The Observer

The Official Publication of the Lehigh Valley Amateur Astronomical Society
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Volume 60 Issue 04

ad astra **********

Most of the time, I revel in the thought that we're living in a science fiction movie. I carry an electronic device in my pocket that is probably about 1,000 times more powerful than anything I thought, as a kid, I would ever see in my lifetime. We have a technology wizard running an amazing company that builds rockets that fly home and land automatically. That guy has got plans to colonize Mars that would seem ridiculous, but for the other ridiculous things he's already accomplished. (And yes, he's polluting our dark night sky with satellites that promise to bring the wonders of the global network to all of the currently-excluded remote citizens of the planet, but at potentially great cost to our hobby.)

That device in my pocket is constantly connected to that global network, enabling me to effortlessly and instantly obtain almost any piece of information conceivable. Another amazing company can cause almost any physical product I can imagine to appear on my front porch a day or two after I wish it.

At least it could, up until about a week ago. I'm writing this on March 24, and now we are living in the wrong science fiction movie. I'm not going to write too much about COVID-19, because there is too much I don't understand about this rapidly-changing situation. Whatever I write will be out of date by the time you read it.

Though there is a lot of debate about various aspects of the science, I'm making decisions for myself and for LVAAS based on a fairly simple and undeniable equation: people are scared, and many of us have been told to isolate ourselves at home, for our own safety and for the safety of our community. But it is still necessary for many of us to leave our homes and go to work: our doctors and nurses, our police and firemen, our truck drivers and grocery store clerks. We that can stay safe at home owe our thanks to the ones who must go out, but the most important thing we owe them is to do what we can to make them a little more safe, and a little less scared. And the biggest element of that is for us to just stay home.

Cool SF versus Nasty SF

So far, the Internet seems to be holding up under the strain of everyone's isolation and boredom, thanks to another cadre of essential workers. I hope that continues. At LVAAS, we are going to take advantage of it by attempting to have some on-line versions of our activities.

By the time you read this, we will have attempted our first electronic Board meeting. A few of us have already done a couple of test runs, so we will see how many of us can succeed in logging in to an Internet meeting room using our computers and phones, to take care of the club's business. Then we'll see if we can manage to have a membership meeting and maybe something like a Star Party on-line.

Meanwhile, we need to carry on as best we can. I know I have an easier time than most, since I love all of my little engineering projects and don't mind the solitude. If I could get somebody to keep bringing essentials to my front door, I could probably stay inside for a year and not be bothered by it. I know not everybody is like that.

And it is impossible to overstate: we need the people to keep those essential supplies flowing, to keep on keeping the peace and caring for our ill. Thank You to all of those heroes, and I will keep doing whatever I can for you.

Ad Astra!

— Rich Hogg

LVAAS General Meeting - Online!

Sunday, April 5, 7:00 p.m.

* check your email for sign in details *

"Observing from the Southern Hemisphere"

presented by

Peter Detterline

Peter is an avid astronomer whose interests cover a wide range of the astronomical spectrum. For thirty-five years he was the Director of the Boyertown Planetarium, where he gave programs to over half a million people. He is a recipient of the Thomas Brennan award from the Astronomical Society of the Pacific for exceptional achievement related to teaching high school astronomy. He currently teaches a hybrid astronomy course at Montgomery County Community College, and online courses at Moravian College and Montana State University. In research he has coauthored numerous papers on eclipsing binaries and contributes data to various organizations. He is the Observatory Director for the Mars Society where he heads up an Astronomy Team providing a solar and a robotic telescope for their members at the Mars Desert Research Station in Utah. He also provides training for a robotic telescope in New Mexico as the Lead Astronomer for the Montana Learning Center. Both robotic telescopes are used remotely by students around the world. Peter was selected to be part of the “Astronomy in Chile Educator Ambassador Program”, where he visited the largest American observatories in that country. As an amateur astronomer he has traveled the globe to view solar eclipses, built his own observatory, and has completed many observing programs including the Astronomical League’s “Master Observer”. He is a life member of LVAAS. pdetterline@gmail.com

Equipment For Sale

I have a strong water tight Pelican 1660 case which has never been used except as a stool.

- **17 inches deep, 28 inches long and 20.5 inches wide. Customizable foam fills the case.**
- **Ideal for some short tube scopes.**
- **Very reasonable price.**

Contact: Terry Pundiak (terrypun@mac.com)

UACNJ Reminder

LVAAS is a member organization of the **United Astronomy Clubs of New Jersey**, which means that LVAAS members may acquire observing privileges at the UACNJ observatories at **Jenny Jump State Park**, near Hope, NJ. There is a fee of $50.00 per year, plus a commitment to assist at UACNJ Public Nights. Normally, this commitment is for five Public Nights during the year, but it has been reduced to four this year, due to the shortened observing season. The 2020 Observer Form can be found on their website: http://www.uacnj.org/observers/2020ObserverForm.pdf.

Also check out the **Meteor Shower Calendar** courtesy of Ken Taylor of UACNJ and thrillist: https://www.thrillist.com/news/nation/meteor-shower-calendar

COVER IMAGE: **IC 5146 – The Cocoon Nebula in Cygnus,** 2015 image. David Moll and Michael L. Morgan combined preprocessed data from observing sites in Pennsylvania and New Jersey to make this deep image of "*a cluster of 9.5 mag stars involved in a bright and dark nebula*" (IGC description). Michael L. Morgan final processing. Copyright 2015 Michael L. Morgan and David Moll.

ASTRONOMY EQUIPMENT FOR SALE

I am continuing to draw down equipment that is left over from my astroimaging adventures. I still have the following equipment for sale, most of it like new, at a substantial reduction from the original cost.

For inquiries or to express interest, please contact me by e-mail at polaris41n@outlook.com

Dave Moll

	ORIGINALLY	YOUR PRICE
Celestron 9.25 Schmidt-Cass (not Edge), OPTICAL TUBE ONLY, like new, with T-adapter, 2" diagonal, f6.3 reducer/corrector, Borg SCT thread 2" filter cell, both Vixen and Losmandy bottom rails, ADM Vixen top rail, flexible dew shield. -Requires suitable mount-	$1,835.00	**$1,300.00**
12" Vixen rail, male-to-male adapter	$39.00	**$20.00**
Telrad finder with Vixen shoe	$36.00	**$20.00**
T-adapter for Celestron Edge HD 9.25/11/14	$58.00	**$30.00**
Chesire collimator, 1.25"	$40.00	**$20.00**
Orion Lasermate collimator, 1.25"	$50.00	**$25.00**
Astronomik CLS CCD imaging LP filter, 1.25"	$100.00	**$50.00**
Neewer moon filter, 13% T, 2" dia.	$17.00	**$10.00**
Uranoport "piggyback" 1.5X Barlow (mounts like a 1.25" filter)	$75.00	**$40.00**
SCT counterweight, 4 pounds, mounts on front end of Losmandy mounting rail, counterbalance for imaging train	$65.00	**$35.00**
3 ea. add-on counterweights, 1 pound each, screw into a drilled & tapped toe saver, and/or into each other (piggyback)	$25.00/ea	**$15.00/ea**
ADM Vixen rail camera mount (1/4X20 tripod screw)	$55.00	**$30.00**
10" diameter Astrozap heated dew shield, slight crack on stitching line, perfectly operational	$82.00	**$40.00**
3 ea. Tube adapters, purpose unknown	?	**FREE**
Also: Huge selection of electrical cables, etc: All cables & adapters $2 each, power supplies $5 each		

Minutes for the LVAAS General Meeting - March 8, 2020

The March 2020 LVAAS General Meeting was held at 2:00 p.m. on Sunday, March 8, at Trumbower Hall, Muhlenberg College in Allentown PA. Approximately 45 people were in attendance. Treasurer Scott Fowler opened the meeting at 2:00 p.m.

Programs Director Sandy Mesics introduced the guest speaker, Steve Miller, who is a lover of all things outdoors. His passions include mountain biking, hiking, camping, trail building and photography. He especially loves to experience and photograph dark night skies. Steve is an equipment specialist, staff trainer and photography instructor at Dan's Camera City. He has been with Dan's since 2004. Steve has led several photography workshops including waterfalls, birds in flight and, of course, night sky photography.

