Hilton, Cambridge, 2020 Jul 10/11.
*Gillian Rushforth*

# Comet C/2020 F3 (NEOWISE)

## *A special report*



**Nick James,** *Director*

This year has been an interesting one for comet observers, with several newly-discovered inbound comets brightening rapidly and having orbits with small perihelion distances. Comet C/2019 Y4 (ATLAS) brightened through March and we thought that it would be a good evening object in May, but it fragmented during April and all that remained was a faint dust cloud [*Journal* **130**(3), p.133]. Another comet, C/2020 F8 (SWAN), performed well as seen from the southern hemisphere and offered the tantalising prospect of becoming a bright northern hemisphere object in the morning sky post-perihelion, but it also fragmented and was only very faintly visible in a bright, twilight sky from the UK. The hoped-for appearance of a naked-eye comet, with a long tail, remained elusive.

On 2020 Apr 1, I presented the first BAA webinar on prospects for C/2019 Y4, just as that comet began to break apart. In the Q&A, John Drummond reported that he had imaged the newly-discovered comet C/2020 F3 (NEOWISE) from his observatory in New Zealand (see Figure 1). This comet had been discovered on Mar 27.8 (*CBET* 4740) as a 16th-magnitude object in Puppis, by the Near-Earth Object Wide-field Infrared Survey Explorer (NEOWISE) satellite. This image was shown live during the webinar and there was some discussion about whether this comet could become a bright object since it had a small perihelion distance ($q$= 0.29au). Perihelion was due on Jul 3 and the comet would be nicely placed for northern hemisphere observers after this date, first in the dawn twilight sky and then moving under the pole into the evening sky from mid-July onwards. At this point, other than the orbit, we really had no idea how the comet would behave. Would it break up coming to perihelion like C/2019 Y4 and C/2020 F8, or would it survive and give us a nice naked-eye midsummer comet?

As it came in to perihelion the comet put on a nice show from the southern hemisphere and it looked healthy as it disappeared into the evening twilight in early June. Michael Mattiazzo, (Victoria, Australia), imaged it on Jun 3 and wrote: 'I have followed it over the past couple of months and seen it brighten from magnitude 12 in mid-April to approximate magnitude 7.8 (moonlight affected) in early June. I won't make any predictions about its peak brightness but I'm quietly confident it will be a case of third time lucky for [the] northern hemisphere'. Michael's final image on Jun 10 (Figure 2), when the comet was at an elongation of 21° and only 5° above his local horizon, showed a 40′ tail and a well-condensed 4′ coma.

The comet was next seen as it entered the SOHO LASCO C3 coronagraph on Jun 23. It was well condensed, with no evidence of fragmentation. By the time the comet left the C3 field of view on Jun 28 it had brightened to third magnitude and appeared to be holding together. Excitement was mounting that the long northern-hemisphere bright comet famine would soon come to an end.

The first ground-based reports from the northern hemisphere were received on Jul 1 as the comet emerged into the dawn sky. Carl Hergenrother (Tucson) reported that the comet was first magnitude, only 3° above his horizon with the Sun only 7° down. I was now sufficiently confident that the comet would be a good one that I posted an alert on the BAA website and on the Comet Section mailing list.

At this time the weather in the UK was rather cloudy. I imaged it as a very faint object in a bright sky between clouds from Chelmsford, Essex on the morning of Jul 3, but the first clear views from the UK were reported on the morning of Jul 6. Andrew Robertson (South Norfolk) wrote: 'It was wonderful, just what a comet should look like. Got it initially below theta Aurigae in 7×50 binoculars at 01:30 UT when it was only 2¼° up. After initial pick-up switched to 15×70 bins. Observed until about 02:10 UT when I did get a brief naked-eye glimpse'. Other BAA observers who saw the comet this morning included Peter Carson (Rochford, Essex), Ian Sharp (Ham, W. Sussex), John Rogers (Cambridge), Neil Morrison, (Crawley, W. Sussex), Honor Wheeler (Hextable, Kent), Tim Haymes (Oxford), Mike Harlow (Suffolk) and Sally Russell (Berkshire). Carson's image is shown in Figure 3.

At this time the comet was in Auriga, not far from the star theta Aurigae, low in the dawn twilight as seen from the south of the UK and it was probably around second magnitude. Over the next few weeks the comet would track through Auriga and then under the pole into Lynx. Closest approach to the Earth was at a distance of 0.69au on Jul 23, when the comet would be in Ursa Major. It would then fade rapidly, moving through the galaxy-strewn fields of Coma as it departed the inner solar system, not to return for 7,000 years.

