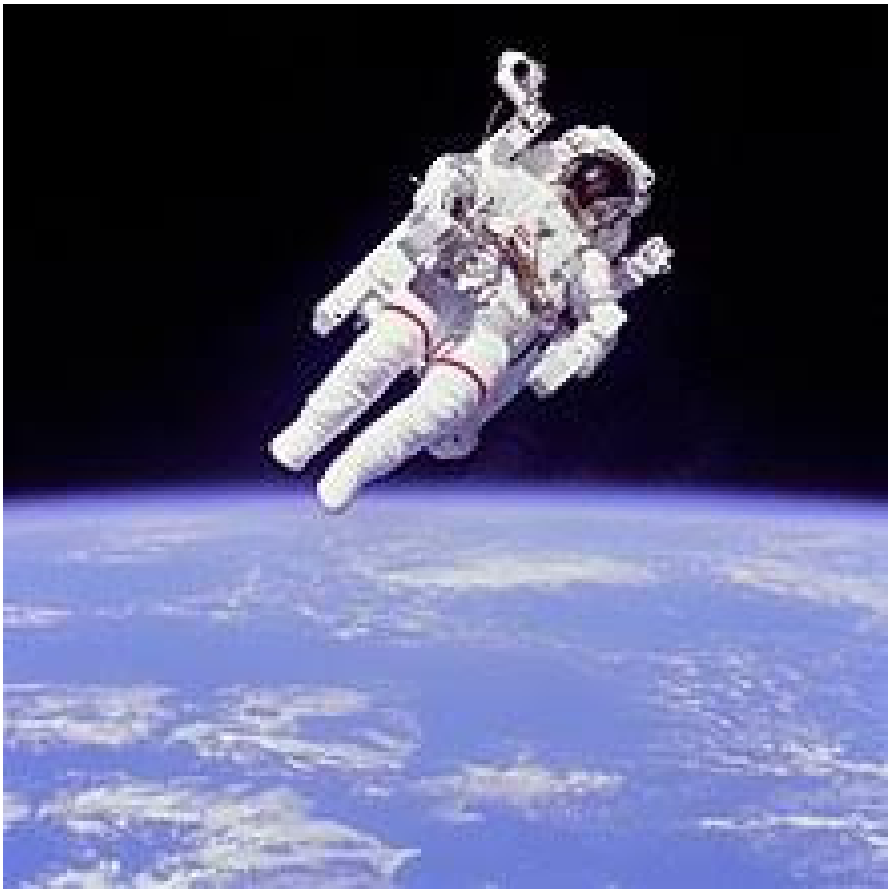
# THE OBSERVER

The Newsletter of Central Valley Astronomers of Fresno January-February 2018



## Bruce McCandless, the First Human Satellite, passes away at age 80

**In one of the most memorable images of the space program, Bruce McCandless floats freely in space on February 7, 1984. McCandless, who pioneered the Manned Maneuvering Unit(MMU) to become the first untethered space walker, died on December 21. Apollo astronaut Richard Gordon also died on November 7 at age 88. Stories about both of them inside.**

**Image-NASA**

**"There is an epoch without time. It is eternity. So we make a quantum leap from eternity into time…"**

**Sydney Coleman-Harvard cosmologist, talking about before and after the Big Bang**

### In This Issue-

**Central Valley Astronomers**

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**www.cvafresno.org**

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**Fellow astronomers,**

**It is an exciting time for the astronomy community. Discoveries in space are happening with wonderful frequency, and a constant wave of improvements in technology has been of great benefit to professional and amateur astronomers alike. Current-generation rockets are blasting new teams to orbit in the International Space Station every few months, while Voyager 1 is still alive after 40 years of flying through space, aided by an alternate set of thrusters fired for the first time in 37 years. Human ingenuity, when channeled properly, continues to be absolutely remarkable.**

**It is also, however, a challenging time for the astronomy community, particularly with regards to amateur club organizations. Like many niche hobbies, astronomy can be very expensive, presenting a hurdle to younger people that don't have disposable income. Travel is required because large metropolitan areas have too much light pollution. Trying out a knowledge-heavy hobby for the first time can be intimidating. Convincing a young person that it is "cool" to go out at night to a place without cellular access is difficult at best. Yet without those young people, our club may eventually cease to exist.**

**As your new president, it is my goal to work to reduce or remove those hurdles and, to put it simply (albeit a little obviously), make astronomy cool again. Discovering and joining the club back in November 2011 changed my life for the better; it is my goal to lead Central Valley Astronomers so that others will find the club and have the same positive experience I had.**

