Event Horizon

Volume 23, Number 9
September 2016

Hamilton Amateur Astronomers

From The Editor

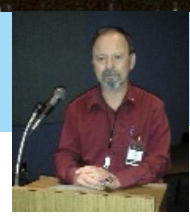
It's approaching Fall, and it's back to school, and back to the Event Horizon!

As always, thanks to all who have contributed.

Clear Skies,

Bob Christmas, Editor

editor 'AT' amateurastronomy.org



Chair's Report by Bernie Venasse

I hope you have all had a great summer. After a two month break, we are about to start our monthly meetings again. Several of our members will be back from their twice-yearly Black Forest Star Party. I look forward to hearing about the goings-on there. Galileo – as portrayed by our own John Gauvreau -will be our featured speaker for September. He will be introducing you to his newest scientific instrument. Hear in his own words how he built this telescope, the observations he made, and the magnificent discoveries that even he realized would revolutionize our understanding of the heavens. This talk should be a must see for all of our members. Our Annual General Meeting takes place at the October meeting. It's at this meeting that we look after most of the club's business for the year, (the delivery of the clubs financial report and the election of the club's council for the upcoming year). After the club business is completed, our speaker will be Bob Abraham. We have been lucky to have some very good people looking after the club's interests this year, and I feel privileged to have been associated with them. The club cannot operate without people willing to get involved with the day to day operations of club's business. Even though we do have a great

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IN THIS ISSUE:

Chair's Report (continued)

group of people now, we are always looking for, and need, new blood. If you think you would like to get more involved in the club, please feel free to contact me at my cell (905) 966-2550 or e-mail me at "chair 'AT' amateurastronomy.org" and we can talk about what you would like to do. This is your club, and it needs your help to continue. I hope to see you at the meeting on September 9th in the Spectator Building auditorium.

H.A.A.'s Loaner Scope Program

We at the HAA are proud of our Loaner Scope Program.

If you don't have a telescope of your own and want to make use of one for a month or so, you can borrow one of our fine loaner scopes.

Please contact Jim Wamsley, at 905-627-4323, or e-mail Jim at:

secretary 'AT' amateurastronomy.org

and we'll gladly get one signed out for you.

HAA Helps Hamilton

To support our community, we collect non-perishable food items and cash for local food banks at our general meetings. Please bring a non-perishable food item to the meeting or a donation of cash and help us help others.

Hamilton Food Share
Hunger. It's just unacceptable.

Our donations go to Hamilton Food Share, which delivers them to various food banks around the Hamilton area.

If you would like to help or have any questions about this initiative, please contact the H.A.A.

Masthead Photo: *The Trifid Nebula (M20), August 2016, by Matthew Mannering.*

Taken from Inverhuron Provincial Park, Ontario, with a Canon T4i DSLR through an Explore Scientific 80mm triplet refractor scope, tracked on a Celestron AVX mount. North is to the right.

The Sky This Month for September 2016 by Matthew Mannering

Welcome to the first of the fall editions of the newsletter. I was looking back at the 2014 edition of the September newsletter and read about the summer weather we had that year. Apparently summer was late arriving and the onset of fall was early. The weather that summer was cool with the upper atmosphere obscured by smoke from forest fires out west. This summer, as I'm sure you're well aware, was just a little different. Record temperatures and rain everywhere except for southern Ontario. In fact, the temperatures were so brutal that we ran the A/C in our trailer more times in one week of camping than we had in the previous four years put together.

Janice and I went back to Inverhuron Provincial Park again this summer and had great weather six out of seven nights. We concentrated on astrophotography and spent lots of time observing the early Perseid meteors while our cameras were busy. An added bonus was a short display of Northern Lights that lit up the sky for about a half an hour between 2:30am and 3:00am the one evening.

Credit: Janice Mannering

What did I learn about astrophotography this year?

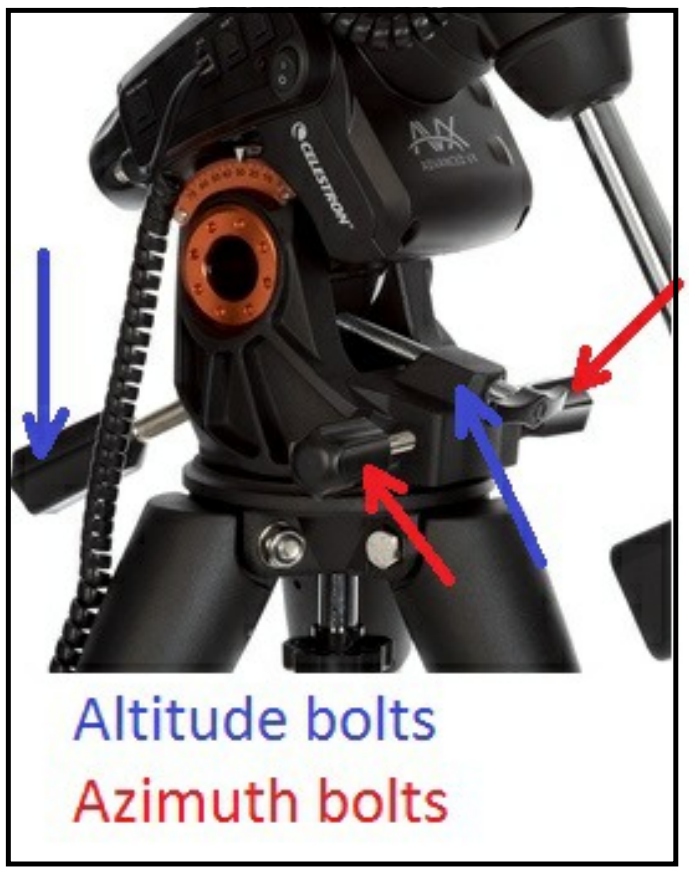
I've been reading about a process called "All Star Polar Alignment" (ASPA) for my Celestron AVX mount and finally decided to give it a go. I don't use a guide scope and camera to help the mount track a target. So getting the mount set up as precisely as possible is really important *(Continued on page 4)*