Steve's talk was titled Memories of Dark Sky Places. His presentation was a series of single frame, unguided (mostly) images of both daytime and nighttime skies. The images were taken at several remote dark sites including: Pisgah National Forest in North Carolina, Northeast Kingdom of Vermont, Pennsylvania Wilds, Monongahela National Forest in West Virginia, and Yellowstone and Grand Teton National Parks. The nighttime images showcased images of stars, the moon and the Milky Way. Steve mentioned that there is going to be a workshop offered by Dan's on Thursday, August 6th and on Friday, August 14th there will be a photo shoot at Hickory Run State Park.

After the presentation concluded, several questions were asked regarding photography equipment and how the images were taken. There was a brief intermission and the meeting moved to LVAAS business:

Meetings:

Tom Duff - There is an **Astroimaging** meeting on Thursday, March 12 at South Mountain. The topic will be Astroimaging Software. If you are interested in Astroimaging updates, please ask to be added to the Astroimaging e-mail listing.

The next **Board of Governors** meeting is on Sunday, March 29 at South Mountain.

Treasurers Report: (Scott Fowler)

Income was $8,460 and expenses were $3,965. $5,700 was from dues and $1,390 was from donations.

Donations can be made directly at **meetings,** through the **United Way** and also via **Amazon Smiles**. Funding will be required for the roof at South Mountain. The shingled roof over the Red Shift will also need to be replaced.

Membership: (Gwyn Fowler)

2nd Readings:

Jeff Lovaasen

Becca Lamar

1st Readings:

Randy Plessor

Varsha Borkar

Daniel Floryshak

Star Parties: (Carol Kiely)

The first Star Party of 2020 was held on Saturday, March 7th. Attendance was down, but the skies were clear. Observations included Venus, the moon, the Orion nebula, and several star clusters. The next Star Party will be on Saturday, April 4th. Pete Detterline will talk about observing from the southern hemisphere. There is always a need for volunteers to assist with the Star Parties. Volunteers are needed to operate the telescopes, work the door and coordinate parking. Speakers are also needed to do 40-minute talks.

LVAAS Book Club: (Blaine Easterwood)

Blaine is continuing his work on the LVAAS Book Club. He is presently working on Facebook and e-mail options. The first books being considered are The Big Picture, On the Origins of Life, Meaning, and the Universe Itself by Sean Carroll. If you are interested, contact Blaine.

40" Update: (Frank Lyter)

Frank gave an update on the 40". The framework is being worked on for the mirror as well as painting and putting everything back together now that spring is nearly here and Pulpit Rock is accessible thanks to a very mild winter.

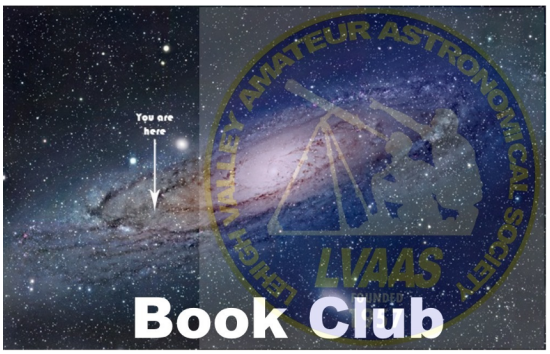
A question was raised about keys and scopes. Key costs and requirements for getting keys and access to scopes were explained.

Next General Meeting:

The next General meeting is planned for Sunday, April 5th at 7:00 p.m. at South Mountain. A question was raised about having the General meeting time moved to 2:00 p.m. all year 'round. Discussion was made about having a survey to determine the interest in changing the General Meeting time.

The meeting was adjourned at approximately 3:50 p.m.

Submitted by Dennis Decker, Secretary



Looking for something to read? Looking to share the experience with fellow LVAAS members? Join our book club!

Here's the Plan:

Step One: Express your interest. If you are interested, let me know either in person, or via email: blaine@ieee.org. I will add you to our private Facebook group. If you don't have Facebook, let me know, we can setup an email list and communicate that way too.

Step Two: Choose a book. We will do this via our private Facebook group and email (if there are any who do not use Facebook.) So far the following are in the running:

1. The Big Picture, by Sean Carroll
2. Astrophysics for People in a Hurry, by Neil deGrasse Tyson
3. Moonshot: What Landing a Man on the Moon Teaches Us About Collaboration, Creativity, and the Mind-set for Success, by Richard Wiseman
4. The Trouble with Gravity: Solving the Mystery Beneath Our Feet

Step Three: Set the meeting schedule. Our plan is to meet in the library, but we can augment that with online conversations.

Step Four: Read, enjoy, discuss, and learn! We can do this both in-person and through online discussions.

This is the first time we are doing this, so I consider it "experimental." I am completely open to suggestions and changes as we go.

Thank you!

Blaine Easterwood, Education Director

Exciting, New, Live-Action Game!!!

RED SHIFT REVENUE

- **Operate an Astronomy Club Gift Shop!**
- **Optimize product lines!**
- **Purchase inventory!**
- **Manage production!**
- **Complete sales!**
- **Report revenue and expenses to the Board!**
- **Help a great organization do a valuable public service!**

As our LVAAS Member Services Director, you will enjoy the challenge of operating the Red Shift Gift/Snack Shop at LVAAS Public Star Parties.

The only way to lose is to not play!

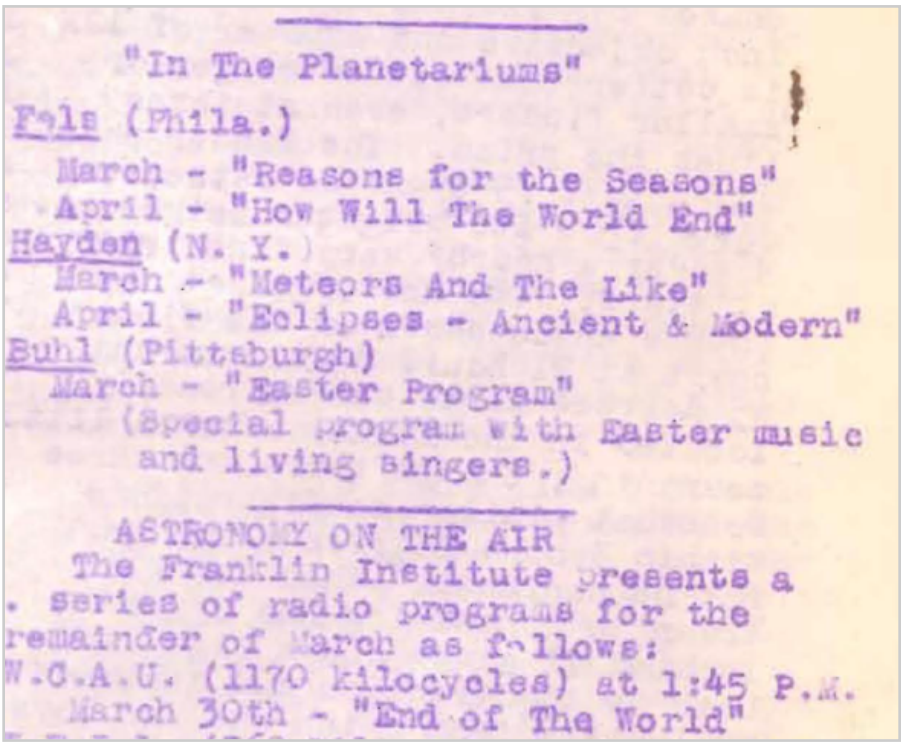
Contact *director@lvaas.org* to sign up!

From the LVAAS Archives:

A Bad Idea from the Franklin Institute

by Sandy Mesics

In the March 1940 LVAS Bulletin, there were a couple of small columns on the last page that seemed unrelated, but the combination of these two items ended up causing a bit of a fiasco.



"In The Planetariums"

Fels (Phila.)
March - "Reasons for the Seasons"
April - "How Will The World End"
Hayden (N. Y.)
March - "Meteors And The Like"
April - "Eclipses - Ancient & Modern"
Buhl (Pittsburgh)
March - "Easter Program"
(Special program with Easter music and living singers.)

