Uranus during the 2015 apparition

Kevin Bailey

A report by the Uranus Coordinator of the Saturn, Uranus & Neptune Section. Director: Mike Foulkes

This report describes observations of Uranus made during the 2015 apparition and subsequently submitted to the Section. Throughout this apparition, specific bright zones and dark belts were recorded both visually and digitally, and some variations of detail within them were identified.

Introduction

Uranus reached opposition on 2015 Oct 12 in the constellation of Pisces, at RA $1^h\ 8^m$, Dec. +6° 32′ and approximately 1° north of the star epsilon Piscium (71 Psc). At opposition its apparent magnitude was 5.7 and its apparent diameter 3.7″.[1] Visual and digital observations were made by 15 observers between 2015 July and 2016 January.

The contributing observers are listed in Table 1. All observers made digital images, except those marked '**V**', for visual observations only.

The observations

Using the *WinJUPOS* program, all disc drawings and images (after standardising their orientation to the traditional 'south-up' view) were measured to determine the latitudinal boundaries of the zones and belts observed. Averaging these measurements allowed approximate latitudinal boundaries to be defined, and these are shown in Figure 1.

It must be made clear that the nomenclature used in Figure 1 is provisional, and the boundaries are approximations; both are specific to this report. Given the many variables – observer

Table 1. Contributing observers

Observer	*Location*	*Instrument*	*Camera*	*Filter*
Abel P. G. **(V)**	Leicester, UK	203mm Newt.	–	–
Bailey K. N. L. **(V)**	Swindon, UK	280mm SCT	–	–
Clitherow A.	Fife, Scotland	254mm Newt.	ZWO ASI224MC	IR filters
Delcroix M.	Tournefeuille, France	320mm Newt.	ZWO ASI224MC	685nm IR
Edwards P.	West Sussex, UK	356mm SCT	ZWO ASI224MC	742nm IR
Foulkes M. **(V)**	Henlow, UK	280mm SCT	–	–
Kardasis M.	Athens, Greece	356mm SCT	ZWO ASI120MC	610nm IR & IR/UV filters
Kidd S.	Cottered, UK	356mm SCT	ZWO ASI224MC	742nm IR
Lewis M.	St Albans, UK	444mm Dob.	ZWO ASI224MC	610nm LP filter
Maksymowicz S. **(V)**	Ecquevilly, France	127mm OG 180mm MCT 254mm SCT	–	–
Milika D. & Nicholas P.	Australia	356mm SCT	ZWO ASI224MC	570, 610 & 685nm IR
Obukhov A.	Moscow, Russia	280mm SCT	–	–
Peach D.	Selsey, UK	356mm SCT	–	RG610, 685 IR, LRGB
Sussenbach J.	Houten, the Netherlands	356mm SCT	ZWO ASI224MC	685 IR

Telescope abbreviations: Newt. = Newtonian; SCT = Schmidt–Cassegrain (Telescope); Dob. = Dobsonian; OG = object glass (refractor); MCT = Maksutov–Cassegrain (Telescope).

Notes: (i) IR = infrared filter. These allow IR radiation to pass through for longer wavelengths than the quoted cut-off wavelength given in nanometres (nm). (ii) LP = longpass filter, which attenuates shorter wavelengths while passing that which is designated. (iii) R = red, G = green, B = blue filters are used with monochrome digital cameras to produce colour images. (iv) UV/IR = ultraviolet/infrared blocking filter, which blocks these wavelengths for colour cameras. (v) L = luminance filter.

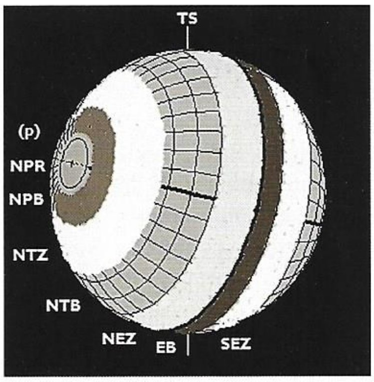

Figure 1. The belts, zones and regions of Uranus. ***Key (latitudes approximate):***

NPR (North Polar Region)	90–75°N
NPB (North Polar Belt)	75–65°N
NTZ (North Temperate Zone)	65–45°N
NTB (North Temperate Belt)	45–20°N
NEZ (North Equatorial Zone)	20–0°N
EB (Equatorial Belt)	0–10°S
SEZ (South Equatorial Zone)	10–30°S

Note: TS = telescopic south; this is the standard 'south-up' view seen in many telescopes. (*p*) = preceding limb; with the drive off, the preceding limb will lead the disc out of the field of view. This, combined with an indication from the bright northern hemisphere, can assist observers in establishing the correct orientation of the planet.

