



NEWSLETTER

Winter 2017

RITTENHOUSE ASTRONOMICAL SOCIETY

Founded 1888 WWW.RITTENHOUSEASTRONOMICALSOCIETY.ORG

MONTHLY MEETINGS OPEN TO THE PUBLIC

7:15 PM

The Franklin Institute

20th Street and Benjamin Franklin Parkway

Upcoming Meetings/Events Include:

Table with 2 columns: Image/Logo and Meeting Details. Rows include: January 11, 2017 (Katie Fehlinger CBS 3, KYW 1060); February 8, 2017 (Gianna Farrell - Rowan University); March 8, 2017 (Pete Detterline - Delaware Valley Astronomical Society); April 12, 2017 (Dr. Derrick Pitts - Philadelphia City Wide Telescope Night); April 28, 2017 (Philadelphia City Wide Telescope Night).

RAS Medal Award

~Ted Williams

On October 22, 10216, Rittenhouse Astronomical Society (RAS) awarded its most recent Medal recipient with the RAS Medal. It was a long awaited ceremony (over 20 years) by RAS officers. With much thanks to Professor Dyson and Exelon it was truly a glorious night enjoyed by all.

I started with the Rittenhouse Astronomical Society (RAS) about 12 years ago. Early on, I gained interest in the RAS Medal award. This honor made the Rittenhouse Astronomical Society rather unique since I was not aware of any other area astronomical groups with a history of an astronomy award that dated back to 1933. The recipients have become a "Who's Who" list of past astronomers. It is an impressive list of individuals. (Check the RAS Main Website for a complete list of past recipients).

I pestered Dr. Friedman, then the president of the society about awarding the medal again. He shared with us some of the challenges that we needed to face to make it happen. At that time, the size of the organization and the structure of its board members posed additional challenges.



Professor Freeman J. Dyson, David Walker, Denise Vacca, Ted Williams, Dan McCormick, Jr. photo by Mitch Berger

The topic was raised to the various officers and board members that I have teamed with over the years, and although there was always much interest, there were more immediate society needs always being addressed. To commit the time needed to properly research and select possible recipients, and conduct an award ceremony was beyond what we could realistically manage. After the establishment of our current board, the topic was raised

“I propose that our universe is the most interesting of all possible universes, and our fate as human beings is to make it so.” Professor Dyson

again, and we accepted the challenge of finding a recipient, arranging a ceremony, finding a venue, and presenting the Medal.

Recently, Professor Dyson presented a book talk at the Free Library of Philadelphia, and a few of our members were in attendance. The conversation of awarding him the medal began amongst the Board Members. In the discussions that ensued, the board found that everyone collectively felt that Professor Freeman Dyson would be an excellent candidate for the next RAS Medal recipient. Also, the opening of the Muddy Run Observatory seemed to provide an excellent partnership opportunity with Exelon to award the medal, in an astronomical setting.

The final stages of research, and an interview with Professor Dyson, confirmed our choice of medal recipient. The medal was prepared and arrangements were made with Exelon who graciously funded the event at the Muddy Run Observatory opening, to host our award ceremony along with the observatory opening. We thank Exelon for their support by allowing us the use of their facilities for our award ceremony and funding the event in its entirety.

I was lucky to be the person selected to interview Professor Dyson about receiving the medal. My awareness of his achievements stemmed back years ago to when I worked at the New Jersey State Museum Planetarium. The director of the planetarium at that time, Richard Perry, had reminisced about working with Professor Dyson when they built the observatory for the Amateur Astronomer Association of Princeton University. In fact, Professor Dyson actually helped to lay the cinder block walls of the observatory now called the Simpson Observatory at Washington Crossing State Park. I had taken thousands of visitors over the years to the observatory following a NJ Planetarium evening presentation. The trip to Washington Crossing was to allow the public to personally participate and observe the sights highlighted in the planetarium portion of the evening. I informed Professor Dyson I was quite proud to have been part of this observing program for just over 10 years and that those visitors (including those still visiting in recent years) all benefit from work he did long ago.

Any research on Professor Dyson easily yielded his insistent opinion of science as a participatory activity. In fact, he asserts that it is where there is excitement and joy. Implementing science by participating in the scientific method is the proper way to excite students about science. Reading about science in an integrated fashion misses the point of participation. A public observatory increases the opportunities for the general public to participate in observing which is one of the foundations of the scientific method. It's those observations that lead to a hypothesis and through continued observation and documentation that the hypothesis is supported. When I shared with professor Dyson my experiences with the observatory that he helped to build and then asked him to help us dedicate the Muddy Run Observatory, I was confident he would accept the medal.

