SIRIUS ASTRONOMER

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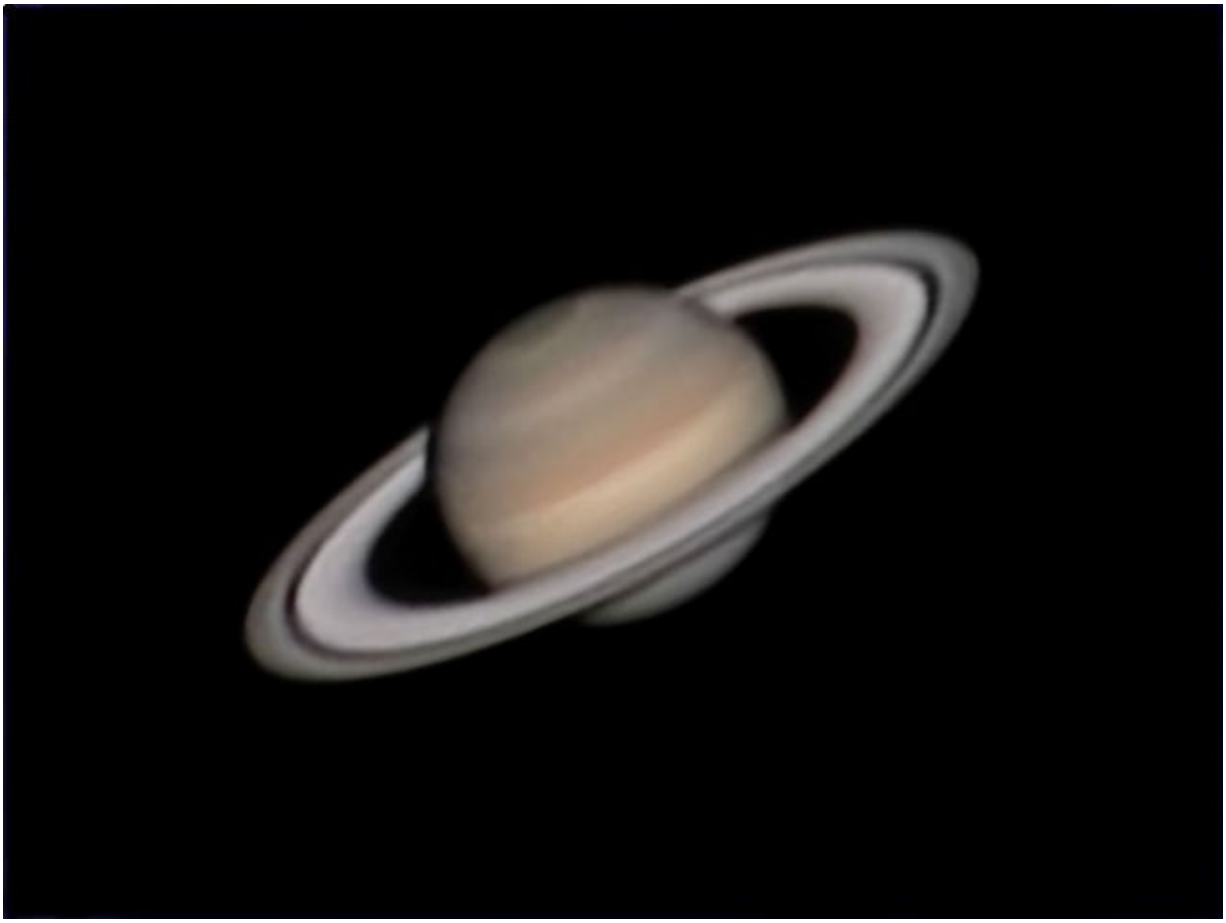
The Newsletter of the Orange County Astronomers

JUNE 2013 *Free to members, subscriptions $12 for 12* **Volume 40, Number 6**



A perennial favorite of the backyard astronomer, Saturn is well-placed for viewing throughout the night. Pat Knoll obtained this image from Kearney Mesa (near San Diego) using a 10-inch LX200 Classic at f/40 using a DFK 21AU618.AS imager. This image was obtained during a full Moon, with moderate sky conditions, in skies as light-polluted as any in Orange County, so Saturn is sure to please no matter what the circumstances. Look for it near the bright star Spica in Virgo about two hours after sunset.

OCA CLUB MEETING

The free and open club meeting will be held June 14 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month, Mike Simmons will discuss the global astronomy community Astronomers Without Borders.

NEXT MEETINGS: July 12, August 9

STAR PARTIES

The Black Star Canyon site will open on June 8. The Anza site will be open on June 8. Members are encouraged to check the website calendar for the latest updates on star parties and other events.

Please check the website calendar for the outreach events this month! Volunteers are always welcome!

You are also reminded to check the web site frequently for updates to the calendar of events and other club news.

COMING UP

The next session of the Beginners Class will be held at the Heritage Museum of Orange County at 3101 West Harvard Street in Santa Ana on June 7. The following class will be held August 2.