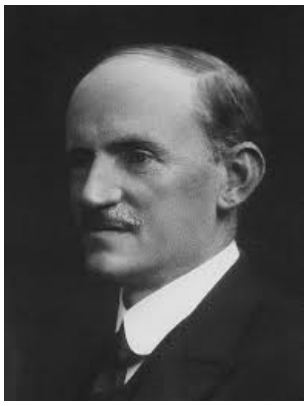
**To that end, the Central Valley Astronomers board of directors will be meeting in January to begin the process of addressing some of these critical roadblocks. We are going to look into the resources available to try to reduce light pollution in the area, as many cities (including some that do not have nearby observatories) have done to protect their night skies. We are going to develop a rigorous educational program for young people that want to become amateur astronomers, with the certificate of completion being their very own telescope. We are going to look hard at the content of our meetings and try to find a way to make them more organized and more interesting for both members and visitors alike. We are going to make contact with other clubs that have found success - especially with the recruitment and retention of young members - and see what we can learn. And we are going to get in touch with current members as well as people who have stopped attending and try to find out how we can do better.**

**Having gotten so much out of being an amateur astronomer, it is my honor to be your Central Valley Astronomers president. I look forward to a great year of observing as well as working with the board and general membership to make Central Valley Astronomers the best it can be.**

**I wish all of you clear skies for 2018!**
**Scott J. Davis President, Central Valley Astronomers**

# Profiles in Astronomy

## Alfred Fowler 1868-1940



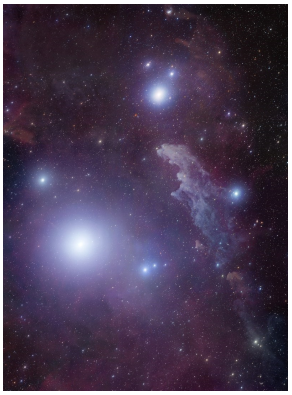
**Alfred Fowler was born in Wilsden, Yorkshire, England, and educated at Imperial College in London, then called the London Normal School of Science. After graduation, he stayed on at the school and became an associate professor and an assistant to Norman Lockyer, who was one of the world's foremost experts in spectroscopy at the time. He eventually became a full professor of astrophysics at the institution. He was also appointed Yarrow Professor of Astronomy of the Royal Society in London. He was president of the Royal Society from 1919 to 1921, and head of the International Astronomical Union from 1919 to 1925.**

**Fowler himself became an expert in spectroscopy, and used it to make many discoveries. He was the first to discover that sunspots are cooler than their surrounding areas. He was also one of the first to make a spectrographic study of the chromosphere and the corona during an eclipse. Again, using the spectrograph, he discovered carbon monoxide in comets and ozone in the Earth's atmosphere, and also magnesium in sunspots. He did work in atomic theory as well, finding the spectral fingerprints of ionized helium and making fundamental discoveries in the relationships between protons and electrons.**

**Fowler won many honors for his work, including the Bruce Medal of the Astronomical Society of the Pacific, the Gold Medal of the Royal Society, and the Henry Draper Medal of the National Academy of Sciences. A crater on the Moon and an asteroid are named after him.**

**Source-The Bruce Medalists, Astronomical Society of the Pacific**

## Star Stories-Rigel, in the Constellation Orion



**(Rigel became a part of American culture in the 1960s. On the original television show *Star Trek*, Captain Kirk always seemed to be saying, "Set a course for Rigel 4, Mr. Sulu.")**

**Rigel is the second brightest star in Orion, known as Beta Orionis, or simply B Orionis. Rigel is actually a multiple star system, with one large blue-white supergiant B type star, known as Rigel A, and as many as four smaller very difficult to see stars. A second star, known as Rigel B, is almost 500 times dimmer and smaller than its companion. As many as three or four smaller stars make up the system. The entire Rigel system is about 860 light years from Earth.**

**The name Rigel comes from the Arabs, who called it *Riji Jauzah al Yurza*, meaning "The left foot of Jauzah." *Jauzah* is the Arabic name for Orion. *Riji* means "foot."**