as that affects how long my exposures can be. I don't know if other mount manufacturers have a similar function available so this only applies to newer Celestron mounts. However, some of this information can help anyone with their setup.

No matter how well you visually polar align your mount, you will have some error. You can virtually eliminate this by doing an ASPA after first polar aligning the mount and doing your regular 2+3 star alignment. Your mount will then calculate how far away you are from a true polar alignment.

So here's how the process works: - after doing the initial 2+3 alignment, tell the controller to do the ASPA routine. Choose a bright star due south about 30 to 45 degrees above the horizon whose name you know. Direct your mount to "Go To" that star. Once the mount has "found" it, use the hand controller to center the star. Read you controller screen to tell it to move to the next step. The mount will move away from and then back toward the star. Note that the star will no longer be in the center of the eyepiece. This offset is the polar alignment error.

Next, you need to re-center the star <u>using only the mechanical Alt/Az bolts on the mount</u> (see lower left).



Tell the mount when you have the star centered and ASPA is now complete. Well, almost. . . Since you have slightly altered the polar alignment - you need to do another 2+3 star alignment. Now this next point is really important (and I didn't do it). Use the hand controller to tell the mount to go back to the HOME position. <u>Don't unlock the Alt/Az clutches</u> and move the mount manually to the HOME position. No matter how accurately you do this, it won't match the HOME position the mount computer has calculated.

So how much does this improve tracking accuracy? Well even with the error I made by unlocking the clutches, my maximum exposure duration went from 75 seconds to 105 seconds. Without my mistake I think that 120 second exposures would have been possible.

Does this sound like a lot of hassle? It's not really. The key is to set up early enough that you are ready to do your first polar alignment as soon as the North star is visible. By doing that, the rest of the alignment - including ASPA - will be done before it is truly dark.

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The Sky This Month for September 2016 (continued)

Another thing that helps to speed things up is to use your camera to do the 2+3 star alignment instead of an eyepiece. You can focus the camera on the North star while in the HOME position and use the camera's live view screen to center each of the stars. Centering the stars is very easy if you activate the grid display on the screen (see lover right). My Canon T4i has two grid systems. The finer of the two grids has an intersection of grid lines in the exact center of the display. Just position each alignment star at that intersection and you will have perfect alignment.

One last piece of advice regarding alignment. When centering the alignment stars make sure that the last buttons you use on the controller are the "Up" and "Right" buttons. If you overshoot the center of the display, move the star back across the field of view and try again. This is important as it takes up any slack (backlash) in the gears of the mount. This significantly improves the mounts pointing and tracking accuracy.

Now lets talk a little about how the focal length of the telescope or camera lens affects the maximum exposure time possible. We will continue to assume that you aren't using a guide scope.

Basically, as the focal length of the telescope or lens increases, the maximum exposure time decreases. Stars in the image will begin to trail if the exposure time is too long. As a rough example you may be limited to a maximum exposure time of 1½-2 minutes with a focal length of 480mm. The exposure time may increase to 3½ minutes with a focal length under 100mm. Your maximum exposure time will vary depending on how accurately the mount is aligned, how accurately it can follow the target and the focal length of your scope or camera lens. There are other factors that affect tracking, but we won't get into them here.

I should also mention the affect of ISO on exposure and noise. ISO on a digital camera isn't the same as ASA on a film camera. Faster films, like ASA 400, have a larger grain which can capture more light per unit time. A digital camera has fixed size pixels that capture light at the same rate no matter what ISO you choose. So

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Fireworks Galaxy (NGC 6946) and nearby star cluster (NGC 6939).
Taken at Inverhuron Prov. Park Aug. 2016.
Equipment: Canon T4i, Explore Scientific 80mm triplet refractor and Celestron AVX mount.
21 frames totalling 36.5 minutes, darks done in camera, no flats.
Credit: Matthew Mannering

when you increase the ISO on your camera you are actually increasing the amplification of the signal from each pixel. The more you amplify the signal, the more noise you incur. For each digital camera there is an optimum ISO where longer exposures overcome signal noise most efficiently. On newer cameras with a maximum ISO of 12800, the optimum ISO for astrophotography is usually 1600 although some can be pushed to 3200 with very little degradation. The optimum ISO on older cameras may be 400 - 800. The best way to cancel out noise in an image is to use the longest exposure possible and get as many frames of the target as time allows. Stacking the frames evens out the noise. This can then be further reduced by other software but that's a whole other topic.