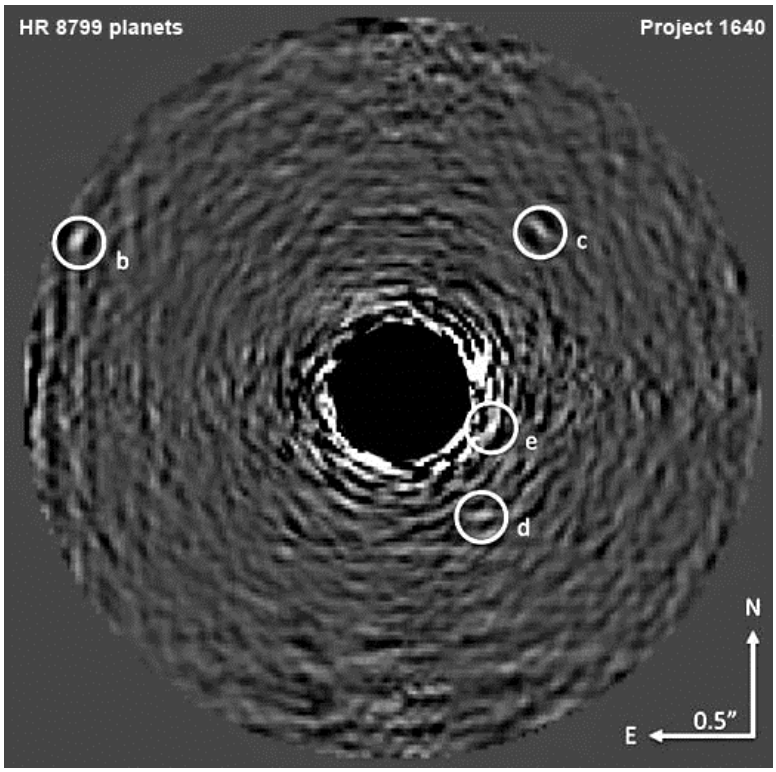
GOTO SIG: TBA
Astro-Imagers SIG: June 18, July 16
Remote Telescopes: TBA
Astrophysics SIG: June 21, July 19
Dark Sky Group: TBA

AstroSpace Update

June 2013

Gathered by Don Lynn from NASA and other sources

BEER – Astronomers have discovered an exoplanet (planet not orbiting the Sun) using a new technique that depends on relativity effects. Most exoplanets have been discovered by the radial velocity method (wobble in the star induced by the planet's gravity) or the transit method (planet blocks a fraction of its star's light). The new method looks for 3 effects on the brightness of a star: 1) relativistic beaming effect on the starlight as it moves to and fro, 2) stretching of the star out of spherical shape by tidal effect of the planet, 3) starlight reflected off the planet. The effects are very small, but seeing all 3 of them in synchronization found a planet. The observations were made by the Kepler spacecraft, which was designed to look for the transit method. The new planet was confirmed with radial velocity data, and surprisingly, a very subtle transit that had been overlooked in the Kepler data. The discoverers have been calling it "Einstein's planet", but it has been officially named Kepler-76b. It is a hot Jupiter, that is, a gas giant orbiting very close to its star. Its year is 1.5 Earth days, its diameter is 25% larger than Jupiter, and its mass is twice Jupiter's. It orbits a type F star about 2,000 light-years away. It is tidally locked to its star, always showing the same face to it. A sunny day there is about 3600° F (2000° C). The astronomers found strong evidence that the planet has extremely fast jet-stream winds that carry the heat around it, resulting in the hottest spot being offset by about 10,000 miles (16,000 km) from the sub-star point. This effect has been observed only once before, on HD 189733b, and only in infrared light. The new technique has advantages over the radial velocity and transit methods in some circumstances: it does not require high-precision spectra like radial velocity does, and it does not require the orbit to be aligned to pass in front of its star. The planet was discovered by BEER, which is not the beverage, but stands for BEaming, Ellipsoidal, and Reflections, a computer program that searches brightness data for those effects.



Exoplanet composition – Though there are more than 800 confirmed exoplanets, only a small fraction of those have been imaged. A project using several techniques at the Palomar Observatory has been successful in not only imaging, but taking spectra of several exoplanets. Since the star is typically 100,000 times as bright as the planet, this is difficult. The techniques used include a coronagraph to mask out the starlight, an advanced adaptive optics system to remove the blur of our moving atmosphere, an imaging spectrograph, a state-of-the-art wave front sensor to compensate for scattered starlight, and working with infrared rather than visible light. The new work examined HR 8799, a large star orbited by at least 4 known giant planets. The results revealed that all 4 planets, though nearly the same temperature, have different compositions. Some, unexpectedly, do not have methane in them, and there may be hints of ammonia or other compounds that were not expected. The astronomers hope to similarly observe other planets. Ideally they would be young planets that still have enough heat left over from formation to emit more infrared light. Also they would be far from their stars to more easily block out the starlight.

Kepler (exoplanet finding space telescope) has discovered 2 new planetary systems that include 3 super-Earth-size planets in the habitable zone, the range where the surface temperature of an orbiting planet might support liquid water. The Kepler-62 system has five planets, known as 62b through 62f. The Kepler-69 system has 2 planets: 69b & 69c. Kepler-62e, 62f & 69c are the planets in the zone. 62f is only 40% larger in diameter than Earth, making it the exoplanet closest to the size of our planet that is known to be in the habitable zone of another star. 62f is likely to have a rocky composition. 62e orbits on the inner edge of the habitable zone and is roughly 60% larger than Earth. 69c is 70% larger than Earth, and orbits in the habitable zone of a star similar to our Sun (type G).

Astronomers are uncertain if 69c is rocky. Its orbit of 242 days around a Sun-like star resembles that of our neighbor Venus. 62e orbits in 122 days, and 62f in 267 days. The 2 orbiting Kepler-62 have 3 companions in orbits closer to the star, 2 larger than Earth and 1 about the diameter of Mars. 62b, 62c and 62d orbit in 5, 12, and 18 days, respectively, making them very hot. Kepler-62 is a K2 star, measuring just 2/3 the size of the Sun and only 1/5 as bright. At 7 billion years old, it is somewhat older than our Sun. It is about 1200 light-years away. 69b is more than twice the size of Earth and whizzes around its star every 13 days. Its star is about 80% as bright as our Sun and is about 2,700 light-years distant.