**Rigel A is almost 100 times the size of the sun, and has an apparent magnitude of .13, making it one of the brightest stars in the sky, sometimes even brighter than Betelguese, Alpha Orionis. It is a pulsating variable of the type known as Alpha Cygni. Rigel B is also a B type star, with an apparent magnitude of 6.6, and is about three times the size of the Sun. It, in turn, has a companion binary star, known as Rigel Ba, which itself may have a companion binary star, designated Rigel Bb. Rigel may also have still another companion star, known as Rigel C, which is estimated to be about the same size as Rigel B.**

# Important Dates in January and February

**January 3-Spirit rover lands on Mars, 2004**

**January 6-Isaac Newton born, 1643(England was then using the Julian calendar, so, at the time, he was born on December 25, 1642. When it switched to the Gregorian calendar in 1752, everything was moved up 12 [or sometimes 13] days. The Eastern Orthodox Church, which still uses the Julian calendar, celebrates Christmas on January 6 [or sometimes7] for the same reason)**

**January 25-Opportunity rover lands on Mars, 2004**

**January 27-51st anniversary of the Apollo 1 fire, 1967**

**January 28-32d anniversary of the Challenger disaster, 1986**

**January 28-Voyager 2 flies by Uranus, 1986**

**January 31-60th anniversary of the launching of Explorer 1, 1958**

**February 1-15th anniversary of the Columbia disaster, 2003**

**February 9-Lincoln's birthday; also Darwin's birthday, 1809**

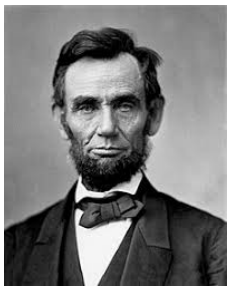
**February 15-Galileo's birthday, 1564**

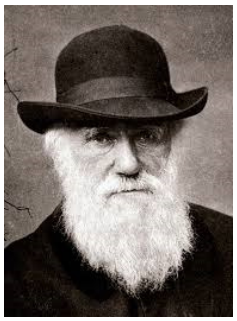
**February 18-Clyde Tombaugh discovers Pluto, 1930**

**February 19-Copernicus's birthday, 1473**

**February 20-John Glenn's Mercury 7 orbital flight, 1962**

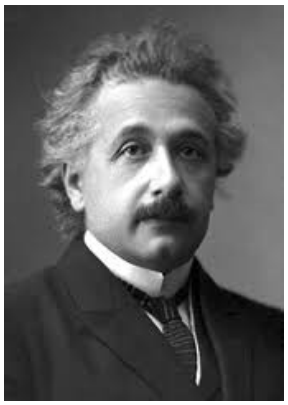
**February 22-Washington's birthday, 1730(actually, since the American colonies were also using the Julian calendar at the time, it can be said that Washington was born on February 10)**





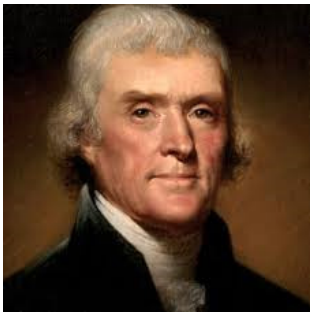
# Great People who Were(and Are) Different

**As noted on the previous page, Isaac Newton, born in 1642(or 1643) stands out among the pantheon of great minds of any age. Scholars have often wondered what made him so brilliant: the discoverer of the universal law of gravity, the calculus, the laws of motion and optics, the reflector telescope, and many other revolutionary findings. Over the last 10-15 years or so, though, a number of mental and behavioral experts have come to believe that he had a type of autism known as Asperger's Syndrome, (named after Hans Asperger, 1906-1980, an Austrian physician who first studied children with its traits), in which a person shows well above average intellectual abilities, but has poor social skills. Based on Newton's journals and the writings of people who knew him, he was seen as a recluse who rarely ventured from his rooms at Cambridge, and was awkward in social settings. It is known that he never married, and probably never had a serious relationship with a woman.**

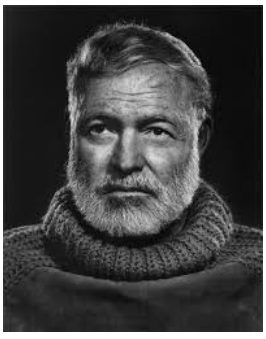


**Newton, though, may not be that much different from many other exceptional people. Experts now strongly suggest that Albert Einstein had Asperger's; those who knew him well said that he was personally cold and distant to people, especially his wife and children. Edwin Hubble also showed possible signs of Aspergers with his aloofness and seeming arrogance. Charles Darwin was very shy, and lived most of his adult life as a virtual recluse on his estate outside London. He may have had Aspergers. Leonardo di Vinci, the great Renaissance polymath, might have had Aspergers as well.**

