Neptune in 2016–2017

John Sussenbach

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

In 2016 and 2017, Neptune was observed by amateurs with medium to large telescopes. During both apparitions, bright storms were detected at different latitudes. Unfortunately, the number of observations in 2016 was too small to derive the daily drift of the spots. In 2017, during the months October and November, a major bright spot was observed, positioned in the equatorial zone of the planet. For this spot, a daily drift of 47.5° could be established. On 2017 Oct 5, a rare occultation of a star by the large Neptunian satellite Triton took place and was recorded by amateurs. Several observers performed a photometric analysis of the event.

Introduction

Neptune is the outermost planet in the solar system. Its small diameter of only 2.4 arcseconds makes it a difficult object for amateurs to study. Telescopes with apertures of 20cm and larger are required to detect any details that may be occasionally present on its tiny bluish disc. The planet has a large satellite, Triton (magnitude 13.5), which moves in a retrograde way and is relatively easy to observe in medium-sized telescopes. In general, the Neptunian disc appears blank, except that the southern hemisphere is seen to be slightly brighter than the northern hemisphere (Figure 1). This seems to be a long-term feature.

In 1989, Neptune was visited by *Voyager 2* and this spacecraft discovered dark and bright

Figure 1. Neptune on 2017 Aug 4 at 02:15 UT. North is up. *(J. Sussenbach)*

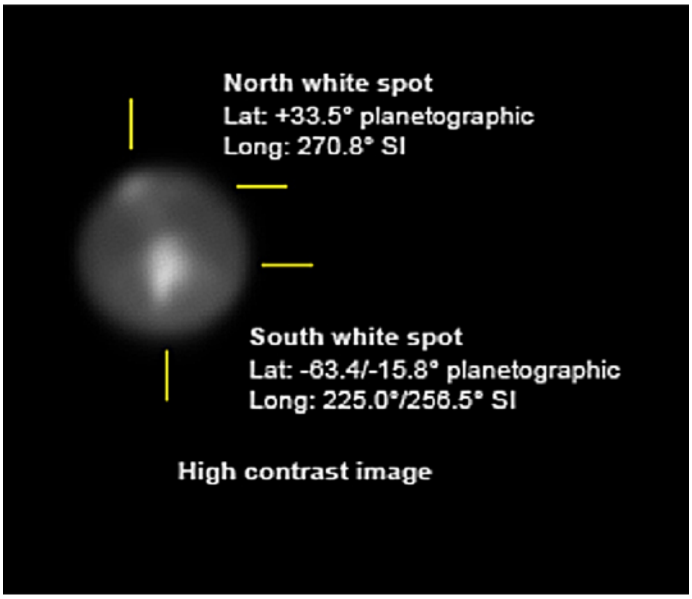

Figure 2. Neptune on 2016 Aug 8 at 23:38 UT. North is up. *(M. Delcroix)*

Figure 3. Neptune on 2016 Sep 21, at different time points. North is up. *(D. Milika & P. Nicholas)*

Table 1. List of observers in 2016

Name	*Observing location*	*Observation type*	*Instrument*	*Camera*	*Filters*
David Gray	Kirk Merrington, Spennymoor, Durham, UK	Visual	415mm DKT	Not applicable	Not applicable
Marc Delcroix (plus C. Pellier, J-P. Cazard, F. Colas)	Pic Du Midi, France	Imaging	1,060mm Cassegrain	ASI 290MM	685nm LP
Martin Lewis	St Albans, UK	Imaging	444mm Newtonian	ASI 224MC	610nm LP
Stanislas Maksymowicz	Ecquevilly, France	Visual	200mm Maksutov, 305mm SCT	Not applicable	Not applicable
Phil Miles	Rubyvale, Queensland, Australia	Imaging	508mm Newtonian	Grasshopper GS3-U3-3-2S4M	610nm LP
Darryl Milika & Pat Nicholas	Adelaide, Australia	Imaging	357mm SCT	ASI 290MM	610nm LP
Neil Philips	Essex, UK	Imaging	Sky Watcher 300P	ASI 290MM	610nm LP
John Sussenbach	Houten, Netherlands	Imaging	357mm SCT	ASI 290MM	610nm LP
Anthony Wesley	Rubyvale, Queensland, Australia	Imaging	406mm Newtonian	Grasshopper 3	610nm LP

Abbreviations: SCT = Schmidt–Cassegrain telescope; MCT = Maksutov–Cassegrain; DKT = Dall–Kirkham.