ASTRONOMY ON THE AIR
The Franklin Institute presents a series of radio programs for the remainder of March as follows:
W.C.A.U. (1170 kilocycles) at 1:45 P.M.
March 30th - "End of The World"

The first column was titled “In the Planetariums.” This column covered the current and upcoming planetarium programs that were scheduled to be presented in the local planetariums, namely the Fels in Philadelphia, the Hayden in New York, and the Buhl in Pittsburgh. The column mentioned that the April 1940 planetarium program at the Fels Planetarium would be “How Will the World End.”

The other column was titled “Astronomy on the Air,” which covered astronomy-related radio programs airing in the upcoming month. The column mentioned that the Franklin Institute would present a program on March 30, 1940 at 1:45 p.m. on W.C.A.U. (1170 kilocycles) titled “The End of the World.” WCAU actually broadcast on 1210 kHz at that time, and KYW Philadelphia was broadcasting at 1020 kHz.

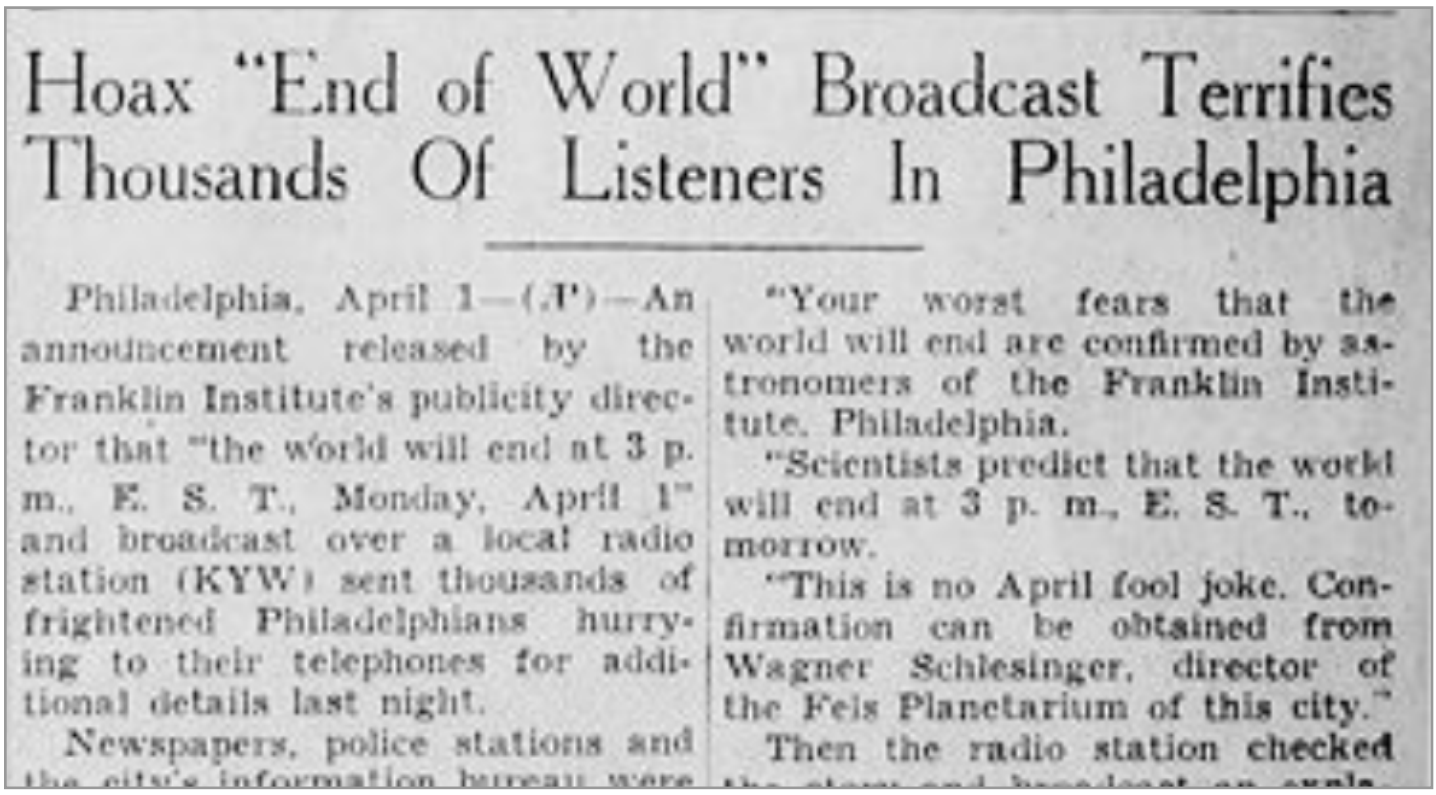
While the exact details differ from what was reported in the LVAS Bulletin, these two events converged into one of the worst April fool's jokes ever foisted on the public. On March 31, 1940, during the weekly Jack Benny Jello Program, Jack had an imaginary comedic phone conversation with Orson Welles about Welles’ purported responsibility for the current sunspots that Jack said had disrupted radio transmissions over the previous weeks and could destroy the Earth. Remember, it was Orson Welles who had been responsible for the notorious War of the Worlds Panic Broadcast of 1938.

In what could only be described as horrible timing, after the Jack Benny program, KYW radio broadcast an announcement that Franklin Institute astronomers had confirmed that the world would end at 3 p.m. the next day. KYW's broadcast alerted listeners that "This is no April Fool joke." The announcement read as follows:

> "Your worst fears that the world will end are confirmed by astronomers of Franklin Institute, Philadelphia. Scientists predict that the world will end at 3 P.M. Eastern Standard Time tomorrow. This is no April Fool joke. Confirmation can be obtained from Wagner Schlesinger, director of the Fels Planetarium of this city."

Of course, it was a joke, and a bad publicity stunt as well.

Needless to say, the public's reaction to KYW's announcement was dramatic. Newspapers, police stations and the city's information bureau received hundreds of calls from frightened citizens. Philadelphia's information bureau estimated it handled 4,000 calls itself.



Hoax "End of World" Broadcast Terrifies Thousands Of Listeners In Philadelphia

Philadelphia, April 1—(AP)—An announcement released by the Franklin Institute's publicity director that "the world will end at 3 p. m., E. S. T., Monday, April 1" and broadcast over a local radio station (KYW) sent thousands of frightened Philadelphians hurrying to their telephones for additional details last night.

Newspapers, police stations and the city's information bureau were

"Your worst fears that the world will end are confirmed by astronomers of the Franklin Institute, Philadelphia.

"Scientists predict that the world will end at 3 p. m., E. S. T., tomorrow.

