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Diagrammatic representation of DNA with images of life on Earth, including humans, from Life: A Cosmic Story by the California Academy of Sciences in San Francisco. © California Academy of Sciences. You can read more about the Academy’s philosophy of producing fulldome on page 24.

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Guidelines for contributors
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• Research articles dealing with educational aspects of the planetarium and other topics are highly desirable and will be refereed if applicable and requested.
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We are gathered together from all corners of the world, inspired by 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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A white paper, thoughts on research, and Apollo 11

This issue of Planetarian should have something of interest to nearly everyone in the planetarium community. And, honestly, I could have used four more pages to get everything in that I wanted to!

An enormous amount of work by dedicated IPS members has led to the adoption and publication of an official IPS White Paper that supports planetariums in education. (See page 9.) What makes this document different from other statements is the references to research into a variety of fields that relate to planetarium education. Yes, it is a statement of IPS’s stance on the topic—and it backs up our position with sound sources.

While editing the white paper, I realized that there have been many changes in the field of astronomy education research since the last time I visited the topic. This prompted me to write a follow-up to a paper I presented nearly 10 years ago called “Where’s the Data?,” a play on the old television commercial for Wendy’s, a fast-food hamburger chain. The abstract: “The interest in astronomy education research is growing, and has transformed over the past decade (or basically since the turn of the century) to include more qualitative studies. The questions being asked have gone from “is the planetarium an effective teaching tool” to “why is the planetarium an effective teaching tool.”

In addition, a move to include grey literature as acceptable research sources has opened up a way for planetarians who are not astronomy education researchers to share their observations and insights. We planetarians need to take advantage of this open door and pro-actively contribute to the field.

I hope that planetarians and affiliates around the world will take advantage of the information I found and will share their own research with a wide audience through the iSTAR Database (https://istardb.org/).

Don’t limit yourself when doing research

Susan Button’s sharing of her research into Alzheimer’s Disease and how memory acquisition and retention processes also apply to learning in planetariums (see page 76) reminded me that we should not limit ourselves when it comes to reasearching various topics in the planetarium.

Even with a renaissance in astronomy education research taking place, research on planetarium topics still lags and remains difficult. It’s a problem that all of us know: that planetariums cannot be easily classified into one discipline, but uses aspects of many fields to present our unique form of education.

As April Whitt shared in her Last Light column in this issue (page 96), “Kyle Doane (educational specialist with Digitalis Education Solutions) offers a definition: Planetarian: An astrophysicist with early elementary teaching experience who minored in theater, computer programming, film making, and public relations.”

In trying to explain to others outside of the planetarium field, we often fall back on the “nots.” We’re not like a movie theater, but we have to know a lot about sound and projection; we’re not teachers, but we teach (on all levels, pre-school through college, the general public, and life-long learners); we’re not computer geeks, but we have to know a lot about programming and how to use business, production, and really specialized software; we’re not marketers, but we have to know how to publicize our facilities and be the experts in front of television cameras.

Because of all these roles we fill, planetarians tend to look to research that covers aspects of our jobs that have nothing to do with astronomy or education. Think of all those things we’re “not,” and look to those fields for research.

I recently had the chance to watch one of the Planetarians’ Web Seminars that was led by Julia Plummer, association professor of Science Education at Penn State and a leading researcher in planetarium education. Her topic was “Getting Started with Educational Research.”

Corresponding with her later, I mentioned the iSTAR Database. She noted that “it is important for my research to look beyond just astronomy education research. That’s actually part of the message I was trying to convey in the talk, I think, that it is important to look outside of astronomy education or planetarium education research to learn and build on other areas of research and bring that back to the planetarium. I can see that it would be useful to have a data base of what has been done specifically in astronomy, but I wouldn’t want people to limit themselves to that and think they have done a thorough literature search.”

Celebrating Apollo

This year, of course, is the 50th anniversary of the first human landing on the moon by Apollo 11. Major missions that led up to the landing and missions that followed also are reaching this milestone, naturally.

Some planetariums are already in the midst of a series of special programs, and others are well into plans for July’s main event.

I would like to thank all the people who responded to my call for information about their programs made on Dome-L, but it turned out that pulling together a story at this late date was nearly impossible. As a result, I decided to publish one submission: a look back at working with the Apollo program by Thomas Wm. Hamilton on page 38.