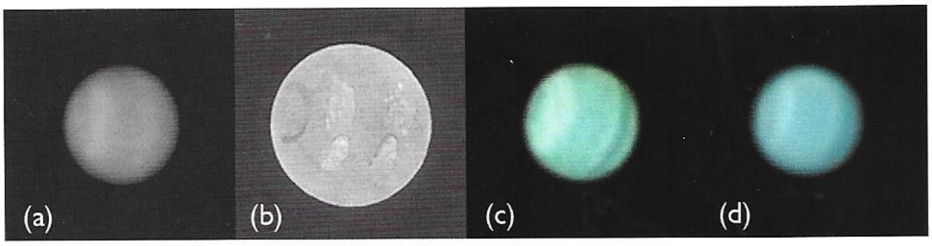

Figure 2. (a) 2015 Aug 14, 18:16 UT. CM = 267.5°. 356mm SCT, 610 IR filter, ASI224MC camera. *D. Milika & P. Nicholas*. **(b)** 2015 Sep 11, 00:20 UT. CM = 246.2°. 280mm SCT. *K. Bailey*. **(c)** 2015 Sep 20, 01:58 UT. CM = 110.9°. 356mm SCT, RG610 filter. *D. Peach*. **(d)** 2015 Sep 25, 22:05 UT. CM = 156.8°. 280mm SCT. *A. Obukhov*. **(e)** 2015 Oct 28, 21h UT. CM = 112°. 180mm MCT. **(f)** 2015 Nov 18, 17:20 UT. CM = 119°. 180mm MCT. *S. Maksymowicz*

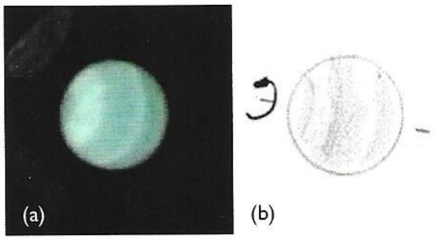

Figure 3. (a) 2015 Sep 26, 01:05 UT. CM = 219.5°. 356mm SCT, 685 IR filter. *D. Peach*. **(b)** 2015 Oct 8, 20:10 UT. CM = 152°. 254mm SCT. *S. Maksymowicz*

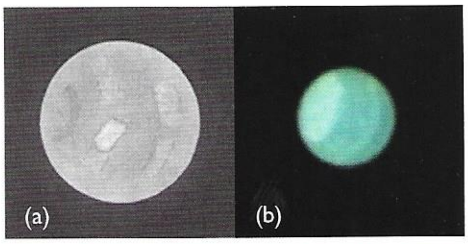

Figure 4. (a) 2015 Oct 3, 00:10 UT. CM = 108.5°. 280mm SCT. *K. Bailey*. **(b)** 2015 Oct 8, 00:43 UT. CM = 105.8°. 356mm SCT, RG610 LRGB filter. *D. Peach*

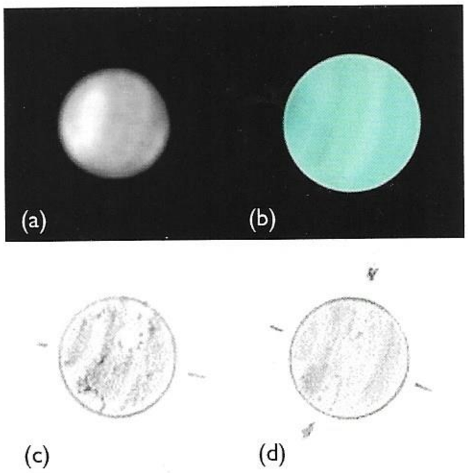

Figure 5. (a) 2015 Sep 9, 00:22 UT. CM = 324.5°. 356mm SCT, 685nm IR filter, ASI224MC camera. *J. Sussenbach*. **(b)** 2015 Sep 27, 22:06 UT. CM = 79.5°. 280mm SCT. *P. Abel*. **(c)** 2015 Oct 8, 20:30 UT. CM = 159°. 254mm SCT. **(d)** 2015 Nov 1, 18:10 UT. CM = 258°. 180mm MCT. *S. Maksymowicz*

experience, method of observing (visual/digital), aperture, filters, seeing *etc.* and the small size of the observable disc – the extent to which the observations broadly agree is impressive. Figure 1 at least provides a temporary point of reference that can be discussed, revised, amended and necessarily redefined by future observations.