At the dedication ceremony, we began with Exelon speakers explaining how this project evolved and their commitment to work with our astronomical society and how we successfully had teamed with other area astronomy groups. We owe a great debt of thanks to those at Exelon since they have funded the project and the dedication ceremony.

I included in my presentation the three criteria that we used to support our decision for the awarding of our RAS Medal to Professor Dyson.

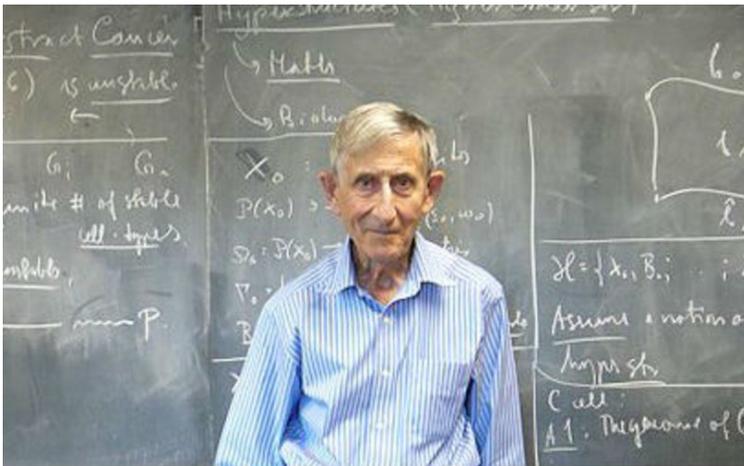
- 1) Quantum Physics – he unified three versions of quantum electrodynamics showing they were three ways of saying the same thing. This required deep insight and elegant mathematics.
- 2) Mathematical Physics – he applied elegant mathematics (again) to the solution or clarification of many areas of physics and science in general (e.g.. Biology) Many of these topics had to do with important military questions of the day including defense and energy.
- 3) Exposition of Science for the Public Good – he wrote many books on scientific and related topics, not just physics. He was professor of physics at many institutions and has profoundly influenced a generation of physicists.



Professor Dyson addressed our group at the dedication as to the importance of providing opportunities to get the public and our youth involved in science. He challenged us to include student observations remotely with the technology that is available today. He complimented us on our conviction to provide these opportunities to the general public, further spreading interest in our Universe as we observe it today. We quoted Professor Dyson for our promotion of this dedication. As you read the quote, consider as we do, that a public observatory is a tool to garner interest in the cosmos.

“I propose that our universe is the most interesting of all possible universes, and our fate as human beings is to make it so.” Professor Dyson

The ceremony concluded with Dr. Derrick Pitts giving a very inspirational talk as to the importance of providing a scientific view to our next generation and encouraging all individuals especially those with no science background. He described the experience of catching those photons with one’s own eyes and the profound effect it has on everyone, especially those who may have had no real prior interest.



Professor Freeman Dyson

~Institute for Advanced Study, Princeton

Freeman Dyson is now retired, having been for most of his life a professor of physics at the Institute for Advanced Study in Princeton. He was born in England and worked as a civilian scientist for the Royal Air Force in World War II. He graduated from Cambridge University in 1945 with a B.A. degree in mathematics. He went on to Cornell University as a graduate student in 1947 and worked with Hans Bethe and Richard Feynman.

His most useful contribution to science was the unification of the three versions of quantum electrodynamics invented by Feynman, Schwinger and Tomonaga. Cornell University made him a professor without bothering about his lack of Ph.D. He subsequently worked on nuclear reactors, solid



Professor Freeman J. Dyson on the panel at the announcement of “Breakthrough Starshot” in New York City in April 2016

state physics, ferromagnetism, astrophysics and biology, looking for problems where elegant mathematics could be usefully applied.

He has written a number of books about science for the general public. “Disturbing the Universe” (1979) is a portrait-gallery of people he has known during his career as a scientist. “Weapons and Hope” (1984) is a study of ethical problems of war and peace. “Infinite in All Directions” (1988) is a philosophical meditation based on Dyson’s Gifford Lectures on Natural Theology given at the University of Aberdeen in Scotland. “Origins of Life” (1986, second edition 1999) is a study of one of the major unsolved problems of science. “From Eros to Gaia” (1992) is a collection of essays and lectures, starting with a science-fiction story written at the age of nine, and ending with a mugging in Washington at age fifty-four. “Imagined Worlds” (1997) is an edited version of a set of lectures given in 1995 at the Hebrew University in Jerusalem about human destiny, literature and science. “The Sun, the Genome and the Internet” (1999) discusses the question of whether modern technology could be used to narrow the gap between rich and poor rather than widen it. “The Scientist as Rebel” (2006) is a collection of book reviews and essays, mostly published in The New York Review of Books. “A Many-colored Glass: Reflections on the Place of Life in the Universe” (2007) is an edited version of a set of lectures given in 2004 at the University of Virginia.

