

# Sky WAA tch



## Lunar Eclipse

Larry Faltz compiled this composite of the September 27<sup>th</sup> Super-moon lunar eclipse from images taken by himself, Rick Bria, Mike Virsinger and John Paladini. Larry, Mike and John all used 80mm refractors (while Rick used a 78mm refractor). Mike's image is a 60 second exposure (at ISO 1600) while John used a one-second exposure. Mike noted that his image is redder than seen through the telescope (sensor artifact).

As he notes, Rick Bria's image clearly shows the arc of the Earth's shadow--guess the world is round, after all. If you missed the eclipse, the next Super-moon eclipse is slated for 2033.

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## WAA November Lecture

### "Light Pollution"

**Friday November 6<sup>th</sup>, 7:30pm**

**Miller Lecture Hall,**

**Pace University, Pleasantville, NY**

Charles Fulco will speak on light pollution, the International Dark-Sky Association and preserving our night sky. Mr. Fulco is a science consultant and curriculum writer with BOCES and the former Planetarium Director at Port Chester Middle School, Port Chester, New York. He is the IDA Local Area Director for Westchester County. An avid amateur astronomer, Charles fosters dark-sky education, and participates in many astronomy events through NASA's Solar System Ambassador program. He enjoys astronomical and terrestrial photography, promoting environmental activities, and chasing eclipses around the world. He is currently involved with the national educational and public outreach for the 2017 total solar eclipse. Free and open to the public. [Directions](#) and [Map](#).

## Upcoming Lectures

**Pace University, Pleasantville, NY**

Our speaker for December 4<sup>th</sup> will be Andy Poineros. He will be presenting on the New Horizons Mission.

## Starway to Heaven

**Saturday November 7<sup>th</sup>, Dusk**

**Ward Pound Ridge Reservation,**

**Cross River, NY**

This is our scheduled Starway to Heaven observing date for November, weather permitting. Free and open to the public. The rain/cloud date is November 14<sup>th</sup>.

**Note:** By attending our star parties you are subject to our rules and expectations as described [here](#). [Directions](#).

## New Members. . .

Christopher Spedaliere and family - Pleasantville

Jose Lugo - Jefferson Valley

Bill Wertheim - Mt. Vernon

Antonio Da Silva - New Rochelle

Louise Elton - Larchmont

Miriam Beveridge - Scarsdale

Tracy Schaffer - Croton on Hudson

## Renewing Members. . .

Edgar S Edelmann - Tarrytown

Woody Umanoff - Mount Kisco

Robert Brownell - Peekskill

Michael Lomsky - Wilton

Anthony Monaco - Bronx

Emmanouil Makrakis - Scarsdale

Kevin Shea - Ossining

Olivier Prache - Pleasantville

Bob Kelly - Ardsley

Kevin Mathisson - Millwood

Vince Quartararo - Katonah

Mauri Rosenthal - Scarsdale



Courtesy of John Paladini is this fisheye image featuring 5/6<sup>ths</sup> of the winter hexagon (Sirius absent). John used an ASI 120mm camera.

## WAA Apparel

Charlie Gibson will be bringing WAA apparel for sale to WAA meetings. Items include:

- Hat (\$15)
- Polos (\$15)
- Tee shirts (\$12)

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



## Almanac

### For November 2015 by Bob Kelly



Nov 3



Nov 11



Nov 19

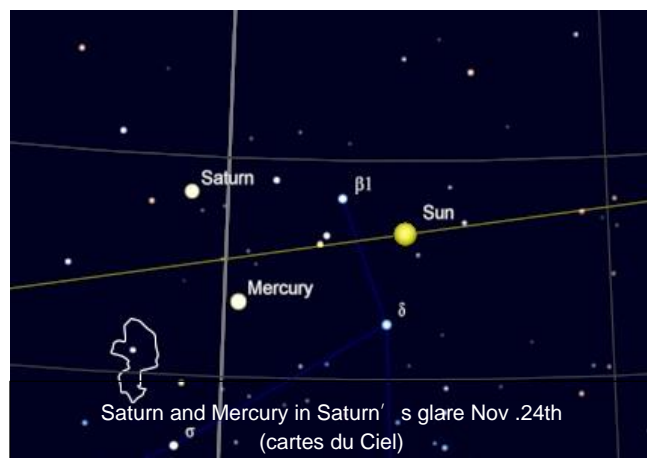


Nov 25



November features the continued dance of the planets in the morning sky, with Jupiter and Venus slowly parting ways. This month, the show is an hour earlier, since Daylight Savings Time ends for the year on the 1<sup>st</sup>. Fainter Mars appears to have a close encounter, passing about  $2/3^{\text{rds}}$  of a degree from Venus on the 3<sup>rd</sup>. By mid-month, Mars is in the middle, alone in the yawning gap between Jupiter and Venus, looking indecisive. The Moon joins the dance on the 6<sup>th</sup> and the 7<sup>th</sup>, making for another great photo-op. Leo, led by first magnitude star Regulus, continues its leap into the morning sky, leaving our planets behind.

