http://www.raclub.org/

The StarGazer

Newsletter of the Rappahannock Astronomy Club No. 1 Vol. 8 May 2019–July 2019

Apollo 11—The Sea of Tranquility

By Jerry Hubbell

(Note: A version of this article was published in the July 2019 ALPO The Lunar Observer *as the* Focus On *bi-monthly article. To see full-size versions of the figures, go to* http://moon.scopesandscapes.com/tlo_back.html *To see the latest issue of* The Lunar Observer, go to http://moon.scopesandscapes.com/tlo.pdf*)*

Figure 1. Apollo 11 Mission Logo/Patch, NASA image.

This is the final article in a series of six on the Apollo lunar landing missions. A version of the first article (on Apollo 17) was reprinted in the October 2018 issue of the *StarGazer*. For the background and thinking on this series of articles to commemorate the Apollo Program, you can read that article here (see p. 9).

On September 12, 1962, in Houston, Texas, President John F. Kennedy called on our nation to commit itself to placing a man on the Moon and returning him safely to the Earth. His speech, referred to as the "We choose to go to the Moon" speech, issued the following challenge:

"…We choose to go to the Moon in this decade and do the other things, not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, because that challenge is one that we are willing to accept, one we are unwilling to postpone, and one we intend to win, and the others, too…"—John F. Kennedy

Figure 2. Apollo 11 Astronauts. (left to right), Neil Armstrong, Michael Collins, and Edwin "Buzz" Aldrin. NASA image.

The Apollo program was the final push in the "Space Race" between the United States and the Soviet Union, which began with the launch of Sputnik on October 4, 1957. During that period in the Cold War, the Soviet Union was perceived to be leading the race up until the Apollo 8 mission in December 1968 when three astronauts, Jim Lovell, Frank Borman, and William Anders circumnavigated the Moon. Up to that point, the Soviet Union had several space firsts to its name, most notably the first satellite launched into space, the first man in space, and the first spacewalk. What made Apollo 8 that much more significant was that the United States had just recovered from the Apollo 1 fire, which in January 1967, took the lives of astronauts Gus Grissom, Edward White, and Roger Chaffee. This was a significant setback and a blow to the American people. Kennedy's goal was successfully reached on July 24, 1969, and became a source of great pride and confidence for the American people going forward and, I believe, led to the explosive development in electronic technology in the decades following the Apollo program.

Apollo 11 was launched on July 16, 1969, at 9:32 a.m. EDT from the Kennedy Space Center. The crew consisted of Commander Neil Armstrong, Command Module Pilot Edwin "Buzz" Aldrin, and Lunar Module (LM) Pilot Michael Collins (Figure 2). The astronauts had a trouble-free 76-hour journey to the Moon and arrived in lunar orbit at 01:22 p.m. EDT on July 19, 1969. ***(Continued on page 3)***

How to Join RAClub

RAClub is a non-profit organization located in the Fredericksburg, Virginia, area. The club is dedicated to the advancement of public interest in, and knowledge of, the science of astronomy. Members share a common interest in astronomy and related fields as well as a love of observing the night sky.

Membership is open to anyone interested in astronomy, regardless of his/her level of knowledge. Owning a telescope is not a requirement. All you need is a desire to expand your knowledge of astronomy. RAClub members are primarily from the Fredericksburg area, including, but not limited to, the City of Fredericksburg and the counties of Stafford, Spotsylvania, King George, and Orange. We also have several members who live outside Virginia and have joined to have the opportunity to use the Mark Slade Remote Observatory (MSRO)—one of the benefits of joining the club.

RAClub annual membership is $20 per family. Student membership is $7.50. Click here for a printable PDF application form.

The RAClub offers you a great opportunity to learn more about the stars, get advice on equipment purchases, and participate in community events. We meet once a month and hold regular **star parties** each month on the Saturday closest to the new Moon. Our website, www.raclub.org is the best source of information on our events.

We also have an active **Yahoo group** through which you will receive official timely information regarding club activities, including meetings, star parties, and special events. Just click this link, then the blue "Join this Group!" button, and follow the instructions to sign up. We also have a Facebook presence.

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Website: www.raclub.org
Yahoo Group:
http://groups.yahoo.com/neo/groups/rac_group/info

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Upcoming Events

Embrey Mill Star Party	August 9
*RAClub Picnic, Caledon State Park	August 24
**Star Party, Caledon State Park	August 24
Star Party, Caledon State Park	September 21
Meet the Moon, Porter Library	October 5
Star Party, Caledon State Park	October 26

Recent Outreach Events Completed

Star Party, Caledon State Park	May 4
Star Party, Caledon State Park	June 1
Backyard Astronomy, Science Café, Porter Library	July 15
Star Party, Caledon State Park	July 27

*Members only, 5 pm, meeting & program at 7 pm
**Public Star Party starting at 7:30 pm

President's Corner

You can now order Rappahannock Astronomy Club embroidered gear online. Just go to www.rockytoponline.com. Under "Shop," click "Rappahannock Astronomy Club." You can purchase embroidered polos, t-shirts, and hoodies. Orders will be processed on the last day of each month to be ready for the next General Meeting.

Yahoo!Groups is how RAC sends out eMails to its members. Please make sure you are subscribed to the RAC eMail list so that you receive timely club eMails concerning meetings, Star Parties, and other events. Subscribe by sending an eMail to rac_group-subscribe@yahoogroups.com. If you have trouble subscribing or don't get a confirmation email, please notify me or the Yahoo Group Admin.

RAC received a dubious Image License Inquiry on July 3, attempting to pressure the club into paying compensation for the "unauthorized" use of an image in the last newsletter. You may read my response letter at the end of this newsletter.

Don't forget our annual club picnic at Caledon on August 24.

Wishing you transparent skies and excellent seeing,

Glenn Faini D. Faini
President

Did You Know? — by Scott Busby

The first observations with the 36-inch Lick equatorial refractor were made on 3 January 1888, 14 years after James Lick first announced his bequest. It was then the largest instrument of its kind anywhere in the world, and its performance matched its size. The history of this great telescope has often been told. Warner and Swasey made the mount; the Clarks made the 36-inch objective and 33-inch photographic corrector. The contract with the Clarks was not let until 1880. Then there were long delays before Feil could produce satisfactory glass blanks: although the flint disk was soon cast, a successful crown glass was obtained only after another 3½ years and 19 failures and a trip by Alvan Graham Clark to Paris; in 1887, Alvan Graham went to Paris again to negotiate for a better crown disk for the photographic lens because the first crown disk intended for this purpose had been defective and had broken under the Clarks' hands. The visual achromatic combination was sent to Mt. Hamilton, California, in 1886; Alvan Graham accompanied the photographic lens west the following year.