On Jul 7 I was very lucky with the weather, with a narrow slot of clear sky low down in the direction of the comet. It was an easy naked-eye object for me on that morning (Figure 4). David Swan (Tynemouth) also saw it and wrote: 'Fantastic comet through binoculars. Well worth getting up for'. Stewart Moore (Thorpe-le-Soken, Essex) wrote: 'Really excellent view this morning in binoculars. Comet superb in strip of clear sky with dark bands of cloud above and below. Observed through open upstairs window. 15×70s showed no extra detail to 10×50s. Tail around 2° at one o'clock position and closer to 2.5–3° with averted vision.'

The comet was a difficult object to observe from Scotland, due to the bright summer twilight, but Bill Ward (Glasgow), submitted images on Jul 8. Also on this morning, Robin Leadbeater (Cumbria) managed to get his first spectrum of the comet using a portable set-up

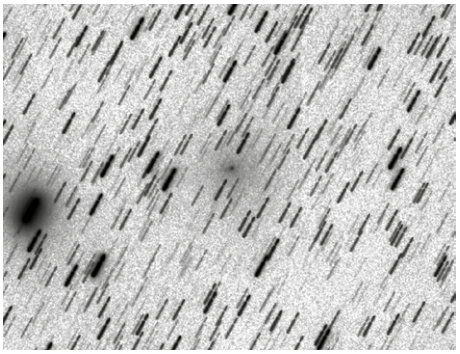

**Figure 1.** Image taken when the comet was still on the Minor Planet Center's Possible Comet Confirmation Page as object N00gbay. 0.35m $f$/10 Meade ACF, SBIG STL11000M. 18×1min, clear, 2×2 bin, –20°C. 2020 Apr 1. *John Drummond, Gisborne, New Zealand*

**Figure 2.** C11 RASA (0.28m, $f$/2.2), Canon 6D, FoV 30′, 2020 Jun 10, 08:30 UT. *Michael Mattiazzo, Swan Hill, Victoria*

**Figure 3.** 200mm FL, $f$/2.8, Canon 60Da, ISO 400, 3.2s, 2020 Jul 6, 01:52 UT. *Peter Carson, Rochford, Essex*

**Figure 4.** 200mm FL, *f*/3.5, Canon EOS 550D, 4×5.2s, 2020 Jul 7, 01:25 UT. *Nick James, Chelmsford, Essex*

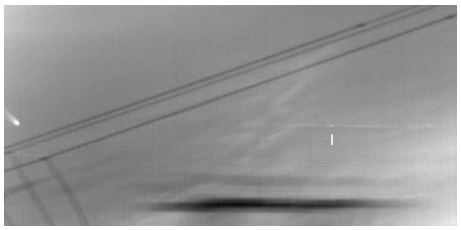

**Figure 5.** Objective grating spectrum with sodium emission marked. 100 lines/mm, 50mm FL *f*/2.8, ASI120M 100×0.25s, 2020 Jul 8, 01:30 UT. *Robin Leadbeater, Cumbria*

**Figure 6.** Pentax 0.075m APO, *f*/6.7, Canon 6D, 15s, 2020 Jul 11, 03:00 UT. *Ian Sharp, Ham, W. Sussex*

consisting of a Star Analyser diffraction grating in front of a 50mm lens (Figure 5). It showed strong Sodium (Na) emission, as did a similar spectrum taken on Jul 11 by Mike Harlow. More details on Robin's spectroscopic work on this comet are on p.268. Through July, spectra were submitted by Robin Leadbeater, Miguel Rodriquez, Mike Harlow, David Strange, Hugh Allen and John Coffin.

By now the comet was becoming more prominent as it rose into a darker sky. David Strange (Sidmouth, Devon) had good views on the morning of Jul 10 and commented: 'A beautiful golden-coloured appearance and easy naked eye object'. The following night, Jul 10/11, was clear across much of the UK and many observers submitted material on that night. I wrote: 'Just got back from one of the great observing experiences of my life. A stunning comet and wonderful NLCs in a clear, deep blue sky.' Andrew Roberston concurred: 'It was truly stunning and by 01:00 UT the tail was getting on for 5° naked eye'.

The dust tail near to the comet's head was bifurcated, with a prominent dark band in the centre. This is shown well on Ian Sharp's image (Figure 6). The wide-field views were spectacular, particularly as there was an extensive display of NLC to the north on that night (Figure 7).

