SkyWAAtch

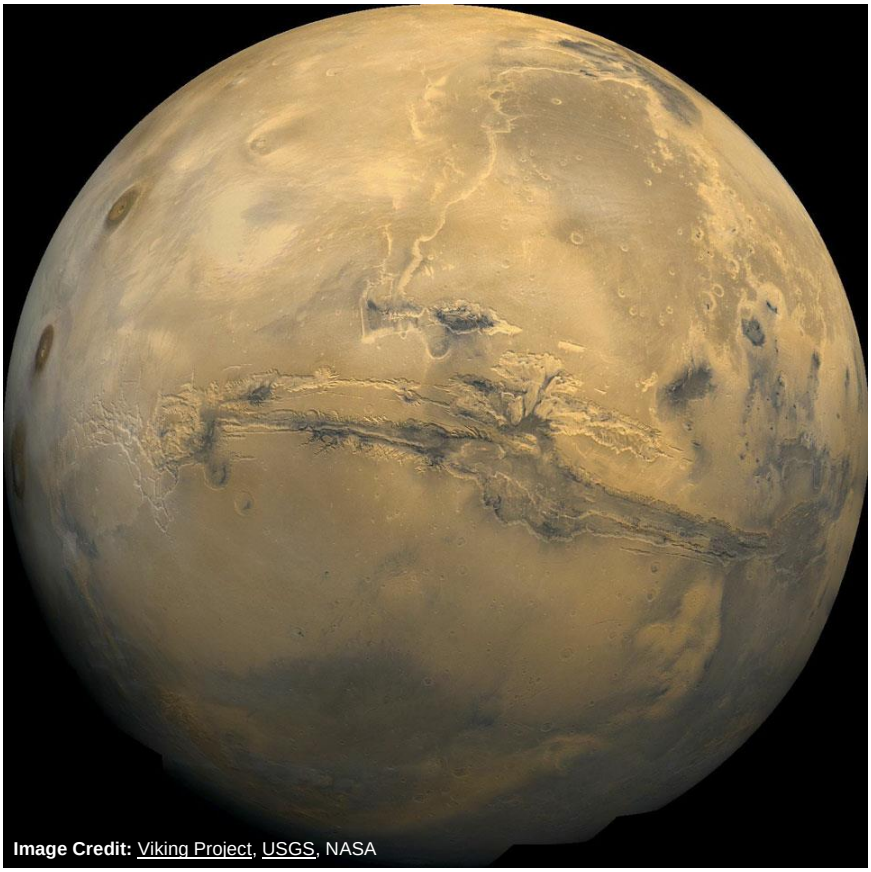


Image Credit: Viking Project, USGS, NASA

The Grandest Canyon

The largest canyon in the solar system cuts a wide swath across the face of Mars. Named Valles Marineris, the grand valley extends over 3,000 kilometers long, spans as much as 600 kilometers across, and delves as much as 8 kilometers deep. By comparison, the Earth's Grand Canyon in Arizona, USA is 800 kilometers long, 30 kilometers across, and 1.8 kilometers deep. The origin of the Valles Marineris remains unknown, although a leading hypothesis holds that it started as a crack billions of years ago as the planet cooled. Several geologic processes have been identified in the canyon. The above mosaic was created from over 100 images of Mars taken by Viking Orbiters in the 1970s. (source and credit: APOD).

In This Issue . . .

Events for June 2014

WAA June Lecture

"From Underwater to Outer Space"
Friday June 6th, 7:30 pm
Lienhard Lecture Hall, Pace University
Pleasantville, NY

Our speaker is Mr. Glenn Butler. He will present on how the STS-61 *ENDEAVOR* astronauts trained underwater to repair the Hubble Space Telescope. Mr. Butler is the founder and CEO of the Life Support Technologies Group (LST). LST is involved in a broad range of Life Safety Engineering and Medical services. These range from Hospital-based Wound care and Hyperbaric Medicine programs, to high altitude military / NASA projects, Deep Underwater diving, Hyperbaric tunneling under New York City and Marine Safety during the construction of the Tappan Zee Bridge. Glenn and Bill Hamilton developed the NITROX Oxygen-Enriched-Air Breathing Systems and helped NASA to train Astronauts to make the planned Hubble Telescope upgrades by simulating Zero-Gravity underwater here on earth. **Free and open to the public**. Directions and Map.

Upcoming Lectures

Lienhard Lecture Hall,
Pace University Pleasantville, NY

As usual, there will be no WAA lectures for the months of July and August. Our Lecture series will resume in September. During the Fall we have tentatively scheduled presentations by Victor Miller on the Galileo Jupiter Probe Mission; Dr. Caleb Scharf on his new book, and Dr. Michael Tuts on gravity. There will also be a Members Presentations Night.

Starway to Heaven

Saturday June 21st, 8:30 pm.
Meadow Picnic Area,
Ward Pound Ridge Reservation,
Cross River, NY

This is our scheduled Starway to Heaven observing date for June, weather permitting. Free and open to the public. The rain/cloud date is June 28th. **Note**: By attending our star parties you are subject to our rules and expectations as described here. Directions.

WAA Club Picnic

Saturday June 14th, 1:30 pm
Trailside Museum, Ward Pound Ridge

The event is for WAA members and their guests **only**. Club members are encouraged to bring side-dishes, salads and desserts. Tell the guard at the gatehouse you are going to the WAA Picnic. Further details will be provided by email blasts. Directions.