Source: Alvin Clark & Sons Artists in *Optics*, Deborah Jean Warner, Smithsonian Institution Press, 1968

Apollo 11—The Sea of Tranquility (Continued from page 1)

After an exhilarating landing (my description) in the southwest region of Mare Tranquillitatis (Sea of Tranquility) (Figure 3) on July 20, 1969, at 4:18 p.m. EDT, the astronauts prepared for a stay of just under 24 hours. Neil Armstrong took manual control of the final approach to landing when the LM computer was leading them to lunar crater West. Armstrong used up most of the last minute of fuel, finally setting the LM down with only about 15 seconds of fuel left. During the landing, the famous "1201" and "1202" computer alarms also interrupted the proceedings. These alarms occurred because the landing radar was in the wrong mode, resulting in the computer becoming too busy. This caused the computer to reboot itself a few times during the landing approach.

The Apollo 11 LM landed approximately 400 meters west of crater West and 20 km south-southwest of the crater Sabine D at selenographic coordinates 0° 40' 27" N latitude and 23° 28' 23" E longitude. The landing site is also 109 mi (175 km) south of crater Arago 16 mi (26 km), and 236 mi (380 km) north of crater Theophilus 61 mi (101 km.) The LM crew spent only 0.9 days on the surface and performed one 2-hour 32-minute EVA during their stay (Figure 4).

At 10:56 p.m. EDT on July 20, 1969, Neil Armstrong became the first man to walk on the Moon. He stepped off the LM and uttered the famous line: “That’s one small step for (a) man, one giant leap for mankind.”

In *To a Rocky Moon*, geologist Don Wilhelms discusses the process by which Apollo landing sites were chosen:

“…After Apollo 12, scientific considerations were given considerable weight but, for the very first landing [ed. Apollo 11], the site was chosen entirely for operational reasons. During the Lunar Orbiter missions, the high-resolution cameras had been focused on promising sites strung out along a 10-degree-wide band straddling the lunar equator. Equatorial sites were of interest because they could be reached with a minimal expenditure of fuel.

Sites were also sought at least 45 degrees west of the east limb of the Moon—the right edge as seen from the northern hemisphere on Earth - because the landers were going to orbit from east to west and Houston was going to need several minutes of tracking data so that the landing computer could be updated prior to the descent. As Jack Schmitt related during a review of this introduction, "The targeted point for Apollo 8 was picked as the easternmost site that the Flight Control Division thought they could handle, the easternmost certified (acceptably smooth) site for which they thought there would be enough time after AOS (Acquisition of Signal) to track the Lunar Module, update its state vector, and get a successful landing. So Apollo 8 was targeted for that site (designated as Apollo Landing Site 1) and, when it came time for Apollo 10, they targeted it to the same site, because they already had a rough data package (that is, data on orbits and the timing of events during the mission) that they could refine based on the relative positions of the Earth and Moon at the planned time of launch. (Launch times were picked in part, so that, at the time of landing, the Sun would be between 5 and 13 degrees above the landing site horizon, low enough to give good shadow definition of the terrain and not so low that everything would be obscured by overly-long shadows. Lighting conditions at the Cape and at abort recovery sites were also factors) …”

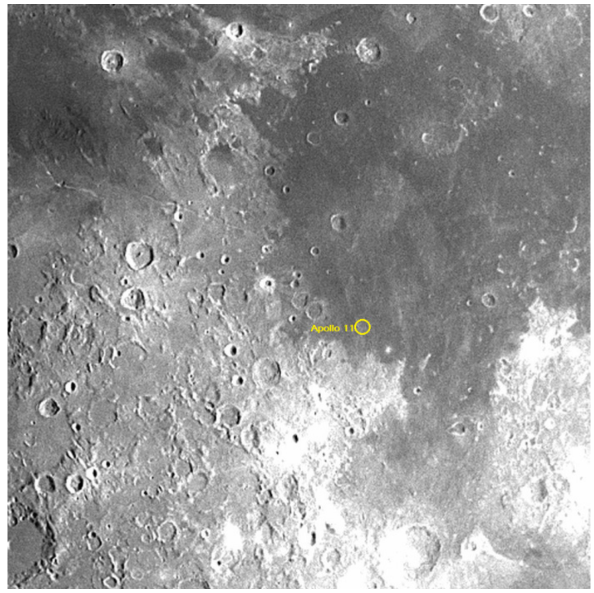


Figure 3. Apollo 11 Landing Site and Surrounding Area, Jerry Hubbell, Locust Grove, Virginia, 03 April 2009, 1926 UT. Colongitude, 17.6°, SkyWatcher 12-cm f/7.5 APO refractor, ATIK 314e CCD Camera. Visibility, 4/5 Transparency, 3/5. (Ed. This is a crop of Figure 5.)

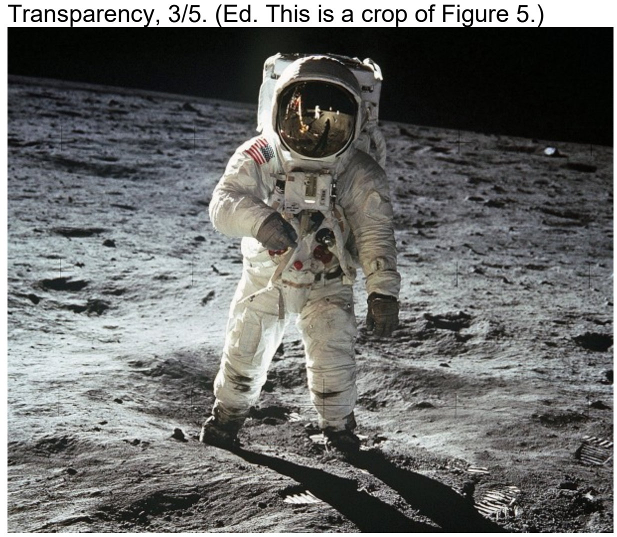


Figure 4. Apollo 11 Astronaut Edwin “Buzz” Aldrin on the surface of the Moon on July 20, 1969 during the 2-1/2 hour EVA. NASA image.

The main mission and program objective was to successfully meet Kennedy’s challenge to *land a man safely on the Moon and return him safely to the Earth*. The secondary objectives included exploring the southwest region of the Sea of Tranquility and to set up and activate the first lunar surface scientific experiments called the Early Apollo Scientific Experiments Package (EASEP). The EASEP consisted of three experiments:

- Laser Ranging Retroreflector experiment
- Passive Seismic experiment
- Lunar Dust Detector experiment.

The astronauts also deployed a camera system, a solar wind experiment, and the first American flag on the Moon’s surface.

