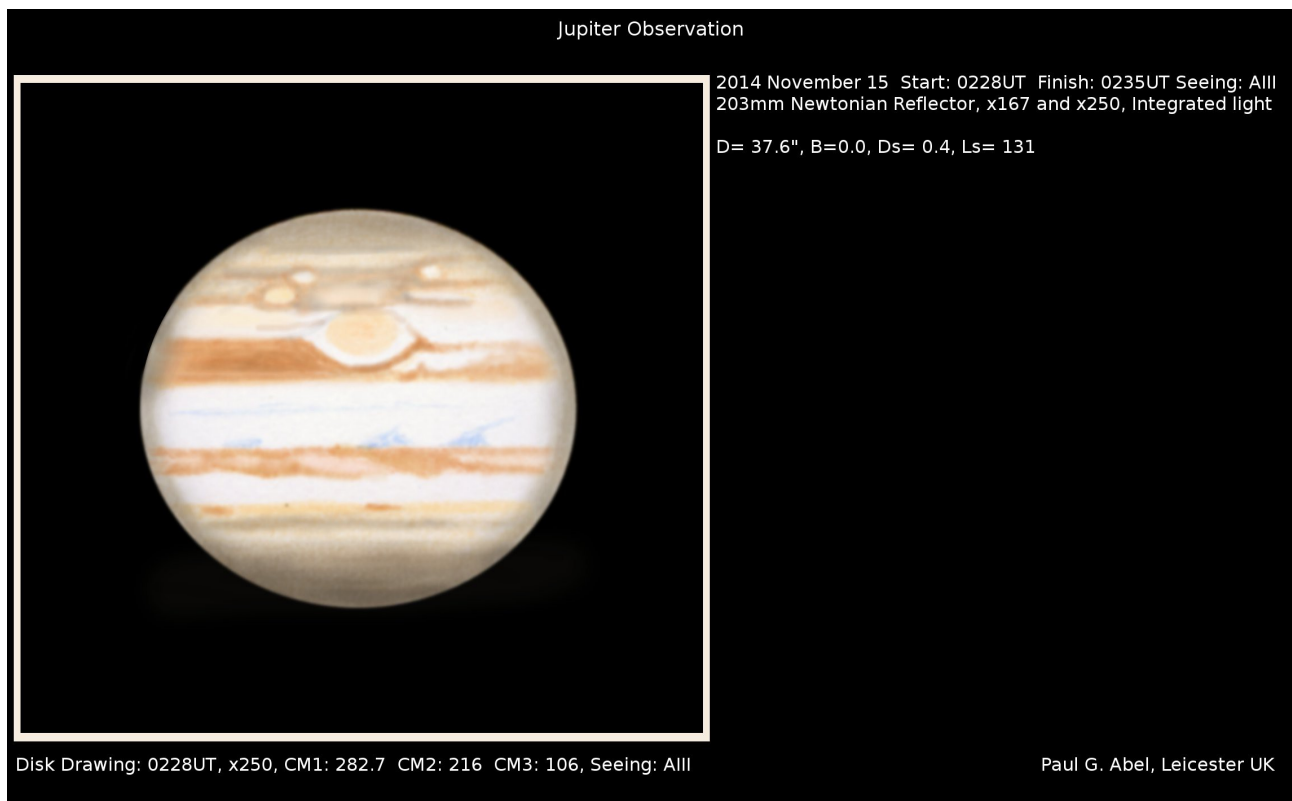
**South Tropical Zone [STropZ]:** A bright zone (similar in brightness to the EZ only marginally fainter) and usually white in colour. The STropZ was home to a number of interesting objects, in particular the Great Red Spot (see below), Oval BA and a number of short length belts. The Half-rotation Map of Section 3 shows the location of these short belts in relation to the GRS and other features as observed on the night of 2015 January 16-17.