New Members. . .

Andrew Crawford - Yonkers
Ireneo Fante - White Plains

Renewing Members. . .

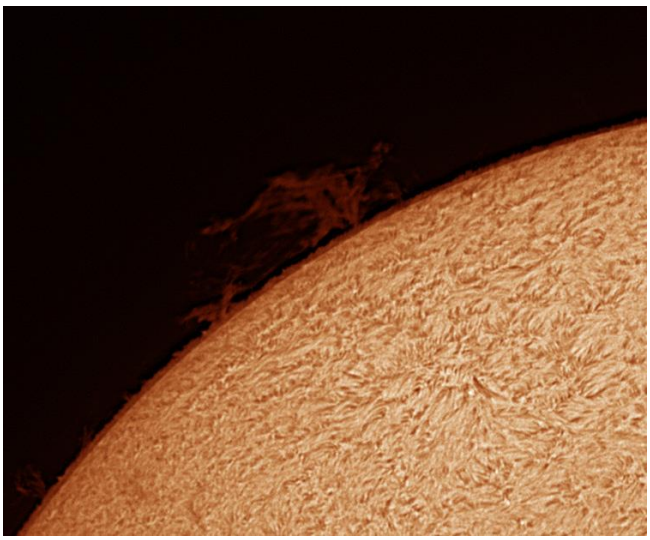
Dante Torrese - Ardsley
Jose E. Castillo - Pelham Manor
Beth Gelles - Scarsdale
Donna Cincotta - Yonkers
Erik & Eva Andersen - Croton-on-Hudson

WAA APPAREL

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

- Caps and Tee Shirts
- Short Sleeve Polos
- Navy hoodies.

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



A solar prominence courtesy of John Paladini's home-made solar scope.

Almanac
For June 2014 by Bob Kelly


Jun 5 Jun13 Jun 19 Jun 27

Jupiter heads for the exits this month – on its way out watch for its changing alignments with 1st magnitude stars Castor and Pollux. Jupiter's moons cast their shadows on the planet this month, with three shadows at once on the 3rd. But that's going to be hard to see, since it's during daytime between 2 and 4pm EDT. If you want to find Jupiter in the daytime sky, look on the 1st about half a fist-width above the Moon to see if this observation is possible.

Mercury starts June low to the right of the dancing Gemini and Jupiter; just above the horizon as twilight fades. Mercury doesn't hang out with the boys for long, so check early in the month. It becomes the closest planet to Earth this month, getting larger, with a crescent phase. As Mercury passes through the glare of the Sun, check it out at the SOHO C3 web site http://sohowww.nascom.nasa.gov/data/realtime-images.html

Just to the upper left of the dancing twins, the backward question mark making the head of Leo looks more like a sickle about to harvest the Moon and Jupiter after sunset late in June.

Saturn is as high as it gets in the sky after dark this year, a bit smaller but with its rings 21 degrees open. It's a fantastic site in any telescope. The two-faced moon Iapetus passes to the south of Saturn on its way to turning its brighter face toward us in early July, when it brightens to magnitude +10.1.

Mars is nicely placed in the southwestern sky at the start of June. But the reddish planet fades and shrinks like a color cotton t-shirt in a hot water wash. Use high power to compensate, and you may be surprised on a steady night to see a bright spot or two and shades of gray and salmon.

Asteroids Ceres and Vesta offer us a two-for-one deal in late June. They get within a full moon's width from each other in our skies from June 29th through July 5th. They are dimmer than they were a few months ago, now at magnitudes +8.4 and +7.1, respectively; so it helps to have a finder chart from an astronomical website to pick out which of the points of light are the asteroids, found well to the left of Mars.

This month is the annual opposition of Pluto to the Earth, the closest we get for the year. Pluto is low in the south at magnitude +14.1 and getting fainter each year as it sails outbound on its 247 year orbit. Borrow a large telescope and a good finder chart if you want to bag it amidst the stars of Sagittarius.

Venus is still the brightest planet at magnitude minus 3.9, but getting smaller at a Mars-like 13 arc-seconds wide and looking like a gibbous Moon in a telescope. Look low in the east-northeast before sunrise. Venus is racing out ahead of us, but we keep up enough so Venus stays in our morning sky though the summer. It's noticeably close to the Moon on the 24th. During the last week of June, with binoculars, can you see the wide star clusters, Hyades and Pleiades in the neighborhood of Venus as they come out from behind the Sun?

Uranus and Neptune are getting up earlier in the morning sky. Will you?

Around the 10th and 11th is the last chance for a somewhat favorable view of Mare Orientale in sunlight on the western limb of the Moon during 2014. After this, there aren't really any favorable tilts of the Moon to give us peeks around the far side until 2015.

Moon points out the way to:

Jupiter on May 31st/June 1st and June 28th
Mars on the 7th
Spica on the 8th
Saturn on the 10th
Venus on the 24th
Aldebaran on the 25th/26th.