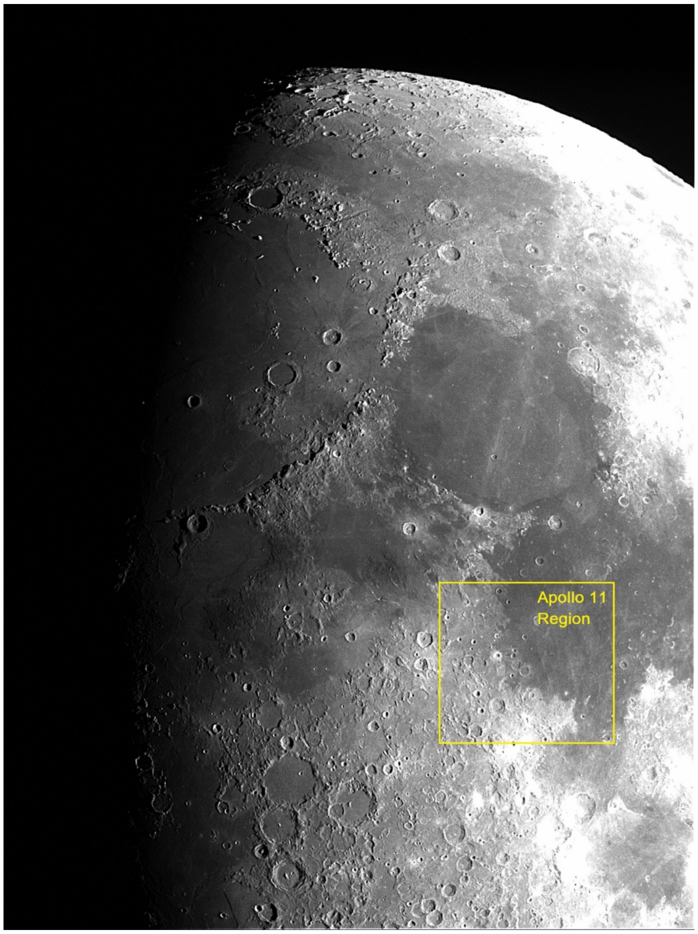


Figure 5 Mare Tranquillitatis (Sea of Tranquility), Jerry Hubbell, Locust Grove, Virginia, 03 April 2009, 1926 UT. Colongitude, 17.6°, SkyWatcher 12-cm f/7.5 APO refractor, ATIK 314e CCD Camera. Visibility, 4/5 Transparency, 3/5.

The early Apollo mission site selection criteria were based on the need to sample sites that were representative of the lunar surface and could provide materials to begin to understand the origin of the Moon. According to the *Criteria for Lunar Site Selection*, Report No. P-30:

"…According to the rationale of level 2, the individual mission sites must be chosen to represent homogeneous provinces and/or scientifically significant features. The homogeneous sites must have characteristics, in so far as can be determined from the orbital reconnaissance of level 1, that are typical of the province in which they lie, so that the information obtained from each site is of significance regarding a large portion of the Moan, or hopefully the entire Moon. By this definition it is to be understood, once such a homogeneous province has been defined, that the actual location of the landing site within the province is not critical and that from a scientific stand point extensive traverse capability is not required. Large fractions of the various lunar maria, the majority of exposed ejecta from Imbrium or Oriental, and portions of the cratered upland plains between Maurolycus and Janssen are examples of areas where level 2 landing sites would yield the desired scientific information."

The Sea of Tranquility is in the northeastern quadrant of the Moon, and the Apollo 11 landing site is in the southwest region of the quadrant (Figure 5). The northeast quadrant of the Moon has a wealth of features suitable for a small telescope to observe, and any time between a 1-day-old and a 7-day-old Moon will give the best views because of the long shadows near the terminator. A long list of craters is viewable even with a 70-mm refractor or a 10x60 set of binoculars. Some of the most prominent (and their diameters) are Plato (61 miles, 98 km), Aristoteles (53 miles, 85 km), Eudoxus (41 miles, 66 km), Cassini (35 miles, 56 km), Archimedes (50 miles, 80 km), Hercules (42 miles, 68 km), Atlas (53 miles, 85 km), Posidonius (58 miles, 93 km), Aristillus (33 miles, 53 km), Delambre (32 miles, 51 km), Theophilus (61 miles, 98 km), Cyrillus (59 miles, 95 km), and Agrippa (28 miles, 45 km). Details on these and more can be obtained using the program *Virtual Moon Atlas* (see References). This is an excellent program for those who want to learn the features of the Moon and identify those features in your own or others' photographs.

Figures 6 and 7 the Sea of Tranquility and Tranquility Base, were submitted by Alberto Martos from an observing session in 2008. He provided the following notes for the observation:

"…I remember a strong difficulty in viewing the small craterlets dedicated to the three astronauts, Armstrong, Collins, and Aldrin. A mild turbulence, I live in a small village close to a large town (Madrid) prevented me to see those craterlets, only a glimpse from time to time. I observed the heavily eroded crater Julius Caesar, whose flat lava flooded surface was proposed for landing site at once and the Ritter and Sabine lack of secondaries as well as rays, but none of the small ones. Then, I decided to take a few pictures with Phillips TouCam Pro camera. Photo 1 (Figure 6) was stacked out of 100 frames and shows the area of SW Mare Tranquillitatis. Crater Maskelyne was cut half, but Ritter and Sabine were well centered. In this photo I have annotated the chief craters visible. Having lost the opportunity to introduce a Barlow lens, I have recently enlarged this photo by means of InPixio Photo Maximizer, in an attempt to take a look to the craters. The result can be seen in photo 2 (Figure 7, but I request the indulgency of the reader, to guess the situation of the three craters. I'm sure they can be perceived, at least I can!"

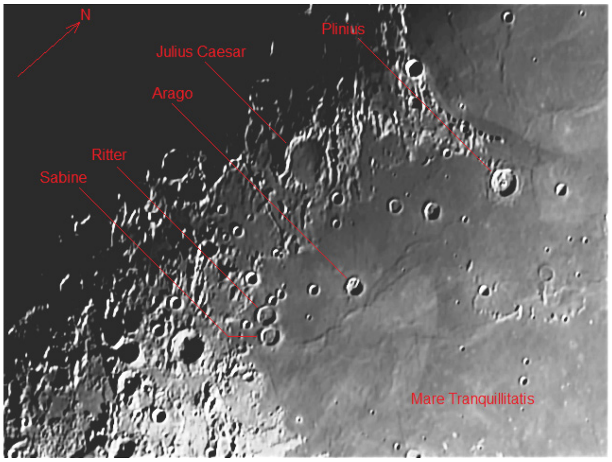


Figure 6. Mare Tranquillitatis (Sea of Tranquility), Alberto Martos, Madrid, Spain, 11 May 2008, 2147 UT, Colongitude, 350.2°, 20 cm f/7.2 Newtonian, Phillips TouCam Pro, Visibility, 3/5 Transparency, 4/5.

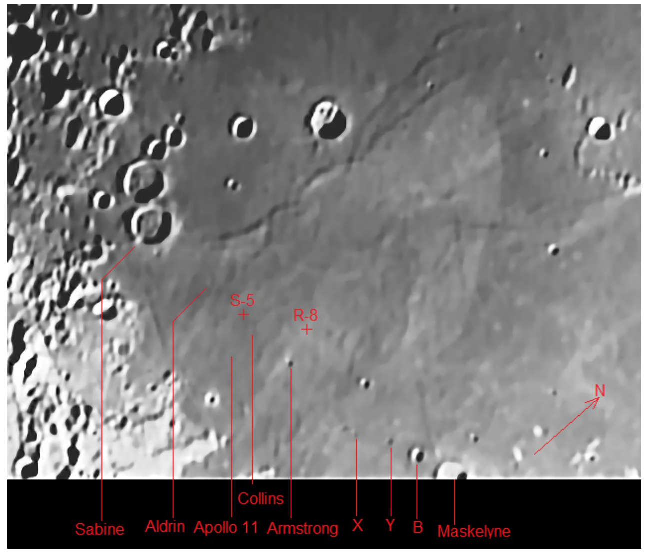


Figure 7. Statio Tranquillitatis (Tranquility Base), Alberto Martos, Madrid, Spain, 11 May 2008, 2147 UT, Colongitude, 350.2°, 20 cm f/7.2 Newtonian, Phillips TouCam Pro, Visibility, 3/5 Transparency, 4/5.

