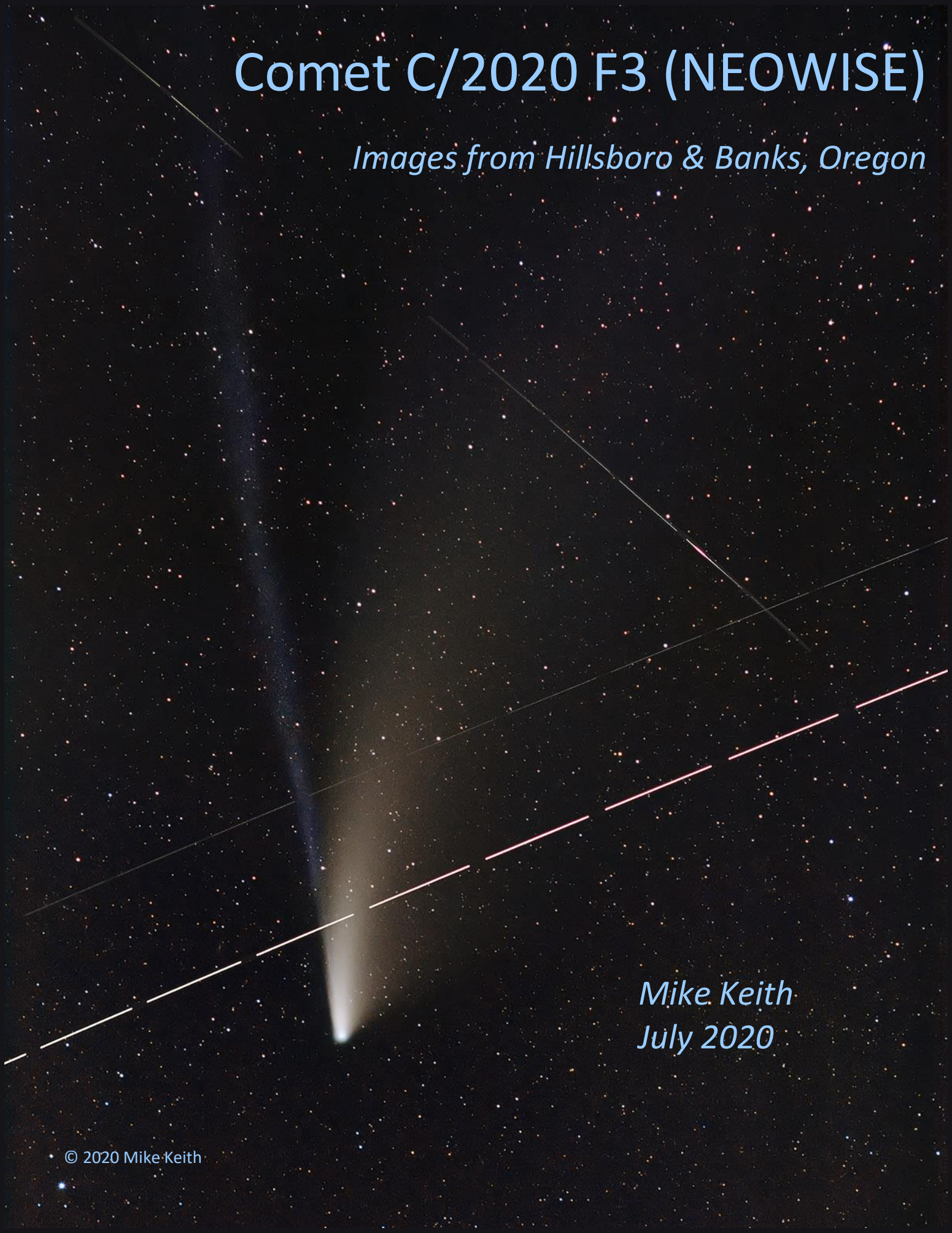
Comet C/2020 F3 (NEOWISE)