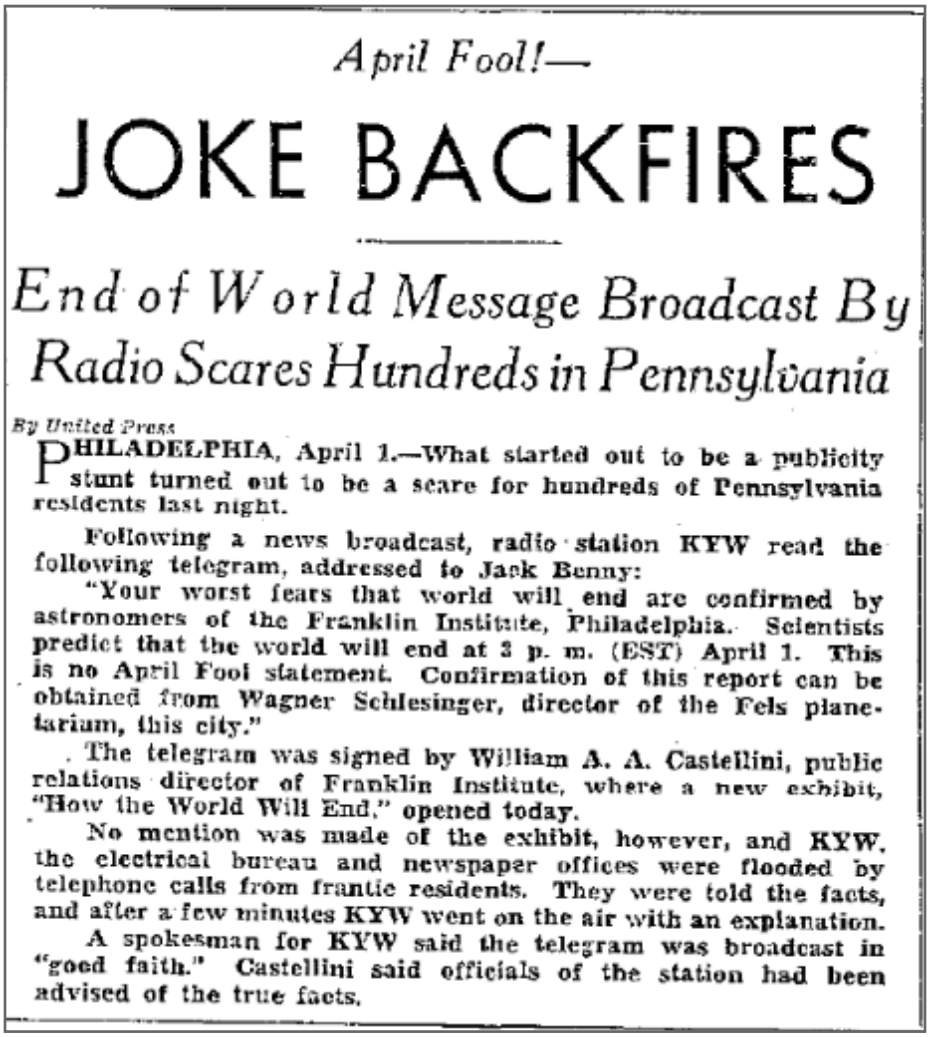
"This is no April fool joke. Confirmation can be obtained from Wagner Schlesinger, director of the Fels Planetarium of this city."

Then the radio station checked

Benny and his writers chose to ignore the whole thing. There was no reference to the stupid scam on the following week's broadcast.

KYW later issued an apology and an explanation. The announcement was, of course, false, but the station denied responsibility for it. It said that it had received the announcement from William Castellini, press agent for the Franklin Institute and had read it in good faith, believing it to be genuine. However, Castellini had intended it as a publicity stunt to publicize an April 1st lecture at the planetarium titled "How Will the World End?"

Castellini later explained that he had come up with the idea for the stunt after hearing Benny's program and thinking it a good chance to get some publicity for the planetarium. He claimed, in his own defense, that he had told "some of the people" at the radio station about the announcement and "thought they would know it was a stunt."



April Fool!—

JOKE BACKFIRES

End of World Message Broadcast By Radio Scares Hundreds in Pennsylvania

By United Press

PHILADELPHIA, April 1.—What started out to be a publicity stunt turned out to be a scare for hundreds of Pennsylvania residents last night.

Following a news broadcast, radio station KYW read the following telegram, addressed to Jack Benny:

"Your worst fears that world will end are confirmed by astronomers of the Franklin Institute, Philadelphia. Scientists predict that the world will end at 3 p. m. (EST) April 1. This is no April Fool statement. Confirmation of this report can be obtained from Wagner Schlesinger, director of the Fels planetarium, this city."

The telegram was signed by William A. A. Castellini, public relations director of Franklin Institute, where a new exhibit, "How the World Will End," opened today.

No mention was made of the exhibit, however, and KYW, the electrical bureau and newspaper offices were flooded by telephone calls from frantic residents. They were told the facts, and after a few minutes KYW went on the air with an explanation.

A spokesman for KYW said the telegram was broadcast in "good faith." Castellini said officials of the station had been advised of the true facts.

Soon afterwards, the Franklin Institute dismissed Castellini. [Oakland Tribune, Apr 1 1940; The Washington Post, Apr 2, 1940.]

Castellini also sent the same press release telegrams to Philadelphia newspapers, but these were coupled with an explanation that the whole thing was mere press agentry.

References:

https://io9.gizmodo.com/in-1940-the-franklin-institute-announced-armageddon-as-5899294

http://hoaxes.org/af_database/permalink/world_to_end_tomorrow

https://tralfaz.blogspot.com/2012/04/jack-bennys-not-april-fool.html

Schlegel Observatory Report

by Rich Hogg – April 2020

Last month, I presented a proposed design for a central hub system to support the main mirror in the radial direction. I received very few comments on it in response to the column, and I do appreciate the responses I got! There was a more involved discussion among a "core group" of machinist-types who I sent it to, before the newsletter came out.

Nobody convinced me that the design was unworkable, and we did not come up with any major ideas to improve it. Just a few tweaks. This is a disappointment, because to be honest, I'm still not really happy with it.

What's bothering me most right now is contamination; just basic dirt. Dead bugs, little flakes of whatever, getting in between the support pads and the mirror, or otherwise gumming up the works. The problem is, the whole thing needs to be put together and stuffed into that hole, and mostly sealed up where it will be next-to-impossible to inspect it, clean it, or adjust it. The seal cannot be complete because it needs to move a little bit, but all the parts will be inaccessible without a major tear down, which would involve working close to the delicate, polished surface of the mirror.

Bottom line, my comfort level is low enough that I decided to go back and look at the alternative, supporting the mirror from the outside rim, with mechanical elements that we can easily get at.

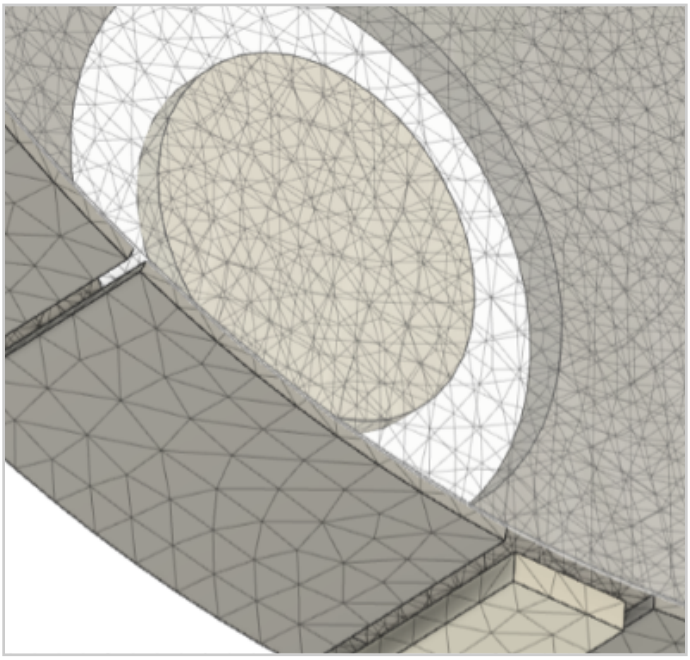
Relative merits - the hub support idea was inviting because it seemed it might be easier to build, and cost less, than the rim support. Also, the deformation simulations that I did seemed to show that it would perform better. Now, realizing that the "difficulty" advantage might have been an illusion, and prepared to accept the additional cost, I decided we need to quantify the performance difference. So, I've been working on simulating the optical effect of the predicted distortion from a hub support system. I'm using mechanical design software (Autodesk Fusion 360) to simulate how much the mirror will bend, and I'm going to feed those results into an optical design program (BEAM4) to see how much that bending will effect the image.

I was hoping to get some early results from this in time for the newsletter, and so I pushed really hard for it.

I thought I was there, but then I ran into a major problem at the last step. And, our editor is tapping her fingers, eagerly waiting for my submission (and I need to come up for air anyway.) So, I'm going to report on what I've been able to accomplish so far, with a couple of cool pictures, and then go catch up on picking up after myself.

Mechanical simulations **-** the first part of the problem is to simulate how much the glass will deform, and in what fashion, under the influence of gravity and depending on how it is supported. We have some numbers for the essential properties of the glass, published by Schott AG, the manufacturer. It has a density of 2,230 kilograms per cubic meter, and a Young's Modulus of 63 gigapascals (GPa). The latter figure reveals how much the glass will bend in response to applied force.