**The Great Red Spot [GRS]:** During the apparition the spot continued to remain small but well defined and appeared strongly coloured- normally a medium orange colour but subtle hints of rose seemed to be present in moments of very good seeing. In general the spot appeared to have a darker perimeter and a darker orange core. On a number of occasions the GRS seemed to be interacting with darker material originating in the SEB(s) and passing just south of the GRS (see figure 2)

**Oval BA:** Observed on three occasions. Early in the apparition, Oval BA was present and contained some slight

orange colouration, this was observed 2014 November 15<sup>th</sup> and again on the night of 2015 January 16-17. However it was observed next on 2015 April 05 and the spot was practically impossible to make out- only the dark material which surrounds and (seemed to be connected to the STB) was evident. Indeed if it was not for this darker material, it would have been impossible to see Oval BA.

**Southern Equatorial Belt [SEB(S)]:** The SEB was one of the main principle belts on the planet. It is large, dynamic and visible even in small telescopes at moderate powers. Visually, the belt seems to be split into three sections: a north and southern component separated by a brighter zone. Interestingly, for some distance before the GRS, the SEB(s) was a well defined belt, brownish in colour, however immediately following the GRS it was rather poorly defined and greyish in colour, with a number of darker greyish sections. After some distance in longitude it then became brownish in colour and continuous in appearance once more.



*Figure 2: Drawing showing the GRS on the CM made on 2014 November 15 at 0228UT with a 203mm Newtonian Reflector.*

The SEB(s) passed down and under the GRS, but after it emerged on the following side, it was far more ill defined and somewhat disrupted. The RSH was always very apparent between the SEB(S) and the GRS.

**South Equatorial Belt Zone [SEBz]:** A lighter region, orange in colour but contained a number of darker orange sections in places. The region just following the GRS was clearly a very turbulent region, and a number of delicate white structures could be seen here although rendering them accurately was very difficult, and one often had to be content to show their appearance without a great deal of internal structure. The SEBz would normally continue as a darker orange streak extending diagonally up away from the GRS until it returned to its normal appearance some distance following the GRS (see figure 3).

**South Equatorial Belt North [SEB(N)]:** A thin greyish belt normally present for all longitudes. In the region immediately following the GRS, it could appear somewhat irregular.

**Equatorial Zone [EZ]:** A bright white zone at the centre of the disk. A number of bluish festoons were present

here, normally starting from the southern edge of the NEB and extending out into the EZ. In previous years, festoons have been rather striking at times and displayed a remarkable amount of structure (especially when examined a red W25 filter). During this apparition however, the festoons were smaller in number and appeared to be much fainter and less well defined than in previous apparitions.



*Figure 3: Drawing showing the turbulent SEBz following the GRS. Observation made on 2015 April 06 at 2114UT with a 203mm Newtonian Reflector.*

**North Equatorial Belt [NEB]:** Another large dark belt, easily visible. The belt was normally a reddish-brown in colour and displayed considerable activity and fine structures within its boundaries. These normally took the form of large bright sections (rifts), along with small darker spots or brighter irregular sections. Some of the rifts were quite long (see figure 4).

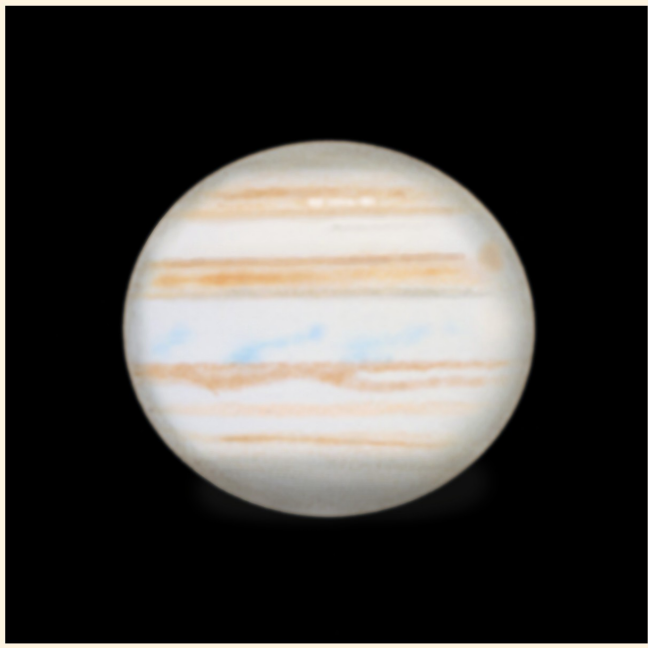
The northern edge of the NEB was rather irregular and it was not uncommon to see a short curved boundary rather than a uniform straight line as can be seen in figures 1 to 4.

