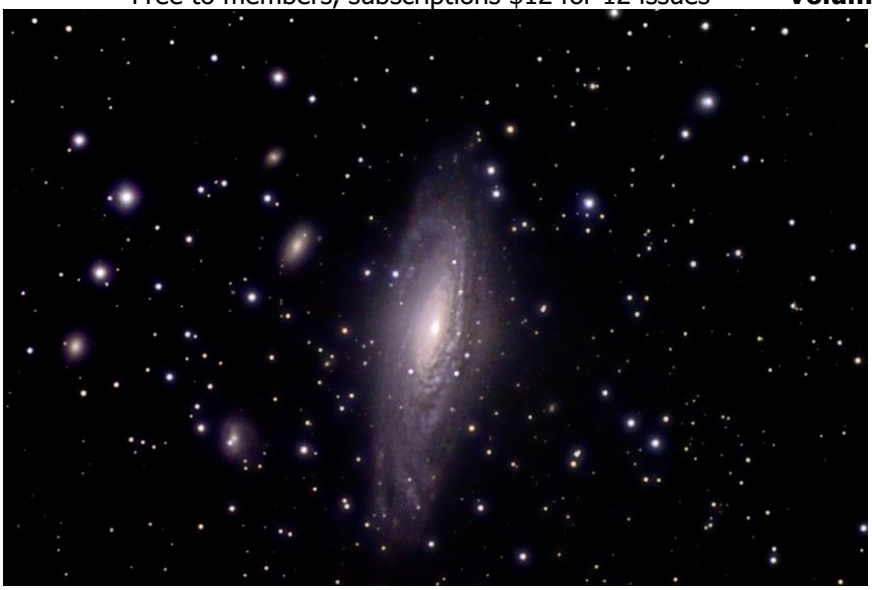
SIRIUS ASTRONOMER

www.ocastronomers.org

The Newsletter of the Orange County Astronomers

April 2020 Free to members, subscriptions $12 for 12 issues **Volume 47, Number 4**



The large galaxy is NGC7331 and shown just to its left are 5 galaxies collectively referred to as the Deer Lick Group. Image by Dave Radosevich and Don Lynn, taken at our Anza site in multiple sessions during 2006 and 2008. It was captured through an 8 inch Maksutov telescope using an SBIG ST8 camera.

From the Orange County Astronomers' Board of Trustees:

Response to COVID-19 Crisis

The OCA Board of Trustees discussed our best course of action for upcoming events at its March 22, 2020 meeting, including **Outreaches, General Meetings, SIG Meetings, Star Parties** and **all other in-person club events**. We are cancelling all of these club events through the end of May, 2020 to help reduce exposure to the COVID-19 virus and in response to the orders from Governor Newsom and the state Health Department.

Chapman University has cancelled our meetings through the end of May as part of its response to the crisis, so these general meetings could not go forward there anyway. We are exploring the possibility of holding at least part of our April and May meetings online, particularly the guest lectures. The details will be posted to the website, email groups and social media when they become available. **Please check the OCA website periodically for updates**, as the information should be posted there first.

Star parties are now cancelled through the end of May. This includes both the Anza Star Parties and Orange County star parties. Any use of the Anza site by members is at their own risk as we have no way of cleaning the site to CDC standards. If you absolutely must go out to the site, be sure to clean and sanitize items you have contact with and make sure it is cleaner when you leave than it was when you arrived. You must also bring any cleaning supplies or sanitizer with you as it is not provided on the site. Be sure to carry out any trash that you generate or find on the site, and please maintain social distancing if anyone else is out there.

If you have any questions, feel free to contact board members and or post them to the email groups or through social media. We will do our best to respond promptly, but please bear with us if there is a delay as we all have other responsibilities as well.

Best wishes to all of you through these difficult times, and may you, your families and friends all remain healthy!

President's Message

By Barbara Toy

Well, we are certainly living in interesting times right now – I do hope all of you are keeping well and taking all the precautions you can to avoid the COVID-19 virus. As I write this, Governor Newsom just issued an order that all California residents are to stay in their homes except for limited essential activities such as shopping for food. The situation has been changing rapidly and that will no doubt continue – I would like to think that, by the time this reaches you, things will be getting back more to normal but that doesn't seem likely right now.

On the club-related front, Chapman University cancelled all activities involving large groups on their campus, including our March general meeting. Group events at Chapman are now cancelled through May, so our April and May meetings are cancelled as well, at least for now. The March Astrophysics SIG meeting was cancelled, our Outreaches in March and April have been cancelled as the schools have been closed, and it looks like our events for April, at least, will also be cancelled as part of the overall efforts to reduce the spread of the virus.

Even if the weather was favorable (which hasn't been the case in March), our star parties are gatherings of more than 10 and so are banned under the current statewide orders, so they have also been cancelled. We ask that anybody who has to go out to our Anza site, for instance to do maintenance or repairs, please follow the CDC guidelines to minimize the risk of infection.

To reduce exposure, we decided that it would be best to have our March Board meeting virtually, rather than in person, but it remains to be seen if we will need to do that with our May meeting as well. If it works well, it may give us an option for dealing with future challenges, such as loss of our meeting site, though there are benefits to meeting in person that meeting virtually can't compensate for completely.