Calculating this bending is relatively straightforward for a long, thin rod supported in a simple fashion, but not so for a thick doughnut supported by a complex system that is trying its best to minimize the distortion. Doing the math directly becomes impossible. The accepted workaround is a technique known as FEA, or "finite-element analysis."



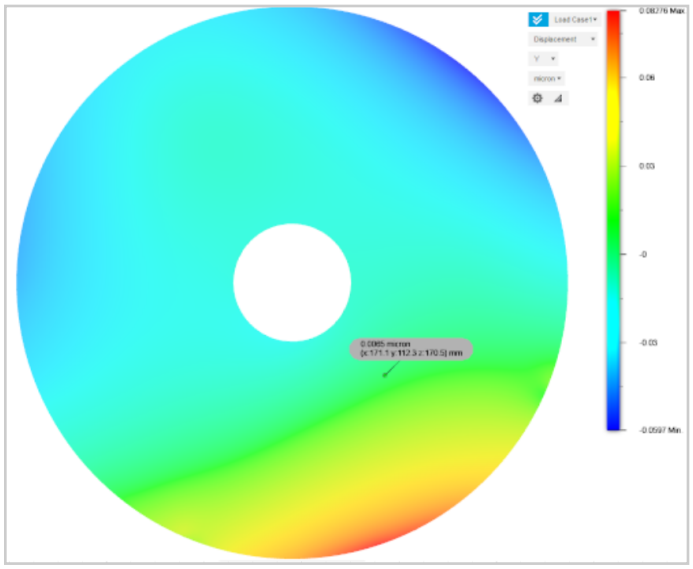
The idea of FEA is that you can exactly calculate the response of a small, simply-shaped Finite Element of the material. And, assuming that each Element responds independently of its neighbors (except for the forces they exert on each other,) you can build a big system of equations that will approximate how the whole thing performs. Here we have a detail of part of our main mirror, along with some of the support elements, in a model consisting of 199,598 tetrahedral elements. It's not the kind of thing you want to mess with, lacking a computer.

Fusion 360 makes it easy to set up and run FEA simulations. It generated the mesh in this image. The only problem is that it does not allow you to export the distortion, or strain field, so there is no way to bring the data into an optical simulation.

I looked at a bunch of alternatives. A few years ago, I used an open-source program called Calculix to do some preliminary FEA on the 40-inch mirror, and it still seems to be the best option other than Fusion 360. The only problem is that I had trouble getting it running on either my Windows laptop or my Linux system, which is a few years out of date. (I am waiting for the next Long-Term Support release of Ubuntu to come out next month to update it.) I could have powered through and got Calculix running, but I just didn't have the heart for it.

Instead, I decided it would be fun to explore ways of getting the data out of Fusion 360. I determined that I could easily write code to control the mouse and capture screen shots in Python, and the first idea

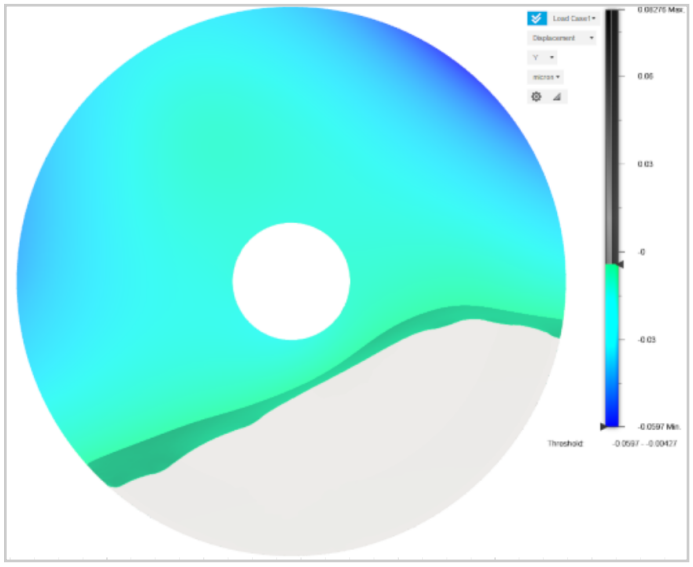
was to use the "Point Probe" feature to pick off the data, one pixel at a time, using Optical Character Recognition to convert the pixels in the screenshot of the probe readout (see image at right.) I spent a couple of days hacking on this, and got it sort of working, almost reliably enough. Then I realized that reading out all of those individual points would be incredibly slow. Too slow.



Note: this result is from a simulation where the telescope is pointed low, and there is a hard support at about the 7:00 position, and 4:00. The rim airbags in between are taking a lot of the weight, but the distribution isn't perfect so the result is slightly lop-sided.

I thought about just capturing a single screen shot, and converting the colors back to numbers using the scale on the right side of the screen. A bit of checking showed the problem with this: the program smooths out the color chart a little too much, so that it is using the exact same shade for a small range of numbers in a couple of places on the chart, limiting the accuracy of the result I could obtain.

Then I had an idea which turned out to be workable: you can use the mouse to move a limit slider down along the scale, and the program responds by making the parts of the shape where the color, or result value, beyond the slider invisible. So, I developed a program that moves the mouse automatically, one pixel at a time, and captures a screen shot after each movement. By comparing successive screen shots, the program can tell which pixels lie under a certain value, and read out the entire data matrix in a couple of minutes.

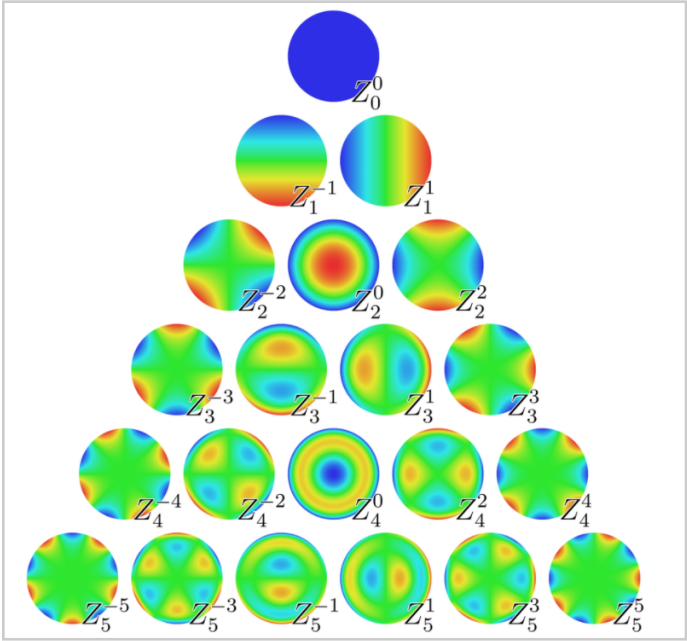


Fortunately, we only care about the data on the front surface of the mirror, which can be shown nicely on the screen all at once. So I was able to use this method to get reasonably accurate data quite quickly.

Enter some Dutch guy - well, not just any Dutch guy. Frits Zernike won the Nobel Prize in Physics in 1953 for inventing the phase-contrast microscope. He also invented some Polynomials that now carry his name, and these became our next tool.

Why? Because BEAM4, which I intend to use to simulate the optical performance of the distorted mirror, has no way of directly accepting the distortion data. But it will accept coefficients for up to 36 Zernike Polynomials.

This is one variation of a technique that has many. If you studied calculus, you probably remember that most mathematical functions can be broken down into a Taylor series of polynomials over the real line. If you are into communications theory, you are familiar with the Fourier series for representing periodic signals. Zernike's series is defined over the "unit disk," which we can use to represent our circular mirror, and is intended for simulating optical systems.



The idea is that any shape or a circular optical element, whether designed or distorted, can be represented as a sum of mathematically simple functions represented by the Zernike Polynomials, each scaled by a coefficient. At top right is a representation of the first 21 Zernike Polynomials (By Zom-B at en.wikipedia, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=15880824), and BEAM4 accepts up to the first 36. You may have already dealt with the three in the third row; they are, essentially, the "sphere" and "cylinder" elements of an eyeglass prescription, in a slightly different form.