Dyson is a fellow of the American Physical Society, a member of the U.S. National Academy of Sciences, and a fellow of the Royal Society of London. In 2000 he was awarded the Templeton Prize for progress in Religion, and in 2012 he was awarded the Henri Poincaré Prize at the August meeting of the International Mathematical Physics Congress.



The Birth of Muddy Run Observatory

~Barbara Siegel Ryan

With a dearth of truly dark skies in southeastern Pennsylvania, the idea of building a new astronomical observatory in our area may seem like a daunting prospect. How then did Rittenhouse Astronomical Society and its corporate partner, Exelon Generation, reach the decision to undertake such a challenge? The answer lies partly in the backstory of the project.

Exelon Generation is an energy producing company with several hydroelectric facilities on or near the Susquehanna River. One of these stations is the Muddy Run facility in Holtwood, PA, in the heart of beautiful, rural Lancaster County. This is where Exelon Generation manages the flow of water in or out of the Muddy Run Reservoir to meet the demands of increased or decreased energy needs of the regional electric grid. The Muddy Run hydroelectric plant is a pumped storage facility that works in concert with the Conowingo Dam hydroelectric plant fourteen miles south on the river. The electricity created by the turbines at the dam and the turbines at the pumped storage facility supplies power to the power grid and can be used by energy providers, such as PECO, for commercial and residential customers' needs.

The Muddy Run Reservoir is surrounded by parkland, a campground, general recreation areas, and sports fields. In addition to providing outdoor amenities, Exelon Generation maintains a permanent visitor center here with interactive science and nature displays in a public lobby, meeting rooms for community events, and offices. The Exelon family of companies, including PECO and Exelon Generation, have a long history of partnering with the communities they serve and in which they do business. The corporation leads or participates in many initiatives that promote environmental responsibility, education, recreation, wellness, volunteerism, and cultural diversity. Jointly, Muddy Run Recreation Park and Conowingo Dam have several public events each year celebrating the seasons and showcasing the facilities and ecosystem inhabitants.

Enriching the community with "An Evening Under the Stars" astronomy event on October 9, 2015 was a grand experiment for the managers at Muddy Run Park. Our RAS member Al Ryan, also an Exelon employee, coordinated the multi-faceted program. In spite of the torrential rain and near tornadic conditions, the indoor program captured the attention of nearly one hundred visitors. Derrick Pitts, Chief Astronomer of the Franklin Institute, gave an inspiring presentation, as did our RAS headliners Ted Williams and Mike Mountjoy. Rounding out the evening, Coralie Jackman, a subcontractor for NASA's New Horizons spacecraft mission, gave a marvelous presentation on the newest images of Pluto.

After the storm had passed, several RAS members set up telescopes outdoors, and many guests remained to ask questions in spite of the frustrating lack of clear skies. Among the Exelon officials, the consensus was that the evening was a great success: The visitors were excited by the topic and the potential to observe heavenly bodies, and Exelon found another way that they could provide something unique for the people in their community. It didn't take long for one of the Exelon officials to exclaim, "We should have a permanent feature here . . . our own observatory!"

The story continues in the next installment . . .





First Light ~Ted Williams

Many who practice astronomy refer to first light as the first sight in a telescope. The first time it catches photons that could have been traveling for thousands of years across the space/time. I have heard it used at the opening of massive observatories and also along with astronomers using their telescope for the first time.

I almost missed the moment at our new Muddy Run observatory due to my mind-set. After installation of the piers, it was our turn to mount the drives, attach the scope and weights, install eyepieces, prep the computer and get the soft ware to talk to the mounts that would drive the scope. Of course, Polaris was obscured by a cloud so we roughly polar aligned by reckoning and set the scope to chase down Vega one of the brightest stars. While it reached the finder (not bad for reckoning!), it took some tooling around to finally catch it in the eyepiece. We were so concerned with syncing the computer and checking out our alignments that the beauty of what I saw almost took the back seat.

I purposely stopped and turned to Dave Walker who was assisting us that night and remarked "It's gorgeous." I've looked at Vega thousands of times yet never in a 14" scope. It's pin point appearance with all the brightness of the light radiating from that point vs. the pitch blackness it was set in was astounding. Astounding since in that darkness I could see a sprinkle of background stars of the Milky Way.