Rik Hill also provided some great views of the Sea of Tranquility and Tranquility Base including Figure 8.

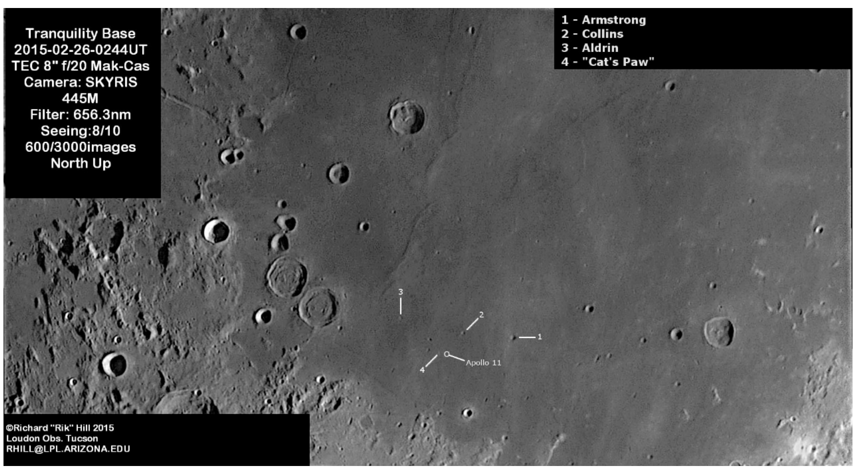


Figure 8. Mare Tranquillitatis (Sea of Tranquility), Rik Hill, Tucson, Az USA, 25 February 2015, 0244 UT, Colongitude, 357.9°, TEC 8-inch f/20 Maksutov-Cassegrain, SKYRIS 445M, 656.3nm Filter, Seeing, 8/10, North Up, East Right.

Figure 9 (on the next page) lists all the Apollo Lunar missions and the features located near each of the landing sites.

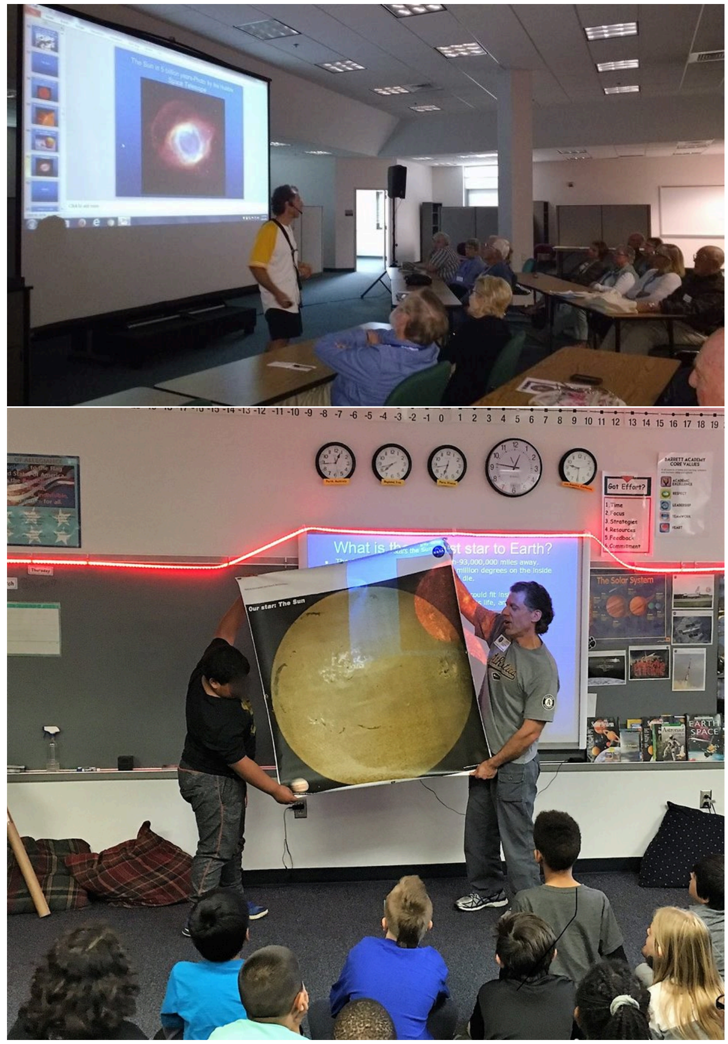
Figure 9. Apollo Manned Lunar Landing Mission Information (compiled by Jerry Hubbell)

