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The completed miniature set of the South Pole Telescope for the E&S fulldome film Black Hole First Picture to be filmed at Mirage3D Studios, The Hague. Chris Wouda provides scale. Photo courtesy E&S/Mirage3D. Read more on page 50.

Ron Walker

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We are gathered together from all corners of this globe, inspired by the world and the universe we inhabit. Our society draws its strength from our predecessors and from the wide diversity of our present membership. Building on our past heritage, we are inspired to dream of future accomplishments, working together as a worldwide society.

IPS President Dave Weinrich Welcome to the 2012 IPS Conference Baton Rouge, Louisiana

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It's been wonderful

It's that time of year again, the season for sentimental holiday movie watching and heartstring tugging. A staple in the U.S. in this fantasy/drama genre is *It's a Wonderful Life*, the 1946 movie directed by Frank Capra and starring Jimmy Stewart.

For my planetarium friends who haven't seen it, the character played by Stewart faces a crisis and contemplates ending his life, believing his family will be better off without him. An angel shows him what it would be like if he had never been born—how much good he has done in his world—and he has a change of heart. And they lived happily ever after is the obvious conclusion.

It was with this movie in mind that I've been contemplating this, my final In Front of the Console as *Planetarian* editor.

So: what would my life be like if I had never become editor? What if I hadn't mustered my courage and emailed Publications Chair Dale Smith and asked the question "Is the editor's job still open?" He loves to share that story; you'll have to ask him about it the next time you see him.

The people always make the difference

First, and most obviously, I think of all the wonderful people I would never have met. Many have become dear friends, separated by distance, but not by heart. I can't mention them all (you know who you are), but I will give a shout-out to Joanne Young.

Long before the editorship, long before she was IPS president, Joanne was a vendor at my first GLPA conference in Cleveland, Ohio, in 1997. I am a loner by nature, so I was ready to walk by the group of ladies sitting together at the hotel bar. Until—until Joanne saw me and called me over to join them. I did, for some reason my shy self still doesn't understand, and that small gesture shaped the way I saw the planetarium field and its people from then onward.

A second remarkable meeting took place only last year, when I attended the 2019 annual meeting of the Association of Mexican Planetariums in Mexico City. What started out as that simple "join us" from

Joanne by now had transformed into a passion for the diverse, quirky, talented wonderful people that make up the planetarium field, and I had by then started a semi-regular feature I called Under One Dome. Its goal was to share the joys and trials of operating a planetarium and the fact that no matter the location, we all face the same issues and share the same dome.

The planetarians I met in Mexico, of course, shared the same dome as I. They worked under the same budget problems, and did their utmost to share the wonder of the stars with children and audiences of all ages.

I have to make a shout-out to Ignacio Castro Pinal, the long-time AMPAC affiliate representative, for being such a wonderful translator and worried father for me, and also to Enrique Fonte (Planetarios Digitales) and his beautiful partner Jessica for an exciting tour of Mexico City after they rescued me from being lost in the middle of the literally millions of people at the Feliz Navidad parade.

Finally, I was so touched by this issue's PARTYcles that I asked Alex Cherman if I could run it on my page. Of course, he said, and graciously drew another one. It appears on page 69.

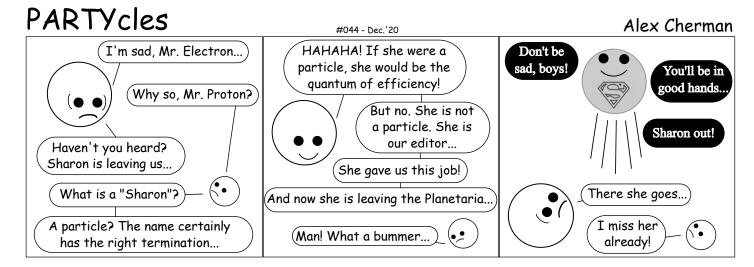
Just doing my job

I got to meet so many of you great people just because I was doing my job. But more than that, my life has changed for the better because of the many years of the sense of fulfilment that comes with doing a meaningful job and doing it to the best of my ability.

Unfortunately, I feel that over the past year I haven't been doing a wonderful job for you, the reader. Each issue has been later getting out, and I know that the number of typographical errors is increasing. My spirit is willing, but my body is failing, specifically my hands and shoulders. Typing and mouse manipulation are painful.

I am pleased to be able to hand the editorship over to Shiloe Fontes of the Flandrau Science Center and Planetarium in Tucson, Arizona, and to know that you'll be in good hands.

 $(Continues\ on\ page\ 48)$



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Thank you to the IPS Community

Thank you.

This is my last President's Message. Four years ago you, the planetarium community, elected me to be your president. For that I was, and continue to be, humbled and thankful. Personally it has been an amazing experience. I've gotten to travel the world and meet some incredible people. But perhaps the most valuable thing that it has given me is change in perspective. As president, it is your job to think about what is best for the entire planetarium community and to advocate for that. Being able to take that step back is a privilege and a joy.

Of course these last two years were filled with some pretty intense challenges as well. The controversy surrounding the selection of St. Petersburg as our 2022 conference site was particularly difficult. Of course we value our LGBTQ+ colleagues and care about their comfort and safety. Of course we want to rise above politics and bring the world together. As is often the case there isn't any perfect solution, but I do feel that we've started a process that has been respectful. I'm quite hopeful for how that process is playing out (with much gratitude to the Equity, Diversity, and Inclusion Committee Co-Chairs Dani LeBlanc and Dayna Thompson), and the impact of that process will go far beyond any single conference.

The pandemic that changed everything

COVID-19 has been devastating. Planetariums have closed, colleagues have lost their jobs, and vendors have gone out of business. For the IPS, we lost our conference, something we had planned and looked forward to for years. Still, in spite of all that, the resiliency of our community has been incredible. It is amazing how people have learned new skills, and pivoted to producing online content, then pivoted again to reopening under often severe restrictions. All of that was on full display in our virtual conference, IPSvCon2020.

Personally I feel like I got more out of that conference than any other IPS meeting; not having to choose between parallel sessions left me with a fuller picture than I had before. The numerous positive comments from those who would not have been able to attend an in-person conference show us the way to a hybrid (in-person and online) future that will reduce financial barriers and be much more inclusive.

Even though things didn't go exactly as planned, I am proud of the accomplishments over the past two years. My involvement with IPS started with participation on the Vision 2020 Task Force. Now we have reached 2020, and many of the things suggested by that task force have become reality. We now have officer term limits, professional staff, and a new governance structure.

I am particularly proud that the African Planetarium Association was founded and became an IPS affiliate under my watch. We are working on adding new regional affiliates as we speak, and I look forward to the Arab Planetarium Association and the Association of South American

IPS President Mark SubbaRao, among his many associations, also is the director of the Space Visualization Laboratory at the Adler Planetarium.

Planetariums becoming IPS affiliates in the near future, and welcoming back the Indian Planetarium Association. I'm also proud of the partnerships we've formed with the International Astronomical Union, with IMERSA, and with LIPS.

All of this progress only happened through the contributions of many of you. In particular, I'd like to thank my fellow IPS executive officers, Treasurer Ann Bragg, Secretary Patty Seaton, Director of Operations Jennie Benjamins, Past-President Shawn Laastch, and President-Elect Kaoru Kimura. Shawn's vast experience with IPS has been invaluable, and made my job much easier.

I also want to thank the Adler Planetarium, and its president, Michelle Larson, for giving me the time and space to serve the IPS. President is a volunteer role, one which can sometimes cause stress with job duties. That was never the case with me; the Adler was always fully supportive of my IPS efforts and values giving back to the planetarium community.

And with that I have one final announcement to make. In December, after nearly 18 years, I will be leaving the Adler Planetarium. I will be moving to NASA's Goddard Space Flight Center, where I will lead the Scientific Visualization Studio. Working at the Adler Planetarium has truly been a dream job. The Adler will always be a part of my identity and in my heart.

2024 conference bids

We have two strong bids to host the 2024 Conference: one of the bids is from Heilbronn, and the other is a combined bid from Berlin and Jena. Both bids are from Germany, appropriate because this conference will also mark the centennial of the optical planetarium.

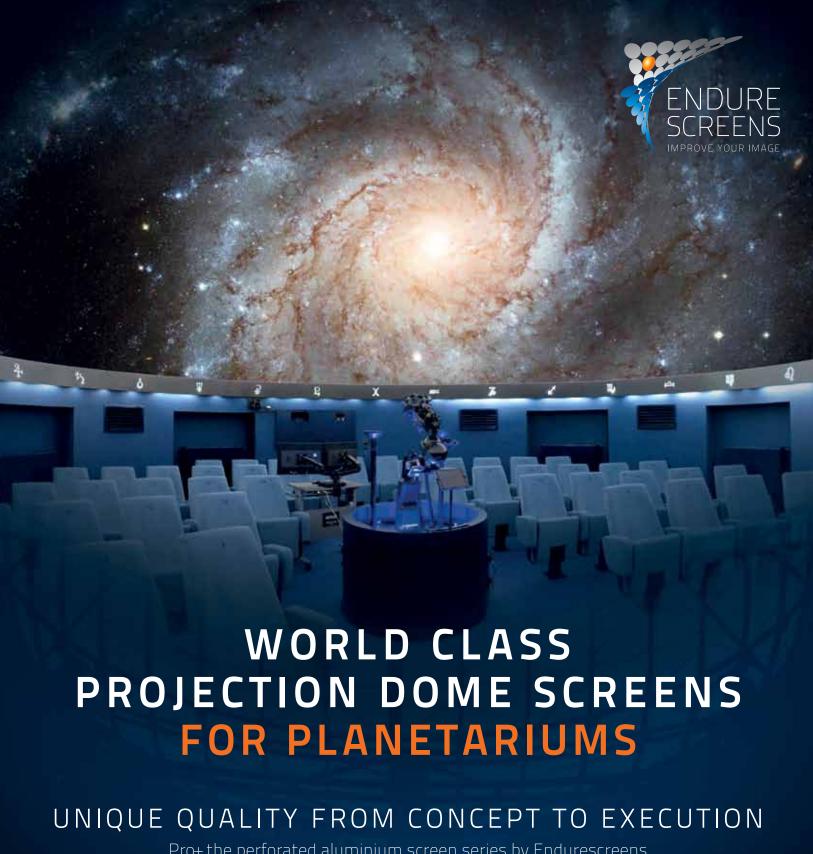
IPS has instituted a number of changes to make the host site selection process more transparent. Bid information for both sites is currently available on the IPS website at https://www.ips-planetarium.org/page/2024bids. This includes the written bid as well as a video describing both sites' plans for the conference.

All IPS members are encouraged to review these materials and to share their impressions with the IPS board member(s) representing their continent.

In October the IPS Board approved a "Conference Site Assessment Toolkit." This toolkit has been prepared by the IPS's Education, Diversity, and Inclusion committee, and outlines the various factors that will be considered when making a decision between sites. In the interest of transparency, this document will also be shared with the IPS membership.

The decision of 2024 host site will be made during the Summer 2021 IPS Board meeting.

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Shawn Laatsch Emera Astronomy Center 167 Rangeley Road Orono, Maine USA 04469 +1 207 581 1341 past-president@ips-planetarium.org

A final past president's report

It has been an honor and privilege to have served as an IPS officer, first as treasurer/membership chair and then most recently in the president cycle (elect-president-past) role. Over the 24 years as an officer, I have witnessed numerous changes to the organization and its membership, had opportunities to meet and collaborate with colleagues from all over the globe, and have served with some of the most incredibly dedicated officers.

Those of you who know me, realize that I do not—and never will—enjoy writing, but I felt that I wanted to put a few words down as I head off into the sunset in terms of official officer duties. (Yes, I'll still be an IPS member, attend conferences, and present on occasion.) The good news for those of you reading this is that I promise to keep it relatively short, and I thank you in advance for indulging me.

Some of the milestones I've witnessed and been a part of included seeing four new affiliates join council: the African Planetarium Association (APA), Association of Brazilian Planetariums (ABP), Association of Dutch Speaking Planetariums (PLANed), and Chinese Planetarium Society (CPS).

Implementation of a number of financial and membership processes including setting up an annual review of our finances, using an online membership management system, launching the EDI (equity, diversity, and inclusion) committee, and implementing the strategic planning of Vision2020. All of these were team efforts and have helped transform the society into being one that is more professional and welcoming to members across the globe.

Seeing behind the scenes

Over my years I've had a chance to see behind the scenes and assist in eleven face-to-face conferences, starting with 1998 in London and finishing with the one I presided over in Toulouse in 2018. I also had the chance to assist with the virtual conference this year. These events are huge undertakings and involve a monumental amount of work by the host facility and their staffs. Thank you to each and every one who has put the time and effort into organizing these important professional development opportunities for all of our members.

A special thank you and merci beaucoup to Marc Moutin for his exceptional dedication and work on the 2018 conference. It was such a pleasure to work with him and the team at Cite de l'Espace!

Many people to thank

My time with IPS has given me the incredible honor of serving with numerous officers and I thank them all for their hard work and dedication to our society. Naming all would be a long list, but I do want to mention a few who I think really deserve special thanks and gratitude. First and foremost would be Lee Ann Hennig, who served as executive secretary from 1996 to 2016. She always kept the officer core organized, made sure we had copious minutes and calendars, and gently guided us on precedent. There really are no words I can offer that would capture Lee Ann's contributions to IPS.

Dale Smith is another officer who has given so tremendously of himself to IPS. Not only serving as president, but then also going on to become publications chair and often being called on for advice by various officers over the years.

Martin George is in this group as well, from his work as president and on the international relations and elections committees to serving as our parliamentarian at council meetings, and to now being a board member. His passion for IPS is always very visible.

Thomas Kraupe served twice in the president's role, separated by more than a decade. He, along with Paul Knappenberger, were the founders of the Vision2020 strategic planning initiative and key in its success. Thomas pushed for partnerships with NASA and other professional societies and, with his own dome, inspired us to think of our domes as theatres for sharing things beyond astronomy.

Susan Button was a champion for a variety of initiatives, and her work beyond her presidency to set up the partnership programs for planetarians to share their knowledge is an awesome example of what IPS can be for its members.

Of course, there are more, each of whom has given their time and talent to the organization, but as I said initially, I will be short...at least relatively so.

The current officers as well

This brings me to the current officer team of President Mark SubbaRao, President-elect Kaoru Kimura, Treasurer Ann Bragg, and Executive Secretary Patty Seaton. This group has been so wonderful to work with, extremely supportive of and there for each other in some challenging times for the organization. While Ann and I will roll off together, the rest will continue, aided by Jennie Benjamins of Managing Matters as our director of operations. I will miss our regular Zoom sessions, wonderful gatherings, and camaraderie. Thank you to each of you for your exceptional service to IPS.

Going forward, my wish for the society is that it continues to grow and be more to its members, that more planetarians will participate and contribute their time and talents to the field and serve the community.

Please always remember the "1" in IPS. We are an international organization first and foremost. We must not lose that, for it offers diversity of perspective, culture, and so much more. We need to remember to make sure we take physical conferences to all continents of the globe and to as many countries as possible. Experiencing cultures firsthand teaches each of us something new and broadens our horizons in so many ways. Sometimes this can challenge us, but it is good to be challenged, as it makes us grow!

To members, especially young members, please consider running for office or a board position, chairing a task force or committee, or volunteering your contributions. Our society is only as strong as its members who share themselves with their peers.

Often over my years in office I've heard "IPS should do this, or IPS should do that." The way for IPS to do "this" or "that" is to have someone with enthusiasm to step forward and take initiative to make it happen. All IPS positions are volunteer ones, so it really does depend on each of us to contribute in ways we are able to make the society a success and have tools to offer its members.

(Continues on page 32)

WORLDS BEYOND EARNET

Narrated by LUPITA NYONG'O

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The V2020 team looks at its own successes, shortfalls



Jon W. Elvert Chair, Vision2020 Initiative jelvert1@gmail.com

Along with Karrie Berglund, Ruth Coalson, Anna Green, Levant Gurdimer, Tom Kwasnitschka, and Jaap Vreeling

In previous articles summarizing Vision2020 updates, emphasis was given to the initiative's tasks at hand, accomplishments, and challenges. In this final report, V2020 team members give their feedback on successes and shortfalls of the individual goals they have worked on throughout this six-year process.

I also wish to thank the previous contributing team members for their valuable input, especially Jim Sweitzer, Marc Moutin, Mark Watson, and Mark SubbaRao. And Vision2020 would not have succeeded without the effective guidance of its moderator, Liz Monroe-Cook, who initiated a process of open, small group discussion and candid conversation that ultimately lead to the many constructive outcomes that have already culturally and operationally changed IPS.

I also owe a debt of gratitude to the originators of Vision2020, without whom this initiative most likely would never have happened: Thomas Kraupe and Paul Knappenberger. At the IPS2012 in Baton Rouge, Thomas collaborated with Paul, future president-elect, on a vision for IPS, which would then become a proposal introduced at the council meeting in South Tyrol in 2013 and subsequently approved. Vision2020 rolled out in Beijing in the following year.

The support of previous IPS Presidents, including Thomas Kraupe, Joanne Young, and Shawn Laatsch, as well as President, Mark SubbaRao, have all contributed to the Initiative's success. To all of you, thank you. The support of previous IPS presidents, including Thomas Kraupe, Joanne Young, and Shawn Laatsch, as well as our current president, Mark SubbaRao, has been substantial; all have all contributed to the initiative's vision. To all of you, thank you.

Goal 1

Goal 1 (Karrie Berglund): Improve and increase professional development efforts that are based on research and best practices (e.g. summer schools, KAVLI Institute).

I took on this goal in fall of 2014, and I decided to invite people to the team to get a broad range of experience and opinions. I invited people from different sizes and types of domes to ensure that we were offering PD options for all dome types.

The PD team's major accomplishments included:

 Feedback via several surveys on PD types and content. We did some generic surveys as well as 2016 and 2018 IPS conference surveys that focused on PD. Survey results were shared with IPS

- officers and conference hosts, and the PD team reviewed results to pull out trends.
- Generated a list of dome types and challenges associated with each. We considered dome diameter, fixed or portable, setting (school district, science center, university, etc.), and more. After generating this list, we focused on listing PD ideas that would address each challenge.
- Given my role with the Live Interactive Planetarium Symposium and the fact that all team members are LIPS supporters, much of our effort went toward PD for doing live, interactive programs. We demonstrated that people enjoy learning in LIPS-style workshops, as highlighted in the 2016 and 2018 post-conference surveys.

I generated ideas for integrating Goal 1 with the other five V2020 goals, and we made some progress toward integration. For example, we held Data to Dome workshops at LIPS 2017, 2018, and 2019 (Goal 2), and we were able to arrange a scholarship through IPS for Imiloa's Emily Peavy to attend LIPS 2018 (Goal 6).

What we hoped to achieve but did not:

- Webinars: We put together a survey to gauge interest and had dozens of responses, but implementing them did not happen.
- Summer schools: I did quite a bit of research on this, but I quickly realized that I simply did not have the time in my schedule to organize it well.
- We did not create a sortable, searchable database of resources.
- I did not work as effectively as I should have with the Education Committee, so there was more duplicated effort than there needed to be.

What is next for professional development:

Professional development is a broad, overarching topic that is relevant to nearly every working group or committee, so we did not simply join an existing group. My hope is that IPS leadership will require working groups and committees to address PD as it pertains to their goals, and I will be happy to assist with this as my schedule allows.

Goal 2

Goal 2 (Ruth Coalson): Membership and international relations

I took on this goal in 2015 and have really enjoyed working with the team and the council to help grow IPS and move them forward. Lots of the initiatives were suggested and successfully implemented during my time on the V2020 team.

My major accomplishments included:

Worked with affiliates to reach out to members.

- Contacted sponsors to encourage giving IPS members discounts or exclusive offers.
- Worked closely with the association management company to share my work and pass on feedback and findings.
- Reached out to all BAP members, past and present, to let them know about the IPS virtual conference and about the benefits of membership.

What I hoped to achieve but did not:

I wanted to see growth in the membership numbers and although I achieved success in some countries, this is more than a one-person role. I am hoping the operations director, council members, and affiliates will all take an active role in the growth to continue to build upon the work I have started. What is next for my goal:

For my goal to continue beyond 2020, I joined the IPS membership advisory group and will continue my work within this group. Through my role on this committee I am heading up a team and contacting IPS past members in Europe to remind them of the great things IPS as an organization can do and to encourage them to join.

Goal 3

Goal 3 (Levant Gurdimer): Expand International Collaboration My major accomplishments included:

- Evaluated the necessary planetarium design standards and documentation.
- Worked with the existing planetarium design committee to identify necessary patch holes to work that they have done in this category.
- Contacted the design committee to offer collaboration and assistance.

Goal 4

Goal 4 (Jaap Vreeling): Achieve Greater Recognition for Research in Education

My major accomplishments included:

- Educational outreach in Namibia with a portable.
- Connected with emerging countries on how formal (secondary) and informal (public)
- education is used in planetariums worldwide.
- Supported local planetariums to influence formal education.
- Contributed to data to dome as an educational tool inside the planetarium.

What I hoped to achieve, but did not:

- Continue implementing transition with Education Committee.
- Create an instrument (evaluation) on how a planetarium's educational value impacts its community.
- Develop a method where communication can take place about education inside and outside the dome.

Goal 5

Goal 5 (Tom Kwasnitschka): Leadership in the Next Generation Planetaria

My major accomplishments included:

- Ordered a 6-meter dome dedicated to marine scientific work (no public shows).
- Concluded research on how to re-render and stream any Open GL based content to other domes (it is a commercial product).
- Open up the field of digestible-topics and provide necessary infrastructure.

What I hoped to achieve, but did not:

- Procure, implement, and test Open GL capture.
- Realize some first dome-casts using this technology.
- · Proliferate the approach throughout IPS.

 Build a network of domes willing to produce and share similar content.

Goal 6

Goal 6 (Anna Green): Encourage and attract younger members to become involved in the future of the IPS, particularly in serving or contributing to leadership roles around the world.

I took over Goal 6 at the beginning of 2019. This goal is important if we want to keep IPS fresh and full of new ideas. Therefore, I gathered a team of five other young planetarians from around the world to try to get a look at what needs to be done to make IPS more accessible to younger members. I wanted input from those who could be impacted or would have been impacted earlier in their careers by this goal and feel it is important for those voices to be considered.

Accomplishments:

- Discussed the Equality, Diversity and Inclusion working group taking over Goal 6 with the new leaders of that group. It was again agreed that this was the correct group to fold Goal 6 into. It is the hope that what is being done to make IPS more accessible to planetariums through the work of the EDI committee will also appeal to younger planetarians.
- Started testing use of the IPS Instagram account. Instagram is more
 popular with younger generations than Twitter or Facebook and
 expanding its usage would provide a platform that could reach
 younger planetarians.
- Reached out to membership to begin forming a plan for an IPS mentorship program for new and young planetarians. This program could also serve to help provide language support at conferences. A thought for the future is that this could also be used in tandem with the current "Week in _____" programs to create an even wider planetarian exchange program within IPS. A meeting was held between Membership, EDI, and me to discuss these possibilities moving forward and a good foundation was built.
- How to apply for a stipend is now more visible for members.
 What we hoped to accomplish but were unable to achieve:
- The mentor program needs to be fully developed. The idea was for a beta trial this year in Edmonton, however the pandemic put a stop to the trial for the time being. It would be good to start this back up again to be in full swing in the future, particularly as mentors can be very closely tied to guiding new young members to fitting leadership roles.
- We were unable to create materials that young professionals could use to convince their administration of why they should be allowed to and supported in attending an IPS conference.
- A way to explain to new, young planetarians why IPS membership is so important and valuable to their career has yet to be found. Many young planetarians only see the financial hurdles that prevent them from attending the IPS conferences and do not see how in-person attendance can support them in their field. The virtual conference this year was a great start to showing them how valuable it can be, but more work needs to be done to really stress the value of IPS to young planetarians. It is hoped that the joint effort between EDI, Membership and Goal 6 can find a solution.

What is next for my goal:

Goal 6 is incredibly important to the longevity of IPS and needs to continue being taken seriously. To continue this goal beyond 2020, I have joined the IPS EDI committee and have also been working with members of the Membership community in conjunction with EDI to find solutions. Moving forward, I believe these teams can find a way to accomplish the goals of bringing younger members to IPS and helping them achieve leadership roles that will continue moving IPS forward. $\quad \Rightarrow \quad$



Minutes of the 2020 IPS Council/Board Meeting

Held virtually (COVID-19 restrictions) 20 June 2020

Bold denotes action items

In attendance:
President Mark SubbaRao
Past President Shawn Laatsch
President Elect Kaoru Kimora
Treasurer Ann Bragg
Secretary Patty Seaton
Director of Operations Jennie Benjamins

Affiliate Representatives

Association of African Planetariums (APA) – Susan Murabana, also board member, Africa Association of Brazilian Planetariums (ABP) – Alexandre Cherman, also board member, Latin America

Association of Dutch Speaking Planetariums (PLANed) - Marlies van de Weijgaert

Association of French Speaking Planetariums (APLF) - Milène Wendling

Association of Mexican Planetariums (AMPAC) - Ignacio Castro Pinal

Australasian Planetarium Society (APS) -Amanda Kruger

British Association of Planetaria (BAP) - Nina Cameron

Canadian Association of Science Centres (CASC) - Frank Florian

Chinese Planetarium Society (CPS) - Jin Zhu, also board member, Asia

European/Mediterranean Planetarium Association (EMPA) - Manos Kitsonas, also Chair: Awards Committee

Great Lakes Planetarium Association (GLPA) - Mike Smail

Great Plains Planetarium Association (GPPA) – Jack Northrup

Italian Association of Planetaria (IAP) - Loris Ramponi

Japan Planetarium Association (JPA) - Sumito Hirota, also board member, Asia

Middle Atlantic Planetarium Society (MAPS) -April Whitt

Nordic Planetarium Association (NPA) - Kai Santavuori

Pacific Planetarium Association (PPA) - Benjamin Mendelsohn

Rocky Mountain Planetarium Association (RMPA) - Michele Wistisen, also board member, North America Russian Planetarium Association (RPA) - Yaroslav Gubchenko

Society of German Speaking Planetaria (GDP)
- Björn Voss, also board member, Europe
and Chair: Planetarium Centennial Task
Force

Southeastern Planetarium Association (SEPA)
- John Hare, also Chair: History Committee
Southwestern Association of Planetariums
(SWAP) - Levent Gurdemir

Board Members

North America: Dayna Thompson Europe: Jiri Dusek Oceania: Martin George, also chair, Elections and International Relations committees

Not Present

Association of Spanish Planetariums (APLE)

Also present:

2022 Conference Host - Evgeny Gudov (CEO and Founder), Planetarium 1, St. Petersburg,

IPS Vision 2020 Planning Team - Jon Elvert, chair

Committee Chairs

Membership Committee - Mike Murray Publications Committee - Dale Smith Education Committee - Shannon Schmoll Equity, Diversity and Inclusion Committee -Danielle LeBlanc and Dayna Thompson History of the Planetarium Working Group -Pedro Raposo

Immersive Sound Committee - Charlie Morrow Planetarium Design and Operations Committee

- Ian McLennan
Portable Planetarium Committee - Susan

Button

Guests

Joanne Young, Membership Committee Sharon Shanks, editor of *Planetarian* (second half of meeting)

Lucia Marchetti, IAU representative to IPS Webmaster Alan Gould

NOTE: Due to time constraints, affiliate reports were turned in and read prior to the

meeting. A summary of the reports that were turned in are printed as "Addendum A" to the minutes. Only the official minutes will be approved.

The meeting was called to order at 12:04 UTC on 20 June 2020 by President Mark SubbaRao, who reminded everyone of the challenge of taking a meeting that is usually two full days and reducing it to half of a day. The plan is to handle the procedural items as quickly as possible to allow plenty of time for discussion on items that require it. He stressed the importance of this meeting since we are transitioning from the council structure to the board structure, a major outcome of Vision2020. Affiliate representatives will now be referred to as the IPS Advisory Council; discussions will include how this advisory council will work with the governing board.

Parliamentarian Martin George reminded members of the basic rules of making motions and debate. He reminded us that with the transition to the new board, only board members will have voting rights and the affiliates (Advisory Council) will not. Affiliates will vote on the minutes of the previous council, before the official transition takes place.

The secretary reminded members that the minutes of the 2019 council meeting in Iceland had already been published in Planetarian. (Vol. 48, No. 4, December 2019). After some logistical measures were sorted out on the best way to vote via Zoom, the **Minutes were approved**.

Treasurer's Report-Ann Bragg

Ann Bragg highlighted the main points of the end-of-year and mid-year 2020 reports: total assets and total income. Income was lower in 2019 than 2018, the biggest difference being ad payments (\$22,000 USD). There were larger ad sales in 2018, but also due to the timing of payments, some 2019 money translated into 2020. So far we have received over \$70,000 USD in ad payments. Note that member dues were down slightly, which is common for a non-conference year.

Expenses were much higher in 2019 because of the hiring of our association management company (Managing Matters); over \$50,000

USD for monthly services (\$4,000 USD per month). The council meeting was more expensive in 2019, which is not uncommon for a non-conference year because there are more travel costs. Note that Perlan, the site of several events in Iceland, generously offered space at no cost, which helped. Travel expenses for 2020's face-to-face officer meeting were paid in 2019. All of these expenses will cost less in 2020 than in 2019: IPS has reduced costs with Managing Matters (as of May 2020); virtual conference costs are negligible; and we expect few travel expenses.

IPS mini-grants made significant dents in the Star Partners and Armand Spitz educational funds, but we expect that we will replenish these through the IPS 2020 virtual conference.

We now accept PayPal for payments (dues). A question was asked if there are any countries where PayPal won't work. Answer: This is unknown. PayPal is easier than wire transfer and credit card payments.

The proposed budget for 2021 was put together before committee budget requests were received, although it shouldn't be a problem to incorporate requests. As a not-for-profit organization, our proposed budget should technically zero out between income and expenses. Note that administrative travel has been crossed out of the proposed budget; we expect that the officer's meeting will be virtual rather than face-to-face (the coronavirus restrictions are expected to still be in place). On the other hand, board lodging and other expenses may end up being higher, as an in-person board meeting may be possible in 2021.

A question was asked on projected member dues, given that we are not having a meeting in 2021, a non-conferences year, will this affect the number? Answer: Memberships for 2020 have come in since the virtual conference was announced (and some came in for early registration for the cancelled Edmonton conference). Given the timeline for an expected membership drive, we believe we can expect membership growth.

Additional notes: \$2,000 is still in place for the Eugenides Award that was not given four years ago. This is listed as a restricted account. The current balance is about \$6,000; some awardees were not allowed to receive monetary awards.

It was noted that the Week in U.S. stipend, currently listed as \$500, should be \$1,000 since we can have up to two awards. We will consider this for the future. The money allocated for this year wasn't spent due to the coronavirus.

A question was asked on the status of the branding project in China Answer: This project has been delayed multiple times, so therefore was removed from our income expectations. Shawn Laatsch checks in every three months on the progress.

Motion was made by Shawn Laatsch to accept the proposed 2021 budget. Manos Kitsonas seconded. Motion passed unanimously. **All reports will be filed**.

Past President's Report-Shawn Laatsch

Shawn thanked everyone for the privilege of being an officer for 25 years (treasurer and president). He said he is excited that during his tenure he has seen the change from IPS membership being two-thirds from the United States and one-third international to approximately 50-50 U.S./International membership. Additional remarks are found in the past president's report that will be published in the December issue of Planetarian (Vol. 49 No. 4). (See page 10.)

President's Report-Mark SubbaRao

Mark began by thanking Shawn for his many years of service. He shared that one of our accomplishments was the approval of a new IPS logo, saying we are slow in rolling this out because of the coronavirus.

The development of planetariums in Africa has been a major focus recently. Over a year ago, he reported that he was fortunate to travel to Sao Tome and Principe for the 100th anniversary of the Eddingon experiment of general relativity during an eclipse. The event was held at a former cocoa plantation where the experiment was actually done. Part of the presentation included the announcement of the site for a proposed future planetarium. They are interested in using scientific tourism as an economic driver.

Mark also spent time in Ghana with Jacob and Jane Ashong, reporting that they are really struggling to keep going. They met with representatives of the University of Ghana for a site for building a larger planetarium there. Negotiations continue.

Mark highlighted another accomplishment of IPS: issuing strategic white papers that make the case of the importance of planetariums, including the future they can take. The "Value of Education in the Planetarium" (https://www.ips-planetarium.org/page/planetariumeducationvalue) paper was important when he traveled to Ghana. Mark also mentioned his participation in the development of the "IDEAS: Immersive Dome Experiences for Accelerating Science" Astro 2020 White paper which presents planetariums as useful for research, making the case that they should therefore receive support and funding from federal agencies.

Mark was invited to planetarium festival in India, the first large planetarium conference in a long time. Mark pushed for the need for revitalizing an Indian Planetarium Association.

There are efforts now underway to make that happen, although progress was stalled due to severe lockdowns caused by the pandemic.

Officers gathered in Tokyo in February and met with representatives from the National Astronomical Observatory, the Japan Planetarium Association, and the International Astronomical Union astronomy outreach team located there.

IPS responded early during the pandemic by postponing the 2020 conference and making the March and the upcoming June issues of Planetarian open access online. Other responses included forming a task force that issued a survey of the pandemic impact, the early release of the Planetarium Network forum, and increasing frequency of newsletter mailings from once a month to twice a month. IPS also offered mini-grants, which had a huge response. Fourteen awards were made to facilities in 14 different countries. A partnership with SLOOH was developed.

IPS also moved into plans for a virtual conference, recently announced. It will be free to IPS members; the non-member price will be the same as buying an individual membership. (More on the conference below.)

He reported that to help save money, we worked with new Managing Matters staff member Jennie Benjamins to reduce our contract to paying for 20% of their time, or one day a week.

Mark pointed out that there is a misperception that the affiliates are no longer part of IPS and no longer matter; they are, in fact, more important than ever. What is changing is the mechanisms for formal governance in voting. We are exploring ways to get affiliates involved, and hoping to see more regional associations around the world that will participate in the new IPS Advisory Council.

The Officers' Reports were filed.