One of our concerns for our general membership as well as our Board members is that we have a lot of members who are at high risk of serious illness if they get the COVID-19 virus, and many have family members who are at even higher risk. We want our members and their families around a long time, enjoying life (and astronomy) to the full. Sacrificing our events for a few weeks or even months is a small price to pay to improve the odds that they will do so.

We plan to post updates on the website, so please check the home page and the calendar regularly for any changes – hopefully we'll be back to our regular activities in time to take advantage of the warmer nights of summer for our viewing events!

While You're "Sheltering in Place"…

If you're missing astronomical activities while you have to stay at home, avoiding unnecessary trips and minimizing contacts with outsiders, one option I read about recently in a book review in Science News (2/1/20 issue, p. 29) is citizen science projects you can get involved with through the Zooniverse. This started as the Galaxy Zoo project, which used the help of citizen scientists to classify hundreds of thousands of galaxies in the mid-2000s.

The featured project right now when I checked their website (https://www.zooniverse.org/) is helping scientists go through data from LIGO searching for gravity waves. Another project, titled "Radio Galaxy Zoo: LOFAR, is to help astronomers locate and identify supermassive black holes and starforming galaxies. Or you could hunt for muons disguised as gamma rays (Muon Hunters 2.0), look for asteroids in Hubble images (Hubble Asteroid Hunter), search for "undiscovered worlds" (Planet Hunters Tess), search for weird variable stars (Superwasp Variable Stars) or track solar storms to help improve solar weather forecasts (Solar Stormwatch II), and many more. There are lots of projects in lots of different areas – most of them at this point don't have anything to do with astronomy but they are all looking for citizen scientists to help the professionals on real science projects.

The book review I mentioned is by one of the founders of the Galaxy Zoo, Chris Lintott, and is called The Crowd and the Cosmos; per the review, it's more an appreciation of the wide range of work done by citizen scientists and the high quality of their contributions than a history of the Galaxy Zoo or the Zooniverse – it sounds like an interesting read.

NASA has a number of citizen science projects, too (https://science.nasa.gov/citizenscience). There seems to be some overlap with the Zooniverse, as Planet Hunters Tess is listed on both sites.

What seems to be needed for these projects is interest, a computer and time to go through a lot of data. If any of the projects on these or other sites interests you, that could be a way of getting some good out of this period of forced inaction.

However you spend your time in the next few weeks or months, I hope you and your families stay safe and healthy!

AstroSpace Update

April 2020
Astronomy and space news summarized by Don Lynn from NASA and other sources

Betelgeuse – It was reported here for the last 2 months that Betelgeuse dimmed to its lowest recorded level. Observations made in late February showed it creeping back up in brightness. Apologies to the supernova fans out there, but the dimming was not indicating an imminent explosion. Recent observations made in infrared showed essentially no change in brightness from observations made years ago. This implies the dimming in visible light was caused by dust that does not block infrared. Such red supergiant stars are known to occasionally throw off material that cools into dust. Also, the surface temperature was measured, and it is too warm to cause the dimming.

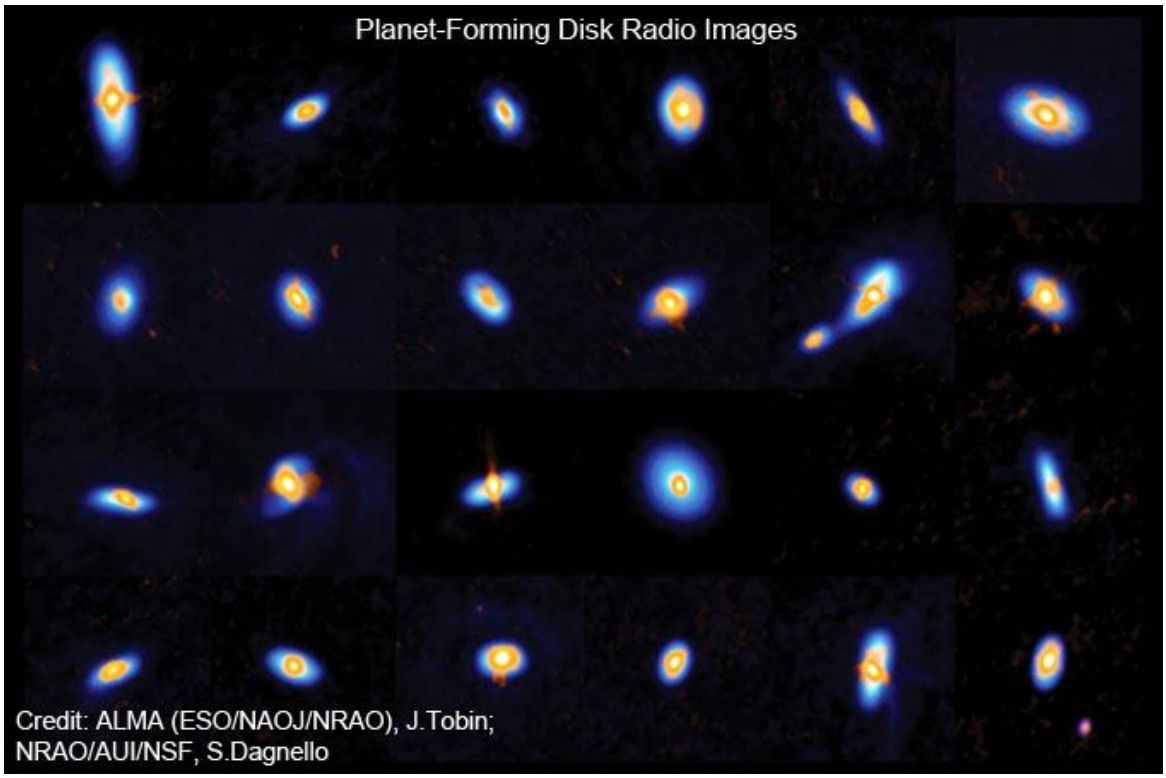
Repeating FRBs – Many fast radio bursts (FRBs) occur only once. But some of them repeat from the same location. It is not clear if repeaters and non-repeaters are caused by the same process, or even what that process or processes are. In order to learn more, the team operating the CHIME radiotelescope in Canada has been searching for new FRBs. That team announced discovery of 9 new repeaters, bringing the total to 20. Bursts from repeaters tend to be longer (but still in the milliseconds area) and show lower magnetization, supporting that repeaters differ in cause from non-repeaters. Yet dispersion appears to be the same for repeaters and non-repeaters. Dispersion is caused by the interstellar matter the burst has passed through on the way to us.