Alas, Kepler ran out of gas (actually wheels). Another reaction wheel, which allows precision pointing necessary for Kepler observations, failed in mid May. The wheel had been showing signs of excessive friction, and was given a rest (turned off) in January to see if lubrication would spread during the rest. The Kepler mission was originally scheduled to end in 2013, but was extended to 2016 when it was found that excessive camera noise and unexpected flickering in stars would require a few years more data to overcome. Unless a way is found to restart either of the 2 broken wheels or a way is found to augment the remaining wheels with thruster power, the mission will be over. If over, Kepler will still have accomplished its goals for finding planets, except that the longest period and smallest diameter planets will be missed. It will take many years to sift through existing Kepler data to find more suspected planets, and to verify with other telescopes the existence of the 2700 suspected planets ("candidates") already found.

Exoplanet debris – Hubble Space Telescope has found the material of which planets are made in an unlikely place: the atmospheres of a pair of white dwarfs (burned-out stars). These dead stars are located 150 light-years away in a relatively young star cluster, the Hyades. The cluster is only 625 million years old. The white dwarfs are being polluted by asteroid-like debris falling onto them. The debris includes silicon and a little carbon. It is thought that these stars early in their lives developed planets, and managed to retain some of them through the process of dying into white dwarfs. The research suggests that small asteroids that approached the white dwarfs too closely were torn apart by tidal forces and their material rained down onto the stars' atmospheres. Astronomers commonly believe that all stars form in clusters. But searches for planets have detected few orbiting stars in clusters. Cluster stars tend to be young, and young stars probably are too active with outbursts to allow planet-finding techniques. So looking at the dead stars in the clusters may be the easiest way to find evidence of planets from the debris in the stars' atmospheres.

Exoplanet atmosphere – A new paper describes how Spitzer (infrared space telescope) has examined a hot Jupiter exoplanet called HAT-P-2b. By monitoring the brightness of the star and planet as it orbits all the way around the star, a global climate map of the planet's atmosphere can be made. This reveals how the planet's atmosphere varies from the hot, sun-facing side to the cooler night side. When Spitzer launched a decade ago, observing exoplanet atmospheres was not imagined. The newest such observation was the longest such Spitzer observation yet, monitoring it for 6 Earth days. What makes the observation more exciting is that the planet has a comet-like eccentric orbit, carrying it from 2.8-9.3 million miles (4.5-15 million km) from its star. This is far closer than Mercury is to our Sun (28 million miles). Because the planet's distance changes, astronomers can watch how fast it heats up (about an Earth day) and cools down (4-5 days). The new observations were among the 1st to use multiple wavelengths of infrared, which enables the scientists to peer down into different layers of the atmosphere. It showed a temperature inversion (a hotter upper layer of gas) when it is closest to its star. Such planets are dynamic, with strong winds churning material up from below, always changing the chemistry.

Mount Sharp – Researchers suggest that Mars' roughly 3.5-mile high (5.6 km) Mount Sharp, next to where rover Curiosity landed, most likely was formed as strong winds carried dust and sand into Gale Crater and dropped it there. Previous observations showed that it was too layered to be a central peak of an impact crater, such as often seen in lunar craters. The new observations showed it was unlikely to have formed as lake sediment, the next best theory. There are signs of Gale Crater containing lakes long ago, but not deep enough to pile sediment as high as Mount Sharp. The new observations showed that strong winds blow into the crater from all directions, then slow in the center, which results in dropping of airborne dust and sand. The winds are caused by cooling of the crater at night, drawing in surrounding air. The layers of the mountain were found to be not flat enough to be lake sediment. The new re-

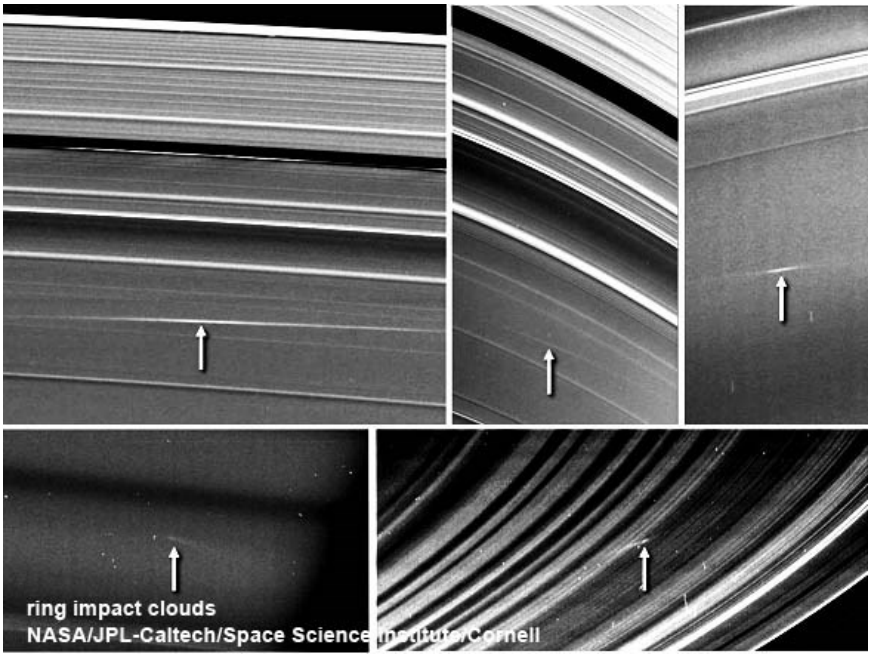
search was done with data from the Mars Reconnaissance Orbiter. This new theory can be tested by looking for evidence of wind deposition when Curiosity examines the base of Mount Sharp. Even if the new theory proves to be true, Curiosity is not wasting its time looking for lake sediment, because finding wind sediment will also tell us the history of Gale Crater.