**North Tropical Zone [NTropZ]:** A bright zone, normally white in colour. Occasionally some faint material from the NEB could be seen extending into this region.

**North Temperate Belt [NTB]:** A somewhat vague band located north of the NTropZ. In previous years the belt has been easy to see, and it could be quite dark in sections. However during this apparition, the NTB continued with its previous apparition appearance in the form of a golden band. At some sections of longitude, thin short dark sections could be seen which were usually brown in colour.

**North Temperate Zone [NTZ]:** A brighter, yellowish coloured zone just north of the NTB. The zone was not uniform at all longitudes however, and on some occasions darker material was observed within it. On 2014 December 29-30, the NTB had a somewhat fragmentary appearance, with a dark section appearing in the NTZ (see figure 5). The half rotation map of section 3 also shows regions which contain darker material

Jupiter Observation



2015 May 28th Start: 2053UT Finish: 2115UT  
Seeing: AIII-IV, Transp: Average

203mm Newtonian Reflector, x250 Filter: W12

B= -0.1, Ds= -0.5, Disk Size= 34.7", Ls= 146

Disk Drawing: 2108UT, x250, Seeing: AIII-IV  
CM1: 280.5 CM2: 167.6 CM3: 109.5

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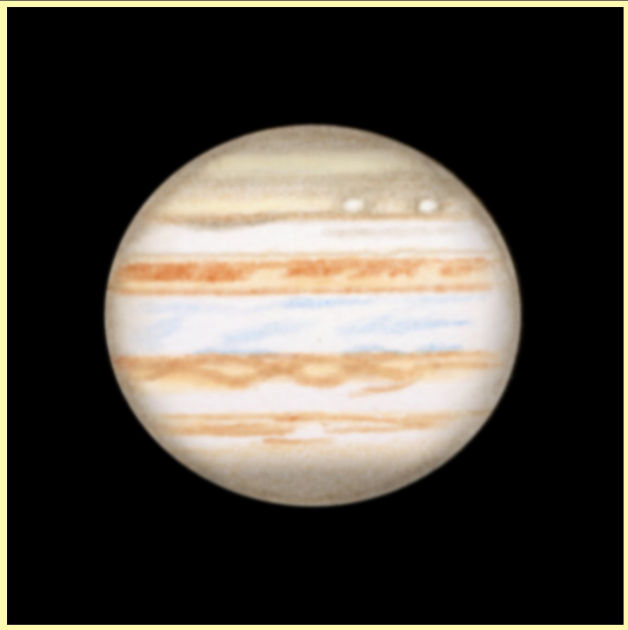
*Figure 4: A large bright rift present in the NEB. Drawing made on 2015 May 28 at 2108UT with a 203mm Newtonian reflector.*

**North North Temperate Belt [NNTB]:** Normally present as a thin belt, usually greyish-brown in colour. The belt was not uniform across the whole disk, at times it could be seen when a thin line of brown material which marked out its location. At other sections of longitude the belt was rather broad and greyish in colour.