Omega Centauri Pulsars Discovered – Pulsars are neutron stars that give off pulses in radio or other forms of light each time they rotate. Many globular clusters have known pulsars in them. They can be used in determining motions within globulars. However, the largest local globular, Omega Centauri, has been resistant to finding pulsars in it. A new search using the Parkes radiotelescope in Australia discovered 5 pulsars in Omega, all millisecond pulsars, meaning that every rotation takes only a few milliseconds. One of them is a binary star, paired with a low-mass star that orbits it every 2.1 hours.

Neutron Star Size – Analysis of the gravitational waves emitted by a neutron star collision that was detected in August 2017 has yielded the most precise size for neutron stars. It is not known if neutron stars consist of neutrons all the way down to the core (except the very surface where pressure is not enough to be pure neutrons), or whether even more exotic material exists at the core, such as quark soup. Therefore there is theoretical disagreement over how large a neutron star should be. The new work pinned down the diameter of a typical neutron star to be between 12.9 and 14.8 miles. This is a little smaller than previous generally accepted estimates and might mean there is exotic material at the core. Scientists hope to observe some collisions between black holes and neutron stars to shed more light on the interiors of neutron stars. Whether a black hole strips apart neutron stars or swallows them whole would depend critically on the size and density of neutron stars.

Largest Known Explosion – A huge cavity has been found in the center of the Ophiuchus galaxy cluster and astronomers believe that it could only have been caused by a huge explosion centered on a massive galaxy in the cluster. To make a cavity this large, it would have had to be the largest explosion known. That much energy could have only come from record-breaking activity at the supermassive black hole in the center of this massive galaxy. The edge of the cavity was first detected in X-ray data, and was confirmed using radiotelescopes. Astronomers were unable to find jets at the black hole, so apparently the black hole activity that caused the cavity has ended. This galaxy cluster is 390 million light-years away.

Protostar Study – ALMA and the VLA radiotelescope arrays were used to image more than 300 planet-forming disks about very young stars (protostars) in Orion. The radio wavelengths used can penetrate the dust and gas found around such protostars. The study yielded the average size and mass of protostars. The results were compared to previous observations of older planet-forming disks. The younger disks were similar in size to older ones, but were more massive. This means that a star steals material from its disk as the star grows. This implies a planet that forms very early in the life of the disk would have more material to form the planet. 4 of the protostars looked peculiarly irregular. It was proposed that these 4 were extremely young and the protostars had not fully pulled together yet. The images also showed outflows from the protostars forming. Theoretically such outflows should dissipate spin and allow the protostars to continue growing.



Eclipsing Brown Dwarfs – Astronomers testing a new 1-meter telescope in Chile by focusing on a known brown dwarf were surprised to find it dimmed for 90 minutes, indicating something passed in front of it. Brown dwarfs are stars without quite enough mass to sustain nuclear fusion, the process that powers ordinary stars. Further observations using larger telescopes showed that 2 closely orbiting brown dwarfs were eclipsing each other. Eclipsing brown dwarfs are rare, this being the second such pair known. They are valuable to astronomers because they can calculate the masses, orbital distance, and sizes of the pair. In this case, the age of the brown dwarfs is also known because they belong to a cluster of stars whose age has been determined. Additionally there is a third brown dwarf distantly orbiting the newly found pair. Triple brown dwarfs are also rare.

Huge Flare – A very small red dwarf star, barely massive enough to not be a brown dwarf, has been spotted in archived XMM-Newton X-ray space telescope data emitting a huge flare in X-rays. It gave off more than 10 times the energy of any flare ever seen on our Sun. Astronomers can't figure out how a star of this small mass could generate this much energy. It might be that this star flares far less frequently than most stars, and so builds up more energy before releasing it. More study is needed of this or similar stars.

Exoplanet Found By Aurora – Astronomers have found another way to detect exoplanets. They found a probable exoplanet orbiting the red dwarf star GJ 1151 by detecting its aurora with the radiotelescope array LOFAR in the Netherlands. The aurora there is caused by a magnetic connection from the star to planet, similar to auroras on Jupiter caused by magnetic connection to Io's volcanoes. However this is different from auroras on Earth that receive their particles from the solar wind, not a magnetic connection. Astronomers plan not only to confirm this planet, but to look for others with detectable aurora. Such planets should be common because red dwarf stars are the most common type and usually have strong magnetic fields.

