End of Apparition Report: Jupiter 2012-13

Dr. Paul G. Abel

Department of Physics & Astronomy University of Leicester, Leicester UK. LE1 7RH. Email: paul.abel@yahoo.co.uk

June 10, 2013

Abstract

Presented here is a short *end of apparition report* covering observations made by the author of the planet Jupiter during the 2012-13 apparition. In §1 we have the introduction which contains some preliminary information about the apparition and techniques used. In §2 we examine the specific features of the planet starting in the far south and working north. In §3 the full planetary strip maps made during the apparition are presented while in §4, we examine an observation made of Ganymede. In §5 the intensity estimates made in IL, W25A and W80A are presented. Finally in §6, we have some concluding remarks.

Contents

1	Introduction	2
	1.1 Preliminaries	2
	1.2 General Overview	2
	1.3 Method for Recording Observations	3
	1.4 Special Events	4
2	The Planet	4
	2.1 Southern Hemisphere	4
	2.2 Oval BA and the Great Red Spot	6
	2.3 The Northern Hemisphere	7
3	Planet Strip Maps	10
	3.1 Less than Half Rotation	11
	3.2 Half-Planet Map	11
4	Satellites	13
5	Intensity Estimates	14
	5.1 Integrated Light	14
	5.2 Red Light: W25A	16
	5.3 Blue Light: W80A	18
6	Conclusions	20

1 Introduction

This is an end of apparition report which summarizes the observations made by the author of the planet Jupiter during the 2012-13 apparition. In this section, we first give some preliminary data, then we give a brief account of the apparition and how observations were made.

1.1 Preliminaries

The preliminary data is for the apparition is as follows:

Start of Observations: 2012 July 21	End of Observations: 2013 May 02
Opposition: 2012 December 03 (Taurus)	
Number of Observations: 19	(24 disk drawings, 1 half-rotation map)
Instruments used:	(A) 203mm Newtonian Reflector,(Knighton Observatory, Leicester)
	(B) 508mm Dall-Kirkham, University of Leicester Observatory

1.2 General Overview

The apparition of 2012-13 saw Jupiter very well placed for observers in the northern hemisphere. The planet came to opposition on 2012 December 03 in the constellation of Taurus, and as a result, the planet achieved a good altitude. Unfortunately, the weather conditions in the UK were very poor, and bad weather conditions seriously hampered observations of the planet. The adverse conditions meant that just 19 observations were made of the planet, compared to 34 for the previous (2011/12) apparition.

Of the 19 observations, a total of 24 disk drawings were made, along with a half rotation map of the planet. Three full planet strip maps were made along with strip drawings of various features like the GRS and oval BA.

Observations commenced on 2012 July 21 and finished on 2013 May 02 giving a total coverage of 10 months, although due to poor conditions there is a good deal of time between observations. By the time of the last observation, Jupiter had sunk low into the western evening sky- the poor seeing due to low altitude effectively put an end to regular observations.

In general the author used his 203mm Newtonian reflector, but a number of observations were made with the University of Leicester's observatory which houses a fine 508mm Planewave Dall-Kirkham telescope. The author was assisted by Dr. Hugh Sasse when using the University of Leicester observatory.

In general, observations comprise of

- Colour disk drawings
- Full disk strip drawings
- Local strip drawings
- Filter work
- Intensity estimates

We give the methodology for making and recording observations in the next section.

1.3 Method for Recording Observations

All raw observations and their associated b/w drawings for the 2012/13 apparition were recorded in the *Field Observations, Vol III* log book. After each observation was made, they were transferred to the *Jupiter Observations, Vol. IV* log book. On all drawings the three systems of longitude are given:

- System I (ω_1) Rotation of the EZ: 9^h 50^m 30.003^s [1]
- System II (ω_2) Rest of the planet: 9^h 55^m 40.623^s [1]
- System III (ω_3): Magnetosphere: $9^h 55^m 29.711^s$ [1]

All systems of longitudes were obtained from the free software WINJUPOS [2].

Disk Drawings Full disk drawings were made at the telescope in black and white using the standard BAA Jupiter Section blank (64×60 mm). Each drawing was was made on the blank (and recorded in under 12 minutes to take account of the planet's rotation) and then details of colour and intensity were added to the drawing. These drawings were then colourized using the notes recorded during the observing session when transferred to the Jupiter Log book.