In most the scopes I've observed with, Vega is so bright it is usually the only star in the field of view.

Since our alignment was not perfect and north was still plagued with some clouds we were off to M11; the Wild duck cluster. Getting close with computer drive (I could see it in our now better aligned finder scope) it was an easy catch in the eyepiece.

This cluster is another staple that I have shown and viewed hundreds of times and yet it seemed anew. I could now see vast difference between the brightest and faintest of the stars within the cluster and more hints of color than I ever observed before. Again for a seasoned observer it was surprising to me that the view was that breathtaking. The thoughts of again tracking down all the Messier objects to see them anew seemed to lift my spirits and take my mind off some of the technical challenges we were facing.

The inspiration of this view seemed to generate from within a renewed energy and commitment that it will take to finish this project bringing both scopes we are installing to their peak performance. That will mark the beginning. We are hoping members will be willing to step forward and assist as we put together a monthly agenda of Public Sky Observation Nights so that we may do what we do best! Share the view and increase the understanding of the visiting observers.

In my mind this first light is the experience I need to focus on and remember (and why I wrote this article.) It will fuel my incentive to share the view and help others to appreciate and understand the universe around us. It will not be the software parameters or the inane menu paths one needs to configure. It will not be challenge of having the equipment and accessories all play nice and work together (not to mention all the people involved.) It will not be all the modern computer equipment and mounts that tempted me to turn my gaze away from the scope.

And to think that I almost missed the experience with my preoccupations with the gear! After recalling the beauty of that first light I observed I'm inspired to challenge us all us to focus on what this facility will provide. It will provide the experience of seeing some of the wonders of the universe around us as we share some of the knowledge contained in that view. I am convinced that view is what can inspire the youth of today as it can ignite a spark of interest that continues on to future careers in science.

We now look forward with excitement and anticipation as to our involvement with this new observatory. Stay tuned for future observing events scheduled through 2017 which will be posted starting this March on the NASA Night Sky Network. Rittenhouse Astronomical Society now has an observatory it can call it's home away from home.

Society Business

The Fire Alarm that Wouldn't Quit Meeting Report - September ~Denise Vacca

I was super excited to conduct the first meeting of the academic year for Rittenhouse Astronomical Society. It was an interesting summer and I had a lot to share with the group. There were more benefits for members, the opening of the new observatory, we were finally going to award the Rittenhouse medal and we had an exciting year ahead planned for Rittenhouse.

Our speaker was Drew Maser and I was looking forward to his presentation on solar observing. It was 7:05 p.m., the powerpoints were loaded, people were entering, music was playing and we were ready to go. What could possibly go wrong?

AAAH!!!! All of a sudden, a siren starting wailing and bright white lights cut through the cool planetarium atmosphere. Oh no!! The fire alarm has just gone off.

With a quick joke and a laugh we made our way out Winter Street and after a few minutes were given the all clear. We returned to a bright planetarium and I did my best to entertain. After all, the show must go on.

I started with welcomes, introductions and an update of club business. Al and Barb Ryan spoke about the Muddy Run Observatory and we unveiled Barb's drawing of what the future observatory will look like.

I also shared the exciting news that we were, after years, awarding the prestigious Rittenhouse medal to professor Freeman Dyson.



Barb Ryans drawing of the planned Observatory



Path of the Total Solar Eclipse of 2017

I was just about to go over the club lineup for the next year and we were finally able to get back online and have the bright fire alarm lights turned off when.....Oh no, the fire alarm was going off again!

Sirens, bright lights and even a bit of laughter ensued.

Luckily, we didn't have to evacuate the planetarium but we did have to wait until the alarm reset and the house lights went off. The hilarity of the situation is what kept us all going since this went on once or twice more throughout the night. Everyone stepped up to make the night fun despite the obstructions.