**And it's not just scientists. Again, behavioral experts conclude that Wolfgang Mozart probably had Aspergers, as did Ludwig von Beethoven. They strongly believe that Thomas Jefferson also had Aspergers, and so did Ernest Hemingway. It may yet be shown that most of the world's leading scientists and intellectuals are autistic in one degree or another(estimates are that at least 50% of the Silicon Valley techno "whiz-kids" have Aspergers. They've been given the nickname of "Happy Aspies"). So, they may be different, but they've made the world a richer and better place, and we can thank them all for that.**



**A Note-What causes autism is still disputed, but the pregnant mother's diet, the age of the parents, the environment, genetics, stress, and the number of neurons in the developing brain are among the suspects. Research shows that almost 90% of people with Asperger's Syndrome are male. Why it occurs so much among men, and rarely among women, is currently unknown. With autism as a whole, the ratio is 60% male, 40% female. It is now estimated that 1 in every 80 people is autistic, along a spectrum from very mild, almost unnoticeable, to extremely severe.**



# Hidden galaxies in Eridanus

## By Shawn Clark

**Twenty two years ago when I began this hobby, there were still frequent visual discoveries of supernovae and comets by amateurs. These days with automated searches and satellites it is rare for amateurs to discover something that is not already known to the wider observing community. Yet that is what appears to have happened when I turned my 20" f/5 toward Tau 1 Eridanus. The mystery to me is why it had not been catalogued visually before.**

**On the night of November 21, 2017, I was observing alone at Big Stump in fair transparency and 45° F weather. On my observing list was Hickson Compact Group 21, one of the galaxy groups that had been profiled in *Sky & Telescope's* November 2017 issue. It seemed a simple star hop from Tau 1, but when I turned to Tau 1 I thought I had made some sort of mistake identifying the constellation's stars (after all, there are *nine* stars designated "tau" in Eridanus.) At 156x there appeared to be a small galaxy near the bright 4.5 magnitude star, and the galaxy was not plotted in Uranometria. I rechecked my charts and confirmed I was looking at the correct star.**

**I examined the galaxy for a time, went to higher power (357x), and moved the star around in the field to be certain the fuzzy companion was not a ghost reflection from the bright star. No, it was real and surprisingly bright for not being in the atlas. I made a note about it for checking when I got home, then observed the galaxy group I had intended to target (five NGC galaxies from the article and two MCG's that were not mentioned, but plotted in Uranometria.)**

**A search at home did not show the galaxy identified in Wikisky, although it was visible in the DSS image. Similarly it was not displayed in Stellarium with other PGC's. However, I was able to use the position search in NED (NASA Extragalactic Database) to identify the galaxy as LEDA 2816331 or IRAS F02426-1847. I posted it on Cloudy Nights to see if anyone had observed it. S&T editor Steve Gottlieb noted that it was identified in HYPERLEDA as 15.79 B magnitude--from a 2000 analysis of 18,351 infrared (IRAS) sources. I estimated the observed visual magnitude as between 14 and 14.5. It is not unusual for a galaxy to be one magnitude brighter in the visual than the B (blue magnitude.) I estimated the dimensions from the Wikisky images as 0.6' x 0.3'.**