Curiosity (Mars rover) has selected a 2nd spot to drill and sample, in similar appearing rock to the previous drill, in order to confirm the previous results. Both are patches of flat-lying bedrock with pale veins and bumpy surface texture due to erosion-resistant nodules within the rock. The nodules have been identified as concretions resulting from the action of mineral-laden water. The 2nd site has more surface bumps, however. During the recent conjunction, where Mars was behind the Sun as seen from Earth, Curiosity collected science data, but did no driving or drilling. The Sun interferes with radio communications, so activities requiring supervision by radio were curtailed. The conjunction also interrupted communication with the 3 orbiters and the other rover at Mars.

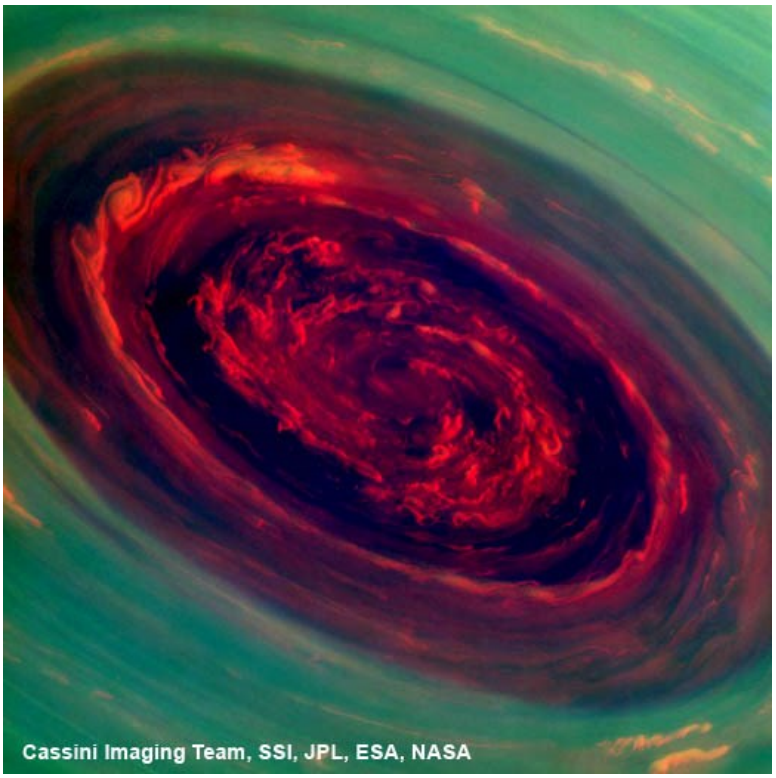
Martian impacts – Scientists have been using wide-field cameras in Mars orbiters to look for suspected newly formed features on Mars, then using the high-resolution camera on Mars Reconnaissance Orbiter to image any suspects and determine if they are new impact craters. The result is that 200 impacts of asteroid or comet bits occur every year on Mars that are larger enough to form a crater of 12.8 feet (3.9 m) or larger. This number will lead to better age estimates of the more geologically recent features on Mars, since those ages are calculated from the number of impact craters that have accumulated on them. Previous estimates of the cratering rate had been 3-10 times higher than this new measurement. Mars now has the best-measured cratering rate in the solar system. Asteroids making these new craters are typically only 3-6 feet (1-2 m) in diameter. Space rocks too small to reach the ground on Earth cause craters on Mars, because the Red Planet has a much thinner atmosphere. The meteor that exploded over Russia in February was roughly 10 times larger in diameter than the typical ones causing the observed craters on Mars.

Hot Saturn – As planets age they become darker and cooler. Saturn however is much brighter than expected for a planet of its age. New research has revealed how Saturn keeps itself looking young and hot. Researchers found that layers of gas, generated by physical instability deep within the giant planet, prevent heat from escaping, resulting in Saturn failing to cool down at the expected rate. Instead of heat being transported throughout the planet by large scale motions, it must be partly transferred by diffusion across some layers of gas inside Saturn.

Cassini (Saturn orbiter) has provided the 1st direct evidence of small meteoroids crashing into the rings and breaking into rubble. The meteoroids must range in size from about ½ inch (1 cm) to several yards (several m). Scientists scrutinized images of the rings and found 9 streaks of the shape assumed by a puff of debris as differential rotation of the rings stretches the puff. The collisions took place in 2005, 2009 and 2012. These results imply the impact rates for small particles at Saturn are about the same as at Earth. The Saturnian equinox in 2009 was an especially good time to see these impacts, as the shallow sun angle accentuated them.



Saturn seasons – Researchers working with data from Cassini have discovered one way the bubble of charged particles, known as the magnetosphere, changes with the planet's seasons. Flux tubes, the structures of hot charged gas which funnel charged particles toward the planet, were found to correlate with the radio-wave patterns in the northern and southern hemisphere, which were previously known to change rotation period with the seasons on the planet.



Cassini has provided the 1st close-up visible-light views of a behemoth hurricane swirling around Saturn's north pole. Previously Cassini's orbit and seasonal lighting had not allowed such images. The hurricane's eye is about 1250 miles (2000 km) wide, 20 times larger than typical hurricane eyes on Earth. Thin bright clouds at the outer edge of the hurricane are traveling 330 mph (150 m/sec). The hurricane swirls inside the mysterious six-sided weather pattern known as the hexagon. Both a terrestrial hurricane and Saturn's north polar vortex have a central eye with no or very low clouds. Other similar features include high clouds forming an eye wall, other high clouds spiraling around the eye, and a counter-clockwise spin in the northern hemisphere. A major difference is the Saturn one is much bigger and spins surprisingly fast. The wind in the eye wall blows more than 4 times faster than Earthly hurricane-force winds. Unlike terrestrial hurricanes, which move, the Saturnian hurricane is locked onto the north pole. Scientists believe the massive storm has been churning for years.

