# SkyWAAtch

## Mt. Wilson Telescope

Larry Faltz snapped this picture of the 100-inch Hooker Telescope during a recent tour of the Mt. Wilson observatory in California. The brainchild of George Ellery Hale, the Hooker Telescope has made truly astounding contributions to the advancement of human knowledge. These include proof the Andromeda galaxy resides outside of the Milky Way, preliminary evidence of the existence of dark matter and verification of Hubble's expanding universe hypothesis.

## In This Issue . . .

# Events for May

## WAA May Lecture

**" A Brief History of Chemistry in the Cosmos "**
**Friday May 6th, 7:30pm**
**Leinhard Lecture Hall,**
**Pace University, Pleasantville, NY**

Come travel with Dr. Daniel Wolf Savin down the cosmic chemical pathway from the Big Bang to the formation of stars and to life as we know it. Chemical studies have advanced understanding of how the first stars formed and how the raw materials needed for life were first synthesized. Join Dr. Savin as he hops, skips, and jumps his way across cosmic time and explains key chemical processes along the way.

Daniel Wolf Savin received his Ph.D. in Physics from Harvard University, working at the Harvard-Smithsonian Center for Astrophysics. He was a post-doctoral research physicist at the Space Sciences Laboratory of the University of California at Berkeley. From there he moved to the Astrophysics Laboratory at Columbia University, where he is now a senior research scientist. His research career began in the area of atomic laboratory astrophysics but has since expanded to include molecular laboratory astrophysics and solar physics. Dr. Savin was a driving force behind the recent creation of the Laboratory Astrophysics Division (LAD) of the American Astronomical Society and currently serves as the LAD Secretary. He has authored or co-authored over 150 publications and is a Fellow of the American Physical Society. Free and open to the public. Directions.

## Upcoming Lectures

**Pace University, Pleasantville, NY**

Our speaker on June 3rd will be Mr. Charles Fulco. Free and open to the public.

## Starway to Heaven

**Saturday April 30th, Dusk.**
**Ward Pound Ridge Reservation,**
**Cross River, NY**

This is our scheduled Starway to Heaven observing date for May, weather permitting. Free and open to the public. The rain/cloud date is May 7th. **Important Note**: By attending our star parties you are subject to our rules and expectations as described here. Directions and Map.

## New Members. . .

Lisa Sacks - Hastings on Hudson

## Renewing Members. . .

Everett Dickson - White Plains
Paul Alimena - Rye
Alex Meleney - Greenwich
George Maroulis - Mamaroneck
Scott Rubin - Yorktown Heights
John & Maryann Fusco - Yonkers
Pierre-Yves Sonke - Tarrytown
James Peale - Bronxville
Tom Crayns - Brooklyn
Karen Seiter - Larchmont
Ruth and Eugene Fischer -Pleasantville

**World Science Festival, June 4th**
**from 7pm-11pm**
**Brooklyn Bridge Park Pier 1,**
**Brooklyn, NY**

Grab your telescope and share your knowledge and passion for astronomy with a diverse audience—from seasoned stargazers to novice night sky enthusiasts—all looking (up) to experience the exhilaration of an illuminated night sky in a city known for its bright lights. If you are interested in bringing your telescope, please complete this FORM by Friday, May 6th. Star chats on our stage will also be back, featuring a NASA astronaut as well as skateboarding tricks that demonstrate physics, robotic soccer, and music.

For more information, see World Science Festival or contact Maggie Seay.

Not affiliated with WAA.

**Call: 1-877-456-5778 (toll free)** for announcements, weather cancellations, or questions. Also, don't forget to visit the WAA website.

# Almanac
## For May 2016 by Bob Kelly


May 6 May 13 May 21 May 29

May is a month for unusual events in our skies. We'll have (at least) two close approaches to Earth this month. Mercury and Mars compete for closest planet to Earth – see the sidebars on the Transit of Mercury across the Sun on Monday the 9th, and our opposition with Mars late in May. On the 9th, when Mercury is closest to us, it's 52 million miles away, Mars is 51 million miles away. We get closest to Mars at 46½ million miles away on the 30th, so Mercury doesn't get closer to us than Mars this month, but there's not much difference. Venus, our 'twin' planet, isn't even 'close' at 158 million miles away on the other side of the Sun. But you may be able to spy both Venus and Mercury together in the SOHO C3 view.

May's lunar apogee is closest in time to the Full Moon of any Full Moon in 2016. Thus, May will have the smallest-looking Full Moon of 2016. On the other side of the lunar month, the new Moon occurs near the lunar perigee, inducing larger-than-normal tidal ranges from the 6th through the 9th. Take a photo of the Full Moon minimoon(?) on the 21st and compare it to November 14th's 'supermoon'. Use the same camera and settings to see the slight, but noticeable, difference in size.

Jupiter reaches highest in the sky during evening Prime Time in May. It looks a bit smaller than in March and April, but it's still the king of the planets. Its shifting moons make a great show. Just for fun, try to see Jupiter's moons in a small, narrow-field, hand-held refracting telescope, just like Galileo did. Then imagine Galileo trying to show those moons to his closest friends. Even more difficult, imagine asking people who thought everything revolved around the Earth to see those tiny-looking moons in a shaky, narrow-view telescope.

The densest band of stars in our galaxy, the Milky Way, will circle the horizon this month during the Prime Time evening hours. Take a minute and try to imagine our galaxy's disk encircling us along the horizon and us looking upward out through the 'top' of our galaxy. The view overhead this month out the 'top' in the direction of the North Pole of our galaxy has less dust and gas in the way, so we can see more galaxies, particularly the clusters in Coma Berenices.

Pieces of Comet Halley (1P Halley) streak into our atmosphere this month. The Eta Aquarids meteors are most frequent in the pre-dawn sky on the 5th and 6th. Since Halley's orbit intercepts our planet from the south, folks in the tropics and Southern Hemisphere are favored. The American Meteor Society predicts 10 to 30 meteors per hour at northern latitudes. Some sources say the Aquarids will be few to none even a few degrees of latitude north of us. Halley itself is in front of the constellation Hydra with an estimated magnitude of +25. It is heading outbound, nearing its aphelion of 3.28 billion miles. Halley will return to the inner solar system in 2061.