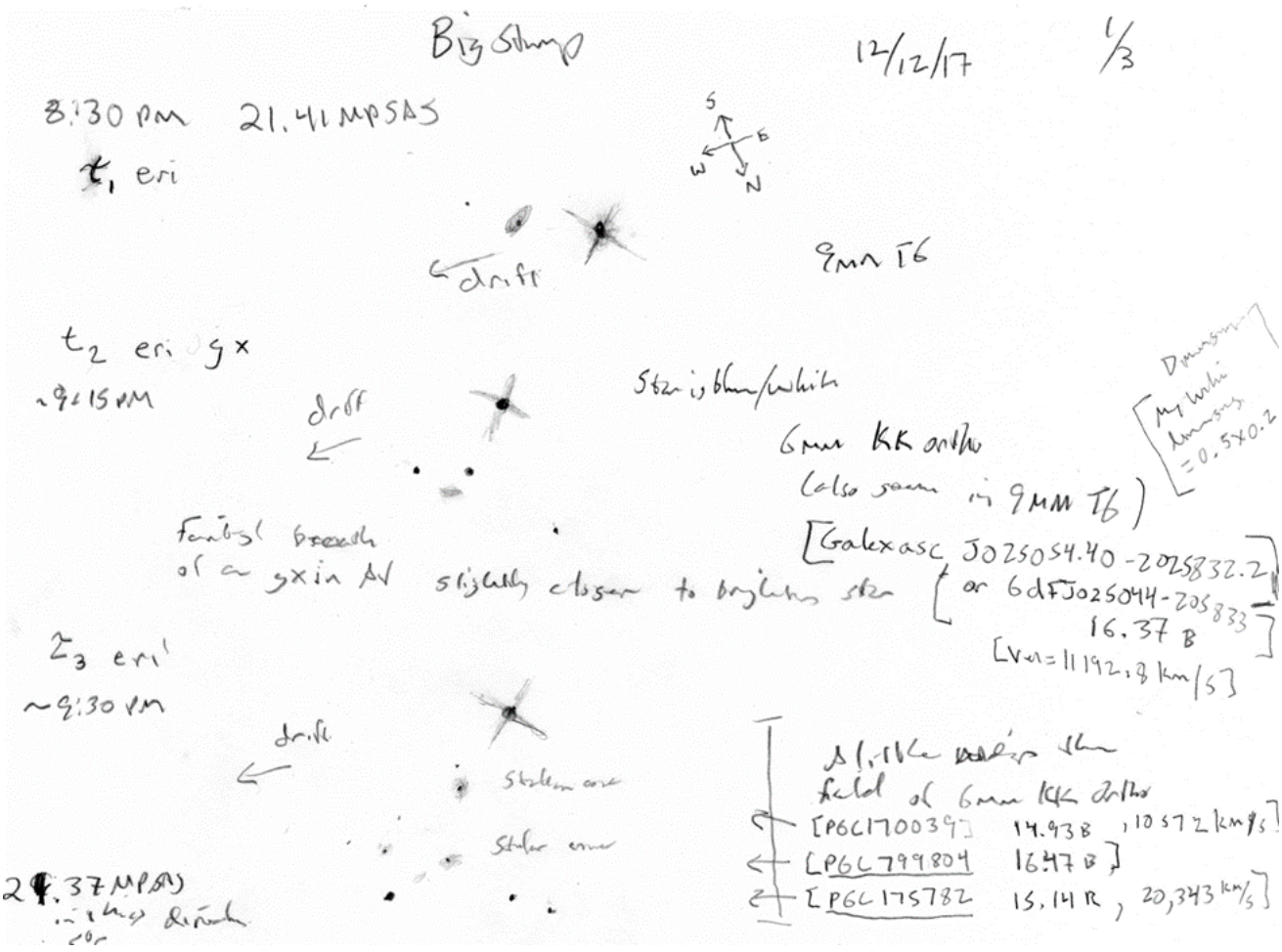
**I returned to Big Stump on 11/27/17 to catch the galaxy again with the first quarter moon on the horizon, providing some idea of how high the surface brightness is, similar to NGC 404 "Mirach's Ghost." On December 12, 2017, I sketched the galaxy at 278x, then located and sketched four other galaxies similarly close to Tau 2 and Tau 3 Eridanus. The core of Tau 1 Eridani galaxy was bright enough in the 20" that I wondered if it might be a superimposed field star (images are not clear on this.)**

**On December 18, 2017,, my son Ian accompanied me to Big Stump with his 10" f/5. He was able to observe the galaxy through the 20", then after some finder difficulties with his 10", we both tried for it in his scope. Ian saw it first, well beyond the end of a diffraction spike. I reconfirmed the position in the 20" and subsequently was able to detect it in the 10". There is a very small and dim averted vision patch in a 10", but it is there. The stellar core was not seen by either of us with the smaller instrument.**

**Steve Gottlieb has since viewed the galaxy with his 24" and confirmed my visual impression, stating that he would be surprised if it proved fainter than 14.0 visual magnitude.**

**The other galaxies mentioned around Tau 2 and Tau 3 were considerably more difficult even with the 20". I had identified them as candidates using Wikisky so it was a matter of seeing if I could detect them. Near Tau 2 Eridani is 6dFJ0250544-205833, detected as the faintest of elongated averted vision smudges at 228 and 417x. HYPERLEDA lists 16.37 B magnitude and from Wikisky I estimate the dimensions as 0.5' x0.2'. Ian was able to see this one in the 20" as well. Tau 3 at 4.1 magnitude has a string of galaxies, the nearest, PGC 170039, is actually plotted in Stellarium. It is given as 14.93 B magnitude. Ian was able to see this one as well. Further out and dimmer were PGC 799804 and PGC 175782. Only one of the latter two was seen by both of us, although I had seen all three before.**