Conferences

IPS 2022: Planetarium 1, 22-27 June 2022-Evgeny Goodov

(Slides are available upon request to the IPS secretary)

Evgeny reported: The facility is a 100-year old abandoned building which has been converted to a museum/planetarium. St. Petersburg is now one of largest tourist centers in Europe. Electronic VISAs were introduced this year; our hosts hope that all who come to St. Petersburg will not need a VISA if their stay is under 7 days. Located on the sea, the weather can be unpredictable at times. Average temperature is 21 C. Flights are centralized to St. Petersburg; and can be reached by ship. Taxis are available from airports into the city. For the IPS conference, we have prepared eight different venues, all located in histori-

(Continues on next page)



cal buildings. Multimedia equipment is available in all of the large venues; huge screens are available, including one 150-m screen. The large size of the venues reduces the number of times presentations have to be repeated (note: important for vendors). Their planetariums are used also for concerts and opera and these types of events will be provided in the evenings during the conference. Planetarium 1 hosts about 400 events a year; it has a huge team to make that happen. They shared photos of an event they hosted for the UN World Tour.

Budget highlights for 2022:

- Expect \$350 for conference fee, based on an estimate of over 500 people.
- Expect sponsor/exhibitor fees to cover remaining costs.
- In Russia, costs tend to be less expensive than in Europe/U.S.
- Included costs for transportation—travel to/from airports and to/from museums.
- Included in costs are two additional domes that can be used for fulldome films. Will be reusing domes from other purposes.
- Hope that there will be a larger profit than proposed. Expect many guests from Russia and European planetariums.

Question: Lodging: is there more information for delegates? Answer: Planetarium 1 will provide a list of hotels they recommend. They work with the hotels regularly because of the guests they have for the events they hold. Costs currently range from \$80-\$200.

Question: IMERSA and LIPS were scheduled to be held with IPS this year; is this a plan also for 2022? Answer: There have not yet been conversations for this, but it will be discussed. St. Petersburg is considered the "City of Planetariums." There are four different planetariums, including a school planetarium. The plan is for the conference attendees to be able to visit all of them, if not as part of the conference, then optionally recommended as tourist attractions.

IPS 2020: Virtual Conference (VCon), Aug. 3, 5, 7 2020-Mark SubbaRao

A schedule is still being developed from the presentations that had been submitted and accepted for the Edmonton conference. The VCon will also include a virtual "poster" session which will be in the form of videos. Presentations will be required to be submitted prior to the conference and available at time of presentation.

IPS 2024: The deadline for bid submissions has been extended until September. We will call for a board meeting in October to have final presentations from bidders to be accepted for vote in 2021. We currently have two

bids, both from Germany.

IPS 2026: Council voted to give Edmonton the right of first approval. They have until September of 2021 to decide whether or not to exercise this right.

At 10:00 EDT, took 10-minute break. Reconvened at 10 minutes after the hour

Committee reports

NOTE: Due to time constraints, only specific committees presented live. A summary of the reports that were turned in are printed as "Addendum B" to the minutes. Only the official minutes will be approved.

Awards Committee-Manos Kitsonas

About the awards that were to be given at Edmonton: The decision was made to inform the awardees after this meeting and officially announce the awards at the virtual meeting. After the VCon, they will be announced on the web and the *Planetarian*. They will be presented in person to the awardees in St. Petersburg along with the 2022 awards. Manos will shorten the presentation, but asked Planetarium 1 to please allow extra time for the awards, normally presented during the membership meeting luncheon.

The awards will have the new IPS logo. Because of the new logo, we are behind in the implementation of presentation medals. Work will move forward to have the new board approve the design. The goal is to have the medals in place for 2022.

Elections Committee-Martin George

The committee has added three new members, Theo Ferreira from South Africa, Mark Rigby from Australia, and Mark Watson from the United Kingdom, with the hopes of adding one more. Results of the board elections from 2019 were summarized. We have a full complement of nine board members based upon the regions agreed upon. Alan Gould was thanked for setting up the elections electronically, which worked very well.

Current election status: President-elect has one accepted nomination and another considering. One nomination was made and accepted for secretary. Two people were approached for treasurer, one graciously declined. Fortunately, the nominations this year are open through 21 September. We would like to have at least one more person standing for the position of president-elect. Reminders have been sent out for nominations.

Equity, Diversity and Inclusion Committee-Dayna Thompson and Dani LeBlanc

The definition of equity, diversity, and inclusion was reviewed, with an emphasis that an inclusive group is diverse, but a

diverse group is not necessarily inclusive. Many people understand equality, but equity is different; it recognizes that not everyone starts at the same place and recognizes barriers that exist. Diversity includes diversity of thought as well as people. Note that an individual can't be diverse; a group is necessary for diversity. Inclusion is difficult to quantify and track but is very important to make sure all feel their ideas are being heard and valued. Culture is the way things are done in an environment (policies and procedures) climate is the environment and how people around it feel.

Highlighted tasks:

- Creation and distribution of a climate survey. This is a tool to create a baseline that can be tracked over time. The survey will be shared with past members, lapsed members, and new members. The goal is to have a survey ready before the virtual conference.
- White papers: define some of the terms for the international community with evidence-based rationale for EDI. The goal is to translate the papers into various languages to help foster communication. (Officer's note: this was expressed as important to our members in Japan). Videos will be used to promote interest. A fulldome short is also under development.
- Creating inclusive event guides to help conference planners. This guideline will be a living document that will evolve to include best practices. Providing a short virtual conference guide to help make the upcoming event as inclusive as possible.
- Providing professional development: planning an anti-racism session/workshop at upcoming conference and a panel discussion on building inclusive environments.
- Creating a conference site "toolkit," a complete draft of which was provided. The goal is to implement use of this toolkit for the 2024 conference bids and include it as part of the package provided to prospective bidders. It includes criteria and best practices, recognizing that the prospective host can include as many elements as possible (not expecting all). It should be used in reviewing bids. Note: weights are not assigned to each item; right now it serves as a baseline.

An action taken by the EDI committee is to have incoming board members need to sign a non-disclosure agreement. Question: There had not been NDAs before. Answer: This document is designed to protect the confidentiality of membership. Problems have been reported, the specifics of which cannot be discussed, so this statement is designed to show that IPS

sees that there are potentially sensitive issues for which we want to preserve confidentiality and be aware of potential conflicts of interest. Note: the NDA was developed after considering best practices from other major organizations.

EDI made changes to the current code of conduct that need to be voted upon. A concern was raised that there should be review and discussion before coming to a vote. It was decided to consider the changes to the code as open for discussion and move to an electronic vote by the board.

Suggestion: include pictures along with the names on the IPS website for EDI Committee. While EDI has a diverse team, they would like to have more international representation and are accepting recommendations for team members. We want to ensure that more than just Europeans and Americans serve. EDI has put out requests, and welcomes recommendations for people who could join.

Question: Why are papers called "white papers?" This term can have different implications for different cultures. Answer: The EDI recommends that the board take action to change the name of "white papers" to "position papers."

Membership Committee-Mike Murray

The Membership Committee has been separated from the responsibility of the treasurer so that we can truly focus on a development process for membership. The team includes many past IPS presidents and would like more international representation. The team is considering what is necessary for a major membership campaign, understanding the membership so they can target specific messages (not just sending general "Join IPS" messages to all).

The committee has started and maintains the Planetarium Network (https://ipshub.mn.co/landing).

Directory Project-Joanne Young, for the Membership Committee

- Searchable directory arranged by planetariums; Dale Smith has worked for decades on this. We have 4,396 planetarium contacts.
- Current database is not compliant with GDPR; our current membership directory is. It has been difficult to combine directories, especially separating members from non-members.
- A plan was shared for updating the list. This includes an option for someone to become a "directory only" member.

Examples were provided on how the new board members could work with the affiliate representatives to update the list.

Benefits: Building relationships between the Membership Committee and board; board

and affiliate; and affiliate and planetariums in their region. The ultimate goal to develop a relationship between IPS and planetarians around the world.

Suggested next steps: Schedule a Zoom meeting with the Membership Committee along with the new board and President Elect Kaoru Kimora to review a directory update message to suit regional cultures and translated as required. Schedule meetings with affiliate representatives.

The suggestion was made to send out a direct email to members about the existence of IPS Network. Mark reported he did send out the invitation as part of the COVID-19 updates. Notice was also included in the *Communicator* newsletter, which is sent via individual emails. It was included on the IPS webpage and Facebook page. It was noted that a lot of mass emails tend to go into spam folders. The Membership Committee is looking into multiple ways to provide information to people rather than mass email, especially with a membership drive.

The committee recognized the great work done by Dale Smith and is pleased that this project is moving forward.

Via a straw poll, the board showed approval to move forward with the membership plan as presented. Mark considers this a mandate that we will proceed.

Vision 2020 -Jon Elvert

In 2019, council approved Vision2020 to wrap up goals by 2020. It was officially launched in Beijing in 2014. In six years, a lot has been accomplished. There were six members that were each responsible for a particular goal. The goals were determined at the beginning of the process with the SWOT (Strengths-Weaknesses-Opportunities-Threats) survey. Action plans and objectives were developed for each goal. Updates have been presented at every council meeting since the committee's inception.

Achievements (highlights):

- Redesign of the website
- Term limits for officers
- Restructuring governance of organization (council to board)
- · Implementation of electronic voting
- MOUs with relevant organizations
- Strategic plan (most significant document produced three years to develop) What still needs to be completed:
- Transfer of goals from working groups to specific committees
- Process to ensure that change continues to be made post-V2020

Unresolved/Loose ends:

- Want goals of Vision 2020 to remain relevant
- Ensure we are supporting membership

- Online content best practices
- Training webinars
- IPS partnerships with existing resources
- Professional development
- IPS not as "nimble" as we had hoped (want more flexibility; decision making process clear)
- Tax status change
- Skepticism that not all tenants of Vision2020 will be embraced

Legacy: Expanding the horizons of IPS and providing opportunities. IPS has made remarkable changes over the years, and V2020 hopes to see the organization continue to move forward. Jon has personally witnessed this, being on council since 1995. On behalf of the V2020 members, he thanked the council and incoming board in support of the quest to improve IPS.

See more about Vision2020 on page 13.

Comments: It was noted that it is generally agreed that there is a desire to move to non-profit status 501(c)(3) of the U.S. Internal Revenue Code rather than the 501(c)(6) status that IPS now holds. The process has been delayed due to the cost quotes from lawyers; it was thought it wasn't reasonable to spend the money required to move forward with this process now. We believe in making the transition when IPS is financially able to do so.

11:34 EDT 5-minute break

Officers, affiliate representatives, and board members were put into breakout rooms for 12 minutes to discuss questions related to the communication between board members and affiliates.

12:08 EDT Official transition from council to board.

Centennial Task Force-Björn Voss

The centennial actually has two key dates: 1923, the first presentation with a planetarium projector, and 1925, the opening of the first planetarium. The planetarium anniversary "year" will be the period between those two dates: October 2023 and May 7 2025, the main event. The IPS 2024 conference will be a "normal" conference, but should highlight the anniversary.

Between these key dates there will be many projects where people of the world should be made aware of the centennial. The vision is that everyone participates. We should use this opportunity to communicate to the world that planetariums are places that are great. Note that over 100 projects were suggested during brainstorming meetings. Projects that should be completed:

(Continues on next page)



- Slogan: "The stars were just the beginning."
- Logo has been approved
- Dedicated website planetarium100. org. Would the International Relations Committee be interested in helping with translation of the website?
- · Social media channels
- Fulldome teaser at a minimum; full-length program desired
- Digital exhibit that every planetarium can use
- Book published on planetarium history
- Calendar of astronomical discoveries
- Showcase what planetariums have become today after 100 years (including domecasting)
- · Physical travelling exhibit
- Every year following, celebrate the date of May 7.

The GDP has sponsored many of the efforts of this committee and is doing much of the work through their own working group. We would prefer a more international effort.

The Carl Zeiss Foundation is supporting the effort financially to help finish the website and creation of a video. There may be enough to finance a fulldome production (still in the works).

Funding also has been provided for a physical travelling exhibition, but more fundraising is needed.

All planetarians in the world should be informed about the centennial, not just IPS members. The event is not just celebrating what happened 100 years ago, but about everything that has happened since. The Milestone Monday initiative on IPS social media channels is underway to help with this message.

Current work:

- Promoting the centennial
- Working with data available in independently-maintained databases and IPS website
- Flat screen trailer in development
- Language-specific travelling exhibit: in German. Encourage fund raising in each region to provide their own travelling exhibit.
- Digital poster will be available to all
- Production of anniversary show: to secure money, have to develop draft concept of the show, which is in progress now

GDP project: working with comic book publisher know to provide comics on the history of science. They want to create the comic for free because they believe they can make money from it. It will like to create a published collection in book form that may be in more languages than German.

Next Steps:

- Not all core projects are started, like the book of history.
- Plan the special events.
- Find more funding and more involvement from the community (beyond GDP). Included: create subgroups for web publications; will present during virtual conference; regional groups should produce regional projects.
- Work with new History of Planetarium Working Group.

Question: Will 7 May be in addition to or instead of the International Day of Planetariums in March? Answer: The intent is to celebrate the birthday. A suggestion made that we officially change the date and have one date instead of two.

Constitution matters-Martin George

Martin is working with Patty Seaton on a wide number of items that need to be changed:

- A track changes-enabled Word document has been sent to officers for comment, then needs to be sent to the board for discussion and to Dale Smith, as a rules guru.
- Created two sets of changes to the Standing Rules: one with English corrections and one with actual content/meaning changes. English changes have been grouped together as one lot to be voted on later.

There are some actual changes needed to the By-Laws, which must be voted upon by the membership. The suggestion was made that this vote be made with the officer elections. These changes include contributions from the EDI Committee; Martin is thankful for their input. All their suggestions have been incorporated.

Unfinished Business

Continuing a discussion from the 2019 Council meeting regarding IPS Conferences and financial management: it is too late to make changes for IPS 2024. Will need to make change of financial management in next board meeting to be ready for 2026 conference (consideration for bids).

IPS is moving forward on the action from the 2019 council meeting to map the goals of the Vision2020 to committee and working group goals. The project was stalled for a number of reasons, including actions that needed to take priority.

Motion was made by Jack Northrup to take the agreed upon work, which was to map the Vision 2020 goals onto committee and working group goals, and continue that work with the new board. Mike Smail seconded. There was no further discussion. The newly appointed board voted, nine in favor, zero against or abstained.

New business

The Memorial Presentation is usually done at the awards luncheon. John Hare can prepare a presentation that will be available through the website, but he was concerned that it may not be seen by everyone since the conference is held over three different days. Discussion followed about whether or not the presentation should be postponed until 2024, or just posted online? The disadvantage to postponing: the number of people will likely make it too lengthy. It was agreed that the memorial should be a video played during the virtual conference. John estimated it would be 8-10 minutes in length. A decision was made to play this video once, highlighted in the schedule. It will also be posted on the website and made available on the new IPS YouTube page.

Our Editor of *Planetarian* for the last 15 years will be retiring at the end of the year. Sharon Shanks was formally thanked for her all her years of hard work and dedication. There is a plan that would include a team of five people to cover the many jobs that Sharon does; position descriptions are in the works. Sharon has offered to stay on to train people in these responsibilities.

For the good of the order

Shawn Laatsch thanked Ann Bragg for her years in the role of treasurer, since she will be rolling off with him at the end of the calendar year.

Mark SubbaRao thanked Shawn for his unbelievable service of over two decades to the organization.

1:01 UTC - Mark called for a close to the meeting. $\quad \ \, \Leftrightarrow \,$

Summary of Affiliate Reports Addendum to Minutes from Virtual Council/ Board Meeting held 20 June 2020

Association of African Planetariums (APA)

This newly-formed association for planetariums in Africa is still waiting for their official registration from the South African government. They have a promised three-year financial support from the department of science and technology in South Africa. One of their projects is to create planetarium content in

English and Arabic that will be accessible to planetariums all over.

Association of Brazilian Planetariums (ABP)

Portable planetariums were hit hardest during this pandemic, many closing permanently. The vast majority of the fixed domes are government owned, which have allowed them to retain personnel and create online presentations. The language barrier continues to be an issue in raising IPS membership of Brazilian planetariums.

Association of Dutch Speaking Planetariums (PLANed)

Cooperation continues between members in creating educational material, digital planetarium animations, and fulldome planetarium films. Novalab is a key project for portables in cooperation with the Dutch organization NOVA, which gathers astronomy departments from different Dutch universities to provide astronomy lessons for primary and secondary schools (ages 6-18 years old). See related story on page 28.

Association of French Speaking Planetariums (APLF)

Many online initiatives that were carried out were outlined in the June *Planetarian*. Not listed was the realization of a fulldome video projection equipment LSS for small structures (portable planetariums). Workshops are held once-twice a year to meet the needs of the users and for collaboration.

Association of Mexican Planetariums (AMPAC)

Many planetariums, science museums, and archaeological sites participated in the yearly Night of Stars in 2019! A new planetarium is under construction in the city of Orizaba in the State of Veracruz, which will impact eastern Mexico. Portable planetariums helped raise awareness of light pollution through their program *Right to Dark Skies*.

British Association of Planetaria (BAP)

BAP celebrated the Apollo 50th anniversary throughout 2019, highlighting the achievements of the Apollo crews and looking to the future of space exploration. Their porta-

ble domes played a major part in this project. A joint project between BAP and the Science and Technology Facilities (STFC) developed fulldome clips on the James Webb Space Telescope, which were made available free to all BAP members. The clips were designed with live presenting in mind and for use in mobile domes to engage schools in areas of social and economic deprivation.

Canadian Association of Science Centres (CASC)

Despite the disappointment of having to cancel the in-person IPS conference due to the pandemic, the TELUS World of Science in Edmonton was able to continue with their Aurora project renovation and addition, creating new exhibit and programming areas along with a larger lobby space. TELUS Spark in Calgary also was able to move ahead with plans to renovate their planetarium theater.

Chinese Planetarium Society (CPS)

Throughout 2019, many venues and institutions organized various forms of events to celebrate IAU100 to an overall audience of 3 million people. Due to the pandemic, activi-

(Continues on next page)





ties for International Day of Planetariums on March 8 launched online. Many planetariums worked collaboratively on these activities, with early statistics showing positive results of 145,000 views.

European/Mediterranean Planetarium Association (EMPA)

The new 18m dome planetarium being built in Cyprus has been delayed due a change in architect and main vendor, but continues to move forward. At the time of the report, all planetariums remained closed due the pandemic, with most reaching out to audiences via their websites and social media.

Great Lakes Planetarium Association (GLPA)

GLPA continues to partner with the Pacific Planetarium Association (PPA) on their series of monthly professional development webinars. They are looking into ways to continue to support the online needs of planetarians in their region and beyond. They recently decided to move their annual conference in October to a virtual event.

Great Plains Planetarium Association (GPPA)

GPPA hosted the 2019 Western Alliance Conference in Omaha, Nebraska. They have worked in collaboration with the Rocky Mountain Planetarium Association to form the new Western Alliance website.

Italian Association of Planetaria (PlanIt)

The deadline for the 2020 edition of the "PLANIt Prize" for best fulldome films was postponed due to the pandemic. PLANIt encourages all IPS Affiliates to organize a similar contest and share the winning productions with the planetarium community. Their "Two Weeks in Italy" activity has been postponed until 2021. Their "Voices From the Dome" project is online on the IPS website. This audio database currently is divided into three languages: English, French, and Italian. Planetariums from different countries are encouraged to collaborate in the project in their language.

Japan Planetarium Association (JPA)

The ICOM Conference was held in Kyoto in September 2019. The JPA annual conference was rescheduled from June to October 2020 due to the pandemic.

Middle Atlantic Planetarium Society (MAPS)

MAPS recently held board elections and retained their incumbents, Lee Ann Hennig, Paul Krupinski, and Patty Seaton. The annual conference, scheduled to be held in April at the Cradle of Aviation Museum in New York, was cancelled due to the pandemic, and there are hopes of providing some sort of virtual conference in the Fall.

Nordic Planetarium Association (NPA)

Reported that there was no news due to the pandemic-related closure of most planetariums.

Pacific Planetarium Association (PPA)

PPA has offered monthly on-line seminars, usually on the last Friday of the month. One major project that originated from their region was *Big Astronomy*, a free show with great resources.

Rocky Mountain Planetarium Association (RMPA)

The New Mexico Museum of Natural History and Science in Albuquerque, New Mexico, is moving forward with renovation plans to replace seats and carpet for better access for mobility- and hearing-impaired visitors. They are collaborating with the National Radio Astronomy Observatory to create a 40th anniversary VLA exhibit. BYU-Idaho Planetarium and the NASA Solar System Ambassador Program collaborated to host AstroFest 2019, with the theme centered on the 50th anniversary of the Apollo 11 moon landing. The Ott Planetarium in Utah is preparing to release three new productions in the fall. The Fiske Planetarium in Colorado has received funding for a unique planetarium film on the MOSAiC Expedition, a collaboration with scientists, engineers and educators.

Russian Planetarium Association (RPA)

Many online activities that have been generated as a result of the pandemic were outlined in the June 2020 edition of *Planetarian*. The diverse forms of online events included lectures, contests, meetings with scientists, photo exhibitions, and more. The Nizhny Novgorod Planetarium organized an online meeting on the work of planetariums in a pandemic.

Society of German Speaking Planetaria (GDP)

Due to the pandemic, their 2020 annual conference was cancelled, replaced by a

series of online meetings. They created a new YouTube channel of the GDP for sharing information.

Southeastern Planetarium Association (SEPA)

SEPA, as many others, canceled their annual meeting due to the pandemic. They plan for a cyber-conference-business meeting, the date yet to be determined. Their upcoming elections are for officers, and will also be conducted online.

Southwestern Association of Planetariums (SWAP)

SWAP has been working to renew their tax status, a process delayed by the pandemic. They are continuing to actively recruit new members and promoting IPS to their members.

No reports filed: Association of Spanish Planetariums (APLE) Australasian Planetarium Society (APS)

Summary of Committee
Working Group/Task
Force Reports
Addendum to Minutes
from Virtual Council/
Board Meeting held
20 June 2020

Standing committee reports

Awards Committee
See official minutes.
Elections Committee
See official minutes.
Equity, Diversity, and Inclusion
Committee

Publications Committee

See official minutes.

The committee highlighted the great diversity represented by the articles in each issue of *Planetarian*, thanking the leadership of Editor Sharon Shanks for embracing and encouraging our diversity. It was noted that advertising revenue nearly pays the entire cost of the journal The Conference Proceedings of the 2018 IPS Conference in Toulouse are available on the IPS website, thanks to the efforts of host Marc Moutin and his team. The Publications chair encourages a "no text, no talk" policy for all future conferences, even virtual ones.

Ad hoc committee/task force and working group reports

Planetarium Centennial Task Force See official minutes.

Education Committee

Jeanne Bishop has stepped down from the position of chair, and the duties have transitioned to recently-appointed Shannon Schmoll. Shannon is working with the team to update the function of the committee and dividing the committee into several subcommittees, each with a different focus on the large topic of education in the planetarium. The smaller subcommittee goals will be driven by the immediate needs of the community while the overarching committee goals will remain more stable.

Emerging Communities

No report filed.

History Committee

The committee continues to maintain the IPS Archives, which are being relocated from

Bradenton, Florida to Richmond, Virginia. They also maintain the deceased members database. John Hare continues to serve as the historian, with Dave Weinrich positioned to assume this role when John retires.

History of the Planetarium Working Group

The goal of this group is to promote research and outreach in the history of planetariums, as well as the preservation and accessibility of source materials for this field. Contacts are underway with a major academic journal in the field of science communication. Goals include the publication of a thematic feature on the scientific, educational, ad societal impact of planetariums since the 1920s to the present, as well as a special essay to mark the centenary of the optical-mechanical planetarium projector. The group plans to assist with planning efforts of the centennial task force.

Immersive Audio Committee

This team has joined hands with the IMERSA audio committee to discuss industry standards, industry networking, education, and presentation. Their goals are to reach

out to immersive experience creators in the industry to enrich the integration of immersive sound with all other immersive sensory creation, to educate the next generation immersive experience creators in cooperation with the Themed Entertainment Association, and to list offerings of sonically interesting production for dome on the IPS website.

International Relations Committee

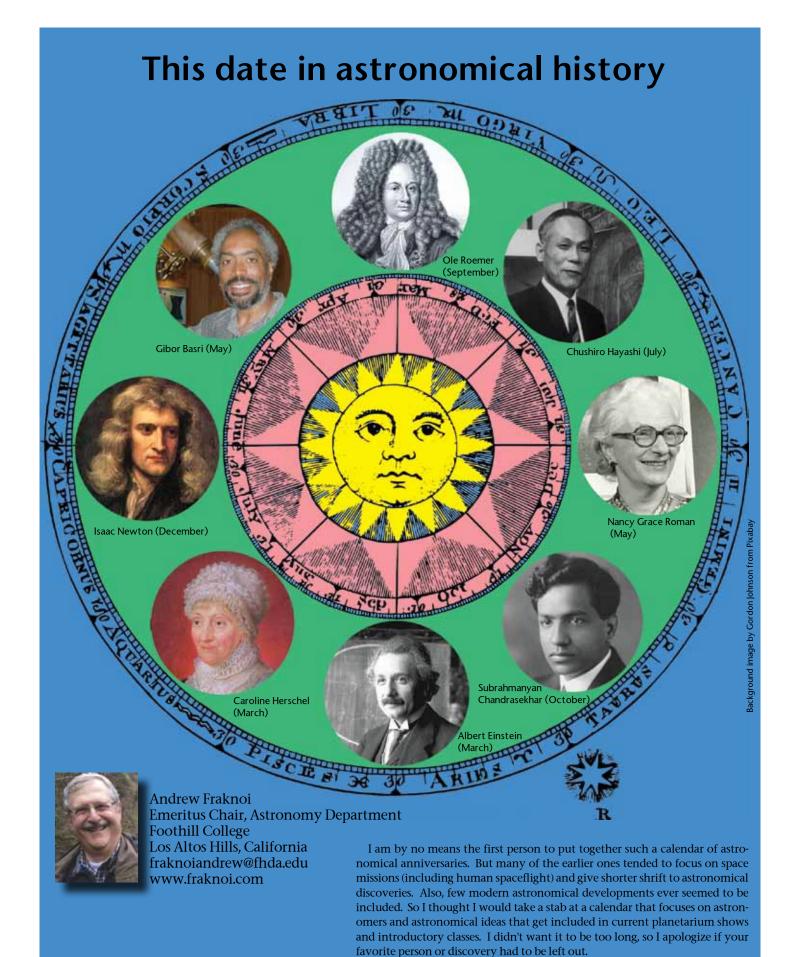
The committee continues to be involved in promoting IPS with a particular emphasis on countries and regions with low IPS membership. Chair Martin George attended the opening ceremony of the new Princess Sirindhorn Astropark in Chiang Mai, Thailand, which includes astronomy exhibits and a new planetarium. It is hoped that Thailand will establish its national group which can eventually become an affiliate. Many initiatives continue with the support of the committee, such as the stipend programs "A Week in Italy," "A Week in the United States," and "A Week with GDP." Noting that the original name if the committee was the "Language Committee," there is more consideration of the importance of recognizing language (Continues on page 32)

EDUCATIONAL, ENTERTAINING, ENGAGING





SCIENCE AT ITS BEST BAYSMOUNTAIN.COM/PLANETARIUM-PRODUCTIONS/



January



Piazzi

- 1: The first member of the Asteroid Belt, Ceres, is discovered by Giuseppe Piazzi in 1801. First thought to be a planet, now it is now also considered a dwarf planet.
- 1: Edwin Hubble's paper on the large distance to M31 (then known as a nebula in Andromeda) is read at the 1925 winter meeting of the American Astronomical Society, demonstrating the existence of other, separate galaxies for the first time.
- 2: George Herbig, American astronomer whose work helped illuminate the early stages in the lives of stars, is born in 1920 in Wheeling, West Virginia.
- 7: Galileo Galilei discovers the four large moons of Jupiter in 1610, the first moons ever found around another planet. (They are now called Io, Europa, Ganymede and Callisto, and each is a fascinating world.)
- 8: Stephen Hawking, the brilliant theoretical astrophysicist, is born in 1942 in Oxford, England.
- 10: Project Diana by the U.S. Army Signal Corps in 1946 bounces the first radar signal off the moon using an antenna at Ft. Monmouth, New Jersey. This is the first technology from Earth to "touch" another celestial object.
- 11: William Herschel discovers two moons around Uranus in 1787 (six years after he discovered the planet itself.) The moons are named Titania and Oberon, after characters in Shakespeare's Midsummer
- 14: The European Space Agency's Huygens probe lands on the surface of Saturn's largest moon Titan in 2005, the first landing on a world in the outer solar system.
- 31: The first white dwarf (40 Eridani B) is discovered by William Herschel in 1783 (although it was not established as a white dwarf until the 20th century). Also, the second white dwarf (Sirius B) is discovered on this same day by Alvan Clark, Jr. in 1862

February

- 3: The Russian Luna 9 probe becomes the first human craft to soft-land on another world (the moon) in 1966.
- 4: Clyde Tombaugh, the discoverer of Pluto, born in 1906 in Streator, Illinois.
- 5: In 1963, Maarten Schmidt, of Caltech, suddenly has the insight that the puzzling spectrum of quasar 3C273 shows ordinary hydrogen lines, but at much greater red-shifts (much larger distances) than anyone had expected. This will help explain quasars as the bright central regions of distant galaxies and open a wider universe for humanity's study.
- 7: The Astronomical Society of the Pacific, the first national astronomy organization in the U.S., is founded in San Francisco in 1889, following fruitful cooperation between professional and amateur astronomers for a total eclipse of the sun. Despite its

states and other countries.



McCandless

7: William Huggins, the pioneer in taking and understanding the spectra of stars and nebulae, is born in 1824 in London, England.

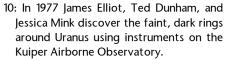
name, the Society soon has members in many

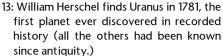
7: In 1984, Bruce McCandless becomes the first orbiting astronaut to let go of the tether to the Space Shuttle (he is wearing the Manned Maneuvering Unit to allow him to return. He thus briefly becomes the first "living moon" of planet Earth.

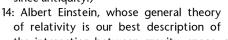
- 15: Galileo Galilei, the pioneer scientist who sets the groundwork for many branches of physics and astronomy, is born in 1564 in Pisa, Italy.
- 16: Gerard Kuiper in 1948 discovers Miranda, Uranus's satellite with the most varied geology (and the location of what may be the tallest cliff) in the solar system.
- 18: Pluto is discovered by Clyde Tombaugh, an observing assistant at the Lowell Observatory, in 1930. It is given its name because the first two letters are the initials of Percival Lowell, the observatorv's founder.
- 19: Nicolaus Copernicus, the influential exponent of the heliocentric picture of the solar system, born in 1473 in Torun, Poland.
- 23: Supernova 1987A in the neighboring Large Magellanic Cloud galaxy becomes visible in Earth's southern hemisphere in 1987. It becomes the best studied exploding star of all time.
- 27: In 1942, James Stanley Hey in Great Britain discovers radio waves coming from the sun for the first time (from a very active sunspot group.)

March

- 1: George Abell, the American astronomer who cataloged clusters of galaxies, is born in 1927 in Los Angeles, California.
- 4: An image taken with the Voyager 1 spacecraft camera in 1979 reveals the faint ring system of Jupiter for the first time.
- 6: Joseph von Fraunhofer, the inventor of the first practical spectroscope and the discoverer of the dark lines in the spectrum of the sun, is born in 1787 in Straubing (in what is now Germany).
- 6: Carolyn Porco, influential planetary astronomer and leader of the Cassini mission imaging team, is born in 1953 in the Bronx, New York.

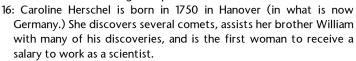






the interaction between gravity, space, and time, is born in Ulm, Germany in 1879. (Some people also celebrate Pi Day, since 3.14 constitutes the first digits of pi.)

Porco



- 23: William Draper takes the first astronomical photograph, of the moon, in 1840 (a daguerreotype-process image exposed for 20 minutes.)
- 24: Eugene and Carolyn Shoemaker and David Levy discover Comet Shoemaker-Levy 9 at the Palomar Observatory in 1993. When the comet hits Jupiter the next year, it serves as a wake-up call about impacts in the solar system.
- 25: Christiaan Huygens discovers Saturn's largest moon Titan in 1655. (It is the only moon we know with a thick atmosphere.)
- 25: Harold Ewen and Edward Purcell in 1951 discover the 21-cm radio radiation from cold hydrogen in the galaxy, using a horn antenna in the physics building at Harvard. It becomes one of the key methods of studying the galaxy.
- 29: German astronomer Heinrich Olbers discovers Vesta, the brightest and second-most massive asteroid, in 1807.

April

2: Hippolyte Fizeau and Leon Foucault in France take the first photograph of the sun in 1845 (using the daguerreotype process.)



Drake

8: Frank Drake begins observations for Project Ozma in 1960 at the National Radio Astronomy Observatory, the first serious search for radio signals from extraterrestrial civilizations.

9: In 1907, Percival Lowell discovers minor planet (asteroid) 793, which he names Arizona, after the state where his Lowell Observatory is located. (Many other observatories are eventually located there as well.) 12: Yuri Gagarin (of Russia) becomes the first

human being to go into space and to orbit the Earth, in 1961. Aboard the Vostok 1 spacecraft, his altitude varied from 91 to 177 miles high.

- 14: Christiaan Huygens, the pioneering physicist and astronomer, is born in 1629 in the Hague in the Netherlands. Huygens goes on to discover Saturn's largest moon and characterize its ring, invent the pendulum clock, and suggest the equation for centripetal force, among many other contributions.
- 24: The Hubble Space Telescope is launched into orbit around the Earth in 1990, to become the most productive telescope in human history.
- 26: The Shapley-Curtis debate on the nature of the "spiral nebulae" is held in 1920 at the Smithsonian Institution's Museum of Natural History in Washington, DC. It shows the division among astronomers about whether or not the Milky Way Galaxy constitutes the entirety of the universe.
- 27: Karl Jansky makes the first public announcement in 1933 (at a meeting of the International Scientific Radio Union in Washington, DC) of his discovery of radio waves from the center of our galaxy, thus starting the field of radio astronomy.
- 28: Jan Oort is born in 1900 in Franeker, Holland. Oort establishes the existence of the distant region of comets now called the Oort Cloud and contributes much to our understanding of our own galaxy.