The International Space Station overflies our area during twilight in the morning from the 8th through the 25th. Then we start a series of visible over-flights in *both* the morning and evening twilight – even five or six a night every 96 minutes. How many can you spot in a night? Updates on activities on board the ISS are at https://blogs.nasa.gov/stationreport/ .

### Transit of Mercury 2016

On May 9th, Mercury will appear as a tiny black dot in front of the Sun. At only 10 arc seconds wide, it will take 60x or more to make out the innermost planet. The next Transit of Mercury will be November 11, 2019. While the Transit of Mercury is harder to see, the next Transit of Venus will not be until December 11, 2117, so enjoy this transit or one of the 12 other Transits of Mercury remaining in the 21st Century. This transit will last over seven hours, all of it visible from the eastern United States. Mercury will take 3 minutes 12 seconds to cross the edge of the Sun's visible sphere. How will you view the Transit of Mercury? And who will you show it to?

| Event | Time (EDT) | Sun's Altitude, degrees above horizon | Mercury's location on solar disk, degrees clockwise from North |
|---|---|---|---|
| Start | 07h13m54s | 15 | 83.2 |
| Mid-transit | 10h 57m 54s | 56 | 153.8 |
| End | 14h41m 23s | 57 | 224.4 |

Tinagong I is smaller and dimmer than the ISS, but is visible in the morning through the 5th and then in the evening dusk until the 25th. The ISS has six souls on board. Tinagong had a crew of three, but no one is aboard now. It was planned to be reentered but telemetry was lost earlier this year and ground control was lost. The unmanned Air Force X-37-B space-plane is visible in the mornings through May 8th and the evenings from the 13th through the 25th. The X-37-B, designated OTV-4 as the fourth mission of this type of craft, is testing a 'Hall effect' thruster and exposing materials to the vacuum of space for scientists to analyze when OTV-4 returns. The Air Force hasn't said when the craft will return. It was launched May 20, 2015.

## Mars' Opposition 2016
**Bob Kelly**

You've seen the headlines – the closest Mars will be to Earth in a decade! Yes, it's been almost ten years since Mars was closest to the Earth in tens of thousands of years and won't be that close for two hundred more, so we aren't going to be closer than we were ten years ago, well, pretty much ever. And in 2018 and 2020, we'll be closer than this year.

But getting a view of Mars 18.6 arc seconds wide is a pretty nice view in modern telescopes. The Martian northern summer is just about over, perhaps we'll get a glimpse of the southern polar cap and some of the seasonal albedo changes as the salmon pink dust speads over the gray volcanic rock.

This year, Mars will be opposite the Sun on May 24th, but Mars is moving closer to the Sun on its elliptical orbit, so Earth will be closest on May 31st. Mars is low in the southern sky; this is especially true in years when Earth is closest to Mars. So the best views in May will be in the middle of the night. Mars will appear 16 arc seconds wide for quite a while; from now through the early July. By June, Mars will still be low in the south, but its nightly high point will be during the evening prime time, an easier time to get out to observe. Mars, at peak brightness, will be as bright as Jupiter for a while, but much smaller, about the apparent size of Saturn's disc (not including the rings).

## Quaker Ridge Elementary School Outreach Event

WAA'ers setting up showing Tom Boustead's 8" dob and Mike Lomsky's 14" dob.

Doug Towers sets up his refractor

On April 15th, over a dozen WAA members shared their time and telescopes with well above 100 elementary school children and their parents at the Quaker Ridge Elementary School in Scarsdale. In a welcome respite the rainy weather of late March the clear, chilly night provided for fine seeing of brighter objects. Unfortunately, a 63% waxing Moon, and some annoying outside lights, somewhat limited the views of fainter sights—not that a few extraneous photons deterred the WAA.

Dave Butler, for example, attached an image intensifying binocular photon machine (or BIPH) to his LX-

90 (an 8" Schmidt-Cassegrain). Using the BIPH Dave showed the Cigar Galaxy (M82) and Globular Cluster M3. The images through the BIPH elicited a few WOWS, which induced a bit of competition between the students and their parents for a look. Without the BIPH, Dave displayed Jupiter at 160x and then reduced power to get all of Jovian moons in the eyepiece.

Erik and Eva Andersen brought their Televue NP 101 (4" refractor). At first, they used a 26mm lens to find objects—the overhead sky was a challenge due to lack of darkness. After pointing out Jupiter to a few families and having them compare and contrast the naked-eye difference between a star and a planet (Eva and Erik used Sirius), a long and patient line formed to observe Jupiter through the scope. Eva switched the eyepiece to an 8mm Ethos. This yielded very nice views of the Jupiter's equatorial bands, Io and other Jovian moons.

Eva Andersen and her 4" refractor

Mike Lomsky generated quite a queue with his Orion XX14G (14" reflector), which required a small step stool to allow students to reach the eyepiece. Mike spent the majority of the event showing Jupiter, and the rare event of the shadow of Io moving across the surface of the planet. The Giant Red Spot was also featured through his scope. Notes Mike: since the conditions were so great, I was able to take the magnification up to 350x. A pair of young sisters kept coming back for more views. They really enjoyed the telescopic views. But it wasn't just the kids. The parents were also excited about what they saw. As the crowd thinned out, Mike was able to move to the Orion nebula (M42) and M3 so that a few folks could see some deep-sky objects.

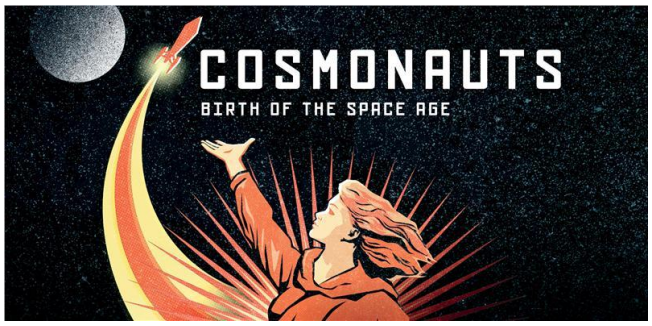
Mauri Rosenthal brought his Questar 3.5" scope, which tracks on its own mount when polar aligned. He started with the moon through a low power eyepiece with a neutral density filter, which had a wide enough field to display the full illuminated portion. Noted Mauri: I could tell that the scope needed to be re-aimed or re-focused if I didn't hear a "wow" when the viewer peered through the eyepiece. One parent said she had never viewed the Moon through a telescope before. He stayed with the moon for some time and had an extended period with 3-5 people waiting to have their look. Mauri also displayed Jupiter through his Questar.