Planetary Strip Maps In the case of full planetary strip maps, drawings were made on graph paper with details recorded every 30 minutes. After each 30 minutes, objects on or close to the CM were recorded on the map. This meant that a strip map for the entire surface could be generated for many hours. Transit times were taken in order to record the longitude of features in between 30 minute intervals. The author had hoped to make a full rotation strip map using this method, however poor weather conditions meant that only a half-rotation map was ever completed. These drawings were made in black and white and coloured later **Local Strip Drawings** These were made to record observations of specific features. They were made by observing a specific feature (usually at medium to high power) and drawing the feature and surrounding environment. The start and end times of the strip drawings were included along with details of ω_1 and ω_2 . These drawings were made at the telescope in black and white, and then coloured later.

1.4 Special Events

On 2012 September 11, BAA Jupiter section director, Dr. John Rogers issued an alert that a bright flash had been reported on the planet. Subsequently a fireball was imaged, however the author was visiting New York at the time and was unable to make any observations of the event.

2 The Planet

We now go on to summarize the observations made of the planet during the 2012/13 apparition. This section is split into three parts, observations of the southern hemisphere, observations of the Oval BA and the Great Red Spot, and finally observations of the northern hemisphere. We adopt the convention of starting with features in the south and moving northwards. In all cases 'following' (abbrv. fol.) is take to mean right of the CM and 'proceeding' (abbrv 'proc.') to the left of the CM.

2.1 Southern Hemisphere

Southern Polar Region [SPR] Normally a vague dull grey region in the extreme south. Hardly any variation in colour or intensity.

South South Temperate Belt [**SSTB**] Only seen occasionally. When present it took the form of a light greyish belt. The SSTB did not appear to be present at all longitudes.

South Temperate Belt [STB] An interesting feature normally always present. The STB took the form of a brownish-grey belt, in some sections of longitude it appears fairly uniform at other longitudes it appeared curved or broken. Early on, the STB passed just south of Oval BA in a uniform manner. However, later observations seemed to show a break in the STB near to Oval BA (see figure 1). This is probably due to the drift of oval BA in the STropZ causing it to pass by the uniform and broken sections

South Tropical Zone [**STropZ**] Normally a bright zone, with the south tropical band (STropB) present for most longitudes. Above the STropB the zone appeared to have a yellowish cast, while below the STropB the colour was white. The STropB itself was of a light brownish colour and appeared to end in a region just proc. the GRS and then start again just above the GRS as can be seen in the strip drawing in figure 1.



Figure 1: An apparent change in the STB near oval BA. The top drawing was made on 2012 October 01-02 at 0021UT, x288 using a 508mm DK, $\omega_1 = 99.6^{\circ}$, $\omega_2 = 179.1^{\circ}$, $\omega_3 = 222.7^{\circ}$. The STB appears as a uniform band. Lower strip drawing was made on 2013 January 15 with a 203mm Newtonian, x250, the STB clearly broken near Oval BA.



Figure 2: A distinct difference in appearance of the SEBz proceeding and following the GRS as observed on 2012 November 21 (a) 2024UT, 203mm Newtonian refl., x167, shadow of Ganymede present, and (b) 2155UT, 203mm Newtonian Refl., x250. Ganymede now on the proc. limb.

South Equatorial Belt [SEB] The SEB was one of the most prominent belts on the planet. It was split into three components: a greyish southern belt component (SEBs), a dark orange zone (SEBz) followed by a yellowish-grey northern belt component (SEBn). The most interesting aspect of the SEB were the changes the GRS seemed to generate in the SEB. Proceeding the GRS, the SEBz was a dark orange and the SEB(s) was greyish, while the SEB(n) was quite a light yellowish grey colour. Around the GRS, the SEBz seemed to be a light colour. The SEBz seemed to be rather turbulent in the region around the GRS and in good seeing a number of delicate fine structures were observed within it. After some distance it seemed that the SEBz returns to its darker orange colour. An example of this is given in fig ??

None of the belt components appeared uniform; it was not uncommon for lighter and darker sections to be seen in all three components of the belt.