Also, don’t forget the availability of videos about the people of the Apollo programs through IPS. They are flat-screen videos perfect for use as video shorts prior to your planetarium program, in kiosks or monitors outside of the dome, in emails to your members, and on your websites to encourage attendance for your programs and events. Go to www.ips-planetarium.org/page/apollopeople for more details.

3 A collaboration between the Pacific Planetarium Association and the Great Lakes Planetarium Association. Learn more at www.ips-planetarium.org/page/profdev

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.
50 years ago the first human walked on the moon... discover the epic story behind this historic moment which will inspire the next generation of explorers, thinkers and dreamers.
President’s Message

Forging strategic partnerships

As I mentioned in our first IPS Newsletter in May, in the first quarter of 2019 the International Planetarium Society negotiated and signed three memoranda of understanding (MOUs) with partner organizations LIPS, IMERSA, and IAU Commission C2. Each of these MOUs outlines a framework to help us work more collaboratively with organizations whose goals complement ours. Through these agreements, we are also able to add significant new benefits to an IPS membership.

The International Astronomical Union

The first new MOU was signed with the IAU’s Commission C2, Communicating Astronomy with the Public. The most significant new initiative of the MOU was the following:

IAU Commission C2 will appoint a member to serve on the IPS Council/Board, and IPS will appoint a member to serve on IAU Commission C2’s Organizing Committee. These appointees will have ex-officio status, meaning that they will not have voting rights but will be invited to all meetings and participate in all group communications other than those conducted in executive session. The role of these appointees is to coordinate activities between the two organizations to their mutual benefit.

The IPS has appointed President-Elect Kaoru Kimura to serve on the Commission C2 Organizing Committee. IAU Commission C2 President Rick Fienberg has nominated Dr. Lucia Marchetti from the University of Cape Town to serve on the IPS Council. Lucia writes, “I am widely involved with the planetaria works right now as with my research group we are working towards the data2dome initiatives.”

Lucia was recently elected “advisor/past-president” of the newly-organized African Planetarium Association, and is an organizer of the data2dome workshop at Colgate University happening this October. In addition, the IAU MOU includes provisions for each organization to organize sessions at the other’s conference, and to amplify each other’s press releases and announcements through our various media channels.

The MOU is just one of the ways that IPS and IAU are strengthening their relationship. Last summer I was invited to give the talk “Effectively Coordinating Museums and Planetariums Worldwide” at a focus meeting at the IAU General Assembly. IPS is an Organizational Partner of IAU100, the celebration surrounding its 100th anniversary. You’ve likely seen some of my emails announcing various IAU100 events.

In April, Past-President Shawn Laatsch attended the “100 Years Under One Sky Celebration” Flagship Ceremony in Brussels. By the time this is printed, I will have attended the Eddington at Sundy: 100 Years Later event on the island of Principe. At this centenary celebration, for which the IAU is a sponsor, I am to speak on “One Hundred Years of the Planetarium.” The workshop is being held at the site where and on the date when Sir Arthur Eddington’s observations of the 1919 eclipse confirmed General Relativity 100 years ago.

IMERSA

Immersive Media Entertainment, Research, Science & Arts was founded in 2008 with the primary goal to advance and promote the art and science of large-scale digital immersive media, fulldome, and immersive group experiences in digital planetariums, mobile domes, themed entertainment and giant screen theaters.

Through this new MOU, IPS and IMERSA will officially recognize one another as Affiliate Organizations and establish a number of collaborations and exchanges. Some of these, such as the “IMERSA Matters” column in Planetarian, have already been in place for a while. As a sign of the closer collaboration between IPS and IMERSA, in 2020 there will be a one-day IMERSA summit in Edmonton associated with our 2020 conference. Also through this MOU we are pleased to announce a significant new member benefit: IPS members will now receive a discount to attend the IMERSA Summit.

LIPS

The primary goal of the Live Interactive Planetarium Symposium (LIPS) is to advance the state of the art in live, interactive programming in the dome. Under the new MOU, IPS and LIPS are also Affiliate Organizations. Likewise, IPS members will now also receive a discount to their LIPS registration fee. At recent IPS conferences a one-day mini-LIPS has been offered, and that will continue in the future. A one-day IPS-organized data to dome workshop was held in conjunction with a recent LIPS conference, and that will continue as well.