Besides the satisfaction of introducing children and their parents to the wonders of the night sky, outreach events can have other advantages as well. As Mauri relates: as the group thinned out one parent was looking strangely at her phone near his scope. She had a planetarium app running and was trying to zoom in on the same image of Jupiter with Io adjacent. While helping with her phone, I saw a way to solve a different problem I'd been musing over for days: how to target faint objects when imaging with a DSLR but without a guide scope. I had a Eureka moment that has already resulted in my buying a cellphone attachment widget and running some new experiments in my backyard. I always expect to learn something useful from the other club members but this was a nice unexpected bonus for me!

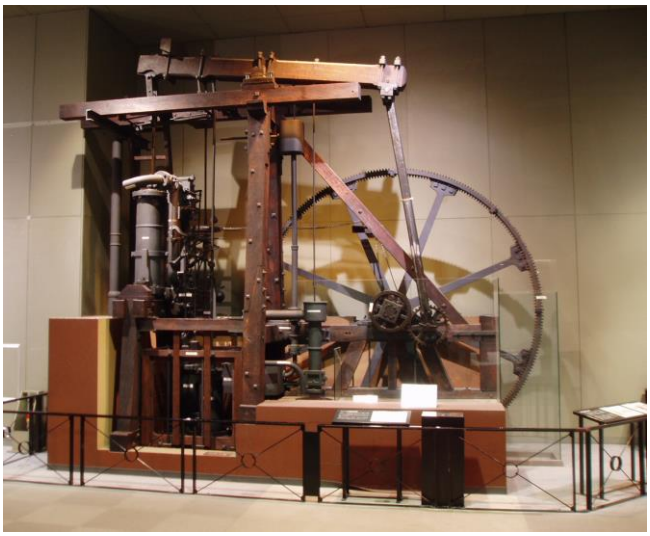
Thanks to other WAA'ers who brought their scopes and/or provided their time at Quaker Ridge. These include Charlie Gibson, Tom Boustead (8" dob), Timothy Holden (4" ES triplet refractor), Kevin Parrington (90mm Celestron SLT), Bob Kelly (8" dob), Harry Butcher, Doug Towers, Jordan Webber, Paul Aimena and Bill Newell (who bought the club 8" dob replete with a Pringles can dew-shield for the finder scope.

## The Astronomer at the Museum: *Cosmonauts* at the London Science Museum

Larry Faltz




Whenever Elyse and I are in London, we always spend some time at museums on Exhibition Road, the street leading north from the South Kensington tube station and its sophisticated neighborhood of restaurants, shops and my favorite place to ogle, the Lamborghini store. Three major museums are located on this street, just across from each other: the enormous Victoria and Albert Museum of decorative arts (commonly called the "V&A"), the Natural History Museum, and the Science Museum. The latter is the equivalent of Washington, D.C.'s Smithsonian Museum of Science and Industry with some of the Air and Space Museum thrown in. Its main floor houses a display of original steam engines, the British invention that defined the Industrial Revolution. Some of these massive beasts are more than 20 feet in height. The section on rocketry and space travel, with a mock-up Apollo LEM, is also quite comprehensive. Their special exhibitions are of uniformly high quality.



James Watt's first steam engine

On a visit to the U.K. in January 2016 (amazingly, we had good weather and no rain for more than a week), we took in a remarkable show about the development of the Soviet space program, complete with ground engineering versions of several important space vehicles, actual Vostok, Voshkod and Soyuz space capsules and all sorts of paraphernalia from and about Soviet space missions brought to England from museums in Moscow, Kaluga and other sites in Russia. The exhibition, which ran from September 2015 to March 2016, traced Russian interest in space from its philosophical beginnings in the writings of Konstantin Tsiolkovsky, through Sputnik and as far as the Mir space station, which was launched in 1986. There was a lot of emphasis on early Soviet manned orbital missions, the "winning" entries in human space flight until Apollo. There was particular focus on four individuals: Tsiolkovsky, Sergei Korolev, the "Chief Designer" of Soviet rockets, the first man in space Yuri Gagarin and the first woman in space Valentina Tereshkova. Actually five, since there was a mock-up of Sputnik 2, which carried the first animal in orbit, Laika the dog. Films of Laika were also shown.

Tsiolkovsky (1857-1935) was a self-taught scientist (he made his living as a high school teacher) whose interest in space had its roots in the political and philosophical ferment that permeated Russia at the end of the 19th century. Russia was a feudal country until 1861, when Tsar Alexander II abolished serfdom. Political instability, intrigue and revolutionary movements followed, stimulated no doubt by increasing exchanges with Western Europe. Just 20 years after his decree, Alexander II was assassinated by members of the "Peoples Will" movement. By their violent act, this reform group achieved the opposite of its intent: Alexander was close to establishing a British-style constitutional monarchy in Russia. As Salvor Hardin, the fictional hero of Isaac Asimov's novel *Foundation* was wont to say, "Violence is the last refuge of the incompetent." Alexander II's successors Alexander III and Nicholas II reversed many of his policies and were fundamentally disinclined to improve the lot of the working class. In spite of its rich literary and cultural history, 90% of the Russian population was illiterate at the time serfdom was abolished. Further unrest eventually led to the overthrow of the Russian monarchy in March 1917 and shortly thereafter the

establishment of the Soviet Communist government under Lenin and his Bolsheviks. The country was then called the Union of Soviet Socialist Republics (Soviet Union, CCCP in Cyrillic) until it was dissolved in 1991, its main technological and scientific assets remaining with the Russian Federation rather than the other newly-independent states. The term "Russia", really a geographic rather than political term, is generically applied to whatever government is in power in Moscow.