Successful astrophotography boils down to practice, experimentation and determination. Each person needs to learn how their equipment works together as a unit. However, I guarantee the first time you successfully image your favourite deep space object, you will be hooked.

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The Sky This Month for September 2016 (continued)

The Planets

(Rise and set times are given for when the planet reaches 5 degrees above the horizon)

- ***Mercury*** isn't visible in the evening. Look for it low in the east starting on September 21st.
- ***Venus*** is very low in the western sky at dusk.
- ***Mars*** is south moving to south-south-west at dusk during the month. Sets at 11:00pm at the start of the month and by 10:30pm at months end. Be sure to follow Mars as it tracks across the Milky Way in Scorpius and Sagittarius.
- ***Jupiter*** is too close to the Sun in September to view safely.
- ***Saturn*** on *Sept 1st* is south at dusk. Sets at 11:15pm.
  On *Sept 30th* is south west at dusk. Sets at 9:30pm.
- ***Uranus*** on *Sept 1st* rises in the east at 10:30m.
  On *Sept 30th* rises in the east at 8:00pm.
- ***Neptune*** is low in the east to south east at dusk.

Events (highlight events are marked "!!")

-*Sept 1st:* — New Moon.

-*Sept 2nd:* — Neptune at opposition.

-*Sept 6th:* — **!!** Mars 3/4 deg from globular cluster M19 at 8:45pm.

-*Sept 9th:* — First Quarter Moon.

-*Sept 14th:* — **!!** Mars 1/2 deg from globular NGC 6335.

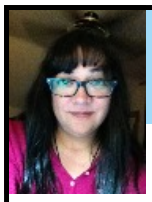
-*Sept 16th:* — Full Moon.

-*Sept 22nd:* — Fall officially begins at 10:21am.

-*Sept 23rd:* — Last Quarter Moon.

-*Sept 28th:* — **!!** Mars 1.5 deg from M8 the Lagoon Nebula at 8:45pm.

-*Sept 29th:* — Zodiacal light visible in the east before morning twilight begins.



AstroCATS Report by Kimberly Andrus

May 21st, 2016, was a pleasant spring day for a drive down to London for the Canadian Astronomy Telescope Show also known as AstroCATS. Many vendors and speakers were available for the admission price of $20 plus free parking. RASC brought in an impressive offering of speakers covering a wide range of topics from astrophysics to astronomical sketching including an appearance by Canadian astronaut Jeremy Hansen.

Jeremy Hansen

Tina Pollmann

David H. Levy

Erika Rix

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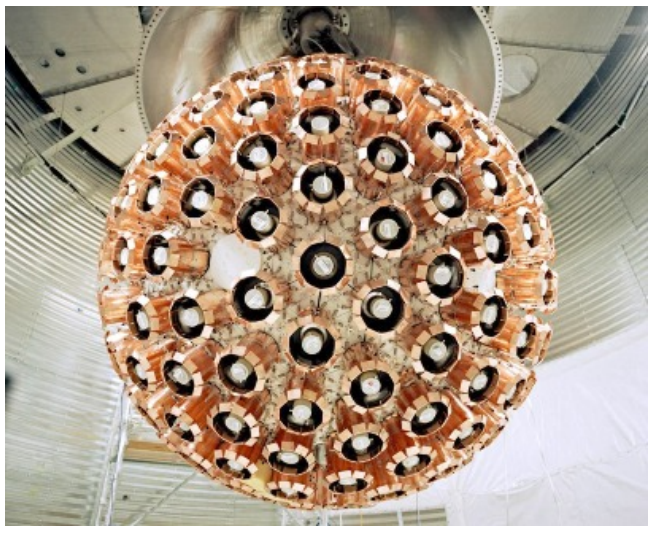
Dark Matter

An interesting presentation by Dr. Tina Pollmann of Laurentian University revealed the specifications of the Dark Matter research project, DEAP-3600, located 2 kms underground at SNOLAB in Sudbury, Ontario. Dr. Pollmann outlined the detailed construction of the particle detector and described its purpose in detecting Weakly Interacting Massive Particles (WIMPs) so that we may begin to understand more of the natural phenomenon in our universe. She outlined the known subatomic particles and deduced how the experiment was designed based on the four fundamental forces of nature. Dr. Pollmann pointed to the weak nuclear force, which is stronger than gravity but only effective at very short distances and how it acts on the subatomic level and plays a crucial role in powering stars and creating elements. It is responsible for much of the natural radiation present in the universe and the DEAP-3600 experiment is searching for evidence that WIMPs exist and can help describe dark matter.