To create the Zernike representation of the distortion, first I had to do something about the central aperture. I could have just thrown some value into there, but that would have created a discontinuity in the surface that would likely have wasted a lot of the representational capability of the limited set of 36 polynomials that BEAM4 can handle. I realized that there is probably a mathematically ideal way of doing this, but rather than dive quite that deeply into it, I decided I would get close enough by coding up an algorithm to just fill in the hole in the data, and smooth it over.

Once this was done, it was fairly easy to generate the coefficients for the polynomials. Hundreds of lines of code and dozens of hours of research and debugging finally paid off, in a punch-line that looks like this:

```
zcoeff = [np.sum(zp * dsag * zern.d_area) / zwt for zp, zwt in zip(zern.zp, zern.zwt)]
```

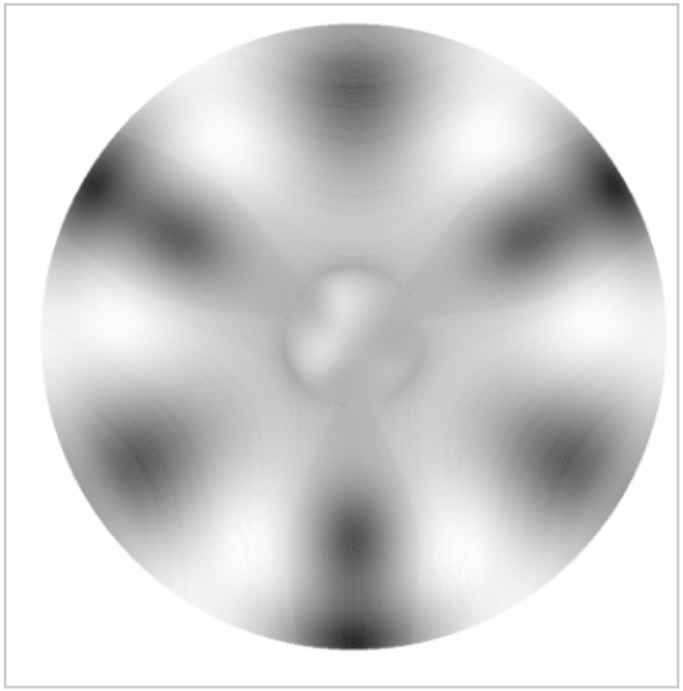
In this fun little one-liner, dsag is the deformation of the mirror, and zern.zp is an array containing values for the Zernike Polynomials. zern.d_area is a pixel-by-pixel weighting factor that accounts for the size of the pixel grid, as well as the partial pixels at the edges, and zern.zwt is a per-polynomial weighting factor needed to make the polynomial representation work properly. It produces zcoeff, which is an array of the coefficients. Basically, you treat the function you are modeling as a vector, and the polynomials you are using to model it as an orthogonal set of basis vectors, and the coefficients are an inner product or "dot product" between the vectors. (This is in a vector space with about half a million dimensions, instead of the 2 or 3 we are accustomed to.)

I'm computing all 36 coefficients, even though I won't use all of them in BEAM4. The first four polynomials, numbered 0 through 3, would count as distortion to the basic position and characteristic of the mirror: its axial position, its tilt in two directions, and its focal length. All of these can be compensated for by slightly repositioning the telescope or adjusting the focus, so we don't need to feed them into the optical simulation. But I need them to check my work, by computing a residue.

(If we had as many polynomials as we had data points — that is, if we had as many basis vectors as we have dimensions in our vector space — then the model would be perfect and the residue would be zero. The success of this technique relies on the fact that the distortion is a smooth and fairly gentle curve, so it can be sufficiently approximated by a handful of the lower-order polynomials. But that assumption needs to be checked.)

The next step is to do just that, by setting the deformation data aside, and using just the coefficients and the polynomials to recreate the representation I have built. Then, computing the difference between that and the original data. This the residue.

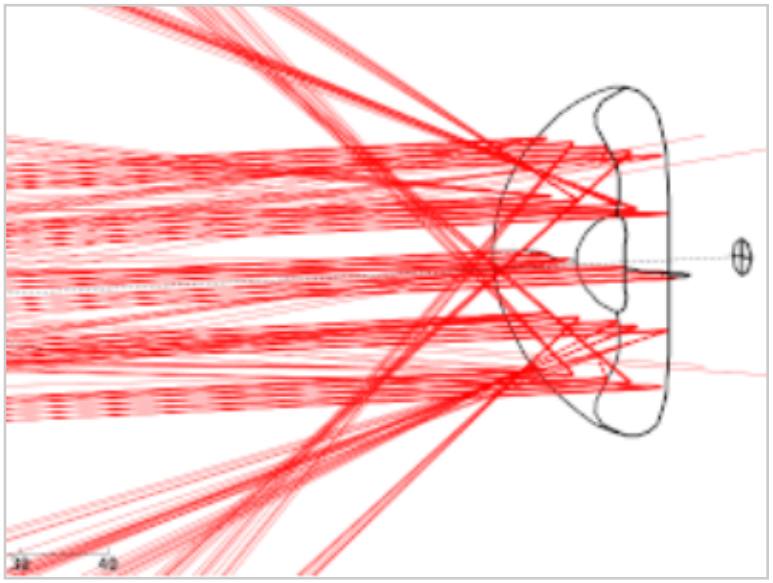
Here is an image of that residue, for an extreme case in which the mirror is supported by only the three axial hard pads, pointed straight up and with no pressure in the air bags. It has a rough six-fold symmetry because the 36 polynomials do a very good job of modeling the 3-fold symmetry of the distortion caused by the three pads, and what's left over is mostly at twice the angular pitch. (The same principle applies to the "balance shaft" used in some automobile engines to reduce vibration. The counterweights on the crankshaft are sized to balance the vibration of the pistons and connecting rods, but since these do not move in a circle, there is a double-frequency residue left over. The balance shaft runs at twice the speed and is designed to balance as much of that residue as possible.)



The residue image contains some hard edges that I think must be due to round-off errors. It looks bad because it is stretched to maximum contrast in the image. But the amplitude of the residue it very small, less than 30nm peak-to-peak between the highest values and the lowest.

Tracing rays - the final step is to feed the Zernike coefficients into the BEAM4 model of the telescope, and see how much it effects the image at the focal plane. Here is where I ran into the latest set of problems, or at least one problem, that prevented me from reporting that result this month.

It's not working right, and I'm getting crazy results, as shown in this example where a radically distorted primary mirror is sending light rays all over the place. Yep, that bagel-like shape is what BEAM4 thinks our primary mirror looks like in this run, and the small circle to the right is the focal plane where the image is supposed to be formed. None of the light rays in the simulation ever get there, since they are scattered wildly by the incorrectly-represented shape of the mirror.



I already found one problem, which is that BEAM4 is overwhelmed by all of those coefficients, and it's just cutting off the input lines that I feed into the program. This should be a fairly simple fix; I just need to hunt around in the BEAM4 source code to find where the author decided that about 200 columns of program input should be enough for anybody, and change it to a bigger number.

We ain't just anybody with this project; we break things, and then we fix them and make them better. Stay tuned.

StarWatch

by Gary A. Becker

All Eyes on Comet Atlas

“Comet are like cats: they have tails, and they do precisely what they want.” That quote, from famed comet discoverer David Levy, pretty much sums up my experiences with these hairy stars. You win some; you lose some, but still a bright comet gracing our warmer, northern spring skies brings a burst of excitement to my checkered comet soul.

Why checkered, you ask? Because comets are like cats, independent. Astronomers still don’t have a very good handle on how comets brighten as they approach the sun, so some comets that were expected to be spectacular fizzle, while others that were thought to be nonevents actually become memorable and outperform. Comets are composed of a mixture of different frozen compounds (ices) and dust, their ratios varying from one comet to another, and this influences how bright they will become.

Dusty comets that produce long curved tails are apt to become more vivid than icy ones because the dust reflects (actually scatters) more sunlight back towards the observer. A comet’s tail composed mostly of ices is actually glowing, producing light as a result of the interaction of the sun’s ultraviolet energy acting on its component gases. These comets appear generally fainter in the sky. The amount of materials released to form the tail can often be related to the structural soundness of the comet’s interior.