Iron Rain – Observations of an exoplanet known as WASP-76b made by the Very Large Telescope in Chile show that it rains molten iron there. The daytime temperature there has been measured at 4300°F, caused by its orbit extremely close to its star. This is hot enough to vaporize iron, and indeed iron vapor has been found in spectra of the planet. High winds blow the vapor over to the night side, where it is a relatively chilly 2700°F, causing molten iron to rain. Take a tungsten umbrella if you visit this planet. It is 640 light-years away in Pisces.

Sombrero Galaxy Study – Study of data taken by the Hubble Space Telescope of the Sombrero Galaxy's halo showed that it is mostly composed of metal-rich stars. Most galaxy halos are chiefly metal-poor stars. Metal-poor stars form from pristine gas, usually early in the history of a galaxy. As a galaxy ages, heavy elements (including metals) build up from nuclear fusion in stars and from supernovas. Then those elements are dispersed all over the galaxy's disk or bulge, but not usually the halo, by stellar winds and supernovas. So stars that form later in that environment will be metal-rich stars. This means that these late generation stars were dispersed into the halo of the Sombrero by some process that doesn't occur often in other galaxies. The likely culprit is collision with a major galaxy. Collision with little galaxies won't do it, and besides collisions with small galaxies are common with other galaxies. But collision with a major galaxy usually destroys the shape of the galaxy's disk, which did not happen with the Sombrero. Possibly the halo is simply short of metal-poor rather than long on metal-rich stars. This would imply that the normal dissipation of metal-poor stars from globulars into the halo didn't happen in the Sombrero. Theorists need to work more on explaining this unusual galaxy.

Lunar Regolith – Analysis of data from the ground-penetrating radar on board lunar rover Yutu 2 has been released. Three layers of differing composition have been found in the lunar regolith (soil): depth 0-39 ft is fine material with some larger rocks, depth 39-79 ft has increasingly large rocks, and depth below this has alternating fine and coarse material. Good data was received from as deep as 121 ft. The radar has 2 frequencies (60 and 500 MHz), and only data from the higher frequency has been analyzed. When the other frequency is analyzed, scientists expect data from much deeper. Yutu 2 is part of the Chinese Chang'e 4 mission that landed on the Moon's far side last year. Yutu 2's predecessor's radar was able to penetrate only 33 ft in depth, due to different material found at its landing site. Lunar regolith is the result of billions of years of meteoroid impacts breaking up and churning the once rocky surface. All instruments aboard Yutu 2 and its lander are working perfectly more than 14 months after landing.

Another Moon – In February astronomers discovered an asteroid that was then found to be orbiting Earth. Known as 2020 CD3, it is about the size of a car and takes 47 days to complete each trip around us. Tracing its path back, it likely was captured by Earth about 3 years ago, and tracing forward it is expected to escape this month. Only one other such temporary moon has ever been seen, and that was 2006 RH120. It is likely a rock because no known rocket parts or spacecraft should be in the vicinity.

TNOs Discovered – Researchers used a custom-built computer program to look through archived data from the Dark Energy Survey to find things that moved like Trans-Neptunian Objects (TNOs) and found 316 of them, including 139 new discoveries. This is a substantial addition to the only about 3000 TNOs known. The objects found range from 30-90 AU from the Sun (where an AU is the Earth's distance from the Sun). The Dark Energy Survey was made with the Blanco 4-meter telescope in Chile, which was fitted with a super wide angle camera known as the Dark Energy Camera, one of the world's largest astronomical cameras. 7 billion objects were found in the data, of which 22 million moved. But only 400 of these moved like a TNO. The researchers are now running their program again with a lower threshold of detectability, which should find hundreds more TNOs.

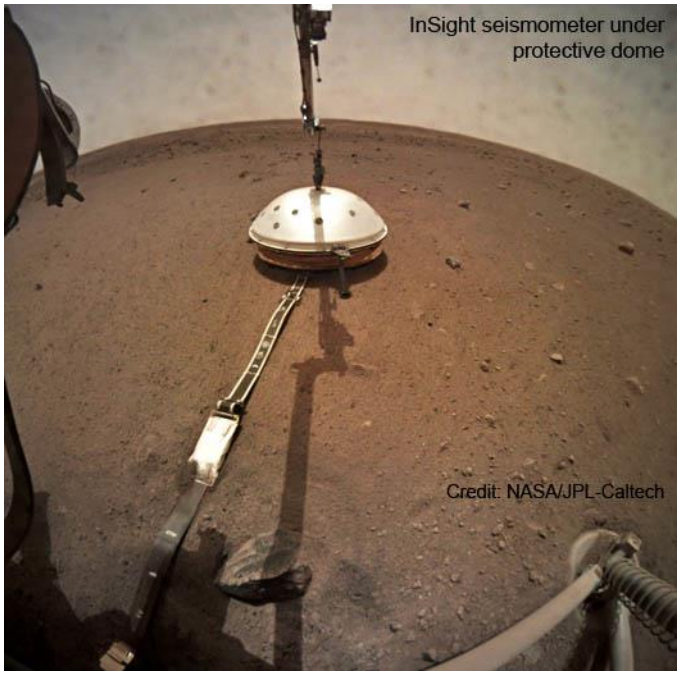
Bennu Features Named – The first names of features on asteroid Bennu have been accepted by the IAU. These features have been found by the spacecraft OSIRIS-Rex, in orbit about the asteroid. The theme chosen for features there is mythical birds and their places. Most of the new names are applied to rocks (Saxa in Latin), because most of the features on this tiny asteroid (1/3 mile diameter) are rocks.