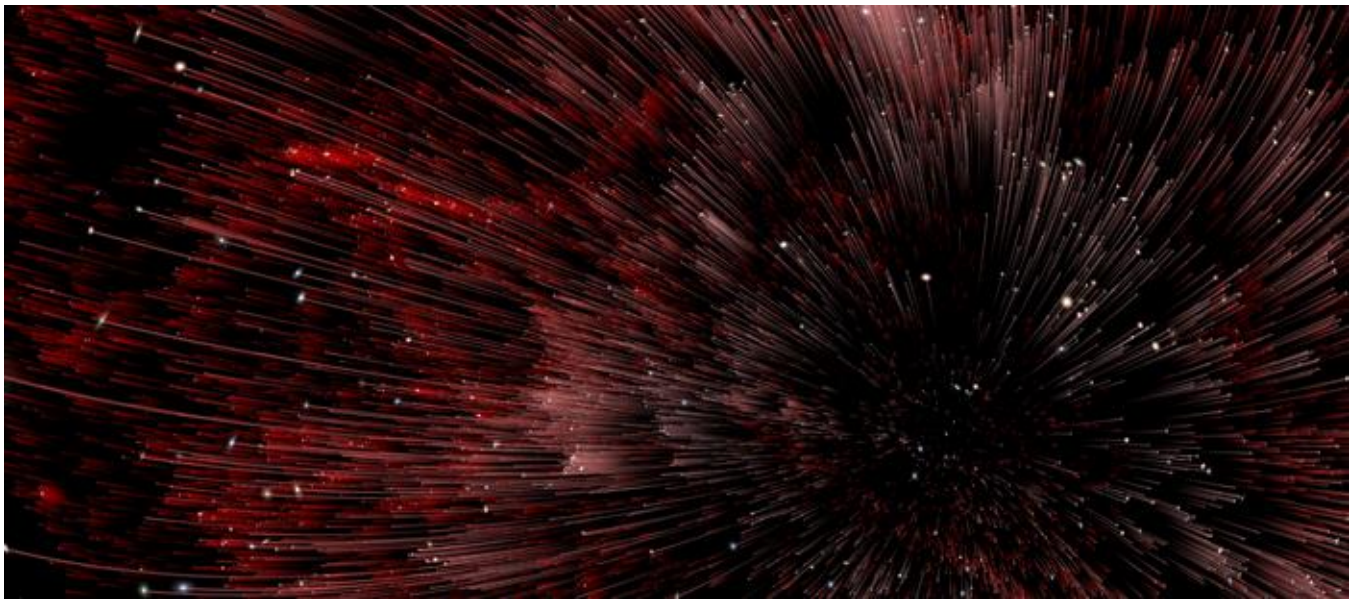
The Milky Way climbs out of the horizon's mists where it hid in May.

The International Space Station spends most of early June in sunlight, so we can see it up to 5 times a night at first, then in the evenings from the 10th through the 21st. Watch continuous live video from a camera mounted outside the ISS (except for when it's out of the range of tracking stations or the Earth is too dark when the ISS passes through the Earth's shadow) at http://www.ustream.tv/channel/live-iss-stream .

The northern summer solstice occurs on the 21st at 6:51am EDT. The earliest sunrise is on the 14th and the latest sunset is on the 27th.

Planetarium Spectacular: Dark Universe. Teaching or Entertainment?

By Larry Faltz



In the heady days of the late 1960's, rock shows were usually accompanied by a "light show," a projection behind the band made by squashing some immiscible colored fluids between two convex bowls sitting on top of an overhead projector. As *The Who* or *Country Joe and the Fish* or *Cream* banged out their tunes at the Fillmore East, the chemically altered audience was transfixed by oozing blobs of oil pulsating to the music. It was a two-dimensional version of the ubiquitous Lava Lamp, the hippie must-have that illuminated many a party evening and post-party munchies session.

Frank Zappa and the Mothers of Invention in front of the famous Joshua Light Show, 1967

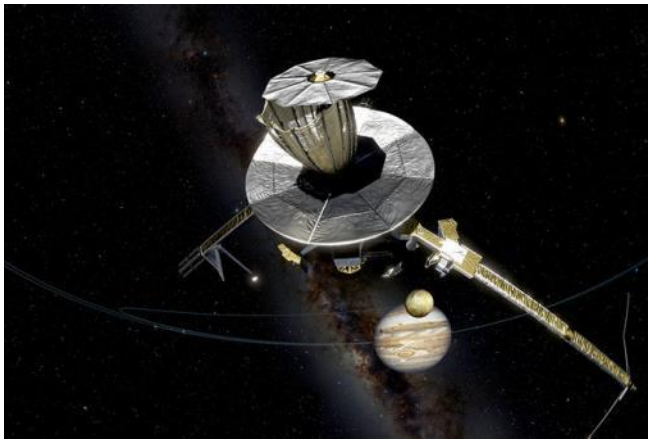
The light show reached its hippie cultural climax not on stage but in 1968 at the conclusion of Stanley Kubrick's *2001: A Space Odyssey*, as our hero is catapulted through…well, we're not exactly sure what, and goes…well, we're not exactly sure where, but it was sure fun. The movie was made in Super Panavision 70, a successor to the original super-side-screen, 3-projector Cinerama technology. In its original showing at the Cinerama Theater in New York, it was projected onto a curved screen. If you sat close enough, everything in your field of view was movie. Hippie *2001* cognoscenti made sure they came to the theater early to commandeer seats in the first row or even lay on the floor to maximize their impending "rushes", if you get what I mean. I won't describe my experiences further…I'm much older and far more personally responsible these days. It's enough to say I saw the movie there 8 times.