The North Polar Region & North Polar Belt

The North Polar Region (NPR), extending from latitude 90°N to approximately 75°N, showed no distinct features during the 2015 apparition and its intensity remained constant throughout. The NPR was encircled by a North Polar Belt (NPB) at an approximate latitude of 75°–65°N and was observed (with varying degrees of clarity) both visually and digitally throughout the apparition. Both features can be seen illustrated in Figure 2(a–f).

Although the NPB was seen in digital images taken with 610nm and 685nm filters, it appeared better defined when observed visually.

The North Temperate Zone & North Temperate Belt

The bright North Temperate Zone (NTZ), approximately at latitude 65–45°N, and the broad North Temperate Belt (NTB), approximately at latitude 45–20°N, are the two most distinct features on the planet whether recorded visually or digitally. The NTZ often shows subtle variations in intensity and texture, while the NTB has occasional embedded lighter patches that may possibly show atmospheric drift. An excellent digital image by D. Peach illustrates the variations in brightness of the NTZ (Figure 3a). These variations are also recorded by visual observers, most clearly by S. Maksymowicz (Figure 3b).

Due to the limited number of Uranus observations contributed to the Section during this apparition, the opportunity to confirm the existence of specific atmospheric features was limited, but observations by K. Bailey and D. Peach *may* show the movement of a bright patch in the NTZ at an approximate latitude of 45°N, shifting from a position centred on longitude 95° (Figure 4a) to longitude 150° between 2015 Oct 3, 00:10 UT and Oct 8, 00:43 UT (Figure 4b). This is an interval of almost precisely five days, indicating a movement of 11° per day.

In almost all the observations contributed to the report, the wide NTB showed a constant intensity and hue whether recorded visually or digitally, but three observers – Sussenbach, Abel and Maksymowicz – did observe what appeared to be a faint, narrow bright zone bisecting the NTB, approximately at latitude 35°N, in observations made between early September and early November of 2015 (Figure 5a–d).

As the observations of three experienced observers cannot be discounted, it has to be concluded that this was either (i) a short-duration feature existing for approximately two months or (ii) an elusive, persistent feature that escaped being more widely recorded by other observers. Questions such as these can only be answered by increasing the number of observers and observations made during future apparitions of Uranus.

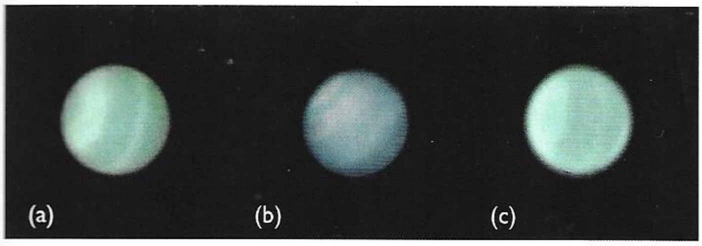

Figure 6. (a) 2015 Sep 26, 01:57 UT. CM = 237.6°. 356mm SCT, 685nm IR filter. *D. Peach.* **(b)** 2015 Oct 30, 13:38 UT. CM = 240.7°. 356mm SCT; 570, 610 & 685nm filters; ASI224MC camera. *D. Milika & P. Nicholas.* **(c)** 2015 Oct 31, 23:13 UT. CM = 221.9°. 444mm Dobsonian, 610LP filter, ASI224MC camera. *M. Lewis*

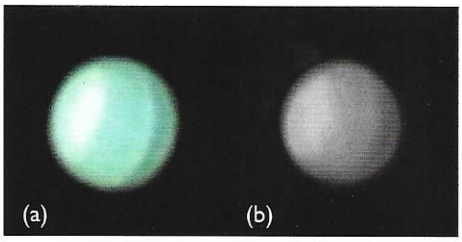

Figure 8. (a) 2015 Oct 31, 21:55 UT. CM = 195°. 356mm SCT, RG610 filter. *D. Peach.* **(b)** 2015 Nov 1, 21:20 UT. CM = 323.7°. 356mm SCT, IR filter, ASI224MC camera. *J. Sussenbach*