Mercury drops out of the dawn sky and hangs out with the Sun, gliding into the view of the SOHO's C3 camera. Saturn joins Mercury in the C3 scene on the 21<sup>st</sup>.



Look there to watch Mercury's superior conjunction on the 17<sup>th</sup> and Saturn's conjunction with the Sun on the 30<sup>th</sup>.



The Moon makes another nice play Thanksgiving morning; a full Moon running in front of first magnitude Aldebaran in twilight just after 5:45am, popping out from behind the Moon just after 6:30. Aldebaran may be hard to find in the glare of the full Moon, a tiny red spark against the edge of the blazingly bright lunar limb.

In the evening sky, we'll get to see how long and how low we can still see Saturn and its rings in our telescopes. If you have a clear west-southwest horizon,



take the challenge on the 12<sup>th</sup> to see Saturn next to the very thin Moon, setting only an hour after the Sun.

It's another good month for finding Uranus and Neptune with your telescope and good finder charts. The Summer Triangle is sailing off into the west, while the Andromeda Galaxy soars to the zenith. Orion throws his legs up sideways over the eastern horizon later in the evening, dragging the winter constellations along with him.

On the 15<sup>th</sup>, Comet C/2013 US10 (Catalina) reaches 82 million miles from the Sun – the closest it will get to the Sun. Normally this would not be notable, but this is US10's first trip into the inner solar system. 'New' comets are often more active as sunlight warms the long frozen ices. It might be visible in binoculars in December, arcing north toward Arcturus.

Leonid meteors slam into the Earth's atmosphere at 44 miles per second. The shower peaks on the 18<sup>th</sup>, at a rate of a few per quarter hour. The morning sky is dark, with a nearly first quarter Moon setting in the middle of the night.

**Satellites:** The International Space Station overflights happen in the pre-dawn sky for most of November. Compare the brightness of the sunlight reflecting off the Station with our morning planets. Will X-37B reenter this month? If this OTV-4, aka, USA-261, stays in orbit, overflights are likely to be in the evening. We'll see what the Air Force decides.

On the 3<sup>rd</sup>, sundials are off by the largest amount for the year, 16½ minutes. Adjust as needed.

### Upcoming in December:

Venus and the Moon are tight on the morning of the 7<sup>th</sup>, with the Moon covering Venus just after noontime in our skies.

The reliable Geminid meteor shower peaks over two nights--the 13<sup>th</sup> and 14<sup>th</sup>.

Our Winter Solstice and the Aussie Summer Solstice occur on the 22<sup>nd</sup> at 0348UTC, which is the 21<sup>st</sup> at 11:48pm US Eastern Time and the 22<sup>nd</sup> at 3:48pm in Sidney

### Bubble Nebula Mauri Rosenthal

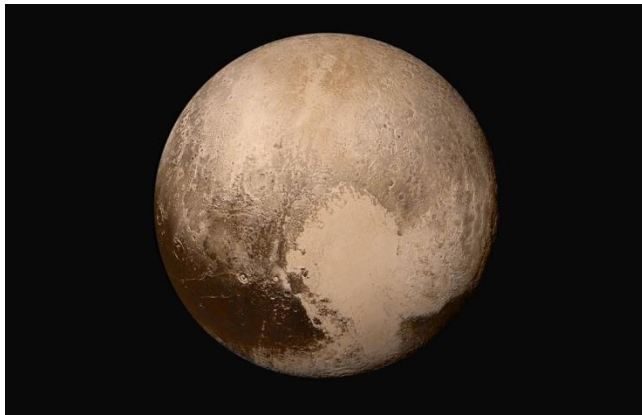


Mauri Rosenthal imaged the Bubble Nebula, NGC 7635, from his yard in Yonkers during two nights in October. High overhead in Cassiopeia, the Bubble is formed by the solar wind from a very hot central star pushing out against a reddish cloud of hydrogen. The image, taken through a Questar 3.5" telescope using a .5x focal reducer and Astronomik CLS filter, used just over two hours of 10 minute exposures stacked and processed with Nebulosity and PixInsight.

## Something Gained, Something Lost

### Larry Faltz

When NASA's Associate Administrator for the Science Mission Directorate John Grunsfeld opened the New Horizons press conference on July 15<sup>th</sup>, the day after the probe's historic close encounter with Pluto, he took the audience on a tour of the Solar System. He started with an image of the Sun from the Solar Dynamics Observatory, then Mercury from Messenger, Venus from Magellan, Earth from the Suomi NPP satellite, Mars from Hubble, Jupiter from Galileo, Saturn from Cassini, Uranus and Neptune from Voyager and finally the first high-resolution New Horizons image of Pluto. All of these are NASA triumphs, and now the tour is complete. (Grunsfeld sheepishly admitted he forgot to include an image of Ceres from the Dawn mission, given its status as the other dwarf planet visited by a NASA probe. He was too excited.)