New type of gamma-ray burst (GRB) – 3 unusually long-lasting GRBs have been grouped as a new class of GRB, termed ultra-long GRBs. They last up to 100 times longer than typical long GRBs, reaching several hours. Long GRBs are believed to be caused by the collapse of a very massive star (say 20 times the mass of the Sun), which has previously blown off much of its outer layers. The newly defined ultra-long GRBs are probably caused by a very massive star that has not lost its outer layers, and has swelled up into a blue supergiant star. This size would prolong the production of gamma rays, and thus cause the burst to be ultra-long.

Powerful gamma-ray burst – A record-setting burst of gamma rays from a dying star in a distant galaxy has amazed astronomers. Designated GRB 130427A, it produced the highest-energy light ever detected from such an event. It lasted so long that a record number of telescopes on the ground were able to catch it. Fermi (gamma-ray space telescope) recorded 1 gamma ray with an energy of at least 94 billion electron volts (GeV), about 3 times the previous record. The GeV emission lasted for hours, and it remained detectable by Fermi for the better part of a day, setting a new record for the longest GRB. It was subsequently detected in optical, infrared and radio wavelengths by ground-base observatories. In fact, one all-sky monitor found it in visible-light 50 seconds before the gamma rays were detected. Astronomers quickly learned that the burst was located about 3.6 billion light-years away, which for these events is relatively close. Astronomers think most GRBs occur when massive stars run out of nuclear fuel and collapse as a supernova. In the case of GRBs, jets of material shoot outward from the supernova at nearly the speed of light. So such GRBs that are near enough are followed by the detection of a supernova within weeks. Astronomers are keeping watch for the supernova.

Supernova – In 2004 scientists reported finding an isotope of iron in a core sample from the Pacific Ocean that does not form on Earth. They calculated the decay rate of the radioactive isotope iron-60 and determined that the source was from a nearby supernova about 2 million years ago. A physicist wondered if evidence of that supernova could be found in fossils also. Some deep sea bacteria soak up iron. Using a core sample from the eastern Pacific, he found traces of iron-60 in the fossils formed 2.2 million years ago. It is not known where the supernova was, but a previous paper established that it was probably 1 of several known in the Scorpius-Centaurus star association.

Hubble Space Telescope has shown for the 1st time that bursts of star formation have a major impact far beyond the boundaries of their host galaxy. These events can affect galactic gas at distances of up to 20 times greater than the visible size of the galaxy, altering how the galaxy evolves. When galaxies form new stars, they sometimes do so in frantic episodes known as star bursts. These events were commonplace in the early Universe, but are rarer now. A team observed 20 nearby galaxies, some of which were undergoing starbursts. The researchers found that the winds accompanying starbursts could ionize gas up to 650,000 light-years away. The

extended material around galaxies is hard to study. Hubble observed more distant quasars shining through the outer material in order to detect it. The starburst galaxies within the sample had large amounts of highly ionized gas in their halos, but non-starburst galaxies did not. A galaxy grows by accreting gas from space surrounding it and converting this gas into stars. Ionizing the future fuel reservoir of gas impedes that gas from accreting into the galaxy, slowing future star formation.

Hubble has observed the blazar PKS 1424+240 and shown that it is the most distant known source of very high-energy gamma rays, at a distance of at least 7.4 billion light-years. Observations by gamma-ray telescopes had not been able to establish a distance. Gamma rays should be substantially absorbed over this great a distance, and calculations of that absorption over various wavelengths allows reconstruction of the spectrum the object must have had when the gamma-ray light left there. The result does not agree with any other blazar spectrum. This means either we don't understand how blazars emit gamma rays, or we don't understand how gamma rays are absorbed over long distances, or we don't understand the extragalactic background light (which is involved in the absorption process). The extragalactic background light is the diffuse radiation from all stars and galaxies, a dim glow that fills the Universe. Blazar emission is thought to result from a relativistic jet of particles powered by matter falling onto a supermassive black hole at the center of the host galaxy.

Hydrogen clouds – The Green Bank Radiotelescope has discovered a cluster of electrically neutral hydrogen clouds strewn between 2 nearby galaxies, Andromeda (M31) and Triangulum (M33). They are about the mass of dwarf galaxies, but contain no stars. It is believed that the clouds condensed out of hot ionized (electrically charged) gas, though these observations cannot see ionized gas. The observations were able to rule out other sources of the clouds, such as streamers tidally stripped from galaxies.

Herschel (infrared space telescope) has made detailed observations of surprisingly hot molecular gas that may be orbiting or falling towards the supermassive black hole at the center of our Milky Way galaxy. Vast amounts of dust lie in the plane of the Milky Way between here and its center, obscuring our view at visible wavelengths. But at far-infrared wavelengths, it is possible to peer through the dust. Herschel has detected a great variety of simple molecules at the Milky Way's heart, including carbon monoxide, water vapor, and hydrogen cyanide. It has resolved emission within just 1 light-year of the black hole. The biggest surprise was how hot the molecular gas gets. At least some of it is around 1800° F (1000° C), much hotter than typical interstellar clouds, which are usually only a few tens of degrees above absolute zero. While some of the heating is due to the fierce ultraviolet radiation from massive stars nearby, they are not enough to explain the high temperatures alone. The team hypothesize that emission from strong shocks in gas may be contributing to the high temperatures. Such shocks can be generated in collisions between gas clouds, or in material flowing at high speed from stars.