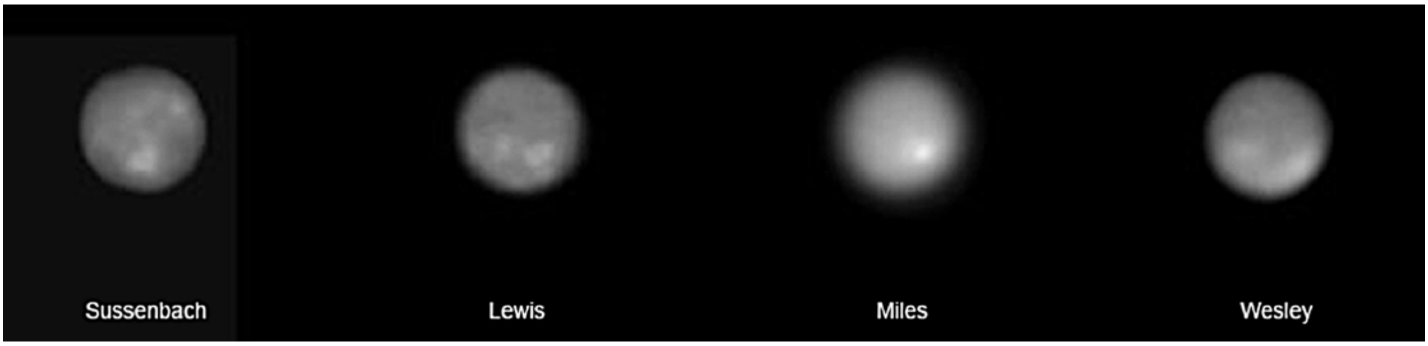

Figure 4. Neptune on 2016 Aug 30 at 22:07 UT *(J. Sussenbach)*; 2016 Aug 30 at 23:09 UT *(M. Lewis)*; 2016 Sep 7 at 13:35 UT *(P. Miles)*; 2016 Sep 16 at 11:03 UT *(A. Wesley)*. North is up.

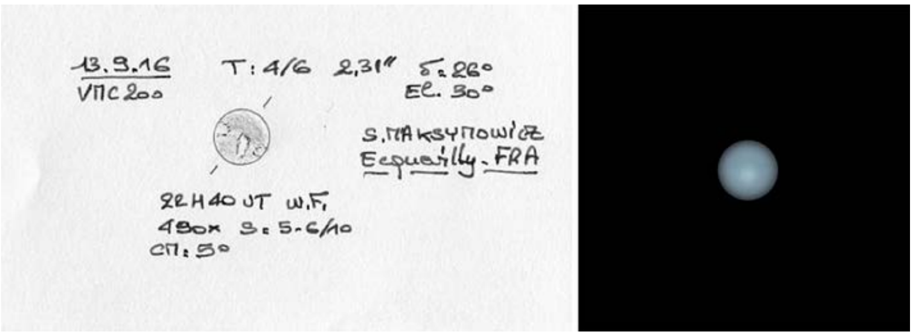

Figure 5. Neptune (drawings) on 2016 Sep 16 at 22:40 UT (left, *S. Maksymowicz*) and on 2016 Aug 22 at 23:25 UT (right, *D. Gray*). North is up.