Mission	**Apollo 11**	**Apollo 12**	**Apollo 14**	**Apollo 15**	**Apollo 16**	**Apollo 17**
Mission Launch	16-Jul-1969 13:32:00 UTC	14-Nov-1969 16:22:00 UTC	31-Jan-1971 21:03:02 UTC	26-Jul-1971 13:34:00 UTC	16-Apr-1972 17:54:00 UTC	07-Dec-1972 05:33:00 UTC
Lunar Landing	20-Jul-1969 20:18:04 UTC	19-Nov-1969 06:54:35 UTC	05-Feb-1971 09:18:11 UTC	30-Jul-1971 22:16:29 UTC	21-Apr-1972 02:23:35 UTC	11-Dec-1972 19:54:57 UTC
Lunar Departure	21-Jul-1969 17:54:00 UTC	20-Nov-1969 14:25:47 UTC	06-Feb-1971 18:48:42 UTC	02-Aug-1971 17:11:23 UTC	24-Apr-1972 01:25:47 UTC	14-Dec-1972 22:54:37 UTC
Splashdown	24-Jul-1969 16:50:35 UTC	24-Nov-1969 20:58:24 UTC	09-Feb-1971 21:05:00 UTC	07-Aug-1971 20:45:53 UTC	27-Apr-1972 19:45:05 UTC	19-Dec-1972 19:24:49 UTC
Mission Duration	8d 03h 18m 35s	10d 04h 36m 24s	9d 00h 01m 58s	12d 07h 11m 53s	11d 01h 51m 05s	12d 13h 51m 59s
Time on Lunar Surface	21h 36m 00s	31h 31m 12s	33h 30m 31s	66h 54m 54s	71h 02m 12s	74h 59m 40s
Number of EVAs	One	Two	Two	Four—One EVA in space	Four—One EVA in space	Four—One EVA in space
EVA Time on Lunar Surface	2h 31m 40s	7h 45m 18s	9h 22m 31s	18h 30m 00s	20h 14m 14s	22h 03m 57s
Mission Commander	Neil Armstrong	Charles Conrad	Alan Shepard	David Scott	John Young	Eugene Cernan
Lunar Module Pilot	Buzz Aldrin	Alan Bean	Edgar Mitchell	James Irwin	Charles Duke	Harrison Schmidt
Command Service Module Pilot	Mike Collins	Richard Gordon	Stuart Roosa	Alfred Worden	Ken Mattingly	Ronald Evans
Mission Goals	First manned landing on the Moon, Early Apollo Surface Experiment Package (EASEP)	Precision Landing near Surveyor 3 spacecraft, Apollo Lunar Surface Experiments Package(ALSEP), lunar orbital experiments and photography H-mission type	First use of the "Lunar Rickshaw," Examination of Cone Crater, lunar surface experiments (ALSEP) and lunar orbital experiments and photography H-mission type	First use of the Lunar Rover, lunar surface experiments (ALSEP) and lunar orbital experiments and photography first J-mission type	lunar surface experiments (ALSEP) and lunar orbital experiments and photography J-mission type	lunar surface experiments (ALSEP) and lunar orbital experiments and photography last mission to the Moon
Landing Site Name	Sea of Tranquility	Ocean of Storms	Fra Mauro Highlands	Mare Imbrium-Hadley Rille	Descartes - Cayley Plains	Sea of Serenity
Landing Site Selenographic Coordinates	0.674°N 23.473°E	3.0124°S 23.4216°W	3.654°S 17.471°W	26.132°N 3.634°E	8.973°S 15.500°E	20.191°N 30.772°E
Landing Site Features	Flat plain, near southern edge of Mare Tranquillitatis	Surveyor 3 spacecraft	First mission to lunar highlands, volcanic activity	Mt Hadley, Hadley Delta, Hadley Rille	Lunar Highland material older than previous missions, volcanic activity in area	Lunar Highland material older than Mare Imbrium, volcanic activity in the area
Focus On Observations	Delambre, Sabine, Ritter, Godin, Agrippa, Maskelyne, Lamont, Theophilus, Torricelli	Copernicus, Reinhold, Lansberg, Ptolemaeus, Alphonsus, Arzachel, Bullialdus, Montes Riphaeus	Fra Mauro, Parry, Bonpland, Guericke, Rimae Parry, Gambart, Lansberg, Reinhold, Tolansky	Hadley Rille, Hadley Delta, Archimedes, Aristillus, Autolycus, Conon, Galen, Aratus	Ptolemaeus, Alphonsus, Arzachel, Rupes Recta, Albategnius, Klein, Hipparchus, Herschel, Abulfeda, Delambre	Posidoius, Plinius, Dawes, Cleomedes, Macrobius, Romer, Jansen, Dorsa Smirnov, Dorsa Lister
Observing Equipment - Minimum to observe all objects listed	50–100 mm Telescope	50–100 mm Telescope	50–100 mm Telescope	50–100 mm Telescope	50–100 mm Telescope	50–100 mm Telescope
Submissions—Images	N/A	3–8 images + comments	1–13 images + comments	5–19 images + comments	3–5 images + comments	4–13 images + comments
NASA Mission Surface Operations Page	NASA Apollo 11 Mission	NASA Apollo 12 Mission	NASA Apollo 14 Mission	NASA Apollo 15 Mission	NASA Apollo 16 Mission	NASA Apollo 17 Mission
TLO—Focus On Article	Apollo 11	Apollo 12	Apollo 14	Apollo 15	Apollo 16	Apollo 17

NASA/JPL Solar System Ambassadors Program

By David Abbou

There is no doubt that we amateur astronomers enjoy sharing our interest in the universe with the public. The NASA/JPL Solar System Ambassadors (SSA) program is one great way to bring astronomy and the space program down to Earth, as I learned when I became a Solar System Ambassador many years ago.



SSA David presenting to (top) University of Mary Washington Elder Study and (bottom) elementary schoolers

The SSA program, managed by NASA/JPL in Pasadena, CA, has 1,000 volunteers nationwide and the U.S. territories who come from all walks of life to bring the excitement of NASA missions to the public. A few of our own RAC members are SSAs too. Since the SSA program began recordkeeping in 2001, SSA volunteers have conducted 45,000 events for over a half-billion people, with almost 10 million of them being reached in person!

Throughout the year, NASA/JPL provides support to volunteers by distributing NASA outreach materials, conducting webinars with NASA scientists, and hosting various other activities and events. New SSAs receive ethics and new ambassador training, and existing SSAs can participate in this annual training as well.

Since becoming an SSA in 2008, I have logged nearly 200 outreach events, spanning the full age spectrum from preschoolers to older adults. Some of my favorite events have been those for elementary schools, where I am always amazed by how much children know and want to learn about our universe.

With Apollo 11's 50th anniversary this summer, SSAs nationwide are in high gear to promote the event. This is also a great opportunity for SSAs to discuss NASA's newly announced plans to revisit the Moon in 2024 as well as promote ongoing and future NASA missions.

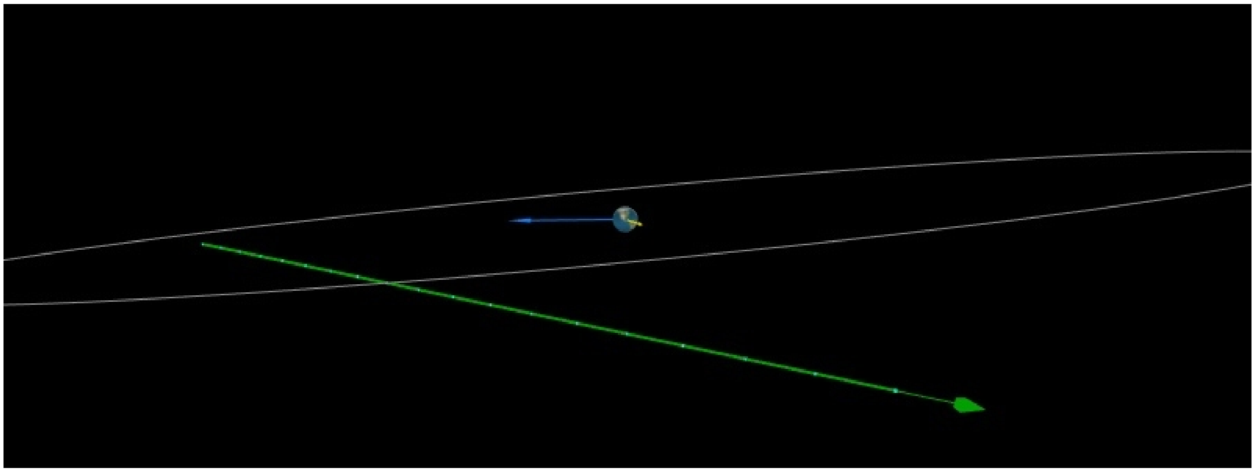
Applications for new SSAs are accepted during September each year. If you're interested, visit https://solarsystem.nasa.gov/ssa to learn more about this astronomical program.

Oops, Did You Blink and Miss That? Near-Earth Object Generates Buzz

By Lauren Lennon

Does 45,000 miles sound like a safe distance? After all…that's almost double the circumference of the Earth and also the same number of miles my car has accumulated in the last 2 years commuting to Richmond.