An interesting observation was made on the night of 2015 April 13<sup>th</sup> when a dark NNTB seemed to extend material northward into the NTZ, making the zone seem somewhat dark and ill defined (see figure 6). On 2015 April 21<sup>st</sup> the region north of the NTB was also rather obscure and ill defined, however when the last observation of the season was made on 2015 May 28<sup>th</sup>, the whole region appeared normal with the bright NTZ restored to its normal appearance.

**North Polar Regions [NPR]:** A darker greyish region covering the north pole of the planet. Sometimes a NNNTB could be made out in good conditions. The NPR seemed a little more extensive and slightly darker than its southern counterpart.

Jupiter Observation



2014 December 29-30, Start: 2350UT Finish: 0005UT  
203mm Newtonian Reflector, x167 and x250.

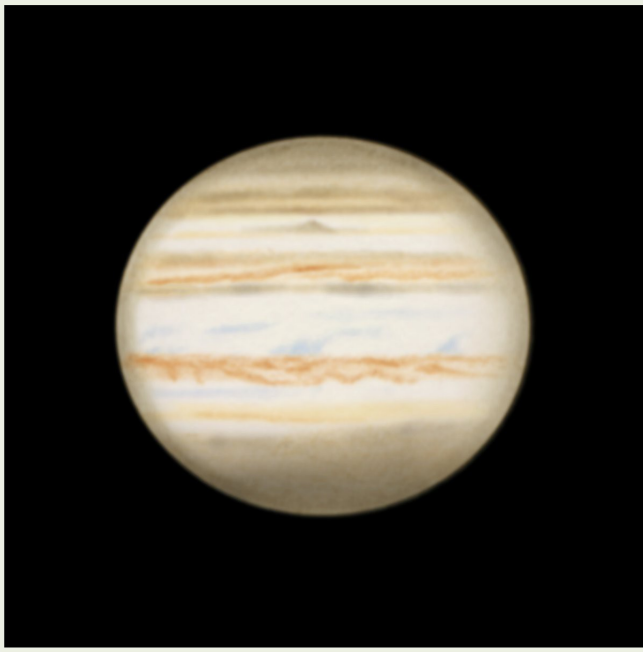
B= -0.2, Ds= 0.2, Ls= 135, Ds= 43"

Disk Drawing: 0002UT, x250, Seeing: All-III  
CM1: 102 CM2: 52.7 CM3: 314.6

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Figure 5: A fragmented NTB with material extending into the NTZ. Drawing made on 2014 December 29-30 at 0002UT with a 203mm Newtonian reflector.

Jupiter Observation



2015 April 13th, Start: 2225UT Finish: 2300UT  
Seeing: All-III, Transparency: Hazy.

203mm Newtonian reflector, x250 Filter(s): None

B= 0, Ds= -0.3, Disk Diameter= 39.6", Ls= 143

Disk Drawing: 2240UT, x250, Seeing: All-III  
CM1: 78.2 CM2: 308.2 CM3: 238

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Figure 6: Drawing showing darker material from the NNTB extending into the NTZ. The drawing was made on 2015 April 13 at 2240UT with a 203mm Newtonian reflector.

### 3. Half Rotation Map

Half rotation map of Jupiter made on 2015 January 16-15 from 2126UT to 0316UT with 203mm Newtonian Reflector.