Photomultiplier tubes (PMT) inside the detector

The detector, using photomultiplier tubes, is in a lab situated underground to protect it from radiation; suspended in a three-story water tank to protect it from gravity; and encased in metal with a liquid argon filled chamber and cooled to -188°C. It is constructed to detect scintillation light generated in the argon. This project is about to launch and is one of two projects of its kind in humanity's search to understand more about our universe.

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AstroCATS Report (continued)

Shoemaker-Levy 9

David H. Levy was also present at the show and brought a unique perspective to observing the sky. He is a Canadian astronomer who has become very well known for his publications, comet discovery (Shoemaker-Levy 9), and educational activities. His mixture of lecturing, photography, music, and poetry depicted his love for the universe and passion for astronomy. Mr. Levy delivers a very intimate expression of the desire that consideration of the cosmos evokes in mankind.

Astronomical Sketching

Erika Rix brought an intriguing presentation on astronomical sketching to the group with advice and experience in the craft. She opened a whole new dimension in observation and creativity that provides a depth to the hobby and another manner of documentation. Her description of sketching at the eyepiece provided information that allows the observer to extend the observing time and record more detail. Discussion on different mediums, techniques, and timelines for sketching were part of the presentation and her earliest sketches were shared as well as some recent work.

Ms. Rix described this hobby as relaxing and improving her observing skills. She provided some encouragement to the group emphasizing that it is important to sketch and not be concerned that the outcome be perfect or accurate but rather, that you are observing and recording.

Erika Rix is an astro-sketcher who has written three books on the subject and is a columnist for Astronomy magazine. She lives in Texas with her husband and will soon be teaching an astro-sketching course at the college level.

Treasurer's Report by Steve Germann

Treasurer's report, HAA, June-Aug31, 2016 (Unaudited)

Opening balance:	$8,547.96
Revenue:	$112.00
Expenses:	$162.16
Closing Balance:	$8,497.80

Revenue consisted of 3 memberships, $80; and 50/50 $32.

Expenses were $28.50 for door prizes; $57.19 for meals expenses for our May and June speakers; $9.89 for Perseid night posters; and $76.58 for supplies for the club picnic.

Oh Me, Let's Get Metaphysical by Bruce Pawlett

When did the contemplation of life begin? At what point on our evolutionary path did our cognitive ability allow us to think beyond mere survival and basic social interaction? Fossil records provide some insight with evidence of ceremony especially with respect to end of life. Emotions generated during such traumatic events would certainly stimulate such contemplation. We will never be certain but it is very likely the search for the meaning of life started with one of our hominid ancestors and it will continue as long as human kind exists. This article is really about a song (well perhaps a bit more than that) but The Flammarion engraving below is a beautiful artistic representation of our quest for the knowledge of life and its relevance provides a great introduction.

From Wikipedia:
The Flammarion engraving is by an unknown artist, so named because its first documented appearance is in Camille Flammarion's 1888 book L'atmosphère: météorologie populaire ("The Atmosphere: Popular Meteorology"). It has been used to represent a supposedly medieval cosmology, including a flat earth bounded by a solid and opaque sky and also as a metaphorical illustration of either the scientific or mystical quests for knowledge. The engraving depicts a man, clothed in a long robe and carrying a staff, who kneels down and passes his head, shoulders, and right arm through a gap between the star-studded sky and earth, discovering a marvellous realm of circling clouds, fires and suns beyond the heavens. The caption that accompanies the engraving in Flammarion's book reads: "A missionary of the Middle Ages tells that he had found the point where heaven and earth touch". (The illustration in Flammarion's book is in black and white. Image credit for the shown 1998 colour version goes to Heikenwaelder Hugo, Austria).

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"Oh, Me"

If I had to lose a mile
If I had to touch feelings
I would lose my soul
The way I do

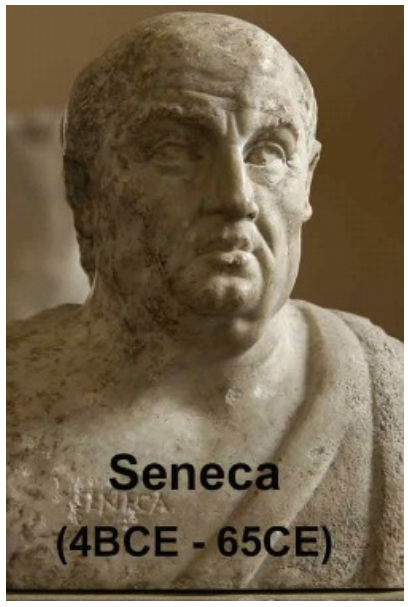
I don't have to think
I only have to do it
The results are always perfect
And that's old news

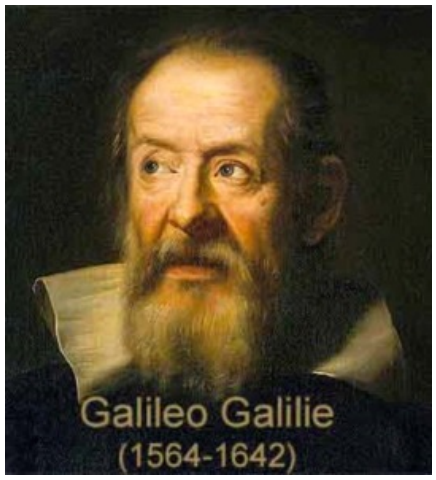
Would you like to hear my voice
Sprinkled with emotion
Invented at your birth?