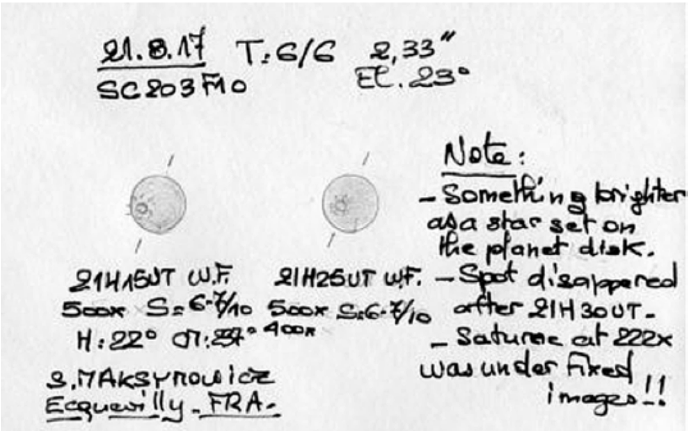

Figure 6. Drawing of Neptune on 2017 Aug 21. *(S. Maksymowicz)*

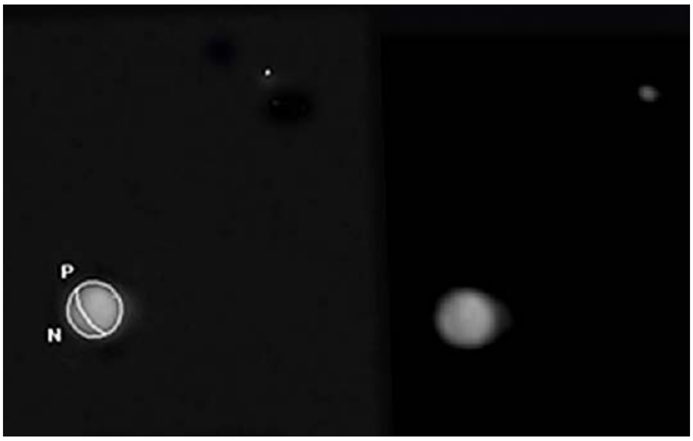

Figure 7. Neptune and Triton in IR on 2017 Oct 3, at 17:33 UT. 'N' indicates the position of the north pole and 'P' the preceding side. *(C. Foster)*

Table 2. List of observers in 2017

Name	*Observing location*	*Observation type*	*Instrument*	*Camera*
Marc Delcroix (plus C. Pellier, J-P. Cazard, F. Colas)	Pic Du Midi, France	Imaging	1,060mm Cassegrain	ASI 290MM
Clyde Foster	Centurion, South Africa	Imaging	357mm SCT	ASI 224C
David Gray	Kirk Merrington, Spennymoor, Durham, UK	Visual	415mm DKT	Not applicable
Nick Haigh	Southampton, UK	Imaging	16-inch *f*/4 Newtonian	ASI 462MC
Manos Kardasis	Athens, Greece	Imaging	357mm SCT	DMK 21
Martin Lewis	St Albans, UK	Imaging	444mm Newtonian	ASI 224MC
Stanislas Maksymowicz	Ecquevilly, France	Visual	254mm SCT	Not applicable
Phil Miles	Rubyvale, Australia	Imaging	Fullum 508mm Tech Mirror	Grasshopper 3
Darryl Milika & Pat Nicholas	Adelaide, Australia	Imaging	357mm SCT	ASI 224C
Alex Pratt	Leeds, UK	Imaging	203mm	WAT-910HX
Nick Quinn	Steyning, UK	Imaging	279mm SCT	STF-8300M
John Sussenbach	Houten, Netherlands	Imaging	279 & 357mm SCT	QHY5LII, ASI 224MC
Anthony Wesley	Rubyvale, Queensland, Australia	Imaging	406mm Newton	Grasshopper 3

Abbreviations: SCT = Schmidt–Cassegrain telescope; MCT = Maksutov–Cassegrain; DKT = Dall–Kirkham.

storms on the planet. In 2014, amateurs became involved in the observation of the bright storms, when the Spanish professional astronomer Ricardo Hueso invited observers to investigate how well these spots could be detected with amateur telescopes. The results of this project have been presented and indicate that amateurs can make a valuable contribution to studies of the distant planets.[1–3]

Neptune in 2016

In 2016, Neptune was located in the constellation of Aquarius and was at opposition on Sep 2. The number of observers and the observations submitted were rather limited. A list of the observers, their locations and their instruments is presented in Table 1. Most observers used 610nm (red) or 685nm (IR) long-pass filters, which give the best resolution.

Most of the time, no details could be detected on the planet (Figure 1). However, in the period August–October, several observers recorded bright spots. M. Delcroix and colleagues detected bright spots on 2016 Aug 8 & 9, using the 1,060mm Cassegrain telescope at Pic du Midi (Figure 2). In the southern hemisphere, the spots formed a smear from latitudes B –63.4 to –15.8°, with the brightest spot at B –50° and longitude L 220°. A minor spot was detected at B +34°, L 271°. It should be realised that measurements on a tiny disc are rather difficult and errors to ±5° and more occur easily.

On 2016 Sep 21, D. Milika and P. Nicholas detected several bright spots at B –38°, L 200–270°. They followed the planet for several hours and their images nicely illustrate the rotation of these spots (Figure 3). On 2016 Aug 30, J. Sussenbach also recorded several bright spots, the brightest being at B –52°, L 124° with a fainter one at B +0°, L 100° (Figure 4). Also, M. Lewis was active that night and imaged Neptune at 23:09 UT. Comparison of this image with the one by Sussenbach demonstrates the rotation of the spot in about one hour.