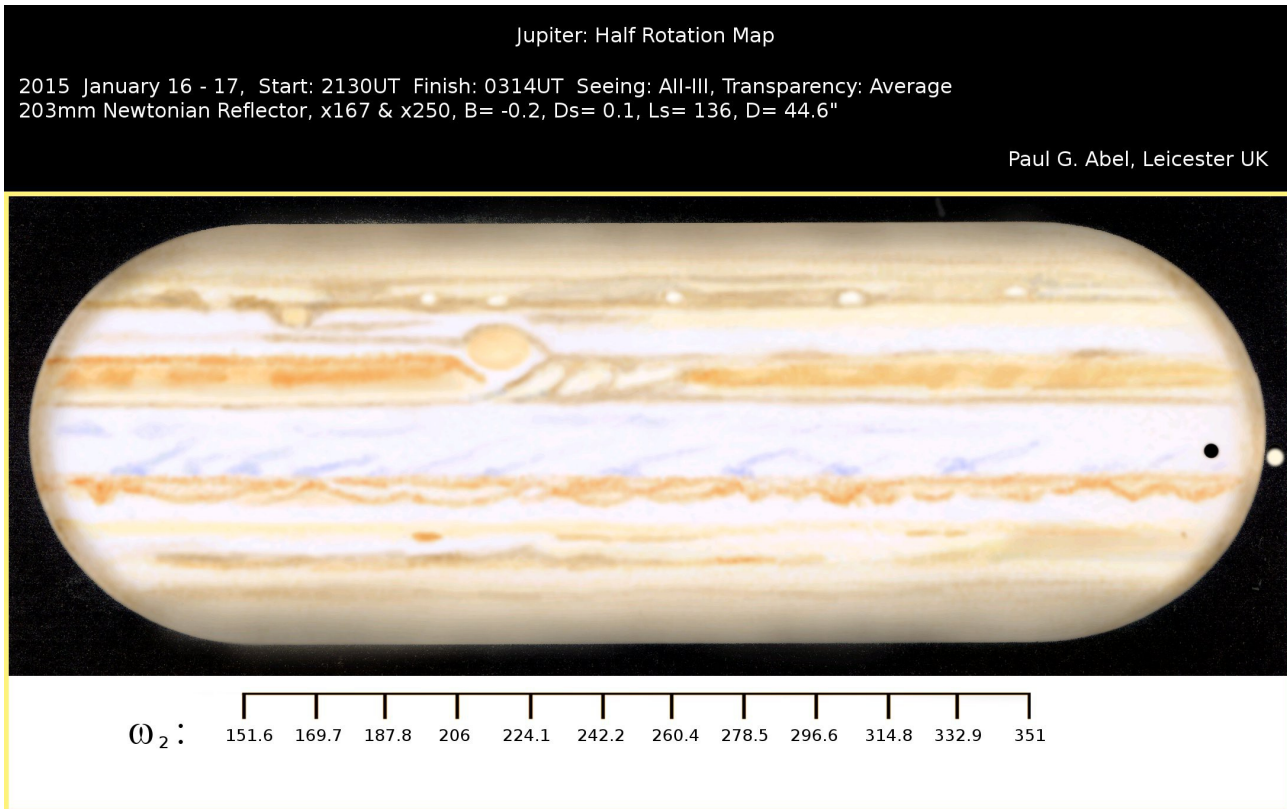


Figure 7: Half rotation map of Jupiter

Seeing conditions were consistently good, around AII-III with good image definition. The map shows a number of interesting features at various sections of longitude:

$\omega_2$ : 150°-206°

- Oval BA present with a faint orange hue present. The darker material surrounding it makes the spot much easier to discern.
- A number of white ovals are present to the south of the STB
- Dark band present in the STropZ
- Both the SEB and Neb seem quite active at these longitudes
- Northern edge of the NEB rather irregular at all observed longitudes
- NTB golden in colour with a dark barge present at 186°.

$\omega_2$ : 206°-280°

- GRS dominates this part of the planet at these longitudes. There appears to be an interesting grey boundary which seems to enclose the southern part of the GRS. Three reasonably well defined white spots in the SEBz following the GRS.

$\omega_2$ : 208°-351°

- More white ovals present here in the STB and the SEB starts to return to its usual appearance. The NEN continues to display many subtle structures including bright rifts and darker sections. Region between the NTB and NNTB not very well defined from 296° onwards. NTZ very ill defined too at this section of longitude.

#### 4. Observation Made at the Hampstead Observatory

On 2014 April 14<sup>th</sup>, this observer along with Mr. Jon Culshaw joined Mr. Kevin McNulty at the Hampstead Observatory. The observatory houses a splendid 150mm OG Cooke refractor on a large equatorial mount, and observations made by members of the Hampstead Scientific Society with this fine telescope can be found in many of the BAA section archives. In particular Mr. Doug Daniels has made many fine planetary drawings using this instrument over many decades.