Images from Hillsboro & Banks, Oregon



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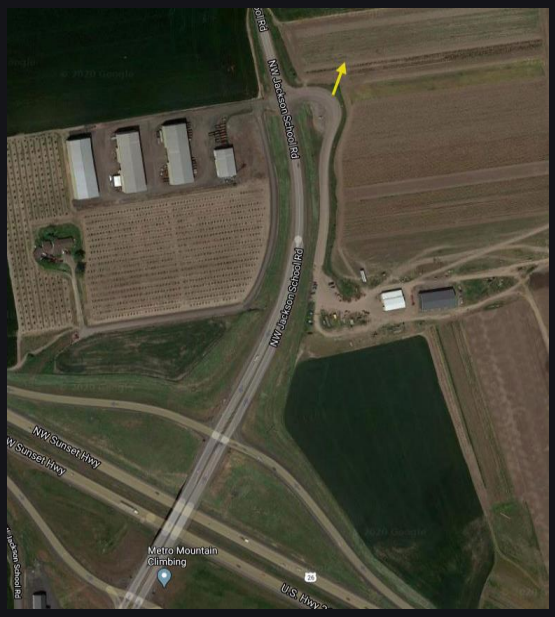
Comet C/2020 F3 (NEOWISE) was discovered with the NASA WISE (Widefield Infrared Survey Explorer) telescope very recently, on March 27 of this year. By early July it had brightened to magnitude 1, making it the brightest comet visible from the northern hemisphere since Hale-Bopp in 1997.

During July 2020 Comet NEOWISE moved through the sky toward the west in the constellations of Auriga, Lynx, and Ursa Major. As luck would have it, for locations on the Earth above 45° N latitude (which includes northwest Oregon) the comet was *circumpolar* from July 13 to 22, which means that it rotated in the sky around the North Celestial Pole (as a result of the Earth's rotation) all night, and never set below the horizon. We were fortunate that this range of dates was also when the comet was best and brightest, and as a result every image in this collection was taken when the comet was circumpolar. One of the images will illustrate the comet's circumpolarity in a very direct way.

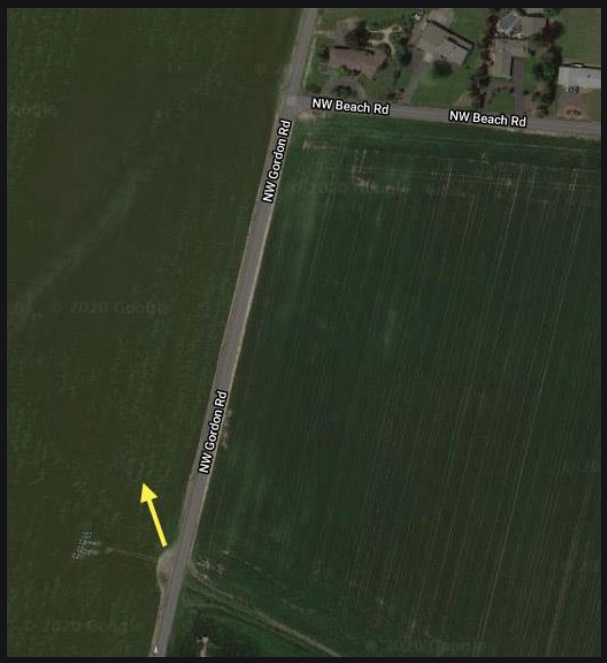
All pictures on the following pages were taken with a standard DSLR (Canon 7D Mark II) on a fixed tripod (Manfrotto tripod plus 3-way geared head) with either Canon's 18-55mm "kit lens", 50mm f/1.8 ("nifty fifty") lens, or 100mm f/2 lens. Even without tracking it is possible to take a relatively short sequence of multi-second exposures and stack the resulting image to decrease noise, and that was done on most of the images taken with the 100mm lens, and even on some of the images with a shorter focal length.

This picture was taken at 4:20 am on July 13, showing the comet rising during dawn in a NE direction, surrounded by various stars from the constellation Lynx. This was right around the period of time when evening started to be a better time to see the comet, but I wanted to have one early-morning photo in the collection. In retrospect I should have started a little earlier - the comet would have been lower to the horizon, but the sky would have been darker.

This was taken from a turnoff with a little parking lot just north of US 26 off Jackson School Road (see map at right). The arrow indicates the location of the camera and which direction it was pointing.



My first evening picture of Comet NEOWISE, from about 11:25 pm on July 14th. This is a more close-up view using a 100mm lens. This image was taken from a small parking area (it fits about three cars) on Gordon Road south of its intersection with Beach Road in western Hillsboro - see map at right. The trees at the bottom of the comet image line the edge of US 26, about a mile away.



Note the fuller extent of the comet's large yellowish dust tail, and a hint of the fainter, thin blue "ion tail". We'll see both of these better in a later image.