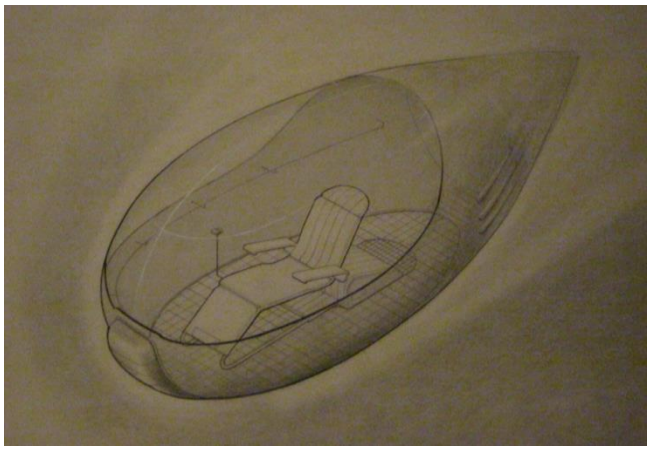
During this time, all sorts of philosophical approaches to transforming society were produced by the country's more optimistic intellectuals. It was only natural for a vast nation with a large population wanting their lives improved, at a time when science and technology were beginning to have impacts on daily life, to seek to transmute its social organization. The Marxist philosophy that characterized the new Soviet state was dedicated to completely new relationships among social classes, and sought to reorganize the means of production, abolish individual wealth and even alter personal relationships. It's not surprising that it was preceded and then accompanied by novel and idealistic linkages between human beings and their environment.

Among the philosophical movement arising at the end of the 19th century was one known as "Cosmism" (not to be confused with current use of the term by some New Age philosophies). It was a mixture of eastern and western humanist philosophies sprinkled with elements from the Russian Orthodox Church. Cosmism sought to perfect the human race (and individual human beings) through collective action by the population, one-ness with the environment and eventually travel to and colonization of space. It was an outgrowth of Russian futurism, a philosophy best expressed in the writings of Nikolai Fyodorovich Fyodorov (1829-1903), a friend of the great Russian writer Leo Tolstoy. Fyodorov believed that the perfection of humanity required space travel and would lead to the achievement of immortality. He believed science had to assist the Orthodox Church in its goal of achieving mankind's salvation. Cosmism in its later stages shed its relationship with organized religion and concentrated more on the more direct idea of perfection through striving to place man throughout in the universe, with all of the technical and behavioral elements that would be required to achieve that goal.

Tsiolkovsky was less of a spiritualist and more of a practical scientist and engineer. He certainly held the Cosmist belief that humanity was destined to leave the Earth and colonize the universe, and his writings often expressed the unity between man and the cosmos. But being practical, he mainly concerned himself with the actual process of space travel. He was the first person to develop a theory of rocketry and make calculations of thrust and fuel consumption that would eventually lead to the space age (*Exploration of Cosmic Space by Reactive Devices*, 1903).

In addition to some of Tsiolkovsky's manuscripts, the exhibit displayed some lovely drawings by architect Georgii Krutakov, who envisioned a "Flying City", a satellite city in space complete with commuter vehicles, in his 1928 master's thesis. I thought of George Jetson's flying car in the cartoon series, but Krutakov's designs are much more elegant.

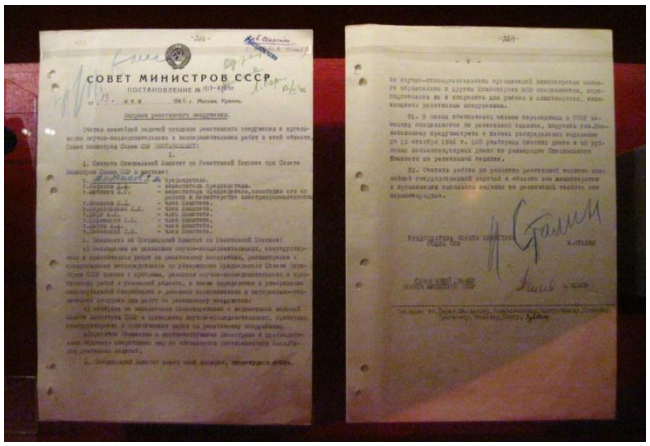
The immediate heirs of Tsiolkovsky were not Russians, but the American Robert Goddard (1882-1945) and the German Hermann Oberth (1894-1989). Both developed actual rockets based on Tsiolkovsky's formulas, although both of them cited the impact early in life of science fiction novels as the prime stimulus their interest in space travel. For Oberth it was Jules Verne's *From the Earth to the Moon*, while Goddard was influenced by H.G. Wells' *War of the Worlds*.



Georgii Krutakov's individual space transportation vehicle, from "Flying City" (1928)

The Soviet space program emerged after World War II under the leadership of Sergei Korolev (1907-1966), an aeronautical engineer who experimented with rockets in the 1930's. Korolev spent 6 years in the Gulag (his jacket, worn in the labor camp, was on display). After the war, Stalin formally committed the Soviet government to support a major space program. Korolev was rehabilitated, although he always lived with fear of being purged, at least until Stalin died in 1953. Eventually he was placed in charge of booster

rocket development. For fear of kidnapping or assassination by Western agents, his name was never used and he was referred to only as "Chief Designer." A large heroic painting of Korolev graced the entrance to the exhibit (see last page of this article).




Order to begin the Soviet space program, signed by Stalin (1946)

Korolev was sent to Germany at the conclusion of the war and brought back 150 V-2 rocket engineers, most of whom were not in the highest levels of the German rocket program, the top guys, led by Wernher von Braun, surrendering to the Americans. Nevertheless, based on recovered plans and many captured V-2 parts, these engineers and their Russian counterparts assembled V-2 clones, called the R-1, which was successfully deployed. These missiles had a solely military intent, as one might expect in the difficult, nuclear-weapon dominated post-war era. US missile development had a similar purpose. They had insufficient thrust to achieve Earth orbit. But both Korolev and his counterpart von Braun dreamed of space travel, and were happy when called upon to develop boosters for orbital and eventually lunar and interplanetary flight.