A frame from the "star gate" sequence in *2001*

Details of how Kubrick made the psychedelic sequence are rather intriguing. Without digital equipment in 1968, he had to use a variety of stop-motion, slow motion and macro techniques. One part was even

filmed in a girdle factory to make use of their elastic fabric. Expansion of the universe, indeed!

That's not how it's done any more. High-tech computerized digital studios can crank out vastly more complex images and sequences and digital projectors offer astonishing depth and clarity that could never be matched by film. Nowhere is this more on display than in the Hayden Planetarium's current sky show, *Dark Universe*, a cinematic tour-de-force that's also scientifically insightful and bold in its intellectual reach. In 23½ minutes of spectacular graphics and only 1,757 of Timothy Ferris' extremely precise and well-chosen words (I counted), we are shown the large-scale structure of the universe, treated to a summary of the current interpretation of cosmology and given an accounting of the universe's content. And who better to narrate the show than the Hayden's own Neil deGrasse Tyson, the Jimi Hendrix of astronomy, a PhD astrophysicist with rock-star cred. Tyson's ubiquitous presence on television, particularly his frequent appearances with Jon Stewart, has made him the most famous astronomer since his (and our) hero, Carl Sagan. Sagan, more productive than Tyson as an academician and researcher, was a less natural showman, not quite as relaxed, humorous or self-assured in front of the camera as Tyson. Each is an eloquent defender of science and rationality and a critic of superstition and magical thinking. Sagan's *Cosmos* series may have had a greater impact than Tyson's is likely to have, which is a sad commentary not on the presenter but on the audience and the times.



The Galileo spacecraft as seen in *Dark Universe*

Dark Universe starts with the planetarium's dome lit by thousands of points of light, and we're told we're "way out here, 10 million light years from planet Earth" [which is, cosmologically speaking, not really all that far] and "every point of light is a galaxy containing billions of stars." Since, remarkably, we've mapped these galaxies, we can "chart an accurate course back home." The images swirl as we plunge headlong through the galaxies, then through the Milky Way and eventually we arrive at Earth. It's a magnificent ride.

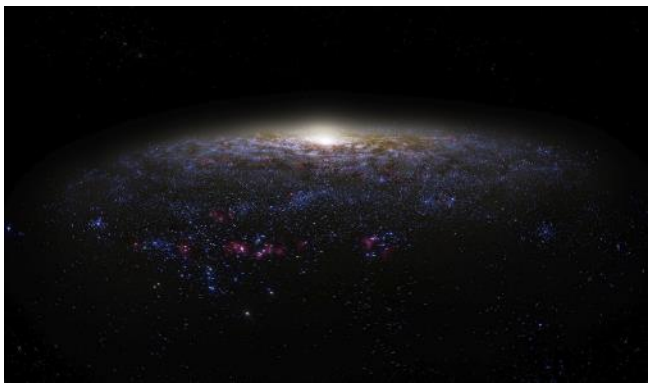
Rather than give you a paraphrase of the narration, I thought I'd simply list the points in the order they are presented.

- The distance to the Andromeda nebula was measured at 2 million light years.
- Red shift shows that galaxies are moving away.
- The farther they are, the faster they move.
- There's no center to the universe.
- The universe is cooling and is now 3 degrees above absolute zero.
- In the past it was smaller and hotter.
- Scientists figured out the Big Bang happened.
- The cosmic microwave background was detected, by accident.
- Satellites mapped the CMB.
- The image from the Planck satellite shows variances; blue is more massive, red is less massive.
- The CMB marks the edge of the visible universe.
- The Galileo spacecraft found "heavy hydrogen" in the atmosphere of Jupiter, confirming the Big Bang [through confirmation of Big Bang Nucleosynthesis].
- Most of the matter in universe isn't made of atoms.
- Motion and lensing of galaxy clusters prove the existence of non-atomic dark matter.
- Dark matter was essential to the formation of the large-scale structure of the universe.
- What is dark matter? We don't know, but we're trying to find out.
- The rate of cosmic expansion is speeding up, as evidenced by measurements of supernovas. That's "dark energy".
- Einstein's $E=mc^2$ says matter and energy are "two sides of the same coin."
- Dark energy is 70% of the "total stuff" in the universe. Dark matter is most of the rest. Normal matter is less than 5%.
- The entire universe is bigger than the part we can see. It might be infinite.
- The presentation concludes with "The Big Bang happened long ago, but not far away. It happened here, there, and everywhere. Peering into the dark, we stand on the threshold of great discoveries and we always will, as long as we keep exploring."

So that's it… cosmology in a nutshell. If you've kept up at all with the subject, even in a superficial way, you know all this stuff. But even so, you would be denying yourself a grand experience if you don't see *Dark Universe* for yourself.