**A scan of my field notes:**

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# Number of Extrasolar Planets Found as of December 2017-3,727

# How Many More Are out There?

# Tens of Thousands? Hundreds of Thousands?

# What's New in Space

## Two More Space Pioneers Pass On

### Richard Gordon 1929-2017

Richard Gordon, one of the Gemini and Apollo astronauts of the 1960s and a member of the third astronaut group, died at his home near San Diego on November 7. He was 88 years old. The reason for his death was not given, but it was believed to be due to natural causes.

Gordon was born and raised near Seattle, and attended the University of Washington. After graduating in 1951, he joined the Navy and learned to fly, eventually becoming a test pilot. In 1963 he was one of fourteen men chosen for the third group of astronauts. He first flew aboard Gemini 11 in 1966 with Pete Conrad. During the mission, Gordon attempted a long-duration spacewalk, but had to cut it short due to exhaustion; he and Conrad later flew the Gemini capsule to over 850 miles from Earth, a record at the time. In November 1969, Gordon went to the Moon, again with Conrad and also Alan Bean, aboard Apollo 12. The mission almost became a disaster when a lightning bolt hit the Saturn 5 rocket only seconds after launch, but little damage was done and the craft reached the Moon. Gordon stayed aboard the Apollo capsule while Conrad and Bean landed on and spent almost two days on the Moon. For Apollo 17, NASA had to choose between Eugene Cernan and Gordon as the mission commander; Cernan was chosen, and Gordon was made commander of Apollo 18, which was eventually cancelled due to budget cuts. Gordon said later that he was disappointed with not being able to walk on the Moon; others who knew him well, though, said that he was bitter about not being chosen for Apollo 17, and in 1972, he left both NASA and the Navy. He was vice-president of the New Orleans Saints football team for several years afterwards, and then as an executive in the oil industry and an engineering consultant before his retirement.

### Bruce McCandless 1937-2017

Bruce McCandless, who became an untethered human satellite floating in space while wearing a Buck Rogers-type rocket backpack in 1984, died on December 21, according to a NASA announcement. He was 80 years old.

McCandless was born and raised in Boston, Massachusetts, and attended the U.S. Naval Academy, majoring in electrical engineering. He later received a masters degree in engineering from Stanford, and a masters degree in business administration from the University of Houston. In the Navy, McCandless became a pilot, and in 1966, was chosen to be one of fifth group of astronauts. He was a backup crewmember for both Apollo 14 and Skylab 3, but became well known as being the capsule communicator for Apollo 11 when it landed on the Moon. Neil Armstrong was impressed with McCandless's intelligence and articulation, and asked that he be the main Capcom for the mission. After Apollo, McCandless made himself the specialist for the MMU-Manned Maneuvering Unit-the flying backpack that would be used

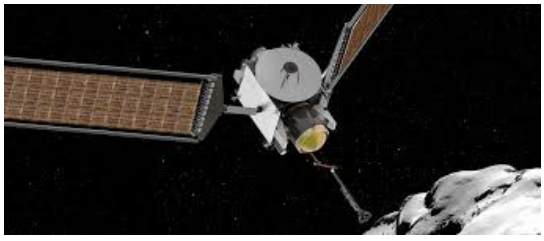
on the Space Shuttle. He helped design it and was its main tester during the years the Shuttle was being developed. Finally, in February 1984, almost 18 years after he was chosen, McCandless went into space on STS-41B, Challenger, and on February 7, he performed the world's first untethered spacewalk, propelling the MMU to over 300 feet from the shuttle. Fellow astronaut Bob Stewart repeated the achievement the next day. The photograph of McCandless floating freely in space has become one of the most iconic images of the entire space program. McCandless also flew on STS-31 in 1990, which deployed the Hubble Space Telescope. A few months after the STS-31 mission, he left NASA, and worked in the aerospace industry until his retirement.