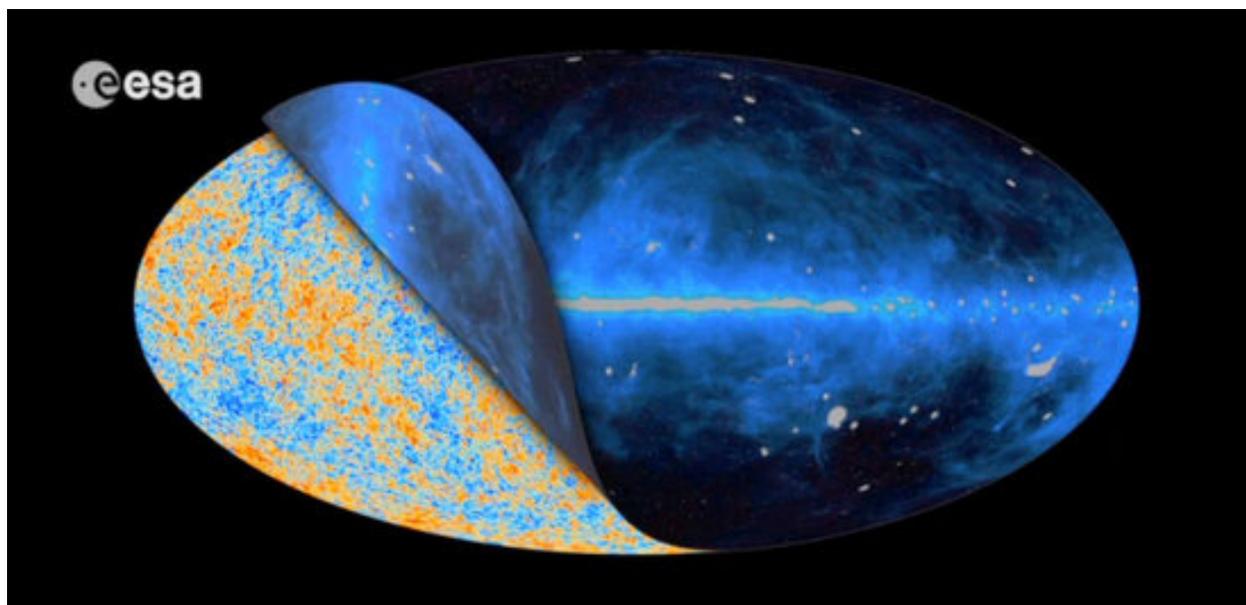
We ran a little late but the night was worth it. Renee did a great planet report, we learned how to find the Andromeda Galaxy naked eye and Drew shared with us how to get the best views of next year's solar eclipse.

Everyone in the group was very patient and in the end, it turned out to be a fun start to our meeting year.

We may have been given a few loud, bright lemons but we made lemonade and it was delicious.



Andromeda Galaxy



Revealing the Cosmic Microwave Background with Planck

Meeting Reports

~Ted Williams

October 2016

For our October meeting we invited two guest speakers to talk with our society. We felt it might be a great combination to survey the visible universe and then determine the chances that there may be life out there. To accomplish this, we invited Brian Abbott (assistant curator of the Hayden Planetarium) and Dr. Jeremy Carlo from Villanova University to share with us a greater understanding of the Drake equation (which through mathematics determines the odds of sentient life.)

Brian Abbott hails from the American Museum of Natural History and oversees the Digital Universe, a 3-D atlas of the cosmos which is available on the web and shown in planetariums around the world. Brian is one of the key scientists who provided astrophysical data and scientific support for the inaugural space show “Passport to the Stars”, Uniview; The Digital Universe and related space exhibits. He remains involved with data analysis and outreach efforts in and out of the museum.

Dr. Carlo is an Assistant Professor of Physics at Villanova University, where his research interests include the properties of magnetic materials. In addition, Jeremy has been an avid amateur astronomer for nearly 30 years, has built several telescopes, and has served as a member or officer for several astronomy clubs in the Northeast. Jeremy has published 25 papers in scientific journals, and has conducted experiments at facilities including Oak Ridge National Laboratory, Brookhaven National Laboratory, TRIUMF, and the Canadian Neutron Beam Centre.

A great evening of exploration and then extrapolation garnered lots of positive feedback from members and guests attending. Brian guided us from the Earth backward through time to the birth of the universe (Cosmic Microwave Background.) Jeremy followed Brian’s presentation and guided the society collecting data from the audience via spreadsheet to estimate possibility of sentient life in the galaxy. Each variable of the equation was thoroughly explained and the audience debated the numerical values to assign each.

DRAKE EQUATION

$$N = R \times f_s \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

R	average rate of star formation
f_s	fraction of good stars that have planetary systems
n_e	number of planets around these stars within an “ecoshell”
f_l	fraction of those planets where life develops
f_i	fraction of living species that develop intelligence
f_c	fraction of intelligent species with communications technology
L	lifetime of the “communicative phase”

While working at the National Radio Astronomy Observatory in Green Bank, West Virginia, Dr. Frank Drake conceived a means to mathematically estimate the number of worlds that might harbor beings with technology sufficient to communicate across the vast gulfs of interstellar space. The Drake Equation, as it came to be known, was formulated in 1961 and is generally accepted by the scientific community. (SETI League at setileague.org)



David Rittenhouse Homestead

November 2016

Anticipating the RittenhouseTown event in 2017, we invited Bunnie Riedel, (RittenhouseTown board member) to give our society a historical perspective of the village and birthplace of David Rittenhouse.