May

- 3: Gibor Basri, the American astronomer and expert on star formation and brown dwarfs, is born in 1951 in Fort Collins, Colorado.
- 10: Cecilia Payne (Gaposchkin) is born in 1900 in Wendover, England. She shows that the stars are made mostly of hydrogen and helium, in what some have called "the most brilliant PhD thesis ever written in astronomy."
- 11: Antony Hewish, the man who built the telescope with which Jocelyn Bell and he discovered pulsars, is born in 1924 in Fowey, England (he received the Nobel Prize in 1974).
- 15: In 1836, during an annular eclipse of the sun, British astronomer Francis Baily first saw the phenomenon now known as Baily's Beads, the round "droplets" of sunlight that filter through the mountains and valleys seen on the edge of the moon.
- 16: Nancy Grace Roman, the American astronomer and NASA official who is often called "the mother of the Hubble Space Telescope," is born in 1925 in Nashville, Tennessee.
- 17: J. Norman Lockyer, the British astronomer and spectroscopist, and the discoverer of the element helium, is born in 1836 in Rugby, England.
- 29: Images taken during a total eclipse of the sun in 1919 are used by a team led by Arthur Eddington to demonstrate the "bending of light" (really the bending of space-time) near the sun, as predicted by Einstein's General Theory of Relativity.

June

- 1: The newly-built Lick Observatory is officially transferred to the University of California in 1888, becoming the first permanently occupied mountain-top observatory in the world.
- 5: John C. Adams, the British mathematician and astronomer who first predicted the existence of Neptune from the deviations of Uranus' orbit from what Newton's laws require, is born in 1819 in Laneast, England.
- 6: Astronomer Sidney Wolff is born in 1941 in Sioux City, Iowa. She becomes the first woman in the world to be appointed director of a national observatory, and contributes to the planning and building of some of the largest modern telescopes. She also becomes the senior author of the line of introductory astronomy textbooks begun by George Abell, and her work helps to educate millions of students about astronomy.



Wolff

- 8: Giovanni Cassini is born in 1625 in Perinaldo, in what is now Italy. He discovers four satellites of Saturn and finds the largest division in its rings.
- 10: Solar astronomer Eugene Parker is born in 1927 in Houghton, Michigan. Parker's work underlies our modern understanding of the sun's atmosphere, magnetic field, and wind; a spacecraft currently exploring the sun is named for him.
- 13: James Clerk Maxwell, the "father" of the theory of electro-magnetic radiation, is born in 1831 in Edinburgh, Scotland.
- 19: In 1962, a team led by Riccardo Giacconi uses a rocket-launched detector to discover the first source of cosmic x-rays other than the sun (Scorpius X-1), thereby launching the field of x-ray astronomy. (Giacconi receives the Nobel Prize in physics in 2002.)
- 22: In 1978, James Christy at the U.S. Naval Observatory discovers Pluto's large moon Charon by careful examination of an "elongated" image of the dwarf planet.
- 24: Victor Hess is born in 1883 at Schloss-Waldstein in Austria. Using high-altitude (for the time, 1911-13) balloons, at considerable risk, he establishes the existence of cosmic rays, ultimately winning the Nobel Prize in physics.
- 26: Charles Messier is born in 1730 in Badonviller, France. In trying to list all the fuzzy objects in the sky that could be mistaken for comets, he compiles the first serious catalog of nebulae, clusters, and galaxies. It is still in use today.
- 29: George Ellery Hale is born in 1868 in Chicago, Illinois. He goes on to discover magnetic fields in sunspots and to lead the construction of some of the largest telescopes of the first half of the 20th century.
- 30: An enormous explosion occurs 3 to 6 miles above the Tunguska River area of Siberia in 1908, caused by the impact of a rocky or icy chunk from space. Some 800 square miles of forest are flattened like matchsticks.

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July

1: Iosif Shklovsky, the great Soviet theoretical astrophysicist, is born in 1916 in Hlukhiv in what is now the Ukraine. His work identifies the

Shklovsky

mechanisms that produce radio waves from the sun and many sources in the galaxy.

2: Hans Bethe, the physicist who developed the details of how nuclear reactions power the sun, is born in Strassburg, Germany in 1906. That work wins him the Nobel prize in physics in 1967.

4: Henrietta Leavitt is born in 1868 in Lancaster, Massachusetts. She discovers the period-luminosity relationship for Cepheid variable stars, which opens up our understanding of the distances of things in the wider universe.

5: In 1687, the first edition of Isaac Newton's *Principia Mathematica* is published, setting out for the first time the laws that govern motion on Earth

and in the heavens.

- 6: In 1995, Michel Mayor and Didier Queloz, working at the Observatoire de Haute-Provence, are finally able to firm up their data and thus to claim the discovery of 51 Pegasi b, the first planet found around an ordinary star other than the sun. (They receive the Nobel Prize in physics in 2019.)
- 14: The Mariner 4 spacecraft flies by Mars in 1965 and sends back the first close-up images of another planet from space. It shows a cratered landscape and no canals or other evidence of martians.
- 14: The New Horizons spacecraft flies by Pluto in 2015, just 12,000 km from its surface, returning the first images of and data from that distant dwarf planet.
- 16: The first photograph is taken of a star other than the sun (Vega) in 1850 by William Bond and John Adams Whipple at the Harvard College Observatory.
- 16: Giuseppi Piazzi, the discoverer of the first asteroid, is born in 1746 in Ponte in Valtellina in Italy.
- 16: The first fragment of Comet Shoemaker-Levy 9 collides with Jupiter in 1994, an event that greatly expands public awareness of impacts in the solar system.
- 17: Georges LeMaitre, astrophysicist and Catholic Priest, is born in 1894 in Charlesroi, Belgium. LeMaitre interprets Hubble's findings about the expanding universe to mean that the cosmos must have had an origin, and thus becomes one of the fathers (pardon the pun) of the Big Bang Theory.
- 20: The first humans (Neil Armstrong and Edwin "Buzz" Aldrin) land on the moon in 1969 as part of the U.S. Apollo 11 mission, the first time our species sets foot on another world.

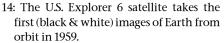


Rubin

- 21: The Viking 1 lander on Mars sends back the first color image from the surface of another planet, just one day after its landing in 1976.
- 23: Vera Rubin is born in 1928 in Philadelphia, Pennsylvania. She becomes one of the key discoverers of dark matter in the universe and a path-breaker for women in astronomy.
- 25: Chushiro Hayashi, the great astrophysicist who clarifies many aspects of the evolution of stars, is born in 1920 in Kyoto, Japan.
- 28: Johann Berkowski takes the first image of the sun's corona during a total eclipse in 1851 at the Konigsberg Observatory in Prussia.

August

- 1: Maria Mitchell is born in 1818 in Nantucket, Massachusetts. She becomes the first woman to work as a professional astronomer and astronomy professor.
- 3: David Fabricius, working in what is now Germany, makes the first recorded observation of a variable star (Mira) in 1596.
- 8: The European Space Agency launches Hipparcos in 1989, the first space telescope devoted to the precise measurement of the positions of celestial objects.
- 9: Nuclear astrophysicist William Fowler is born in 1911 in Pittsburgh, Pennsylvania. He leads a team that, for the first time, spells out the pathways by which stars build up the heavier elements in the universe. He receives the Nobel prize in physics in 1983.
- 11: Asaph Hall discovers Deimos, the smaller of Mars' two tiny moons, in 1877 at the U.S. Naval Observatory.
- 12: E. Margaret Burbidge is born in 1919 in Davenport, England. She contributes to the study of galaxies, quasars, and the formation of the elements; and becomes the first woman to use the largest telescope in the world independently.





Burbida

- 17: Asaph Hall discovers Phobos, the larger of Mars' two tiny moons, in 1877 at the U.S. Naval Observatory.
- 17: In 2017, the LIGO/Virgo collaboration observes gravity waves from the first merger of two neutron stars ever seen. A gamma-ray burst and a kilonova (a powerful supernova) are seen from the same region, ushering in the era of "multi-messenger" astronomy (where electromagnetic and gravity waves are both coming from the same object).
- 18: During a total eclipse of the sun in 1868, several observers use a spec
 - troscope to examine the spectrum of the sun and find a bright unknown line, which points to a new element (later named helium after the Greek helios for the sun.)
- 19: John Flamsteed, the first Astronomer Royal of England, is born in 1646 in Denby. He assembles important catalogs of brighter stars, predicts and observes and eclipses, and becomes the first astronomer to observe Uranus, although he takes it to be a star.



Flamsteed

- 22: Samuel Langley, the American astronomer and inventor, is born in 1834 in Roxbury, Massachusetts. He fosters a way of marking standard time through astronomical observations, invents the bolometer, and makes pioneering studies of the sun.
- 28: William Herschel discovers Saturn's intriguing moon Enceladus in 1789. With its warm salt-water geysers implying underground water reservoirs, this icy moon is now thought to be a possible abode for microscopic life.
- 28: The Galileo spacecraft flies within 1500 miles of the asteroid Ida in 1993, discovering its moon Dactyl, the first satellite ever found around an asteroid.

September

- 1: In 1859, Richard Carrington and Richard Hodgson independently observe the first solar flare in recorded history, observing a dramatic brightening in a projected image of the sun. This is during a huge magnetic storm on the sun, which leads to noticeable effects on Earth now known as the Carrington Event.
- 2: German astronomer Karl Harding discovers the third known asteroid, Juno, in 1804. At first, it is considered a planet, but as the number of asteroid discoveries continues to grow, they are re-classified as minor planets.
- 3: Gerry Neugebauer, pioneering infrared astronomer, is born in 1932 in Gottingen, Germany. He is a key figure in infrared telescope design, surveys, and discoveries.
- 7: James Van Allen, whose satellite-borne instruments discover the Van Allen belts around Earth and other planets, is born in 1914 in Mount

Pleasant, Iowa.



laans

- 11: James Jeans, who explores the physics of stars, is born in 1877 in Southport, England. His work contributes to our understanding of how stars form and evolve, and how energy is transported through them.
- 13: The Russian Luna 2 probe impacts the surface of the moon in 1959, becoming the first human-made object to make contact with another world. 14: The first gravitational wave event is discov-

ered by the two LIGO stations on opposite sides of the U.S. in 2015. It comes from the merger of two massive black holes.

- 17: William Herschel discovers Saturn's moon Mimas on this day in 1789. Mimas has a giant crater (about 1/3 the diameter of the moon) which has been named Herschel.
- 23: Johann Galle discovers Neptune on this day in 1846, based on positions calculated by Urbain LeVerrier (this was the first planet found through mathematical predictions, based on Newton's laws of motion and gravity)
- 24: The Russian Luna 16 mission achieves the first automated return of samples from another world back to Earth in 1970. Material from the moon lands safely in Kazakhstan.
- 25: Ole Roemer, the Danish astronomer who first measures the speed of light, is born in Aarhus in 1644.
- 27: Pioneering radio astronomer and builder of radio telescopes, Sir Martin Ryle is born in 1918 in Brighton, England. For his work on surveys of the radio universe and new techniques for radio measurements, he shares the first Nobel Prize in physics given for astronomical experiments in 1974.
- 28: Paul Villard, the discoverer of gamma-rays, is born in 1860 in St. Germain a Mont d'Or in France.
- 30: In 1880, Henry Draper takes the first-ever photograph of a nebula (the Orion Nebula M42).

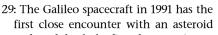
October



2: Astronomer Robert Trumpler is born in 1886 in Zurich, Switzerland. He establishes the existence of interstellar reddening by dust and makes systematic observations of open clusters of stars. 6: Riccardo Giacconi, one of the pioneers of x-ray astronomy and space astronomy, is born in 1931 in Genoa, Italy. He wins the Nobel prize in physics in 2002.

Giancconi 7: The Russian Luna 3 spacecraft takes the first photos of the back side of the moon in 1959.

- 8: Ejnar Hertzsprung, the co-developer of the Hertzsprung-Russell Diagram (which helps astronomers understand the life sequence of stars), is born in 1873 in Copenhagen, Denmark
- 9: Physicist and astronomer Karl Schwarzschild is born in 1873 in Frankfurt am Main in Germany. He applies Einstein's equations of general relativity to predict the simplest kind of black hole.
- 10: English astronomer William Lassell discovers Neptune's largest moon Triton in 1846. It is the only major moon in the solar system to have a retrograde orbit (to revolve in the direction opposite to its planet's rotation.)
- 11: Heinrich Olbers, astronomer and doctor, is born in 1758 in Arbergen, in what is now Germany. He discovers asteroids and comets, devises a new method of orbit calculation, and proposes the dark night sky paradox.
- 15: Jesse Greenstein is born in 1909 in New York. He contributes to many fields of astronomy, including the understanding of white dwarfs, star clusters, and quasars, the abundances of the elements, and the interstellar medium and its components.
- 19: Subrahmanyan Chandrasekhar is born in 1910 in Lahore (in what was then India). He does crucial theoretical work on the lives and deaths of stars and wins the Nobel prize in physics in 1983.
- 21: The Yerkes Observatory, the site of the largest refractor telescope in the world, is dedicated in 1897. There is a meeting of the country's astronomers during the days before the dedication, which eventually leads to the formation of the American Astronomical Society.
- 22: The world's first radio astronomer, Karl Jansky, is born in 1905 in Norman, Oklahoma.
- 22: In 1975, the Russian Venera 9 mission to Venus sends back the firstever images from the surface of another planet.
- 25: American astronomer Henry Norris Russell is born in 1877 in Oyster Bay, New York. He goes on to create the Hertzsprung-Russell Diagram and make many other contributions to astronomy.
- 29: The great astronomer and mathematician Edmond Halley was
- born in 1656 (according to the Julian calendar, still in official use in England at the time.) Halley discovered much more than the periodicity of the comet now named for him. He found proper motion among the stars, figured out how a transit of Venus could give us the size of the solar system, invented actuarial statistics for insurance, supported the publication of, and applied, Newton's laws of motion to the heavens.





Halley

first close encounter with an asteroid and sends back the first close-up pictures of an asteroid's surface.

November

- 1: Charles Kowal discovers Chiron, the first object designated as a centaur (half asteroid, half comet) in 1977, using images he took at the Palomar Observatory. It orbits between the asteroid belt and the Kuiper Belt.
- 2: In 1885, American astronomer Harlow Shapley is born in Nashville, Missouri. Shapley makes the first modern map of the Milky Way Galaxy and measures our sun's position in it.
- 5: Fred Whipple, who proposes the modern model of comets, is born in 1906 in Red Oak, Iowa
- 8: Wilhelm Roentgen discovers a new kind of ray, which he calls x-rays (after the symbol for the unknown in algebra) in 1895. X-ray astronomy eventually shows a much more violent side of the universe.



Banneker

9: Benjamin Banneker, the first African American astronomer (and author of almanacs) is born in 1731 in Baltimore County, Maryland.

11: Vesto Slipher is born 1875 in Mulberry, Indiana. A pioneer in spectroscopy, he discovers the large redshifts of "spiral nebulae" (now called galaxies) and investigates the rotation of planets and galaxies. 12: Seth Nicholson is born in 1891 in Springfield, Illinois. With Edison Pettit, he makes the first infrared survey of the sky,

opening the infrared universe for our exploration. He also discovers several moons of Jupiter and observes sunspot activity.

- 14: The Mariner 9 probe becomes the first spacecraft to orbit another planet (Mars) in 1971.
- 15: William Herschel is born in 1738 in Hanover, Germany. Herschel goes on to discover the first new planet ever found (Uranus) and the infrared part of the spectrum, among other pioneering work.
- 16: Frank Drake (with help from a number of people) sends the first intentional radio message aimed at extra-terrestrials into space from the Arecibo radio dish in Puerto Rico. It is aimed at a globular cluster (M13) which is 25,000 light-years away.
- 17: The Russian Lunokhod rover lands and moves around on the moon in 1970, the first remotely controlled rover to move across the surface of another world.
- 18: NASA launches the Cosmic Background Explorer (COBE) satellite in 1989 to measure the properties of the microwave background radiation left over from the big bang. George Smoot and John Mather share the 2006 Nobel prize in physics for the experiments on board that explored the properties of this radiation.
- 20: Edwin Hubble is born in 1889 in Marshfield, Missouri. He would grow up to become the father of extra-galactic astronomy.
- 26: Bertil Lindblad is born in 1895 in Orebro, Sweden. He makes crucial measurements about the rotation, center, and mass of our galaxy.
- 28: In 1659, Christiaan Huygens sees and draws the first distinctive markings on the surface of Mars, making the first drawing/map of another world and estimating the rotation rate of Mars for the first time.
- 28: Jocelyn Bell and Antony Hewish discover the first pulsar in 1967 at the Mullard Radio Astronomy Observatory in Cambridge, England. Pulsars turn out to be rotating neutron stars, the remnants of some supernova explosions.
- 29: Christian Doppler is born in 1803 in Salzburg, Austria. His discovery of the Doppler effect allows astronomers to measure motions toward us or away from us in the universe.

December

- 2: In 1973, the Pioneer 10 spacecraft becomes the first instrument to send back images of an outer planet (Jupiter) that showed more detail than anything we could obtain from Earth; later Pioneer 10 becomes the first spacecraft to go beyond the realm of the known planets into deep space.
- 4: In 1639, Jeremiah Horrocks in England becomes the first modern observer to see a transit of Venus (when Venus crosses the face of the sun as seen from Earth,) allowing him to make a rough estimate of the scale of the solar system. (Horrocks himself would have said he made the observation on Nov. 24, since England had not yet switched to the Gregorian calendar.)
- 7: Gerard Kuiper, the Dutch-American astronomer who was the key figure in the renaissance of 20th century planetary astronomy, is born in 1905 in Tuitjenhorn in the Netherlands. His work on comet orbits suggests the existence of what is now called the Kuiper Belt.

- 7: NASA launches Orbiting Astronomical Observatory 2, the first successful telescope platform orbiting in space, in 1968. There are a series of instruments on board for observing the universe in ultraviolet
- 7: In 1995, the Galileo probe becomes the first spacecraft to go into orbit around a giant planet (Jupiter). Put another way, it becomes the first artificial moon of a giant planet.
- 7: Abd al-Rahman al-Sufi is born in 903 in Rey, Persia (today Iran). He would construct a great catalog of the "fixed stars" (the most important star catalog since Ptolemy), measure the precise length of the year and the inclination of the ecliptic, and make the first recorded observation of what today is called the Andromeda Galaxy.
- 11: Annie Cannon is born in 1863 in Dover, Delaware. She fleshes out our modern classification system for stars and classifies the spectra of a huge number of stars.
- 13: In 1920, at the Mt. Wilson Observatory, Albert Michelson, Francis Pease, and John Anderson use an interferometer to measure the diameter of another star (Betelgeuse) directly.
- 14: In 1962, NASA's Mariner 2 becomes the first spacecraft to have a close encounter with another planet (Venus), passing within 22,000 miles of the planet and measuring the high temperature of its atmosphere.
- 14: Tycho Brahe, whose careful measurements of the motion of the planets inform Johannes Kepler's laws of planetary motion, is born in 1546 in Knutstorp Castle, Denmark.
- 15: The Russian Venera 7 probe in 1970 becomes the first human craft to land on another planet (Venus) and transmit information back to Earth.
- 16: Edward E. Barnard is born in 1857 in Nashville, Tennessee. He discovers Barnard's Star, the star with the greatest proper motion, and becomes a pioneer in the photographic study of nebulae and our galaxy.
- 19: Albert Michelson is born in 1852 in Strzelno in what today is Poland. He measures the speed of light and develops the astronomical interferometer, making the first direct measurement of the diameter of a star. He wins the Nobel prize in physics in 1907.
- 22: Grote Reber is born in 1911 in Wheaton, Illinois. For about a decade, he is the only working radio astronomer in the world.
- 25: Gerhard Herzberg, the pioneer spectroscopist who helps us understand and observes the spectra of molecules (on Earth and in space), was born in 1904 in Hamburg, Germany. He would win the 1971 Nobel prize in chemistry.
- 25: Isaac Newton is born in Woolsthorpe by Colsterworth in England in 1642. He would grow up to establish "the system of the world" the laws of motion and gravity.
- 27. In 1571, Johannes Kepler is born in Weil der Stadt in what is now Germany. He uses Tycho Brahe's observations to develop the laws of planetary motion.
- 28: Sandra Faber is born in 1944 in Boston, Massachusetts. She makes pioneering contributions to our understanding of the evolution of galaxies, helps diagnose and fix the Hubble Space Telescope, and helps define the scientific objectives and design of the instruments for the Keck Telescopes.
- 28: Arthur Eddington is born in Kendal, England in 1882. He is a key figure in our theoretical understanding of how stars form and how they make their energy; he leads the 1919 eclipse expedition that confirms a key prediction of Einstein's General Theory of Relativity.
- 31: Robert Aitken, perhaps the greatest discoverer and cataloger of binary stars in history, is born in 1864 in Jackson, California.



Keyword: Zich aanpassen

Making a flat screen work when you can't use the dome

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Abstract

NOVA—The Netherlands Research School for Astronomy—coordinates a group of three inflatable mobile planetariums that visit around 200 primary and secondary schools per year (approximately 30,000 students/year). After an initial stop in activities (March-June 2020) due to the COVID-19 crisis, NOVA has invested in a high quality screen in order to resume planetarium operations safely during the pandemic.

The same interactive shows as presented in the dome are now given in a large, darkened room projected onto a flat screen with students sitting on cushions in a close group (current Dutch regulations allow close contact between children under the age of 18). A test of this COVID-19-safe "mobile planetarium" at a summer school for primary

school children (ages 7-11; 180 students; 20 teachers) was highly successful. The evaluation showed that all participants found the experience to be highly inspirational. The expert presenters felt that the setup with the screen enhanced the interaction between the presenter and the students.

Background

The Netherlands Research School for Astronomy (NOVA) operates three mobile planetariums running Evans & Sutherland Digistar 6 software with a customised dashboard. The NOVA mobile planetariums visit around 200 primary and secondary schools per year, reaching approximately 30,000 students and 1,000 teachers annually.

The NOVA inflatable domes have an internal diameter of 5.5 metres and therefore are large enough to accommodate a single school class of a maximum of 30 students per show.

The planetarium shows are led by an expert, typically a later-year bachelor or

master student in astronomy, and are highly interactive. There is no set programme and after a short introduction, the show is led by the interests and questions of the students.

Whilst research shows that the use of a dome brings unique learning enhancements—e.g. the immersive experience improves a student's ability to retain information (Zimmerman et al., 2014) and a three-dimensional space is effective in teaching three-dimensional concepts (Sumners et al., 2008; Plummer, 2009)—NOVA has looked to alternative solutions for the COVID-19 period.

The useful article of Reiff (2020) published on the IPS website calculates reduced capacities per show and alternative configurations for the continued use of a dome in the COVID-19 era. However, in the Netherlands,

the time and monetary costs incurred by such a drastic alteration in the numbers of students able to attend a single interactive lesson makes such an approach unattainable. NOVA, therefore, has developed an alternative approach using a high quality flat projection screen. In this article we describe the NOVA COVID-19 solution and present initial feedback from a test school and the experts giving the shows.

The NOVA flat screen solution

NOVA has invested in a high quality flat projection screen (Figure 1). The full screen measures 1.7m x 1.7m with a projection area of 1.6m x 1.0m and is light-proof (no light is transmitted through the screen.) Projection is with the same high-power projector used within the inflatable dome. A flat-projection



Testing the NOVA flat-screen planetarium at a summer school for primary school students, July 2020. Photo courtesy the author.

lens is used rather than the fisheye lens used in the dome. The room in which the screen is used needs to be reasonably well darkened, but does not need to be fully blacked out due to the high intensity of the projector (6500 lumens).

The NOVA mobile planetarium uses Digistar 6 software with a customized dashboard and set of routines for ease of use. The customized routines have been modified to enable projection onto a flat screen.

In order to recreate, as much as possible, the atmosphere within the dome, students still sit on cushions on the floor close to the screen rather than on chairs as in a traditional classroom configuration. The expert presenter sits next to the screen facing the students for maximum interaction.

The current COVID-19 situation in the Netherlands

(Correct at the time of writing-August 2020)
As of 1 July 2020, primary school students (under 13 years old) in the Netherlands are no longer required to socially distance, either amongst themselves or from adults. Older students (13-17 years old) are also not required to socially distance amongst themselves but do need to remain a minimum of 1.5 metres from all adults. All adults (18+) are required to keep a minimum of 1.5 metres from each other. At the time of writing, there is no requirement for any age group to wear masks in the school setting.

Whilst the new COVID-19 rules (as of July 2020) could allow for the use of the inflatable dome in primary schools, NOVA has taken the decision that, for now, the flat-screen option is still preferable for safety reasons. The flat-screen is the only possible mode of operation in secondary schools at the time of writing.

Test of flat-screen at a summer school for primary students

In July 2020 the NOVA flat-screen planetarium was tested at a summer school for primary school students in the Amsterdam area. Six interactive shows were given, each lasting approximately 45 minutes. The ages of the students were 7-11 years old. In total around 180 students and 20 teachers attended the shows.

The flat-screen was positioned in the school gymnasium. The room was chosen for its size (larger areas are considered safer for groups at the current time). The lighting was disabled and windows were taped off to increase the level of darkness. The presenter was seated next to the screen, positioned to face the audience whist also being able to view the screen (Figure 2). The students sat close together on cushions on the floor, the front row being just 50cm from the screen. The teachers sat at the back of the group on chairs, more than 1.5m

away from each other and the presenter.

Aside from the difference in setup, the interactive shows were given in the same way as in the dome in pre-COVID-19 times. The presenter starts the show during the day at the location of the school and scrolls to nighttime. The students are actively encouraged to ask questions and give suggestions of what they would like to see and learn.

The experience of the NOVA mobile planetarium staff

Four NOVA mobile planetarium staff attended the test day and shows were given alternately by two presenters. Before the test day, all staff had reservations about whether the COVID-19-safe (flat-screen) version of the planetarium would live up to experiences in the dome.

All NOVA planetarium staff felt that the test day went far better than they had expected. Specific quotes include:

"The room was dark enough and the setting is intimate with the children sat close by on the cushions. In this way, the experience comes very close to that within the dome."

"The dome experience is unique, and that's difficult to replicate, but the new setup has other advantages. The presenter has a better overview of the class and as such, it's easier to make contact with the children and ensure everyone gets a chance to contribute to the discussion and ask a question. In the dome this isn't as easy as there are always children sitting behind the presenter."

"The projector-lens-screen configuration actually gives a sharper image on the screen so some details are easier to see on the flat screen."

In summary, in "normal times" the dome will still be the operation mode of preference, but all NOVA staff felt that with the flat screen solution, it is still possible to provide an inspiring experience during the COVID-19 crisis.

The experience of the summer school teachers

In addition to the internal evaluation of the flat-screen, NOVA asked for feedback from the summer school. Quotes from the teachers include:

"The presenters did a great job. They posed thought-provoking questions to the group to stimulate the interaction and the focus of the show stemmed from the interests and questions of the children. As such, each show was different."

"The room was dark, the images good, and the children sat in a close group on cushions on the floor, close to the screen and the presenter. This was a unique experience and certainly not a normal lesson!"

"A super cool experience. Every school should have a planetarium day!"

"The flat screen, set-up as it was, was definitely not less inspirational than a show in the dome."

NOVA mobile planetarium bookings in the COVID-19 period

NOVA mobile planetarium shows were cancelled for the period March-June 2020 inclusive. Schools were quickly informed of the new flat screen version of the planetarium, which was available from July 2020. A more general announcement will also be released in the annual flyer distributed to schools in September 2020.

Whilst the bookings are not yet up to pre-COVID-19 levels, there is significant interest from schools with many reservations for the flat screen version of the planetarium already in place for the new school year, starting in late August 2020.

Conclusions

Whilst the default operational mode of the NOVA mobile planetarium will continue to be the use of the inflatable dome, during the COVID-19 crisis the flat screen projection mode provides a safe yet still inspiring experience.

The flat screen approach allows NOVA to continue to reach primary and secondary school students across the Netherlands during this challenging time. Schools across the country are keen to try out the new flat screen version of the planetarium and whilst bookings are not yet back to pre-COVID-19 levels, many bookings for the new school year are already in place.

References

Plummer, J. D., "Early elementary students' development of astronomy concepts in the planetarium," *Journal of Research in Science Teaching*, DOI:10.1002/tea.20280, Vol 46, p192-209 (2009).

Reiff, P. H., "Portable planetariums in the age of COVID-19," an article distributed via the International Planetarium Society (IPS) website (2020): www.ips-planetarium.org/page/portableresources; directly at www.ips-planetarium.org/resource/resmgr/portabledomedocs/Reiff-Portables-AgeOf-Covid.pdf

Sumners, C., P. H. Reiff, and W. Weber, "Learning in an Interactive Digital Theater," *Advances in Space Research*, DOI:10.1016/j. asr.2008.06.018, Vol 42, p. 1848-1854 (2008).

Zimmerman, L., S. Spillane, P. Reiff, and C. Sumners, "Comparison of Student Learning about Space in Immersive and Computer Environments," *Journal and Review of Astronomy Education and Outreach*, V1, p. A5-A20, (2014). Available from: www. toteachthestars.net/JRAEO/issue-1/



Keyword: Criatividade Scheduling virtual school trips during the pandemic

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Introduction

Before the pandemic, our planetarium had a wide variety of activities, which could be divided into three branches:

- Actions in the fixed dome, in which the visit of school groups is the primary use;
- Activities with the mobile planetarium, where we travel to other cities and participate in events; and

• Others, like observations with telescopes. Among all of them, planetarium participation in the virtual environment was small, with some eventual productions used mainly to publicize our facility and to have a contact channel. Right after planetarium closure due to the pandemic, Planetario da Unipampa started a series of productions on the web, promoting a diversification in its virtual services. Figure 1 shows a schematic diagram of planetarium activities. Among our virtual activities we began with the virtual school trips to the planetarium. Planetário da Unipampa was the first Brazilian planetarium to offer such school trips and, as a result, we had schools from all over the country visiting us, including cities 4.000km away.

Researchers have already asked "why do they come," investigating "The motivation behind field trips to the planetarium" (Schwarz, Ghent, Plummer, 2019). They were interested in understanding:

- What factors influence teachers' choices when planning a classroom field trip?
- To what extent (if any) do teachers integrate their visit to the planetarium into their lesson plans?
- What are teachers' goals for their students during their visit to the planetarium? (Schwarz, Ghent, Plummer, 2019, p. 20)

We decided to ask almost the same question to understand the motivation behind virtual field trips to the planetarium. Why do they "come?" To answer that question, we conducted a qualitative study based on a focus group interview (Tracy, 2013).

The visits

We host school groups through Zoom and offered a mix of planetarium sessions and lectures, using some interactive tools, especially those offered by the platform. We use Nightshade to show the night sky, the path of the sun and moon, visible planets, and constellations. As we do in our dome, each session starts with this kind of content.

We also use Stellarium, NASA Eyes on the Solar System and Eyes on Exoplanets, and Space Engine to show different content and



explore, for example, exoplanets and Mars missions. Flat videos, images, and animations also are used.

One of the biggest challenges faced by teachers during the pandemic is dealing with education at a distance, with its virtuality, which was also our biggest fear with planetarium virtual shows. How would we engage the children?

Even though we didn't conduct a study about the children's behavior, we can certainly speak that during these visits, we have perceived, sometimes, kids interacting even more than they did inside the dome. Why?

Maybe because we have prepared shows with this concern for interactivity, or maybe it was a result of social distancing, or maybe that's what a planetarium promotes: interactivity.

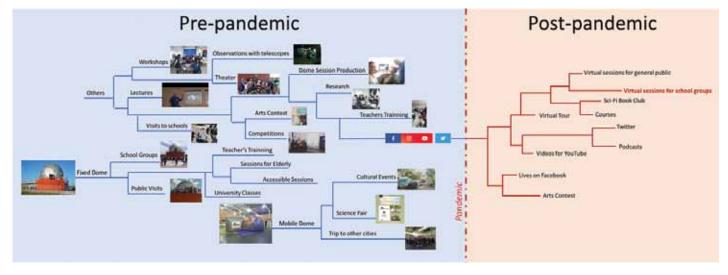
We write this article while we are still having virtual school field trips, scheduled through our webpage. More than 2.000 kids have attended our shows, including a special event streamed live on YouTube. Because many more trips are coming, we decided to perform this research now to better understand what is going on and how we can improve.

The research

We asked the first nine teachers who scheduled the virtual field trip to answer a brief online survey. From their answers, we know they are from different states in Brazil, from the south (Rio Grande do Sul) to north (Piauí), 4000 km distant, with five working in private schools and four working in public schools. Three of the teachers have never visited a planetarium before, while two teachers only visited a planetarium when they were students and four teachers visited a planetarium with their students. Only one teacher affirmed that she visits a planetarium once a year.

After the teachers answered the survey, we invited them to a virtual meeting to better understand their feelings, expectations, and motivations that led them to schedule a virtual trip to the planetarium. Even though only four teachers took part, we have a variety of school types and teachers backgrounds and some amazing testimonies.

Teacher 1: Educational coordinator in a private school; 10-12 years experience with the school in the Brazilian Astronomical Olympics. Each year, before the olympics, the school promotes a luau, an event based on gathering people together. The school replaced the luau by the virtual tour. The school is located in a city which has a plan-



Schematic diagram of the Planetario da Unipampa activities.

etarium, which they usually visit. It's one of the first opto-mechanical planetariums in Brazil.

Teacher 2: Works in a new private school, only 1 year old. The closest planetarium is the Rio Planetarium, four hours away from the school. The teacher indicated he was motivated to visit the planetarium after the pandemic. The teacher, who is also in his first year teaching, visited the planetarium when he was a student. He was teaching about the solar system and the virtual tour became part of his classes.

Teacher 3: This teacher has worked at a public school located in land reform settlement, far from any bigger city and with dirt roads, for the last 6 years. Once the teacher visited a planetarium with a school group, an endeavor that took the whole day.

"I would like to ask to the university, even after this pandemic, if it would be possible to keep the virtual field trips, once a while, at least once in a month, because the students were so happy and they participated in..."

Teacher 4: Works in a public school, far from a planetarium, but they take the high school students to visit a planetarium.

We focused our attention on answering similar questions placed on the influencing factors of virtual attendance, the integration to the curriculum, and the teachers goals. We also try to understand how these visits will impact future teachers plans about visiting a planetarium.

Influencing Factors

In some cases, the virtual tour came as an alternative to regular visits conducted by the teacher, as in the Teacher 1 case, who makes the visit with 5th, 6th, and 7th graders each year. Teacher 2 mentioned that he heard from a friend about the virtual tour right after teaching about the solar system, which moti-

vated him to schedule. Teacher 4 mentioned that she saw it as an opportunity to learn more about astronomy. Both Teachers 3 and 4 mentioned that they have already taken the students to a planetarium, but the distance is an important factor that makes these visits difficult.