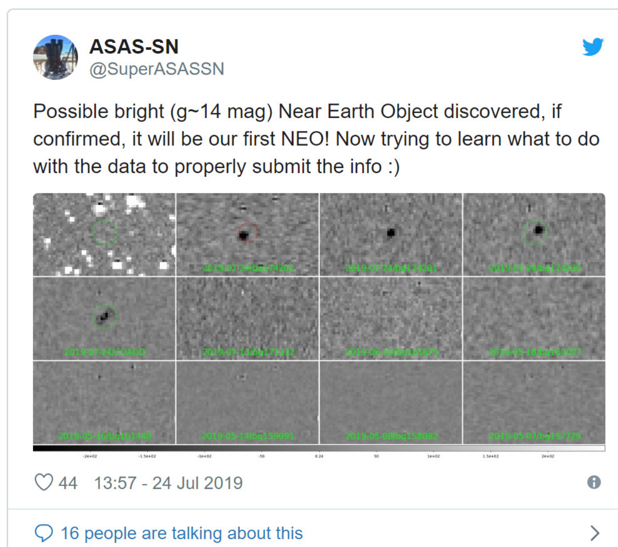
At 0122 GMT on July 25, 2019, Asteroid 2019 OK passed within only 43,500 miles of the Earth. For scale, that is about 1/5 of the distance from the Earth to the Moon. Although it certainly would not have been an extinction-level event if it had impacted the Earth, this asteroid was approximately 187–427 feet wide and would have certainly done damage on the ground. Traveling at an estimated 54,000 mph, the majority of the asteroid would have survived entry through the atmosphere and hit with enough force to destroy a city—an estimated explosive force of up to 10 megatons of TNT, according to Dr. Michael Brown at Australia's Monash University's School of Physics and Astronomy.



Interactive Geocentric Orbit Sketch. Source: International Astronomical Union Minor Planet Center

The last asteroid of similar size to impact the Earth struck more than a century ago—the Tunguska event in Siberia on June 30, 1908. The explosion leveled approximately 770 square miles, and the 120-foot-across asteroid fragmented and released the equivalent of about 185 Hiroshima nuclear bombs.

Our next *expected* Near-Earth visitor will be the Apophis asteroid—estimated to arrive Friday, April 13, 2029. Apophis may pass as close as 18,600 miles from the Earth and is an estimated 1,300 feet wide. Four times larger than 2019 OK, Apophis is still orders of magnitude smaller than the Chicxulub asteroid that wiped out the dinosaurs—in the event of an impact, we would not be looking at mass-extinction events.



ASAS-SN Tweet on its detection of 2019 OK

Credit for recognizing the asteroid as a Near-Earth Object goes to the Southern Observatory for Near Earth Asteroids Research (SONEAR) survey (Oliveras, Brazil) and the All-Sky Automated Survey–Supernovae (ASAS-SN) telescope network. 2019 OK has been imaged previously, which narrowed down its orbit—it is very elliptical, with each orbit taking approximately 2.7 years as the asteroid travels from the asteroid belt beyond Mars to within the orbit of Venus. We'll be seeing 2019 OK regularly, but at least now we will know to expect it for dinner.

References:

JPL Small-Body Database Listing: Asteroid 2019 OK. https://ssd.jpl.nasa.gov/sbdb.cgi?sstr=2019%20OK

Minor Planet Center Observation Data: Asteroid 2019 OK. https://www.minorplanetcenter.net/mpec/K19/K19O56.html

Tunguska Event. https://science.nasa.gov/science-news/science-at-nasa/2008/30jun_tunguska

Recent Club Events and Star Parties

By Glenn Faini, David Abbou, and Linda Billard

June 1 saw another very successful RAC Star Party at Caledon State Park. Glenn Holliday and Glenn Faini were the only club members present. Although neither had brought telescopes, there were plenty of guests with telescopes—three 8-inch SCTs and two 4-inch Newtonians. Guests Eric and Doug had a new 8-inch Celestron SCT on a VX GEM that they needed instruction on setting up and using. We think they went home much more confident that they could operate the telescope. Mark Burns, an Astronomy teacher at King George High School, brought his 8-inch Celestron EVO SCT. Many of Mark's students also attended. Rob had an 8-inch Meade SCT on a fork mount. About 30 guests attended and most stayed until about 10:00 when dew and humidity started becoming an issue. The two Glenns were the last to leave at about 10:30. Several guests showed interest in joining the club and coming to our next meeting.

On the evening of July 15, David Abbou conducted an outreach event at the Porter Library in North Stafford titled "Science Café-Backyard Astronomy for Beginners." Although attendance was low, there was a lot of interest and engagement from the attendees. David covered general astronomy, observational astronomy, and the space program during his hour-long presentation. He also discussed RAC's monthly star parties with attendees interested in attending.

On July 27, RAC had a very successful and well-attended Star Party at Caledon State Park with clear skies and seeing and transparency excellent for a warm summer evening. Glenn Faini, Tim Plunkett, and Rolando Pancotti, and at least 30 guests participated with seven telescopes and a pair of binoculars. There weren't any large groups, but several families brought chairs and picnic blankets. Several guests indicated that they would join RAC. Glenn F. brought his C80 refractor on a GEM and his NexStar 102SLT and 8SE Alt/Az telescopes, and spent the evening answering questions, explaining how the telescopes differed and operated, and viewing Jupiter and Saturn. The four Galilean moons and Titan were also visible and impressed people. Glenn found that his new 8mm-24mm zoom eyepiece (see next article in this newsletter for a product review) didn't give views as crisp as his Ultima fixed focal length eyepieces, but it was certainly more convenient for changing magnification in the dark. Several satellites and many bright meteors, probably Delta Aquariids, were visible. Most people stayed until nearly 11 p.m., with six staying until 12:15.

Product Review: Celestron 8–24 mm 1¼-inch Zoom Eyepiece

By Glenn Faini

I confess to being a brand name loyalist. All three of my telescopes are Celestrons, as are my diagonals, Barlow, and eyepieces, except for a ScopeTronix MaxView. Most of my eyepieces are Celestron Ultima® Series, which were Celestron's top-of-the-line eyepieces and rated best in their class when I got them 20 years ago. They are wonderful long eye relief, wide angle, parfocal, fully multicoated 1.25-inch eyepieces…so why do I need a zoom eyepiece of lesser quality?

Convenience, and peace of mind.

Each time I set up my Celestron NexStar telescopes, I have to precisely center three different stars in the field of view. To do that accurately, I need to first find and center each star with a low power (24 mm) eyepiece and then switch to a higher power (12.5 mm) eyepiece to more accurately center each star. With a zoom eyepiece, I no longer have to switch eyepieces over and over again in the dark, making the Sky Align process quicker, simpler, and safer (for my eyepieces).

Celestron Ultima® Series
©1998 Celestron International

If you use filters such as a Contrast Booster, using a single zoom eyepiece eliminates the need to move the filter from eyepiece to eyepiece as you change focal lengths.