New Horizons high resolution image of Pluto

It was a thrilling moment, the exclamation point on 58 fantastic years of space exploration. On October 4, 1957, the Soviet Union launched Sputnik, a tiny sphere that could only beep. Just 7 years later (and 50 years to the day before New Horizons' encounter) we received a close up video image of Mars with Mariner 4, dashing the hopes of scientists and science fiction aficionados alike that, for good or evil, we'd find Mars to be habitable. From that moment we realized that although the Solar System was a fascinating place full of new and unexpected phenomena, it was inhospitable to life of the human type: individual multicellular organisms that live by converting free oxygen molecules to carbon dioxide, use tools, and have those essentially indefinable qualities of consciousness, intelligence and abstract thinking. That disappointment (or if like Stephen Hawking you are paranoid about the intentions of extraterrestrials, that reassurance)

was balanced by the sheer geophysical wonder and diversity of the Solar System, from Mercury's large iron core to the unexpected moons of the outer planets. On a few of those moons there's evidence for sub-surface oceans, bodies of water unimaginable 40 years ago, perhaps containing *primitive* life.

Science fiction wouldn't be very engaging if space travelers only found rocks and mountains made of ice, as interesting as those are from a scientific perspective. The discovery of primitive life in the oceans of Europa or Enceladus would be astonishing and would rock humanity to its core, but it wouldn't be as interesting as finding intelligent life. Primitive life couldn't be the muse for the rich body of fiction that posits encounters with beings who can challenge our mental powers and human virtues (or lack thereof). I can't imagine Captain Kirk flying the Enterprise from one pile of unicellular bacterial goo to another, week after week. The discovery of even primordial unicellular life, though, would be particularly challenging to the world's monotheistic religions, which hold that a divine being put life exclusively on Earth.

It was a popular if not theological belief until the late 19<sup>th</sup> century, when temperatures of the Moon and planets could be extrapolated from observations, that life existed on other planets in our Solar System, including our Moon and even the Sun. The Moon was clearly a celestial body to the Greeks, and although their religion held that the Moon goddess Selene wasn't an inhabitant (her role was to transport it across the heavens, like Apollo carried the Sun in a chariot), Greek philosophers and their intellectual descendants thought of the Moon as a habitable place not dissimilar from Earth. The Pythagoreans believed that the Moon was populated by large animals that are superior to those on Earth because they don't discharge excrement. Around 300 BC, the Greek philosopher Epicurus codified the thoughts of several earlier sages into the statement "There are infinite worlds both like and unlike this world of ours.... In all worlds there are living creatures and plants and other things we see in this world." The Roman philosopher Lucretius, who is credited with imagining the atom, wrote "it is in the highest degree unlikely that this Earth and sky are the only ones to have been created." Around 180 BC, the Greek poet Lucian even wrote a work of science fiction, *Vers Historica* (True History). Intended as a satire, it includes a flight to the Moon on a

whirlwind (subsequently a favored mechanism of fantastic travel, as in “Toto, I don’t think we’re in Kansas anymore”) and describes a war between the Kings of the Moon and the Sun over the colonization of Venus.

In the Middle Ages, the theological question of whether God created life on other worlds was debated by Thomas Aquinas and other medieval churchmen. Their conclusion was that an omnipotent God *could* have created other worlds, but He *didn’t*. The Catholic dogma that denied the existence of extraterrestrial life was adopted by Protestantism in the 16<sup>th</sup> century, as evidenced in this argument by Philipp Melancthon, with Luther and Calvin one of the three most important figures of the Reformation.

Jesus Christ was born, died and was resurrected in this world. Nor does He manifest Himself elsewhere, nor elsewhere has He died or resurrected. Therefore it must not be imagined that Christ died and was resurrected more often, nor must it be thought that in any other world without the knowledge of the Son of God, that men would be restored to eternal life.

The Crucifixion had to be a unique event. Since Christian theology, whether Catholic or Protestant, promises eternal life to everyone who is not a sinner (or, conveniently, who repents), worlds where Christ did not die for the inhabitants’ sins simply could not have life. In this pre-scientific, theologically-dominated era no proof for this argument needed to be offered, of course, and if you imagined otherwise, you could be charged with heresy.

The rebellious 16<sup>th</sup> century Italian friar and philosopher Giordano Bruno’s well-known claim of life on other worlds was not based on scientific reasoning, although Neil deGrasse Tyson spent a good deal of air time in the recent *Cosmos* suggesting that Bruno was a martyr of the scientific revolution and should occupy a hallowed place alongside his contemporaries Copernicus, Tycho Brahe, Kepler and Galileo. Some other historians of science also advocate this view. Bruno’s idea of a universe filled with populated planets was primarily an extension of a radical, New-Age style religious belief that he espoused as a counterpoint to what he saw as the failure of Christianity to recognize that the entire universe was “alive” in the sense of having some internal *animus vitae*. It ran counter to the Catholic Church’s credo that all life flowed from a creator God. He may have adopted some ideas from Copernicus, but his thoughts about life on other worlds were more science fiction than science. Because his theology ultimately denied the divinity of Christ, Bruno was declared a heretic and burned at the

stake in Rome on February 17, 1600. To its credit, the Catholic Church now accepts the possibility of extra-terrestrial life, without imposing theological complications or justifications. Three years ago it sponsored a week-long conference on astrobiology at the Pontifical Academy of Sciences that resulted in a comprehensive book on the current scientific state of the subject, *Frontiers of Astrobiology*, edited by Chris Impey of the University of Arizona, Jonathan Lunine of Cornell and José Fuentes of the Vatican Observatory (Cambridge University Press, 2012).