Integration

Teachers 3 and 4 mentioned that they don't usually teach astronomy in class, but they conducted class work with the students after the virtual field trip. As mentioned before, Teacher 2 heard about the virtual tour right after teaching about the solar system which was very important to him. After the visit, the school coordinator asked him to schedule other classes because, even though they were not studying astronomy in class, they considered it to be a wonderful experience.

Finally, Teacher 1 is a school coordinator usually in charge of astronomy week, when the students study deeply about astronomy to participate in the Brazilian Astronomical Olympics and, during that week, they replaced the traditional planetarium visit with the virtual one.

Goals

We consider the goals presented by Schwarz, Ghent and Plummer (2019) in order to understand why the teachers scheduled a virtual field trip to the planetarium. It is important to mention that we have only four teachers' data and we don't intend to make this a panorama of teacher beliefs about the planetarium. Instead, we only want to better understand the role that virtual planetarium shows had played during the pandemic and how we can adapt for the near future.

Also, it is important to mention that we conducted the focus group interview after the visits and the teachers' goals for their students

may be mixed with their experience on the virtual tour.

Review Classroom Material: Teachers 1 and 2 were very clear their goal of reviewing classroom material for their students, while Teachers 3 and 4 weren't working on astronomy contents in class.

Overall experience of the planetarium: Teacher 3 mentioned they have already taken students to the planetarium and when she knew about the virtual tours, she thought that would be an opportunity for the students to have a broader overall experience of the planetarium.

Chance to ask questions: Teacher 4 told us about her lack of knowledge about astronomy and how the visit would be a great opportunity to learn about the sky and give the kids a chance to ask questions.

Excitement/interest about the space: All teachers mentioned in different ways kindling excitement about space as one of their goals, especially teachers who virtually visited us more than once and who came back to excite young kids about the space.

View of night sky: None of the teachers mentioned the view of night sky as a goal and it is quite easy to understand, since most of them live far from big cities, some even farther in rural areas, and have astonishing dark skies.

Conclusions

The pandemic brought some new challenges to everybody all around the world and planetariums aren't finished with these challenges. As the virus spread through different countries and continents, all institutions started to chart paths through the virtual world. Schools moved their classes to Zoom, Teams, Classroom, Webex, and other platforms. Some planetariums started to develop virtual (Continues on page 32)

(Scheduling virtual school trips during the pandemic, continued from page 32)

content on Facebook, YouTube, Twitter, and more, including virtual field trips.

Questions emerged from this new way of interaction: Why should we schedule a virtual school field trip? How should we organize it? Will it replace real visits? Will it remain after the pandemic?

We drove our attention on understanding why teachers schedule a virtual field trip. We sent a survey to the first nine teachers who scheduled a visit and invited them to a focus group. Even though only four teachers appeared for the meeting, they configured a very diverse group, including: a private school teacher from a big city that has a planetarium and a public school teacher from a rural area; a first-year teacher and one with 30 years of experience; and teachers who usually visit a planetarium and teachers who had visited only once.

This diverse group presented distinct motivations to schedule a virtual field trip, ranging from reviewing classroom material to the chance to let kids ask questions about the space.

We also extended our discussions about virtual classes from where we understand that the virtual planetarium offered enormous help to teachers who were still learning how to deal with this new way of teaching through the computer screen.

Finally, one teacher mentioned that for her, a virtual trip was very interesting because they did not spend time in traffic jams, there were no delays, and there were none of the other time-consuming things that may happen during a trip. It would let us think that she would consider replacing a trip to the planetarium to a virtual tour.

Another teacher, from the rural area, who already took a group to a planetarium, mentioned that it is a very difficult trip that they do not do with younger kids and the virtual tour was an amazing experience. She asked us to, even after the pandemic, keep some virtual tours available.

A deeper study would be necessary to understand the role of the planetarium in education during the pandemic, encompassing different countries, different planetariums, and different cultures; however, it is clear for our planetarium that we played an important role in this pandemic scenario. The planetarium is well known as a place that perfectly matches quality education and high technology, which is a goal of any city, state, or country education secretary.

Now we face new challenges with maintaining safe environments when going back to in-person activity while we also try to keep our virtual content alive and to promote outstanding outreach. Going farer, going together.

References

Schwarz K., Ghent C., Plummer J., Why do they come? The motivation behind field trips to the planetarium. *Planetarian*, Vol 48, No 1, March 2019

Tracy, S. J. Qualitative Research Methods Collecting Evidence, Crafting Analysis, Communicating Impact, Wiley-Blackwell, 2013. ☆

(Minutes, continued from page 32)

differences across the world. This includes discussions on making available translations, or summary translations, of sessions that will take place in the virtual conference.

Membership Committee

See official minutes.

Planetarium Design and Operations Committee

The IPS Planetarium Design and Operations Committee has been a willing resource for advice on the design of new facilities or operational considerations for older institutions. The group has made presentations at various IPS and regional conferences and has written articles for *Planetarian*. The committee members recommend dissolution of the committee as a formal structure, with all remaining available (through a key person contact) to provide similar assistance and advice, as needed, in the future.

Portable Planetarium Committee

The committee has made revisions to the *Portable Planetarium Handbook* chapters 4 ("Practical Applications") and 5 ("Manufacturers"). They have posted online a collection of reopening strategies as well as ideas for keeping the momentum of programs moving forward. Included in these suggestions are taking advantage of networking and information available from resources such as The Planetarian Network and Dome Dialogues.

Science and Data Visualization Task Force

The mission of this task force is to streamline the process of going from data to dome, increasing the potential for scientific communication and storytelling in the planetarium. A successful Data to Dome workshop was held at Colgate University on 18-19 October 2019. The task force developed a position paper on the research value of the planetarium, which was submitted to Astro2020 (available on the IPS webpage). Future plans are to refresh membership of the task force to keep the momentum going.

(Past president, continued from page 32)

Astronomy can be a binding force for good and understanding. We all share one sky regardless of where we come from, what our background may be, or what we believe. The planetarium community is my family, not the family I was born into, but the family I chose. We are a group of passionate people who love sharing the sky and universe with everyone.

I am proud to call you family and look forward to seeing you at future IPS and other planetarium events. I hope all of you stay safe and that you continue to share the wonders of the universe with your audiences

Thank you for making this possible and giving me the honor of serving this wonderful organization. ☆

"Astronomy taught us our insignificance in Nature."
- Ralph Waldo Emerson

"Astronomers, like burglars and jazz musicians, operate best at night." - Miles Kington, Journalist

"For my confirmation, I didn't get a watch and my first pair of long pants, like most Lutheran boys. I got a telescope. My mother thought it would make the best gift."

- Wernher yon Braun

"Mortal as I am, I know that I am born for a day, but when I follow the serried multitude of the stars in their circular course, my feet no longer touch the earth; I ascend to Zeus himself to feast me on ambrosia, the food of the gods." - Ptolemy

"Only two things are infinite, the universe and human stupidity, and I'm not sure about the former."
- Albert Einstein



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Keyword: Flexibilidad

Turning adversity into opportunity when pandemic hits



Bryant Gonzalez mochilerosastronomicos@gmail.com Currently in Montevideo, Uruguay

What a year for astronomer travelers!

2020 was a really tremendous year for everyone. Each story of failure and success due to the COVID-19 pandemic and quarantine is important, and every single person and their tales must be remembered as human perseverance stories that can inspire future generations or prepare us to new events.

All of us in the planetarium community had plans and very important projects. Even me, a very new member of this community, had been involved in planetariums in South America. During the last months of 2019 I was invited to the South America Planetari-

um Association, naming me an honorary member after visiting more than 30 planetariums in 6 countries. I also received in my e-mail the IPS conference invitation to travel to Alberta, Canada in June 2020 and I decided to expand my horizons by traveling to a new continent and sharing my experiences with different cultures and people.

I started the travel from Argentina to Brazil in January to join fellow IPS members Guilherme Marranghelo and Alexandre Cherman, along the way preparing to learn Portuguese and beginning this new chapter of my life as a backpacker during our flight to Canada from Sao Paulo's airport.

In February 2020 I met with Alina Sabyr in Paraguay, a Kazakhstan girl who accompanied me during my trip with her beautiful project. She is an astronomer and traveler who visited different astronomical cultures around the world and in our travel across Paraguay we supported each other sharing our activities and learning from local people until we took different routes in March 2020. (You can learn

more about her travels in the September *Planetarian*, Vol. 49 No. 3.)

Once in Brazil everything changed. The pandemic quarantine surprised me in Guilherme's house, and with his wife, son, and daughter I became part of his family for a month. I then decided to travel to Sao Paulo, believing that the quarantine wouldl finish soon and I could go to Canada, but day by day the world started to change.

Being a traveler, a foreigner without local documents, house and limited resources, I started to travel in short distances, staying in refuges and very cheap rooms, working on

line and developing new projects.

During this time I received support and donations from Brazilian Planetarium Association members and others who knew my project, and that allowed me to survive and focus on my work. After visiting more than 40 planetariums in 8 countries. I wrote my first book about them and dedicated it to every dome around the



world. After a few months in Brazil I decided to visit Uruguay to prepare and execute my new big project.

A frustrated jump

Uruguay is the only Latin American country that allowed travel to Europe; I had decided to introduce my project to every



Summary of my journey in one graphic.

planetarium in this new continent. I communicated with several representatives of astronomy there and prepared (again) everything to take my first flight in an airplane, but the day I was in the airport and ready to leave, a reality came to this moment: my nationality.

Due to my three years traveling as a Venezuelan immigrant, I never stopped in any of these countries to regularize my legal situation. I never worried about becoming a citizen because I was a tourist, and I had performed my astronomical activities as a volunteer or invited guest but never had a legal hire or commitment with any government. I was only the international visitor, and after my demonstrations I will keep traveling until the next destination.

I avoided those processes because the bureaucracy and requirements were too many and or took a lot of time, and my rhythm of travel was didn't allow me to stay long in (Continues on page 48)



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From curiosity to capital consequence: Edouard Roche chases the limits of gravity

Dr. Jean-Michel Faidit Planetarium and astronomy historian contact@faidit.fr

Nowadays, you only have to open an astronomy book or magazine to find the terms "Roche limit" or "Roche radius." Their applications are numerous and varied: planets and the minimum distances of their satellites, comets and asteroids, double stars, "hot Jupiter" extrasolar planets, cataclysmic variables, x-ray binaries, and double black holes that allowed the recent detection of gravitational waves, a century after their prediction by Einstein.

The emergence of the understanding of Edouard Roche's boundaries resulted from his questions about the cosmogony of Saturn's rings in 1849 and the study of a simple rotating ellipsoid model distorted by the attraction of a distant point. Comparative reading of his manuscripts and publications allows us to trace his reflections. Around 1900, Henri

Poincaré and George Darwin became aware of their importance.

As for his studies of atmospheres from 1851, they apply to double stars after the nature of the stars was established by Arthur Eddington. Taken over by James Jeans in 1919, Roche's model is generalized to compact nuclei. Extending Subrahmanyan Chandrasekhar in 1933, Zdeněk Kopal ended up in 1955 with the figure of the lobes. The limits of satellites are revisited, with the cohesion forces of solid bodies and space missions. Roche's problem had become more complex, from the stationary case of synchronous circular or elliptical orbits to a dynamic problem, with asynchronous, parabolic or hyperbolic keplerian orbits. We even explore the problem of Roche relativist.

Although the same problem is that of grav-

itational interactions by tidal forces on rotating satellites, two different concepts are found depending on whether homogeneous bodies or bodies with central condensation surrounded by an atmosphere are considered. The first gives a minimum distance where a satellite can maintain itself, the "Roche boundary," while the second provides the figure of a distorted atmosphere until it completes another boundary, the critical equipotential of Roche's lobes in tight binaries.

By worrying about the first, Edouard Roche thus successively put his finger on these two concepts, the two "limits." He discovered the value of the first in 1849 at the age of 28, and led the way through his work by modeling the atmospheres in curves of levels, undertaken as early as 1851, to the formulation of the second, whose exact figure was completed in

the middle of the twentieth century with an application to double stars.

But who was Edouard Roche? How did these results come to and how long did these concepts go through for almost a century before the scientific community fully recognized their importance?

Origins of the Roche problem

The roots of Roche's problem predate Roche himself, joining the three-body restricted problem for the Roche Lobes and the problem of the balance figure of rotating ellipsoids for satellite boundaries.

The three-body problem is historically associated with Isaac Newton's work on gravitation, Alexis Clairaut in 1758 for the return of Halley's comet, Leonhard Euler and Joseph-Louis Lagrange in 1772, and Carl Gustav Jacob Jacobi in 1836. Poincaré, to solve it, simplified it in 1892 by introducing the problem with a small three-body.

His condition that the mass of one of the three bodies was negligible compared to the other two might have interested Roche's studies in 1851 on an atmospheric particle attracted to his body and a nearby star. It finds its applications in the later developments of the Roche lobes, considering for the third body the exchange of matter between two stars, or the aggregation of a particle to a satellite as close as possible to a planet.

The problem of ellipsoids originates in Newton's work on the figure of the Earth, with the controversy that followed publication of the *Principia* (1687) where a spheroid flattened at the poles was opposed to the spheroid oblong defended by the Cassinians, a quarrel decided after the expedition of Pierre Louis Moreau de Maupertuis, Alexis Claude Clairaut Clairaut, Pierre Charles Le Monnier, Charles Camus, and Anders Celsius in Lapland combined with that of Pierre Bouguer, Joseph Jussieu, Louis Godin, and Charles Marie de La Condamine in Peru in the 1730s.

Subsequently, studying a fluid mass in uniform rotation whose outer surface is that of a revolution ellipsoid, Colin MacLaurin (1742) found, according to the angular velocity, two ellipsoids satisfying the equilibrium conditions, one elongated and another almost in the shape of a spheroid.

In 1836, Jacobi showed that such a mass could also be in the form of an uneven three-axis ellipsoid, reviving the interest of surveyors, such as Meyer, who in 1842 examined the relationship of Jacobi's ellipsoids with the Maclaurin spheroids, before Joseph Liouville challenged his results in 1846.

Mathematicians of the time followed these debates, notably M. Lenthéric, professor of Edouard Roche, and Roche himself, who then studied the cosmogony of the solar system.

The Laplace hypothesis developed and the emergence of boundaries

Edouard Roche sifted through Pierre-Simon Laplace's cosmogonic hypothesis, inserted in the first edition of ...du système du monde (The System of the World), published in 1796, and developed with formulas in later editions, as

well as in his *Celestial Mechanics*. It was one of the few during the 19th century that marked what Bruno Morando called "the golden age of celestial mechanics" between Laplace and Poincaré. While most of these "astronomermathematicians" are busy perfecting the calculations of the movements of stars already in orbit, Roche is invested in the cosmogonic aspect of their formation.

Based on this hypothesis of the formation of the solar system within a rotating and contractional nebular mass, it first formulates the equations of preservation of the angular moment during this contraction, and the conditions imposed on molecules by centrifugal force. Extending Laplace's work, he sets out to explain many properties of the solar system concerning the orbits of the planets, the moon, the rotation of planets on their axis, the law of planetary distances, and even the anomalies then known to the solar system as well as satellites and rings.

The only known rings at the time are those of Saturn. These rings disappear in appearance every fifteen years, and the winter of 1848-49 is the time.

Passionate about astronomical observations, Roche follows day after day their reappearance, noting their increase in brightness with a bezel of Dumoutiez design of 80 mm and 1.10 m of focus (according to a correspondence published in the *Proceedings of the Academy of Sciences*).

It is possible to think that this "live" vision may have played a triggering role in his reflections on the respective distances of the ring and satellites to the planet. For if the explanation of these disappearances is known, then the cosmogony of the rings remains open. Do they exist of origin, by analogy with the formation of the planets around the sun? And did Saturn's ring remain as it is, or did it partially aggregate into satellites?

At the intersection

Both theorist and observer, Roche finds himself at the combination of two current questions: ellipsoids in mathematics and the ring of Saturn in astronomy. His genius is to connect them because you had to be a mathematician and an astronomer to establish this junction. Mathematically, by varying the

distance of an ellipsoid, it obtains a modeling of the problem that no longer has a solution graphically from a certain value. This disappearance of the balance of the ellipsoid corresponds, astronomically, to a disintegration of the satellite. In June 1849 Roche's boundary was formulated. By considering objects



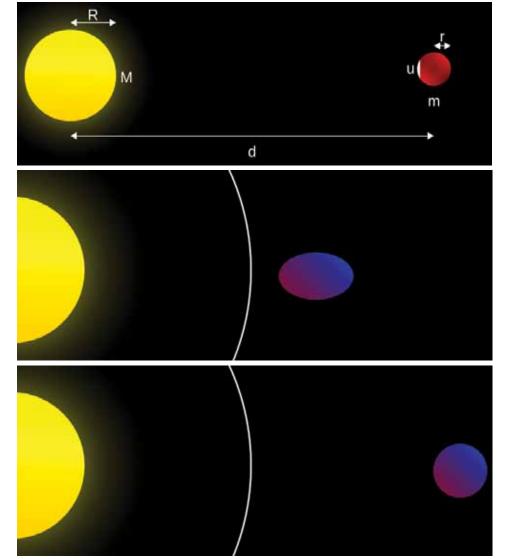
Handwritten memoir of Edward Roche (1849), preserved today in Paris in the Archives of the Academy of Sciences. Image and following figures provided by author, except where noted.

surrounded by atmospheres, he developed in the following years a dipole that would lead in the twentieth century to another "rock boundary," delimiting the lobes of Roche in a tight binary system.

Expanding his reflections to the satellites of the solar system in general, he considers the stable ellipsoid little different from the sphere, "the only one that meets in nature," and generalizes the formulas of Laplace—who had treated the moon only in the form of a spheroid—to Jupiter's four Galilean satellites and to Saturn's first known satellite at the time, calculating their flattening and conditions. Assuming this satellite of the same density as the ringed planet, it is faced with the impossibility of making use of the approached formulas used for the moon and Jupiter's satellites.

As the general equations are too complicated, he builds tables to test the stable ellipsoids that may be suitable. As they approach "fictitiously" the planet, he discovers that this balance continues, provided the satellite stays at a distance of more than 2.44 rays from the planet. He makes the interesting remark that

(Continues on next page)



Top: llustration for the derivation of the Roche limit (small mass); Center: Closer to the Roche limit the body is deformed by tidal forces. Bottom: Far from the Roche limit the mass is practically spherical. Wikimedia Commons, Theresa Knott

this distance is barely greater than the size of the ring by studying the conditions of stable solutions, in the case of a very small fluid mass compared to an attractive mass: "Below this distance, a very small satellite could not maintain itself in balance with an elliptical figure. It will be noted that this limit distance is barely

greater than the outer radius of Saturn's ring."

Timeline of the emergence of concepts

At the source level, his founding work is undoubtedly his Memoir on the figure of a fluid mass subjected to the attraction of a distant point. It is published in three parts in the *Memoirs of the Science Section of the Academy of Montpellier* (1849-1850-1851), notes are inserted in the *Proceedings of the Academy of Sciences* and the autograph manuscript, dated June 3, 1849, examined at the session of June 18, is kept in the archives of the Academy of Sciences.

Roche's problem is that of the close interaction of the stars by tidal forces. But, apart from the rupture of the bodies, this problem can hide another. When the tidal-force satellite has an atmosphere, the deformation of the atmospheric layer will lead to the 20th century's Roche lobes of binary stars. The solar and planetary nebulae he considers to be fluid in their formation.

However, these cosmogonic nebulae, by contracting, result in a central condensation, surrounded by a low-density atmosphere. This naturally leads him to study the shape of the atmospheres, first in the isolated case of a distant satellite, and then in the interaction of the Earth-moon dipole in formation. Modelling according to a geometry in curves of levels allows him to describe his equipotentials and the deformation of their limit surface.

Among the sources available, in addition to his first dissertation on atmospherics in 1851, are the one on satellite atmospheres in 1852, and another on the figure of atmospheres, to which he returns eight years apart, in 1854, and then in 1862, after a nearby memoir on the atmospheres of comets published in 1858. Unusually inserted in the *Annals of the Paris*

Observatory, he states a repulsive force coming from the sun, which allows him to correctly explain the shape of comets before the physical discovery of radiation pressure.

Finally, a decisive step for his notoriety was constituted in 1873 by his "Essay on the Constitution and Origin of the Solar System," where he summarized his mathematical complements to the cosmogony of Laplace.

It is possible to trace the paths of his reflections. With the exception of his first sealed folds deposited at the Academy of Sciences in 1846 and 1847, Roche's first lecture on the figure of a fluid mass mentioned in the minutes of the Montpellier Academy dates back to January 15, 1849. He examines a Cartesian explanation of Huygens'. He clutches in April with a note "On the figure of the Moon," re-discussing Laplace's explanations by assuming our fluid satellite. Roche's boundaries are in the air with recent developments in ellipsoid theory. In May, keeping among two stable ellipsoid figures the one lying towards Earth, he simplifies the formulas that bind the three axes of this ellipsoid. Noticing that this figure is not found in any of the known satellites, he makes the theoretical calculation for our satellite, finding that it merges with Jacobi's ellipsoid.

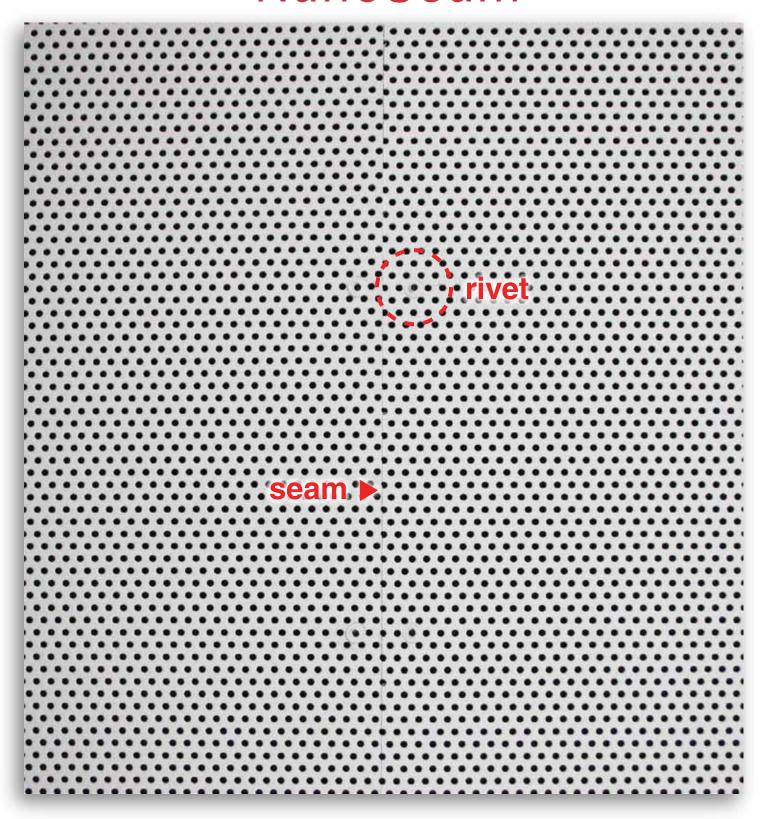
The emergence of the boundary culminated in June with Saturn's ring and research on ellipsoid stability. His 1849 dissertation, presented at the June 11 session of the Academy of Montpellier, was examined at the Academy of Sciences a week later, on June 18. The first report by Cauchy and LeVerrier suggests further investigation. On March 11, 1850, he presented new research on the figure of a fluid mass rotating on itself and in revolution around a very distant outer body, developing the asynchronous case and the continuous deformation of the fluid satellite.

A prelude to Roche's lobes: the study of atmospheres

One can also follow the emergence of the other "limit" of Roche, this time concerning the figure of the atmosphere of one star by approaching another. It was on February 10, 1851 that Roche presented his first note on the theory of atmospheres.

(Continues on page 40)

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According to Laplace, the sun's atmosphere, extended beyond the planetary world, contracts as it cools. Rings, left in the equatorial plane, lead to the formation of planets. These rings result from the release of molecules near the equatorial periphery, under the action of the higher centrifugal force due to accelerated rotation by contraction. Laplace postulates that this atmosphere initially extended to its limit, where centrifugal force counterbalances gravity.

In this purely rotational problem, Roche's most promising contribution to the release

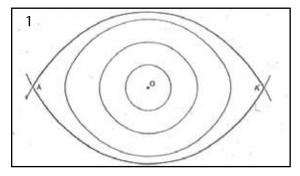


Fig. 1: Roche's model (rotational problem), with two protruding edges releasing rings in the equatorial plane.

of Laplace's rings by contraction is to reformulate it according to a three-dimensional vision. Modelling these atmospheres in layers of levels, it defines the free surface as the largest of the closed-level surfaces, that is, the one that reaches the limit surface.

The new fact discovered by Roche is that this free surface has a protruding ridge of 120 degrees at the equator, resulting from the rotation of a figure flattened at the poles with a generating curve resulting from the two-point double revolution at the equator. As Poincaré pointed out in his classes at the Sorbonne, through the liberation of the rings by this equatorial ridge, he thus shows that the basis of Laplace's theory can be interpreted as a consequence of his geometric theory of atmospheres.

Always absorbed by his cosmogonic concerns, the application of the Roche problem to bodies with an atmosphere begins with the study of the Earth-moon system in formation noting "a precaution to be taken that Laplace does not appear to have noticed," the atmosphere ending at the distance where gravity to the moon is equal to zero, "a relative gravity, i.e. resulting from the difference between the action of the Earth on the molecule and its action on the center of the moon."

Studying these interactions for stellar atmospheres will pave the way for Roche's lobes. But it does not yet delve deeper into the, as the atmosphere can cover the nucleus of a comet that seems to interest it alone. Its objective is to study the shape of the layers of levels and

in particular that of the free surface. It assumes synchronous rotation and reviews various mass ratios for the Earth and moon leading to the calculation, for an infinitely small satellite, a distribution of the atmosphere on three axes, with differences all the more sensitive as one moves away from the center of the satellite.

This brief was not included in the 1852 Memoirs, but it is clear that the main results were formulated as early as 1852. He has in mind his cosmogonic concerns, including showing that the Earth's atmosphere may have extended beyond the orbit of the moon,

the theory of co-accretion with the Earth being dear to him.

The release of his 1873 essay, including the description of what Jeans would call the "Roche model," explained the mention of this date in most of the current bibliographical references for Roche's second problem. But his first approach to the problem of satellite atmospheres actually dates back more than twenty years, as early as 1851.

In the 19th century, the actual structure of the stars was not yet established. If he did not explain the double hourglass figure of the lobes,

Roche is the forerunner. As early as 1849, he conceived of extending his results for satellites with synchronous rotation to double stars.

Gradual awareness of importance of the first "limit" of satellites

If Roche first describes his research on the balance of ellipsoids as "curiosity," in his subsequent writings the resulting limit becomes a conclusion "worthy of note," then "remarkable," and finally "capital."

In 1849, having assumed the two stars of the same density and formulated its limit, he did not even consider it useful to write the formulas concerning the likely situation of different. In 1862, things changed and the limit with different densities is calculated. This minimum limit or distance of a satellite has become a conclusion "worthy to be noticed." In 1873, with the calculations again for stars of different densities, the conclusion became "remarkable." Finally, in 1882, in the recap of his academic work, describing in more detail the interpretation of the ring-satellite system, this limit became a "capital consequence."

The gradual spread of Roche's boundaries and lobes

It was not until the threshold of the twentieth century and their emphasis in the Poincaré courts that Edouard Roche's contributions to cosmogony and the famous "limits" began to cross the English Channel and the Atlantic and be perceived in all their potential. The British astronomer George Darwin, son of the famous author of the theory of evolution, pays tribute to him by calling them "the limits of Roche." And his pupil James Jeans endorsed the phrase "Roche model" in 1919: "For convenience, we now refer to it as "Roche's model." Half a century after the formulation, its posterity is established.

In his 1906 memoir in the *Philosophical Transactions*, Darwin attributes this delay to the ignition to "the singular modesty of Roche's style."

"More than half a century ago Edouard Roche wrote his celebrated paper on the form assumed by a liquid satellite when revolving without relative motion, about a solid planet. In consequence of the singular modesty of Roche's style, and also because the publication was made at Montpellier, this paper seems to have remained almost unnoticed for many years, but it has ultimately attained its due position as a classical Memoir."

As for the other "Roche limit," the equipotential of Roche's lobes in the double stars, it was named in his honour by Kopal in 1955. He deepened the early works of Jeans in 1919 and Chandrasekhar in 1933 applying the Roche problem to stellar objects. A century later, as with the limits of satellites in planetology, they now have multiple applications in astrophysics.

First relays in the dissemination of Roche's work in celestial mechanics

It took half a century for the astronomical world to truly appropriate it. We have seen in the biographical approach that two reasons contribute to explaining this slowness in the 19th century: on the one hand, Roche's choice to publish in the *Memoirs of the Academy of Montpellier,* whose dissemination is limited. On the other hand, the precocity of his ideas at the time for their planetary and especially stellar applications.

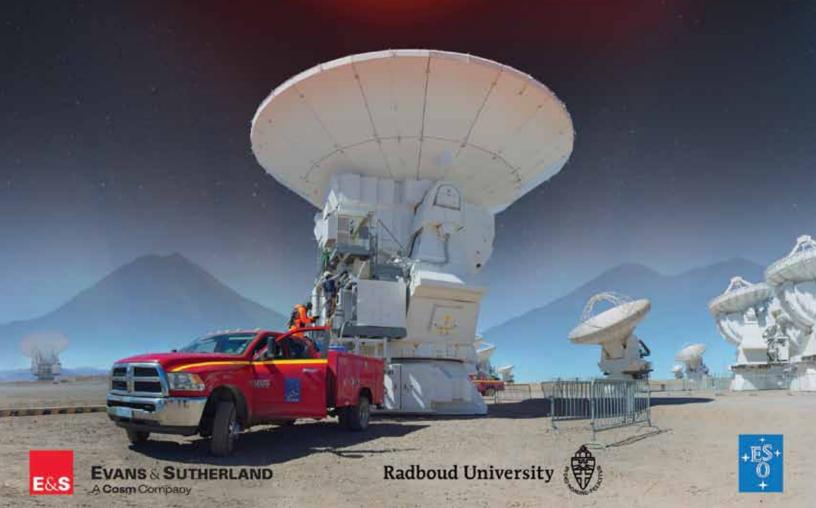
Of course, echoes are relayed in the *Proceedings of the Academy of Sciences*, in addition to excerpts by Roche himself, as early as 1849, with the reports of Cauchy and Le Verrier, or Faye, in 1873, for the presentation of his essay. In the works of celestial mechanics, Hervé Faye, Maximilian Wolf and Résal also relay his concepts, the latter introducing into higher education his main results in the continuation of Laplace's cosmogonic ideas. Yet the potential importance of boundaries is not yet understood.

It has also been seen in the biographical approach that in Weaver's memoir proposing his election to the Academy of Sciences in 1883, most of his works are listed, except the astronomical applications of these limits that have made it pass to posterity! It was not until Poincaré and its undeniable international influ-

(Continues on page 42)

BLACK HOLE

FIRST PICTURE
COMING SOON



ence that the integration of Roche's work in its courses and works attracted the attention of the scientific community at the threshold of the 1900s. Some twenty years after his death in 1883, Roche's problem crossed the English Channel. In 1906, in a famous memoir inserted into the Philosophical Transactions, Darwin gave it new extensions in the study of the rotational and gravitational problem. At the same time, Lyapunov and Schwarzschild also incorporated Roche's sequences into their ellipsoid research.

At the same time, Roche's boundaries crossed the Atlantic, although Chamberlin, in a correspondence with Comstock in 1903, mentioned that Roche's work was not available in Chicago. This indicates that we are now looking to obtain these Memoirs of Montpellier, which have not been widely distributed on the other side of the ocean. It is now a long time since Maxwell and Hirn, demonstrating in 1859 the unsolid nature of Saturn's rings, ignored his contributions.

It may also be necessary to take into account the language barrier. A telling indicator of the importance of the Roche problem a century later, it was not until 1996 that an excerpt from his 1873 essay, "On the Origin of the Solar System," was first translated into English by Brusch in his historical work on the cosmogonic theories of the solar system.

Theoretical expansions of the Roche problem

Over the decades, Roche's problem has become more complex in a bundle of different approaches. Depending on the orbits and whether or not the rotations are synchronized, the shift from a stationary problem to a dynamic problem is shifted. From fluid satellites to solid satellites, from the Newtonian frame to the relativistic framework, the angle of approach to the problem may also be to take it back to the source with new theoretical tools available.

Extension of the homogeneous case with two fluid bodies: Darwin's problem

If the initial Roche problem consists of a fluid object rotating around a point mass, in 1906 Darwin presented a first generalization by assuming that this fluid object revolves around another. This is what we now call Darwin's problem. Darwin is actually considering two steps:

- First a satellite of infinitesimal mass in revolution around a spherical planet (which Roche considered a point mass), what he calls "modified form of the Roche's problem";
- Then a finite mass satellite, with the planet also becoming ellipsoidal by mutual interactions, what it calls "modified problem of Roche" to determine the

influence of the flattening of the planet by a rotation equal to the revolution of the satellite.

The first case provides a Roche limit of 2.45539 rays of the planet, close to 2.44 of Roche's initial problem, while in the second case, its calculations study stability limits with various mass ratios for these two fluid ellipsoids interacting, until the two masses are equal. By considering identical densities, it obtains stability limits at 2.48 when the planet is flattened, and 2.35 when it is spher-

ical, confirming the intuition that elitability causes instability at a greater distance. In addition to refining the value of the Roche boundary, Darwin's concern was to have a model for describing double stars, unaware that it was unsuitable because of the inhomogenic structure of the stars.

rotating masses subjected to their own gravitational forces: • incompressible model (homogeneous

- incompressible model (homogeneous mass of incompressible matter, uniform density);
- Roche model (high density point mass, atmosphere of negligible density);
- generalized Rock model (incompressible homogeneous core, atmosphere of negligible density);
- adiabatic model (mass of gas in adiabatic equilibrium);

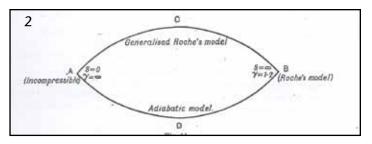


Fig. 2: Jeans diagram (1919) considering Roche's incompressible model and model as limitations of the adiabatic model and its generalized rock model.