A friable nucleus releases more materials to become a brighter object. The latest interloper to bring a sense of expectation to the astronomical community is Comet Atlas (C/2019 Y4,) discovered on December 28, 2019, with one of the two NASA-funded, robotic, 16-inch reflectors of the Asteroid Terrestrial-impact Last Alert System (ATLAS), one telescope located on Mauna Loa, (Big Island) and the other on Haleakala on Maui in Hawaii. This all-sky search program for small asteroids that could impact Earth weeks to only several days before collision was instituted in 2017 with a southern hemispheric twin installation that will be operational very soon.

When first discovered, Comet Atlas was over a quarter million times fainter than the average human eye could detect. Calculations showed Atlas' orbit would approach the sun to a mere 23.5 million miles, a very respectful distance for a showy event. What the comet has done since that time, and particularly since early February, is outperformed, increasing its brightness by nearly 4000 times. If this brightening is extrapolated forward to its closest approach to Sol perihelion on May 31, Atlas would be visible in broad daylight near the sun, one of only a handful of comets to have ever achieved this distinction.

However, here is the rub. The last highly speculated barn burner, Comet ISON (C/2012 S1) which passed deep within the sun's corona on November 28, 2013, disintegrated, never to be seen again. Could this happen to Atlas? Absolutely! Part of that conjecture has arisen simply because of its extraordinary brightening and the fact that astronomers have been unable to determine the size of its nucleus. If Atlas' over-performance is resulting from a small loosely packed snowball, then the chances are much better for an event that will end in a puff, with complete disintegration or a breakup of the main body. If the comet's nucleus is larger, and more tightly packaged, then it has a much better chance of surviving its passage around the sun, producing a memorable naked eye event during late April thru mid-May, a bright spot in our isolated, dismal spring, and perfectly adapted for social distancing. Stay tuned to more information about this developing story, particularly if Atlas becomes a naked-eye event.

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astronomy.org facebook.com/StarWatchAstro/

I Like To Think

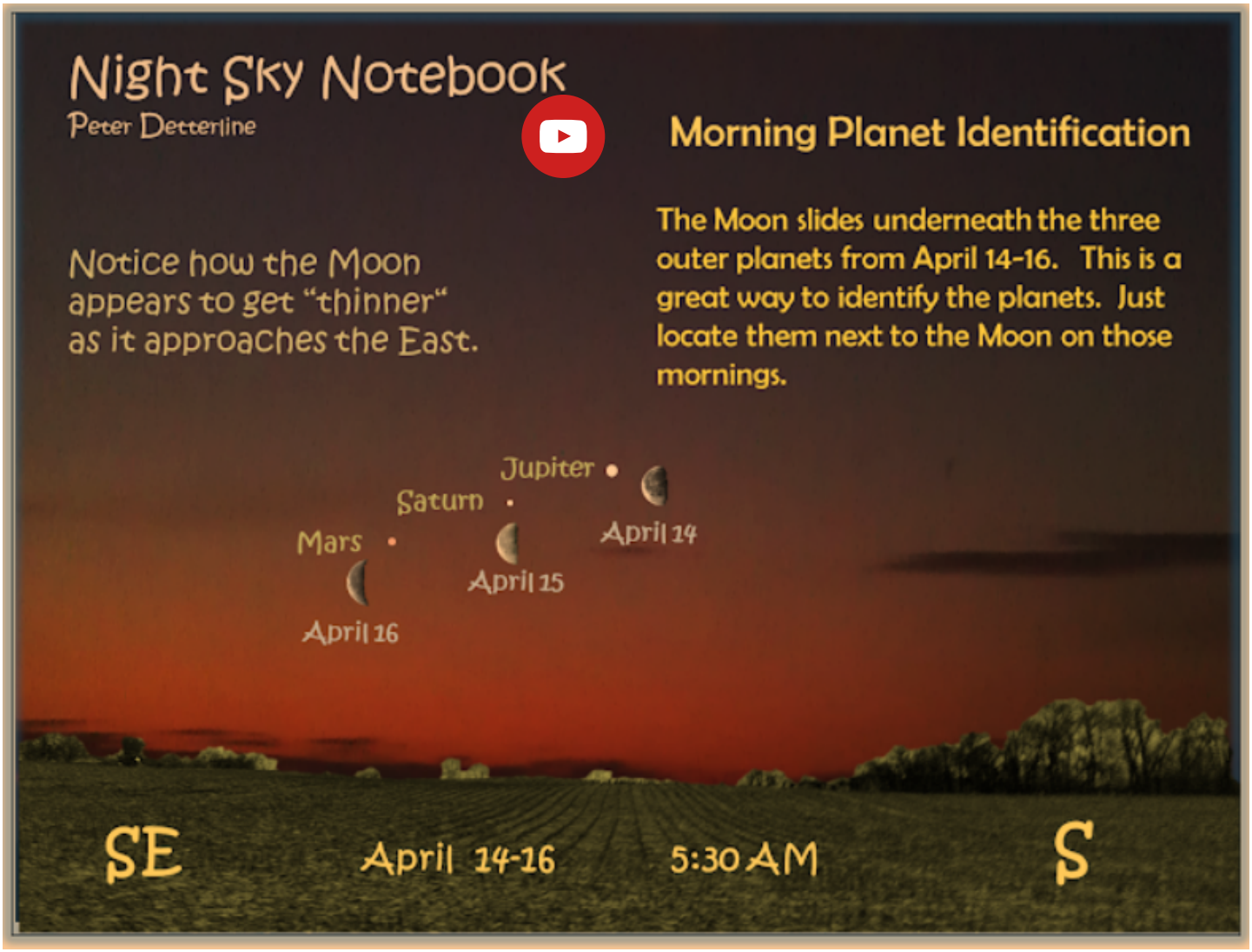
Standing in the park, alone in the darkness,
Anti-socially isolated from the world,
Watching the spark of the space station crossing the sky,
Climbing silently past Venus, arcing over Orion then fading
From view between Leo's outstretched paws
I knew the world had changed.

When the curve has finally flattened; when the crisscross patterns
Of black and yellow tape are peeled off supermarket floors;
When our front doors are no longer the ice walls
Surrounding our fear-filled flat-screen Earths;
When we don't swerve around strangers in the street like Pele,
Exchanging apologetic smiles while passing silent judgement
On each other's bulging shopping bags;
When we don't dread that back-of-the-throat tickle,
Don't feel terror trickling ice cold down our spines
Every time we cough or feel "a little hot"
We'll all be different.
We'll value some simple things more, and realise how worthless
Other things have always been.