At star parties, I can quickly and conveniently change the magnification to suit the target and sky conditions when sharing my telescope with guests, and I don't have to worry about my more expensive eyepieces getting dirty, dropped, or marred with fingerprints. At 8 oz, it is also the heaviest eyepiece in my collection. Specifications are as follows:

Celestron 8–24 mm Zoom Eyepiece
©2019 Celestron, LLC

- Focal length: 8 mm to 24 mm
- AFOV: 60° at 8 mm to 40° at 24 mm
- Eye Relief: 15 mm to 18 mm
- Barrel Diameter: 1¼ inches
- Threaded for 1¼-inch filters
- Fully multicoated

The eyepiece has indicators for 24 mm, 18 mm, 12 mm, and 8 mm, but it can be turned to any focal length between 8 and 24, allowing you to use the optimum focal length for the target you are viewing. If you insert the eyepiece with the indicator arrow up, you can easily see the focal length setting, if that is important to you.

The zoom mechanism turns very smoothly; however, the eyepiece is not parfocal, so some focusing is required as you change magnification. Eye relief, brightness, and clarity seem comparable to my Ultima 24-mm eyepiece, which is a pleasant surprise.

An interesting feature, which might come in handy for planetary imaging, is hidden beneath the rubber eye cup. Remove it and you will find t-ring threads for eyepiece projection photography.

Overall, I am very pleased with the quality and convenience of this eyepiece. It is quite a bargain for the price.

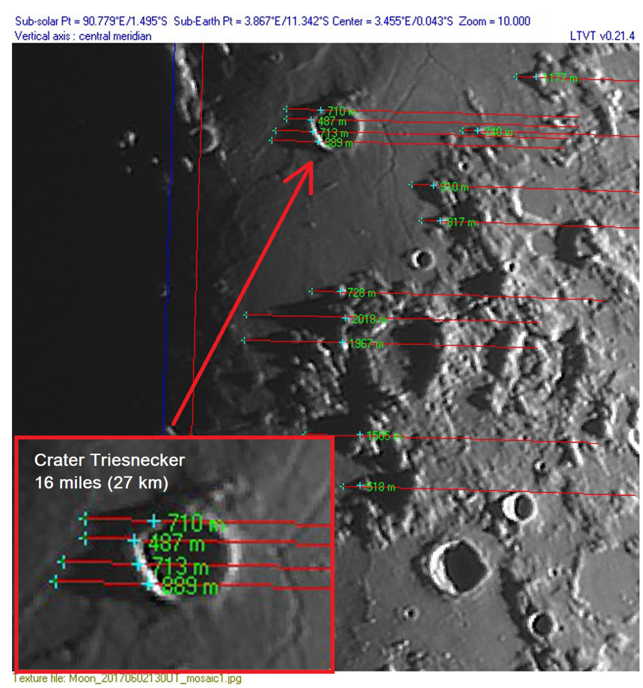
Highlights of Recent RAClub Presentations

Abstracted from Bart Billard's Meeting Minutes

May 2019—Looking at the Moon: Online Tools

Jerry Hubbell's presentation covered tools available online for planning and analyzing lunar observations. He started with lunar charts available for personal computers (PCs) or phones. The first tool was Virtual Moon Atlas (the page for the PC download is here). Jerry started it and showed the initial view was a relief drawing of the Moon as it appeared on the current date. He showed how to go to other phases and see when they were or would be. He also showed how to pick a date and find how the Moon appeared or would appear. On the chart, one can point to a feature and click to identify it.

Someone asked about the lines radiating from the crater Tycho. Jerry explained they were from debris thrown out by the impact that created the crater. He showed that Virtual Moon Atlas allows zooming in on features. When he zoomed on Copernicus, the program automatically switched charts to provide more details. The user can go to a configuration window to control the chart type selected according to the zoom level. Jerry indicated a camera icon that allows access to features viewed.



Analysis of Crater Triesnecker using the Lunar Terminator Visualization Tool (LTVT). Source: J. Hubbell

When Jerry clicked the “Terminator” tab, a list of craters near the terminator at the specified time displayed. He said this feature is useful for planning observations because the angle of the Sun would be favorable for seeing a lot of detail in those features. Tom Watson asked about the letters that appeared near some of the craters. Jerry showed the “A” near Gassendi marked a small crater named Gassendi A.

Don Clark asked about finding Apollo landing sites. Jerry typed “Apollo 11” into the Find tool and brought up the Apollo 11 landing site. The image also indicated the locations of the Surveyor 5 site and three craters nearby named for the Apollo 11 astronauts.

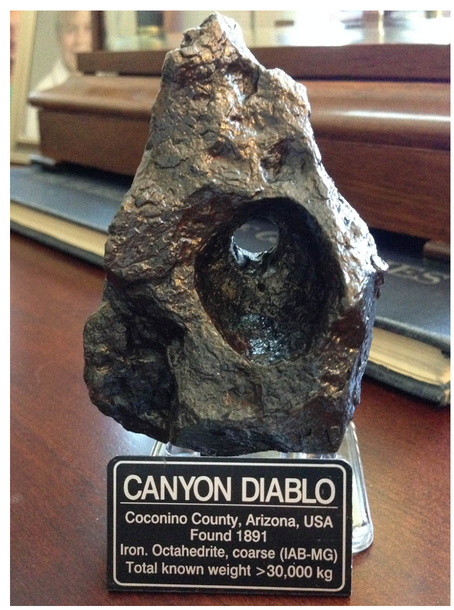
Various types of information were shown along the right side of the diagram. One heading Jerry pointed out was “Observation.” With Copernicus N1 selected, the notes indicated a 100-mm refractor would be needed. Jerry mentioned he recently visited the crater near Flagstaff, Arizona, and liked to think of it when observing lunar craters. He talked about the Association of Lunar and Planetary Observers (ALPO) and its Lunar Section Newsletter, *The Lunar Observer*. Jerry said he was a member and lately has been doing articles on the Apollo mission landing sites for the “Focus On” column in the newsletter.

Another tool was the Lunar Chart (LAC) series website. It is published by the Aeronautical Chart Information Center, United States Air Force. Jerry briefly sampled maps available at the site. He then mentioned Robert Reeves as a good source on how to do high-resolution lunar photography.

Jerry also demonstrated the Lunar Terminator Visualization Tool (LTVT) for advanced analysis of images of the Moon. It can render the Moon as seen from an observer’s Earth location. It can calibrate users’ images and show them on the chart. Then it can adjust the image to appear as though it were seen from directly above a selected feature. Craters that look oval in the original image then appear round. Jerry illustrated how to draw a circle on a crater image you have taken and see what size the image indicates for the crater. The result can be compared with the accepted size to see how good the measurement from the image is. He also demonstrated how to determine the height of a crater rim or mountain from the length of its shadow. In inverse shadow length mode, he set a reference point at the edge of the shadow, and then clicked at the peak along the red line drawn by the program to represent the path of sunlight past the mountain to the location of the reference point. LTVT calculated the height of the peak based on the angle of the Sun at the time of the image.