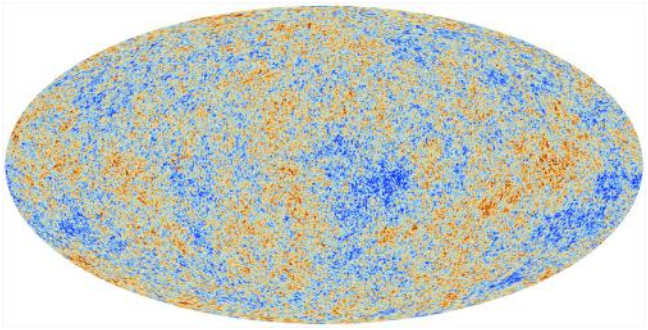
Neil deGrasse Tyson recording the narration

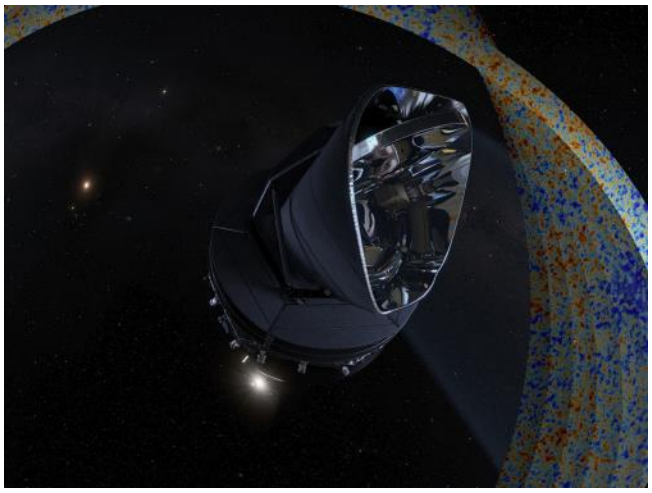
I do have some minor criticisms of the production, the main one being that it's not long or deep enough for me. I'd love to sit through two hours of fabulous video and get the science with much more detail and rigor. Then there's the quality of NdGT's narration It's "punched", as we used to say in radio, to the extreme, with a hyper-dramatic ebb and flow to its cadence and rises and falls in pitch that I find too sing-song for my taste. If you've seen the current *Cosmos*, you know what I mean. It's not my style (I once flunked a screen test to be a physician correspondent for ABC News because of my straightforward delivery), but I'm sure it helps hold the attention of kids and most of the audience and so it's a good choice in spite of my mild discomfort with it. I was also a tad disappointed that no scientist is actually named (except for "I'm Neil de Grasse Tyson" at the beginning of the narration and the mention of Einstein near the end); Hubble, Penzias, Wilson and the rest are simply referred to generically as "scientists." It's clear that Ferris' challenge was to maximize the value of every single one of those 1,757 words, and the names wouldn't have really added anything to the points being made.



Heading into the Milky Way in *Dark Universe*

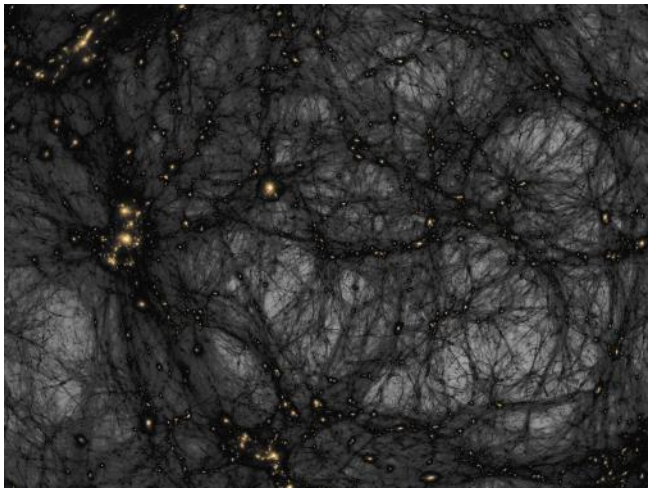
On the other hand, there are some truly illuminating segments even if you already know the facts. Tyson shows what happens when you remove the dark matter from a galaxy cluster, which for effect has the galaxies churning and gyrating to an unholy degree: "The galaxies orbit too fast to be held together by the gravity of normal matter alone. Remove the dark matter, its lensing stops and the cluster flies apart." And indeed, all of a sudden the galaxies fly every which-way across the dome. The data from the Planck satellite are shown not as the oval whole-sky picture we're used to seeing, but as a ribbon arcing across the sky as the signal is acquired. That may have gone over the heads (so to speak) of most of the audience, but I thought it was an illuminating way to do it.





Planck whole-sky image of the CMB (top); gathering the data, from *Dark Universe* (bottom)

The accompanying musical score helps to underline the points in the text. The Hayden's amazing digital sound system has 12,000 watts of power and enough subwoofers to slam your hemorrhoids into your throat when the occasional blast (Big Bang, supernova explosion) comes along. Projected onto the dome of the planetarium, the hyper-detailed images have a 3D quality and far surpass the visual experience of those front-row *2001* viewings of my youth.



The cosmic web of galaxies and dark matter

If you haven't already, see *Dark Universe* at the Hayden Planetarium.

There's a larger question in these planetarium shows that I've been wrestling with ever since I saw the opening production at the rebuilt Hayden in 1999: Does a slick, ultra-high-tech, totally automated production have real *heuristic* value (heuristic: "serving to indicate or point out; stimulating interest as a means of furthering investigation.") In other words, do these shows result in any attendees new to the field going out and learning more on their own? Isn't that the real goal, or rather, shouldn't it be?