## Voyager Flexes its Muscles

On December 1, the Voyager 1 spacecraft, now almost 12 billion miles from Earth, fired up its main thruster rockets for the first time in 37 years. It was a test to see if they still worked, in the event that they are needed to keep the spacecraft in proper orientation to communicate with Earth. In recent years, the attitude control thruster have not performed as well as expected, and NASA wanted to see if the main ones could be used as a backup. In order to perform the test, NASA engineers have to go to the archives to look up almost 40 year old information about the thrusters before sending orders to fire them. The craft came through with flying colors, and NASA now expects it to remain in contact for at least eight to ten more years. NASA may perform the same test with the Voyager 2 craft as well.

The two Voyager spacecraft were originally launched in 1977, passing by Jupiter in 1979 and Saturn in 1981. Then Voyager 1 was programed to go out of the solar system, while Voyager 2 flew by Uranus in 1986 and Neptune in 1989. In 2013, Voyager 1 crossed the heliopause, the point where the Sun's influence ends and is now in interstellar space. Voyager is so far away that a radio signal from Earth takes almost 19 hours to reach it. 2017 was the 40th anniversary of the Voyager launchings; many of the original Voyager team members are still regulars at the Jet Propulsion Laboratory in Pasadena, working with the younger scientists and engineers on the project, and making sure that their two "children" are still phoning home.

## NASA Chooses Two Finalists for the Next New Frontiers Mission



NASA has picked two programs for its next New Horizons mission, one that will land on Titan, Saturn's largest moon, and the other that will visit a comet to take samples and return them to Earth. On December 20, the space agency announced that the Dragonfly mission to Titan and the CEASAR mission to comet Churyumov-Gerasimenko are the two finalists out of over a dozen proposals, One will be chosen in 2019 for a 2024 launch. The Dragonfly mission will involve a rover with drone capabilities that will soft land on Titan; it will then be able to lift off and fly above the surface up to two hundred miles away from its landing spot, doing scientific analyses and taking images. The CEASAR(for Comet Astrobiology Exploration Sample Return)mission will approach the comet, scoop up samples of its material, and return them to Earth. This will be the fourth in the New Horizons series of missions.

Above right-the CEASAR spacecraft. Image-NASA/JPL

## American Commercial Spacecraft Ready for Launch-Finally

Both Space-X and Boeing are preparing to launch their manned spacecraft in 2018, and, if all goes well, both will be used by NASA to ferry American and foreign astronauts to and from ISS. Space-X's Dragon V2 was originally scheduled to be launched in 2017, but delays concerning the recovery systems pushed the program back. Space-X originally planned a system similar to the Russian Soyuz, which comes down on land, but to prevent damage to the craft and injury to the crew, fires a braking rocket a few seconds before touchdown to make the landing less rough. Space-X has had one problem after another with the braking rockets, which threatened to delay the craft's first flight by at least a year or more. Finally, NASA and Space-X agreed to forego the braking rocket and have the initial manned flights of the V2 land in the ocean, like the missions of the 1960s and 70s. So the first launch will be in March, and, if all goes well, the first manned mission in June. The two person crew for the June mission has not yet been announced.

Boeing's CST-100 Starliner spacecraft is currently being prepared for its first unmanned launch in April, and, if all goes well, its first manned mission in August. Like the Dragon V2, it has had problems which has delayed launching for over a year; it was originally scheduled for its first mission in early 2017. The two man crew has tentatively been announced as Douglas Hurley and Robert Behnken. Both are Space Shuttle veterans.

In the meantime Sierra-Nevada Systems mini-shuttle Dreamchaser has been undergoing drop tests, and may be ready for its first unmanned test flights in late 2018. It lost out in the three way race to build a manned commercial spacecraft to ferry astronauts for NASA, but recently won a NASA contract to deliver supplies and equipment to ISS, starting after 2020. Sierra Nevada is also contracting with the European Space Agency for possible manned ferry flights to ISS in the 2020s.

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## Astronomy Short

Before its true nature was revealed by the Mariner spacecraft in 1962, the planet Venus was named after the Roman goddess of love, and its symbol is also the one for females. The term Venera means "love" in Latin; hence we get the term Venereal Diseases, literally the "diseases of love." In Greek mythology, one of the goddess of love's names was Kytheria, and, as such, the formal adjective form for the planet is not Venerian(which is rather awkward, but is seen and heard in many old sci-fi stories and movies), but Cytherian, which sounds a lot better, and is easier to pronounce.