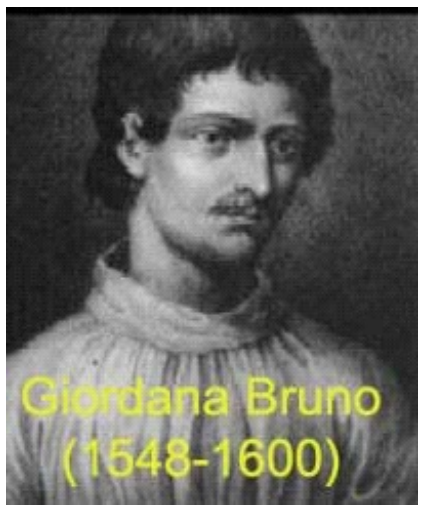
I can't see the end of me
My whole expanse I cannot see
I formulate infinity
Stored deep inside me

Curtis Kirkwood
Meat Puppets

Oh Me, Let's Get Metaphysical (continued)







There is little doubt that cognitive skill of humans far surpasses that of all other creatures on Earth. There is no denying that our scientific endeavours are humbling but our passion for artistic expression although different is equally incredible. I became aware of the above song through its rendition by Kurt Cobain from the Nirvana: MTV Unplugged in New York CD. Although I don't consider this melancholic piece to be a masterpiece I like it because of the beauty of its succinctness on such a deep subject.

I readily admit that my skill level for interpreting songs and poetry and such is not high but I guess my particular knowledge made this one easy for me. I have asked others for their interpretation and most struggled. I believe that Kurtwood is referring to the world viewpoint of 17th century Jewish Dutch Philosopher Baruch Spinoza (1632-1677). Spinoza was a highly intelligent student that was brought up in a very religious environment.

Spinoza was much influenced by the ancient Greek and Roman stoic philosophers. Stoicism is branch of philosophy where it is believed we need to expect and plan for the negative aspects of life. We need to put on a brave face and get on with it knowing that we will eventually get through whatever life throws at us. Expecting and planning is practical in that enables one to reduce those hardships. Spinoza was strongly influenced by the stoic philosopher Seneca, tutor to Emperor Nero. Seneca stayed true to his word and bravely accepted his fate when the brutal emperor commanded him to commit suicide in the presence of his family. Spinoza expressed his worldview in his book "Ethics" published shortly after his death in 1677.

Spinoza insisted that he was a defender of God and God plays an essential role in "Ethics". However, Spinoza's God is impersonal and indistinguishable from nature. "God is the Universe and its laws, God is reason and truth, God is the animating force in everything that is and can be. It is our task to understand why the Universe works the way it does and accept it." According to Spinoza, the best way for us to know God is to "understand how life and the Universe work, through a knowledge of psychology, philosophy and the natural sciences. We should understand what God wants and we can do so in one way above all, by studying everything that is. By reasoning we can exceed to a divine eternal perspective. Spinoza envisaged his philosophy as a route to life based on freedom from guilt, from sorrow, from pity or from shame. Happiness involves aligning our will with that of the Universe." This belief system is called pantheism and is contrasted to panentheism that also associates God with the Universe but with an active presence in the world. It is noted that in Einstein's 1954 letter to Mr. Gutkind, Einstein referenced Spinoza and clarified his alignment to Spinoza naturalism. (Quotations from The School of Life – Baruch Spinoza).

Unfortunately, as can be expected for espousing such radical ideology in this era, at age 23, Spinoza was excommunicated and had horrendous curses cast upon him. Members of the synagogue were forbidden to associate with him. He made an austere living as a lens grinder and died at 45

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Oh Me, Let's Get Metaphysical (continued)

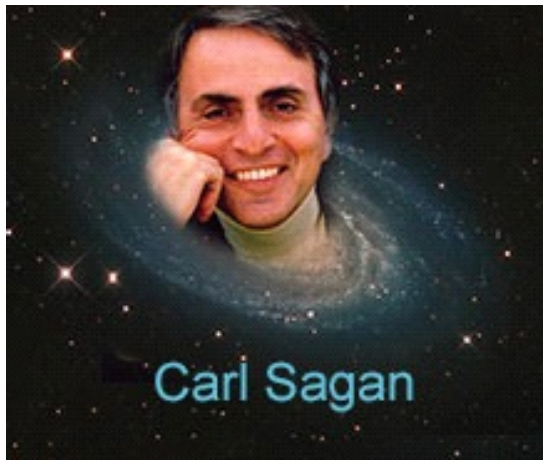
years old from lung disease that may have been exacerbated by the lens grinding. He joins the ranks of the unjustly persecuted along with Galileo who was placed under house arrest for publishing his observational conclusion of the heliocentric solar system and Italian philosopher, astronomer Giordano Bruno who was burned at the stake in 1600 for his heretical beliefs including that the stars were objects like the sun only much further away, perhaps with their own planets.