Equatorial Zone [**EZ**] Usually quite a bright zone and home to the blueish coloured festoons. In general the festoons would start on or in the NEB(n) and then extend out into the EZ. At times it looked like the structures joined a tenuous equatorial Belt.

2.2 Oval BA and the Great Red Spot

Oval BA The feature was observed a total of 10 times. Oval BA usually presented itself as a small light orange oval in the STropZ just north of the STB. The feature seemed to be touching the STB on a number of occasions. The rapid motion of Oval BA was also noted, when first seen on the night of 2012 October 01-02, it was close to the proc side of the GRS with a $\omega_2 \sim 170^\circ$, by the time it was last observed on 2013 February 27th $\omega_2 \sim 143^\circ$.



Figure 3: Two close up strip maps of the GRS. (a) Drawing made on 2013 January 3rd, 2220UT-2230UT, 203mm Newtonian refl., x250 and x400, AI-II. The GRS and surround-ing environs, turbulence present in the SEBz following the GRS. (b)

The GRS The Great Red Spot was an interesting feature. In general it appeared to be a light salmon pink oval which was sometimes darker and better defined on its proc. side. In good seeing at high magnification there appeared to be some structure inside the spot; a slightly darker region appeared to be present inside the spot. The spot seemed to be a little harder to see this apparition compared with the 2011-2012 apparition, indeed on 2012 November 05-06, Oval BA seemed to contain more colour and be better defined than the GRS. Two strip drawings of the feature are given in fig 3.

2.3 The Northern Hemisphere

North Equatorial Belt [NEB] Another prominent belt. Throughout the apparition this belt seemed to be thinner than the SEB, moreover it did not appear to be split into components. The NEB was home to a number of interesting phenomena, these include

- *Rifts* These took the form of long thin bright sections, varying in length. A number of long bright rifts were observed.
- *Dark Sections* Often appearing near rifts, dark sections were normally sections of the NEB which appeared a dark brown colour. *Dark Spots* A number of these were observed within the belt, none were as conspicuous as those of the previous apparition.

On 2012 November 05-06, a total of five disk drawings were made along with a strip drawing showing a large rift in the NEB. Many of the above phenomena can be seen in the NEB. These drawings are given in fig 4.



Figure 4: Five disk drawings and a strip drawing of a rift in the NEB made on the night of 2012 November 05-06 with a 203mm Newtonian refl. The times and CM longitudes of each disk drawing are given in the figure.

North Tropical Zone [NTropZ] A very interesting feature during this apparition. Normally the zone appears as a bright cream-white coloured zone just north of the NEB. At the start of observations on 2012 July 21st, the NTropZ appeared to have a strong yellowish colour. As the apparition continued, the NTropZ got noticeably darker and took on a ruddy yellowish colour. On 2012 August 09, a number of fine structures were seen extending from the NEB into the zone (fig 5). On the night of 2012 October 13-14, the NTropZ appeared to be very dark. A period of bad weather meant that the next observation of the planet occurred on 2012 November 02.

For the rest of the apparition, the NTropZ remained a bright whitish coloured zone.

North Temperate Belt [NTB] At the start of observations the belt appeared to be a brownish, orange colour. The belt seemed to undergo some small changes as the NTropZ darkened; the NTB seemed to darken and it was not uncommon to see a number of darker sections present within the belt. There also appeared to be a greyish colour present in sections along its northern edge. As the NTropZ brightened and returned to normal, so the NTB seemed to lighted and return to a golden yellow colour. A number of dark brown sections seemed then to be present at various intervals of longitude along its northern border, or sometimes within the belt itself.

North Temperate Zone [NTZ] A brighter zone immediately north of the NTB. The zone was whitish in colour and seemed to vary little in intensity.



Figure 5: Observation made on 2012 August 09 at 0305UT, 203mm Newtonian Refl., x167, seeing: AII-III, $\omega_1 = 313.3^{\circ}$, $\omega_2 = 84.1^{\circ}$, $\omega_3 = 113.2^{\circ}$. A number of fine structures seen extending from the NEB into the dark NTropZ.



Figure 6: The NtropZ returns to normal. Observation made on 2012 November 02, 22h6UT, 203mm Newtonian Refl., x167, $\omega_1 = 63.2^{\circ}$, $\omega_2 = 259^{\circ}$, $\omega_3 = 311^{\circ}$.