## From NASA's Space Place

# Studying Storms from the Sky

**By Teagan Wall**

**The United States had a rough hurricane season this year. Scientists collect information before and during hurricanes to understand the storms and help people stay safe. However, collecting information during a violent storm is very difficult. Hurricanes are constantly changing. This means that we need a lot of really precise data about the storm. It's pretty hard to learn about hurricanes while inside the storm, and instruments on the ground can be broken by high winds and flooding. One solution is to study hurricanes from above. NASA and NOAA can use satellites to keep an eye on storms that are difficult to study on the ground. In Puerto Rico, Hurricane Maria was so strong that it knocked out radar before it even hit land. Radar can be used to predict a storm's path and intensity—and without radar, it is difficult to tell how intense a storm will be. Luckily, scientists were able to use information from a weather satellite called GOES-16, short for Geostationary Operational Environmental Satellite – 16.**

**The "G" in GOES-16 stands for geostationary. This means that the satellite is always above the same place on the Earth, so during Hurricane Maria, it never lost sight of the storm. GOES-16's job as a weather satellite hasn't officially started yet, but it was collecting information and was able to help. From 22,000 miles above Earth, GOES-16 watched Hurricane Maria, and kept scientists on the ground up to date. Knowing where a storm is—and what it's doing—can help keep people safe, and get help to the people that need it.**

**Hurricanes can also have a huge impact on the environment—even after they're gone. To learn about how Hurricane Irma affected the Florida coast, scientists used images from an environmental satellite called Suomi National Polar-orbiting Partnership, or Suomi-NPP(left) One of the instruments on this satellite, called VIIRS (Visible Infrared Imaging Radiometer Suite), took pictures of Florida before and after the Hurricane. Hurricane Irma was so big and powerful, that it moved massive amounts of dirt, water and pollution. The information captured by VIIRS can tell scientists how and where these particles are moving in the water. This can help with recovery efforts, and help us design better ways to prepare for hurricanes in the future.**

**By using satellites like GOES-16 and Suomi-NPP to observe severe storms, researchers and experts stay up to date in a safe and fast way. The more we know about hurricanes, the more effectively we can protect people and the environment from them in the future.**

**Article courtesy of NASA's Space Place**

**Images-NASA**

*Another in a continuing series on lesser-known-but still important-astronomical observatories throughout the world*

## The David Dunlap Observatory

**The David Dunlap Observatory is located just north of Toronto, Ontario, Canada, and is administered by the Royal Astronomical Society of Canada. Until 2008, it was run by the University of Toronto, whose scientists and graduate students still use it. At one time, it had the second largest telescope in the world.**

**The observatory was originally conceived by Clarence Chant, a physics professor at the University of Toronto, and also one-time president of the Royal Astronomical Society of Canada. In the 1920s, he secured the financial support of David Dunlap, a wealthy Toronto businessman. Dunlap died before the observatory could be built, but his widow forwarded funding and construction began outside Toronto in 1932. In 1935, the main buildings of the observatory were completed and it was dedicated. The main telescope, which also went into operation in 1935, was a 74"(1.88 meter) reflector, at that time the second largest in the world, after the 100" Hooker reflector at Mount Wilson. The mirror for the telescope was made by Corning in New York, and came from the same batch of Pyrex glass that was used to make the 200" Hale Telescope mirror at Palomar. Eventually, several other telescopes were built at the observatory. In 1956, the observatory built a radio telescope on the grounds, and in 1963, another radio telescope was built at Algonquin Park in northern Ontario. In 1971, the observatory, in response to encroaching light pollution, built a .6m telescope at the Las Companas Observatory in Chile. The telescopes at the Toronto site continued to be used.**

**Today, the observatory has four optical operational telescopes: the 1.88m reflector, a .5m Cassegrain, and a 6.m Cassegrain at the original facility; the 6.m reflector which was originally at Las Companas, and in 1997 was moved to El Leoncito in Argentina; and the two radio telescopes. The observatory's library has been moved to downtown Toronto, near the university, as have some of the administration offices, although the main facilities are still at the original site.**

**The DDO, as it is called, has played a leading role in modern astronomy. Cygnus X-1's companion star was discovered by a DDO-U of Toronto scientist, Tom Bolton, as a result of DDO sponsored scientific rocket launches from White Sands New Mexico. Supernova 1987A was first seen by a University of Toronto graduate student, Ian Shelton, with the DDO's .6m at Las Companas. A number of major discoveries concerning globular clusters has been done through the DDO, as well as groundbreaking research on Polaris and other stars.**

**Images: top right-the main administration building and domes for the two smaller telescopes Bottom left-the dome for the 1.88m reflector**

**Source: Wikipedia**