Jul 11/12 was also clear. The ion tail continued to grow in length as the comet approached the Earth and it now stretched for more than 20° as seen in images from dark sites. The comet may have faded compared to earlier in the month, but it was approaching its best for imagers. Images showed the huge, curving, banded dust tail and the much fainter, straight, blue ion tail. An image by Andy Wellington (Preston, Lancs.) also shows a reddish tail in PA 4° relative to the ion tail (Figure 8). Spectroscopists were picking up strong sodium emission at this point, most likely due to the comet's sodium tail. The general view was captured in a lovely pastel drawing (Figure 9) by Chris Nuttall (Bishopthorpe, York), who wrote: 'The naked-eye view of this comet in a dark sky was amazing. Easily seen with direct vision, a bright coma and a tail about 2° long pointing upwards from the horizon. The colour to the naked eye is yellow to amber.' David Swan also captured the view (Figure 10).

The comet was now moving into the evening sky as it tracked under the pole. On the night of July 12/13 Stewart Moore wrote: 'Third consecutive night that comet was visible. It is still easy naked eye … tail seemed shorter tonight but also possibly broader. Tail more like 3° in 10×50s. Possibly also fainter overall but some haze in ►

## List of C/2020 F3 (NEOWISE) observers

We have received a huge number of observations from BAA members and there is not enough space to include them all. Many thanks to the following members who contributed observations but who are not mentioned elsewhere in this preliminary report:

James Abbott, Miguel Araújo, Dean Ashton, Nick Barton, David Basey, Paul Brierley, John Chuter, Graeme Coates, David Davies, Rob Davies, Simon Dawes, James Dawson, Peter Edwards, Ray Emery, Len Entwisle, Nigel Evans, Terry Evans, Mike Foulkes, Patrick Franks, Jimmy Fraser, Gary Gawthrope, Martin Griffiths, Kevin Gurney, Eliot Hall, Alun Halsey, Werner Hasubick, Steve Harvey, Guy Heinen, Nick Hewitt, Adam Jaworski, Andrew Jeffries, Philip Jennings, Ron Johnson, Geoffrey Johnstone, Simon Kidd, Steve Knight, Martin Lewis, Lars Lindhard, Lee Macdonald, Philip Masding, John Mason, Janice McClean, Hazel McGee, Peter Meadows, Tom Moran, Peter Mulligan, Clive Nanson, Michael O'Connell, Andrew Paterson, Mark Phillips, Pauline Phillips, Callum Potter, Alex Pratt, Grant Privett, Martin Ratcliffe, David Reynolds, Ian Rothwell, John Savage, James Screech, Jonathan Shanklin, Andrew Stephens, David Storey, Nik Szymanek, Peter Tickner, Alan Tough, Eric Walker, Ivan Walton, Johan Warell, James Weightman, James West, Paul Whitmarsh, Ken Wood.

**Figure 7.** 29mm FL, *f*/5.6, 20s, ISO 800, 2020 Jul 11, 03:00 UT. *Rob Bullen, Forest of Dean, Gloucestershire*

**Figure 8.** 280mm FL, *f*/5.6, Canon 6D Mk 1, 26×20s, ISO 3200, 2020 Jul 12, 01:55 UT. *Andy Wellington, Hough Hill, Lancs.*

**Figure 9.** Naked-eye pastel drawing. 2020 Jul 12, 01:15 UT. *Chris Nuttall, Bishopthorpe, York*

**Figure 10.** 85mm FL, *f*/2.8, ISO 800, Sony A7s, 2020 Jul 12, 01:01 UT. *David Swan, Tynemouth*

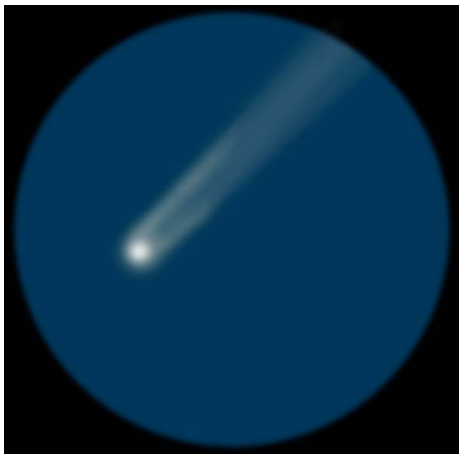

**Figure 11.** 10×50 binoculars, 2020 Jul 12, 22:23 UT. *Paul Abel, Leicester*

► NNE so difficult to be sure. Still a great sight and enjoyed showing it to a neighbour. Observed from 00:15 to 01:30 UT.' Paul Abel (Leicester) wrote: 'It was easy to see with the naked eye, even though it was towards the city centre where light pollution is naturally at its greatest. I used my pair of 10×50 binoculars to make the drawing (Figure 11) [and] there seemed to be two brighter parts to the tail with a darker region in the centre. The golden colour continues to be fairly prominent.'