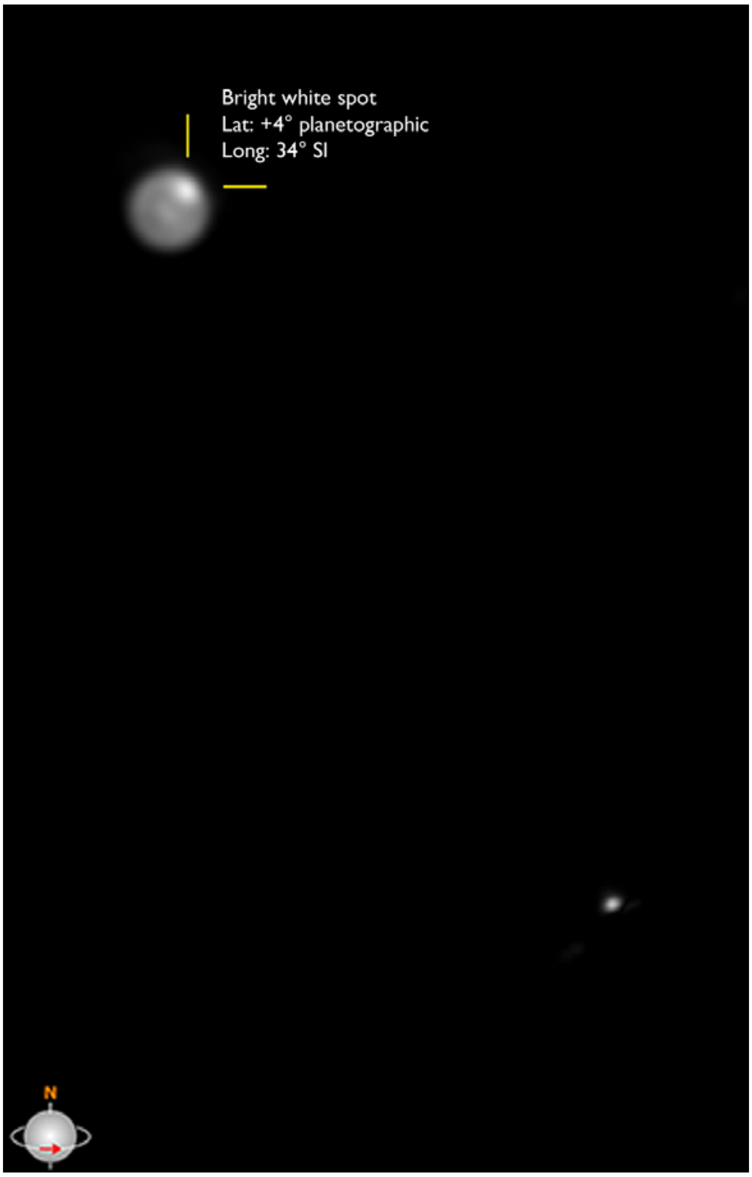

Figure 8. Neptune on 2017 Oct 10 with Triton. *(M. Delcroix)*

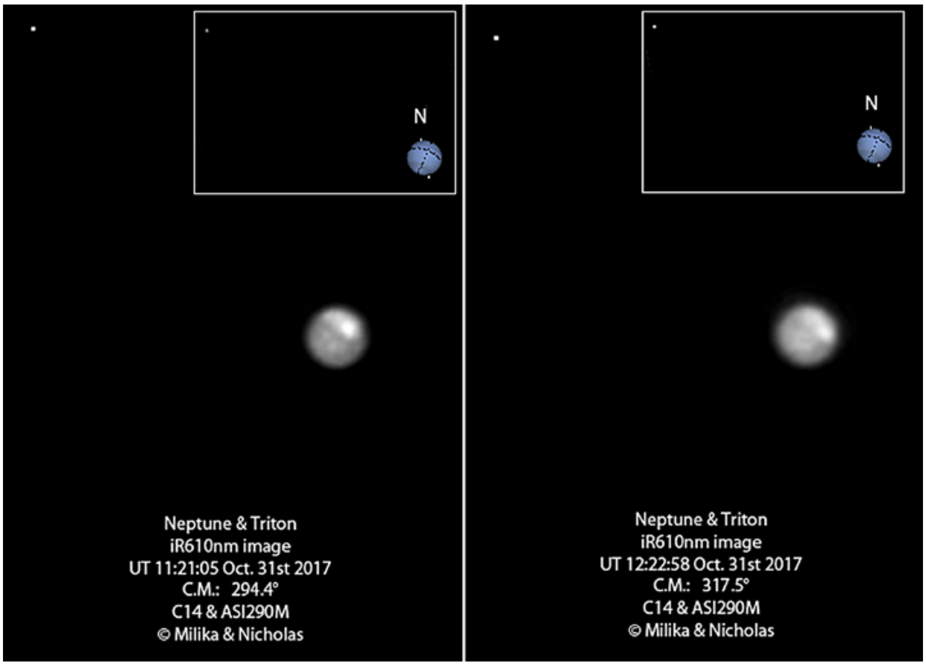

Figure 9. Rotation of a bright spot on Neptune, 2017 Oct 31. *(D. Milika & P. Nicholas)*