McNulty kindly arranged for us to use the telescope, and as it transpired the weather was (for once) actually in our favour: the skies were very transparent and we had excellent image definition with both Venus, and then later Jupiter producing very steady images in the eyepiece. The seeing was consistently around AII (and higher) for much of the time. As a result we were afforded some excellent views of Jupiter and this observer was able to make two drawings (figure 8)

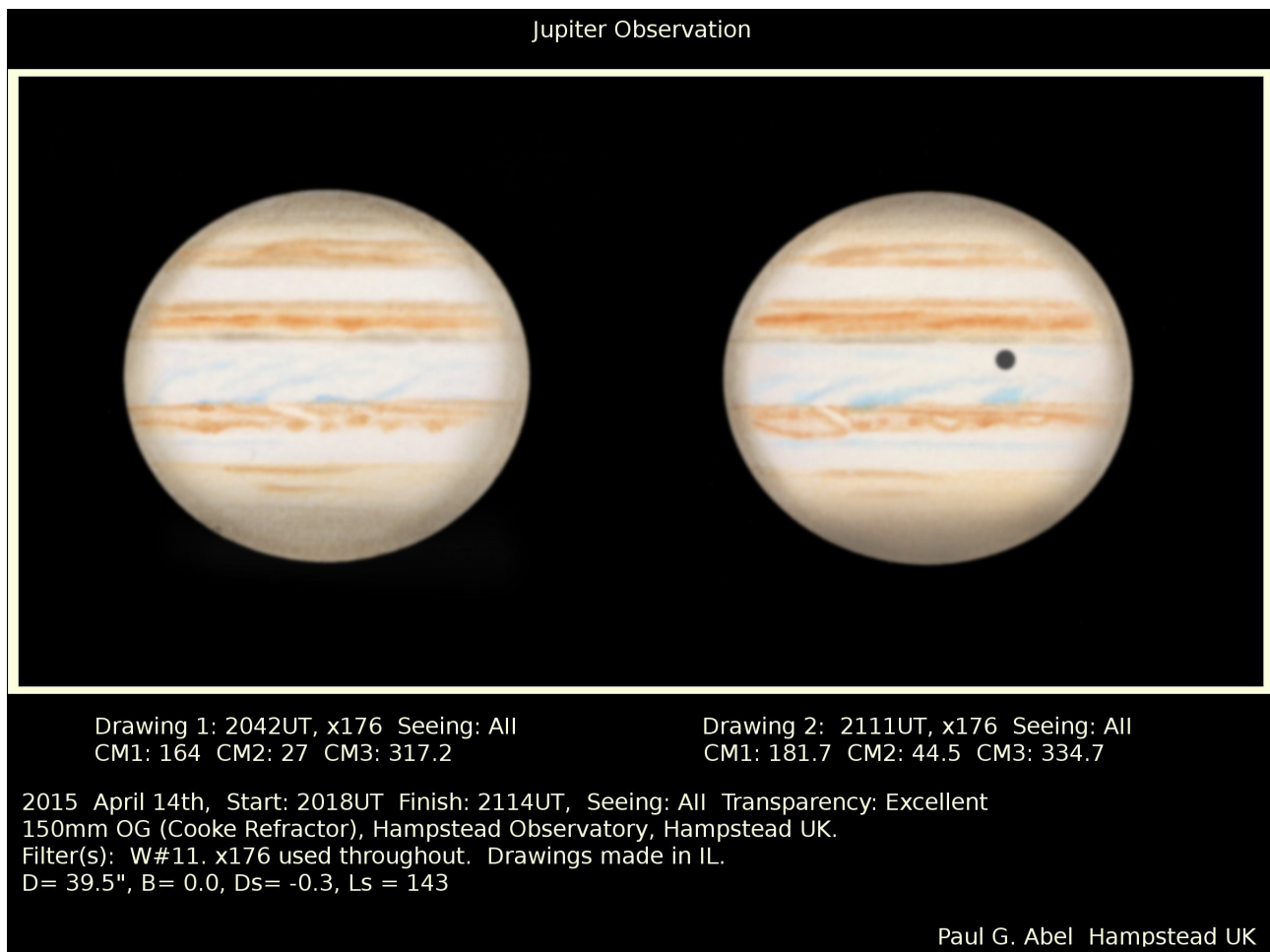


Figure 8: Two drawings of Jupiter made by the author on the evening of 2015 April 14th at 2042UT and 2111UT with the 150mm OG Cooke refractor at the Hampstead Observatory.

A number of interesting features were seen on the disk:

- STB appeared to be rather broad, brownish in colour with some finer details present
- SEB was rather broad, the SEBz was orange in colour and seemed to contain a number of darker sections.
- Fine view of the EZ, a number of subtle festoons present which were a pale light blue in colour.
- NEB rather active- the belt contained a number of brighter rifts, irregular sections and dark spots. In the moments of excellent seeing, the amount of fine detail and pastel hues in the NEB were truly remarkable.
- Bluish material visible in the NTropZ?



- NTB and NNTB very hard to discern- indeed everything at these longitudes from the NTB down to the NPR had a rather homogeneous view.

#### **A Note on the Transit of Ganymede**

At around 2100UT, McNulty noticed what he described as a shadow present in the EZ. This had not been there previously. The author looked at object in question and it did indeed appear to be a very dark (but not completely black) small circle, strongly resembling a satellite shadow cast onto the Jovian cloud tops. The drawing on the right hand side in figure 8 shows what was observed.