As part of this MOU, the LIPS community will advise IPS on best practices of live planetarium programming. In this role they will replace the former Presenting Live Under the Dome ad-hoc committee.

I am excited about the new opportunities that these MOUs will bring to IPS and its members. Going forward we will seek to forge new partnerships with other organizations with the goal of maximizing the impact of our society and increasing IPS member benefits.

If you would like to see the actual MOUs, please go to www.ips-planetarium.org/page/partners.

IPS President Mark SubbaRao, among his many associations, also is the director of the Space Visualization Laboratory at the Adler Planetarium.
COMING SOON
clarkplanetariumproductions.org
contact: msheehan@slco.org  385-468-1226
An official IPS White Paper
IPS takes stance to support planetariums in education

Introduction: Mark SubbaRao

As planetarians, we all know the incredible power the planetarium has to both inspire and educate. We’ve seen the looks on children’s faces as their conception of the Universe is transformed. We’ve heard from elderly visitors who can recount in great detail a transformative experience they had in a planetarium growing up. We’ve met astronomers, engineers, and astronauts who tell us how instrumental a planetarium experience was in their career path.

Still, as we each advocate for our planetarium, it is not enough to know that these things are true, we need to be able to prove it. For this reason, I asked Jeanne Bishop and the Education Committee to put together a document on the educational value of a planetarium that summarizes the latest and best research available. They have produced two excellent documents the full “white paper” which is printed here, and a one page document that contains the highlights from the full white paper.

Both of these documents are available for download on our website, please use them to build support for your planetarium. I would like to sincerely thank Jeanne Bishop for the considerable effort in putting together this document. Dayna Thompson and Sharon Shanks also played key roles, and they have my thanks as well.

Introduction: Jeanne Bishop

IPS President Mark SubbaRao asked me to prepare a document that could be used to promote the educational value of the planetarium. There are two versions, a single page, which can be a handy item to distribute at meetings with many people, and a longer white paper. I see the goals for both versions to be:

- A rationale for building or purchasing a planetarium.
- A rationale for funding an existing planetarium and keeping it in operation.
- A continuing rationale for all who work in planetariums to disseminate positive information about planetariums, including IPS and all of its affiliates.
- A document for referral by everyone involved in planetarium work, with ideas that can be shared with administrators, teachers, planetarium attendees, and the voting community.
- A document for use by planetarium educators that touches on some best practices for their work.

This is not the first time this topic has been addressed. IPS, GLPA, and MAPS each prepared statements on the educational value of the planetarium, and some individuals have prepared excellent papers on the subject. However, all (that I located) were prepared years ago, before the current digital era of planetarium technology. Very importantly, planetarium research now is verifying our educational value statements.

To produce a credible, inclusive document, in January I wrote to many people, including all members of the IPS Council and many others. I requested their views relating to the goals listed above. I wanted to know what IPS affiliate organizations and experienced planetarium professionals have to say about the educational value of current planetariums. When I did not receive many responses, I turned to articles in back issues of Planetarian, to (English-language) organization and planetarium facility websites, and to related literature on astronomy education. I believe the following white paper version of “The Value of Education in the Planetarium” includes all the main points that should be made.

Thank you to those who responded to my letters with ideas and information. I thank two people, in particular, who have greatly helped with this project: Dayna Thompson, a member of the IPS Education Committee, and Sharon Shanks, Planetarian Editor. Thanks, also, to IPS webmaster and Education Committee member Alan Gould for adding links on the IPS website.

Both of these documents (the white paper and the one-page summary) are free to download and duplicate as you need. Please go to www.ips-planetarium.org/page/planetariumeducationvalue.
The Value of Education in the Planetarium

Prepared for The International Planetarium Society, a nonprofit organization comprised of planetarium professionals from around the globe, by Dr. Jeanne Bishop, Chair of the IPS Education Committee.

What is a Planetarium?
A planetarium is a specially-designed theater with a domed ceiling that is able to project a realistic image of the night sky indoors. First used to educate about stars, planets, and constellations, planetariums today are unique immersive facilities often used to support Science, Technology, Engineering, and Mathematics (STEM) learning and to cross learning disciplines into art, culture, and history.