Jeans' extension of inhomogenic case modeling: the generalized Roche model

In the classic Roche model, the nucleus is finite mass, but of infinitesimal volume, literally a point. It is surrounded by an atmosphere of zero mass, but of finite volume. It can be said that the density of the nucleus is infinite while that of its atmosphere is zero. In his 1919 work, Jeans introduced a generalized Roche model (GRM), with a solid solid core, of finite volume and therefore density, surrounded by an atmosphere of infinitesimal mass and density, whose respective properties can be compared.

This introduction of a generalized Roche model, in its chapter IX of the configurations of compressible rotating masses, is still purely theoretical, because the internal constitution of the stars is not yet established and like Darwin fifteen years earlier, he deals with the problem of double stars, which he refers to as "star problem," in his previous chapter of configurations of rotating fluid masses. Nevertheless, it is a remarkable contribution, rich in astrophysics.

He is led to formulate his GRM by noting that between the three spheres in rotation possible, except that fluid, between the fully gaseous and the gaseous one with the bulk of the concentrated mass at a central point, one could also consider the case of a gas sphere with a non-punctual central nucleus. He even plans to bridge the gap between the incompressible model of liquid bodies and Roche's model: "It is obviously very desirable to bridge over, if possible, the wide gap between these two extreme cases." One of his concerns is to compare the four models available to describe

The first two models appear to him as borderline cases of the other two, he summarizes his work by drawing up a diagram linking the models.

In the end, Jeans contributed from three angles to Roche's problem: thanks to his scientific influence, he gave an undeniable boost of interest to the tidal problem that his master Darwin had revived. In terms of applications, it still concerns satellites, but in its work it deals only with a problem of "pure" tides, of a theoretical nature since the primary object must have an orbital motion around the source, which leads it to the spheroids of Jeans. Finally, his introduction of a generalized Roche model proved to be particularly well adapted to the internal structure of the stars, paving the way for the shift of the "double star problem" to the compressible domain in the 1930s.

In his studies of GRM stability, Jeans' goal was to study the different ways in which the nucleus and its envelope break in extreme conditions of tides or rapid rotation. His model of generalized rock was taken up thirty years later by Kopal, who targeted another objective in 1949: to study small movements, purely radial in nature, resulting from a disturbance of the equilibrium state of a satisfactory object. As Kopal mentioned, the main reason astrophysicists took so long to recognize the fundamental nature of Roche's contributions was the ignorance of the internal structure of the stars. Even at the beginning of the 20th century, it was not excluded that these were homogeneous spheres, if not incompressible. NARRATED BY RICHARD DORMER

BIRTH OF PLANET

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Introducing Roche's lobes into the stellar domain

After the 1910s and 1920s, with the contributions of Eddington and his contemporaries, it became clear that Roche's models could be a much better approximation than any homogeneous model. The young Chandrasekhar, in 1933, formalized the theoretical first of this application of Roche's concepts to the stellar domain by demonstrating that with an increase in the degree of central condensation, the geometric properties approached asymptotically those of the Roche model.

Under Kopal's leadership, the astronomy of double stars underwent a meteoric development and thegeometry of the lobes became the subject of multiple researches after he completed the equation of the equipotential limit of Roche in 1955.

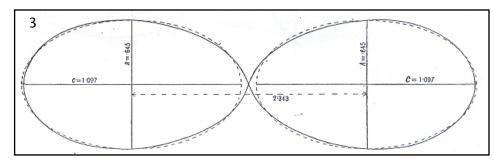
Apart from a drawing with half a lobe in the figures of the atmospheres of comets under the effect of the solar wind, Roche has never designed for double stars these famous lobes that bear his name. Their development is very later and is interesting to trace. In terms of representations, the first "approaching" figure of Roche's future lobes is Darwin's work, conjectured in his 1906 Memoir, presenting the juxtaposition of two elongated fluid ellipsoids. This scenario was more than unlikely, below the stability limit obtained by assuming the two ellipsoids of equal masses and densities. But it results in a kind of stretched ∞, in the hope of applying it to binary stars.

This is a different representation of the problem of atmospheric deformation, carried out with a homogeneous model, before the determination of the stellar structure. However, the beginning of a representation is there, with a knot. After Jeans' contributions in 1919, this hourglass figure of distorted stars was developed and also designated in 1955 by Kopal as "The Limit of Roche." Subsequently, in order to avoid confusion between this surface of the lobes exchanging matter by the first point of Lagrange with the other limit, that of satellites, the terminology prefers to substitute the expression "Lobes de Roche" denoting the volume contained within this limit equipential equipotent, the first publication to incorporate it in its title being that of Rucinski in 1971.

While this approach might be suitable for a homogeneous planet and satellite or a double-shaped asteroid, it is unapplicable to stars whose non-homogeneous structure was still unknown, with a dense core and a tenuous atmosphere, but the figure of the roche lobes of binary stars was on its way.

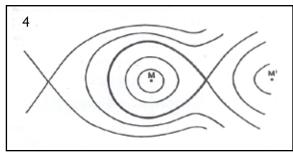
Following Eddington's decisive work on the nature of stars with dense nuclei, Chandrasekhar first applied the Double Star Rock model in 1933.

To avoid confusion with the limits of satel-



5

Fig. 3: Darwin's drawing (1906) extrapolating juxtaposition of two roche fluid ellipsoids Fig. 4: In bold, the surface of Roche's lobes after Jeans (1919). Fig. 5: The "Rock Limit" equipotential equipotential modeled in theory by Kopal (1955).



lites, in its application to double stars, the term "Roche lobes" was preferred to him from the 1970s on.

Over the decades, these Roche lobes found many applications in binary astronomy. Examples include novae and symbiotic stars, X-binaries, Algols systems, β Lyrae, Be stars, some pulsars, microquasars, dwarf galaxies, not to mention extrasolar planets with hot Jupiters. Depending on the type of objects involved, the mech-

anisms of overflow and material transfer are the subject of specific studies to model the Rock Lobe OverFlow (RLOF) of massive stars. In terms of observation techniques, Roche's lobes are visualized by a new method, called Roche Tomography, developed in 1994 by Rutten and Dhillon, applied with Watson to cataclysmic variables. Finally, in 2005, the dimensions of Roche's lobes were investigated by Zhao to test the MOND (Modified Newtonian Dynamics) theory, introduced by Milgrom in 1983 to eliminate the problem of dark matter in the universe.

From the stationary rock problem to the dynamic problem

For the record, in 1849, Roche's initial problem was the circular motion of one primary body around another, reduced to a point mass, with synchronous rotation. In 1963, Limber extended it to non-synchronous orbits, opening the comparison of the two cases for satellite limits. In 1971, Nduka expanded the problem to that of the eccentric orbits of a homogeneous satellite. In 2003, Williams developed the extension of the Roche boundary to non-circular, non-synchronous orbits, which also concerned parabolic or hyperbolic orbits, in order to determine the behavior of a

comet entering deep within its Roche boundary in the Newtonian case or a star passing near a black hole in the relativistic case, while for the lobes , Hadrava extends their study to eccentric orbits.

Reformulation of the limit of satellites for solid bodies

Planetology is particularly concerned with "atypical" satellites, such as Phobos resistant to the theoretical threshold. Even assuming the same density for planets and satellites, the break-breaking distances of these satellites are quite different from those calculated with Roche's fluid satellites. Jeffreys was the first in 1947 to take cohesion forces into account in solid bodies, followed by Opik in 1950, Aggarwal and Oberbeck in 1973, and more recently Dobrovolskis in 1990 through the properties of matter, including its elastic constants and failure parameters. The consequences are various. Jeffreys and Opik, neglecting the satellite's rotation and self-gravitation, first concluded that an unlikely rupture was made. But the strengths of the materials were overestimated at the time. Taking self-integration into account, Aggarwal and Oberbeck ended up at a lower limit. In 1975, Alfven and Arrhe-(Continues on page 46)

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nius proposed to introduce the term "modified Rock boundary" so as not to confuse it with the classical boundary. The separation of regolite grains is now being considered to determine the minimum stability distance of constrained satellites. Bursa is also developing a new theoretical approach to rupture by studying the progression of the fracture on the surface of a satellite.

Exploring the rings of giant planets, starting in the 1970s, brings a harvest of observations and the limits of Roche's solar system find new relevance. With the precision of the numerical simulations, the 1990s saw the research focus on the Roche accretion zone, at the boundary separating the rings of small satellites with the work of Canup and Esposito in 1995, and then those of Ohtsuki. A border confronted with data from space probes like the Cassini-Huyghens mission that showed that Saturn's outer rings are outside the boundary.

Geographically, we can almost talk about schools with research centers like the one in Boulder, Colorado (Canup, Esposito, Ohtsuki, Ward, Kokubo) or NASA AMES and the Lick Observatory in California (Aggarwal, Dobrovolskis, Lissauer).

In 1981, the Roche boundary, previously confined to the interior of the solar system alone, is applied by Robe to the study of objects in orbit near the galactic center, while from 1995, extrasolar planets offer a new field of application, both for the rock lobes of the hot Jupiters and for the Roche limits of exo-Mercury, Ford and Rasio opening these studies in 2005 by comparing minimum orbital separations. In the 2000s, other areas of application, such as asteroids, were developed by the work of Davidsson or Sharma et al, and then Descamps for double asteroids.

Roche's problem resumed with new theoretical tools available

Chandrasekhar, considered the greatest astrophysicist of the 20th century, made a historical and scientific synthesis of the problem of ellipsoid equilibrium figures in the 1960s. Some thirty years after applying Roche's model to the stars in 1933, and in addition to research on the solid satellites of the solar system, he undertook a complete reinvestment of the theoretical approach by considering incompressible fluid bodies. From 1962, The classic notion of Roche's limit thus saw a revival of interest with his work and those of Lebovitz, and a debate on the respective positions of the bifurcation point and the neutral point, using the Viriel theorem and its generalizations. They compare Roche's incompressible sequences with those of MacLaurin, Jacobi and Jeans. Robe contributed to this research with several memoirs tending to show a secular instability of Roche's ellipsoids

at the edge of Roche. The sum of this work is collected in 1969 in the major work of Chandrasekhar equilibrium figures of ellipsoids. It establishes that Roche's ellipsoids are not dynamically unstable at the Roche radius, but at a later point in the sequence, when the object has emerged from the Roche boundary, which is itself only a limit of vibrational stability in a stationary orbit and which does not provide any information on the destiny of an object that crosses it. The expansion of Nduka in 1971 to eccentric orbits confirms that the primary body is totally destroyed below the classical limit.

The problem of Roche relativist

As the fate of an incompressible mass was considered to be elucidated, studies turned to the relativistic generalization of this incompressible case that prevailed during the first half of the 1970s on the purely Newtonian treatment of the compressible case. This relativistic extension of the Roche problem was initiated by Chandrasekhar in 1966. The homogeneous case, leading to the sequences of Maclaurin and Jacobi, then the Roche model are successively examined. Mashhoon and Fishbone model the problem of relativistic Rock with black holes.

In 1985, Luminet reconsidered the incompressible case as a special degenerate case of the compressible refined model for parabolic orbits. With Carter, other types of behaviors are highlighted. The theoretical description of the rupture of a star passing near a black hole is elaborated, leading to the "pancake stars." Advances in numerical simulations have helped address cases of interacting compact objects, such as the rupture of a neutron star orbiting a black hole, and of course the extreme case of double black holes, the meeting of which allowed the first detection by LIGO of gravitational waves on September 14, 2015, a century after their prediction by Einstein.

We have seen that the scientific community waited for Poincaré and the beginning of the 20th century to measure the interest of Roche's boundaries. However, few researchers used them before 1940. It was after the Second World War that Roche's problem really became the subject of extensive research.

This growth in the use of Roche boundaries and lobes is related to the fact that their areas of application are evolving. On the one hand, the exploration of the solar system offers a wide range of investigation, from the ring-satellite systems of the giant planets, to the question of the origin of the moon, the limits also finding applications for distances among the extrasolar planets of exo-Mercury to their stars or in the nuclei of galaxies for the rupture of a star near a black hole. On the other hand, the lobes find new fields of appli-

cation: from the stellar astrophysics of double stars to the astrophysics of interacting primordial dwarf galaxies, to the "hot Jupiters" close to their stars, they have become an essential tool for astrophysicists.

Edouard Roche manuscripts and publications

For the Roche limit of satellites:

The manuscript of June 1849, preserved in the archives of the Academy of Sciences, served as the basis for Roche's famous three-part publication in the *Science Memoirs of the Academy of Montpellier:* "Memory on the figure of a fluid mass, subject to the attraction of a distant point." Memoirs of Science, 1849, I, 243; 1850, I, 333; 1851, II, 21.

For the draft of the "rock lobes" of the stars with atmospheres:

Academy of Sciences and Letters of Montpellier, Verbal Trials 1851, session of February 10. 25.

"Memory on the figure of the atmospheres of celestial bodies." Montpellier Academy of Sciences and Letters, Science. 1854, II, 399 and 403.

"New research on the figure of the atmospheres of celestial bodies." Memoirs of the Academy of Sciences and Letters of Montpellier, Science Section, 1862, V, 271.

"Test on the constitution and origin of the solar system." Memoirs of the Academy of Sciences and Letters of Montpellier, Memoirs of Science, 1873, VIII, 235

Other sources:

Laplace, Pierre-Simon, Exhibition of the World System. Paris, 1796.

Laplace, Pierre-Simon, *Celestial Mechanics*. 5 vol. Paris. 1825.

Poincaré, Henri, "Chap. III: Analysis of the Laplace hypothesis. Roche works. Study of the stability of a ring. Satellite formation." In *Lessons on Cosmogonic Hypotheses*. Paris, 1911.

Poincaré, Henri. "Lessons on the balance figures of a fluid mass." (Readings at the Sorbonne, Dreyfus). Paris, Carré and Naud, 1902.

Darwin, George Howard, "On the figure and stability of a Liquid Satellite-Roche's infinitesimal satellite in limiting stability-Roche's ellipsoidal satellite, in limiting stability, the planet being also ellipsoidal." *Philosophical Transactions*, London, 1906, 206, 162.

Jeans, J. H., "Roche's Model" in *Principles of Cosmogony and Stellar Dynamics*. Cambridge, 1919. 393 pp. (150-165).

Chandrasekhar, S., Ellipsoïdal Figures of Equilibrium. New Haven, 1969.

Kopal, Zdenèk, The Roche Problem and its significance for double-star astronomy. Kluwer, Dordrecht, 1989. 263p

(Continues on page 48)



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(Turning adversity into opportunity, continued from page 48)

one place. I repeated every single time, "I am South American citizen, I am cosmopolitan, I belong to the world, I am astronomer, we have no borders." But those were only words; the reality is that I have to belong somewhere and to condition myself to the system, to a country, to the rules, and the pandemic changed the rules.

Travel to Europe could only be made for Uruguayan citizens or legal residents, and I wasn't any of those, only a Venezuelan traveler without legal residence. I couldn't take the plane. They denied my boarding pass and told



Looking forward to the eclipse.

me "if you want to fly, become a resident." The clock started to run that day.

I gathered documents, vaccine records, my travel records, and everything else that I had to introduce to the immigration offices to validate the legal residence and get the document to go to Europe. It was a month and a half of waiting for approval, and finally, when I got it, it was too late. My Venezuelan passport expiration was due to expire in less than 90 days, below the limited time allowed to fly to Europe. Even with the Uruguayan document I was not allowed to fly once again. I breathed deep, and I saw the airplane taking off again without me.

With my feet on the ground

Maybe my destiny is to stay here in Uruguay, in South America, for more time than I expected. After all, there are more things to do in this continent, so I decided to apply and develop new projects here. Thanks to a donor in the U.S I bought a small telescope, which will be used to share a partial solar eclipse visible in this country on 14 December and, with my knowledge of astronomy, I will prepare children and adults alike to observe and close the year with this astronomical event.

Next year I will continue to do new activities of extreme outreach with a traveling telescope and dedicate the time to planetariums, observatories, and groups in this country, continent, and the world.



The journey that was not to be.

I would like to keep working with astronomy as a traveler, as a citizen of a particular country or not, because to me astronomy is the entire world. There are no borders in astronomy. If I have the support of other astronomers, associations, institutions, and donors, I won't give up in this battle to advance. So if you want to help, please contact me.

Probably I will return to my country or go to other continents after 2021. This world is too big to stay in one place.

I am grateful of everyone who knew about me this year, who supported and helped in my difficulties. I thank everything I have learned about health and care, I thank the life and the lessons and the families with whom I shared during these months, and I wish a happy new year to everyone. I end with hope: I hope everything goes well and we support each other in this beautiful planetarium community.

(Console, continued from page 6)

In this issue

Once again Loris Ramponi and I decided not to run the Planetarian's Calendar of Events owing to the continued uncertainty of the global pandemic.

I had three articles that looked at how to adapt to presenting during the pandemic. I thought it appropriate to group them under the theme "Planetarians adapt." That's what we do, as Mark Percy notes in Classdome on page 44. Joanna Holt tells about the success the Netherlands Research Institute for Astronomy has had in using a flat screen instead of the dome on page 28. Guilherme Marranghello and crew gathered data from teachers to examine virtual school trips on page 30.

And Bryant Gonzalez, the backpacking astronomer in South America, had his three years of wandering come to an end thanks in part to the pandemic, but turned circumstances into an opportunity. See page 34.

I have been supporting Bryant ever since

learning about his travels, not only through words in *Planetarian* but also financially. I am passionate about helping him succeed, playing forward the kindness and support that I have received from so many in this field. I invite others to help him as well (as so many planetarians in South America have already done—Kudos!), and to reach a hand of friendship and support to other young people struggling to enter this community.

I've never met Bryant in person, nor have I met Hari Mogosanu, author of 41 South. (I hope to change this distressing fact in the future). Hari applies knowledge from a former career in risk communication to the need to communicate more clearly and aggressively with our audiences on page 68.

Here is a suggestion: that she present an IPS professional development workshop on risk communication and how it can be put to use by planetariums.

Andrew Fraknoi shares a holiday gift with

Sharon Shanks has been *Planetarian* editor since Vol. 35 No. 3 (September 2006). She retired in 2015 from the Ward Beecher Planetarium at Youngstown State University in Ohio, returning to her journalism roots after a pleasantly passionate career sharing the stars. This is her final issue as editor.

readers with his astronomical calendar, a great educational resource for planetariums everywhere. See page 22.

Ron Walker and his Different Point of View column has received mixed reviews from *Planetarian* readers, but I enjoy his writing and his advocacy for the amateur planetarian. He shares with us a great story about a homebuilt dome from Cornwall on page 74.

Finally, I must thank Bill Tomory, whose name you're never supposed to hear. He has been my printer representative for many years, and is the one who makes sure we get to print each issue. He's the one who knows when I say I'll be done on Monday, I'll actually be done on Tuesday. Or Wednesday.

(Roche, continued from page 48)

Faidit, Jean-Michel (Coordinator) and 35 astrophysicists and planetologists from 15 countries), *Limits and Lobes de Roche*. Vuibert, Astronomical Society of France, Paris, 2007, 400 pp.

Faidit, Jean-Michel, *These French in the Moon:*Craters and Biographies. Les Presses du Midi,
2013.

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The cover of this issue of *Planetarian* features the completed miniature set of the South Pole Telescope for the E&S fulldome film *Black Hole First Picture* to be filmed at Mirage3D Studios, The Hague. The South Pole Telescope is one of nine observatories in seven geographical locations around the globe which form a network called the Event Horizon Telescope (EHT). During two observing campaigns in 2017 and 2018, the EHT collected data simultaneously at all locations, which led to the historic first image of a black hole in 2019.

The decision to build this miniature set for the fulldome film was made for several reasons. First, a trip to the South Pole to film the telescope itself would have been very expensive. Not only is it a hard journey, but it is difficult to get permission to travel there. It also would have been impossible to make certain aerial shots due to safety limitations. All in all, it was decided to create a VFX shot instead.

Of course it would have been much easier to create a computer-animated special effect shot, but since this fulldome film consists of 95% live action shots and all the other telescopes of the EHT are filmed at their location with live action footage, we reached the second reason to build the miniature: a CG shot of the South Pole Telescope would stand out and possibly break the illusion.

Hence the decision was made to go the extra mile and make a real physical model.

It has been a six-month project to build this scale 1:10 miniature. Many different skill sets were needed to complete the task, from conventional woodwork and welding to 3D modeling, computer-controlled machining, 3D printing, model building, and weathering.

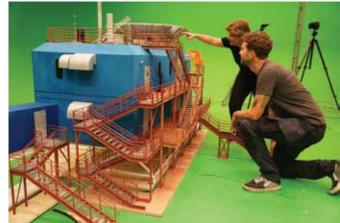
Pretty much the entire telescope had to be 3D modeled first, and for a lot of the details on the outside a few thousand parts were printed on 950 print platforms. This took 6 months of nonstop 3D printing on 3 SLA printers using over 50 liters of resin. It was madness!

The next step is to light the set and to film the miniature with a motion-controlled camera rig. In post production a terrain extension will be created with CG and an atmosphere will be added.

We were hoping to push the boundaries of fulldome video with this miniature, but at the same time we have to admit that it was much harder than expected to get to the end result. We hope it will be worth all the effort, and that the audience will really believe that they are at the Amundsen-Scott South Pole Station.

Top: The South Pole Telescope miniature team (from left) Laura Jolly, Chris Wouda, Marijn Kuiper, Bas de Boer, Kevin Bauer, lede Reckman, Arend Groosman, and Robin Sip. Next: Adding details to the Dark Sector Lab with 3D printed structures. Next: Inspecting the look of the radio shield around the BICEP-3 refractor telescope. Next: Sanne Terweij is adding snow weathering effects to add to the realism. Bottom: One 3D printed part prior to print support removal and painting. All photos courtesy E&S/Mirage3D.

















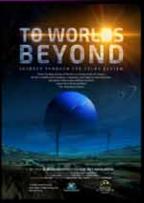














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Zooming into virtual immersion

By all accounts, the year 2020 will be one for the history books. That's certainly true for those of us in the immersive community, ranging from domes to VR producers. As we read about in the last issue of Planetarian, the COVID-19 pandemic has changed the world and the ways we interact with each other. Take the obvious example of meetings and conferences. The old days of traveling to a colleague's city and facility, attending talks, and taking part in hallway conversations and late-night Taurus incidents in hospitality suites have given way to meetings via Zoom and other portals.

When the IPS meeting was cancelled in Edmonton, our plans for an on-site IMERSA Day Summit also fell by the wayside. Michael Daut and I had put in nearly a year's worth of work and arrangements into that one day, so it was a big blow to our organization's plans.

Still, the show must go on, so we began pulling together a hardy group of presenters to share their expertise via Zoom.

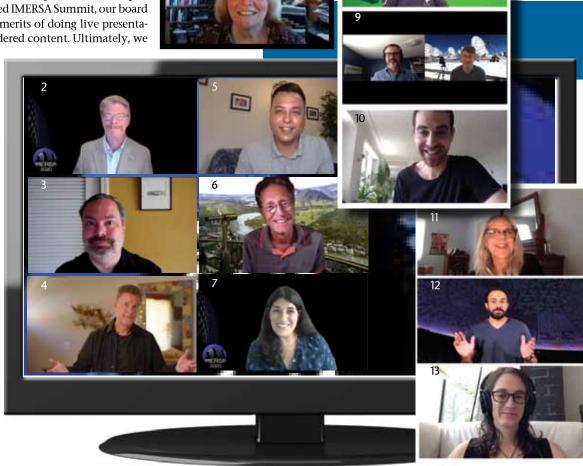
Live vs. pre-recorded?

One of the oldest discussion points in the dome field is "live or taped"? (also known as "pre-recorded or pre-rendered"?) For our reimagined IMERSA Summit, our board debated at length about the merits of doing live presentations versus offering pre-rendered content. Ultimately, we decided to do both!

First off, we asked Dani Khoury LeBlanc (Museum of Science, Boston) to reconstitute her panel on Art in the Dome. Clearly we couldn't replay fulldome material in the Zoom environment, but they found some creative ways to present their ideas. We also asked our producer friends who had originally been scheduled to do a camera demo in the dome at Edmonton to put together a "flat screen" panel discussion with videos. We searched out a unique keynote presenter for the final day and he offered a video presentation followed by a live discussion. In fact, we planned each pre-recorded segment to be preceded and followed by live commentary and Q&A.

While all that was in progress, Michael and I both realized that, while we're getting to be good at using Zoom, we didn't have as much confidence running it as a conference host. We enlisted some help in the form of Michael Schultz, the IT/Zoom guru from Mosaic (Mosaic.org) in Los Angeles, a community of faith that routinely runs Zoom services hosting hundreds of attendees. After two intense training sessions with Michael, we felt confident enough to schedule a Zoom IMERSA Day.

Next up, we had to schedule the whole thing, figure out timings, and how we would replay the videos. Thanks to the expertise of Monica Bolles (our stage manager) and Ben Gondrez (our "videographer" and remote tech), we ended up using Zoom connected to the open-source OBS Studio program. We gave all our presenters a deadline to submit



their final videos, and Ben then encoded those for replay at the appropriate time.

We ended up with pre-recorded files that conveyed greetings from our board members, a talk by Michael Daut, a panel discussion about Art in the Dome, a panel on cameras and techniques, and our keynote talk by former Disney Imagineer Eddie Sotto. Our live segments included introductions to IMERSA, a discussion about our community in the wake of COVID-19, all the Q&As, and some live discussions between segments.

Timing is everything

The final question we discussed with the IMERSA Board was: one day or multiple days? By mid-summer this year, we figured most of our colleagueswere familiar with "Zoomfatigue" and "Zoombutt." Weallhad attended other meetings—some full day, some just an hour or two long. Given those experiences, we opted for three two-hour segments, sort of an "IMERSA Limited" series. We tailored the presentations to fit into that time frame, along with ample Q&A sessions, and a little "hospitality" afterwards. Finally, we set the dates: August 14, 21, and 28. To make sure we didn't leave out many of our guests around the world, we tried to set the time so that few were having to stay up until 3 a.m., and we decided to let all registered attendees have access to a replay of each Friday's events for a week afterwards via the IMERSA Vimeo channel.

Once we had it all together, we realized we needed to practice the whole thing. So, under Monica Bolles's direction, there were several rehearsals so that Michael, Dan Neafus, Ben, Monica, and I would know exactly what buttons to push, when, where, and how. We met each Wednesday before the Friday "live" Summit Day to do a full-up rehearsal that also included panel discussion leaders. Monica directed us via a private WhatsApp channel, which is how we also funneled questions that popped up in the Zoom chat window to the day's moderator. Dan, Michael, and I each moderated one day of the Summit.

Image 1: IMERSA Board Member Carolyn Collins Petersen during IMERSA Day, introducing the upcoming features of the three-session event. She and Michael Daut (Image 4) organized the speakers and sessions. Carolyn also hosted the third day's sessions featuring keynote speaker Eddie Sotto. Image 2: IMERSA Executive Director Daniel Neafus joined in welcoming attendees each day. Image 3: Board Member Ryan J. Wyatt joined in the IMERSA Summit festivities, and also presented a short introduction to the California Academy of Sciences' latest work called *Big Astronomy*. Image 4: Board Member Michael Daut presented on audience engagement on Day 1.

Image 5: Former Disney Imagineer Eddie Sotto joined the Virtual IMERSA events on Day three and presented attendees with a fascinating look at how Disney engages its guests. Sotto is currently working on his own as an experiential producer and consultant. Image 7: Dani Khoury LeBlanc of the Museum of Science, Boston, brought in a panel of creatives to talk about art in a discussion called Art in the Dome. They covered the challenges of bringing in performers to the dome and talked about the business aspects. Also joining the Art in the Dome panel was producer James Wetzel (6), Museum of Science, Boston.

Images 8, 9, 10: It wouldn't be an IMERSA meeting without a look at cameras and how our producers use them. Joining Michael Daut (4) for a panel discussion were Robin Sip (8), Mirage 3D/Evans & Sutherland, Ken Ackerman and Mike Schmitt (9), California Academy of Sciences, and Paul Raphael (10) of Felix & Paul Studios.

Images 11, 12, 13: Kate McCallum (11), Ben Gondrez (12), and Monica Bolles (13) described their experiences with art in the dome. Kate works at Vortex Immersion in Los Angeles; Ben is at the Fort Collins (Colorado) Museum of Discovery and runs DomeLab sessions in his facility; and Monica Bolles is a freelance artist and sound designer in Denver.

Then, show time!

After all the preparations, arrangements, pre-show meetings, and rehearsals, we pushed the button on our first IMERSA Day segment and welcomed well more than a hundred attendees. Michael Daut presented a wonderful exploration of creativity and audience engagement. That was followed by a great Q&A session and some informal chat at the end of the meeting.

On day two, a week later, we welcomed Dani and her panel of creative geniuses, which included James Wetzel (Museum of Science, Boston), Kate McCallum (Vortex Immersion), immersive artist Monica Bolles, and Ben Gondrez, founder of DomeLab at the Fort Collins Museum of Discovery in Colorado. Their presentations on bringing artists and creatives into planetariums engendered many good questions from the audience. That was followed by a frank discussion of the effects of COVID-19 on our community, featuring useful input from Tammy Seldon (Giant Screen Cinema Association, GSCA) and others. Again, we had well over a hundred folks join us throughout the two-hour session.

Day three of IMERSA Days featured a panel discussion with prerecorded segments from the GSCA, Robin Sip (Mirage3D and Evans & Sutherland), Paul Raphaël (Felix & Paul Studios), and Ken Ackerman and Mike Schmitt (California Academy of Sciences). They discussed the challenges of getting the sequences with the equipment they were using on recent projects.

Finally, we were pleased to present Eddie Sotto (Sotto Studios), who spent about an hour sharing his insights about how Disney creates experiences and memorability. He linked it to our needs in the immersive community. We were most gratified to welcome a large crowd for our final day that ended with some good hospitality time and a chance to visit with friends and colleagues informally.

Would we do it again?

Absolutely! Based on lessons learned and the fun we had putting our IMERSA Days together, our governing board is looking at doing future events as part of outreach to our members. And, yes, IMERSA will be instituting a membership structure early next year.

After 12 years of Summits and meetings, which all featured outreach, teaching, sharing, and learning, we have collected a library of valuable resources that stand the test of time. Whether we are writers, producers, show presenters, animators, or film crew, our group has something to offer. And, the success of our IMERSA Days shows that there is an interest out there in sharing and learning about immersive media. We had 304 registrants attend across three days of meetings, encompassing the range of roles we all play in the immersive community. We had log-ins from nearly everywhere on the planet.

In our eyes, the IMERSA Days Series was a great success. Many, many thanks go to Monica and Ben for keeping the whole thing going in the background—we couldn't have done it without them. As well, we appreciated the insights shared by our speakers and panelists, and, we can't wait to do it again!

Thanks to Sharon

For many years now, we have worked closely with Sharon Shanks, editor of *Planetarian*, to get our columns and articles into each issue. She has been a patient editor and very much an advocate for bringing IMERSA News to the planetarium community through this publication. As this is Sharon's last issue before retirement, we want to extend our sincere and enthusiastic thanks to her for inviting us to have a voice here. It's been fun to work with her, and we wish her a long and happy, healthy retirement. Bravo, Sharon, from all the IMERSA team!

Carolyn Collins Petersen is an IMERSA board member, and also is CEO of Loch Ness Productions. She can be reached at carolyn@imersa.org.



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Seeking what works during a pandemic

This summer, the Big Astronomy Project sent out a survey to planetarians. Part of this survey was to understand how the project could best support the planetarium community. However, there were also questions that were meant to help us characterize how the pandemic was affecting the planetarium community and how the planetarium world was responding to the rapid changes.

We wrote a report based on the results so we could document its effects. The full report, Current State of Planetariums during the

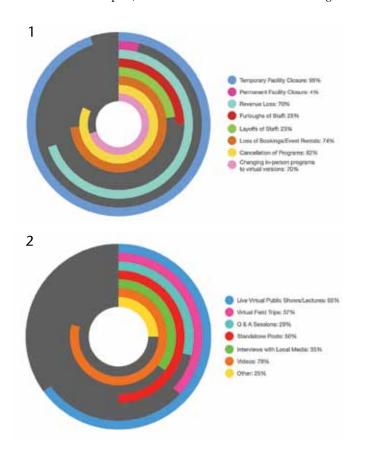


Fig. 1: The various effects on planetariums due to the pandemic and the percentage of respondents who reported these effects. Fig. 2: Type of virtual programming commonly offered by planetariums during the pandemic

COVID-19 Pandemic, can be found on the IPS website. The report simply summarized the results, while this article will offer some additional considerations and context.

The survey was sent out via Dome-L and Dome Dialogues. We had 57 planetarians respond. The respondents were mostly from the U.S., with about a fifth from other countries. A variety of planetarium sizes and types were represented, including those with annual attendance from 1,500 to about 200,000 visitors a year.

A snapshot of time

It is important to note that the report represented a snapshot of the planetarium field in the summer of 2020. The timing, mixed with the ever-changing landscape of the COVID-19 pandemic, means there is only so much we can definitively say. The situation for some planetariums has likely changed for better or worse since the original survey was sent out.

The report showed about 99% the respondents were dealing with at least temporary closures. A large majority were dealing with revenue loss (70%), cancellation of programs (82%), and loss of bookings (74%).

A significant number had also reported furloughs (25%) and layoffs (23%) of staff. These results are not surprising when we have seen expectations of a significant number of museums and other informal learning institutions going through similar issues. One report from Forbes magazine in July 2020 reported an expectation of 13% of museums worldwide permanently closing due to the pandemic.

While some planetariums and museums have started to reopen, it has often been at reduced capacities and therefore resulted in revenue loss. Overall, the news regarding informal learning institutions appears grim and this is the uncertain environment in which many planetarians are working.

The community is responsive

Despite the grim numbers, the report also shows a community that is responsive to a dynamic crisis. Within the report, 89% of those that responded said they were conducting virtual programming.

Planetarians were left unable to use the spaces that are so integral to their work. The mission of most planetariums is to teach the general public, and, when doors literally closed, planetarians sought out other means to reach audiences. While our domes are amazing and powerful tools in helping us with our mission, it is ultimately the people in those domes driving the mission.

The title of this column is "Seeking What Works." It has looked at education research and focused largely on how to best teach under the dome. But when we are cut off from the very environment we use everyday to do our jobs, we are having to "seek what works" in a more trial and error sense.

The full report can offer some insights in what people have found to work at the beginning of the crisis. Again, things may have changed, but it gives a sense of our starting point.