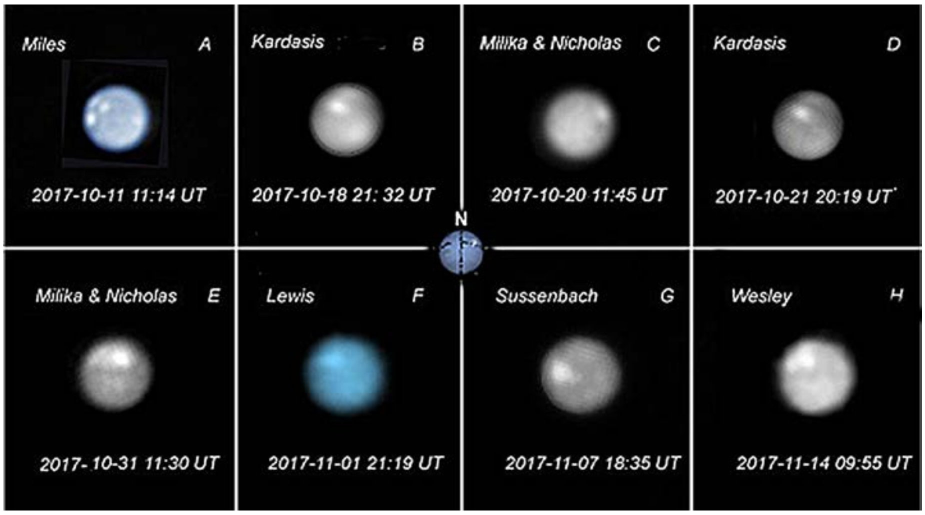

Figure 10. Bright spots on Neptune in 2017 October and November. All images are made with red or IR pass filters. The blue images have been coloured artificially. North is up.

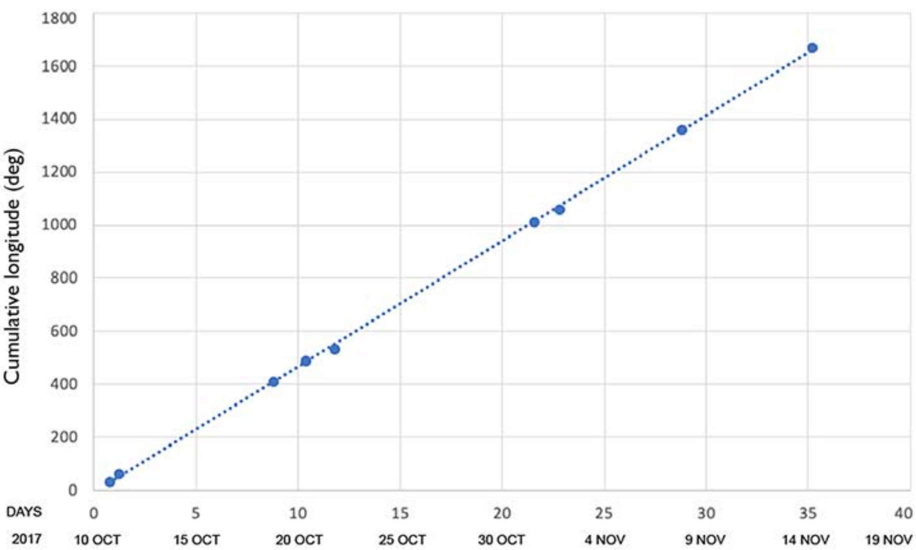

Figure 11. Drift of the bright equatorial spot, derived from the images in Figures 8–10.

P. Miles recorded Neptune on 2016 Sep 7, showing a bright spot at B –44°, L 240°. A. Wesley did so on 2016 Sep 16 at 11:03 UT; he detected a bright spot at B –51°, L 315° and a fainter one at B –36°, L 31°. These results demonstrate that the bright storms on Neptune may last for several weeks and sometimes even months. Unfortunately, the number of observations was too small to calculate the daily drift of the spot.

Interestingly, some bright spots have also been detected visually (Figure 5).

Neptune in 2017

In 2017**,** Neptune was still found in the constellation of Aquarius and was at opposition on Sep 5. Fortunately, for this apparition the number of observers submitting images was higher than in 2016 (Table 2). Most images were obtained with digital cameras using an IR filter, but S. Maksymowicz and D. Gray submitted drawn images (Figure 6).