In the pre-Leeuwenhoek era, before the discovery of microbes, “life” meant people, plants and animals similar if not identical to those on Earth. The idea that Earth-like life existed on other worlds persisted in parallel with theological denial, even in the minds of clergy, and it stayed below the radar of conservative theological authorities as long as it was not used to undermine basic doctrine. An example is in *On Learned Ignorance* by Cardinal Nicholas of Cusa, published in 1440. Nicholas, an important ecclesiastical authority, also had a strong interest in mathematics and astronomy. He discussed the possibility of multiple worlds, felt that the orbits of the planets and stars were not circular, and wrote that other beings could exist on the Moon and the Sun, similar to what Lucian depicted 1,600 years earlier. Popular literature of the day included stories about travel to the Moon and meetings with its inhabitants. One prominent example is Ludovico Ariosto’s epic *Orlando Furioso* (1516), one of the most popular and influential poems in the history of Western literature. This enormous work in 38,736 lines of verse tells the story of the battles of the Franks, led by Charlemagne and Orlando (Roland) against the Saracens in the 9<sup>th</sup> century. A masterpiece of war and adventure, it’s also about love, chivalry and honor. In one of its scenes, Orlando is driven mad by his love for a pagan princess. He rampages through Europa and Africa, destroying everything in his path. The English knight Astolfo goes to the Moon in Elijah’s flaming chariot. When he gets there, it’s clear that the Moon has a civilization.

Here other river, lake, and rich champaign [countryside]  
Are seen, than those which are below described;  
Here other valley, other hill and plain,  
With towns and cities of their own supplied;  
Which mansions of such mighty size contain,  
Such never he before or after spied.  
Here spacious hold and lonely forest lay,  
Where nymphs forever chased the panting prey.  
[Canto 34, Verse 72, translated by William Stewart Rose].



It turns out that there's a place on the Moon where everything that's been lost on Earth is to be found, not just material things, but fame, love, sanity, desire, and even Orlando's wits! The wits are brought back in a bottle. Orlando takes a sniff and his sanity is restored.

Stories of lunar habitation aren't confined to Western literature. A 10<sup>th</sup>-century Japanese story, *The Tale of the Wood Cutter*, tells of the Moon Princess who comes to Earth and lives with a bamboo cutter and his wife. Beautiful and mysterious, she charms the Emperor, but later travels back to her home world to everyone's disappointment.



(L) Rudolf II by Josef Heintz the Elder. (Kunsthistorische Museum, Vienna) (R) Rudolf II as the Roman god of the seasons Vertumnus, by Giuseppe Arcimboldo (Skokloster Castle, Sweden). Both portraits are from the 1590's. The witty and erudite Rudolf liked Arcimboldo's clever painting.

Just 8 years after Bruno's immolation, none other than Johannes Kepler wrote *Somnium (The Dream)*. Not published until 1634, this is a strange work, written partly to explain some of Kepler's scientific conclusions about astronomy, particularly how the Earth would look from the Moon. The plot involves an Icelandic boy who comes to study astronomy with Tycho Brahe, returns to Iceland and then is transported, perhaps in a dream, to Levania, an island in the sky, which is a placeholder for our Moon, where he meets its inhabitants. Kepler, who was born a Protestant and had refused to convert to Catholicism while living in Austria in 1600, moved with Tycho to Prague under the sponsorship of the tolerant and enlightened Holy Roman Emperor Rudolf II, who was a devotee of art and science. Rudolf appointed Kepler as Imperial Mathematician and it is for this reason that the planetary ephemeris that Tycho began and Kepler completed after his death in 1601 is known as the Rudolphine Tables. Rudolf had a very famous *Kunstkammer* (literally "art chamber" but more commonly called a "cabinet of wonders" or "cabinet of curiosities"), a

collection of a vast range of objects and artifacts, many of which came from the natural world. This was housed in the famous Hradčany Castle in Prague, which is said to be the largest castle in the world and dominates the city to this day. A tiny bit of Rudolf's collection was shown at the Metropolitan Museum of Art in 2014 at an exhibition on the work of artist Bartholomeus Spranger, who was active during the time Kepler was at Rudolf's court.