Many different avenues for virtual programming were reported by planetarians in the survey. However, the most frequent type of offerings were virtual public shows and lectures or creating pre-recorded videos. Similarly, a variety of virtual platforms were reported, though Facebook and Zoom were used by a majority of respondents. In the other category, YouTube was the most cited platform. At least in the earliest stages of the pandemic, this type of programming and platforms seemed to be the most popular and effective for planetarians.

Program frequency declines

Many planetariums, prior to the pandemic, offered near daily



The full report on the effects of the COVID-19 pandemic on planetariums can be found at cdn.ymaws. com/www.ips-planetarium.org/resource/resmgr/pdf-articles/PlanetariumsDuringPandemic20.pdf and at www.bigastronomy.org/research/

programming with some offering multiple shows a day. However, the frequency of virtual programming offered has not been nearly as comparable. About 45% of respondents said they were offering programming less than once a week, 32% were offering programming once or twice a week, and 23% were offering programming more than 3 times a week.

Many planetarians are having to learn new software and new ways of reaching our educational goals. This need to learn new ways of working was reflected in the survey when a majority of respondents stated they wished they knew more about the software and hardware used in creating pre-recorded and streamed content prior to the pandemic. This is also likely exacerbated by reported furloughs and layoffs, meaning there are fewer people to support the work of creating novel virtual programming.

Regarding frequency of programming, there is also a consideration of what audiences need and want. An article from the BBC in April of 2020 summarized studies done regarding "Zoom burnout." Many people are and have been using video conferencing platforms for work and socialization. This way of interacting with people takes more concentration and results in people feeling more exhausted afterward.

Virtual activities make separation of time difficult

In addition, with more and more activities being virtual and from home, there is a lack of separation from work, social, and home life. Ultimately, the suggestion is to keep as much of your life offline as possible. Virtual programming is not new, but the context in which we are conducting it is new. Now everyone is creating virtual content and we are creating it in a world where people cannot get away.

There are numerous other considerations that were not reflected in this report. There are questions on accessibility, reach, whether or not we should be charging, and more.

As a result, we are going to continually seek what works. Everyone is dealing with a lot, which is making everything harder.

On a more personal and reflective note, I have seen our community rise to the occasion. We have been there answering each other's questions and hosting virtual conferences so we can have ways to share lessons learned, as we always have. Those lessons will move forward with us as we reopen, as people return to our domes.

The theme of the virtual Great Lakes Planetarium Association meeting this year was "we are more than our domes." This year has proven that beyond a doubt. Remember to take care of yourselves!

Dr. Shannon Schmoll has been the director of the Abrams Planetarium for the past six years and is currently serving as the IPS education chair. She also serves as research lead for the Big Astronomy project. Ultimately, we are all figuring it out and doing the best we can.

Special thanks to Dr. Jesica Trucks for writing the survey and providing all the graphics used in this article. Also thank you to Dr. Katie Hinko and Gloria Imelda Lopez who round out the Big Astronomy Research Team.

Articles Referenced

"Covid-19 Pandemic Could Shutter A Third Of All U.S. Museums" by Alison Durkee at https://www.forbes.com/sites/alisondurkee/2020/07/22/covid-19-pandemic-could-shutter-a-third-of-all-us-museums/?sh=ed3a1ba1d040

"The reason Zoom calls drain your energy" by Manyu Jiang. www. bbc.com/worklife/article/20200421-why-zoom-video-chats-are-so-exhausting

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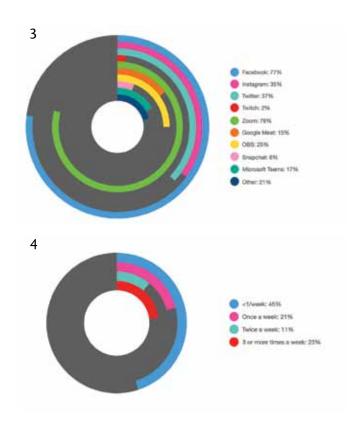


Fig. 3: The most common platforms planetariums are using to generate and deliver virtual content.

Fig. 4: How often planetariums are offering virtual programming during the pandemic.



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We're adaptable. We survive.

A quote that is often attributed to Charles Darwin¹ reads "It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is most adaptable to change." This school year's start has forced us all to adapt to survive.

My predecessor at the Williamsville Space Lab Planetarium was Robert Reilly. He taught me how to hand opaque slide film and program the slide projector automation system. As I learned with him, I was blown away by his creative innovations to make shows. Bob used every trick possible to keep the planetarium fresh and full of visitors. He used his creativity and work ethic to adapt to difficult situations, and did so through many years of austerity budgets. His ability to adapt was what kept my planetarium open all through those difficult times. Even now, 20 years later, I find myself striving to fill the giant shoes he left behind.

My school year started tumultuously. Just a week before school was supposed to start, we had no idea what the plan was. Our superintendent said he had it all figured out, and then the school board figured out that he didn't have a plan and put him on administrative leave. Our students were in school for four days and then they had to go fully remote. Parents were livid, protests ensued, Williamsville made the national news (for bad reasons) and all the plans I made were out the window.

I had to adapt to the situation and move forward. What could I do to deliver my lessons virtually? Whatever it was, I had to do it quickly. I also had no budget to work with, nor did I have the time to wait for purchase orders and deliveries because my teachers needed something right away. I won't tell you all of my adaptations, but I would like to share a couple that I am happy with as well as some tales from other teachers in the Classdome Cadre.

Live spectra

Sometimes I refer to our planetarium as a "light lab" because I do activities with the spectrum, just like many of you do. The kids love seeing the emission tubes and other lamps through the diffraction grating glasses. How could I do this remotely?

My first deadline was to run my lab about star classification. Although not a big part of the lab, I do show the kids the spectrum of an incandescent lamp while dimming the light so that they can see how the violet end of the spectrum fades before the low energy end.

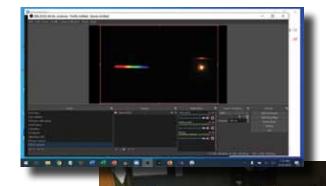
I tried using my webcam with a diffraction grating in front of it, but the dynamic range was not acceptable. I tried using my phone camera and that did better, but how to get the video stream online? Google to see on the computer.

have a greater dynamic range and better performance. Indeed it did, but how would I show that online? Google to the rescue yet again.

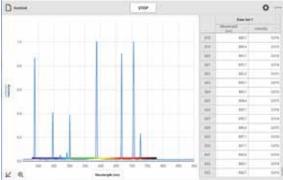
the rescue! I found an app that let me use the phone as an IP camera to connect to the laptop. But I still wasn't satisfied with what you could Getting a little desperate, I went to the photography teacher and asked to borrow a digital single-lens reflex camera, hoping it would

Top: OBS screen showing incandescent lamp and its spectrum. Next: DSLR wearing spectrum glasses. Next: Equipment setup for the chemistry spectrum lab. Note the ring stand used to hold the fiber optic cable for the spectrometer in place. Bottom: Vernier software window. All

images by the author.







¹ In reality, the quote seems to be a summarization of Darwin's ideas by Leon C. Megginson. See quoteinvestigator.com/2014/05/04/adapt/

First, I found an article from Canon² explaining how to use a DSLR as a web cam, but the camera that I borrowed was older and not set up for streaming. More searching led to an article about how to make an older Canon DSLR work as a webcam.³ I had to buy a program for a few euros, but it worked! I think my most amazing innovation was the one involving scissors and duct tape to fit a pair of diffraction grating glasses on the camera.

I created a Google Doc with some full spectrum images and explained to the kids how to crop the image in their "copy to" record with what they saw as I dimmed the bulb up and down.

My next challenge was the chemistry version of the lab wherein the kids identify some unknown gas tubes by matching them up with a wall chart. Even with the DSLR, I wasn't seeing enough agreement between what was on the screen and the wall chart for the kids to have hope of success. Besides, the kids weren't in school, so how could they look at a wall chart? Not wanting to set them up for frustration and failure, I went back to the drawing board.

One of the things we have to do in theater just about all the time is to solve a problem with what we have on hand, and do so immediately. The show must go on, right? I love that adrenaline rush. I made an inventory of all the tools I had in hand and pressed forward.

Last year, I had purchased a Vernier spectrometer device. I had thoughts of incorporating it with the regular in-person version of the lab, but it was too complicated both physically and technologically. I got it out again and took a long, hard look at the device and its software interface. The software is designed for kids to collect numerical data sets, but it also has a live graph of intensity vs wavelength.

One of the things that I didn't like about it previously was the fact that the software shows from 350-900 nm, and there was no way to narrow that down to just the visible portion of 380-700 nm. The spectra from the lamps showed numerous IR and UV peaks that nobody could see with their eyes. I hadn't wanted to confuse the kids in the past, but maybe I could find a way to make this work anyway.

I carefully noted all the colors visible in the DSLR's view and compared that with the Vernier graphs that each produced. Then it came to me! I could reinforce the principle of chemical fingerprinting by having the kids match the Vernier graphs with the spectra they could see via the DSLR. No wall chart was needed for this approach.

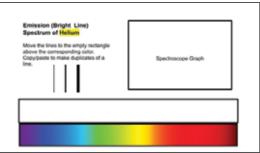
Manipulating the information

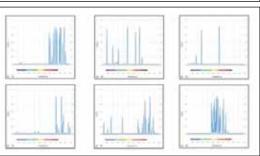
How would the kids manipulate the information in a way that could be submitted online? Amie Gallagher's paper talk for the MAPS vCon in September gave me the solution. I had been trying unsuccessfully to use Google Docs, but Amie's talk showed how to use Google Slides with young kids to learn about the day and night sky. She had the kids move images of clouds, stars, etc., into boxes for day and night. I could use the same method to get the students to record the spectra.

First, I show the students the emission tube through the DSLR and talk about how the light is produced. Then, I put the glasses on the camera so they can see the spectrum. I then switched over to the Vernier software and explained the software's interface. I discussed how the lines of light related to the peaks on the graph, as well as how the Vernier display was showing us invisible UV and IR lines.

I then went through each of the gas tubes and had them record each







Top: OBS screen used during the xhemistry spectrum lab. DSLR output in lower left, Verner output in upper right, and my masked face in the view so the kids know I'm doing this all live. Center: Google slide given to students. Note the pre-made lines for them to move on to the spectrum, as well as the box for the Vernier graph. Bottom: Repository of Vernier graphs at the end of the Google slide deck. Students moved each of these onto the appropriate slide to match their recorded spectrum lines. All images by the author.

spectrum on a Google Slide. I gave them pre-made lines (wide, medium and narrow for different brightnesses) to move on top of a continuous spectrum to record what they were seeing. As they moved their lines, I added the Vernier graph to their view (using Open Broadcast Software⁴) and discussed the correlation.

A couple lamps with strong IR lines got really hot and I hammed it up a bit as I changed the lamps—ouch, that one is hot! At the end of the slide deck they were given Vernier spectrum graph screen captures that I made earlier. Their homework was to move the graph onto the correct slide based on the agreement between the lines they recorded and the peaks in the graph.

It is far from perfect, but it worked. The chemistry teacher was very happy with how it reinforced the idea of chemical fingerprinting. Yes, we do need to work on the difference between bright line and absorption spectra since what they were recording was really an absorption spectrum. But for having no money and barely any time, I'm pretty happy with the lab. Besides, I had no other choice than to adapt.

Here are some ways that other ClassDome Cadre members have adapted.

Use the Force

Neil Pifer, Margaret C. Woodson Planetarium, Salisbury, North Carolina

At our facility, we are going 100% outreach and virtual, so one of the more exciting lessons is "May the Force be with You." I dress as a Jedi and am "beamed" into four different classrooms at the same time.

We are doing an activity called "Touchdown" through the North Carolina Space Grant in which third graders design a lander to save (Continues on next page)

4 obsproject.com

² www.usa.canon.com/internet/portal/us/home/support/self-help-center/eos-webcam-utility

³ www.cameraremote.de/how-to-use-canon-dslr-cameras-as-webcams



Zoom screen from Neil's lesson. Screen captures by Neil Pifer.

the Jedi and my trusty sidekick, in this case my dog, Hobbs. The kids had great ideas and were able to test their landers and learn about balanced and unbalanced forces and engineering design processes. This took more set up than a normal outreach, but being able to leverage the technology into teaching 4 classrooms at the same time made this extra prep work worth it. You can find the activity at www.jpl.nasa. gov/edu/teach/activity/touchdown/.

We had to adapt the lesson to North Carolina standards and prebuild some of the parts to allow access to all third graders, but they were able to "take off" from there.

Get Moving!

Chrysta Ghent, Liberty Science Center, New Jersey

(We have a new addition to the Classdome Cadre from New Jersey. Chrysta shares her adaptation of a show for young learners.-Mark Percy)

I created a Canva⁵ presentation (an awesome alternative to Power-Point if you haven't heard about it) about the sun, moon, and stars. I ask the participants to look out their windows and tell me what they see in the sky, follow along with their fingers as I have the sun travel across the sky/screen to create motion, and have them turn on their microphones and sing "Twinkle Twinkle Little Star" with me as I have an animated sun go down and the stars and moon come out. I then have them look for shapes (thanks for that, One World One Sky) in a real image of a starfield.

I'm also playing around with having them stand up in their space and spinning around like Earth. Basically, I'm trying to find ways to let the viewers participate physically from the other side of the screen, and create some sort of motion that they're missing with the immersive dome.

As for constellations, I have viewers look for shapes in the starfield image. Next, I introduce constellations and tell the story (or one of

the stories) behind Ursa Major and Ursa Minor, so I illustrated a short version of Zeus changing a mother and son into bears to protect them from a snake, then putting them up into the sky as constellations (I don't go into asterisms here, but definitely could).

NGSS Units

Peggy Hernandez, Elgin School District Planetarium, Elgin, Illinois

Since I am making Next Generation Science Standards-focused units in Canvas⁶ for teachers to copy and use in their classrooms, I have been able to include specific pre- and post-visit activities that are useful for teachers in either synchronous and asynchronous class time. I have always offered pre- and post- ideas, but never in a package like a course they can take and call their own.

I learn something new everyday, but this week my favorite is to make a short slide deck in Google Slides that uses a layout I created. I use that background to allow students to sort pictures or graphics in an activity designed just for that grade level. For example, I have second graders sort the planets by visible features (PS1-1) and it allows them to do it in a multitude of ways.

Teachers can assign the slide deck to their class, have them submit it as a slide deck, and then I can refer to it when they have their virtual



Slide deck screen capture by Peggy Hernandez.

visit. Eventually I sort them in session by terrestrial and gaseous and then we focus a bit on rocks…and then impact rocks abd meteorites (2ESS1-1, 2ESS2-2). Teachers are so appreciative that it is made for them and ready to go…and I am appreciative that they are doing the pre-visit activities.

Virtual Outreach

Lisa Swaney, Horwitz-DeRemer Planetarium, Waukesha, Wisconsin

The year 2020 definitely has been the year to adapt. Whether it was personally or professionally, I believe everyone has found ways to do numerous everyday activities or tasks differently to accommodate the very fluid world we are living in right now.

Obviously, the Horwitz-DeRemer Planetarium operations and staff needed to adapt too, and we continue to adapt weekly if not daily. We started the 2020-21 school year without knowing if any type of school

6 A learning management system; see www.instructure.com/canvas



Top: Canva slide seeking responses from children about making observations. Right: Slide used during sing-along with children as they observe diurnal motion, and illustrations to accompany storytelling about Ursa Major and Ursa Minor. All screen capture by Chrysta Ghent.





group (Waukesha School District or non-Waukesha district) visits were in the cards, so we decided to try to focus on what we could control: educating the public in general. With a rise in numbers of virtual learners and homeschoolers in our area, this was an obvious audience we could address and help support. This made sense as we always wanted to explore offering weekday public shows.

Three considerations were implemented and each has been quite successful thus far. The first two involved offering public shows on weekdays in conjunction with the Retzer Nature Center. For the virtual learners and homeschoolers, we're collaborating with the Nature Center and offering two public shows every Wednesday (pre-sale only). One show is at 11:00 a.m. after a Nature Center program and the other at 2:00 pm before a different Nature Center program, a total of four different shows geared toward kids per month within those given time slots.

Our attendance numbers have been close to our maximum capacity of 22 people with many patrons coming week after week for the various shows.

The other public planetarium show we added is one regarding health and wellness. With the help of Retzer Nature Center, we offer wellness nights for anyone who is interested. These wellness nights include a sunset meditation show followed by a guided night hike. Both shows offered have sold out. We are hoping to add more as staffing allows.

The last adjustment we've made has been quite a fun adventure, but offers its own challenges. We are providing supplemental space-themed activity bags free for the taking outside the planetarium lobby for any families interested. Each bag contains approximately 10 activities and resources for all age levels. Examples include monthly sky

charts, a zodiac sign activity, at least one STEM build, coloring sheets, lab explorations, reading exercises, space jokes, and anything else we find useful and educational based upon the monthly theme.

Themes thus far have been the sun, flight, and Earth. Other themes will include the solar system, galaxy, constellations, stars, planets, Hubble, seasons, moon, and light pollution.

The bags have been so popular that we made more than 75 bags during the first month and now are over 100 bags taken already in October. We are thrilled so many people are finding the activities useful for their households.

Summary

My new principal shared some great wisdom. He said "At some point a lesson may have or will totally fall apart. But, as I mentioned, tacos also fall apart and tacos are awesome—and so are you—don't forget that!"

I'm sure everyone reading this has been forced to adapt in their own way. Some adaptations will work and some won't. Share what works as well as what hasn't so that others can learn. We are all in this together. Thanks for reading our stories.

Mark Percy, who coordinates the Classdome Cadre of educators who provide this column, is in his 20th year as the planetarium director of the Williamsville Space Lab Planetarium, having taught chemistry and earth science for nine years prior to moving to the dome. He holds a bachelor's degree in chemistry from SUNY/Buffalo and a master's degree in earth science education from SUNY/Buffalo State.







This is my third column under the severe effects of the COVID-19 pandemic. It is almost like we are getting used to it, but we are not. Many planetariums are still struggling to survive and, at the same time, finding ingenious ways to communicate science and astronomy, in particular, in many alternative ways, as you will see below. But there is no doubt that we all long to have the domes filled with audiences again when the pandemic is hopefully conquered all over the world in the months to come.

For this section I'm indebted to contributions from Zinaida Sitkova, Alexis Delivorias, Loris Ramponi, Amie Gallagher, John Hare, Ignacio Castro, Andrew Kerr, and Bart Benjamin.

Let's start this tour around the world in Russia.

Russian Planetariums Association

Russian planetariums are preparing to celebrate the centenary of planetariums, and the RPA has formed a historical section that consists of M. Kazantseva, Z. Sitkova, and I. Lapina. In mid-August, letters were sent out to the leaders of the planetariums with a request to send photos and information about their facilities. Now information goes to the historical section, and the chronicle of Russian planetariums is born.

Nizhny Novgorod. On 24 July, the second online conference was held, organized by the Nizhny Novgorod Planetarium on the topic "Planetariums: a modern model of a lecturer." The event was attended by 37 participants from many cities. The conference was moderated by G. A. Muromtseva, director of the Nizhny Novogorod planetarium. The following questions were discussed: Which competencies does a lecturer need today? How can this conversation be arranged so that the listeners come back again and again?

Barnaul. On 8 September, the planetarium hosted a presentation of the traveling exhibition The First Cosmonaut of Siberia from the funds of the Altai State Memorial Museum of G. S. Titov. It is dedicated to the 85th anniversary of the birth of cosmonaut German Titov.

Volgograd. Until 1 October, visitor access to the planetarium was suspended. During the quarantine, the lecturer team actively posted materials on astronomy on social networks. The most popular section was Astronomical Minute, which highlights current and upcoming astronomical events. Of great interest are such columns as Visiting the Ursa Major, Journey to the Southern Cross, Sitting at Home-Guess the Astronomer, Astronomers are Joking, Universe, Tales of the Volgograd Planetarium, Black Holes, Legendary Astronomers, Voyage through the Nebula, Names on the Moon Globe, and others. Work on creating

Lars Petersen, PhD, is an astrophysicist and science communicator. From 1997-2016 he was director of Orion Planetarium, Denmark. At present he is engaged in various astronomy communication projects. He is a fellow of IPS.

new lectures is currently in full swing. The lecturers' team of the Volgograd Planetarium is inevitably full of creative ideas.

Novosibirsk. On the night of 4-5 August, the Big Novosibirsk Planetarium carried out astronomical online observations. For six hours, the planetarium staff introduced the audience to a variety of astronomical objects that the telescope was aiming at. Among the objects viewed were open and globular star clusters in Hercules, Cassiopeia, and



RPA. Novosibirsk. Sergei Maslikov leads the "SibAstro" programme. Courtesy of Sergey Yazev.

Perseus, binary stars in Lyra and Cygnus, planetary nebulae M57 (Ring Nebula) and M27 (Dumbbell Nebula), the nucleus of the Andromeda galaxy, planets of the solar system (Jupiter, Saturn, Mars, Uranus, Venus), and the moon.

The online format of the event made it possible to expand the geography of observers outside of Novosibirsk and cover many cities of the Siberian region, as well as the Urals, Central Russia, and Europe. The maximum one-time viewership of the live broadcast was 207 persons. The total number of connections and views of the broadcast recording reached more than 2,600 by the end of September in two months. The broadcast recording of the online observations is available on the planetarium's YouTube channel.

The 15th Siberian Forum of Astronomy Amateurs, "SibAstro," took place on 18-20 September with the active participation of the Novosibirsk Planetarium. It was held in the Chkalovets camp on the shore of the Ob Sea. Here it was possible to look through excellent telescopes at a dark sky, not spoiled by light, accompanied by experienced guides. In the afternoon, astronomy lovers listened to lectures by remarkable popularizers of science.

Kemerovo. The planetarium of Kemerovo State University orga-

nized a creative competition titled Starship Troopers for students and school children in the categories of literary and artistic creativity. The competition was dedicated to important astronomical events of 2020 and people who made a huge contribution to the development of Soviet and Russian cosmonautics.

23 October marks the 90th anniversary of Kuzma Petrovich Matsukov (1930-2018), the founder of the university planetarium and popularizer of astronomy in Kuzbass. A number of special events are dedicated to this event. The Kemerovo State University Planetarium was named after K.P. Matsukov.

European/Mediterranean Planetarium Association

Greece. The Eugenides Planetarium in Athens is still adversely affected by the pandemic. It only opened for a couple of weeks in September, then it had to shut down once again for the public due to new measures against the spreading of the virus. At the time of writing (13 October), the planetarium once again opens for schools and the general public at the reduced capacity of 30% (approximately 83 out of 280 seats).

The giant screen film *Dinosaurs in Antarctica* was scheduled to premiere on 14 October; the premiere of its spring show *The Story of Earth* was postponed for 20 November. Nevertheless, the Eugenides Planetarium is still pursuing the production of new shows, the latest of which is provisionally titled *Voyage through the Milky Way* and is scheduled to premiere in March 2021.

During this period, the staff of the New Digital Planetarium communicates with the public through its Facebook page, with numerous articles, quizzes, etc. on astronomy, astrophysics, and space exploration with the organization of webcasts, etc.

Croatia. During summer and autumn, the Rijeka Astronomical Centre (RAC) continued to work upon the instructions of the Croatian Civil Protection Headquarters that required mask wearing and a minimum safe distance of 1.5 m between visitors. Even though the available seats at the planetarium were reduced from 50 to 20, the RAC organized public programs continuously. Unfortunately, the observatory remained closed for public visits.

Given the difficult situation, attendance on regular week programs and programs for tourists was quite good. The largest negative impact of the pandemic was the severe reduction of organised group visitors.

The smaller capacity of the RAC challenged the staff to invent new programs suitable for the occasion. For instance, combining programs in the digital planetarium with open air activities, visitors had the chance to participate in the *Starry Nights, Celestial Pearls* and *Autumn Overture* programs, each lasting for one and a half hours and included the night sky exploration with the use of either a laser pointer or a telescope.

Matinee Saturdays for children started again in late August and September with *Kaluoka'hina* and *Race to Earth*, combined with two new workshops, Earth and Moon Seas and Rocket Launchers. At the same time, there was a new planetarium live program titled *The First Space Pilots*, on the pioneers of space exploration, as well as a new workshop for kids titled Animals in Space, both for 8-13 years old.

The RAC celebrated the Astronomy Day and the International Observe the Moon Night with a full day program for all ages with different planetarium screenings, workshops for children, quizzes, lectures, and night sky gazing through a telescope, in collaboration with the Rijeka Academic Astronomical Society.

At the time of writing, the RAC is preparing programs for Children Week, World Space Week, and Earth Science Week. There will be organized thematic live programs and planetarium shows accompanied by lectures, quizzes, hidden treasure hunts, a public forum as well as stargazing through portable telescopes.

RAC is also preparing for the Glowing Globe international conference and exhibition for digital media artists, in collaboration with the



EMPA. Poster for the show The First Space Pilots. Courtesy of Rijeka Sport

Centre of Innovative Media. Finally, RAC is preparing its new planetarium show for preschool and elementary school children about two curious kids and their pets determined to explore space.

Italian Association of Planetaria

Last September, Italian planetariums met on the web to organize the first online issue of the International Day of Planetariums that usual takes place on the second Sunday of March in many Italian domes. But the spread of the coronavirus last spring obliged planetariums to stop any public event and therefore Planit Association invited the Italian domes to share on the web ideas about a common subject: Equilibrium.

The title of the event was developed through astronomical descriptions (for example, the "equilibrium" between day and night during the equinox) and new ideas, as looking for a just balance of public activities in person and virtual, one of the topics discussed during the event.

The audience of the event was shown not like a meeting for planetarians, but as a public initiative. The best result obtained will probably help Planit to repeat other events online with the collaborations of the colleagues connected through the web. But in any case, the next International Day of Planetariums will be held on 14 March 2021.

Next March is also the deadline of the Planit prize for an original video production. Another date for the calendar of Italian planetariums is 23-25 April 2021, when the next National Meeting of Italian planetariums will be held. We will meet in Florence at the Planetarium of Fondazione della Scienza e Tecnica, www.planetari.org.

"Close to close with..." is the title of a new initiative organized by the Italian Association of Planetaria that involves astronomers and planetarians. The idea comes from the lockdown and increases the activities available on the web. Planit invites professionals, including those outside of Planit, to an interview, live or recorded, to discuss their job under the sky domes or to share original teaching activities or latest research, and also to tell about curiosities from their personal life. The audio recordings are diffused online and through different initiatives.

Teachers are invited to use the mp3-files in the classrooms. After a presentation prepared by Planit, the students can listen to a selected (Continues on next page)

review of the interviews. Some contain not only information of astronomical interest, but also experiences of life that can promote the attraction to science for the students. For instance, the astronomer Marco Micheli describes his first telescope observations in the local observatory during his years in the primary school. His particular attention was to Titan, the object of many observations to follow the orbit of the main satellite of Saturn, which showed a mind where the passion for research began to increase. Today the astronomer, after six years of activities at the Hawaii works observatories. with the European Space Agency, in particular in the field of near-Earth objects that can become



IAP. Comet Neowise from a window connecting astronomical observations with a virtual guide. The participants can interact with the guide in any place, also at home, and observe the sky listening to audio recordings sent by WhatsApp. Courtesy of Luigi Cocca.

very dangerous if they approach our planet.

About the long period in Hawaii, the astronomer describes the amazing experience to observe directly with the eyepiece of a giant telescope and of the zodiacal light so difficult to see in polluted areas full of light in Italy and other European countries.

Teachers interested in receiving the audio recording are invited to write to osservatorio@serafinozani.it. The audio files are also shared with the participants of the astronomical observations with a virtual guide through WhatsApp, another initiative organized during the difficult period of the pandemic. The virtual observations will continue in future, hoping that the pandemic will end soon.

Middle Atlantic Planetarium Society

The 2020 MAPS Conference was scheduled to be held this past April at the Cradle of Aviation Museum in Garden City, Long Island, New York. It was rescheduled as a virtual conference, Beyond the Dome, that was held on 25-26 September. Kerri Kiker, who was to be the host at the Cradle of Aviation Museum, was still the host online.

The two days of talks were highlighted by the annual Margaret Nobel Address, usually given at the banquet. This year, Michael McConville was to be the in-person speaker and gave a twist to his virtual presentation, inviting the membership to be part of the talk. Members were asked to send him a short video clip answering one of three questions about the past, present, and the future of the planetarium community: "What was your first planetarium experience," "What new skills or insights have you gained in 2020," or "What changes do you see in the planetarium community moving forward."

MAPS will be joining SEPA and WAC in Kingsport, Tennessee in June 2021 for a joint conference.

Southeastern Planetarium Association

The Southeastern Planetarium Association 2020 conference was held virtually via Zoom on 5 August. Items of business included future conference sites, officer reports, committee reports, nominations of candidates from the floor, and election of officers via elec-

tronic voting. For the term running from 1 January 2021 thru 31 December 2022, the electronic ballots turned out these results: President-elect Jason Dorfman, Kingsport, Tennessee; Secretary-Treasurer Patsy Wilson, Salisbury, North Carolina; and IPS council representative John Hare, Cocoa, Florida. The following officers move to the position of president, Liz Klimak, Columbia, South Carolina; and past president, James Aubury, Gainesville, Florida.

SEPA has formed a committee to implement the awarding of minigrants that will be available to SEPA members. Jon Elvert has been appointed chair of the committee. SEPA members will be able to access grant information and applications at the SEPA website.

SEPA will return to Kingsport, Tennessee in 2021 for its 50th anniversary conference. The facilities at the conference site, Bays Mountain Park, include a recently-renovated planetarium situated in a 3550-acre nature preserve. Conference dates are 22-26 June. SEPA 2021

will be a huge conference with six of the seven U.S. affiliate regions participating (except GLPA). See more on page 64.

For information regarding SEPA, please visit the website sepadomes. org or contact IPS representative John Hare (johnhare@earthlink.net).

Association of Mexican Planetariums

SARS-CoV-2 has changed our lives and planetariums in Mexico have remained closed since mid-March. However, most of them have adapted their social networks to spread scientific information related to the coronavirus itself and prevention measures.

Such is the case of Planetario Lunaria in Jalisco with a series of online lectures given by specialists, professionals, and innovation entrepreneurs as well as science fiction and astronomy enthusiasts. They are planning to continue Lunaria Talks and projects to diversify contents and create new services and continue their presence in schools and communities with extramural activities.

A new project is the creation of a Mexican garden with regional endemic species and hopefully, at some point, a return to dome projections.

The Torreon Planetarium reports dome projections on Saturdays and Sundays with four hours projection time and one third of public attendance, applying all health and prevention measures. Hopefully, other planetariums will follow on a similar basis.

Pacific Planetarium Association

Black Lives in Astronomy, a new 8-page resource guide by astronomer/educator Andrew Fraknoi, includes written and video resources about and by 25 black astronomers as well as general materials to examine the history and issues facing black members of the astronomical community. Both older, established scientists and people early in their careers are covered. It is aimed at the Astro 101 and amateur astronomer level, and thus does not include any technical materials. It is designed to give educators and students examples of authentic black voices that can be shown in planetarium shows, classes, or used in assignments. You can find it free of charge at http://bit.ly/blackastro.

For a broader examination of the astronomy (and astronomers) of non-white cultures, see Fraknoi's Astronomy of Many Cultures at the website of the Astronomical Society of the Pacific, at http://bit.ly/astrocultures.

These have been hard times, both in the world and within our community. In light of that, PPA membership decided in June to initiate a mini-grant program. This was inspired by the mini-grant program IPS instituted earlier this year due to the impact of COVID-19 on planetariums.

It was initially decided that up to three \$500 grants would be awarded, so a Mini-Grant Committee was formed and solicited applications. After deciding on two initial recipients of \$500 grants, the PPA authorized the committee fund additional awards due to the high number of quality applications. Ultimately, eight additional \$400 awards were granted.

Although priority was given to PPA members and planetariums within the region, some grants went to support others in the larger planetarium community. Listed below are the recipients and summaries of their projects.

- Thomas Planetarium/Anchorage Museum, Alaska: Student memberships in an online astronomy club, using Slooh to operate remote telescopes while learning about astronomical objects and concepts within a supportive community.
- Pierce College Science Dome, Lakewood, Washington: New program for elementary and middle school students working in teams to research, develop, and design a sustainable 3D habitat on either the moon or Mars.
- Jim and Linda Lee Planetarium, Prescott, Arizona: Purchase of supplies for free virtual demonstrations and activities to K-12 students.
- Bechtel National Planetarium/Columbia Basin College, Pasco, Washington: Development of coronavirus-safe lobby displays that engage visitors' minds but are "hands-off."
- Planetario Digital Carl Sagan, Paraná, Entre Rios, Argentina: Investment in resources to facilitate online teaching during school closures.
- Sutherland Planetarium, Sutherland, South Africa: Upgraded equipment to create and share planetarium content featuring southern skies.
- Flandrau Science Center & Planetarium/University of Arizona, Tucson: Funding of tools for university students to create digital resources supporting K-12 students.
- Howard B. Owens Science Center, Lanham, Maryland:
 Creation of an interactive program around a cultural story
 featuring a live actor (in collaboration with fellow planetarian
 Elizabeth Bracey of the Franklin Park Arts center in Purcellville,
 Virginia).
- Cabrillo College Planetarium, Aptos, California: Planetarium modernization to allow for new content and an improved experience.
- El Camino College, Torrance, California: Additional equipment for use in presentations; outdoors during the pandemic and indoors later on.

Some of the recipients will report back on their programs during future PPA monthly webinars, so we look forward to hearing about their work in greater detail. The PPA was happy to be in a position to assist so many planetarians during this year of great change and need and is committed to continuing the mini-grant program on a smaller scale in the years ahead.

Great Lakes Planetarium Association

Illinois. Adler Planetarium in Chicago has ramped up their online offerings. Adler Astronomy Live is their new, bi-weekly series that discusses a variety of scientific topics. Sky Observers' Hangout answers

audience questions and helps people find interesting objects in the night sky. Finally, people love seeing "behind the scenes," and the Adler staff recently produced a video that featured their Dearborn Telescope, an 18--inch Alvan Clark refractor that was the world's largest when it was constructed in 1862. Adler's many videos can be found at https://www.youtube.com/c/adlerplanetarium/videos.

The William M. Staerkel Planetarium at Parkland College in Champaign has started offering live shows over Zoom. Their monthly James B. Kaler Science Lecture Series resumed online in October. The planetarium debuted its first live show narrated in Spanish, Noche de estrellas en Champaign, in August.

Although Olivet Nazarene University in Bourbonnais is opening in the fall, the Strickler Planetarium is unlikely to do so because of COVID-19 constraints. In the meantime, they've produced short "virtual planetarium" shows to keep the community updated on celestial happenings. Their YouTube channel can be found at https://www.youtube.com/channel/UCkL-mMyUHHuSOEQLq7qdPDg.