One reason for the increased number of observers was the occultation of the star UCAC4 410-143659 by Triton on 2017 Oct 5. In the course of the 2017 apparition, several distinct bright spots were again detected, also boosting the interest in this most distant planet.

Bright spots on Neptune in 2017

Also in 2017, Neptune showed a southern hemisphere that was brighter than the northern (Figure 7). Several observers detected bright spots on the planet. On 2017 Oct 10, Delcroix reported a bright spot at coordinates B +4°, L 34° (Figure 8). The images by D. Milika and P. Nicholas illustrate the rotation of the spot (Figure 9).

In the months October and November, several reports of a bright equatorial spot were received from Delcroix, Kardasis, Lewis, Miles, Wesley, Milika & Nicholas, and Sussenbach (Figure 10). In general, bright storms around the equator show large daily drifts due to the high wind speeds in the Neptunian atmosphere.[1,2] The drift of the bright equatorial spot was analysed by measuring its latitude and longitude over a period of two months.

The coordinates of the bright spot were determined using *WinJUPOS*.[4] It should be realised that positional measurements on Neptune are rather inaccurate, for several reasons.

Table 3. Coordinates of the equatorial bright spot

Observer	*Date*	*Time (UT)*	*Lat. (°)*	*Long. (°)*
M. Delcroix	2017 Oct 10	21:24	4	34
P. Miles	2017 Oct 11	11:14	–2	51
M. Kardasis	2017 Oct 18	21:32	–1	44
D. Milika & P. Nicholas	2017 Oct 20	11:45	–5	289
M. Kardasis	2017 Oct 21	20:19	–4	184
D. Milika & P. Nicholas	2017 Oct 31	11:30	2	289
M. Lewis	2017 Nov 1	21:19	2	353
J. Sussenbach	2017 Nov 7	18:35	2	276
A. Wesley	2017 Nov 14	09:55	2	230

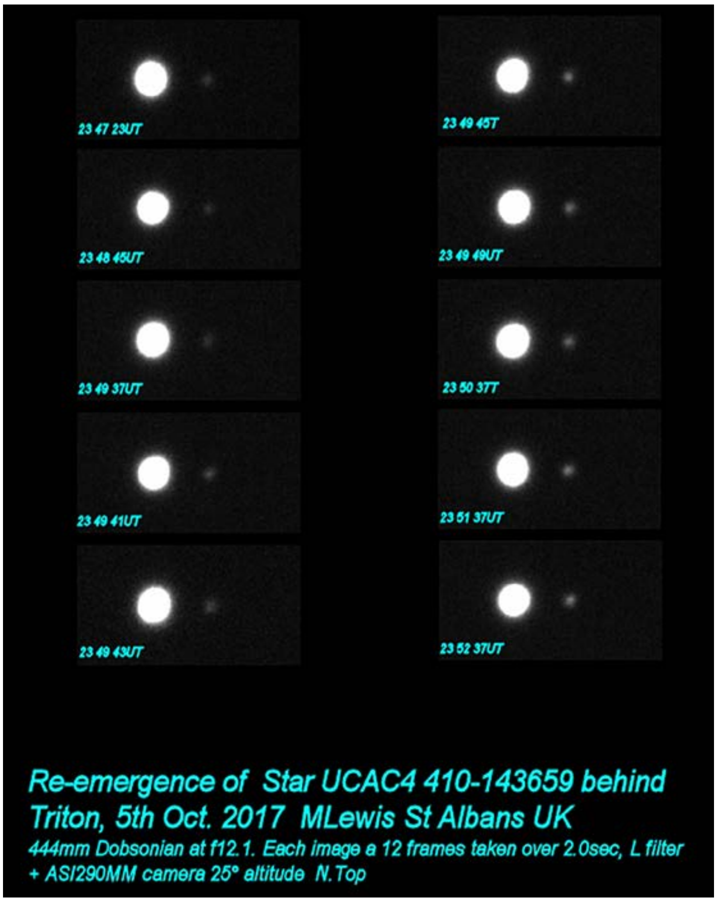

Figure 13. Occultation of the star UCAC4 410-143659 by Triton on 2017 Oct 5. Duration 144s. *(M. Lewis)*

During the processing of the images, the precise position of the disc's rim might easily be lost by contrast enhancement. Furthermore, the orientation of the disc is difficult to establish from the image of Neptune alone. The accuracy can be improved significantly by establishing the relative position of the brighter satellite Triton and comparing that with the predictions of *WinJUPOS*. The positions of the brightest spot presented in Figures 8–10 were established using *WinJUPOS* and the results are shown in Table 3.