I know I digress but not without point. Sure there is much variation in the severity of the punishments described above but, essentially they all are cruel and demonstrate man's inhumanity.
Right or wrong everyone should be free to express their point of view as long as they are not promoting hatred, bigotry or somehow purposely intending malevolence and do so without fear of being ostracized or otherwise mistreated. I believe overall that society is making moral progress and remain optimistic that mankind will eventually rise to the humanistic challenges of life on our planet, but man's inhumanity remains a challenge. We all need the wisdom and courage to do our part not only to be kind to others but also, to stand up to group dynamics that may lead to cruelty.

Anyway, finally let's get to the interpretation of the song. The last stanza is a very obvious reference to our Universe. The first two stanzas reference the pantheistic ideology or naturalism where the Universe and God are one and the same. Our Universe is God and God is our Universe with the operating mode the natural laws. Our Universe progresses without flaw based on those natural principles. The first stanza indicates that an interaction outside those laws (as in a panentheistic ideology where a God has personal interaction with our Universe's creations) would detract from the flawlessness and interfere with its natural progress. Our Universe would lose its essence, its soul if it had to deal with feelings. The second stanza emphasizes the permanence or eternity of perfection achieved with undistracted naturalism.

The third stanza is a reference to man's invention of the panentheistic ideology. Our Universe just is but the birth (evolution) of Homo sapiens a species that invoked the need for interaction with a personal God. Surely, we would like to hear God's voice with sweet emotion in answer to our questions and prayers.

The last stanza "I can't see the end of me…. My whole expanse I cannot see…. I formulate infinity…. Stored deep inside me" placement at the end is significant. Our Universe will not become flawed and lose its essence to placate a perhaps significant but needy life form because in the grand scheme of our Universe humans are in reality, insignificant…. lost and unseen in the infinite expanse.



A nice touch is the inherent paradox of the composition. Although the lyrics proffer an impersonal pantheistic Universe, it is done through the personification of our Universe. The last stanza reminds me of the famous excerpt from Carl Sagan's book "Pale Blue Dot" that was inspired by the image of Earth taken by the Voyager spacecraft on February 14, 1990 when it was 6 billion km into its journey.

"Look again at that dot. That's here. That's home. That's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every corrupt politician, every "superstar," every "supreme leader," every saint and sinner in the history of our species lived there--on a mote of dust suspended in a sunbeam.

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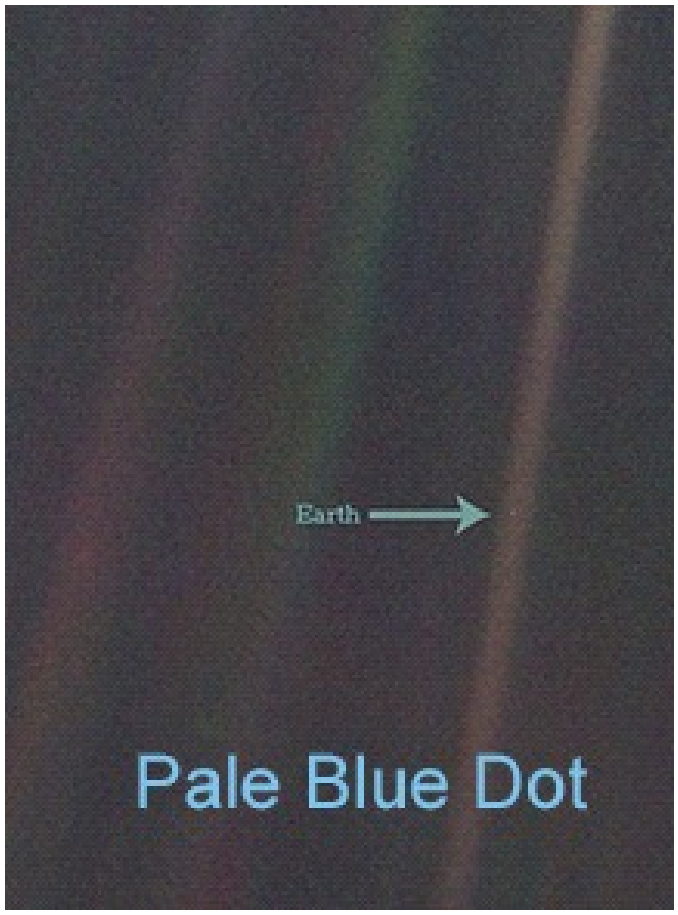
Oh Me, Let's Get Metaphysical (continued)



The Earth is a very small stage in a vast cosmic arena. Think of the rivers of blood spilled by all those generals and emperors so that, in glory and triumph, they could become the momentary masters of a fraction of a dot. Think of the endless cruelties visited by the inhabitants of one corner of this pixel on the scarcely distinguishable inhabitants of some other corner, how frequent their misunderstandings, how eager they are to kill one another, how fervent their hatreds.