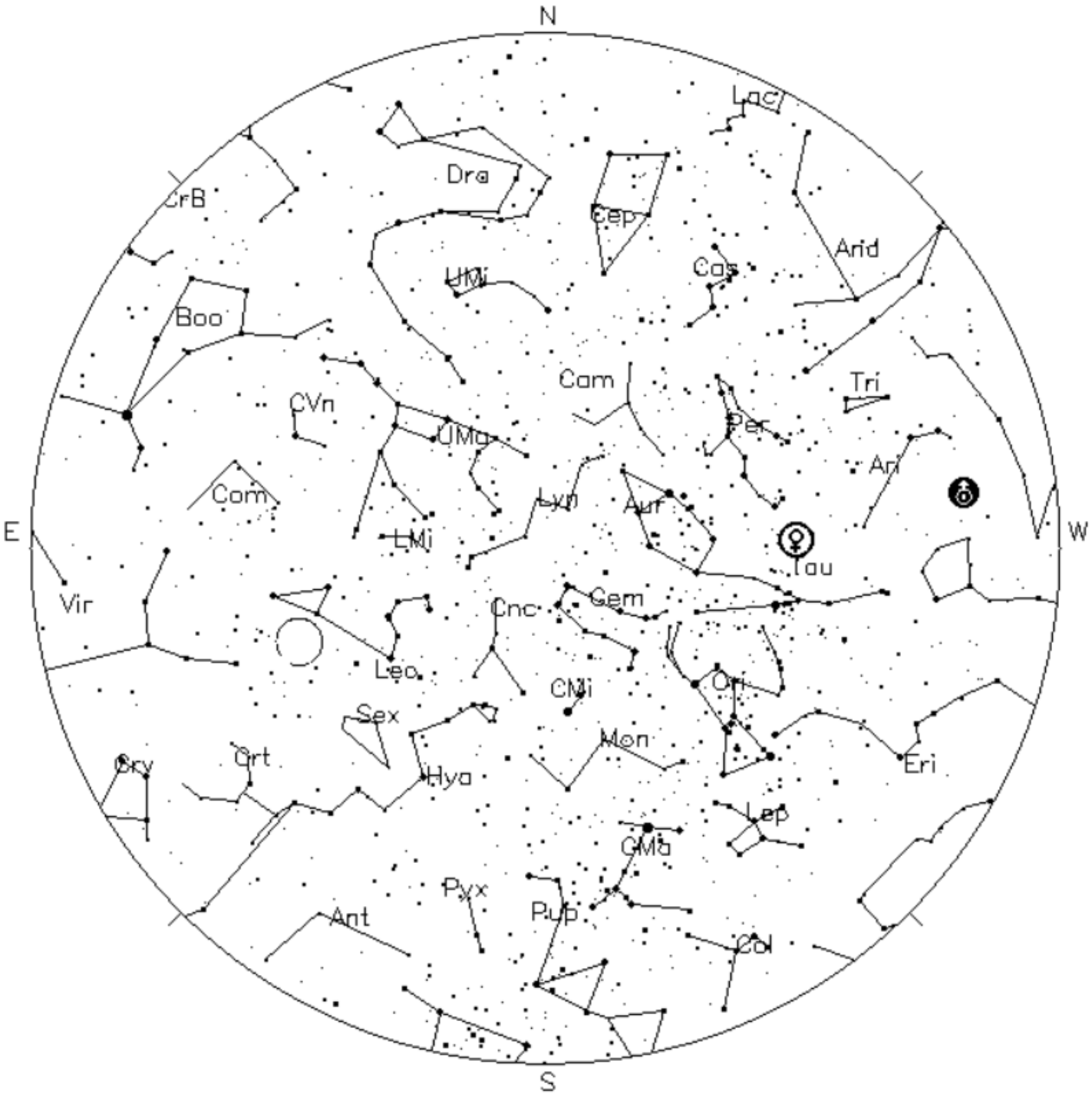
When all the twee "Earth is healing itself!" and "Nature is fighting back!" memes
Have been replaced by pouting Kardashian faces
And YouTube clips of adorable cats snoring in ridiculous places
Maybe someone will dare to stand up and speak the truth:
People did this, not the planet.
Politicians brazenly chasing Brexit votes by making "expert"
A dirty word, shedding lies as easily as snakes shed their skins,
Making people distrust everything they hear,
Will have blood on their sanitized hands and should hang
Their heads in shame, if only for the way they treated their "heroes"
Before The Virus came, when they were happy to pay nurses wages
So low they had to go to food banks to feed their hungry kids;
When the carers, cleaners and checkout girls they now praise
To the hills were dismissed as worthless and "unskilled".

Maybe. Maybe.
Until then we'll wash and wash and wash our hands,
Stand on our balconies banging pans and clapping
For the weary warriors in gloves and masks
Fighting to save the lives of the stupid and the kind alike.
And hope we are spared.

Night Sky Notebook for
April
by
Peter Detterline



Sky above 40°33'58"N 75°26'5"W Monday April 6 2020 00:00 UTC



Your Sky was implemented by John Walker in January and February of 1998. The calculation and display software was adapted from Home Planet for Windows.

The GIF output file generation is based upon the ppmtogif module of Jef Poskanzer's pbmplus toolkit, of which many other components were used in creating the images you see here.

ppmtogif.c - read a portable pixmap and produce a GIF file

Based on GIFENCOD by David Rowley

Lempel-Zim compression based on "compress"

Modified by Marcel Wijkstra

Customize Your Sky -> *at :* **http://www.fourmilab.ch/yoursky/**

APRIL 2020

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
			First Quarter Moon 01	02	03	Star Party CANCELED 04
General Meeting - South Mountain 7:00 PM - held on-line 05	06	Full Moon 07	08	09	10	11
12	13	Last Quarter Moon 14	15	16	17	Astro Imaging - 7:00 PM CANCELED 18
Deadline for submissions to the Observer 19	20	21	New Moon 22	23	24	25
LVAAS Board of Governors Meeting 26	27	28	29	First Quarter Moon 30		

MAY 2020

SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY
					01	Star Party 02
General Meeting - South Mountain 7:00 PM 03	04	05	06	Full Moon 07	Scouts at Pulpit Rock 08	Scouts at Pulpit Rock 09
Scouts at Pulpit Rock 10	11	12	13	Last Quarter Moon 14	Scouts at Pulpit Rock 15	Scouts at Pulpit Rock 16 Astro Imaging - 7:00 PM
Scouts at Pulpit Rock 17	18	19	20	21	New Moon 22 MegaMeet	MegaMeet 23
MegaMeet 24 Deadline for submissions to the Observer	25	26	27	28	First Quarter Moon 29	30
LVAAS Board of Governors Meeting 31						

2020 LVAAS Event Calendar

2020 LVAAS Event Calendar

	Sundays				Thursday	Saturday	Mondays	Multi-Day Weekends	Moon Phase			
	General Meeting time	Date/location	Board meeting	Observer submission deadline	Astro Imaging	Star Parties	Scouts at S. Mountain	Scouts at Pulpit R.	New	First	Full	Last
January	2:00 PM	12 Muhlenberg	26	19	16	no mtg		no camping	24	2	10	17
February	2:00 PM	9 Muhlenberg	23	16	13	no mtg		no camping	23	1	9	15
March	2:00 PM	8 Muhlenberg	29	22	12	7		6 – 7 – 8	24	2	9	16
April	7:00 PM	5 S.M.	26	19	18	4		10 – 11 -12	22	1 30	7	14
May	7:00 PM	3 S.M.	31	24	16	2		8 – 9 – 10	22	29	7	14
June	7:00 PM	14 S.M.	28	21	13	27		5 – 6 – 7	21	28	5	13
July	5:00 PM	11 S.M.	26	19	18	25		3 – 4 – 5 31	20	27	5	12
August	7:00 PM	8 Pulpit	30	23	15	22		1 – 2	18	25	3	11
September	7:00 PM	13 S.M.	27	20	12	26		4 – 5 – 6	17	23	2	10
October	7:00 PM	11 S.M.	25	18	15	24		2 – 3 – 4 30 – 31	16	23	1 31	9
November	7:00 PM	8 S.M.	29	22	12	21		1	15	21	30	8
December	**	12	27	20	10	no mtg		no camping	14	21	29	7

July, Aug & Dec are Saturday meetings with rain date on Sunday
Jan, Feb & March meetings are at Muhlenberg College
August meeting is at Pulpit Rock
December meeting / Holiday Party ** check website for time

NEAF	April 4 – 5
Cherry Springs S.P.	June 18 – 21
Stellafane	Aug 13 – 16
Black Forest S.P.	Sept 18 – 20 (not confirmed)
MegaMeet	May 22-24

Contributed by Bill Dahlenburg

Publishing images is a balancing act!

When preparing your images for publication in The Observer, please consider the following guidelines:

Put the quality in:

- Considering the "print" size of the image, make sure you have at least 150 pixels/inch.
- Use a reasonably good quality for the JPEG compression ratio.

But watch the "waistline"!

- Don't go too much above 200 pixels/inch max.
- Use the lowest JPEG quality that still looks good!
- Shoot for <300KB for a 1/2 page image or <600KB for a full page.

Tip: If you're not Photoshop-savvy, you can re-size and compress undemanding images ("human interest" not astroimages), with an online tool such as: https://www.ivertech.com/freeOnlineImageResizer/freeOnlineImageResizer.aspx. It will also tell you the pixel size and file size of your original, even if you don't download the processed copy.

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