Herschel has solved a long-standing mystery as to the origin of water in the upper atmosphere of Jupiter, finding conclusive evidence that it was delivered by the dramatic impact of comet Shoemaker-Levy 9 in July 1994. This source had been speculated, but proof was missing. Scientists were able to exclude an internal source, such as water rising from deeper, because it is not possible for water vapor to pass through the cold trap that separates the stratosphere from the visible cloud deck below. Thus the water detected in Jupiter's stratosphere must have been delivered from outside. Herschel's observations found that there was 2-3 times more water in the southern hemisphere of Jupiter than in the northern, with most of it concentrated around the sites of the 1994 impact. Additionally it is found only at high altitudes. Another possible source of water, a rain of small interplanetary particles, was eliminated by the non-uniform distribution. The possibility of 1 of Jupiter's moons delivering the water was ruled out because none of the moons is in the right place to deliver water into the locations where it was found. The observations also ruled out impacts smaller than Shoemaker-Levy 9 (and some have been observed) and local variations in temperature causing variations in water. That leaves Shoemaker -Levy 9 as the only suspect.

Alas, Herschel ran out of gas. In order to operate at its infrared wavelengths, key parts of the telescope are cooled by liquid helium to extremely low temperatures. As expected, it finally ran out of coolant April 29, and when the temperatures of the detectors rose, they had to be turned off, ending all observations. Herschel highlights include: discovering long, filamentary structures dotted with star-making knots, 1st detecting oxygen and other molecules in space, discovering high-speed outflows around central black holes in galaxies, finding extremely distant galaxies that could be seen only with Herschel, finding evidence comets could have brought a substantial amount of water to Earth, discovering some of the youngest stars ever seen, finding a peculiar planet-forming disk at star TW

Hydra which indicates planet formation may happen over longer periods than expected, and shown that stars can leave trails as they move through clouds of dust and gas.

Meteorite – An expert has confirmed that an object that crashed through a house in Wolcott, Connecticut, recently was a meteorite. It damaged the roof and copper piping, and cracked the ceiling of the kitchen. People from several towns nearby called police and reported a loud boom that rattled windows, caused by the fall of the meteorite. It was during the end of the Lyrid meteor shower, so it may be a Lyrid. Nearby Wethersfield was hit by falling meteorites twice since 1971. The 1st recorded meteorite fall in the western hemisphere occurred in nearby Weston. All within 50 miles, all beginning with W. What are the odds of that?

Supernova debris – Scientists have discovered 2 tiny grains of silica, the most common constituent of sand, in primitive meteorites. This is surprising because silica is not a mineral expected to condense as stars and meteoroids form. 5 silica grains have been found before in meteorites, and those were identified by their isotopes as coming from a red giant. The 2 new grains were isotopically identified as coming from a supernova. It is believed from previous evidence that formation of the Sun was triggered by a nearby supernova. It is possible that these grains came from that supernova.

Relativity supported – A strange stellar pair of a neutron star and a white dwarf star has provided physicists with a unique cosmic laboratory for studying gravity. The extremely strong gravity between the close pair puts competing theories of gravity to a test more stringent than any available before. Once again, Einstein's general relativity, published in 1915, won the competition. Extensive radio observations of the pulses from the neutron star yielded data on subtle changes in the pair's orbit as it decayed due to radiating gravitational waves. This is good news for gravitational wave scientists, since it shows such waves from similar systems are close to being detectable.

Matter – A collaboration of scientists has announced another asymmetry between matter and antimatter. Both matter and antimatter are thought to have existed in equal amounts at the beginning of the Universe, but some asymmetry since has resulted in the current Universe essentially made of only matter. The new discovery is during the decay of the B^0_S particle. It is the 4th known matter/antimatter asymmetry. The others involve the kaon, B^0 and B^+ mesons. The total effect of these 4 is not enough to explain today's matter-dominated Universe, so the search continues.

Bennu – The asteroid that will be explored and sampled by the OSIRIS-Rex spacecraft has been named Bennu by 9-year-old Michael Puzio, who won the contest to choose the name. Bennu is an ancient Egyptian avian deity who bears a strange resemblance to the spacecraft with its solar array and sample arm extended. Bennu means "the ascending one" or "to shine". The spacecraft is schedule to launch in 2016, rendezvous with Bennu in 2018, and return a sample of the asteroid to Earth in 2023. More than 8000 students from more than 25 countries entered the contest. The winning name was then submitted to the IAU, which approved.

Instant AstroSpace Updates

Half of the crew of the **International Space Station** (ISS) returned to Earth in mid May, soon to be replaced by 3 more astronauts. One of the returnees was Chris Hadfield, the Canadian commander of ISS, who has become quite popular on social media with his videos and tweets from space.

Just before the crew change, ISS developed a leak of ammonia from a cooling system involved with the solar panels, and 2 astronauts were called on to perform a **spacewalk** to replace a pump control system thought to be the source of the leak. Repair was successful.

Scientists have created the 1st global topographic **map of** Saturn's moon **Titan**, using data from Cassini's radar, which penetrates the hazy atmosphere. The map will probably be revised at the end of the Cassini mission in 2017, since more of Titan will have been radared.

Bad (Space) Weather Cancels Pigeon Races

Pigeon racing is a big sport that dates back almost 2,000 years. All over the world, there are people with the hobby of training and racing a special kind of homing pigeon. They take their caged pigeons to a spot that is a carefully measured distance from their home. Then they open the cages and time how long it takes for the pigeons to fly home. The pigeon with the shortest time gets the prize—or rather its owner gets the prize. The pigeon just gets tired, since it has flown as fast as it could for 60 – 600 miles or more (100 to 1000 kilometers)!

But how do the pigeons know where home is?

It has taken a lot of scientific study to figure it out, and there are still questions. One thing that seems certain is that the pigeons can detect Earth's magnetic field lines.

Earth is like a big magnet, with lines of magnetic force that loop around Earth from one magnetic pole to the other. A compass needle will line up along the magnetic lines of force. That's how humans can know which way is north. The pigeons seem to have a compass too, but it is "built in," so they always know in which direction they are flying. We know they are not navigating by the position of the Sun in the sky, because they fly straight home even at night or in cloudy conditions when they can't see the Sun.