There's a technology-driven shift in education. That's to be expected, but there are consequences. The best example I can think of is in medical school. In my first year of medical school, in the late 1960's, I had to dissect a real human cadaver, as every med student had done for perhaps 500 years. Elbows deep in formaldehyde-pickled organs, trying to expose delicate nerves, arteries, veins, muscles and lymph nodes to understand how they relate to each other, I was challenged to be both patient and focused. There was also a social element as my 3 partners and I shared the responsibilities and critiqued each other's performance. And, as a side benefit, there was the necessary early exposure to the less-than-beautiful side of medicine: guts, disease and death. Then there are the unexpected, never-to-be-forgotten incidents, such as the day that a group of applicants for the following year's class toured the anatomy lab just as one of my classmates, frustrated and screaming after a long morning of dissecting, whacked the bejeezus out her cadaver's skull with a hammer and chisel to expose the brain, bits of tissue flying everywhere, at which point two of the applicants passed out. Today, cadavers have been replaced with videos and maybe a few professionally dissected examples, and the anatomy experience has become passive. It's anatomy by watching, not anatomy by doing. I expect few medical students today will carry specific memories of their experiences in anatomy lab (as distinguished from the facts they might have learned) as I do 45 years on. Although the subject matter may be effectively absorbed, I wonder if the course enhances the development of the student's professional persona (as distinguished from their knowledge base). That's an essential objective of every aspect of the medical school experience, often achieved by things that happen *between* the facts.

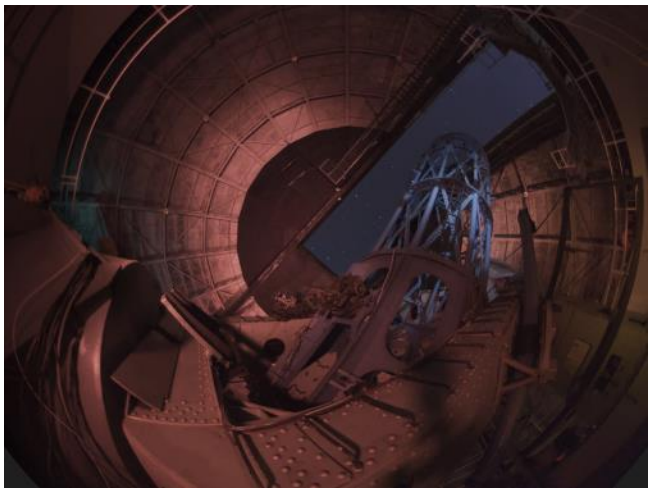
The ISS, carrying the dark matter AMS detector

The Hayden's space show has been similarly transformed by technology. The old shows were live experiences where a human being drove the then-fantastic (now quaint) Zeiss projector and interacted with the audience, often posing questions and eliciting answers. You were in a classroom as much as a theater. That feeling is gone in the new planetarium. Has anything else been lost?

In March 1995, David Gelernter, a writer, Jewish scholar and professor of computer science at Yale (Gelernter was injured in 1993 by a letter bomb sent by Unibomber Ted Kaczynski) wrote an op-ed in the NY Times entitled "The End of Dignity," stimulated by the American Museum of Natural History's announcement of plans to replace the old Hayden Planetarium. The museum was reacting to its reputation for stodginess, and a new, urbane, high-tech facility meeting the demands of our "more sophisticated" turn-of-the-millennium society would be a tonic and attract new attendees. Gelernter disagreed, writing that "the society of the planetarium's youth was the more sophisticated one, and the old building's impending

death is part of a trend that has damaged American life."

Gelernter argued that museums today are becoming theme parks. He wrote "Back then [when the original Hayden opened in the 1930's], a museum was for enjoyment and reflection, not thrills…. The museum was a serious institution, and it addressed its audience with calm dignity." He goes on to lament "the slow death of dignified public discourse [that] echoes through our culture" and attributes that to the "death of authority", the waning influence of individuals and institutions that get recognized for their serious contribution to the common good. Today, everyone (or no one) is an authority; "shouting" has replaced discourse, opinions carry as much weight as do facts, and society is the worse off for it. Gelernter wrote "The slow death of dignified public discourse echoes through our culture. In politics, it has meant the triumph of negative campaigning. In art, nuance and beauty are drowned out by the acid blare of the message. The public has become increasingly cynical about politics and art. It will become cynical about technology, too, when the actuality fails to live up to the advance billing." It's a serious charge. Is it true?



Inside the dome of the 100-inch Hale at Mt. Wilson

Back in the fall of 2010, WAA was asked to provide some telescopes for an event featuring Neil deGrasse Tyson. As an auction item at some organization's fund-raiser, you could rent Dr. Tyson for an evening with you under the stars talking about astronomy. The high bidder gave the event to a cub scout troop, and so we found ourselves in a field in North Salem with Tyson, a dozen or so scouts, the club's 20" Obsession, two 8" SCTs (one with a Mallincam), several other scopes and a BiPH. The scouts surrounded Tyson as he discussed a vast range of topics and answered questions. What was remarkable to me was Tyson's complete command of everything and his clear, eloquent off-the-cuff delivery. He could discuss cosmology and stellar dynamics, explain the names of the stars, describe spectroscopy, tell mythological stories about the constellations and even explain the significance of complex numbers. He held the young audience's interest so fully that few of them wanted to break away to look through the fabulous instruments at the wonders in the sky. His enthusiasm was palpable.