Our posturings, our imagined self-importance, the delusion that we have some privileged position in the Universe, are challenged by this point of pale light. Our planet is a lonely speck in the great enveloping cosmic dark. In our obscurity, in all this vastness, there is no hint that help will come from elsewhere to save us from ourselves.

The Earth is the only world known so far to harbor life. There is nowhere else, at least in the near future, to which our species could migrate. Visit, yes. Settle, not yet. Like it or not, for the moment the Earth is where we make our stand.

It has been said that astronomy is a humbling and character-building experience. There is perhaps no better demonstration of the folly of human conceits than this distant image of our tiny world. ***To me, it underscores our responsibility to deal more kindly with one another, and to preserve and cherish the pale blue dot, the only home we've ever known."***

-- Carl Sagan, Pale Blue Dot, 1994 (Note: for full impact, recommend watching YouTube version with Carl Sagan narrating to related visual images).

The emphasis on the last sentence is mine. No matter what your belief system it cannot be denied that we are inextricably tied to the ecosystem of our planet. Perhaps we are the most intelligent life form and are superior in our knowledge of our Universe and its natural laws, but of all the creatures on this planet we are the most out of touch with nature. Nature is filled with awe-inspiring beauty but also has its unforgiving but necessary brutal mechanisms. Similarly, humanity is filled with awe-inspiring creativity in art, music, literature, science and engineering. However, in spite of the phenomenal enabling of our intellect that should allow us to transcend the remnants of our inhumanity, we still annihilate masses of our own kind over petty differences in philosophic opinion, greed and desire for power; our success demands a heavy toll on Earth's ecosystem and the creatures with which we share this planet.

We have the cognitive capacity and now the knowledge; all we need is the wisdom, the courage and the will to accept our differences and collectively as the human race save ourselves from ourselves. As is everything, we are also subject to the formidable forces of nature that are of such strength its triumph is assured with absolute certainty. Earth will survive us but will we? That is for us to decide.

Peace

This article is provided by NASA Space Place.

With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology.

Visit spaceplace.nasa.gov to explore space and Earth science!

Is there a super-Earth in the Solar System out beyond Neptune?

By Ethan Siegel

When the advent of large telescopes brought us the discoveries of Uranus and then Neptune, they also brought the great hope of a Solar System even richer in terms of large, massive worlds. While the asteroid belt and the Kuiper belt were each found to possess a large number of substantial icy-and-rocky worlds, none of them approached even Earth in size or mass, much less the true giant worlds. Meanwhile, all-sky infrared surveys, sensitive to red dwarfs, brown dwarfs and Jupiter-mass gas giants, were unable to detect anything new that was closer than Proxima Centauri. At the same time, Kepler taught us that super-Earths, planets between Earth and Neptune in size, were the galaxy's most common, despite our Solar System having none.

The discovery of Sedna in 2003 turned out to be even more groundbreaking than astronomers realized. Although many Trans-Neptunian Objects (TNOs) were discovered beginning in the 1990s, Sedna had properties all the others didn't. With an extremely eccentric orbit and an aphelion taking it farther from the Sun than any other world known at the time, it represented our first glimpse of the hypothetical Oort cloud: a spherical distribution of bodies ranging from hundreds to tens of thousands of A.U. from the Sun. Since the discovery of Sedna, five other long-period, very eccentric TNOs were found prior to 2016 as well. While you'd expect their orbital parameters to be

(Continued on page 15)

randomly distributed if they occurred by chance, their orbital orientations with respect to the Sun are clustered extremely narrowly: with less than a 1-in-10,000 chance of such an effect appearing randomly.

Whenever we see a new phenomenon with a surprisingly non-random appearance, our scientific intuition calls out for a physical explanation. Astronomers Konstantin Batygin and Mike Brown provided a compelling possibility earlier this year: perhaps a massive perturbing body very distant from the Sun provided the gravitational "kick" to hurl these objects towards the Sun. A single addition to the Solar System would explain the orbits of all of these long-period TNOs, a planet about 10 times the mass of Earth approximately 200 A.U. from the Sun, referred to as Planet Nine. More Sedna-like TNOs with similarly aligned orbits are predicted, and since January of 2016, another was found, with its orbit aligning perfectly with these predictions.

Ten meter class telescopes like Keck and Subaru, plus NASA's NEOWISE mission, are currently searching for this hypothetical, massive world. If it exists, it invites the question of its origin: did it form along with our Solar System, or was it captured from another star's vicinity much more recently? Regardless, if Batygin and Brown are right and this object is real, our Solar System may contain a super-Earth after all.