At the heart of the thriving early industrial community known as RittenhouseTown, the first paper mill in British North America built by William Rittenhouse and his son, Nicholas, occupied the north bank of the Monoshone Creek. A second mill, Homestead and Bake House quickly followed. For the next 200 years, while eight generations of Rittenhouse family members continued to live and work all along the Monoshone and Wissahickon Creeks, the focus of the community remained this intimate cluster of buildings enclosing both public and private space. One of the buildings within the cluster is the birthplace of David Rittenhouse.

In 1891, the Fairmount Park Commission demolished the Mill and a number of nearby buildings as part of their plan to create parkland for city residents and to eliminate sources of pollution which were making the city's drinking water taken from the Schuylkill River unsafe.

Historic RittenhouseTown, a National Historic Landmark District, is dedicated to informing the public about the life and times of this early industrial village – British North America's first paper mill, founded in 1690. The non-profit organization is committed to the site's preservation through research, restoration and high-quality educational programming.

As an added treat to the evening, President Ted Williams donned his David Rittenhouse garb and portrayed David in character. As David, he congratulated the group on the recent awarding of the RAS Medal to Professor Freeman Dyson and drew comparisons between Dyson and himself. Many enjoyed the portrayal and Ted was asked to consider

bringing that role to RittenhouseTown. Members should know the board is considering a picnic at RittenhouseTown this year. It was at a similar picnic a few years back that Dr. Milt Friedman challenged the society to award the Rittenhouse Medal.



*Carolyn Herschel (Lynn King)
David Rittenhouse (Ted Williams)*

New Ways of Renewing ~Dan McCormick - RAS Treasurer

Dear fellow Society Members,

This year a lot of big changes have been happening with the Society. One of our most exciting changes is we are now accepting membership dues both digitally and in person. If you would like to renew memberships at the club we now take all major debit/credit cards! We process these transactions through Square and then the funds will be sent directly to our bank account. These will help us keep much more accurate records and is more convenient for our members. Of course, checks and cash are always accepted. We are also accepting payments via PayPal through our members' site, NING.

I also wanted to take this opportunity to publicly thank our membership for stepping up to help keep our NING site alive. Thanks to your generous donations the past few months I am happy to report that this bill has been taken care

of so we can continue the growth of this site. The President and I started this site almost 7 years ago and we are thrilled with the direction it is moving towards. Through this site members can communicate with one another, outside of our meetings, on anything from observation reports to astrophotography tips. It has enlightened and inspired me to try more astrophotography and has shown that you do not need to venture out in dark, rural skies to get amazing photographs.

Over this past summer, the Bylaw committee got together to renew our Bylaws which haven't been updated for some 50+ years. These outdated Bylaws were no longer serving our organization effectively with the changing times. Thanks to our new Bylaws we were able to establish ourselves as a Non-Profit in the State of Pennsylvania. This was a big step for us to take part in new activities as a Society.

To help pay for more functions within the group we have also started to look at fund raising opportunities. This year we have kicked off our solar shade campaign to help you get ready for the 2017 Eclipse. These shades can be purchased at the end of our meeting and can be used at any time to safely look at the Sun. More ideas are in the pipeline. If you have any ideas for fund raising please see reach out to any of us at our monthly meeting.

I am glad I am able to update you on the financial status of the organization. Thanks to your dues and donations we are able to keep everything going. As an all-volunteer Society money collected goes directly back to the Society to keeps the organization together.

Your Appointed Officers

This year due to unforeseen circumstances, our officers were appointed by the Board. Here is a list of your current officers and Board members:

Officers	
President	Ted Williams
Vice President	Denise Vacca
Secretary	David Walker
Treasurer	Dan McCormick, Jr.
Board Members	
Eric Carter - Astronomical League	
Fern Culhane - Registrar	
Ruth List - Newsletter Editor; Historian	
Mike Mountjoy - Instructional Technology Advisor	
H. ALfred Ryan - Public Outreach	
Renee Stein - Educator	