Titan's Atmosphere – Archived spectroscopic observations of Saturn's moon Titan by ALMA (radiotelescope array in Chile) were analyzed to determine the ratio of acetonitrile containing ordinary nitrogen to that containing the heavier isotope (mass 15) of nitrogen. The ratio matched what was theoretically predicted if the acetonitrile were produced by cosmic rays striking the atmosphere. Nitrogen ratios differed for other compounds, such as hydrogen cyanide, indicating they were produced by ultraviolet from the Sun striking the atmosphere, not cosmic rays. Ultraviolet is absorbed higher in Titan's atmosphere than cosmic rays, so this tells us which nitrogen compounds exist at higher and lower altitudes.

Rover Named – NASA held a contest to name the Mars 2020 rover. A 13-year-old middle school student submitted the naming essay that won, and so the rover is henceforth known as Perseverance. 28,000 entries were received, and judges narrowed the field to 155 semifinalists, and then to 9 finalists. The public voted on the 9 to determine the winner. All 155 semifinal essays have been written on a microchip that will accompany the rover to Mars. The winner is being sent to Florida to watch the launch of Perseverance in July.

Mars Launch Delayed – Launch of ExoMars 2020 has been postponed until the next alignment of Earth and Mars, in 2022. This mission is a joint European and Russian project that includes a lander and a rover with a drill to sample soil more than 6 ft below the surface. The testing still to be done was judged unachievable this year, particularly considering the travel restrictions in Europe due to the coronavirus outbreak. The lander has 13 instruments and the rover 9. The rover has been named Rosalind Franklin, honoring that pioneer in discovering the structure of DNA.

InSight Progress Report – The Mars InSight team has stated that efforts to get the craft's heat probe pounded into the Martian soil seem to be working. InSight controllers are using the craft's arm to press on the probe while simultaneously pounding with the probe's internal hammer. All previous efforts have failed because the soil kept rebounding the probe, negating hammering progress. It has to reach 3-5 yards under the surface to get good readings on the heat escaping from the core of Mars.



The count of marsquakes detected by InSight has now exceeded 450. Most have been fairly small, less than magnitude 3. Scientists are hoping for bigger ones, because they can reveal more about the interior structure of the planet. It is believed the cause of marsquakes is cooling and shrinkage of the planet. Impacts may also contribute to marsquakes.

Martian Magnetic Fields – Results announced from the InSight magnetic sensor shows that the magnetic field at the landing site is about 10 times stronger than had been measured by orbiting spacecraft. This implies that Martian magnetic fields are more localized than can be measured accurately by distant sensors. InSight also found that the magnetic field varies over seconds and days. It is believed that the magnetic field is caused both by magnetic rocks underground and by events in the upper atmosphere related to disturbed solar wind. Near midnight magnetic pulses have been detected that probably result from a shift in solar wind interacting with the planet. Future plans include making surface magnetic measurements by InSight simultaneously with measurements from the MAVEN orbiter passing overhead.

OCA Loaner Scope Program

Telescopes are checked out only on one designated weekend every 3 months. The loan period is 6 months. Available scopes are listed on the club website. Reservations will be accepted until 7 days prior to the next pickup day. To reserve one, send the program director an email at scopes@ssccorp.com

The request should contain the desired scope's inventory number, the member's name, address, telephone number and email contact address. Pick up time and location will be sent to the borrower via email. Please bring proper identification and sign the club's loan agreement at the time of scope pickup. When ready to return a borrowed scope, please contact John Hoot to make arrangements. He may be able to accept the scope at the OCA general meeting.

OCA Scopes For Rent

INV#	Type	Size	Mfg	Model	Accessories/Notes	Available	Rent
1	Mac	3.5"	Meade	ETX90	Alt/Az Goto	04/12/2020	$5/Mo
2	Newtonian	4.5"	Meade	DS2114ATS	Alt/Az Goto	04/12/2020	$5/Mo
5	SCT	8"	Meade	LT8	Alt/Az Goto	04/12/2020	$5/Mo
6	Newtonian	4.5"	Celeston	1114EQ	Wt Bars In Storage	01/12/2020	Free
10	SCT	8"	Celestron	Orange Tube	w/Encoders,Wedge,Tripod & SlowMo. Ctl	04/12/2020	Free
16	SCT	10"	Meade	LX200 Classic	Alt/Az Goto	04/12/2020	$5/mo
19	Mac	2.25"	Meade	ETX60	Alt/Az Goto	04/12/2020	$5/mo
20	Reflector	8"	Orion	SkyView	German EQ wTracking & SlowMo, 2 axis	04/12/2020	Free
22	Reflector	4.5"	Celestron	NexStar	Alt/Az Goto	04/12/2020	$5/Mo
24	Reflector	4.5"	Meade	4504	German Mount Goto	04/12/2020	Free
26	Dobsonian	8"	Celestron	Starhopper	Alt/Az Manual	04/12/2020	$5/Mo
29	Schmidt-Cas	8"	Celeston	NexStar 8	Alt/Az Goto	04/12/2020	$5/Mo
31	MAK-Cas	5"	Meade	ETX-125	Alt/Az Goto	04/12/2020	$5/Mo
32	Newtonian	4.5"	Meade	DS-114AT	Alt/Az Goto	04/12/2020	$5/Mo
33	Schmidt-Cas	10"	Meade	LX90-AFCF	Alt/Az Goto	07/12/2020	$5/Mo
34	Dobsonian	12"	Meade	Light Bridge	Alt/Az Manual	04/12/2020	$5/Mo
35	Newtonian	4.5"	Meade	DS-2114	Alt/Az Goto	04/12/2020	$5/Mo
36	Schmidt-Cas	8"	Celestron	Ultima 8	Fork Mount w/Wedge, Tripod Motorized	04/12/2020	$5/Mo
37	SCT	8"	Meade	LX200GPS	Needs Spreader & Hand-box	04/12/2020	$5/Mo
45	Refractor	4"	Tashihaki	106FSQ	Motorized German Mount Astro-Imaging	07/12/2020	$5/Mo
49	Dobsonian	4.5"	Orion	StarBalster 4.5	Table Top Dob - Easy to use	04/12/2020	Free