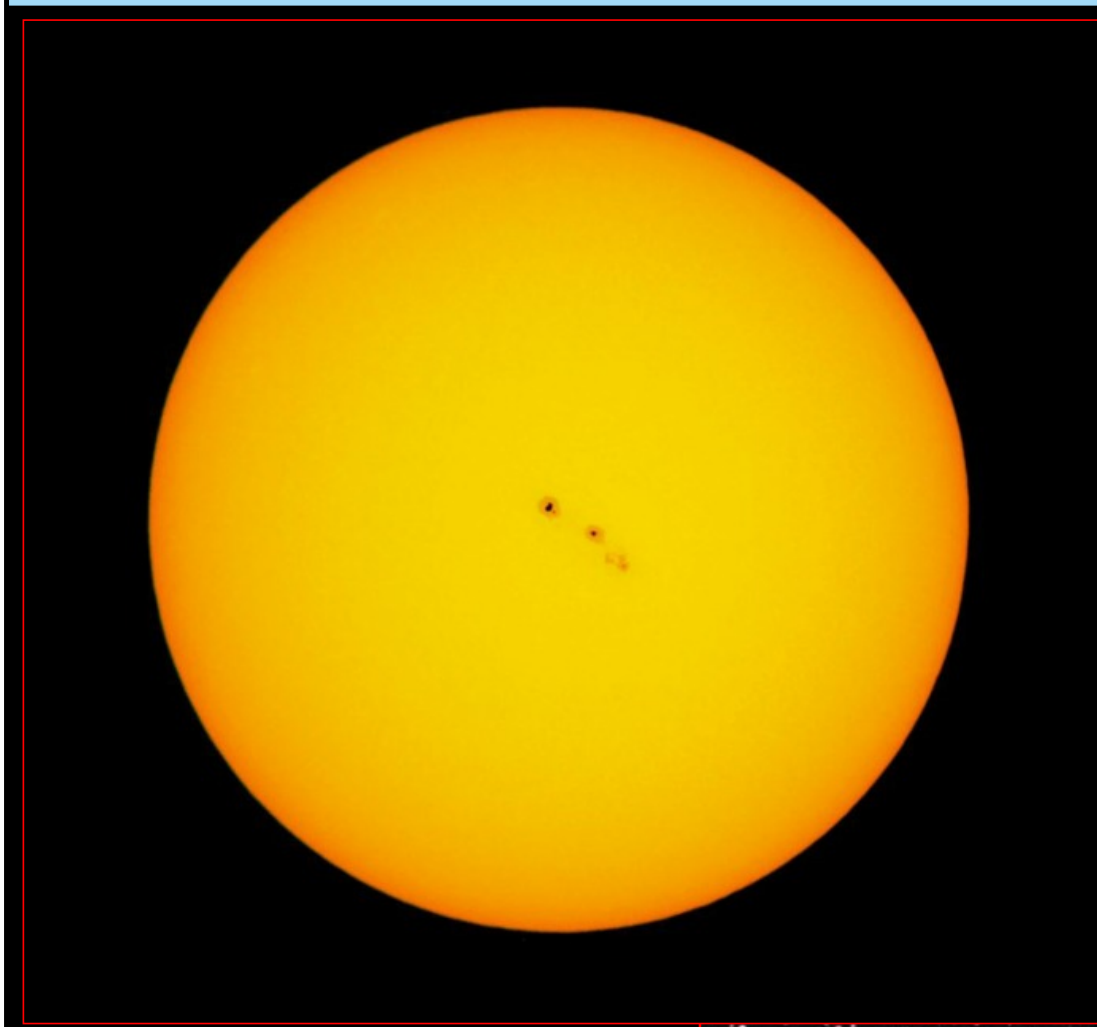
A possible super-Earth/mini-Neptune world hundreds of times more distant than Earth is from the Sun. Image credit: R. Hurt / Caltech (IPAC)

Eye Candy the Members' Image Gallery

The Dumbbell Nebula (M27), August 2016, by **Matthew Mannering**
Canon T4i DSLR through an 80mm triplet refracting scope, tracked on a VXQ mount.

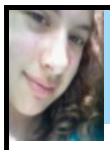
The Lagoon Nebula (M8) and, above it, the Trifid Nebula (M20), August 2016, by **Janice Mannering**
Canon T5 DSLR with 18-135mm zoom lens, tracked on an ioptron mount.

Eye Candy the Members' Image Gallery



The Sun, with sunspots, July 2016,
by **Jim Wamsley**

Comet 252P/LINEAR in Ophiuchus, May 2016,
by **Bob Christmas**
Canon 40D DSLR through a Tamron 300mm f/2.8 lens, tracked on an SP EQ mount.



Cartoon Corner by Alexandra Tekatch

"The Earth's rotation makes my day!"

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UPCOMING EVENTS

September 9, 2016 - 7:30 pm — *HAA Meeting* at the Hamilton Spectator Auditorium. Our main speaker will be long-time H.A.A. member **John Gauvreau**. His talk is entitled, "A Moment in Time; Visiting Galileo's Classroom".

October 14, 2016 - 7:30 pm — *Annual General Meeting* at the Hamilton Spectator Auditorium.

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