The values of the spot's coordinates from 2017 Oct 10 till Nov 14 are presented in a graphic presentation (Figure 11). This analysis illustrates that bright storms might live six weeks or longer, and also shows that the drift is rather constant. For the bright equatorial spot, a daily drift of 47.5° was established. Besides the major bright spot, in some images fainter spots are also detectable (Figure 10A, E, F & H). These observations illustrate again that Neptune, just like Jupiter and Saturn, is an interesting planet from a meteorological point of view and worthwhile for amateurs to observe in a systematic way.

The Triton occultation of 2017 October 5

The occultation of the star UCAC4 410-143659 by Triton was a rare event. We received observations from Gray, Haig, Lewis, Pratt, Sussenbach and Quinn.

The step-by-step passage of the star is demonstrated in images obtained by J. Sussenbach (Figure 12) and M. Lewis (re-emergence of the star; Figure 13). Photometric data were collected by Pratt, Quinn and Haig. The brightness of the star underwent a gradual drop at the start, and a rise in the final phase of the occultation. This is probably caused by the fact that Triton has an atmosphere, which causes gradual dimming and re-emerging of the star (Figure 14)

A brief report on the observation of this occultation by members of the BAA has been published.[5] Based on the results of 10 UK contributors, chords were calculated for each observer using the accepted diameter of Triton of 2,705km (Figure 15).[5] The chords represent the time when the star was occulted, taking into account the observer's geographical position.

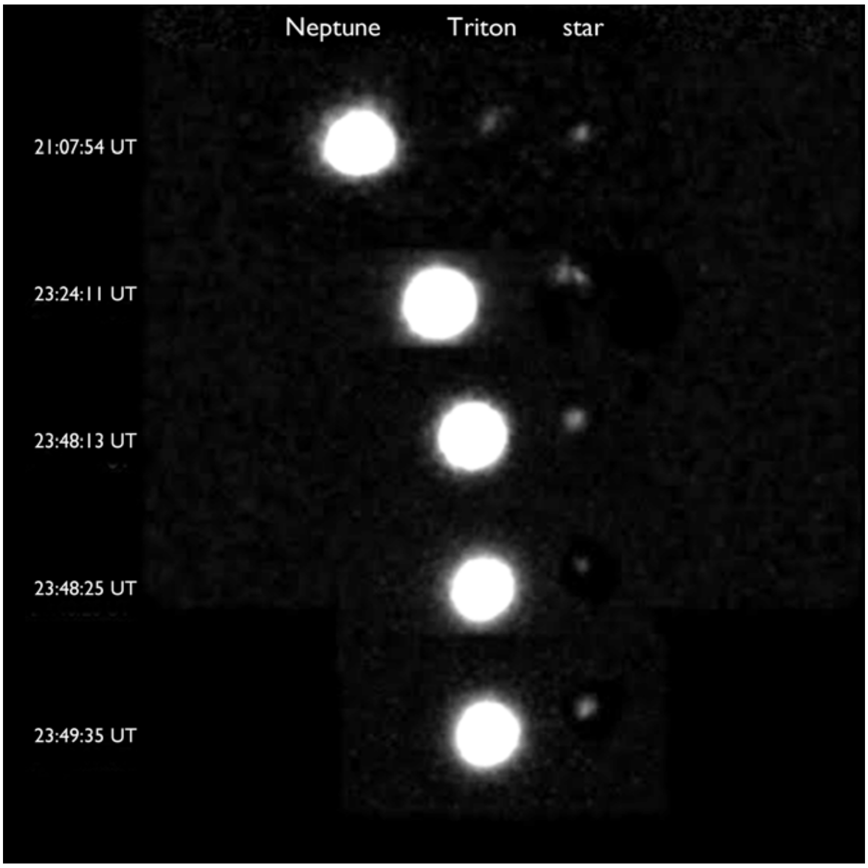

Figure 12. Time course of the occultation of the star UCAC4 410-143659 by Triton on 2017 Oct 5. *(J. Sussenbach)*