The next day, the author used WINJUPOS to identify the shadow and was surprised to learn that it was in fact the satellite Ganymede which was in transit and not a shadow. The author has observed a number of Ganymede transits in the past, but this is the darkest the satellite has ever appeared in transit. This must have been a contrast effect: due to the fact that Jupiter was 'edgewise' onto earth, Ganymede made a transit through the EZ- the brightest region on Jupiter. Previous transits observed have occurred at higher latitudes where the zones are much less bright than the EZ. It was a most interesting effect!

## 5. Mutual Phenomena

Every six years, the equatorial planes of Jupiter and the Earth are aligned, and Jupiter appears to be 'edgewise' on from our point of view. When this happens, the four bright Galilean satellites and their shadows can occult one another and this is known as 'mutual phenomena'. This apparition had a number of excellent mutual events, but poor weather meant that this observer was only able to observe three of them. They are given below:

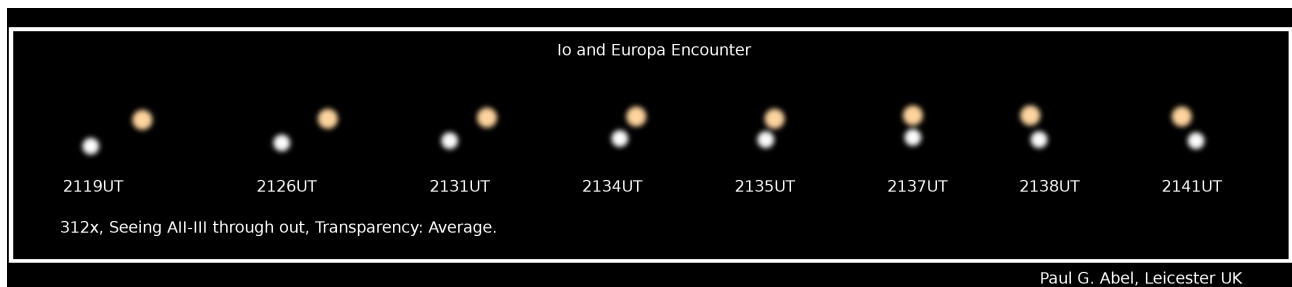
### **(I) 2015 February 26<sup>th</sup> 2219UT to 2223UT, Europa Passes Behind Io:**



*Figure 9: Io partially occults Europa. Observation made on 2015 February 26th with 203mm Newtonian reflector*

During this sequence, Io partially occults the satellite Europa. Seeing was good, around AII-III and Io appeared somewhat yellowish in colour, Europa was white. Powers of x250 and x312 were used, no surface details were apparent on either satellite.