A pigeon racer releases his pigeons far from home and hopes to see them again soon.

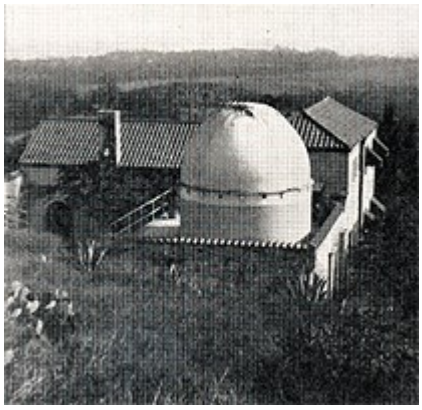
While the pigeons don't use the Sun for navigation, the Sun does affect their ability to navigate. When the Sun is in a stormy mood, it blasts charged particles into space at high speeds. If the blast of particles hits Earth, it shakes up Earth's protective magnetic field. When this happens, the magnetic field that the pigeons use for navigation will change direction and the pigeon's navigation system will get confused and send the pigeon the wrong way. The anxious owner may never see his expensive champion racing pigeon again.

For that reason, some pigeon racers call up the Space Weather Prediction Center (part of the National Weather Service) in Boulder, Colorado, before a big race. They want to know the "space weather" forecast. The scientists who work there keep an eye on the Sun using satellites such as the GOES (for Geostationary Operational Environmental Satellites). These satellites have special instruments that monitor the Sun's x-rays and ultraviolet light output. They can detect the beginnings of a storm that might send bad space weather toward Earth.

If bad space weather is on the way, the pigeon race is postponed. No one wants to lose a prized pigeon!

Inside the Space Weather Prediction Center in Boulder, Colorado, scientists keep an eye on the Sun. The GOES satellites send images that show activity on the Sun's surface that means a flare or eruption may be about to happen.

The Bishop Observatory—Some History (Part 1 of 3)
By Larry Adkins
Rancho Santiago College District
Santa Ana, California
(reprinted from OCA Website)



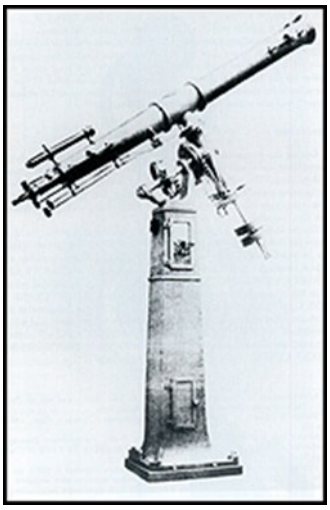
Mr. Bishop's Telescope 1923 - 1930

The 8" Alvan Clark refractor of the Bishop Observatory inspired and instructed students of Santa Ana College (*SAC*) for more than three generations. The college is located in the city of Santa Ana, the county seat of Orange County, immediately south of Los Angeles. Although the telescope has been in the possession of the college for over half a century, it was originally owned by amateur astronomer Clyde Bishop who built an observatory for it at his home in Lemon Heights (*left*). Mr. Bishop (1875 - 1927) was a well known Orange County attorney in the early years of the twentieth century and was very active in civic affairs. His biography, given in ***The History of Orange County*** (1921)[1] , speaks of a solid citizen, the head of a successful law firm, twice elected to public office on the Republican ticket (state assemblyman), and, for a time, city attorney for the city of Orange. Despite these solidly conservative credentials, the early part of his life appears to have been rather adventurous. At the age of twenty he left the family farm outside Orange and joined a traveling theater company as an actor. Exactly how long he pursued this profession is not known, but long enough to tour and perform on both coasts and south into Mississippi. His theatrical career came to an end when he was stirred by the call to arms at the onset of the Spanish - American war and volunteered for the army. He saw no action, however, serving out his enlistment at the Presidio in San Francisco.

After leaving the army, he returned to Orange County where he studied law as an apprentice at the law firm of McKelvey and Montgomery in Santa Ana. By 1902 he had established his own law office and began his rise as a "pillar of the community". Exactly when he acquired an interest in astronomy is not known, but he clearly was in contact with Jennie Lasby (later Tessmann) almost as soon as she began her teaching career at Santa Ana Junior College in 1919. This can be surmised from the fact that Ms. Lasby is known to have served as Bishop's "technical advisor" in the selection of the telescope and in the construction of the observatory which was initiated shortly after her arrival in Orange County[2] .


Jennie Belle Lasby

I think that the case can be made that Jennie Lasby was the major influence in Bishop's acquiring the telescope and equipping the observatory. Ms. Lasby was a first rate professional astronomer, in the first group of women hired by George Ellery Hale to work at Mt. Wilson, and co-author with future observatory director Walter Adams of a pioneering work on solar spectroscopy [3] . She was subsequently offered positions with J. C. Kapteyn in Germany (thwarted by World War I) and at the University of Chicago, but she chose to move to Santa Ana to be near her ailing parents. Ms. Lasby received her undergraduate degree from Carleton College in Minnesota and her master's degree from Mt. Holyoke College in Massachusetts. She worked in the observatories of both of these institutions (Goodsell at Carleton and Williston at Mt. Holyoke), and they both had 8" Alvan Clark refractors [4] . It would appear that Mr. Bishop was advised to install a modern (1920s) version of these academic observatories at his home. The earlier telescopes were research grade instruments, equipped with spectroscopes, camera attachments and Herschel wedges for solar observing. The Bishop observatory's 8" refractor had all of these accessories, making it the equal of the institutional instruments. Ms. Lasby makes it clear in several articles published in the 1930s that she expected to do serious work with the Bishop telescope. I have been unable to locate the original spectroscope or the camera attachment, but the Herschel wedge is still in the eyepiece box.