On Jul 16/17 David Graham (Richmond, N. Yorks.) sketched the comet as seen in his 0.12m, *f*/8.3 refractor (Figure 12). Nick Haig imaged the comet on this evening and commented 'I trekked out into the hills west of Salisbury to get some decent dark skies last night … I must say this exceeded my expectations.'

The following night (July 17/18) Nick Quinn (Steyning, W. Sussex) took the image which appeared on the cover of the 2020 August *Journal*, **130**(4). The ion tail on that night stretched for over 25° (Figure 13). The next night David Swan wrote: 'A fascinating object. Friends and passers-by have been out for a look and have been most impressed. I have found that non-regular stargazers, with just help to point them in the right direction, are able to pick it up with the naked eye and notice the fuzziness reaching upwards. Most people favour the view through binoculars (10×50s) rather than the telescope (0.20m SCT, 32mm Plössl).'

On the night of Jul 20/21, Damian Peach had an excellent view from Hartland Point in Devon (Figure 14). He wrote: 'The view of the night sky here was possibly the finest I have ever had from this country. The comet itself was a grand sight indeed, and this was by far the best view I've had of it. Visually the dust tail could be seen extending to Dubhe (alpha UMa) with averted vision.' On the same day, Richard McKim made a drawing (Figure 15) and reported: '10×50s – Much as last time but despite the better sky and the use of a tripod clamp, the comet as a whole is a little fainter and the ion tail oddly is not seen for sure. Magnitude approx. 3.5. Coma diameter 8′. The DC is higher than last night, DC 6. Tail (dust) directly visible to about 5°.'

By now the comet had risen high enough that it was in the range of larger instruments in fixed observatories. Images showed considerable structure in the inner coma and tail, while time-lapse videos showed that much of this structure was highly dynamic. Richard Miles imaged the comet in blue and near-IR bands (Figure 16). He comments: 'Imaging with two filters, a B filter having a passband of 370–510nm and a Sloan i′ passing 700–850nm, allows a comparison of the dust and gas in the inner coma'.

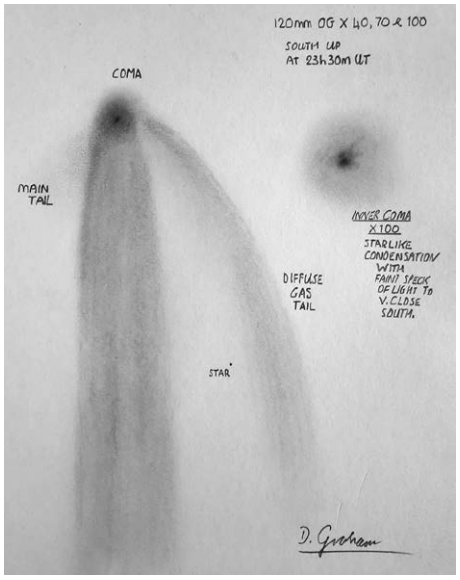


**Figure 12.** 0.12m refr., 2020 Jul 16, 23:30 UT. *David Graham, Barton, N. Yorks.*

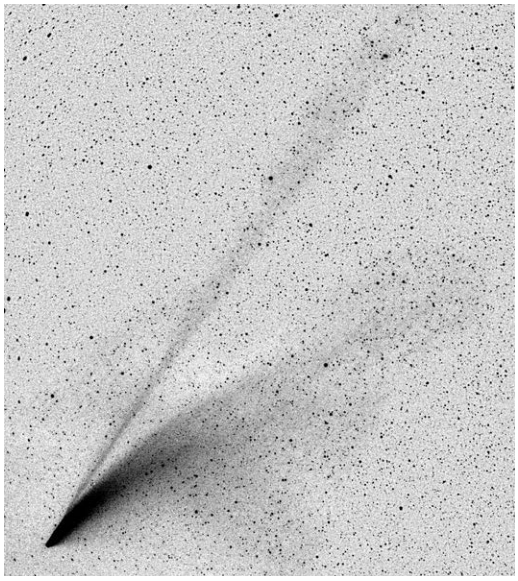

**Figure 13.** 50mm, *f*/2.2. Sony A7s, 30×20s, ISO 400. Blue channel. Vertical dimension 27.5°. 2020 Jul 18, 00:43 UT. *Nick James, Chelmsford*

**Figure 14.** 70mm *f*/4, Canon 6D 50×20s, ISO 1600, 2020 Jul 20, 23:50 UT. Dubhe and Merak are visible at the top of the frame. *Damian Peach, Hartland Point, Devon*