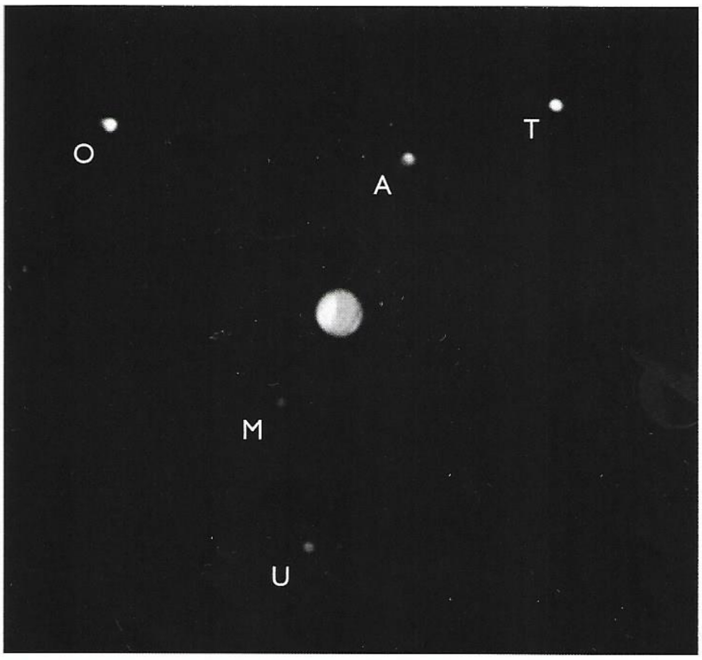

Figure 9. 2015 Sep 9, 00:56 UT. CM = 336.4°. 356mm SCT, 685 IR longpass filter, ASI224MC camera. *J. Sussenbach*

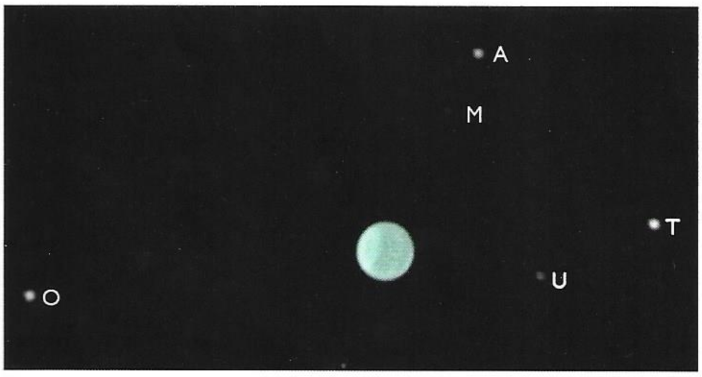

Figure 10. 2015 Oct 31, 23:13 UT. CM = 221.9°. 444mm Dobsonian, 610LP filter, ASI224MC camera. *M. Lewis*

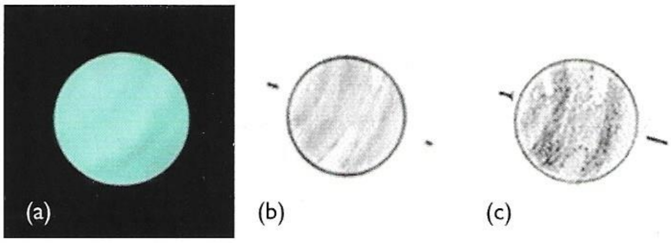

Figure 7. (a) 2015 Aug 26, 23:17 UT. CM = 266.5°. 203mm Newtonian. *P. Abel.* **(b)** 2015 Nov 7, 22:15 UT. CM = 110°. 254mm SCT. **(c)** 2015 Nov 23, 17:20 UT. CM = 105°. 254mm SCT. *S. Maksymowicz*

The North Equatorial Zone & Equatorial Belt

The North Equatorial Zone (NEZ), approximately at latitude 20–0°N, was recorded by almost all contributing observers throughout the apparition. In most digital images it appeared as a narrow and well-defined bright band (Figure 6a–c), whereas visual observers (Figure 7a–c) recorded a broader feature that sometimes showed brighter patches within the NEZ.