The Dome Planetarium and Peoria Riverfront Museum reopened to the public on 1 July, with limited capacity and masks required. They selected Mars as a theme this summer and fall, and are presenting a live show each day titled To Mars and Beyond. Mars will also be the theme for a virtual field trip package they are offering to schools this fall. In September, they began showing *Big Astronomy: People, Places, Discoveries*. They also continue to offer virtual programming. Their live stream



GLPA. Collections Manager Chris Helms dusts the Dearborn Telescope. Courtesy of Adler Planetarium.

of the full moon recently reached 40,000 views.

The Illinois State University Planetarium in Normal, which remains closed to the public due to the pandemic, continues to share astronomy and general science information and educational materials on its website and Facebook page.

The Cernan Earth and Space Center at Triton College in River Grove began offering Virtual Field Trips (VFTs) in April and saw modest success. The staff is now working on a more concrete menu of live online programs and planning a series of weekly videos. The Cernan Center also has some staffing changes. Planetarium educator Johnathan Nelson departed at the end of June. Their new staff member is Wayne Foster, who joined the staff in April.

Indiana. The Koch Immersive Theater and Planetarium in Evansville opened in late June at half capacity. Public observing of the opposition of Saturn was held in August. In addition to daily planetarium shows, they also hosted their third annual International Drone Film Festival in September, as well as premiering the fulldome movie Big Astronomy: People, Places, Discoveries to coincide with the fall observance of National Astronomy Day.

(Continues on next page)

Michigan. Although the University of Michigan Museum of Natural History Planetarium is closed, the Museum has been placing web-based video and virtual tours online for months to satisfy the growing requests from teachers for virtual programming.

This summer, the Kalamazoo Valley Museum initiated weekly star talks to keep both the planetarium and the museum connected with the public. Subjects of these live star talks included Comet NEOWISE and the Perseid meteor shower.

Ohio. In Dayton, the Boonshoft Museum's Astronomy Department offered two new in-person summer camps this summer: First Kid on Mars and Urban Astronomy. Another virtual camp was offered as well, titled Backyard Astronomy. Campers were sent supplies for a week's worth of astronomy and were taught through Zoom for the week. Campers also visited Boonshoft's sister site, the Sunwatch Indian Village and Archaeological Park, to tour the reconstructed village. They also launched model rockets and found Comet NEOWISE through telescopes.

In Toledo, the Ritter Planetarium is open on a limited basis for UT astronomy labs and is offering online programs for astronomy classes. Alex Mak began a virtual monthly sky tour program starting in September and began upgrading the Brooks Observatory's Celestron telescope with a camera that will allow him to stream the telescope's view to the internet.

Bowling Green State University's planetarium will be hosting several physics and astronomy department classes as its 21-person COVID-19 seating capacity (out of 114 seats) can handle classes that regular classrooms and the department's conference room cannot.

Wisconsin/Minnesota. The Bell Museum in St. Paul has been

awarded a three-year cooperative agreement from NASA's Teams Engaging Affiliated Museums and Informal Institutions program to create a new, accessible planetarium show and toolkit of science activities. The project will feature the contributions of people with disabilities to NASA/science discovery.

The Horwitz-DeRemer Planetarium in Waukesha has been slowly trying to re-open its doors since July. When re-opening does occur, it will feature two seats between each person and every other row utilized for a maximum of 22 people.

The Minnesota State University Moorhead Planetarium is starting a very slow re-opening with less than half of maximum capacity. They will offer virtual field trip options for school groups. Director Sara Schultz recently completed her doctoral degree in science education from the University of Wyoming and has been busy presenting her research on teaching methods in the planetarium. If you wish to learn more, please contact Sara at schultz@mnstate.edu.

The University of Wisconsin-Milwaukee Manfred Olson Planetarium will offer only virtual public programming this fall after having some success with such programming during the summer. In the fall, they will offer a Harry Potter-like show *Fantastic Beasts in the Sky* and the rescheduled from the spring show Under African Skies.

The Soref Planetarium in Milwaukee has been producing 2- to 4-minute videos on astronomy news mixed with a current sky tour. They also offered a live streaming show called *Virtual Wisconsin Stargazing* via YouTube for museum members. Their latest show production, titled *Constellations*, is complete and ready to ship, and they are next producing a new family show titled *A to Z Astronomy*.

Bays Mountain set to host SEPA-MAPS-WAC in 2021

"It Takes a Universe" is the timely theme of the 2021 combined SEPA-MAPS-WAC conference set for June 22-26 at Bays Mountain Park and Planetarium, Tennessee.

The focus of will be on a field that flourishes with diversity in relation to identity and race and a diversity in skill sets and backgrounds, including students.

Bays Mountain Park is one of the largest city-owned parks in

the world, owned and operated by the City of Kingsport in east Tennessee. It is a 3,600 acre nature preserve that includes a 44-acre lake, 30+ miles of hiking and biking trails, the main Nature Center that houses the planetarium and exhibits, the herpetarium building with reptiles, and numerous outdoor animal habitat exhibits.

As a gift to all of our visiting delegates and their families, the conference is providing free entrance to the park and its public programming (except the zip line) from June 21 through 27.

Host planetarium

The 102-seat planetarium theater at Bays Mountain has a 40ft Astro-Tec dome, a ZKP-4 Zeiss, and Spacegate Ouinto fulldome.

The conference site and hotel is the MeadowView Marriott Conference Center and Resort.

A day-long pre-conference Astronomy Teaching Boot Camp workshop is being offered on June 21, designed to enhance one's skill set to teach astronomy concepts, but from the viewpoint of the educator. Led by renown astronomy educator Dr. Tim Slater, the

workshop is limited to 40 attendees. At this time, there is a \$25 fee to attend to cover basic expenses of snacks, drinks, supplies, and the workshop. Lunch will be on your own at the hotel restaurant.

Also planned is a pre-conference Mini-LIPS Workshop led by Karrie Berglund on the first day of the conference (but ending prior to the first official conference activity, the opening reception). If you are not familiar with this event, it is a sharing of hands-on, inter-

active activities that can be done in the planetarium theater. It is limited to 40 attendees and has a \$35 fee which includes a box lunch in addition to the basic expenses of snacks, drinks, supplies, and the workshop.



Planetarians, astronomy educators, students

Conference Chair Adam Thanz, planetarium director, said "We want to address an important point of this conference here. Our theme is 'It Take's a Universe.' Again, it is to highlight the different persons that make up our strange little planetarium world. The two pre-conference workshops are a way to invite those who may not normally attend

a planetarium conference, and are a way for planetarians to learn some skills they may not already have. We feel that it is important to attract professional astronomy educators and students that have an interest in astronomy and education. By providing these cross-pollination opportunities, everyone wins. "

Full details, including maps and the conference schedule, are available from Thanzat Adam Thanz@KingsportTN.gov, and will be uploaded soon on the SEPA website at www.sepadomes.org. $\ \, \Rightarrow \,$

Sky Explorer REAL TIME UNIVERSE

2020

INTERACTIVE EXPERIENCE

Audience response system

Gamepad, full Ipad control;

Manual console

"Studio": Easy and intuitive GUI

CONNECTED COMMUNITY

Dome Casting

Data2Dome

Cloud & Social Network

STUNNING REALISM

Advanced terrain and atmospheric effects



Volumetric trail and active nucleus for comets

Scientific and volumetric Milkyway & globular clusters









RSACOSMOS





Hanging with wolves

Many of us have been there before.

Even if your planetarium is a large part of an even larger organization, many of us know what it's like to be included in a department that may have absolutely nothing to do with our mission.

When I started working at the National Air and Space Museum's Albert Einstein Spacearium (its name from 1976 to 1983) in November 1978, we were a part of the Presentations and Education Division, which was headed up by the well-known and respected planetarian Von Del Chamberlain. "Presentations" at the time consisted of the planetarium and the Samuel P. Langley Imax® Theater, which was more than appropriate.

In 1983, we were bounced over to the Department of Aviation History as the Albert Einstein Sky Theater, which coincided with the 100th anniversary of Wilbur and Orville Wright's first flight. Why was that? So that we could produce and run a show glorifying aviation and space history to date, plus include a speculative

look into the future.

Several years later, we became the Albert Einstein Planetarium (AEP) and, before I left in 1991 to come to Stockholm, we had also been a part of both the Education and the Space History departments (the latter did actually cover some history of astronomy topics). We were the hot potato that no one seemed to know what to do with, or wanted.

Cosmonova, the Omnimax® theater/ Digistar® planetarium of the Swedish Museum of Natural History I moved overseas to help build and be a staffer in, was always a part of the Publika avdelningen (Public Department), which was a catch-all for everything that had to do with public outreach. And, like most of the departments that the AEP found itself in during my 1978 to 1991 tenure, we too were the odd ducks, as the rest of that department—besides all the scientific research departments

making up the other half of the nation's largest museum—were strongly oriented to biology, nature, and the environment.

Certainly the museum's mandate letter that they received every year from the government clearly pointed out that it should "show our place in the universe" as a part of this scheme, but we were never really treated as being related to nature.

High ho, high ho, it's off to work we go...

I don't know about your particular situation, but Swedish organizations are very gung-ho when it comes time to their various departments doing stuff as a group, which can run the gamut from taking

IPS Fellow Tom Callen has approximately 40 years experience across five planetariums. He lives on an island in the Stockholm Archipelago under dark skies with wife Mariana Back and two trilingual cats.

a course together and going teambuilding in a remote location to everyone having a traditional pre-Christmas dinner together. It was no exception for the Publika avdelningen, and there were some excursions and other activities in which we were expected to participate.

The then head of the department was a biologist, and one of the trips that he managed to arrange was to the Kolmården (pronounced COALmoor-den) Wildlife Park, the largest in Sweden and typically visited by half a million tourists every year. Not only had he arranged this, but also we were going to be able to spend some time inside of the wolf enclosure, mingling with these large furry wild beasts of the forest. Don't get me wrong. These were not tame or performing animals; they were just as they had been when they left their native environments.

More to it than "Little Red Riding Hood"

In days of old, wolves in Swedish forests were to be as feared as we

Kolmården wolves inside their enclosure. All photos courtesy Björn Hedén.

have been led to believe from children's fairy tales. I was in a local hospital for an emergency appendectomy in the spring of 1998. One of the other patients sharing my room was a man who was probably pushing 90 years of age at the time. He got to talking with the third person in our four-bed abode, another oldster. The two of them got to swapping tales about their childhoods and the older of the two told about how, when he was 5 years old at around the start of the 20th century, he was living with his mother in a wooden cabin encircled by a deep and dark Värmland forest in the central southwest part of Sweden. There had been a snow-

storm that left them surrounded by deep snow. He was looking out a window and became puzzled by all the big dogs that he saw stalking around among the pine trees just outside their door. They were, as you've certainly guessed, a pack of wolves.

The wild wolves that continue to remain in Sweden today—believed to be 100 animals, including 11 breeding pairs—are protected by law, but this hasn't always been the case. A bounty was put on them from 1647 after populations of deer and moose had been seriously reduced due to overhunting and the wolves developed a taste for livestock. By 1960 they had been eliminated, but from 1978 on they were gradually re-introduced to the country with new stock from Finland.

Hanging with wolves

The day of our visit arrived and the department staff piled into a large tour-type bus and headed off for the nearly two-hour drive down to the Kolmården Wildlife Park, which lies northeast of Norrköping.

Upon arriving, we toured the exteriors of the rest of the attraction's other animal enclosures before we had lunch in their restaurant. This was to be followed by the main event of the day: a visit inside the wolf enclosure.

Contrary to what you might think, this was not, as it turned out, a super-special thing that we were being allowed to do just because of the museum we worked at. Truth be told, between 1991 and 2012 about 8,000 people a year had the same experience, as part of a special program called "Close contact with wolves." By paying a special fee,

you, too could spend about a half hour of pre-arranged time in such near proximity under the guidance of the wolves' handler, who also had to be in attendance.

There were so many of us from the Publika avdelningen on this outing that we had to be divided into three groups of about 15 people each so as not to overwhelm the eight wolves inside the enclosure. Their handler, the human that the pack trusted and considered to be "one of their family," explained to us what we could and couldn't do, the most important of which were not to make any really sudden moves or do anything that might be misinterpreted as being threatening. He also told us that, if he wasn't inside with us, the wolves would attack as they would any other prey. This kind of put a damper on the whole thing and elicited some nervous snickers from the group.

Our department head, however, had himself visited before and was quite enthusiastic about the whole thing. Perhaps he felt a kind of kinship between the wolves and his large German Shepard that he kept in his office while at work. Yes, you read that right: some people were allowed to bring their dogs to work, though that practice finally ended while I was still an employee.

The planetarium staff was part of the second group that was allowed into the enclosure, and, since nothing had happened with the first group, it was assumed that nothing would happen with us either.

Nice... doggie?

At first glance, you might have the impression that these Eurasian wolves are very dog-like animals, but when you are up that close and personal with them, you realize that you have to change your assessment. These are big, powerful animals with long especially un-dog-like pointed snouts full of some very large teeth. This type of wolf, found in Russia and Scandinavia, is larger and stockier when compared to their Western European neighbors. Central Russia's can measure 105-160cm (41-63in) in body length and 80-85 cm (31-33in) in shoulder height. They can weigh, on average, 32-50kg (71-110lbs), though the largest can have a maximum weight of 69-80kg (152-176lbs). Their Swedish and Norwegian counterparts are even deeper in the shoulder and are more heavily built.

Upon entering the doorway into the enclosure, the wolves were

lounging around as if this were an everyday occurrence, notwithstanding the fact that they had just entertained another group right before us. When they saw that their handler was leading our group some raised themselves and came over wagging their very long and bushy tails, just like any other canine would do upon seeing someone they knew.

More came up to us and began to mingle with our group. Someone had to break the ice sooner or later, and hesitant hands began to reach out and stroke them on the top of their heads, down their powerful

shoulders, and even behind their tall pointy ears. Much to our delight and surprise, they responded just as a dog would. The fur itself was relatively coarse and shorter than what one would have thought and nothing like any dog I had ever known. They seemingly enjoyed this human contact and some of them even licked the hands that petted them.

At one point their handler sat on the edge of a cliff face inside the enclosure that was part of a large formation of giant boulders. Sitting there, surrounded by some of the pack members, he threw his head back and did an apparently passable wolf call as several of them answered. What was even more interesting was that some of the ones that were elsewhere within the enclosure also responded.



Top: Kolmården wolves and author Tom Callen (on left) with other Cosmonova staffers. Below: the wolves and Cosmonova Head Technician Björn Hedén.

Why waste the opportunity?

I got to talking to one of the biologists in the Publika avdelningen, who was one of two who were responsible for answering public inquiries—emails, letters, or phone calls—and we decided to try a little experiment. I had been petting some of the wolves for a while, so my hands were pretty covered with wolf scent to the point that they actually felt kind of greasy, as if I

had been petting a sheep. Clearly, I had enough for what we wanted to try.

The longer it took on our bus ride home, the more my hands began to itch mildly and I was beginning to smell them. It was kind of like a doggish smell, yet it wasn't. By the time I had gotten into my wife's car for the commute home at the end of the day I was past ready to wash my hands, but that would ruin the experiment.

And what exactly was the experiment? As soon as I got inside our house, I located the family cat and thrust my wolf-saturated hands into his face so that he would get a good whiff. There was no response whatsoever. I tried again, this attempt making sure that he got an even longer exposure. Again, the exact same reaction—none, zero, zip, nada—the same as what happened the third time, which clearly was no charm. Satisfied with the lack of results, I washed my hands to get rid of the wolf taint.

The next day, the biologist I had cooked this experiment up with and I concluded that the wolf smell was not a part of our cat's "threat (Continues on page 82)



Risk communication and the planetarium

Here we are from New Zealand, securely locked behind our modern iron curtain of COVID-19. While everyone else is dealing with the disease, here we roam free, no masks required, and the planetarium has long resumed its activity as if the closures never happened. As I write this is November 2020 and we have about 60 cases across New Zealand (population around 5 million citizens) and they are all in quarantine or under surveillance.

After our very short lockdown, we reopened and some experiences got more visitors than usual, while some others did not. We were not really closed for too long. The break gave me the opportunity to rethink everything, just like everyone else did, for sure. The biggest lesson for me was relearning something I knew from my previous job in risk communication: that people love two-way communication, as they want to be heard and seen.

Risk communication and the pandemic

Since I spent almost 10 years doing risk communication I could not help but compare what we do in the planetarium with the COVID-19 communication going around us. I always look for the most effi-

cient way to share my love for space, given that many times I heard "Hari, not everyone likes space." So what is it that I can do better to engage more people? Surely, I'm thinking to myself, they might not like it, but do they know how much comfort and technological advancements it's brought to us? Let alone technologies that are saving lives?

It turns out that actually people who find it hard to quantify risks/benefits intuitively look for information from third parties in order to come to a judgement about the seriousness and acceptability of a given risk/benefit. In a debate, the majority of lay people have hardly any other choice but to believe one side or another (Luhman 1986, 1990). In risk communication we call this "second hand information delivery."

Do you trust the people who are delivering it? Then you are more inclined to believe it. It's like if you really like your doctor then you do what they say. If you don't like them, you often look for a second or third opinion. This phenomenon is long known to risk communicators and there is something you can do about it. Make people trust

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you as an institution. Credibility is crucial where lack of personal experience requires people to depend upon neutral and disinterested information (Renn 2008).

We deal with incomplete, ambiguous information

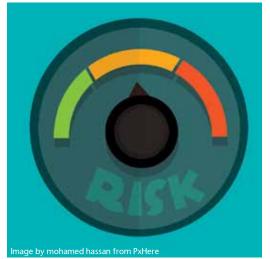
Probably, one of my favourite things to ponder on, that I learned

in the same context of information and processing information, is that people make judgements based on incomplete and ambiguous information: People have no conscious experience of most of what happens in the human mind. Many functions associated with perception, memory, and information processing are conducted prior to and independently of any conscious direction.

What appears spontaneously in consciousness is the result of thinking, not the process of thinking (Heuer 1999). We tend to perceive what we expect to perceive.

It takes more information and more unambiguous information to recognize an unexpected phenomenon than an expected one. Maybe that's why space is so hard to conceptualise. It's nothing like being here on Earth.

The tendency of the people to perceive what they expect to perceive is more important than any tendency to perceive what they want to perceive. These patterns of expectations, called "mind-sets," tell people what to look for and what is important, how to interpret what they have seen. Mind-sets tend to be quick to form but resistant to change. Heuer suggests this is happening because we learn by assimilating new information to existing images from our brain (Heuer 1999).



Group information and the individual

And last, but not least, a study undertaken by Walker (1995) underlined how policy makers are naturally concerned with characteristics of groups. They rely on data about groups and subsequently make predictions about groups, which righteously have a commonality of interest. Then they try to convey to individuals the group information available. Individuals mostly care about "what's in it for me?"

Fortunately, space spin offs here are a hook that we cannot ignore. *To Space and Back*¹ is a fantastic show about space spin offs, which is why it is one of my favourite planetarium movies out there. Space spin offs are dear to me because I believe they are one of the reasons why civilian space research got institutionalised; in other words, why we kept going to space beyond the cold war, as I researched and found out a few years ago. So space is really awesome, but from it being acknowledged,

¹ Subtitled *Space Exploration Shaping Your Life*; find it at www.fi.edu/movies/space-back

to getting people to actively be engaged in doing more space, we can learn a lot from risk communication.

First developed by policy makers, risk communication investigates how expert assessments could be best communicated to the public, so that the tension between public perceptions and expert judgement could be bridged (Renn 2008). Risk communication is also a subset of science communication, of which planetarium content also belongs.

The three big objectives

Three big objectives stand at the core of risk communication: (1) to share information, (2) to change beliefs and (3) to change behaviour. In our case, we share information about what's happening in the universe every day, what exploded, how many exoplanets we have found now, what we found out about Mars and so on. This is the easy part; all we have to do is list the information out there and hope that the public will come and take it.

Changing beliefs is a bit harder. Take for instance the UFO believers, or those who believe in flat planets. This is where it gets tricky because, as I mentioned above, Heuer, one of the giants of (intelligence) analysis, is warning us about mindsets. When the UFO person comes to your planetarium, you know after the show they will wait there outside the door to tell you that UFOs are real.

And, if changing beliefs is hard, try changing behaviours. Get the people from the city to turn their lights off for the sake of the sea turtles. Or the city council for that matter.

Probably most of us planetarians agree we need to become a spacefaring civilization in order to survive, and I'm not sure how many of us know deep down in the heart of our hearts that this is what we are advocating for. Our space science communication under the dome tries to change the hearts and the minds of the public, and not just to get them to stop smoking or eat their vegetables but to create our own overview effect. In the end we are all advocating for more space.

When risk communicators realised that nobody was listening to their speeches, even when they were really good, they re-invented dialogue (Renn 2008). The data spoke. A succinct history of risk communication, made by Morgan et al. (2002) illustrates how things changed during the last fifty years.

All we have to do is:

- Get the numbers right.
- Tell our audience the numbers.
- Explain what we mean by the numbers.
- Show our audience that they have accepted similar risks in the past.
- Show our audience that it is a good deal for them.
- · Treat our audience nicely.
- Make our audience our partners.

In the 1950s the U.S. public felt that that a decision was acceptable if they had been informed about it. In the 1970s that evolved towards the public's feeling that it needed to be heard before the decisions were made. Beginning from 1980 to today, society believes that it must actually influence the decision (Creighton 1992 cited in Morgan et al. 2002).

Risk communication points out that two-way communications build up mutual trust, as the public and the relevant stakeholders feel heard. The ultimate goal is to help people understand why we do what we do and to help see that there is solid science and factual evidence about the matter at hand, and that space research is good for human-kind in general, and is aligned with people's own interests and values.

Mars is not "plan(et) B," as I heard few people saying, but is a place that if we ever learn how to terraform, for instance, it will inform our activities of combating climate change here on Earth. By studying the storms on Jupiter we understand how they work here on Earth. The institution from where the planetarium operates then acts as a conduit of information to the public, and in turn the public turns to the planetarium for information. People make informed decisions about matters of concern to them.

Awareness strategies "seem to work best as they scale down the concepts, and bring problems and solutions into the local every day level" (Uggla 2008). Citizen science is probably my favourite one. I wrote about this previously how we started a light pollution campaign while in lockdown. The beauty of the Globe at Night campaign is that you can see when people do measurements of their night sky. In New Zealand we can see more dots since we started actively engaging with people online during lockdown, which gave them something to do at the time, and now we harvest the fruits of that as they feel like they are contributing something and not just being lectured at as we did before.

There are many manuals on risk and science communication but these were points that made me think and revisit the way I communicate space sciences to the public.

References

Heuer, R. (1999). *Psychology of Intelligence Analysis*. Washington: CIA Luhmann. (1995). *Social Systems*. Standford University Press.

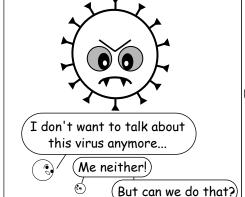
Morgan, G., Fischhoff, B., Bostrom, A., & Atman, C.J. (2002). *Risk Communication, A Mental Models Approach*. Cambridge: Cambridge University Press.

Renn, O. (2008). Risk Governance: Coping with Uncertainty in a complex world. London: Earthscan.

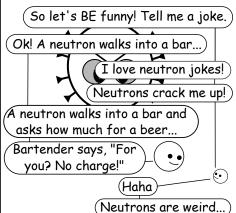
Uggla, Y. (2008). "Stragtegies to create awareness and legitimacy: the Swedish climate campaign." *Journal of Risk Research*, 719-734.

Walker, V. R. (1995). "Direct Inference, Probability, and a Conceptual Gulf in Risk Communication." Risk Analysis, 603-609 ☆

PARTYCLES #045 - Dec '20 Alex Cherman So let's BE funny! Tell me a joke.









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Hiring a presenter for live, interactive planetarium programs

As I write this, it's been one week since the Great Lakes Planetarium Association's virtual conference. While it was wonderful to see and hear so many friends and colleagues via Zoom, I imagine that I speak for everyone when I say I am more than ready for in person meetings to resume. Hang in there, everyone!

Some of you reading this hopefully participated in a LIPS-style workshop I co-led with Mark Webb and Paulette Epstein at GLPA. The workshop was about hiring (my section), training (Mark), and evaluating (Paulette) presenters of live planetarium programs.

The 90 minutes we had for the workshop absolutely flew by, as we all knew it would. I opted to focus my limited GLPA workshop time

on interviewing questions and strategies, and to use this column to discuss job descriptions and publicizing open positions. In future columns I will look at interview questions and strategies, training, and evaluations.

Crafting a job description

What are the primary purposes of a job description? In a nutshell, you want to communicate the following:

- Brief summary of the institution/organization offering the job: "XYZ Planetarium has been providing live, interactive planetarium shows to public and school groups since 1989."
- A short, memorable job title: "planetarium educator," "planetarium presenter," etc.
- One or two sentences about the big picture duties of the position: "The planetarium educator presents live, interactive astronomy programs on a variety of topics to audiences of all ages. When not presenting programs, the planetarium educator helps maintain planetarium equipment and teaching supplies, and may also develop new programming."
- Full time or part time, with approximate hours if known: "This is a full-time position, typically Monday through Friday from 8 a.m. to 4:30 p.m. Some weekend and evening hours may be required."
- A detailed list of job duties: See below.
- Requirements for the position: Include physical, educational, and experiential requirements.

It's obvious that the core duties and job requirements of planetarians will vary somewhat by institution; there is no "one job description fits all" for a presenter of live planetarium shows. However, there are some consistent requirements and desired personality traits for presenters of live shows in any dome:

- · Comfortable speaking in front of audiences
- Friendly and approachable

- Interested in astronomy and/or science in general. Note: For college/university planetariums, an advanced degree in astronomy or physics is typically required, as those planetarians often present to undergraduate or graduate students.
- Flexible and able to "roll with the punches" (especially critical for those doing outreach)
- · Able to effectively work with different age groups
- Sufficiently tech-savvy to operate and help maintain the equipment in your dome

Some of these requirements are difficult to quantify—there's no unit of measure for how friendly someone is—but during the inter-

> view process you can and should assess the personality traits that you consider most important. I will discuss interviewing in depth in my next column.

Most planetarians, of course, also have additional duties, such as:

- Acting as media liaison for astronomy events
- Producing content to display on the dome
- Writing curriculum aligned with state and/or local educational standards
- Maintaining equipment and/or consumable supplies
- Tracking show attendance
- Assisting with fundraising and/or grant writing
- And many more

I want to give special recognition to Keith Turner of the Carmel Clay Schools Planetarium in Indiana. Keith has compiled an extensive list of job duties common to school planetarium directors, and I drew heavily from that in the



I spent several years traveling around Washington state for Pacific Science Center's Science on Wheels outreach program. Space Odyssey featured two portable planetariums, which is where I got my start in astronomy education.

above lists. Thank you, Keith!

I also received great feedback from the LIPS community. Carole Holmberg of Museum of York County's Settlemyre Planetarium in South Carolina told me:

I look for someone who can communicate concepts well, is enthusiastic, and is able to learn how to manipulate the equipment. (I had to let someone go once because she was unfamiliar with how to use a computer keyboard

and did not seem to be able to learn!) They must also be willing to learn some astronomy, although that is not a requirement at the start. They also need a college degree for any paid employment with us.

Waylena McCully of Parkland College's Staerkel Planetarium offered similar comments:

Willingness and genuine desire to share the subject in a meaningful way is top in my book for what to look for in a live presenter. Someone can be a great presenter (like a game show host or tv car salesperson) but if they view it as a chore and don't really care how the audience relates, then they won't be as effective.

Waylena commented that her own job description:

... boils down to: Can do the creative stuff, the tech stuff, the research stuff, and live shows while not wanting to be director and is willing to work odd hours and with very small operating budget. I wonder how many of our jobs boil down to the same.

Katy Downing of Schuele Planetarium at the Lake Erie Nature and Science Center wrote:

In my eight years in planetariums, I have been through several hiring/firing situations. And I now have a good idea of what I look for when I'm involved in the interview process.

In general, we know that if the person has a good head on their shoulders and appears flexible with content and age groups, we know that having a background in astronomy isn't necessary, and we can teach them the [pre-kindergarten] info they need before they get in front of an audience. We also look for someone who is comfortable with using basic computers and is comfortable speaking in front of kids and adults.

During an interview that person is making jokes, smiling, responding quickly to questions and new information, and speaking loudly and clearly. For the type of shows we do, and our schedule in the before [coronavirus] times, we really focused on that last part, and on flexibility.

Thank you to Carole, Waylena, and Katy for your input!

I mentioned stating physical requirements of the job description. These differ by position, largely by whether the presenter is working in a fixed or portable dome. Outreach educators will have a longer list of physical requirements due to the nature of the job. Having done both outreach and fixed dome teaching myself, I can assure you that outreach is indeed much more demanding on the body.

Susan Button, who writes the Mobile News column for this journal, knows a thing or two about portable planetariums. Susan sent me a document titled "Who Do You Want to Run Your Mobile Dome?," which has a wealth of information. Here is one particularly apt excerpt:

"The job candidate needs to be able to physically fulfill the requirements for assigned teaching duties. He or she needs to be able to lift and set up the equipment, enter and exit the dome easily, teach four to six classes in a day, get up and down off the floor several times during the lesson, and then pack up and take the equipment away. This requires good health and a high energy level.

"Management skills needed include: a healthy sense of humor, patience, flexibility, a realistic sense of human nature, and good organizational skills. It is important to hire someone who is assertive and can communicate with school officials as well as teachers. Schedules must be made and kept and record keeping is essential. There must be a regular maintenance schedule for the equipment and it must be stored properly. The program must be advertised effectively as well.

"A good candidate will be interested in promoting their own professional development through the reading of professional journals and, as funds allow, through course work as well as attendance at conferences and through communication with colleagues."

Karrie Berglund is the director of education for Digitalis Education Solutions, Inc. and leads the Vision 2020 initiative on professional development. She is a former director of the Willard Smith Planetarium at Pacific Science Center in Seattle, Washington, USA.

I couldn't have said it better myself. Thanks, Susan!

Note: If you work at an institution that does not have an internal human resources department, there are companies that provide HR consulting services. We have worked successfully with a company called Archbright when we needed feedback on legal issues, to help with delicate situations, etc. Many of these HR consulting companies offer fee-based services such as job description and/or employee handbook reviews, in addition to yearly contracts.

Publicizing open positions

When you have your job description written, how do you get the word out about the opening? This varies somewhat by institution, but asking your current presenters to invite qualified friends to apply is a good and free way to announce positions. You should also take advantage of institution-specific publicity opportunities like job boards (physical or digital) or career centers if you are at a college or university planetarium.

You may not have complete control over where positions are posted. Carole Holmberg commented that, "All open positions are posted through our County HR department. We rarely, if ever, post elsewhere." However, Carole also noted, "I tell my volunteers and other employees if we have an open position, so that there's also word of mouth."

In general, I suggest you cast as wide a net as possible, since a wide net will give you a larger candidate pool and assist you in creating as diverse a team as possible. IPS' Equity, Diversity, and Inclusion committee function statement nicely summarizes why a diverse team should be a goal:

"To work to make sure that the IPS fully benefits from the talents of all our members, regardless of race, religion, gender, sexual identity, or disability. We will propose practices to make public programming in our planetariums as welcoming and as accessible as possible to the diverse communities we all serve. (Excerpted from https://www.ips-planetarium.org/page/equity)

There are job boards that can help you reach this goal, and this webpage lists 20 such websites: https://breezy.hr/blog/top-20-job-boards-diversity-hiring.

And, of course, the IPS web site offers a career center on its website, available only to members who have logged in. See the Members Only section at https://www.ips-planetarium.org/.

Thank you again to all who contributed on this topic! Stay tuned for future installments on other aspects of hiring staff as well as training and evaluating performance.

As always, I end with reminders about the LIPS Google Group and Live Interactive Planetarium Symposium Facebook group. Contact me (karrie@DigitalisEducation.com) if you need information about either group, or if you just want to share ideas.

Until we meet again, I hope that you and your families and friends stay healthy in body and mind. $\mbox{$\,\not\!\!\!\!\!\!\!\!/}$

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Interviews of interest

Each month the Association of Italian Planetaria (Planit) organizes different interviews online with astronomers, planetarians and museum operators. Here is the first interview, with a mobile planetarium director.

Loris Ramponi (the interviewer) relates, "Not all accounts of contributors to culture can be found in books or on television. For instance, the story of Gianluca Di Luccio is an important one. He was born in Milan and now lives in Piovene Rocchette (Vicenza). His activity is itinerant, without borders, he goes wherever they call him. His presentations are always entertaining and informative, as he tells famous stories like *The Little Prince* under an inflatable dome full of stars.



Unfortunately, his touring mobile planetarium enterprise, with which he went to schools and many other venues, has suffered a sudden setback following the pandemic. Ensuring appropriate social distancing in a spherical dome of just a few meters in diameter is not easy.

So, while waiting for better times, Gianluca reinvented his job. Now

he works as a lecturer who is not behind a projector but in nature; his new registered trademark is Star Trekking, a name that recalls a successful television series.

The franchise that holds the rights to Gene Roddenberry's envelopepushing series¹, including the use of the name Star Trek, hired a wellknown law firm and ordered Di Luccio to suspend use of the brand. Many other people around the world have run into similar problems and succumbed to the request, but not our David. He challenged Goliath!

So, at the end of a year of legal disputes, Di Luccio won. Not only does his brand still exist that recalls the assonance with Star Trek, but also has encompassed the moon in his journeys. The traveling lecturer organizes guided excursions whose times are calculated on the rise of our satellite. When he sets out to lead a group, at first glance he looks like a companion, and then he puts on the shoes of the speaker. He is inspired by the full moon that appears on the horizon and speaks about the moon of poets and writers, astronomers, and astronauts. One story leads to another and the enchantment of Luna, born in the open air, becomes the show of the same name that is staged among the evocative architecture of the Palladian villas. The summer program of *M'incanto di Luna* has as its stage the famous villas in the region of Vicenza. Here the lecturer is joined by a group of musicians.

Who knows, maybe his presentations will sooner or later arrive in Brescia, a city where he did his military service.

Each month, through dialogues and interviews, operators of planetariums and science museums, disseminators and astronomers who work in Italy and abroad, will talk about their professional activities, the research they deal with, and the initiatives they organize.