Figure 7: An observation of Jupiter made with Dr. Hugh Sasse using the University of Leicester's 20" DK. Structure present in the dark NTropZ, and some vague structures present in the NPR. Observation made on 2012 October 06-07, 0040UT, x230.

North Polar Regions [NPR] A vague yellowish-grey feature covering the extreme north of the planet. It seemed that there were a number of subtle features present in the region in the moments of good seeing (see fig 7.)

3 Planet Strip Maps

Strip maps are an excellent way to capture disk features over an extended period of time. It was hoped that a full rotation would be obtained during the apparition since near and at opposition, the planet would be observable in the sky for longer than one Jovian day. However excessive wet and cloud conditions in the UK meant that only one half-rotation map was made, and a number of other strip maps showing less than half a rotation, were also made.



Figure 8: A half rotation map made by the author. The map was drawn on the night of 2012 December 05-06 starting at 2012UT and finishing at 0305UT. Observations were made with a 203mm Newtonian using a combination of x250 and x312. The map covers $\omega_2 : 145^\circ$ to $\omega_2 : 327^\circ$.

3.1 Less than Half Rotation

3.2 Half-Planet Map

The strip made on 2013 January 09 shows the planet between $\omega_2 : 232^\circ$ to $\omega_2 : 322^\circ$. This is shown in fig 9, and was made with the author's 203mm Newtonian reflector.

The strip map of 2013 January 15th covers longitudes ω_2 : 74° to ω_2 : 201°. The strip covers the GRS and surrounding regions and was made with the author's 203mm Newtonian reflector (fig 10).

The strip map of 2013 February 27th covers longitudes $\omega_2 : 74^\circ$ to $\omega_2 : 201^\circ$. This was the last drawing to be made of the 2012-13 apparition (fig 11).



Figure 9: A strip map made on 2013 January 09 from 1804UT to 2048UT using a 203mm Newtonian refl., x250. Also shown is a short strip drawing showing a bright rift in the NEB.



Figure 10: A strip map made on 2013 January 15 from 1840UT to 2215UT. The Map shows the GRS, Oval BA and the interesting structures of the NEB.



Figure 11: A strip map made on 2013 February 27 from 1840UT to 2050UT, 203mm Newtonian Reflector.



Figure 12: An observation of Ganymede and Io in very good seeing conditions on 2013 January 03. At 2219UT and at x400 on a 203mm Newtonian Refl., some faint markings were detected on the surface of Ganymede.

4 Satellites

A number of transits of both the Galilean satellites and their shadows were observed during the apparition. There was also an unusual observation of Ganymede made during this apparition; the observation was unusual in that some faint detail seemed to be present on the disk. On 2012 January 03 there were some exceptionally calm moments of seeing. During this period, the author was able to use powers of x400 to examine the planet and its satellites. At x400 it appeared that there was a faint greyish marking on the bottom part of the disk of Ganymede and a brighter region at the top of the disk. Io remained featureless throughout, though notably a light orange colour. The observation is given in fig ??.

5 Intensity Estimates

A number of intensity estimates were made in integrated light, in red light using a W25A filter and in light blue light using a W80A filter. The BAA Jupiter Section intensity estimate scale is employed which adopts a scale of 0 (very bright) to 10 (dark sky). Increments of 0.25 are also used in this scale. In the tables below, the intensity estimates are presented along with the average and standard deviation for the apparition.