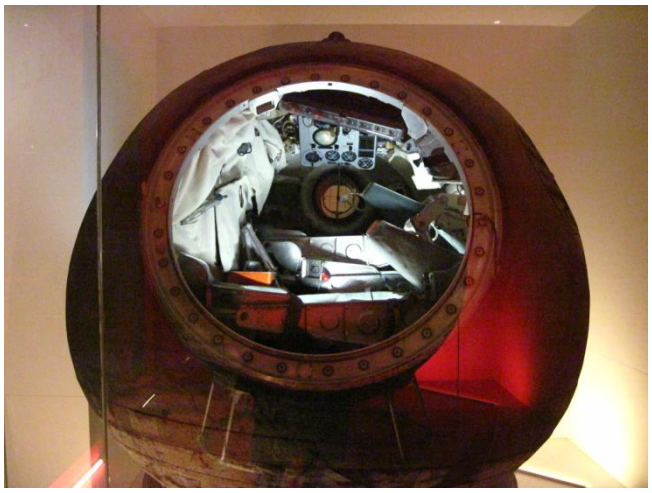
Korolev's team designed and successfully flew ever-larger rockets capable of carrying thermonuclear warheads, but ultimately his R-7 design, the world's first true intercontinental ballistic missile, placed Sputnik-1 in orbit on October 4, 1957, to the world's utter amazement. Two mock-ups of Sputnik-1 were on display, one of which was an exploded example to show its simple internal workings. Sputnik-1 was actually not supposed to be the inaugural Soviet satellite. The much larger, more complicated and scientifically outfitted Sputnik-3, an example of which was also on display, was supposed to have gone first. Korolev, worried that the US would beat him into space during the International Geophysical Year of 1957, decided to launch the simpler Sputnik-1, which was merely designed to send a radio signal indicating its presence rather than to gather scientific data. While Sputnik-1 is a simple but elegant polished sphere, Sputnik-3 looks a bit like one of the robotic Daleks on the Dr. Who television series.

Sputnik-3 engineering model

Sputnik-2, carrying the dog Laika, was hurriedly launched only a month after Sputnik-1, just in time for the 40th Soviet Party Congress and thus another helpful element in Khrushchev's consolidation of power in the competition to be Stalin's heir. Although Laika, a friendly mutt found living on the Moscow streets, was officially said to have been euthanized in the capsule, it is more likely she died from asphyxiation when the oxygen supply ran out. Some reports say she was boiled to death from inadequate temperature control in the spacecraft.

The first space flight by a human being was, of course, Yuri Gagarin's epoch-making journey in Vostok-1 on April 12, 1961. The Vostoks were spherical, rather than cone-shaped like American capsules, designed to be recovered on land, of which there was plenty in the Soviet Union as it spanned 11 time zones. Three actual capsules from Soviet orbital missions were on display in the exhibit.

Vostok-6 was the single-occupant craft that carried Valentina Tereshkova into orbit on June 16, 1963 on a mission that lasted just under 3 days. There was a lavish amount of information about Tereshkova, including details about her marriage in November 1963 to Andriyan Nikolayev, a cosmonaut on Vostok-3.



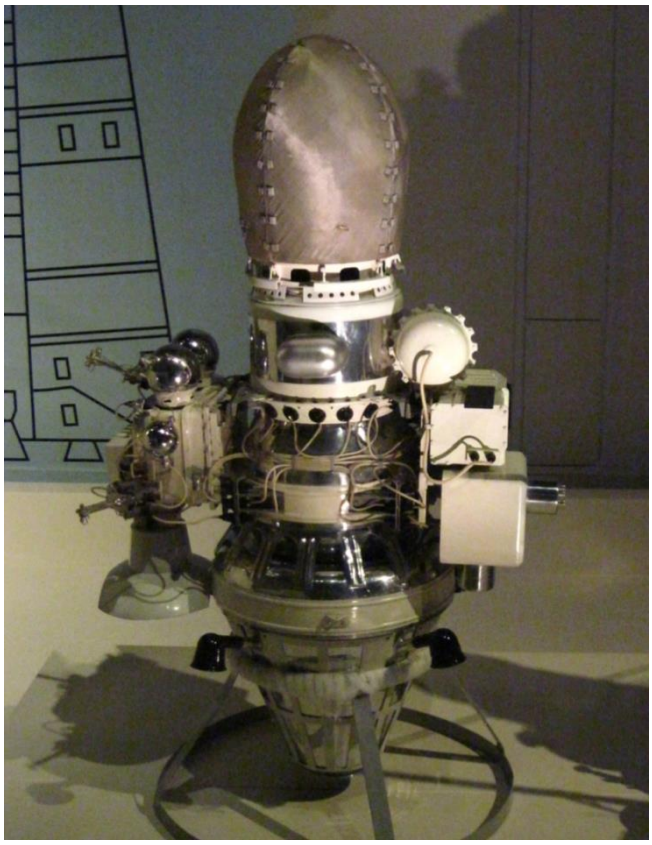
Voshkod-1


Valentina Tereschkova

The Voshkod-1 capsule was basically a Vostok into which three cosmonauts were stuffed. The amount of space was truly minimal, and perhaps out of sympathy for the cosmonauts the two Voshkod missions lasted only one day each. Voshkod-2, a two-man mission on March 18, 1965, was remarkable for the first space walk, a 12-minute perambulation by Alexei Leonov that was shown on a film loop.

A Soyuz command module, used to travel to the Mir space station, was also on display in a room that focused on life on Mir. Among the artifacts were an actual EVA suit and the test version of the toilet that cosmonauts on the Mir space station used to relieve themselves in zero gravity. The Vostok, Voshkod and Soyuz capsules all showed scars on their surfaces from the heat of re-entry.