Speculation about intelligent extraterrestrial beings ran rampant after the heavens were unlocked by Galileo. The Catholic Church itself still acted with cognitive dissonance. Some of the medieval arguments were cited at Galileo's 1616 trial, from which he escaped with only a mild rebuke for his views. The trial was the culmination of a series of virulent attacks on Galileo's support for Copernicus' heliocentric theory by influential prelates, one stating that Galileo's

...pretended discovery vitiates the whole Christian plan of salvation.... It upsets the whole basis of theology. If the Earth is a planet, and only one among several planets, it cannot be that any such great things have been done specially for it as the Christian doctrine teaches. If there are other planets, since God makes nothing in vain, they must be inhabited; but how can their inhabitants be descended from Adam? How can they trace back their origin to Noah's Ark? How can they have been redeemed by the Savior? [quoted in Andrew Dickson White, *A History of the Warfare of Science with Theology in Christendom*, 1896]

Galileo himself, however, was clearly skeptical of life on the Moon, based on scientific principles. In *Dialogue Concerning the Two Chief World Systems* (1632), he gives the following speech to Salvati, his alter ego in the book:

I consider the Moon very different from the Earth. Though I fancy to myself that its regions are not idle and dead, still I do not assert that life and motion exist there, and much less that plants, animals, or other things similar to ours are generated there. Even if they were, they would be extremely diverse, and far beyond all our imaginings. I am inclined to believe this because in the first place I think that the material of the lunar globe is not land and water, and this alone is enough to prevent generations and alterations similar to ours. But even supposing land and water on the Moon, there are in any case two reasons that plants and animals similar to ours would not be produced there.

The first is that the varying aspects of the Sun are so necessary for our various species that these could not exist at all without them. Now the behavior of the Sun toward the Earth is much different from that which it

displays toward the Moon. As to daily illumination, we on the Earth have for the most part twenty-four hours divided between day and night, but the same effect takes a month on the Moon. The annual sinking and rising by which the Sun causes the various seasons and the inequalities of day and night are finished for the Moon in a month. And whereas for us the Sun rises and sinks so much that between its maximum and minimum altitudes there lie forty-seven degrees of difference (that is, as much as the distance between the tropics), for the Moon it varies no more than ten degrees or a little less, which is the amount of the maximum latitudes of its orbit with respect to the ecliptic.

Now think what the action of the Sun would be in the torrid zone if for fifteen days without pause it continued to beat down with its rays. It goes without saying that all the plants and herbs and animals would be destroyed; hence if any species existed there, they would be plants and animals very different from present ones.

In the second place, I am sure that there are no rains on the Moon, because if clouds collected in any part of it, as around the Earth, they would hide some of the things on the Moon that we see with the telescope. Briefly, the scene would alter in some respect; an effect which I have never seen during long and diligent observations, having always discovered a very pure and uniform serenity.

This truly investigative, evidence-based reasoning did not always hold sway for subsequent practitioners of the new discipline of observational astronomy. Like Nicholas of Cusa, one could be both religiously and scientifically inclined at the same time. John Wilkins (1614-1672) was a clergyman and one of the organizers of England's Royal Society, which from its founding in 1660 has been one of the pre-eminent organizations fostering objective scientific investigation. Wilkins wrote books on religion, such as *A Discourse Concerning the Beauty of Providence* (1649), but also on astronomy, cryptography, language, mathematics and mechanics. His *The Discovery of a World in the Moone* (1638) was a work of popular astronomy. It included speculation, similar to Bruno's, that there were many inhabited planets, even extra-solar ones, and he went into detail about the possibility of intelligent beings on the Moon in spite of Galileo's reasoning. He even suggested ways to travel there.

Stories of adventures on the Moon proliferated after the invention of the telescope. That the average 18<sup>th</sup> century person would not be at all surprised that beings similar to us lived on the Moon is evidenced by an opera buffa by the great Franz Joseph Haydn (1732-1809), *Il Mondo Della Luna* (The World of the

Moon). This cheery work was premiered in 1777 but is now rarely presented. I saw a creative production by the Gotham Opera in 2010 at the Hayden Planetarium (see my review in the [March 2010 WAA Sky-WAatch](#)). The plot concerns a wealthy man who is tricked into believing that he is seeing Moon creatures through a telescope. He's then drugged, and when he awakes in his garden that night the perpetrators, dressed as lunar denizens, fool him into thinking he is actually on the Moon. He eventually acquiesces to their actual, beneficent goal: allowing his daughter to marry the person of her choice, with some of his fortune thrown in for her dowry.



Life on the Moon, lithograph from New York Sun, 8/28/1835

Scottish preacher Rev. Thomas Dick wrote *A Christian Philosopher, or the Connexion of Science and Philosophy with Religion* in 1823. He claimed that the Solar System contained exactly 21,891,974,404,480 inhabitants, and 4.6 billion of them lived on the Moon. His works were popular with the public during a time of growing religiosity, particularly in America. Ralph Waldo Emerson was said to be an aficionado. The following year, Franz von Paula Gruithuisen, Professor of Astronomy in Munich, claimed to have actually seen evidence of vegetation on the Moon as well as geometrical shapes that he ascribed to walls, roads and cities. In 1835, the Great Moon Hoax was perpetrated on the American public by the New York Sun in a series of 6 articles describing all sorts of newly-observed moon creatures and edifices. The report was attributed to a fictitious companion of the astronomer John Herschel, who was in South Africa and couldn't be reached quickly to deny the report. Herschel later expressed amusement about the affair, but eventually grew frustrated when people persisted in questioning him about these impossible discoveries. Edgar Allen Poe had earlier that year written a story, "The Unpar-