5.1 Integrated Light

THE BAA JUPITER SECTION: VISUAL INTENSITY REPORT FORM: INTEGRATED LIGHT

OBSERVER:	Paul G. Abel
YEAR	2012-2013

Instruments: A 203mm Newtonian Reflector

Month	July	Aug	Oct	Nov	Nov	Jan	Jan	Jan	Feb			
DAY	23	10	14	6	15	3	9	15	18			
UT	02:46	02:47	03:18	00:16	23:19	23:14	18:50	19:26	19:32			
INSTR	А	А	А	А	A	А	А	А	А			
MAG'N	x167	x167	x250									
SEEING	AIV	AIII	AII	AIII	AIII	AIII	AI-II	AIII	AII-III			
CM1												
CM2												
CM3												
OBSER- VA- TIONS										INTEN- SITY AVER- AGE	NUM- BER OF ESTI- MATES	STAN- DARD DEVI- ATION
THE PLANET												
SPR	4	4	3.75	3	3.5	3.5	3.75	3.75	3.25	3.61	10	0.33
SSTB	-	-	3	-	3.25	-	-	-	-	3.12	3	0.18
STZ	2	2	2	2.5	2.5	2.5	2	2.5	2.5	2.28	10	0.26
STB	4	3	3	4.25	3	3	3	3	3	3.25	10	0.50
STropZ	1.75	1.5	1.5	1	1.5	1.25	1	1.5	1.25	1.36	10	0.25
StropB	-	-	-	-	-	6	-	3	3.75			
GRS	-	3	-	-	-	3	-	-	3	3.00	4	0.00

RSH	-	1	-	-	-	1	-	-	1	1.00	4	0.00
SEB(S)	4	4	4	4.75	5	5	4	5.5	4	4.47	10	0.59
SEBz	6.5	3.25	6.5	6.75	6.5	1	6.5	6.25	6.25	5.50	10	2.00
SEB(N)	3.5	4	4	4.5	5	5.5	5.5	4.5	4	4.50	10	0.71
ΕZ	1	1	1.25	1	1	1	1	1	1	1.03	10	0.08
NEB	4	4	5	6	3.75	6.25	5	5	5.25	4.92	10	0.88
NTropZ	2.25	3.75	2.5	1	1.5	1.75	1.75	1.5	1.5	1.94	10	0.81
NTB	4	5	4.5	1.5	4	4	4.25	4	4	3.92	10	0.97
NTZ	1.25	1.25	1.25	2	2.5	2.5	2.25	2.25	2.5	1.97	10	0.57
NNTB	4	-	-	-	-	-	-	-	-	4.00	2	#DIV/0!
NPR	4	4	3.25	3.5	3.5	3.5	3.5	3.75	3.5	3.61	10	0.25

5.2 Red Light: W25A

THE BAA JUPITER SECTION: VISUAL INTENSITY REPORT FORM: W#25A

OBSERVER: Paul G. Abel YEAR 2012-2013

INSTRUMENTS A:	203mm Newtonian reflector
-----------------------	---------------------------

Month	July	Aug	Oct	Nov	Nov	Jan	Jan	Jan			
DAY	23	10	14	6	15	9	15	18			
UT	02:52	03:01	03:32	00:29	23:42	19:05	19:32	19:46			
INSTR	А	А	А	A	А	A	А	A			
MAG'N	x167	x167	x250	x250	x250	x250	x250	x250			
SEEING	AIV	AIII-IV	AII	AIII	AII-III	AII	AIII	AII-III			
CM1											
$\rm CM2$											
CM3											
OB-									IN-	NUM-	STAN-
SER-									TEN-	BER	DARD
VA-									AVER-	OF ESTI-	TION
TIONS									AGE	MATES	11011
THE PLANET											
SPR	3.5	3	3	3	3.5	3.5	4	3.75	3.41	9	0.38
SSTB	-	-	-	-	-	-	-	-	#DIV/0!	0	#DIV/0!
STZ	-	-	2	-	2.75	3.5	2.5	-	2.69	5	0.62
STB	3	3	3	-	3	-	3	-	3.00	6	0.00
STropZ	2	2.75	2	2.5	2	1.25	2	2	2.06	9	0.44
StropB	-	-	-	-	-	-	-	-			
GRS	-	-	-	-	-	-	-	2	2.00	2	#DIV/0!
RSH	-	-	-	-	-	-	-	-	#DIV/0!	0	#DIV/0!
SEB(S)	3.25	3	3	6	5.75	3	4	3	3.88	9	1.28
SEBz	5	6	4	6.75	6.25	6.5	6.25	6	5.84	9	0.91
SEB(N)	6	3	3	6	6	3	3	3	4.12	9	1.55
EZ	1	1	1	1.5	1	1	1	1	1.06	9	0.18
NEB	3	3	4	3.5	3	3	4	4	3.44	9	0.50
NTropZ	-	2	2.75	1.5	2	1.25	2	1.75	1.89	8	0.48
NTB	3	3	3	3	3	2.75	3	2.25	2.88	9	0.27