OCA Scopes For Sale

INV#	Type	Size	Mfg	Model	Price
39	Cassegrain	8"	Celestron	C8 F10 Optical Tube (no mount)	$250
41	SCT	14"	Celestron	C14 Classic w/ Wedge & Tripod	$1,000
42	Dobsonian	16"	Obsession	Truss Tube w/Digital Setting Circles	$600
48	SCT	12"	Meade	LX200 Classic w/Tripod	$1,200
50	Dobsonian	10"	Orion	Classic Dob	$200
51	Dobsonian	12"	Oddessey	Red Tube Dob	$250

Email: Scopes@ssccorp.com with question or for details

Next Scope Pickup Date 12 April 2020

Advertisements

Buy, Sell or Trade some of your gear ? This is where club members can place advertisements. Please contact the editor at newsletter@ocastronomers.org to place an advertisement or to learn more about placing one. There is no cost to club members for non-commercial advertisements in the newsletter.

For Sale contact Jeff Gortatowsky jeff.gortatowsky@gmail.com

- Jupiter Ridge pad 5 lease privilege – for sale to any OCA member $1200
  This is a pad with no pier on it. Price is negotiable

For Sale contact Val Akins akins7821@gmail.com

- Celestron piggyback mount for 35mm DSL cameras or finderscopes $20
- Orion Astro View 120ST f/5.0 Richfield refractor OTA with two inch mirror star diagonal, rings and dove trail attached. $175

For Sale contact Bill Prats b.bill.p@gmail.com

- Meade LX-70 Tripod & Mount 20lb capacity, Meade Polar Scope (#670010), Dual axis motor drive with Controller (#670011), original accessories, fresh 6 volt battery. Very clean, Used 1 year. $300 OBO

For Sale contact John Derks derksjm@yahoo.com

- Meade 14" LX200 GPS UHTC w/ complete original accessories package: 2" diagonal, 8x50 finderscope, zero image shift focuser, Autostar II handpaddle, Series 4000 26mm Super Plossl 1.25 eyepiece, vibration iso pads $3200
- Meade Giant Field Tripod
- Meade Superwedge
- 14" SCT Dewshield

OTA is in like new condition in original Meade foam lined box . Located in So. Orange County

For Sale contact Tom Kucharski astrophd50@gmail.com

LEASE FOR SALE - Cinder Block observatory (Anza Site OBS-A) $38,000

- 400 Sq ft raised observatory floor with automated roll off roof
- 2 pier footers in place with room for a third
- 2 private bedrooms of approx. 60 sq ft each and 120 sq ft common area with desks and bookshelves
- Great for TWO astro buddies!
- Private driveway and parking

The Manned Apollo Missions – a Very Brief Summary

Gathered by David Fischer from NASA material available on these web-sites:
https://www.nasa.gov/mission_pages/apollo/missions/index.html
https://airandspace.si.edu/explore-and-learn/topics/apollo/apollo-program/
https://science.nasa.gov/toolkits/apollo-anniversary

Our celebration of the 50th anniversary of the Man's first landing on the moon continues with the third part of an article about the manned Apollo missions. The NASA sites have much better (but longer) descriptions of the missions along with very nice photographs. I recommend visiting them for a very enjoyable reading experience.

Apollo 17

Crew
Eugene A. Cernan, Commander
Harrison H. Schmitt, Lunar Module Pilot
Ronald E. Evans, Command Module Pilot

Backup Crew
John W. Young, Commander
Charles M. Duke Jr., Lunar Module Pilot
Stuart A. Roosa, Command Module Pilot

Payload
America (CM-114)
Challenger (LM-12)

Launch
December 7, 1972; 12:33 a.m. EST

Lunar
Lunar Location: Taurus-Littrow
Lunar Coordinates: 20.16 degrees north, 30.77 degrees east

Touchdown: 7:54:57 p.m. December 11, 1972
Lunar Liftoff: 10:54:37 p.m. December 14, 1972

Landing
December 19, 1972, Pacific Ocean
Recovery Ship: USS Ticonderoga

Mission Objectives

The primary objectives were geological surveying in the Taurus-Littrow region, investigation of physical properties of the surface (regolith), seismic profiling, investigation of lunar atmospheric composition, surface sampling, and experiments relating to effects of space radiation on living things. The landing site was chosen with the expectation of collecting samples, some of which would be younger than those previously collected and others older than those from prior missions. In addition, imagery of the area showed interesting boulders that scientists hoped to investigate.