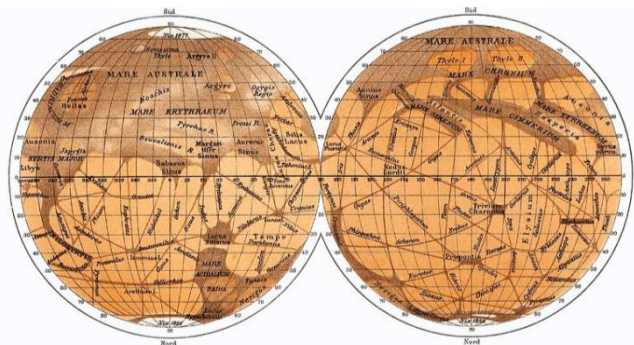
alleled *Adventure of One Hans Pfaall*,” in which the protagonist uses a balloon and a breathing device of his own invention to travel in 19 days to the Moon, where he meets its inhabitants. Poe claimed that the Great Moon Hoax was plagiarized from his story, since his editor at the *Southern Literary Messenger*, where it was published, was Richard Adams Locke, who is credited with writing the Great Moon Hoax for the *Sun* although he never admitted to being behind it.

Among other Moon novels featuring its inhabitants that were widely read in their time are *Histoire comique par Monsieur Cyrano de Bergerac contenant les Etats & Empires de la Lune* [Comical History by Mr. Cyrano de Bergerac including The States & Empires of the Moon] (1657) by the actual Cyrano de Bergerac, not Rostand’s theater hero; *The Consolidator or, Memoirs of Sundry Transactions from the World in the Moon* (1705) by Daniel Defoe; *The Conquest of the Moon* (1809) by Westchester’s own Washington Irving, in which Moon creatures come to Earth and enslave our race, a commentary on our treatment of Native Americans; and *The First Men in the Moon* by H.G. Wells (1901). Few astronomers other than Gruithuisen found evidence of lunar seasonal changes or industry, and stories about travel to the Moon written from a scientific perspective generally eschew habitation. Jules Verne’s two Moon novels, *From the Earth to the Moon* (1865) and *Around the Moon* (1870) don’t depict Luna as populated.

There’s a much richer scientific rationale for intelligent extraterrestrial life on Mars. Christiaan Huygens first made surface drawings of Mars on November 28, 1659. By 1702, Giacomo Filippo Maraldi was convinced that the surface features were not constant. He noted changes in the polar caps and even detected clouds. During a series of favorable oppositions in 1777, 1779, 1781 and 1783, William Herschel studied the surface of Mars through his speculum-metal reflectors. He was convinced that the polar caps were made of snow and ice. He noted changes in color of the surface and believed these were caused by vegetation. He believed Mars had an atmosphere “so its inhabitants probably enjoy conditions analogous to ours in several respects.”

Improvements in glass technology helped perfect the refracting telescope in the early 19<sup>th</sup> century. High quality lenses (incorporated into achromatic doublets) could be made larger than 4 inches in diameter, improving light-gathering ability and enabling higher magnification and resolution. This progress had the

greatest impact on observations of Mars. Between 1830 and 1878 a series of increasingly detailed maps were published, culminating with Schiaparelli’s map, drawn during the close 1877 opposition. This showed what he described as “canali,” taken by many to be purpose-built “canals” (not the simple connecting “channels” that Schiaparelli intended) and thus evidence of habitation by intelligent beings. The title of Schiaparelli’s report was “Astronomical observations concerning the axis of rotation and the topography of the planet Mars.” As Willy Ley says in *Watchers of the Skies* (1963), “Behind this sober title lurked the possibility of intelligent beings on another planet; the philosophical speculations of centuries (themselves secret desires in hiding) had found a focal point.”

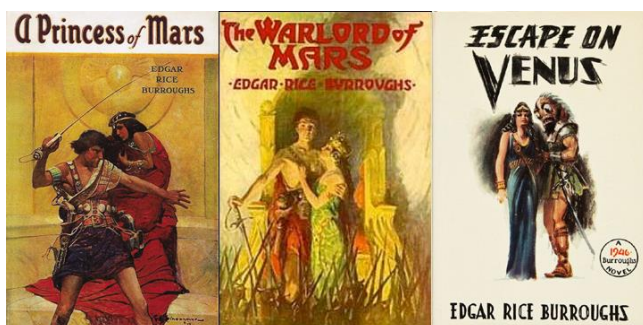


Schiaparelli's 1877 map of Mars

Schiaparelli’s map had an instant world-wide impact. Mars became an object of intense popular interest. A form of literature arose dedicated to the idea that Martian civilization had built canals to manage increasing aridity on the surface, something that Schiaparelli himself didn’t agree with. Jakob Schmick’s *Der Planet Mars, eine zweite Erde* (The Planet Mars, a Second Earth, 1879) and Otto Dross’ *Mars, eine Welt im Kampf ums Dasein* (Mars, a World Engaged in the Struggle for Survival, 1901) both advanced this idea. Dross described in detail Martian engineers struggling to rescue arable land from the encroaching desert. Percival Lowell founded the Lowell Observatory in Flagstaff, Arizona in 1894 and installed a magnificent 24-inch f/15 Clark refractor to look for clearer visual evidence that the surface features were artificial constructs. Although Svante Arrhenius, founder of the discipline of physical chemistry, discoverer of the greenhouse effect and winner of the 1903 Nobel Prize, argued from scientific evidence that the surface of Mars was too cold for life, those “secret desires” had been unleashed.