A few minutes later I took the image on the following page. I knew beforehand that the ISS (International Space Station) would be flying over the same general area of sky, so I took a series of 6-second exposures at a 24mm focal length. The Big Dipper is very well seen, with the ISS passing between the two stars at the end of the "handle". The comet would stay under the Big Dipper for another couple weeks after this.

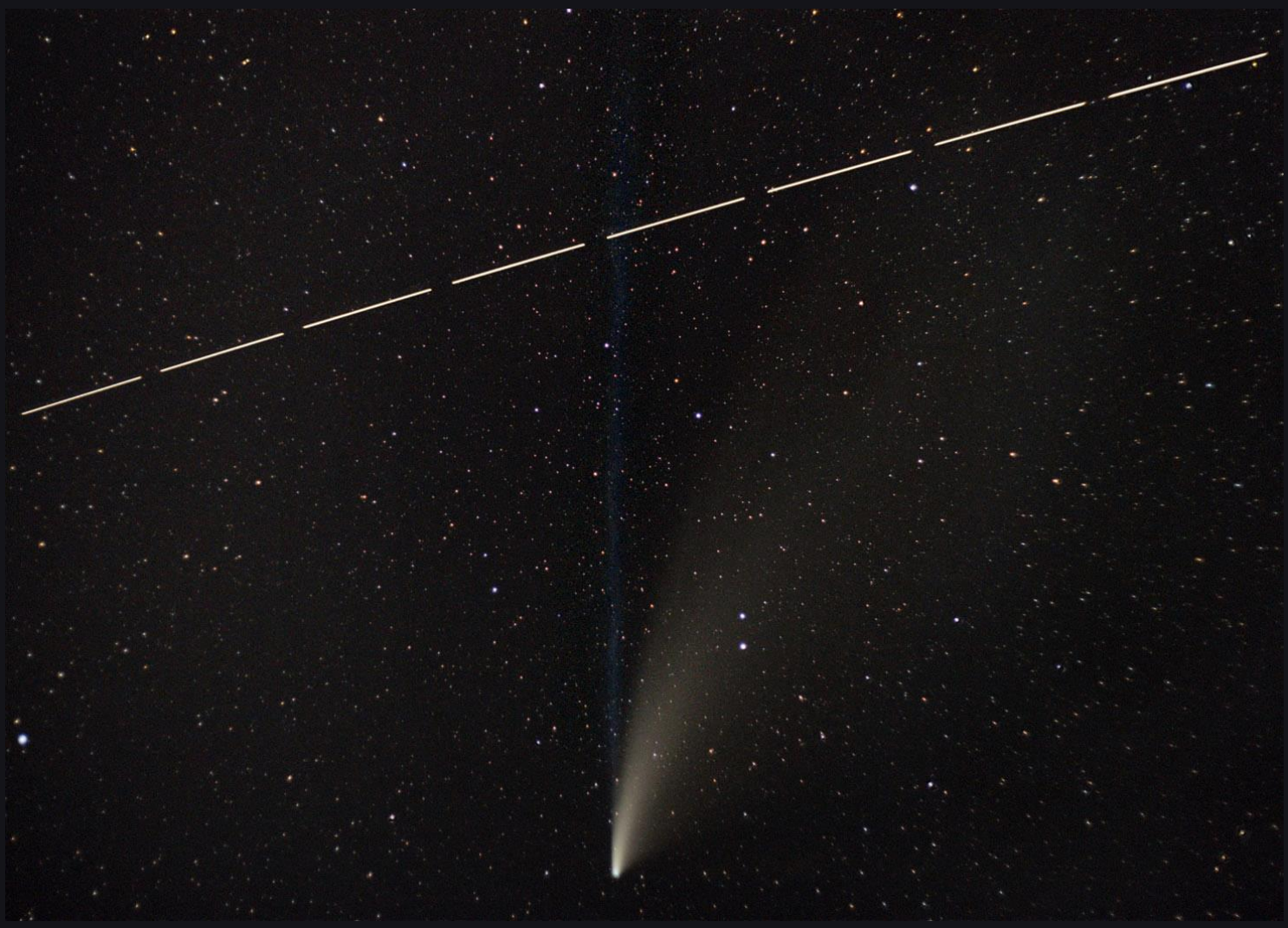
At the bottom right is the scene from the previous page, with Comet NEOWISE above US 26, while the ISS moves through the top of the frame. The gaps in the ISS trail are caused by the delay in the camera between the end of each exposure and the start of the next.