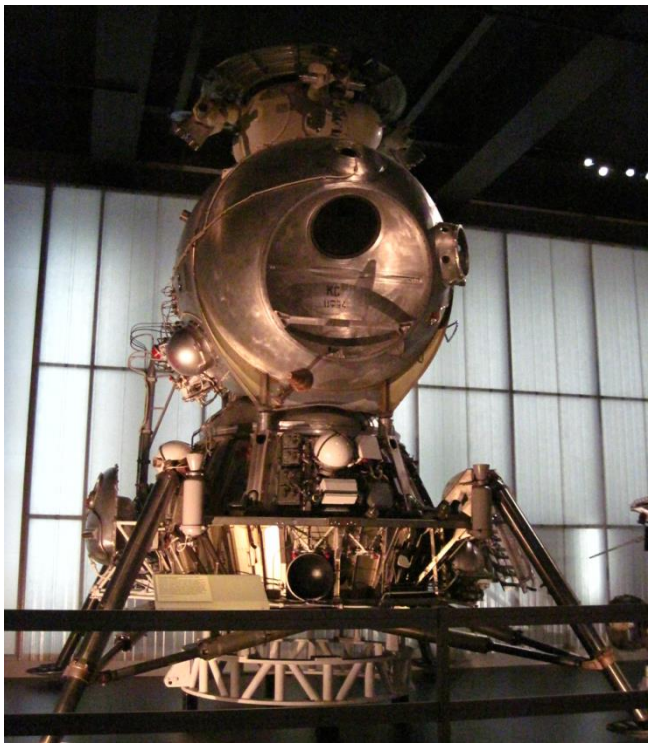
EVA suit and Soyuz 6



Luna E6 engineering model

Although the Soviets never landed a man on the moon, they were serious competitors in the race that was ultimately won by the United States. They launched many impact probes, flybys and landers although they suffered a large number of technical failures early in the game. On January 2, 1959, Luna-1 became the first vessel to escape the Earth's gravity, although it missed the moon entirely. In September

1959, Luna-2 made the first lunar impact, and a month later Luna-3 photographed the moon's far side. On January 31, 1966, Luna-9 made the first soft landing on the moon. The Luna probes were represented at the exhibit by an engineering version of the E-6 spacecraft, the technical heart of the Luna missions.



LK-3 Lunar Lander

A large one-manned lunar landing craft, LK-3, was designed as the competition for Apollo, but the Soviet manned lunar program foundered because of technical problems and funding cuts. Unlike the angular and foil-clad Lunar Excursion Module of Apollo, the Russian lander was metallic and round. When Apollo succeeded, the Russians opted to concentrate their manned space flight efforts on orbital missions and extended-duration stays in space. Unmanned lunar missions included a lunar rover (Luna-17, 1970) and two sample return missions (Luna-20, 1972 and Luna-24, 1976). After a number of failures, the Soviets achieved success at Venus with the Venera probes. Venera-7 landed on the surface and transmitted pictures and data for 23 minutes on December 15, 1970. Similarly, Soviet missions to Mars were all failures before an orbital mission succeeded in 1971, the first of only three Soviet missions (out of a total of 17) to the Red Planet to fully achieve its objectives.

The success of the space program was a source of pride for the Russian people and a scaffold for Soviet political propaganda. This was probably helped by the suppression of news about the many mission failures. The cosmonauts themselves were public figures. Tereschkova was prominently photographed with Soviet Prime Minister Nikita Khrushchev. A vast array of commercial and commemorative objects celebrated achievements in space. Among those displayed were a set of nesting Matryoshka dolls with the face of Tereschkova and space images on the bodies, numerous postcards, medallions and original posters, many wonderfully artistic, commemorating the space program in general or specific missions or individuals. A brass tea set in the shape of a Voshkod was something I rather wanted to take home.

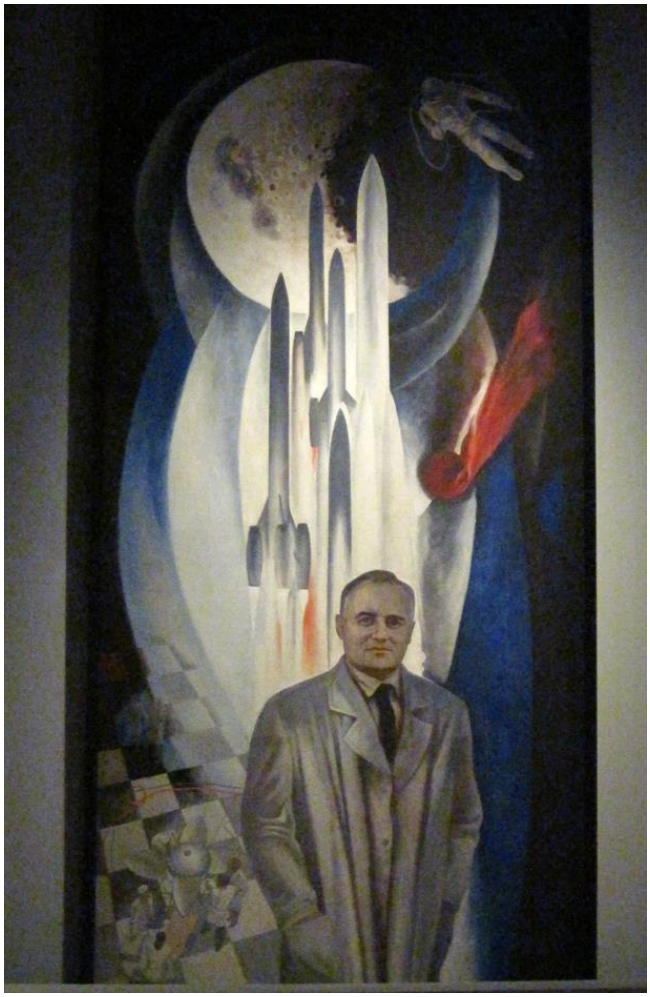
Space-themed Matryoshka dolls

Mir space station zero-gravity toilet

The actual story of the race between the Soviet Union and the United States for priority in outer space is fascinating, involving technology, economics, internal politics, and international competition and even intrigue between governments and ideologies. The space race was entwined with, and really grew out of, military imperatives and fears. Two books in my personal library shed light on the subject. In 1966, none other than Wernher von Braun himself, with coauthor and fellow rocket engineer Frederick I. Ordway III, wrote *The History of Rocketry and Space Travel*, a large, well-illustrated and very detailed tome that thoroughly explores the development of space flight. The authors provide a vast amount of detailed historic, scientific and even cultural background: it has a particularly thorough discussion of the treatment of space in works of fiction, starting in Greek times and ending with H.G. Wells. There are portraits of Tsiolkovsky, Goddard (with a vast amount of information on all his test flights) and Oberth. It exhaustively describes each space mission and, as might be expected, has a heavy emphasis on technology, but it doesn't skimp on historical and personal information. My copy is the 1975 Third Revised Edition, which covers everything up through Skylab. I picked up this slightly worn copy in the summer of 2010 in Vail, Colorado, when I passed by the town's small but well-designed library and found they were culling their inventory and selling "withdrawn" books. This important title cost me exactly $1. It's evidence of why you should always be on the lookout for used bookstores and library sales. That's one of my regular travel behaviors.