Novels (and later movies and TV shows) about or involving the inhabitants Mars proliferated in the 9 dec-

ades after Schiaparelli. H.G. Wells' story *The War of the Worlds* was first published in serial form in 1897 to enormous acclaim and popularity, as much for its clever method of victory over an irresistible enemy (our lowly microbes knocked off the Martians, but I've always wondered why their lowly microbes didn't wipe us out). That it didn't take much to expose the public's subconscious belief in the existence of Martians was proven on the night of October 30, 1938 when Orson Welles generated panic in the minds of a substantial number of Americans with his radio dramatization of Wells' story. Among the most widely read works of Mars fiction are the 11 Mars ("Barsoom") novels by the prolific Edgar Rice Burroughs, creator of Tarzan and author of some 80 books, most of them works of fiction. Three of his novels take place on Venus and one, *The Moon Maid*, on our satellite. Mars figures prominently in the work of other well-known science fiction writers, notably Robert A. Heinlein's early *Red Planet* and later his most widely read novel, *Stranger in a Strange Land*, a hippie Bible of sorts read by me and all my friends in the late 1960's (I had my copy with me at Woodstock). Perhaps the best of all is Ray Bradbury's *The Martian Chronicles*.



Dust jackets from 3 of Burroughs' novels

If you haven't read *The Martian Chronicles*, I urge you to do so. More of a work of fantasy than science fiction, it's a series of connected stories written between 1946 and 1950 that paints a haunting and tragic picture of a Martian society imbued with many characteristics similar to ours. Its downfall comes when it comes into contact with newly space-travelling humans. The plot spins out in Bradbury's inspired, musical prose, getting us to envision things that would otherwise have been unimaginable.

They had a house of crystal pillars on the planet Mars by the edge of an empty sea, and every morning you could see Mrs. K eating the golden fruits that grew from the crystal walls, or cleaning the house with handfuls of magnetic dust which, taking all dirt with it, blew away on the hot wind. Afternoons, when the fossil sea was

warm and motionless and the wine trees stood stiff in the yard, and the little distant Martian bone town was all enclosed, and no one drifted out their doors, you could see Mr. K himself in his room, reading from a metal book with raised hieroglyphs over which he brushed his hand, as one might play a harp. And from the book, as his fingers stroked, a voice sang, a soft ancient voice, which told tales of when the sea was red steam on the shore and ancient men had carried clouds of metal insects and electric spiders into battle.

I think it was very hard to write something like this after Mariner 4, and probably impossible now.

With its many space mission confrères, New Horizons has made our Solar System a *place*. Subsurface oceans of Europa and Enceladus, volcanos on Io, ice in the poles of Mercury, lightning on Jupiter, the hexagons on Saturn's poles, the winds of Neptune, methane rain on Titan and ice mountains on Pluto are just some of the discoveries that, had they have come from a fiction writer, might have strained credibility, but we now accept them totally. With all its scientific and technological brilliance, New Horizons also puts the exclamation point on mankind's dashed expectation of engaging with intelligent denizens of the other planets. There are no Solarians, Mercurians or Venusians, no Moon men (plenty of Lunatics, but they're all here on Earth!) or Martians, no Jovians, Saturnians, Uranians, Neptunians or Plutonians to meet and challenge the human race. There might be Europeans or Enceladusians, and maybe even Martians now that flowing water has been found, but they are almost certainly going to be simple life forms, the consequence of a more homogeneous environment with fewer ecological niches into which life can evolve with new characteristics. Darwin's mechanism must be universal as long as reproduction is a property of living creatures.

In the popular imagination, Martians have been replaced by Vulcans, Klingons, Romulans, Ferengi, Borg and the memory of the Krell. We are going to have to reach beyond the Solar System if we are to find new intelligent life forms. That cannot involve physical contact: the laws of physics and the vast distances involved (and the frailty and brief duration of human life) conspire to make travel to the next star an impossibility. It seems equally unlikely they can come to us, Roswell notwithstanding. Dreams of a First Contact will persist; it's only natural that we seek companionship among the stars. But it will be indirect, through the agency of SETI, the search for extra-terrestrial intelligence, about which I will write in a future article.

## How We Know Mars has Liquid Water on its Surface

### Ethan Siegel

Of all the planets in the solar system other than our own, Mars is the one place with the most Earth-like past. Geological features on the surface such as dried up riverbeds, sedimentary patterns, mineral spherules nicknamed "blueberries," and evidence of liquid-based erosion all tell the same story: that of a wet, watery past. But although we've found plenty of evidence for molecular water on Mars in the solid (ice) and gaseous (vapor) states, including in icecaps, clouds and subsurface ices exposed (and sublimated) by digging, that in no way meant there'd be water in its liquid phase today.