A week or so afterwards, I emailed to thank him for inviting us, but then something came over me (perhaps I channeled Gelernter) and I felt compelled to mourn the passing of the old interactive sky shows and offer a critique of the slick new planetarium productions. His response was, "Every generation cites something indelible from their youth that they are sure would be indelible to the generation that follows. The task of the educator is to ensure not that the actual exhibit remains, but that the force of its influence on you is captured in subsequent exhibit designs, tuned for a next generation…Too bad for the nostalgic set, but not for the next generation. The attendance in the last year of the old Hayden was about 350,000. In the first year of the new facility it was 1.5 million. This past year, a decade later, the number remains above a million per year…. Astronomy has progressed, but no less important is that educational methods and tools have progressed as well." It's true that old styles don't communicate effectively forever, no matter how much we might wish they did. And it's hard to argue the importance of the benchmark that the museum's Trustees ultimately care about: Are people coming? No money, no mission.

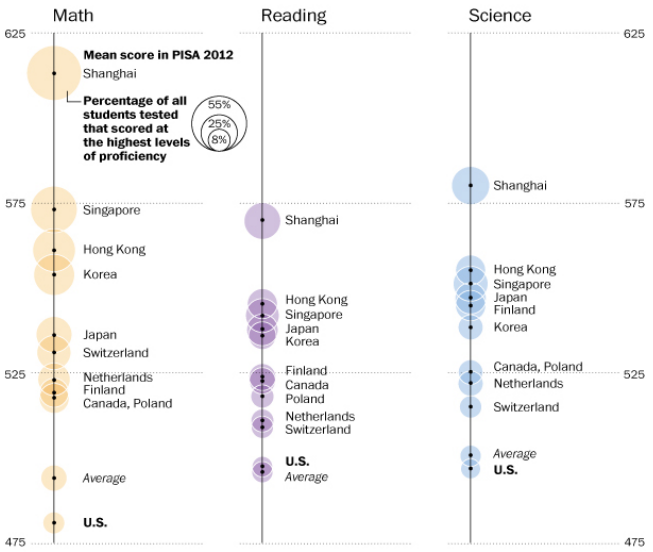
So a question that comes to mind is whether there is any evidence, other than that implied by the statistic of paying customers, that we've advanced *education* with these new methods. There's just not a lot of useful information to inform this question.

I found an interesting presentation about planetarium based learning from the Western Conference on Science Education, a Canadian organization, entitled "More Learning, Less Memorizing: Increasing Engagement and Understanding using Interactive Planetarium Shows". The researchers used a small, inflatable planetarium to augment a 101-level undergraduate astronomy for non-science majors course, based on previously documented studies that showed that "Abundant research in school science points to the potential learning gains in active, engaging learning

experiences in which students are constructing their own knowledge." They compared a TA-led experience in the dome with one in which the students guided themselves using the planetarium's controller. The self-guided experiences were fundamentally a bust. The TA-led planetarium sessions were rated better, although classroom lectures were the most appreciated (I suspect due to the poise and polish of the experienced faculty). The authors write, "We suggest an explanation for these results may be that students have been socialized in school to be knowledge consumers, rather than knowledge producers." Although this study does not really compare interactive planetarium shows versus totally produced ones, if attendees are merely "consuming" information one might expect little *post hoc* change in their interest or knowledge level. Perhaps this is peculiar to non-science majors suffering through a mandated science course, but in a sense aren't they equivalent to the audience at a current Hayden show? If a planetarium show is to be truly educational, as its producers claim it should be, then something more may be required of the audience, something that was once present but is now gone.

Had I been bolder, I might have interviewed a few audience members after the show to try to get some sense of what they thought and whether, if new to the subject, they actually retained anything. That's probably not what AMNH really wants to see happening to their visitors after the show. But wouldn't it be revealing to administer a "pre-test," a "post-test" and then maybe a 3-month follow-up, to really judge the impact of the experience. Get me an NSF grant!

There's no question that US students fare poorly when compared to other countries in science and math education. The reasons are varied but it's not hard to list most of them: lack of funding; lack of trained science teachers; curricula that concentrate on basic skills in a standardized manner (*i.e.* No Child Left Behind); social and media trends that discourage concentration, focus and patience; decreased reading opportunities; a long-standing disdain for "nerds", "geeks" and "egg-heads"; a society that worships the rich and famous and the quick buck, neither necessarily achieved by acts that enhance the common good (I mean, exactly *why* is Kim Kardashian rich and famous?); in some areas of the country, a religious disdain for science that spills over to curricula and textbooks. It might be that two-income families also play a role, the absence of a parent at home for young children somehow blunting subtle behavioral skills that would ultimately help the child to become a more effective learner.



Data from the 2012 Program for International Student Assessment. The US ranks last among the countries listed.

A 2005 book of conference proceedings, *Teaching and Learning Astronomy: Effective Strategies for Educators Worldwide* (edited by the ubiquitous Jay Pasachoff of Williams College and John Percy), noted "Members of the IAU Commission on Education and Development might also be made aware of changes in the planetarium world. While the traditional star projector (providing a naked-eye view of the night sky) is far from dying, many new facilities have instead opted to go fully digital, whereby any image (naked eye-view of the night sky included) can be reproduced on the hemispherical dome. The trend is towards 'immersive experiences.' In the wrong hands, presentations can stray far from astronomy. In the right hands--such as at the Hayden Planetarium in the American Museum of Natural History, New York City—the technology can be used to carry the audience through the galactic neighborhood and beyond." The question of whether this really translates to better astronomy literacy or mints a few amateur astronomers isn't answered. But I guess Tyson is doing the best he can.