A superb narrative account of the political history of the Soviet and American space rivalry is Matthew Brzezinski's *Red Moon Rising: Sputnik and the Hidden Rivalries That Ignited the Space Age* (2007, available in paperback). Brzezinski was the Moscow correspondent for the Wall Street Journal and is the nephew of the famous (or infamous, depending on your point of view) former National Security Advisor Zbigniew Brzezinski. He had access to newly available material from Soviet archives in addition to many original interviews and sources in the United States. This is a fine work of historical and political journalism, telling a complex story with polish and excitement.

One wonders what Korolev, Stalin and their American cold war counterparts would have thought about the current manned space travel situation: Russian boosters carrying American astronauts to an internationally built, financed and occupied space station. I doubt they could understand how this could come to pass. Von Braun died in 1977, just after the 1975 Apollo-Soyuz mission that marked the end of the competition between the US and the Soviet Union for space dominance. While earthly political jockeying continued until the Soviet Union's demise in 1991 (and continues to this day with the Russian Federation), we might be somewhat closer to the Cosmists' dream of the whole human race, not just one part of it, colonizing space. However, true internationalization of space exploration doesn't appear imminent. The wild card right now is China, whose space program is beginning to achieve substantial success. They have plans for an Earth-orbiting space station and a moon landing in the not-too-distant future. Because of tensions over technology theft and computer hacking, by act of Congress Chinese citizens may not enter NASA facilities, nor can NASA staffers work with any scientists who are affiliated with Chinese companies or government bureaus. So perhaps the race is still on; it's just the teams that are different. ■



Heroic Soviet-era painting of Sergei Korolev, the Chief Designer. The work was 10 feet in height.

## Sidewalk Astronomy in Alexandria, Virginia

WAA's southernmost member, John Higbee, lives in Alexandria, Virginia, just across the Potomac from Washington, DC. He bought and restored Bob Davidson's C14 two years ago. On the weekend of April 16-17, 2016, he set up the scope on his street and sent the following report.

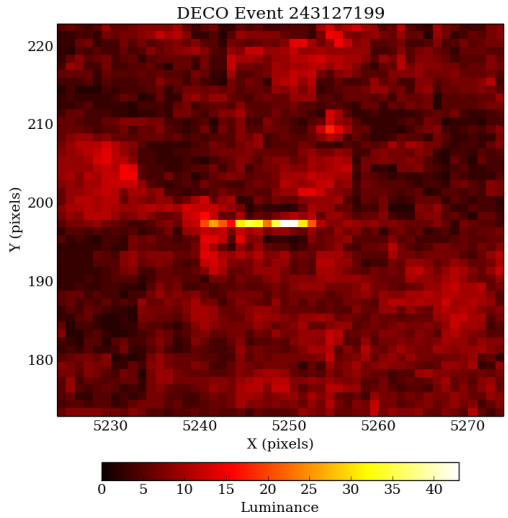
(Saturday): "Had a great evening with the C14 - out for four hours, and the weather was great - very little wind, and comfortable (shirtsleeves, eventually going to light jackets). Seeing was boiling a little initially...steadied nicely by 9:15PM. First time out with the new dewshield and Dewbuster system - not a trace of dew during the sessions.

Star partied with four families from the neighborhood...Moon and Jupiter were the main events. Many "Wows"..."I don't believe it"..."That's so cool" from parents and kids alike. We had five middle schoolers present...usually a tough crowd...but not last night. They particularly enjoyed "flying down the terminator" (I really like the C14's hand control box, at slew speed...worked like a champ).

Last group took pictures using their smartphones.

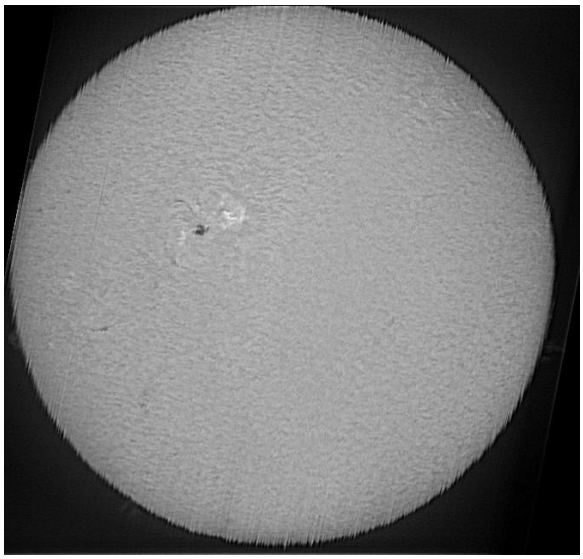
(Sunday): "Quick report...seeing spectacular...second star party in a row (all adults this time, but no less amazement in looking at Jupiter and the Moon)...Jupiter at 310X (with a blue filter) in the C14 was a stunner...C14 showed its full design capability tonight...WOW...6 belts with detail on the belt edges...delicately shaded polar regions...Great RED Spot (yes, it is that red) rotated into view before 10:00pm...saw Ganymede rise from behind Jupiter, a brilliant point touching the disk, then rising and disappearing into Jupiter's shadow a few minutes later... way cool...walled plains on the terminator of the Moon showed sharply edged detail."