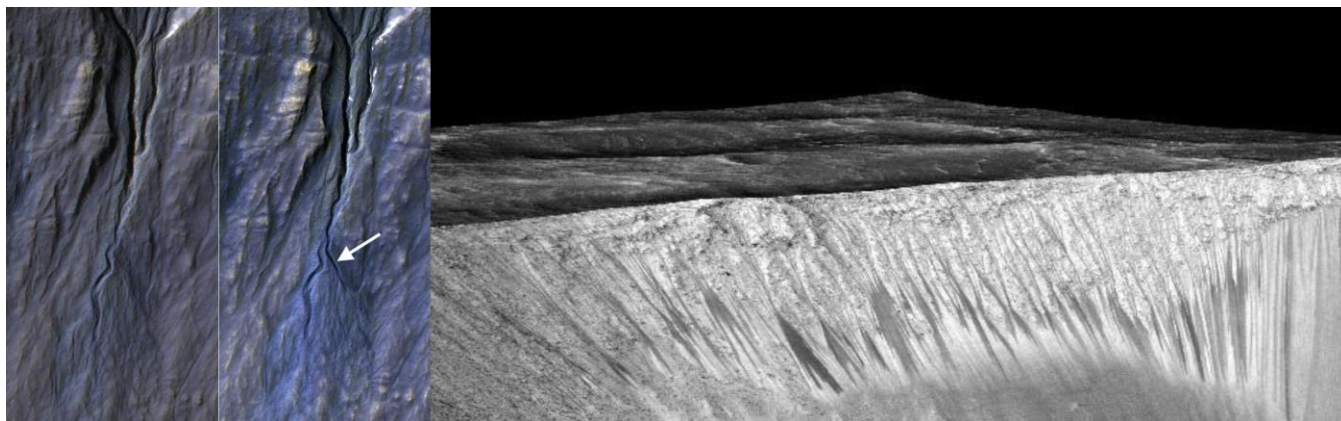
Sure, water flowed on the surface of Mars during the first billion years of the solar system, perhaps producing an ocean a mile deep, though the ocean presence is still much debated. Given that life on Earth took hold well within that time, it's conceivable that Mars was once a rich, living planet as well. But unlike Earth, Mars is small: small enough that its interior cooled and lost its protective magnetic field, enabling the sun's solar wind to strip its atmosphere away. Without a significant atmosphere, the liquid phase of water became a virtual impossibility, and Mars became the arid world we know it to be today.

But certain ions—potassium, calcium, sodium, magnesium, chloride and fluoride, among others—get left behind when the liquid water disappears, leaving a "salt" residue of mineral salts (that may include table salt, sodium chloride) on the surface. While pure liquid water may not persist at standard Martian pressures and temperatures, extremely salty, briny water

can indeed stay in a liquid state for extended periods under the conditions on the Red Planet. It's more of a "sandy crust" like you'd experience on the shore when the tide goes out than the flowing waters we're used to in rivers on Earth, but it means that under the right temperature conditions, liquid water does exist on Mars today, at least in small amounts.

The measured presence and concentration of these salts, found in the dark streaks that come and go on steep crater walls, combined with our knowledge of how water behaves under certain physical and chemical conditions and the observations of changing features on the Martian surface supports the idea that this is the action of liquid water. Short of taking a sample and analyzing it in situ on Mars, this is the best current evidence we have for liquid water on our red neighbor. Next up? Finding out if there are any single-celled organisms hardy enough to survive and thrive under those conditions, possibly even native to Mars itself!

(This article is provided by NASA Space Place.



Images credit: NASA/JPL-Caltech/Univ. of Arizona, of a newly-formed gully on the Martian surface (L) and of the series of gullies where the salt deposits were found (R).



## Mare Nubium & Rupes Recta



The Mare Nubium is a lava-filled plain about a quarter of a million square kilometers in size, located halfway between the prominent craters Copernicus and Tycho. Near its southeastern edge is the Rupes Recta, or Straight Wall, the longest linear fault on the moon. It's just below and to the right of center in the image. About 110 km in length but only 240 meters high with a slope estimated to be about 7 degrees, it would be a pretty nice beginner ski slope if it was covered in snow and if you could get there! Just to its west is the young, sharply defined crater Birt, 17 km in diameter. To its east is the flat 57 km-wide crater Thebit with the younger Thebit A on its northwestern edge. Further to the east and slightly north is another terraced crater with a central mountain, the 97-km wide Az-rachel. On the far western side of the Mare Nubium is the 61-km wide Bullialdus, also with a central peak and terraced sides.

The fault is thought to have resulted from uplift of lunar material to the east.

The Rupes Recta is best seen in an 8, 9 or 10-day moon when it casts a shadow because the sun is coming from the east. In the waning moon with western illumination it is a harder-to-see whitish line. This image was taken on August 24, 2015 when the moon was 10 days old. The terminator cuts across the upper left corner of the image. I used an Orion Apex 127 mm Maksutov telescope and Celestron Skyris 445 camera. A red filter (#25) helped bring out the contrast. Best 200 of 2,000 frames stacked with Auto-stakkert!2, very mild wavelets in Registax and final contrast adjustment in Photoshop Elements. The image shows an area of about 850x680 km.

Larry Faltz