This 3-minute exposure of Comet NEOWISE was taken from the parking lot of a cemetery in Banks, OR. The large dust tail is seen even better here and the blue ion tail is also fairly prominent. This was shot at 11:55 pm on July 18. The better visibility of the ion tail is partly due to the change in orientation of the comet (in 3D) that occurred in the 4 days since the picture on the previous page, as well as the comet being closer to Earth here than it was on the 14th.

The small not-quite-star labeled NGC 2841 is a nearby spiral galaxy at a distance of “only” 40 million light-years. NEOWISE was about 6 light-minutes away at this time, meaning that this galaxy was about 3,500,000,000,000 times farther away from my camera than the comet.

After taking the picture on the previous page I stayed in the same spot and just turned around 180 degrees and captured this view. The brightest “star” in the image is actually the planet Jupiter, and the bright one to its left is the planet Saturn. Five months after this picture the planets Jupiter and Saturn came together very closely in the sky, in an event known as the Great Conjunction of 2020.

On the right side of the picture is the center of our Milky Way galaxy above the eight bright stars of the constellation Sagittarius, as well as several star clusters and nebulas. For example, the tight group of stars at the lower right is open cluster M7 in Scorpio.



This image is from the very next night, at 11:00 pm on July 19. I had looked up the ISS trajectory and saw that it would be passing even closer to the comet - in fact, close enough to cross the outer reaches of the comet's tails. So again I took a series of 6-second exposures and combined them to create this image.

Notice that the segments in the ISS trail get longer as it moves from left to right. They are all the same duration - 6 seconds - so this indicates that the ISS is moving faster, from our perspective, on the right side. The reason for this is simple - as the ISS was moving from left to right, it was also getting closer to the camera. The same effect can be seen with an airplane, which seems to move slow near the horizon and very fast overhead. Its actual velocity is not changing (nor is the ISS velocity here), but the apparent angular speed of an object is (inversely) proportional to its distance, so when it gets closer its apparent speed as seen by the observer increases.

This picture is from 10 minutes after the one on the previous page, from a different spot in the cemetery and with a wide-angle lens.

This picture is also from the same night, at about 11:16 pm. The streak to the right of the comet could be either a shooting star (meteor) or an artificial satellite, but based on its speed of movement and brightness it is more likely to be a satellite.

This is the last image from that same night, July 19. From 12:15 am to 3:00 am I took a photo once every 10 minutes and later combined (overlaid) them all. Several things can be gleaned from the result:

(1) That Comet NEOWISE was circumpolar on this night, meaning that it never sets below the horizon, is apparent. The comet is closest to the horizon around the 3rd or 4th image from the right, after which it starts to climb higher in the sky again.

(2) As time goes forward in this time lapse, everything in the sky is rotating anticlockwise (around the celestial North Pole, which is out of the frame at the upper right), so the stars and the comet were moving from left to right. But at the same time, the comet was moving right to left relative to the stars. This can be easily seen by noticing how the head of the comet moves relative to the bright star next to it.

(3) The comet gets dimmer and harder to see as it nears the horizon. This is because the lower it is, the more air you are looking through to see it, and this “airmass” attenuates light passing through it. Notice that it also gets more yellow/red as it gets lower. This happens for the same reason that the setting sun turns yellow/orange/red, which is that the atmosphere attenuates blue light more than other colors.

(4) When you look at a comet, the direction (angle) that the tail of the comet points depends on several factors, but one of those is simply what time of night you are looking at it. Over the course of these three hours, and angle of the comet tail changes by 45 degrees.

My final image of comet NEOWISE, from 11:02 pm on July 21. I had noticed a few days earlier that this time the ISS would be passing right in front of the brightest part of the comet, so again I a took a series of 6-second exposures and combined them. By sheer luck I captured not one but three man-made objects passing in front of the comet. The dim trail above the ISS trail is Starlink 2-BE, one of the many Starlink satellites launched in 2020 by SpaceX. The third trail (the one that varies in brightness) is GCOM-W1, a Japanese satellite that gathers data about water distribution on the Earth for climate change research. The brightness variation is caused by a two-meter-diameter disc shaped antenna on the satellite that rotates. As the antenna spins, the amount of sunlight reflected off its complicated shape constantly changes. Notice that it flares up really bright at one point due to catching the sun just right for a brief moment.