The drawings in Figure 7a–c also show the dark Equatorial Belt (EB) located approximately at latitude 0–10°S. During the 2015 apparition, the EB was consistently the darkest surface feature recorded by observers, as illustrated in digital images taken by D. Peach and J. Sussenbach (Figure 8).

The South Equatorial Zone

Due to the orientation of the planet during the apparition, the southern hemisphere was only observable down to a latitude of approximately 30°S. This, and the small diameter of the disc, means that the South Equatorial Zone (SEZ), approximately at latitude 10–30°S, most frequently appeared in observations as a bright limb feature of varying width and intensity. This can be seen in a number of the images included in the report; specifically, Figure 2(c & f), Figure 5(a), Figure 7(c) and Figure 8(a). No distinct features were observed in the SEZ during this apparition.

The satellites

Several observers captured images of the five brightest moons, as illustrated in Figures 9–11. A satisfying achievement, given the respective mean apparent magnitudes of the satellites at opposition:[2] Miranda, mag. 15.79 ± 0.04, 'M'; Ariel, mag. 13.7 ± 0.04, 'A'; Umbriel, mag. 14.47 ± 0.04, 'U'; Titania, mag. 13.49 ± 0.04, 'T'; and Oberon, mag. 13.7 ± 0.04, 'O'.

Discussion & conclusion

To include here comparisons between the results of this report and contemporary professional studies is premature, and potentially misleading. Professional teams (notably those led by Prof P. G. J. Irwin in the UK, and Professors I. de Pater and

L. Sromovsky in the US) are using the world's major telescopes to record very detailed multi-wavelength images of Uranus. These are defining the character and dynamics of the atmosphere of the planet with a precision that is far beyond the present scope of amateur work – but notably, these observations are made during observing windows of relatively short duration. By contrast, amateur observations record 'coarse' disc features over a much longer period and therefore provide a more general cumulative description of the planet. The usefulness of amateur work (*vis à vis* that of the professional) remains the amateur's ability to make multiple observations throughout an apparition. The comparison is therefore between the specific and the general, and – except where these observations clearly converge (for example, regarding the 2014 'White Spot') – such comparisons are perhaps best deferred until there is a more refined body of amateur observations.

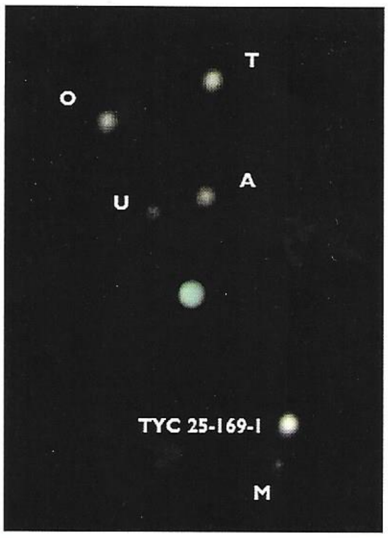

Figure 11. 2015 Nov 15, 19:30 UT. CM = 101.3°. 356mm SCT, IR and UV filters, ZWO 120MC camera. TYC25-169-1 is a field star. *M. Kardasis*

Uranus is an extremely challenging subject for observers – but with more experience, more sophisticated methods of observation and greater technical capability, the old assumed limitations with regard to amateur work in relation to this planet can be dispelled. With Uranus favourably placed for observation over the next decade, and with an increase in the number and quality of observations, there is no reason why the secrets of this beautiful blue-green planet should not be revealed – and redefined – by amateur astronomers. However, this will only happen if sufficient numbers of amateurs commit themselves to making regular observations throughout an apparition and, crucially, submit them promptly and directly to the Section Director or Uranus Coordinator.

Acknowledgement

My thanks to Mike Foulkes for his help and advice in preparing this report.

Address: 4 Ellingdon Road, Wroughton, Wiltshire SN4 9HY *[hqbailey@googlemail.com]*

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2 Jet Propulsion Laboratory (JPL), California Institute of Technology, 'Planetary Satellite Physical Parameters': **ssd.jpl.nasa.gov** (accessed 2020 September)

Further Reading

Schmude R., *Uranus, Neptune, and Pluto – and How to Observe Them*, Springer, 2008

Alexander A. F. O'D., *The Planet Uranus*, Faber & Faber, 1965 [Now somewhat outdated, but an excellent source of information regarding the observational history of Uranus.]

Received 2020 September 26; accepted 2020 October 28