This story of the unique activities of Gianluca Di Luccio is the subject of the first of the series of interviews that the Association of Italian Planetariums (Planit) will post on social media channels. The head-quarters of Planit is at the Serafino Zani Study and Research Center in Lumezzane, Italy.

These interviews also will be posted on the Planit Facebook page and on the Science for All programme that is released monthly to all interested parties by the group that manages the Lumezzane Observatory.

You can also visit the IPS webpage Voices from the Dome to read about and hear portions of Loris' interviews. https://www.ips-planetarium.org/page/voicesit

Portables in focus in Africa

During World Space Week 2020, the African Astronomical Society (AfAS) Outreach Committee and the African Planetarium Association (APA) celebrated by presenting a seminar called "Portable Planetarium Innovations for Africa." During three sessions we learned about some amazing innovations and efforts to promote the building of low cost planetariums.

The presenters were encouraged to contribute some articles to *Planetarian* to further share these unique projects with our communi-

¹ The series and its various spin-offs were owned by separate corporations over the years, but currently it is CBS/Viacom, with Paramount owning the rights to some of the individual movies.

ty, to build partnerships in developing content, and to inform about low cost portable and stationary planetariums in Africa. Hopefully you will read more about this in future issues of *Planetarian*.

The three sessions presented were:

The Nairobi Bamboo Planetarium. Susan Murabana and D. Chu Owen

During this session we learned about a unique way to build a planetarium. A 10m geodesic dome was fashioned with fast growing, strong, and locally sourced bamboo; it is the newest addition to the Traveling Telescope Program with its 8m portable dome. We learned about the actual methods of construction and how economical it was to build this dome. This planetarium in Kenya serves as a good example for others to replicate in other regions of Africa. The hope is to have a planetarium in every Capitol city in Africa. https://travellingtelescope.co.uk/about

Outreach with a Portable Planetarium: The CCC. Hichem Guergouri and Jamal Mimouni

The Sirius Astronomy Association is located in Constantine, Algeria. During this session we learned about the very extensive activities of a group that is extremely popular and devoted to promoting astronomy and science with the public. The Constantine Cosmos Caravan (CCC) is a portable planetarium which is supported by a gallery of very large and beautiful posters which are used to give people basic knowledge about astronomy before entering the planetarium. Members are available to explain the posters' concepts and to answer questions before people experience a show in the planetarium. Currently, during the time of the COVID-19 epidemic, lectures and the poster gallery are being used to continue the program. http://siriusalgeria.net

Virtual Visits to the Sutherland Planetarium and Zridi's Portable Planetarium. Nico Van der Merwe and Abdelatif Zridi

Since Sutherland in located near the Southern African Large Telescope, it is

a high tourist area. Nico Van der Merwe's parents are in the tourism industry. After graduating with an engineering degree, Nico's parents asked him a question, if they sold their home would he be able to use the money to build a fixed planetarium. He accepted the challenge and successfully built two brick and plaster domes. Because the first was not perfect it was considered the one for "practice!"

The structures were constructed by local dam builders using an inflatable dome as a guide for placing the 62,000 bricks. The domes are connected to each other and one houses the planetarium and the other (the one for practice) is an information center and coffee shop. I hope Nico will share his amazing story more fully in a future issue of *Planetarian*. http://www.sutherlandplanetarium.co.za





Image from physicalmap.org, public domain

Jamal Mimouni is the head of the Affordable Planetarium group of AfAS, which organized the event. For more information or to lend assistance to this group, you can contact Jamal at jamalmimouni@yahoo.com.

The NOVA mobile approach during the pandemic

I recently received a wonderful email from Joanna Holt, who is graciously offered to share a new way to work in the time of this world pandemic.

She wrote, "I have recently joined the Netherlands Research School for Astronomy (NOVA) to coordinate their national primary and secondary astronomy education programme, including managing the NOVA mobile planetariums. I have taken over this position from Jaap Vreeling, who has now retired. I am an astronomer by training, but after a number of years in research I have spent the last 8 years working in science education.

"I joined the IPS this week and I have been trying to follow a few of the talks during the online conference. I have also been exploring the website and discovered the page with resources for mobile planetariums.

"Whilst looking at the articles published with tips about how mobile planetariums can continue to function during the pandemic, I was inspired to share the experiences of the NOVA planetarium and what we are doing at this time.

"I attach an article I have put together about the NOVA COVID-19 solution and the first experiences we have had implementing our coronavirus-safe programme. NOVA has taken quite a different approach to the tips and suggestions already published and we feel it would be useful to share our experiences with the community. As described in the article, both our staff and teachers at a test school were surprised at how well our implemented solution has worked.

Contact Information: Dr. Joanna Holt, Nova Informatie Centrum, Science Park 904, Postbus 94249, 1090 GE Amsterdam. You can read her article on https://www.ips-planetarium.org/page/portableresources or on page 28 in this issue of *Planetarian*.

As we say in New York State: Stay safe—be tough, smart, united, disciplined, and loving.

Susan Button is a past president of IPS and has chaired the Portable Planetarium Committee since 1988. She is a retired portable planetarium director for the Onondaga Cortland Madison BOCES in Syracuse, New York, USA.



Ron Walker The Star Barn Planetarium P.O. Box 161 Cave Creek, Arizona 85327-0161 thestarbarn@gmail.com

Sharing an interesting project from across the pond

I would imagine that by this time most of you have had enough of my pedantic scribbling, so I thought you might like to hear from other amateur planetarians. Let me introduce you to Scott Tucker from across the pond (at least from me), who will tell you about his most interesting project. See the sidebar.

Keith's captured quips, chapter thirteen

"Can I work at the planeteream now. Tell me if I can gota go."

"When we got there I never wanted to leave!"

"Thank you for showing us the planets."

"Im sure I liked it."

"It was awe some with the star thing." [No, this was not George Bush's ${\rm kid}...]$

Ten years ago

December 2010: I can't imagine watching my planetarium being destroyed right before my eyes, but this fate befell Kris McCall. On the bright side, the old planetarium had to go to make room for her new and improved one. In "New Star in Music City," Kris tells a story of the many rebuilds of the Sudekum Planetarium.

The remembrance of "Jack Horkheimer: Planetarian and Star Hustler (1938-2010)" by Jane G. Hastings is a fitting tribute to this first magni-

tude planetarian. Jack wrote in his Star Bound program,

"Once upon a time....

In a galaxy not so far away....

There existed a creature strange

With an insatiable thirst for knowledge.

Now this is the peculiar part:

The more it learned, the less it knew.

For with every answer, came another question.

Now this is the beautiful part:

Of all the creature's thirsts,

This one brought him closest to the gods.

Twenty-five years ago

December 1995: When John Morehead asked Harlow Shapley which, a planetarium or an observatory, would better suit the children of North Carolina, Shapley suggested that a planetarium would be better because he felt the people of North Carolina were among the "most astronomically ignorant" people in the United States.

Thus begins James G. Manning's article "The Role of Planetariums in Astronomy Education," a look at what several different planetariums were doing to educate the masses. While some of the tools have

(Continues on page 82)

The Bridge Planetarium project, Launceston, Cornwall, UK



The Bridge Planetarium being reconstructed in the Bridge Church main meeting room. Potos by the author.

By Scott Tucker Launceston, Cornwall United Kingdom

The precursor to the Bridge Planetarium project was a small dome I made in my attic, supposedly to entertain the kids (but in truth to entertain myself). An original obsession with amateur telescope making had followed what I thought was a natural progression into amateur planetarium making.

Over about a decade of casual tinkering, my cardboard geodesic sphere—held together with bulldog clips and gaffer tape—evolved into a little 2.3-m diameter plywood-framed dome covered with stretched tissue paper (a bit like old-fashioned radio-controlled plane air frames). I would do Christmas shows for the children and, occasionally, a small group of friends.

When Phil Parsons, a wonderfully-enthusiastic farmer from our church, saw a show he demanded that we build a "public" version that did not involve climbing into an attic and set off to find a budget for materials from a small local Methodist charity. The Bridge Planetarium project was born.

The Bridge planetarium dome was 4.6 metres in diame-

ter—the result of some not very scientific guesswork about how many people could squeeze into it and whether it would fit in potential venues. The aim was to house it in the Bridge Church in Launceston, Cornwall but aldo make it semi-portable so it could be used elsewhere.

By far the hardest part in amateur planetarium making is simply having a (free) weatherproof space big enough to build a dome. Initially we worked in a redundant meat processing plant which was, bit by bit, being converted into the church meeting room and community center. The first week of construction in May 2018 was spent sweeping up concrete dust and clearing out various abandoned industrial fittings from our corner of the warehouse.

The dome was made from 8 plywood framed petals with a foamex (foam core) skin and held together with glue, screws and kitchen cabinet connectors. It took about 3 months of evenings and weekends just to cut out all of the plywood arcs. One evening our shadowy late-night presence in the warehouse attracted a visit from a police patrol. He was delighted to talk about the technicalities of domes and stars rather than having to deal with burglars.

A beautiful construction site

By September our workspace was needed, so we used Phil's livestock trailer to move lock stock and barrel to Broadwood Chapel—a tiny Victorian rural chapel which had closed down a few weeks before hand and was offered for free, complete with electricity, by the Methodist circuit. This rather beautiful setting became our construction site for the remainder of the build.

An important part of the project was that it retained its amateur "maker" roots in that surplus or household components were re-purposed. The optical starfield was projected with home-made plywood box projectors, LED security lights, and some rather beautiful achromatic industrial photocopier lenses mounted on an old washing machine bearing. The appearance of the central projector was suitably complicated and enigmatic, a key ingredient of a planetarium visit.

The sun projector assembly used a 100:1 gearing device from an old central heating system that gave an extremely smooth mechanical sunset. The sunset ambient light was provided by Arduino-controlled LED light strips around the circumference fading very slowly through the orange and purple hues in time to the music and the setting sun.

Ilike to think that what the Bridge Planetarium lacked in professional slick engineering it made up for in a sort of home-made charm. The spring line had a forest silhouette that



Top: Interior of the dome with the beloved florest silhouette. Below: under construction in the Broadwood Chapel.

was home to owls, bats, squirrels, and foxes. Searching for the animals in the forest was a key activity for some of the smaller children.

In addition to the optical starfield, scientific accuracy, planets, zoom capability, and constellation art were provided by digital projection through a home-built Lhoumheau Sky System) http://lss-planetariums.info/index.php?lang=en&menu=projector&page=videoprojector) running Stellarium software.

In December 2018 the dome was shipped back to the warehouse—which by now had been converted into the Bridge Church main meeting room. We ran 25 "Star of Bethlehem" shows with 380 people coming through the doors. The show was in two parts: an old-fashioned shadow silhouette show of the journey of the magi (with some adventurous embellishments), followed by a scientific tour of the night sky from the latitude of Bethlehem on the first Christmas night.

Reactions

We left a few sheets of paper outside for visitors to write comments. One elderly man at the very first show said that it held no interest at all for him. I am still not sure why he was so keen to voice such a worrying verdict, which was not a good sign, but as time went by he turned

out to be in the tiniest minority.

Some people couldn't believe that a relatively small town had its own planetarium. There was a theme that people loved the old-fashioned shadow show "so good and rare to get such storytelling away from the i-pods of today. My inner child was so engaged...more please."

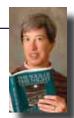
Being aware that the planetarium was "home made" and therefore somehow within reach led some to confess that they now really wanted one of their own. Gary Likert articulates this desire in his *Paper Moon* podcast, in which he imagines a burgeoning trade in planetarium projectors on a par with used car sales and the size of the backyard planetarium being a key factor in which house people buy. I have never really understood why so few people take up this hobby.

Some audiences were noisy and chatty, others hung on every word in silence. My favorite sessions were those during which people really "got it" and the tour of the sky section turned into a two-way conversation and we just went where people wanted to go.

Reaction to the moment of darkness when the stars come out ranged from complete silence to a round of applause and my favorite: the traditional "aaaaah."

We had requests for more shows. A group of homeschoolers and our local scout group arranged a special session based on what they had studied and our local cub scout group had a show as part of their astronomy badge.

(Continues on page 82)



April S. Whitt Fernbank Science Center 156 Heaton Park Drive NE Atlanta, Georgia 30307 USA april.whitt@fernbank.edu

Einstein's monsters, exomoons for kids, and cool women in space

Einstein's Monsters: The Life and Times of Black Holes

Chris Impey, W.W. Norton & Company, 2019.

Reviewed by Francine Jackson, Ladd Observatory, Providence, Rhode Island.

This book should have actually been called "everything you've ever wanted to know about black holes." The life and times just isn't enough.

It starts with a good, comprehensive history of black holes, even before they were really known. From there, the reader is placed into the birth of a black hole and the many varied types and sizes that they

can become. Of course, the biggest problem with black hole is their gravity. This causes problems, of course when, among other things, they collide.

How do we even know they exist? The author goes into detail as to how they are born into both our fairly close neighbor-

hood and throughout the universe. Is it true we need one to create a galaxy? Are there galaxies without one?

Another fascinating section is the use of LIGO, the Laser Interferometer Gravitational-

Wave Observatory, a very integral part of the discovery of the results of black hole interactions, a work so detailed that the major scientists involved in this received the Noble Prize in Physics in 2017. Also, a nice addition, the author gives a biography of each recipient rather than just naming them and their accomplishments, proving there is more to a scientist than just the glory.

For those who would like to have a comprehensive text containing virtually all there is of the topic, Einstein's Monsters is a nice, compact volume. It might take a bit longer to finish as there is so much contained within its pages, but it is a good read.

Goodnight Exomoon: An Astronomical Parody

Kimberly K. Arcand, with pictures by Kelly Kennedy, Cottage Door Press, 2020.

Reviewed by Francine Jackson.

CHRIS IMPEY

THE LIFE AND

TIMES OF

LACK HOLES

According to the author, *Goodnight Exomoon* began its life as a story for her two young children. A visualizationist for the Chandra X-ray Observatory, Kim Arcand thought this was a good way to introduce them to how she spends her daytime hours. But, then, as all good things do, it grew into a new way of wishing more than just children a good night: It shows the fascinating tools used by her work and the different people who form the team.

The book itself is, in fact, a different way to say good night to chil-

dren. It shows the respect we should have, not only for people, but for the instruments needed in any occupation. In this case, it is the tools of astronomy, so the concept of wishing a pleasant dream to a telescope, a micrometer, or a lantern shouldn't just brushed off. It shows each object as an essential part of the whole job.

The words are very simple, and only a few are written on each page of this durable board book. The pages are beautifully colorful. *Goodnight Exomoon* can become part of your library, or your child's library, for a long time to come.

Astronomy: Cool Women in Space

Anita Yasuda, Nomad Press, 2015.

Reviewed by Michele Wistisen, Casper, Wyoming.

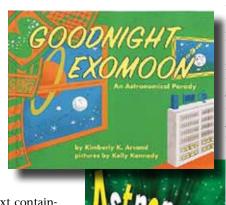
Suggested for readers age 9-12, Anita Yasuda's writing helps young people to understand perspectives different from their own and settings and people living during a different time period. There is a wealth of information in this book about the history of astronomy and many women who contributed to our understanding of the cosmos. The author has included information about women in science

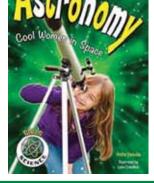
that can help young girls identify with them and realize that they, too, could have a career in science.

The book provides QR codes to give readers links to learn more about related topics, like astronomical events depicted in cave paintings. There are links in the back of the book that correspond to all QR codes in the event that a reader would need to access the information

through the internet. I found the Ask and Answer call out boxes with questions such as "Do you think it is important for women to have the same educational opportunities as men?" valuable because they encourage the reader to think further. Questions like these could lead to a valuable discussion with an adult.

Overall I would recommend this book for an avid reader who would like to learn more about women who had careers in astronomy and the challenges they faced.





April Whitt is an astronomy instructor at Fernbank Science Center in Atlanta, Georgia, USA. She shares that she is so old that she has flown on both the Kuiper Airborne Observatory (KAO) in 1995 and the Stratospheric Observatory for Infrared Astronomy (SOFIA) in 2015.



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Mahalo and aloha, as Sound Advice says farewell

Well, as I mentioned in the September issue, this December issue will be my last after authoring this column for about 25 years. It features a collection of my most important columns and some thank yous to some people who have been influential in my planetarium work.

If you want me to cover any specific topics, send an email to jbsoundideads@gmail.com.

First, IPS has an amazing collection of past issues. In Sharon Shanks' words: "From the main IPS menu, go to publications, drop down to *Planetarian* and hover, and a new menu will appear. Or go directly to https://www.ips-planetarium.org/page/plntrnarchive."

If you type "Bowen" in the search bar, a list of columns I authored populates the screen.

Here are some of the articles I think are most significant:

"Arte dal Vivo nelle Cupole: Music under the Dome"

https://cdn.ymaws.com/www.ips-planetarium.org/resource/resmgr/planetarian/202006planetarian.pdf

"Going Thru a Phase: Acoustics in the theater"

https://cdn.ymaws.com/www.ips-planetarium.org/resource/resmgr/planetarian/201512planetarian.pdf

"There is nothing wrong with your television set. Do not attempt to adjust the picture."

https://cdn.ymaws.com/www.ips-planetarium.org/resource/resmgr/planetarian/2007-2012/201206planetarian41-2.pdf

"Upgrading and renovations: your assignments"

https://cdn.ymaws.com/www.ips-planetarium.org/resource/

resmgr/planetarian/201909planetarian.pdf

Also, there are some Sound Advice columns and valuable dome and exhibit technology papers available at http://bowentechnovation.com/resources/workshops/

And a couple of quick thank yous:.

- Sharon Parker and Lura Kyro, who encouraged me to start designing soundtracks in 1988.
- David Dundee, who invited me to do my first composing workshop at SEPA 1990.
- Jon Frantz, who involved us in most of his projects in the 90s and beyond.
- John Serre, who stays in touch and was very supportive of my work in domes.
- Mark Trotter, who was a valuable customer and fantastic emplyee for 19 years at Bowen Technovation
- Sharon Shanks and John Mosely, who published my columns.

And thanks go out to IPS and GLPA for naming me a fellow of their organizations. These awards are mounted on my music room wall at our house in Kona, Hawaii.

Mahalo and aloha.

Z

Jeff Bowen has worked worldwide as a planetarium and exhibit specialist since 1985 and has been named a Fellow of GLPA and IPS. Jeff also served until recently on the IPS Sound Committee and is the founder of Bowen Productions, Bowen Technovation, and AstroFX.



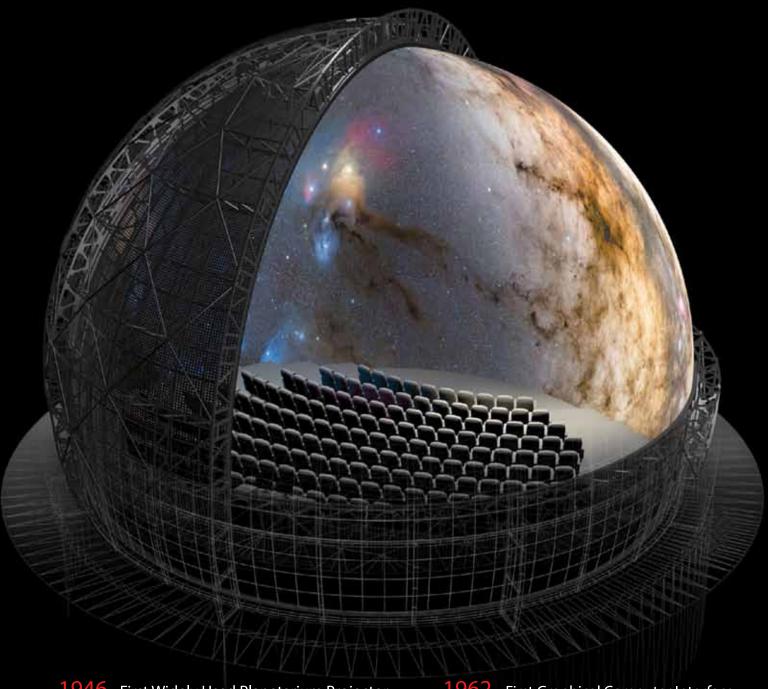




Jeff Bowen, through the years: Upper left, presenting at the Southeastern Planetarium Association 1992 Conference on Greenville, South Carolina (screengrab from https://www.youtube.com/watch?v=fMOgUqBFwr8.) Below left, always the instructor; from http://bowentechnovation.com/about. Above and right, photos from the archives of IPS Historian John Hare.



Over 75 Years Of Innovation



1946 First Widely Used Planetarium Projector 1962 First Graphical Computer Interface

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1990 First Powder Coated Dome 2002 First integrated real-time astronomy & full-dome video

2008 First Seamless Dome 2019 First LED Dome







Lara Albanese

Lara Albanese 7 April 1967-24 November 2020

Lara Albanese, 53, co-founder of PLANit and a member of its first board of directors, and co-founder of Googol, one of the first Italian associations to deal with science didactics, passed away on 24 November 2020.

She was born in Parma on 7 Aprile 1967. She received her degree in physics, with honors, from the University of Parma, where she also completed a two-year specialization in materials science and technology. She received her qualification to teach mathematics and physics on the high

school level in 2000. She spent a number of years teaching within the various faculties at the University of Parma, including computer science, astronomy, and museum teaching and scientific dissemination.

She conducted research in Italy and England before concentrating on science communication through a number of diverse activities: science journalism, exhibition development for science centres, teaching and workshops on science communication, research in science communication, management of science projects, and management and animation of science events.

A long time collaborator with the Arcetri Observatory and the planetarium of Florence, she published many books on astronomy, especially aimed at children, has organized exhibitions, and participated in international projects.

She also authored and collaborated on three scientific popularization shows through theatrical communication and designed and implemented shows for planetariums in Florence and Parma. Working with both fixed and traveling planetariums, she worked in education with the Planetarium of Florence and Bedonia and organized activities with the STARLAB planetarium in numerous Italian cities.

Her translated works include "The Journey into the Universe" (Chinese and Arabic), "The Four Elements" (Korean), and "It Depends" (English, Czech, Portuguese).

She was a member of the International Astronomical Union and active in Commission 46: Astronomy Education and Development. In the past decade she had worked as a freelance consultant and expert in science education, both in Italy and abroad.

The author of twenty children's science books, in 2013 Lara she won the Italian Andersen award for her ability to combine astronomy, science, and storytelling. In 2014 she won the national award "A book for the environment" and since that time decided to devote herself mainly to writing children's books.

-Source: Googol, PLANit



Gregory Cornwell

Gregory Chaffin Cornwell August 10, 1953-October 27, 2020

Gregory Chaffin Cornwell, 67, of Greenville, South Carolina, retired director of the Roper Mountain Science Center, passed away on October 27, 2020.

Greg was born August 10, 1953 in Baltimore, Maryland, to Jeptha Eli and Yvonne Gigere Cornwell. After 35 years, he recently retired from Roper Mountain Science Center, where he served as curator of education, director, and planetarium and public program specialist.

He was an active member of Fellowship Greenville, where he served

on the tech team. Previously he was a member of Shannon Forest PCA congregation, where he taught children's Sunday School and assisted with Youth Group.

An enthusiastic lover of nature, Greg and was passionate about sharing his knowledge with young and old alike. Being outdoors, hiking, kayaking, fishing, and leading Furman educational trips to Costa Rica, Alaska, South America, Hawaii, and local trips to North and South Carolina and Georgia were activities he truly enjoyed.

He is survived by his wife of 38 years, Anne Anthony Cornwell, and a son, Benjamin Scott Cornwell of Tega Cay, South Carolina. The family requests that donations be made to the Piedmont Women's Center in Greenville, South Carolina, or to Samaritan's Purse Ministries.

-Source: www.thepalmettomortuary.com



Eileen Starr

Eileen M. Starr September 30, 2020

Dr. Eileen M. Starr died on Wednesday, September 30, 2020 from cardiac arrest after bouts with COVID-19 and a broken leg. She was a Spokane, Washington resident since 1979.

Eileen, originally from Lakewood, Ohio, graduated from Lakewood High School, where she received the Selzer Award for Biology. She earned her bachelor's and master's degrees from the University of Michigan in science education and a Ph.D. from Washington State University. She

was a member of the Phi Kappa Phi academic fraternity.

During her University of Michigan freshman orientation in 1958, Eileen discovered the Exhibit Museum and immediately asked for a job. The only student position that offered enough hours was as student operator of the soon-to-be installed Spitz A-1 planetarium. She accepted it and became the museum's first student planetarium operator.

Eileen credits her tenure as a UM Museum of Natural History student docent for directing her life course, which included working as either a

planetarium director or a teacher of Earth science classes in cities across the country. Eileen was a gifted and passionate teacher who infused her lessons with humor. She had the ability to draw her students into subjects they never expected to find interesting.

Eileen taught junior and senior high science classes in Richmond, Indiana; Hershey, Pennsylvania; and Rockwood, Maryland. She was planetarium director at the William Penn Memorial Museum in Harrisburg, Pennsylvania; for the Milwaukee, Wisconsin public schools; the Jacksonville Museum of Arts and Sciences in Jacksonville, Florida; at Eastern Washington University in Cheney, Washington; and at Valley City State University, in Valley City, North Dakota.

She was director of the Eastern Washington Science Center in Spokane's Riverfront Park in the 1980's. She also taught classes at Eastern Washington University, Valley City State University, and for North Dakota State University. She retired in 2002 as professor emeritus for science from Valley City State University.

Eileen published a number of books, including: Meteorites Found in Pennsylvania; Vanished Explorers: A Tale about the First Americans; Star Myths of Northern Cultures; Heiltsuk Northwest Coast Explorers: A Tale of the People on the Islands off Coastal British Columbia, North America; (Continues on page 82) A new fulldome experience from the CALIFORNIA ACADEMY OF SCIENCES

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(Eileen M. Starr, continued from page 80)

and American Explorers: A Tale about the First Americans Living on the Channel Islands of California.

She and her husband, John, travelled all over the world together. In a piece titled "Backward Bucket List," Eileen documented many of her adventures, including visiting all of the continents except Antarctica; swimming in the Pacific, Indian, and Atlantic Oceans; sailing the Rhine, the North Atlantic, Lake Erie, and the Inside Passages of the Northwest and Chile; enjoying the pyramids of Mexico and Egypt and the statues of Easter Island; meandering through Stonehenge in England and the Nazi death camps in Latvia; excavating a French Neanderthal site and uncovering 300 million year old fossils; strolling the Great Wall of China and the castles of England, Scotland, and France; exploring the Smithsonian, British Museum, Hermitage, Holocaust Museum, and the Louvre; swinging on a trapeze; acting in plays; helping to dissect an elephant; and walking Bloomsday.

Eileen was a member of the Unitarian Universalist Church of

(Dome Under, continued from page 67)

scent vocabulary," so he didn't perceive it that way, like he might have done with a more local smell, such as neighborhood dogs or a fox from the surrounding woods.

Postscript

The "Close contact with wolves" project ended up being terminated in June 2012, after a group of the Kolmården wolves attacked and killed a 30-year old biologist and zoo-guide on their staff. The official responsible for the accident, who was found guilty of severely neglecting his duty, was fined and given a suspended jail sentence. Kolmården Wildlife Park itself had to pay the deceased's family a fine of 3,5 million SEK, or about \$402,000 USD in today's money.

In 2018, there were only four wolves remaining in Kolmården, who had been there since they were pups. But now they were deemed to be so old and in such poor health that a veterinarian determined that they should be euthanized, with no new wolves brought in to take their place. This was doubly tragic, since the animals are in such a small population in the country, as well as the fact that there had been a pack in this wildlife park for over 50 years.

Things, however, may not quite be over for the wolves at Kolmården. When looking up background information for this article, I came across a newspaper item from 2019 stating that the wildlife park was considering having a new wolf family on site in about five years, which would make it around 2024.

It remains to be seen if they will have another "Close contact with wolves" experience, but I'm pleased to say that a close encounter with a wolf, while it was never on, is certainly now ticked off my personal bucket list.

I believe that space travel will one day become as common as airline travel is today. I'm convinced, however, that the true future of space travel does not lie with government agencies—NASA is still obsessed with the idea that the primary purpose of the space program is science—but real progress will come from private companies competing to provide the ultimate adventure ride, and NASA will receive the trickle-down benefits.

Buzz Aldrin, Magnificent Desolation

Spokane and the Humanist Focus Group. She was active in local bowling leagues and had numerous hobbies including knitting, rug hooking, and stained glass. She met weekly with a tight-knit group of writers with whom she developed deep and long-lasting friendships.

Eileen was predeceased by her father, Norman Philpott; her mother, Alma Pearl Hicks Philpott; and her grandson, Thomas Christopher Starr Mears. She leaves behind her husband of 35 years, John E. Douglas, and his children and grandchildren; her daughter, Kimberly A. Starr and her husband LJ Da Corsi; and her granddaughter, Gwyn Zoe Harvey and her fiancée, Shay Farnam.

Please consider making a gift to honor Eileen's memory to the organization which inspired her career path, the University of Michigan Museum of Natural History in Ann Arbor, Michigan.

-Submitted by Kimberly Starr, StarrBrightConsulting@gmail.com

(Bridge Planetarium project, continued from page 75)

Community involvement

The technical nature of the build meant that perhaps the original vision of having lots of people involved in the carpentry did not quite pan out. While most of the construction work was done by Phil and the indefatigable Dave Kerwin, we were supported by other woodworkers and a string of about 15 contributors writing music, painting the external artwork, and designing the fliers.

They were supported by volunteer stewards, silhouette "cutter outers," and one supporter who persuaded 12 local shopkeepers to host elements of a nativity star trail treasure hunt in their shops. Children who followed the trail around the town could claim a small prize at the planetarium.

After the Christmas show had run its course, the planetarium became a chill out room at the back of the youth club that also used the building until the sad day came when the space was needed and it was carefully dismantled and stored away. It is currently in 8 segments waiting for current social restrictions to end and for an opportunity to be brought back to life.

(Point of View, continued from page 74)

changed, the old adage comes to mind: "The more things change, the more they stay the same."

This article, well worth reviewing, concludes with "In the planetarium profession, ours is not so much the astronomy of research and discovery as it is the astronomy of interpretation and enlightenment. We help bridge the distance between the scientist and the public, between the individual and the universe. We strive to channel human reaction to the pretty lights in the sky into a deeper understanding of the universe from which we spring."

Forty-Five years ago

December 1975: Dr. Gerrit L. Verschuur pens a most unusual article on education in the planetarium called "The Role of the Planetarium in Astronomy Education or Should We Do Shows on UFO's?

Dr. Verschuur basically says no, but how can we give up such an entertaining concept? While we can certainly say no by the end of the show, we can certainly give our audiences some fun stuff to bring them in. I don't think I'm alone in this and for proof I offer up the vinyl LP put out by the Morrison Planetarium titled *The UFO's*.

After 40 years as a commercial, industrial, and feature film maker, for Ron Walker controlling the universe in his "Star Barn Planetarium" was a natural step forward. He reports that surprisingly, viewers actually enjoy his shows, which unfortunately forces him to write new ones between naps.





















Zooming through with planetarium professionals

We're all getting pretty good at Zoom meetings. Clever backdrops, screen sharing, animated bitmojis—planetarium professionals have pivoted through a pandemic with grace and humor. As Dan Tell put it during the GLPA 2020 (virtual) conference, "Part of being a planetarium—you could have good light, or no light, but not bad lighting."

And what would be the point of a conference if there weren't fun conversations in the halls? Even virtual conversations

Before one session, participants were playing with Zoom filters, adding a halo over their heads, adding weird eyeglasses, doing "makeup." Hirsute Mike McConville noted that, "I added a beard and it did nothing." Jack Dunn noted that he couldn't add any crafting because he needed his screen for lasers.

Anna Green: "Hey Mike!"

Mike McConville: "Yes?"

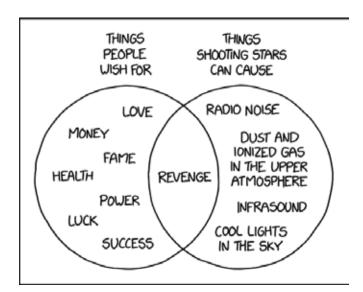
Anna: "The other Mike. The Smail variety."

Mike McConville: "dammit."

During a later session, Paulette Epstein mentioned that "it wouldn't be a GLPA conference if we weren't drinking way too much coffee. And we aren't hung over enough for it to be GLPA."

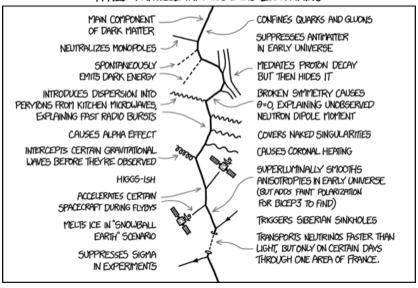
Bring a date?

Then there was the public "Bring a date night" program, that male members of the Events and Adventures group mistakenly took for "Pick up a date night." They left shortly after arrival.



Congratulations to whoever wished for revenge on a forest near the Tunguska River, a 1980 Chevy Malibu in Peekskill, New York, Alabama resident Ann Hodges, every building in Chelyabinsk with glass windows and the non-avian dinosaurs. Courtesy Xkcd/2345

A CHRISTMAS GIFT FOR PHYSICISTS: THE FIXION A NEW PARTICLE THAT EXPLAINS EVERYTHING



My theory predicts that, at high enough energies, FRBs and perytons become indistinguishable because the detector burns out. Courtesy Xkcd/1621

Several participants shared observations by their children. During a walk through a cemetery, several offspring called a memorial obelisk a "rocket ship."

One virtual hospitality suite featured Paulette Epstein hosting a question-and-answer game. A question was asked and answers posted on the screen. Not all of the questions were astronomical in content. (Those were usually answered with "Uranus.") An example:

Q. What is the best way to defeat terrorism?

A. Outlaw existence

A. Buy a hybrid system from a foreign vendor

A. A sing-a-long

A. Declare "mission accomplished"

During Shannon Schmoll's presentation, her office telephone rang, interrupting the talk. The chat box filled with chatter.

Jay Heck announced that "The call is coming from inside the conference" (reminiscent of the "baby sitter" scares of yesteryear).

Mark Percy asked, "Oh, sorry. Is this a bad time?"

Even the turtle was disgusted

It's still hard, this virtual meeting/teaching/working. A work colleague mentioned that one day, everyone in his house was angry—his wife, his daughter, himself. Even the family pet was upset. At 5:00 a.m. they were awakened by "What is that noise?" The turtle was flipping rocks over in frustration and disgust.

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