End of Society Buisness

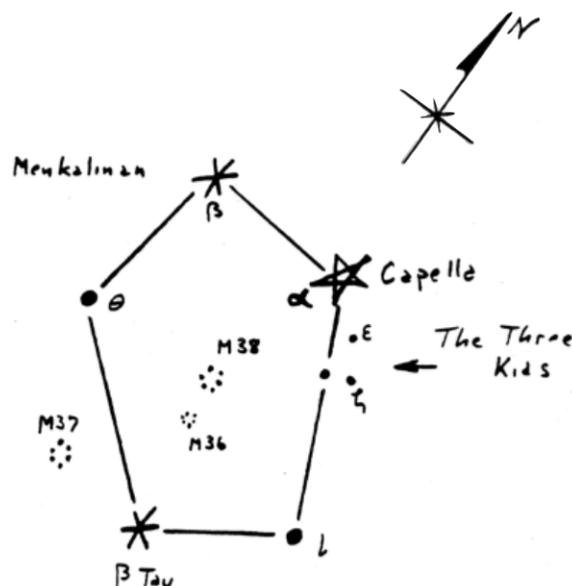
Off the Beaten Path!

~Alan Pasicznyk

There are actually more than just a few constellations which are not connected with any mythology in particular. Most of these lie in the Southern Hemisphere, having been "invented" since 1600, and have names like Dorado the swordfish, Fornax the furnace, and Horologium the clock (of all things!). But we are lucky enough to have a few in the Northern Hemisphere, probably the most conspicuous being Auriga the Charioteer.

For a starter, Auriga is pictured in the sky without a horse or even a chariot. Well this I can cope with; perhaps he is on holiday! But to make matters worse, he is pictured holding a goat (the star Capella) and three kids in his left hand, and the reins to a horse in his right hand. Thus he appears as a retired charioteer who has become somewhat eccentric in his old age. (Incidentally, "Capella" is Latin for "she goat", but I like to refer to the Italian translation of "Cappella" which means "choral singing without musical accompaniment", because of the way the star twinkles red and green on the horizon, in the late summer months).

Auriga is only vaguely related to Greek mythology. Supposedly he was the crippled son of Vulcan and Minerva. He invented the chariot for himself so that he could travel around, and was transformed to the skies because of his wonderful invention. This invention has caused much consternation through the ages, even today it has become computerized and fuel injected and we know it as the automobile. It is with great irony that during the winter months, when people have trouble starting their cars, Auriga can be seen in the evening, high in the sky overhead. Perhaps he has come to beckon the souls of all those automobiles that won't start, to join him in the heavens.





INRS: Heavy Launchers 2016-11-20

~Dave Walker

If you want to dream big about exploring Space, you have to dream about how to get there.

The biggest of course, was the legendary United States' Saturn V which could lob 140,000 kg into Low Earth Orbit (LEO), one and a half times as much as it's nearest competitor the Soviet Union's N1 at 95,000 kg. But that was the 1960's and 1970's

Later Super Heavy Launchers, vehicles capable of sending more than 50,000 kg into LEO, such as Soviet Union's Energy (62,000 kg), and the United States' Space Transportation System aka "Space Shuttle" (26,000 kg payload, 69,000 kg Orbiter do the math!) rivaled them. But that was the 1980's through early 2000's.

How do we get it there today?

In the Second Decade of the 2000's our options are a variety of Heavy Launch Vehicles which can launch at least 20,000 kg into LEO, or less into Geostationary Earth Orbit (GEO) or Earth Departure for interplanetary, or even interstellar, exploration.

Clocking in at 21,000 kg for the European Space Agency is the Ariane 5, named for the daughter of King Minos, this launcher is the 5th in a series of rockets developed for the ESA. Ariana uses Liquid Oxygen (LOX) and Liquid Hydrogen (H₂) like the former Space Shuttle.

First launched in 1996, Ariane was developed to support human space flight, although no human have yet to fly on it.

Ariana has been used to launch such notable probes as Rosetta, and the lander Philae, to comet 67P/Churyumov-Gerasimenko (67P), and Herschel Space Observatory, the largest Infrared space telescope ever launched.

Making a showing for the Russian Federation is the Proton-M with roots extending back to the Soviet Union's Lunar Program. Derived from the UR-500 Intercontinental Ballistic Missile (ICBM, no snickering please) and using dangerous Hydrazine fuels, Proton has launched everything from Lunar Sample Return missions and the Lunokhod Rover, to the first Space Station "Salyut" in 1971, not to mention the first component of the international Space Station (ISS) "Zvezda".

China is rapidly modernizing, and in addition to bullet trains, it is developing a crewed space program including space stations housing it's "Taikonauts". To put all of this into orbit they have developed the Changzheng (Long March) family of boosters including the CZ5 than can take 25,000 kg into LEO. LOX and H₂ feed these massive launchers.