This was the only mission to bring a trained scientist to the moon: Harrison (aka Jack) Schmitt had earned his PHD in geology prior to becoming an astronaut.

Mission Overview

Outward bound: Liftoff encountered a delay of 2 hrs, 40 minutes due to a failure in the automatic countdown sequencer. Trans-lunar insertion went nominally and only one midcourse correction was needed. Lunar orbit and subsequent circularization were achieved without difficulty. Descent and landing also went smoothly with actual touchdown on target.

Like the previous couple of missions, this one included a lunar rover to allow distant travel on the surface.

First day: Landing occurred at 7:55 PM 11 Dec with the first of three EVA activities starting 4 hours later. This EVA lasted 7 hrs, 12 minutes and included deployment of the ALSEP science package and a surveying trip with the rover. Each time the astronauts stopped on their tour they would deploy the Traverse Gravimeter which would provide a reading of the local gravitational field strength, then pack it back up onto the rover. One of the rover's fenders got damaged when the astronauts were loading it up for the first rover mission and it fell off during this EVA.

Second day: The next morning, before EVA, Gene Cernan built a temporary fender following instructions from NASA. This worked quite well for the remainder of the mission.

The second day's EVA went for 7 hrs, 37 minutes. First drive was 6 km to explore a feature called Hole-in-the-Wall and subsequently drove through it and on to the South Massif where they examined boulders that had long ago rolled down from that mountain. This site yielded lots of interesting samples as did the second stop on this day's tour. The second stop was so fertile for sampling that the team stayed there over an hour examining and grabbing samples. By contrast, stops on previous missions were typically much shorter.

The gravimeter was deployed on the stop and while there they used a tool called the Universal Handling Tool to grab and bag surface samples. While trying to get back onto the rover, Gene Cernan slipped and fell on the ground next to it. No harm was done and as he got up again, they saw that he had uncovered some interesting soil that had been beneath the very top layer so they grabbed a sample of that too.

Another problem occurred on this EVA when they were coring for subsurface samples and had great difficulty pulling the coring drill out of the ground. Though they eventually succeeded, it used up time and air supply and forced shortening of the rover trip planned for Emory Crater. While this was going on, Schmitt was trying to get surface samples but because of the awkward positions he had to get into with his scoop and the fatigue in his arms, gathering them went slowly.

Still on this EVA, their next stop turned out to be very interesting. It was a crater called Shorty which the science team thought might be an impact which would have punched through the loose surface material and brought up some of the material from the valley floor. There was a second opinion in from the science team that it might be a volcanic vent and could reveal pyroclastic material.

When Jack Schmitt started exploring the area near a shattered boulder, he found orange colored soil. They dug a little trench to see how it ran and found its color ranged from red to orange. They used the coring tool to get a deep sample which showed variation in composition from orange to red and then to black as they got deeper. They took pictures of the area and found more locations of orange soil. Post mission analysis showed the material to be tiny spherical volcanic glass particles which had indeed been brought up to the surface when the crater was formed.

Problems arose for some of the experiments planned for this day. One related to use of the Surface Electrical Properties experiment which measured a radio signal emitted from a pair of wire antennas laid out on the ground near the Lunar Module. In concept the variation in signal characteristics when measured at various points along their tours would indicate some properties of the surface. The instrument intended to record these signals for post-mission analysis failed due to overheating and very little data was recorded.

There was also a crude instrument intended to detect gravity waves which would take advantage of the moons paucity of quakes and would be synchronized with an Earth-bound detector to see if simultaneous events could be found. This system failed on deployment and was later found to have a design error that prevented it from operating at all.

Third day: Final EVA was 3 km drive to the base of North Massif and then over to a large split boulder that lay on the base of the mountain. They spent nearly an hour examining the boulder, finding evidence that part of it had at one time been molten.

They stopped for samples and study at a few more places including the finding of interesting white colored soil just below the surface at what would have been the second to last stop. They extended their stop to get core samples and pieces of surface rocks. With the extra time expended, the last stop was skipped. In total, this third EVA lasted 7 hours, 15 minutes.

All together there were about 22 hours of work time outside of the LM and 30.5 km of travel on the surface. 243 pounds of samples were brought back to Earth.

Return: Nominal flight back with a 1 hour EVA to retrieve film cassettes from the service module.

Lunar Module Experiment Names

ALSEP Experiment Package

Heat Flow Experiment measured the amount of heat coming out of the Moon

Lunar Atmospheric Composition Experiment measured the composition of the Moon's tenuous atmosphere

Lunar Ejecta and Meteorites experiment measured the impact of small meteorites on the Moon

Lunar Seismic Profiling Experiment provided information about the structure of the upper kilometer of the lunar crust

Lunar Surface Gravimeter attempted to detect gravity waves

Other Surface Experiments

Cosmic Ray Detector measured very high energy cosmic rays from the Sun and other parts of our galaxy

Lunar Neutron Probe measured the penetration of neutrons into the lunar regolith, which helped to measure the overturn rate of the regolith

Soil Mechanics Investigation studied the properties of the lunar soil with a coring drill to get samples from below the surface

Surface Electrical Properties measured the propagation of electrical waves through the lunar crust

Traverse Gravimeter Experiment measured how the Moon's gravitational acceleration varied at different locations near the landing site, which helped to measure the thickness of the basalt layer in this region