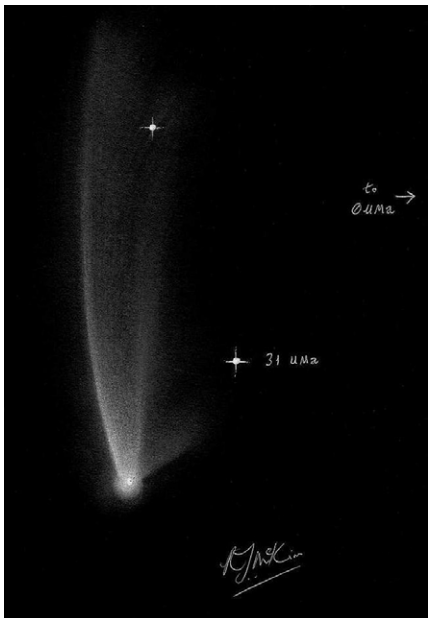


**Figure 15.** 10×50 & 15×60 binoculars, 2020 Jul 20, 22:10 UT. *Richard McKim, Upper Benefield, Northants.*

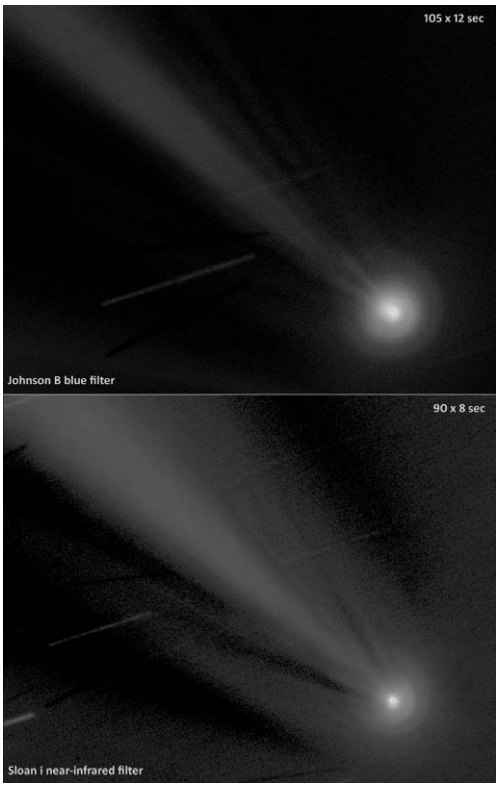


**Figure 16.** 0.35m, *f*/7.7 SCT. 2020 Jul 20, 23:00 UT, 105×12s (B) and 22:32 UT 90×8s (Sloan i′), Larson–Sekanina processing. *Richard Miles, Golden Hill, Dorset*

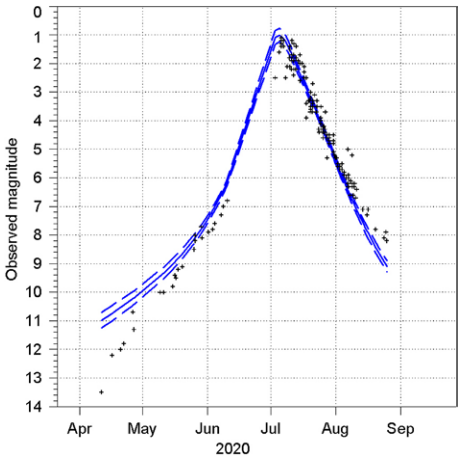


**Figure 17.** Light curve from BAA observations. *Jonathan Shanklin*

**Figure 18.** 0.28m, *f*/2.2 C11 RASA. 2020 Aug 18, 03:24 UT. ZWO ASI071, 3×120s. *Martin Mobberley, iTelescope*

By Jul 24 the comet had passed its closest approach to the Earth and began to fade more rapidly. There were still many impressive images obtained after this date, but the very best of the show was over, less than three months after the comet had been discovered. A preliminary light curve compiled by Jonathan Shanklin (Figure 17) shows that the comet peaked at about first magnitude in early July and had faded to around magnitude 5 at the end of the month. Martin Mobberley's iTelescope image shows it with multiple Virgo galaxies on Aug 18, when it had faded to around eighth magnitude (Figure 18).

According to integrations by Graeme Waddington using elements from *MPEC* 2020-O07, the comet had an original period (at 244au, incoming) of 4,674 years and a final period (at 250au, outgoing) of 7,200 years. The change was due to perturbations by the major planets.

There will be a full report in a future edition of the *Journal*. Many observations and images are recorded in the Section archive (**bit.ly/33w9Ro0**).

If you have not already done so, please submit observations to **cometobs@britastro.org**.