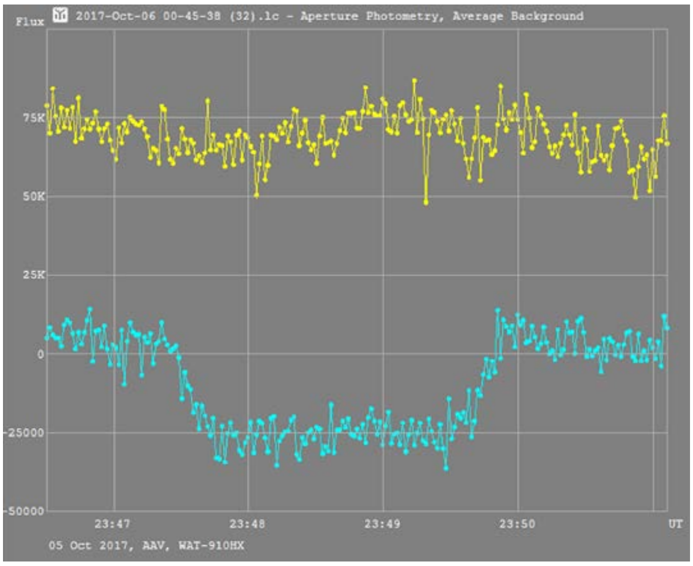

Figure 14. Occultation of the star UCAC4 410-143659 by Triton on 2017 Oct 5. Duration 133 ± 4s. *(A. Pratt)*

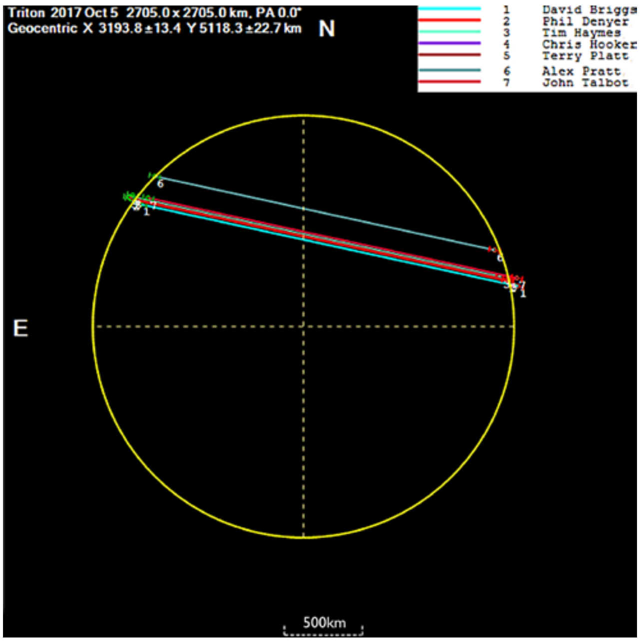

Figure 15. Chords calculated, based on the results of seven UK observers and projected on Triton (see ref. 5). *(Produced using Occult 4.3.4.0)*

Concluding remarks

It is obvious that detection of albedo features on Neptune is quite a challenge and that it requires a telescope with an aperture of 20cm or larger. Even then, it is not an easy task and good seeing conditions are a requirement. The development of astronomical cameras with high sensitivity to the infrared part of the spectrum was essential to these observations, increasing the contrast of features present.

The detected bright spots represent major storms that sometimes develop in the Neptunian atmosphere. The outer atmosphere contains different components, including methane. When astronomical cameras in combination with a Baader red long-pass filter (>610nm) or IR long-pass filter (>685nm) are used, that part of the reflectance spectrum of Neptune is captured that covers the methane absorption bands at 619, 727, 862 & 889nm. The deeper the sunlight penetrates into the Neptunian atmosphere, the more light can be absorbed by methane and less is reflected. When high-altitude clouds are present in the Neptunian atmosphere, they appear as bright spots, because the reflected sunlight does not pass a thick layer of methane-containing atmosphere, but is reflected by the high-altitude clouds accompanying the storm.

The reported detection of bright spots by several observers demonstrates that these phenomena are definitely within reach of the amateur community. Even the measurement of the drift of individual spots is possible.

Address: J. S. Sussenbach (Neptune Coordinator; Saturn, Uranus & Neptune Section): Meekrap-oord 3, 3991 VE Houten, The Netherlands. Tel. +31-30-2203383 *[john@jsussenbach.nl]*

References

1 Hueso R. *et al*., 'Neptune long-lived atmospheric features in 2013–2015 from small (28cm) to large (10-m) telescopes', *Icarus*, **295**, 89–109 (2017)
2 Sussenbach J., Kivits. W. & Delcroix M., 'Bright features on Neptune in 2015', *J. Br. Astron. Assoc*., **127**(2), 79–81 (2017)
3 Sussenbach J., 'Neptune in 2014–2015', *ibid*., **131**(5), (287–290) (2021)
4 *WinJUPOS* website: **http://jupos.org/gh/download.htm** (accessed 2021 July)
5 Haymes T. & Pratt A, 'The occultation of UCAC4-410-143659 by Triton, 2017 Oct 5', *J. Br. Astron. Assoc*., **127**(6), 366–367 (2017)

Received 2021 July 17; accepted 2021 September 8