A Brief History
The first optical-mechanical planetarium was introduced in Germany in 1923. Now thousands of planetariums of many types and sizes exist worldwide in schools, museums, science centers, and other locations. Portable planetariums are also used and expand educational possibilities to far-flung audiences. It is estimated that over 1 billion people have been served by planetariums since their introduction. The Soviet cosmonaut who first flew in space and the Apollo astronauts who walked on the moon 50 years ago were trained in planetariums.

Value of Astronomy
Astronomy is an integral part of human history. Cultural constellation stories reflect how past societies viewed their world. Hunters, farmers, sailors, and other explorers studied the sky to learn the rhythms of nature for survival and commerce. Understanding modern astronomy helps people comprehend their place in space and time. Astronomical understandings regulate many parts of our lives today: daylight savings time, seasons, the calendar, and also some holidays are determined by sky events. Additionally, the scientific method is demonstrated in a concrete way when we learn about sky objects such as galaxies and black holes.

Unique, Inspirational Environment
Every planetarium immerses visitors in a 3-D environment that evokes realism. The sight of stars appearing in a dark sky, now being lost to light pollution in many areas, immediately captures attention and evokes awe. As cities expand, the lack of personal contact with nature is producing negative psychological effects. A planetarium’s night sky is a powerful, memorable, and soothing image which encourages learning. Immersion sparks a viewer’s creativity, interest, and engagement, aspects of education’s affective domain.

Educational Standards
Earth and Space Science and the scientific method are major themes in national and state pre-college educational standards. For example, countries require teaching the fact that patterns of the motion of the sun, moon, and stars in the sky can be observed, described, and predicted, and that seasonal patterns of sunrise and sunset be observed, described, and predicted. Both topics are best taught in a planetarium because of their ability to speed up time and show unobservable phenomena.

A Superior Learning Environment
The immersive planetarium shows learners our universe in ways that flat screen films do not. For example, moon phases is a projective spatial concept, one that requires a person to mentally switch back and forth between Earth and space views and relate the two perspectives for better understanding. Earlier research had found that most students were unable to reach this coordinated level of understanding of moon phases. However, it was found to be possible in the fulldome planetarium.

Place for Inquiry-based Learning
Inquiry-based learning is a teaching strategy and learning method that prioritizes student questions, ideas, and analyses. The planetarium environment triggers learner curiosity in ways that normal classrooms cannot. Students are able to discover sky changes that are parts of important long-term cycles, including day and night as a result of Earth’s rotation, differences in the daytime paths of the sun during different seasons, lunar phase and position changes during a month, and planet movement among the fixed stars. Acceleration of these sky changes, so that they occur in a convenient student-visit time period, provides exceptional opportunities for learning astronomy with inquiry procedures.

Reinforcement of Classroom Learning and Retention
Students who attend a planetarium presentation in conjunction with classroom learning, have the opportunity to resolve misconceptions introduced by 2-D textbook illustrations and computer diagrams. Research is showing that classroom learning coordinated with planetarium lessons show the most gains in knowledge and retention. In addition, since many elementary classroom teachers receive limited training in science, the planetarium integration provides them opportunity to improve their own knowledge and teaching methods.

Help for the Difficult Learner
The planetarium experience can be an important gateway to learning for children who dislike learning in formal environments. Additionally, live planetarium programs benefit learners with short attention spans.

Unique Capabilities of Current Planetariums
Increasingly, planetariums employ digital projectors that can zoom the learner from Earth to the moon, other planets, stars, and distant galaxies. The ability to see objects from different perspectives offers the opportunity to understand our true place in space. Basic spatial understanding, like the Earth’s rotation, seasons, and moon phases can be visualized both from Earth and space. Cutting-edge science research, whose data is normally shown only in spreadsheets, can now be visualized and understood by the general public. Observatories can stream directed content to planetarium audiences, showing real-time views of the cosmos. Additionally, planetariums stream astronomy lectures and multi-discipline programs live to other planetariums in small schools, museums, and even remote locations.

Multi-Discipline Presentations
Planetariums are natural multi-discipline facilities. Thousands of planetarium programs are offered across the globe and range from live artistic performances to programs that take the audience underwater to learn about topics beyond astronomy. Even foreign language lessons, creative writing sessions, and reenactments of historical events take place in planetariums. Current and future artists, musicians, writers, animators, and many other non-STEM professionals are inspired by planetariums.