### **(II) 2015 April 06 2119UT to 2141UT: Close Encounter Between Io and Europa**



*Figure 10: Io and Europa encounter on 2015 April 06 between 2119UT and 2141UT, made with a 203mm Newtonian reflector x312.*

The encounter was made in average seeing, with a power of x312. Although the two satellites appeared to get quite close to each other, no eclipse took place and both remained two distinct objects throughout the encounter.

### **(III) 2015 April 21 2136UT to 2149UT: Io and Ganymede Encounter**

This encounter was observed in average conditions and at a power of x250. At 2131UT, Io started to emerge from Jupiter's shadow, and by 2133UT it was increasing in brightness until at 2134UT it was at its normal brightness.

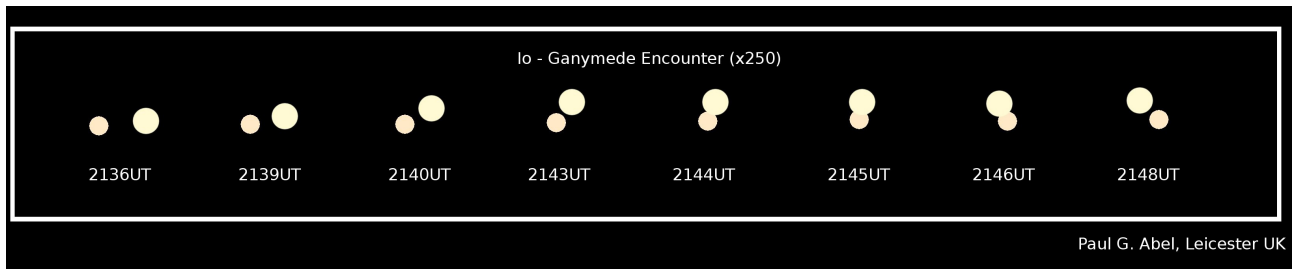


Figure 11: Encounter between Io and Ganymede on 2015 April 21st between 2136UT and 2149UT, made with a 203mm Newtonian reflector, x250

## 6. Conclusions

The 2014-2015 apparition was an interesting one, and it is a pity more observations could not have been secured. The planet continues to show many interesting phenomena:

- SSTB and STB not uniform and vary at different section of longitudes, sometimes they appear as thin uniform bands, at other times they are somewhat fragmentary
- White ovals can still be observed in the STZ
- GRS continues to be a prominent feature in the STropZ
- SEB rather active in places, particularly in the region where it encounters the GRS
- EZ bright and showed a smaller number of festoons. The festoons themselves were fainter and harder to discern than in previous apparitions
- NEB rather active, not as broad as the SEB but containing far more well defined structures in the form of bright rifts, lighter irregular sections and darker spots.
- NTB rather vague and ill defined in many places.
- NNTB could be much easier to observe than the NTB, in places it appeared as a dark uniform belt but did disappear at other sections of longitude.

Observations made at the Hampstead Observatory were done in excellent conditions, and the Cooke refractor housed there provided some excellent views of Jupiter with great seeing.

Of the many mutual phenomena which occurred this apparition, this observer was only able to see three of them due to the poor weather conditions in the UK

BAA Section director Dr. John Rogers has issued a long term weather forecast for Jupiter, this is now available on the Jupiter Section website. It will be interesting to see whether Jupiter will oblige or do its own thing entirely during the 2015-2016 apparition!