According to Mabel Sterns' ***Directory of Astronomical Observatories in the United States*** [5] , the observatory was built in 1923, a "Concrete building with a motor-driven steel dome". The 1923 date may refer to the telescope's manufacture (see below), since real estate records indicate that the house itself was not occupied until sometime in 1926. The estate was clearly something of a showpiece in the mostly rural Orange County of the 1920s, as evidenced by a featured pictorial in the real estate section of the ***Santa Ana Register*** dated November 18, 1926[6]. A concrete pier firmly anchored in the ground was provided to support the mounting. This pier was isolated from the structure of the house to insure that vibrations were not transmitted to the telescope. Although the observatory was moved from Lemon Heights in 1940, as late as 1999 a portion of the pier still remained intact at the Bishop estate[7] (the house has since been completely renovated and the remaining section of the pier removed).

I have not been able to locate a period photograph which gives an overview of the completed telescope on its mounting. However, I can attest that when it was operational in the1980s it looked virtually identical to the accompanying illustration which is from the authoritative ***Alvan Clark & Sons, Artists in Optics*** by Deborah Jean Warner and Robert B. Ariail[8] . The distinctive feature of the telescope is the mounting which the company called the "Universal Observatory Mount, Type B". Warner and Ariail state that this mount was very rare and only a handful were ever built. Its distinguishing feature is the horseshoe shaped casting which supports the polar axis and is large enough to hold a right ascension setting circle of considerable diameter. The clock drive was electrically driven with a governor to regulate the speed. Overall, the mounting is very similar to a design offered a few years later by Warner and Swasey. The telescope was equipped with three eyepieces, along with the previously mentioned spectroscope, camera attachment and Herschel wedge.

The 8" objective lens is an achromatic f/15 doublet and is identical to the one prepared for Manuel Grno de Castresano of Arequipa, Peru. The technical details for the Arequipa lens are given on page 259 of the notebook in which Robert Lundin (the Clark corporation's chief optician) kept a record of every Alvan Clark objective made from 1882 to 1927[9]. At the bottom of this page is the notation: "*C. Bishop's same glass and curves as above*". The page is dated January 7, 1924, implying that the actual fabrication of the Arequipa objective was in 1923. Since the Bishop notation was clearly added later, the fabrication date for the Bishop lens is less certain, although the lack of a separate entry implies that it was made at about the same time. It appears that the glass blanks were from a new vendor, since there is a brief notation on the page margins which states "*The material is entirely different from any I have record of* ". The data in the notebook suggest that the unknown characteristics of the glass led to an error in the original curvature, and the lens had to be reground to achieve the desired color correction and focal length. Since the Arequipa lens was ground and polished first, there would have been no need for a similar learning curve with the Bishop objective.

The date of 1923 is significant in accessing the optical quality of the objective lens. Alvan Clark and his sons, George and Alvan Graham, were the premier American telescope makers of the late 19th century, probably the finest in the world, and builders of the two largest refractors ever made, the 36" at Lick and the 40" at Yerkes. The definitive history of this telescope making family and their company is given by Warner and Ariail (*op. cit.*). All of the Clarks were dead by the turn of the twentieth century, but the master optician C. A. R Lundin who had been hired by Alvan Clark in 1874 remained to carry on the tradition of fine optical craftsmanship. Lundin's son Robert, a skilled optician trained by his father, was in charge of the company's optical department in the 1920s. However, by the 1930s the company was in decline. Lundin had left, and the historic grinding tools and other equipment were disposed of in an early World War II scrap metal drive. The fact that the Bishop telescope dates from 1923 means that the lens might well have been polished and figured by Robert Lundin himself who, among other things, polished and figured the 13 inch camera lens for Lowell Observatory with which Clyde Tombaugh discovered Pluto[10].

Exactly what use was made of the telescope in the early years is not known. It was definitely involved in variable star work by 1929, but there is no evidence that it was used for this purpose in the first few years of its operation. There is an article in a 1941 issue of ***El Don*** (*SAC* student newspaper) that states that students began visiting the observatory in 1926 (*Telescope in Action for 15 Years*)[11] , but earliest record of a student field trip to Lemon Heights I have been able to find is 1930[12]. At any rate, this initial period of the observatory's history came to an abrupt end on October 31, 1927 when Clyde Bishop died unexpectedly at the age of 52. His death merited a front page obituary with a large headline in the ***Santa Ana Register***[13]***.*** His enthusiasm for astronomy and the fact that he had built an observatory at his home was mentioned, though no further details were given. That same year (1927) Jennie Lasby traveled to Germany and married John Tessmann, a German scientist and mathematician whom she had met on her first trip to Europe on the eve of World War I.

(To Be Continued In The July Issue)

Photographs are from ***El Don***, ***Del Ano***, and ***El Vivaz*** (SAC student publications), ***Ariel*** (Santa Ana High School yearbook), ***The Santa Ana Register***, ***Western Woman***, ***The Tustin Historical Society, Historical Panoramics of Orange County,*** and Larry Adkins

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11. Bruce Ragan "Telescope In Action for 15 Years", El Don, March 21, 1941
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13. "Clyde Bishop Dies", Santa Ana Register, October 31, 1927, p. 1.

You'd be a dumbbell to miss this one: M27, the Dumbbell Nebula, is a 7th-magnitude planetary nebula (the first to be discovered) visible in the constellation Vulpecula (about one hour RA east of the Deneb -Altair side of the Summer Triangle). Although Leon Aslan used an 8-inch telescope operated remotely at Anza to capture the image, M27 is accessible to binoculars and small telescopes.

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