A conference participant noted "the use of amateur astronomy groups in the school environment is a very valuable and under-used resource. Teachers are not aware of the depth of knowledge and range of equipment that amateurs can contribute. Local amateur societies are very willing to share their equipment for little or no reimbursement. Their enthusiasm is usually transferred to students and parents alike." That's certainly the spirit and experience of WAA and I suppose it's up to us to follow-up wherever we can. In the words of Seneca, *Non est ad astra mollis e terris via.* (There is no easy way from the earth to the stars.)

The Hottest Planet in the Solar System

By Dr. Ethan Siegel

When you think about the four rocky planets in our Solar System—Mercury, Venus, Earth and Mars—you probably think about them in that exact order: sorted by their distance from the Sun. It wouldn't surprise you all that much to learn that the surface of Mercury reaches daytime temperatures of up to 800 °F (430 °C), while the surface of Mars never gets hotter than 70 °F (20 °C) during summer at the equator. On both of these worlds, however, temperatures plummet rapidly during the night; Mercury reaches lows of -280 °F (-173 °C) while Mars, despite having a day comparable to Earth's in length, will have a summer's night at the equator freeze to temperatures of -100 °F (-73 °C).

Those temperature extremes from day-to-night don't happen so severely here on Earth, thanks to our atmosphere that's some 140 times thicker than that of Mars. Our average surface temperature is 57 °F (14 °C), and day-to-night temperature swings are only tens of degrees. But if our world were completely airless, like Mercury, we'd have day-to-night temperature swings that were *hundreds* of degrees. Additionally, our average surface temperature would be significantly colder, at around 0 °F (-18 °C), as our atmosphere functions like a blanket: trapping a portion of the heat radiated by our planet and making the entire atmosphere more uniform in temperature.

But it's the *second* planet from the Sun -- Venus -- that puts the rest of the rocky planets' atmospheres to shame. With an atmosphere **93 times as thick as Earth's**, made up almost entirely of carbon dioxide, Venus is the ultimate planetary greenhouse, letting sunlight in but hanging onto that heat with incredible effectiveness. Despite being nearly twice as far away from the Sun as Mercury, and hence only receiving 29% the sunlight-per-unit-area, the surface of Venus is a toasty 864 °F (462 °C), with *no difference* between day-and-night temperatures! Even though Venus takes hundreds of Earth days to rotate, its winds circumnavigate the entire planet every four days (with speeds of 220 mph / 360 kph), making day-and-night temperature differences irrelevant.

Catch the hottest planet in our Solar System all spring-and-summer long in the pre-dawn skies, as it waxes towards its full phase, moving away from the Earth and towards the opposite side of the Sun, which it will finally slip behind in November. A little atmospheric greenhouse effect seems to be exactly what we need here on Earth, but as much as Venus? No thanks!

Check out these "10 Need-to-Know Things About Venus":

http://solarsystem.nasa.gov/planets/profile.cfm?Object=Venus.

Kids can learn much more about the crazy weather on Venus and other places in the Solar System at NASA's Space Place.

Image credit: NASA's Pioneer Venus Orbiter image of Venus's upper-atmosphere clouds as seen in the ultraviolet, 1979.

Westchester Amateur Astronomers

Mare Humorum

By Larry Faltz

The Mare Humorum (Sea of Moisture) is a 400-km wide basin on the southwestern side of the moon's face. It isn't moist: it's filled with lava, and judging from the relatively small number of craters its surface it is probably fairly young by lunar standards, according to Gerald North's *Observing the Moon* (Cambridge, 2000). Perforating its edge at 10 o'clock is the large (100 km-wide) shallow crater Gassendi with the smaller, sharper Gassendi A on its northwestern edge. The flat crater at 8 o'clock is Mersenius. To its lower right is Liebig. The Rupes Liebig is a fault running from Gassendi past Liebig, over 180 km in length. The well-formed crater at 4 o'clock on the Mare's edge is Vitello. The large flat crater near the bottom right of the image is Schickard, 227 km in diameter. The dark area on the lower left is the lunar terminator, not the satellite's edge.

The image was captured from my driveway in Larchmont on May 11th when the moon was 12 days old. I used a Stellarvue 80mm f/6 refractor on an iOptron Minitower alt-az mount, Celestron Skyrix 445M monochrome CCD camera. The avi frames were stacked in Autostakkert!2 (best 400 of 2000 frames), wavelet processing in Registax 6.1, tonal adjustments with Photoshop Elements 2.0.

Antenna Galaxies

Scott Nammacher captured this image of a galactic collision--the Antenna galaxies in Corvus (NGC 4038,9). About 1.2 billion years ago NGC 4038 was a barred spiral galaxy (like our Milky Way) and NGC 4039 was a spiral (like our neighboring Andromeda Galaxy). In the future our Milky Way and Andromeda will experience a similar encounter.

Larry Faltz giving his outreach presentation at the Greenburg Public Library.

John Paladini took this image of Mars through his Celestron 9.25