Cosmic Ray Detector measured very high energy cosmic rays from the Sun and other parts of our galaxy

Lunar Neutron Probe measured the penetration of neutrons into the lunar regolith, which helped to measure the overturn rate of the regolith

Command and Service Module Experiment Names

Orbital Experiments

Lunar Sounder Experiment used radar to study the structure of the upper kilometer of the lunar crust

Infrared Radiometer measured the cooling of the Moon's surface at night to determine physical properties of lunar soil

Laser Altimeter to measure heights of lunar surface features

Metric and Panoramic cameras were used for systematic photography of the lunar surface

S-Band Transponder Experiment measured regional variations in the Moon's gravitational acceleration

Ultraviolet Spectrometer Experiment studied the composition of the lunar atmosphere

Transit Experiments

Biostack Experiment studied the effects of cosmic rays on several types of biological materials, including bacteria spores, seeds, and eggs of brine shrimp, beetles, and grasshoppers

Heat Flow and Convection Demonstration studied convective flow and heat transport driven by surface tension

Light Flashes Experiment studied light flashes seen by the crew that are related to charged particles in space

Window Meteoroid experiment studied impacts on the windows of the Apollo 17 Command Module to obtain information about the size distribution of very small micrometeorites

From the Editor

Sirius wants photograph submissions from club members

We need submissions for this year. I will also pull some from the OCA members images section on our website but those will be at my discretion. If you would like your picture on the cover, please send it to me along with a brief description of the subject, where the image was taken, and the equipment used.

Ideas for Future articles

The newsletter includes articles from members and / or about subjects suggested by our members. We seek ideas and writers to cover them. To contribute an article or work with the editor to produce one, please contact me at newsletter@ocastronomers.org .

Due dates for submission of articles, pictures and advertisements

Issue	Due date
May	18 Apr
June	23 May
July	20 June

SIRIUS ASTRONOMER
www.ocastronomers.org
The Newsletter of the Orange County Astronomers

Nonprofit Organization
U.S. Postage
PAID
Santa Ana, CA
Permit No. 1468

NEWSLETTER OF THE
ORANGE COUNTY ASTRONOMERS
P.O. BOX 1762
COSTA MESA, CA 92628

DATED MATERIAL
DELIVER PROMPTLY

RETURN SERVICE REQUESTED

HANDY CONTACT LIST

OCA WEBSITE: http://www.ocastronomers.org STARLINE 24-HR. Recording: 714-751-6867 ANZA OBSERVATORY: 951-763-5152

CLUB OFFICERS (to contact the entire board at once, send an email to board@ocastronomers.org)

President	Barbara Toy	btoy@cox.net	714-606-1825
Vice-President	Reza AmirArjomand	reza@ocastronomers.org	949-791-7072
Treasurer	Charlie Oostdyk	charlie@cccd.edu	714-751-5381
Secretary	Alan Smallbone	asmallbone@earthlink.net	818-237-6293
Trustee	David Searle	dwsearle@gmail.com	909-455-8853
Trustee	Cecilia Caballero	ceci@ocastronomers.org	949-299-8333
Trustee	Doug Millar	doug@ocastronomers.org	562-810-3989
Trustee	Sam Saeed	sam@ocastronomers.org	714-310-5001
Trustee	Helen Mahoney	helen@ocastronomers.org	562-424-3737
Trustee	Gary Schones	gary378@pacbell.net	951-687-7905
Trustee	John Hoot	jhoot@ssccorp.com	949-498-5784

COMMITTEES, SUBGROUPS, AND OTHER CLUB VOLUNTEERS

Anza House Coordinator	Manuel Baeza	manugb33@yahoo.com	323-394-3042
Anza Site Maintenance	Don Lynn	dlynn@ieee.org	303-719-7490
Beginner's Astronomy Class	David Pearson	p.davidw@yahoo.com	949-492-5342
OC Star Parties	Steve Mizera	mizeras@cox.net	714-649-0602
MTW Star Parties	Bob Nanz	bob@nanzscience.com	760-751-3992
Librarian	Karen Schnable	karen@schnabel.net	949-887-9517
Membership, Pad Coordinator	Charlie Oostdyk	charlie@cccd.edu	714-751-5381
Mt. Wilson Trips	Michele Dadighat	mmpkb8@gmail.com	573-569-3304
Observatory Custodian / Trainer / Member Liason	Barbara Toy	btoy@cox.net	714-606-1825
OCA Outreach Coordinator	Leonard Vorhis	outreach@ocastronomers.org	
Sirius Astronomy Editor	David Fischer	newsletter@ocastronomers.org	949-831-1163
Telescope Loaner Program	John Hoot	jhoot@ssccorp.com, scopes@sscorp.com	949-498-5784
WAA Representative	Cecilia Caballero	ceci@ocastronomers.org	949-299-8333
Webmaster	Reza AmirArjomand	webmaster@ocastronomers.org	949-791-7072

SPECIAL INTEREST GROUPS (SIGS)

AstroImagers SIG	Alan Smallbone	asmallbone@earthlink.net	818-237-6293
Astrophysics SIG	Bob Sharshan	rsharshan@aol.com	714-845-6573
Dark Sky SIG	Barbara Toy	btoy@cox.net	714-606-1825
Youth SIG	Doug Millar	doug@ocastronomers.org	562-810-3989