The King of the Mountain is the Delta IV the most powerful launch vehicle in use today, hauling 28,000 kg into LEO on behalf of the USA it can carry only 1/4 what the Saturn V could.. A scalable system ranging from Medium to Heavy launch the Delta IV has a long and successful history beginning in 2004. It is the workhorse of the United States' heavy launch program.

In 2014 a Delta IV launched a prototype of the Orion Space Capsule into an orbit of 5,800 km, simulating the re-entry velocity of a Lunar mission of 32,00 km/h; 25 times the Speed of Sound.

Today most launches are Light to Medium launches, but for big missions you need a big launcher; especially for interplanetary probes.

Food for thought: the International Space Station required over 40 launches of both Proton and Space Shuttles. The same sized staton could have been launched using only three Saturn V vehicles.



History and Astronomy: More Linked Than You Think: Part II

~Christian Murphy

History and astronomy, rather astronomers, cosmologist and all practitioners of the celestial sciences have intertwined with each other over the millennia. As was stated before the relationship between the two has been at times tumultuous and enlightening. Sometimes as in the case with Hypatia the inertia of history and the new thoughts of the time have consumed the celestial scientist for the worse. Conversely they have lifted the likes of Copernicus and Newton to the status of Demigod.

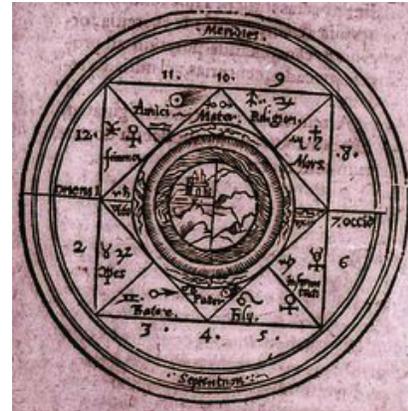
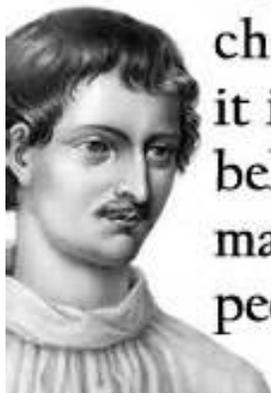
As I have stated before the purpose of these articles is to expose the relationship of history and astronomy throughout the ages. However in my research for these articles I have found that while the demigods of the celestial sciences are well known and celebrated, there are many who are not. People such as Giordano Bruno the subject of this article. Giordano Bruno was born in the year 1548 in a Europe being torn apart by the Protestant Reformation, and the Catholic Church's counter reformation efforts. He was born in Nola, in the Kingdom of Naples in Italy not far from Rome and the Papal States the stronghold of the Pope.

Giordano, as a young boy was afforded an education by private tutors at an Augustinian monastery. In a world where the secrets and education of the classical world of Greece and Rome were kept alive in Europe by the Church, and in the east by the kingdoms of Islam. The problem only came when the teachings ran up against the dogma of the church. Bruno then aged 17 entered the church and was eventually ordained a priest at the age of 24. During his time in the Dominican order he continued his education where he gained many accolades. But then his habit for free thinking and interest in controversial books, caused some problems for him. After one particular incident he

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“Truth does not change because it is, or is not, believed by a majority of the people.”

Giordano Bruno



Giordano Bruno: Diagramma del cosmos in forma di oroscopo (diagram of the cosmos in the form of horoscopes)

fled the order for a time and became a wanderer.

During these wandering around Europe he formulated many cosmological and astronomical theories. His theories included the ideas of an infinite universe, and he defended and elaborated on Copernicus' theory of heliocentricity, in a world where the geocentric model of the solar system was the predominant teaching. However his most interesting theory was the theory of the plurality of worlds. In this theory he proposed the idea that the stars were actually Suns like ours with their own planets, which he said have no less nature or virtue than our own and are perhaps contain animals and inhabitants. This theory of plurality of worlds we have proven to be at least half true with the discovery of many exoplanets surrounding distant stars, via the Kepler space probe.

Unfortunately for Bruno his free thinking and more particularly his ideas of a plurality of worlds ran him into conflict with the Church. He was called before the inquisition, the body of the church which prosecuted heresy. He was imprisoned for seven years and then burned at the stake for his heretical beliefs in 1600. He was a victim of a time where the Church tried to maintain its hold on a Europe being rapidly changed by new thoughts brought on by the proliferation of the written word in the vernacular and the new beliefs of the Protestant reformation. This reformation called on people to challenge what the priest and church told you to believe. Bruno has been called by some a martyr of science. While his contrary religious views were the predominate factor in his heresy trials his cosmological views also lent weight to his conviction. He was yet another celestial scientist who ran into and became a victim of his times.

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