June 2019—Meteors and Meteorites

Scott Busby said his program was an update of the material he presented in March 2009. He said meteors and meteorites can be a side hobby for amateur astronomers. It can be relatively inexpensive, and amateurs can even find meteorites on the ground. Scott had samples from his meteorite collection spread out on the table. He mentioned the 20-pound sample he showed in 2009, his “pride and joy” from Argentina. When he and his wife moved from Stafford, the box it was packed in somehow got mixed up with boxes marked for Goodwill. Someone wound up with a nice bonus.



Source: Scott Busby

Scott first discussed the source of meteors and meteorites. He said they are basically rocks from space. Some meteors are part of showers, which mostly come from periodic comets. They are remnants of the formation of the solar system, when gas and dust coalesced to form the Sun, planets, comets, and planetesimals. Planetesimals sometimes collide and grow, and the resulting heat can melt the material. The melting allows heavier materials to sink and form iron cores. Sometimes the collisions break apart planetesimals into fragments that can eventually become meteors and meteorites. Ones from iron cores have crystal structures that are revealed by cutting, polishing, and etching. Ones from planetesimal crusts are stony. Pallasites are a mixture of metal and silicate crystals. They are very beautiful but unstable, corroding easily.

Scott talked about meteorites found on Earth that have been determined to have come from the Moon, Mars, and maybe Mercury. Impacts on these bodies have blasted off material, some of which eventually found its way to

Earth. He was asked whether Venus has been a source of meteorites. Scott said it seems very unlikely because of the dense atmosphere, which would affect both the impactor on the way to the surface and the fragments blasted off the surface. Someone said he believed he had read that we had to get data back from probes to Mars before we could identify any meteorites on Earth as Martian-sourced.

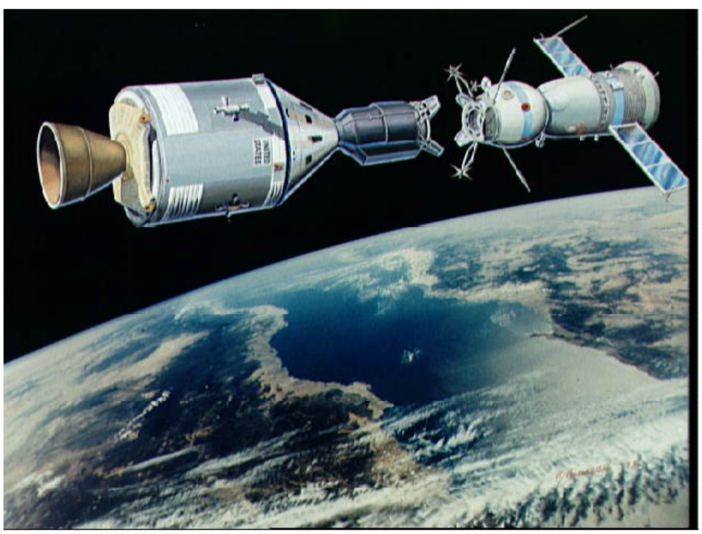
Scott presented descriptions of the major types of meteorites. The iron types were ataxites, with no crystalline structure; hexahedrites, with fine crystals; and octahedrites, with large crystalline structure. The stony types were achondrites; chondrites, with chondules that can be seen when the meteorite is cracked open; and mesosiderites. The stony/iron types were mesosiderites and pallasites, mentioned earlier. In his 2009 presentation, Scott had been able to show his pallasite sample before it had corroded. Irvin Sugg asked whether crystalline structure was a result of heating in our atmosphere. Scott said it was the result of slow cooling over thousands of years, probably as part of a larger body that later fragmented.

Scott showed a chart of the mean composition of meteorites, notably including oxygen and chlorine, which are found as gas pockets. Bart asked, and Scott confirmed the composition chart was a mean over all the different types of meteorites.

To help him identify meteorites by type, Scott said he used a list of questions. Is it heavier than it looks? Does it have “thumbprints” (called regmaglypts)? Does it show signs of rust? Does it have angular faces but at least slightly rounded corners? Is it attracted by a magnet? If it is metal, does it pass the nickel test?

Glenn Holliday showed three northwest African chondrites he received in a kit from the University of Arizona where he attended a course on astronomy outreach. He also had a tektite. Scott explained tektites form by melting of material in the ground where an impact occurs, and they are like volcanic glass. Glenn’s tektite had an elongated shape, probably from rotating in the atmosphere and cooling before falling back. Scott ended with a few pointers about collecting meteorites.

July 2019—Apollo, Skylab, and Viking in the News


Artist’s rendering of Apollo–Soyuz docking. ©NASA

To mark the 50th anniversary this month of the Apollo 11 mission to the Moon, Glenn Faini led a discussion on the history of Apollo, Skylab, and Viking. He noted that the date of the current meeting (July 17) was also the 44th anniversary of the Apollo–Soyuz linkup. Glenn F. said he was in elementary school at the time of the Moon landing and that neither he nor his father could remember having watched on television. He did remember the Apollo missions after 12 and 13. Glenn Holliday said July 17 was also the 50th anniversary of the first color television broadcast from space (from Apollo 11).

Glenn F. said he remembered a classmate in third grade bringing in pictures and literature about current NASA programs for “Show and Tell.” He said he was then inspired to write to NASA asking for pictures and other materials. Show and Tell was the practice at the time, so he decided to use that format for the program at the current meeting. He passed around the materials he received from NASA, including brochures on the Kennedy Space Center, a report on Mariners Six and Seven, some “NASA Facts” about space flight, and information about Apollo 15.

He mentioned the astronauts had named the Apollo 9 lunar module “Spider,” and Apollo 10 astronauts named the command and lunar modules “Snoopy” and “Charlie Brown.” We also talked a little about the current PBS retrospective show “Chasing the Moon.” Bart Billard said the show skipped over the missions between Apollo 8 and Apollo 11, and he wondered whether it was because of the module names the astronauts chose.

Glenn F. passed around a number of news items, including a montage of original newspaper clippings (some entire pages) from the *New York Daily News* and the *New York Times* on Skylab and Apollo–Soyuz. Scott Busby mentioned that NASA provides all the images from the Apollo program for download. Don Clark mentioned that some lunar samples from the Apollo missions were sealed away for 50 years in anticipation of development of improved technologies for analysis. We talked about lunar samples on public display. Someone said one sample, perhaps in Australia, was displayed so that visitors could touch it. Linda Billard mentioned one sample is mounted in a stained-glass window at the National Cathedral.

Image of the Quarter

M106, otherwise known as NGC 4258, taken by Scott Busby on July 1, 2019. M106 is an intermediate spiral galaxy in the constellation Canes Venatici. Discovered by Pierre Méchain in 1781, it is 24 million light years away. The presence of a central supermassive black hole has been demonstrated. Astronomers have attributed the presence of “extra arms” (more than the typical two) to the violent churning of matter around the black hole. A Type II supernova was observed in M106 in May 2014. Scott took this image with his Takahashi FRC300 (12-inch) telescope and ZWO ASI1600MM-C camera. He used a Canon 1.4x extender resulting in a focal length of 3,276 mm @ f11.

Rappahannock**Astronomy**Club

July 6, 2019

Geoff Beal
Compliance Officer
PicRights Ltd.

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Glenn D. Faini
President
Rappahannock Astronomy Club