NTZ	2	2	2.5	2	2	2.5	2.25	2.75	2.25	9	0.30
NNTB	-	-	-	-	-	-	-	-	#DIV/0!	0	#DIV/0!
NPR	3.5	4.5	4.5	4	3.5	3.5	4	3.75	3.91	9	0.42

THE BAA JUPITER SECTION: VISUAL INTENSITY REPORT FORM: W#80A

OBSERVER:	Paul G. Abe	l
YEAR	2012-2013	
INSTRUMENTS:	А	203mm Newtoninan Reflector

Month	July	Aug	Oct	Nov	Nov	Jan	Jan	Feb			
DAY	23	10	14	6	15	9	15	18			
UT	03:00	02:54	03:24	00:21	23:32	18:59	19:38	19:40			
INSTR	А	А	А	А	А	А	А	А			
MAG'N	x167	x167	x250	x250	x250	x250	x250	x250			
SEEING	AIV	AIII-IV	AII	AIII	AII-III	AII	AIII	AII-III			
CM1											
CM2											
CM3											
OBSER- VA- TIONS									IN- TEN- SITY AV- ER- AGE	NUM- BER OF ESTI- MATES	STAN- DARD DEVI- A- TION
THE PLANET											
SPR	4	3.75	3.75	3.5	3.25	3.5	3.75	3.25	3.59	9	0.27
SSTB	-	-	3	-	-	-	-	-	3.00	2	#DIV/0
STZ	-	-	2.75	2.5	2.25	2	2	2.25	2.29	7	0.29
STB	4.5	4	4.5	3.5	3	3	3.5	-	3.71	8	0.64
STropZ	1	1.75	1.75	1.5	1.5	1.25	1.25	2.25	1.53	9	0.39
StropB	-	-	-	-	-	-	-	-			
GRS	-	-	-	-	-	-	-	2	2.00	2	#DIV/0
RSH	-	-	-	-	-	-	-	1	1.00	2	#DIV/0
SEB(S)	3.25	3.75	4	6.75	6	3.5	3.5	3.5	4.28	9	1.33
SEBz	6.25	6.25	6.5	7	6.5	7.5	7	6.75	6.72	9	0.43
SEB(N)	6	6	4	6.5	6	4	3.5	3.5	4.94	9	1.29
ΕZ	1	2	2	2	1.5	1	1	1.5	1.50	9	0.46
NEB	4.5	4.75	6.5	5.25	4.5	6.75	7	6	5.66	9	1.03
NTropZ	1.75	2	2	1	1.5	1.25	2.5	1	1.62	9	0.53
NTB	5	6	5.5	4.5	4.5	4.75	4	4	4.78	9	0.70

NTZ	1.75	1.5	2.5	2	2	2	2	2.5	2.03	9	0.34
NNTB	-	-	-	-	-	-	-	- :	#DIV/0	! 0	#DIV/0
NPR	3.75	4	5	4	4	4	3.5	3.5	3.97	9	0.47

6 Conclusions

The 2012-13 apparition saw Jupiter reach a good altitude, and when skies were clear this afforded some excellent views of the planet in steady conditions. The UK weather severely restricted the number of observations made; there were many extended cloudy periods last sometimes for a number of weeks at a time. A numb er of interesting phenomena were observed on the planet:

- Some interesting fine details in the STB.
- The observation and the rapid movements of oval BA.
- The Great Red Spot and the turbulence which seemed to follow it in the SEB. The turbulence exhibited fine structure which seemed to change over the course of a few nights.
- A Broad SEB, the SEB(s), SEBz and SEB(n) all seemed to contain darker and lighter sections. SEBz rather dark and orange coloured in places.
- An active NEB. The belt appeared thinner at times and contained a number of bright rifts, dark sections and spots. At times fine details associated with the NEB seemed to extend down into the NTropZ.
- A variable NTropZ. Initially the zone appeared quite dark and a ruddy yellowish colour for a while before reverting back to its normal appearance.

All in all, there was plenty of activity on the planet which could be observed by the visual observer.

References

- [1] Patrick Moore and Robin Rees. *Patrick Moore's Data Book of Astronomy*. Cambridge University Press, 2011.
- [2] WINJUPOS free software. jupos.org/gh/download.htma.