(Continues on next page)
Unlimited Possibilities with Digital Fulldome

The evolution of technology extends the possibilities of the multi-discipline planetarium learning environment. Structures and processes within atoms, cells, DNA, human anatomy, land forms, weather systems, and ocean currents can be illustrated at different scales and from different points of view. Simulated trips can take learners to a nuclear power plant, the Egyptian pyramids, the terra cotta warriors of Xian, Greek and Roman temples, the Grand Canyon, Stonehenge, and more. Recent archaeological discoveries at Mayan, Viking, Celtic, and other sites are visualized and shared. Visitors also can travel across geological time periods, historical timelines, and even the predicted futures of human civilization.

A Positive Social Environment

The planetarium is a place where diversity and equality can be promoted, particularly when facilitators use interactive techniques. Live programming provides the opportunity for participants to connect with each other and the presenter. Also, accommodations have been developed for people with disabilities: the visually and hearing impaired, those with autism spectrum disorder, people with intellectual disabilities, and more.

Impacting Communities

Planetariums are not just for young learners. They welcome everyone from the community to attend public events. Many community groups and professional organizations visit the planetarium for lifelong learning experiences. Many STEM-related issues affect our planet today. It is the public who must have the capacity to understand these issues to make informed decisions and encourage powerful, global impact. Planetariums inform the public on these matters.¹⁷

Inspiration to Follow STEM and non-STEM Career Paths

Astronomers, space scientists, and others working in STEM fields were influenced to follow their careers after planetarium visits.¹⁸ Currently, it is estimated that employment in the STEM field will increase by 1 million jobs by 2022¹⁹. Also, the development of planetarium programming requires skills of computer programmers, writers, artists, animators, musicians, and others. These programs in turn inspire future writers, artists, and countless others.

Statements in Support of the Educational Value of the Planetarium

“Student comprehension of complex concepts is enhanced by the ability of the planetarium to compress term patterns and cycles into shorter segments which result in powerful learning experiences.”—The Middle Atlantic Planetarium Society (www.mapplanetarium.org)

“The planetarium can motivate students with its stimulating learning situation. Surveys have shown that students like astronomy more than other sciences, and the stimulating environment can build on initial interest and help it develop into a lifelong interest.”—The Great Lakes Planetarium Society (www.glpa.org)

“Space science makes an important contribution to social, cultural, and intellectual development, which are inseparable from economic development in the long run... planetariums can make an important contribution to the Universe around us.”—Office for Outer Space Affairs, United Nations

“The President of the United States, Barack Obama, and his wife and two young daughters attended a planetarium show in a portable dome set up on the South Lawn of the White House on October 7, 2009 at a NASA star party... the President asked a question that had come up during their dinner earlier that evening about the cause of the seasons. I gave a short demo on DigitalSky showing the changing Sun illumination at the North Pole over a six-month period... Later I learned that the family normally spends much less time at White House lawn events than the hour they did that evening--we made an impact.”—Martin Ratcliffe²³

“The immersive planetarium medium is well suited for productions that combine art and science... While the specific missions of museums vary, it has been argued that imparting a sense of social responsibility is a universal imperative. The capability to deliver powerful media experiences ought to translate into the capability to more deeply influence the visitor’s core beliefs and worldviews. This focus on transformation is an emerging trend in fulldome programming.”—Ed Lanz²⁴

“The immersive dome experience itself can be an outstanding source of inspiration that will encourage guests to engage in a lifetime process of learning.”—Michael Daut²⁵

“Information from research institutions often is a vital part of many planetarium presentations. In this sense, planetariums can function as a media outlet for education and public outreach offices at research facilities. These theatres are an effective magnet for the ‘motivated, interested public’ that education and public outreach offices seek to reach.”—Carolyn Collins Petersen²⁶

“Planetariums have a way of attracting people’s attention and their imagination, ushering learners into a deeper understanding of scientific concepts.”—Dayna Thompson²⁷

“The environment of a planetarium provides a family and community gathering place where children and parents can have shared experiences in the learning process.”—Astronomy Literacy, Great Lakes Planetarium Association²⁸