## ASTROPHOTOS



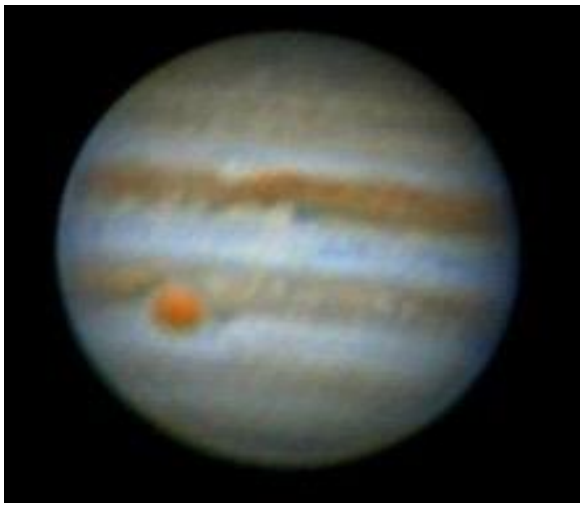

### ⬅ Cosmic Rays on Your Smartphone

John Paladini located this new app for Android phones from the Distributed Electronic Cosmic-ray Observatory (DECO), a citizen science project that enables users around the world to detect cosmic rays and other energetic particles with their cell phones and tablets. The recorded events are automatically uploaded to a central database. In addition to detecting particle events, users can analyze the data produced by their own or other users' phones. John joined and ran the app for a few days gathering data. He transmitted his data to the data center, which processed, reduced and send back results—a picture showing a MUON strike.



### ⬅ Solar Close-Up

John Paladini took this excellent image of the Sun in Hα with his spectroheliograph—an instrument for imaging the Sun at various wavelengths of light using a diffraction grating.



### ⬅ Jupiter

John Paladini captured this photo of Jupiter with a C8 and a neximager. Note the prominent Giant Red Spot.

## Hubble Shatters The Cosmic Record For Most Distant Galaxy

### Ethan Siegel

The farther away you look in the distant universe, the harder it is to see what's out there. This isn't simply because more distant objects appear fainter, although that's true. It isn't because the universe is expanding, and so the light has farther to go before it reaches you, although that's true, too. The reality is that if you built the largest optical telescope you could imagine -- even one that was the size of an entire planet -- you still wouldn't see the new cosmic record-holder that Hubble just discovered: galaxy GN-z11, whose light traveled for 13.4 billion years, or 97% the age of the universe, before finally reaching our eyes.

There were two special coincidences that had to line up for Hubble to find this: one was a remarkable technical achievement, while the other was pure luck. By extending Hubble's vision away from the ultraviolet and optical and into the infrared, past 800 nanometers all the way out to 1.6 microns, Hubble became sensitive to light that was severely stretched and redshifted by the expansion of the universe. The most energetic light that hot, young, newly forming stars produce is the Lyman-α line, which is produced at an ultraviolet wavelength of just 121.567 nanometers. But at high redshifts, that line passed not just into the visible but all the way through to the infrared, and for the newly discovered galaxy, GN-z11, its whopping redshift of **11.1** pushed that line all the way out to 1471 nanometers, more than double the limit of visible light!

Hubble itself did the follow-up spectroscopic observations to confirm the existence of this galaxy, but it also got lucky: the only reason this light was visible is because the region of space between this galaxy and our eyes is mostly ionized, which *isn't true* of most locations in the universe at this early time! A redshift of 11.1 corresponds to just 400 million years after the Big Bang, and the hot radiation from young stars doesn't ionize the majority of the universe until 550 million years have passed. In most directions, this galaxy would be invisible, as the neutral gas would block this light, the same way the light from the center of our galaxy is blocked by the dust lanes in the galactic plane. To see farther back, to the universe's first true galaxies, it will take the James Webb Space Telescope. Webb's infrared eyes are much less sensitive to the light-extinction caused by neutral gas than instruments like Hubble. Webb may reach back to a redshift of 15 or even 20 or more, and discover the true answer to one of the universe's greatest mysteries: when the first galaxies came into existence!

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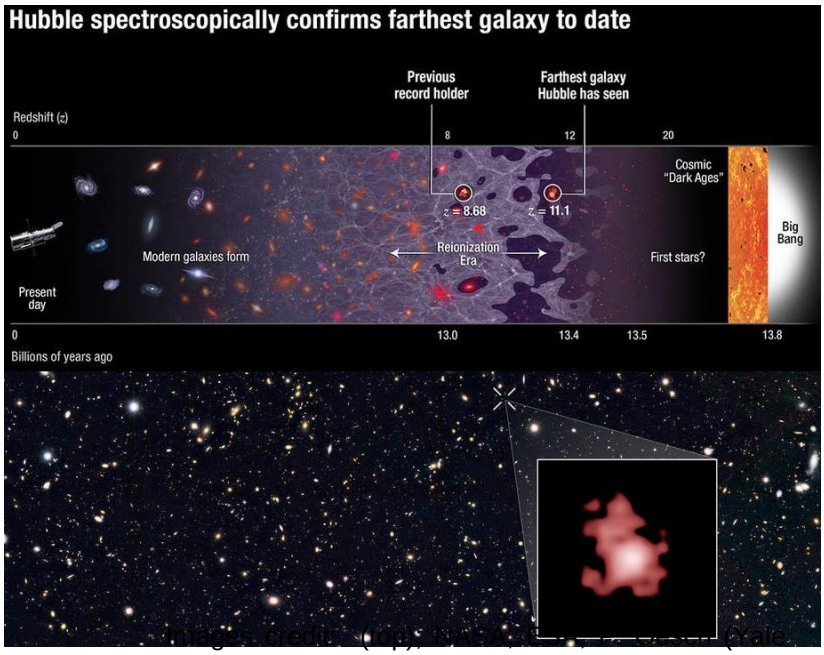


[illegible] University), G. Brammer (STScI), P. van Dokkum (Yale University), and G. Illingworth (University of California, Santa Cruz) (bottom), of the galaxy GN-z11, the most distant and highest-redshifted galaxy ever discovered and spectroscopically confirmed thus far.