“We currently are living in a time when truth, reality, and science are under constant fire from sources seeking to spread alt-truths, unsupported fantasies, and disinformation about scientific results... A planetarium can be a place in a school, museum, or science centre that can best present current science information to both students and the general public of all ages in a way that is accurate, engaging, and inspirational. Regardless of whether the facility is analogue or digital, the planetarium can go a long way in helping teach STEAM topics and instill the spirit of the scientific method, something people likely will not get in other places.”—Tom Callen²⁹

This document was prepared by Dr. Jeanne E. Bishop, Chair, IPS Education Committee (jeanneebishop@wowway.com) with major support from Dayna Thompson and Sharon Shanks and additional assistance from Susan Button, Tom Callen, Sumito Hirota, Kaoru Kimura, Martin Ratcliffe, and Mark SubbaRao. April 2019.
Further Reading

Endnotes
10 Thorburnugh, ibid.
15 Plummer, (2009), ibid, pp. 192-209
27 Personal communication, March 2019.

Everyone’s Universe
by Noreen Grice

Strategies for disability access to use in your planetarium!

Also available:
Tactile Sun images!

www.YouCanDoAstronomy.com
Where’s the data? Why, here it is!

Sharon Shanks
Editor, Planetarian
International Planetarium Society
Sharon.shanks@gmail.com

Abstract
The interest in astronomy education research is growing, and has transformed over the past decade (or basically since the turn of the century) to include more qualitative studies. The questions being asked have gone from “is the planetarium an effective teaching tool” to “why is the planetarium an effective teaching tool.” In addition, a move to include grey literature as acceptable research sources has opened up a way for planetarians who are not astronomy education researchers to share their observations and insights. We planetarians need to take advantage of this open door and pro-actively contribute to the field.

Introduction
Nearly 10 years ago I gave a paper at the Great Lakes Planetarium Association conference (2010, Notre Dame) in which I asked “Where’s the Data? (The need to survey planetariums for educational efficacy).” I reviewed recent publications on planetarium efficacy and mourned its scarcity. The paper wasn’t attended by many, and was duly included in the conference proceedings, where it also wasn’t noticed and became just another unfindable piece of grey literature.

I am happy to revisit this question in 2019 with the observation that astronomy education research has come of age in the past decade and the question of “are planetariums effective” is being answered as “yes.” Moreover, the adoption of fulldome and its immersive ability have changed the question, from “are planetariums effective” to “why are planetariums effective,” opening new lines of research.

This is wonderful news, but for planetarians who have worked “in the trenches,” so to speak, for years, there is something even better: our intuitions are being validated. Many veteran planetarians, myself included, have shared thoughts and observations over the years with each other about how and why a planetarium is an effective teaching tool, and our unquantifiable gut intuitions are right. Planetariums are the best tool to teach:
- Movement over time, such as daily motion, celestial motion, and other periodic motions that cannot be easily observed;
- Concepts that require or benefit from spatial and three-dimensional understanding, such as the sun-earth-moon system, moon phases, and seasons; and
- Concepts that benefit from allocentric and geocentric observation, again such as moon phases and seasons, and a sense of scale, distance, and time.

In addition, we planetarians have known in our hearts that our facilities—both fixed dome and portable—make an impact on the affective realm of student experience and that positive experiences can improve learning; that teachers need to be active participants to make the best use of the planetarium experience; and that the dome is just one tool that can be used to educate and cannot be expected to “teach everything my students need to know to pass the test in 45 minutes.”

So what happened?
Several major changes in educational research, along with planetarium technology change and the much-needed debut of a research database, have taken place roughly since the turn of the decade. In his 2017 paper “Illuminating Learning in the Dome: Constructing the International Studies of Astronomy Education Research Database,” Dr. Timothy Slater at the University of Wyoming provides an overview of the new iSTAR Database (more on this below). He also reviews discoveries in his 2017 book Research on Teaching Astronomy in the Planetarium, co-written with Coty B. Tatge. Among his findings is the existence of a research gap in astronomy education, roughly from 1990 to 2005. This also is the approximate time frame of the adoption of digital fulldome by many planetariums, a technology change that transformed planetariums from “theater of the stars” to immersive learning environments. Although beloved analog projectors (many still in use because of their superior star quality) had always provided an immersive environment, the ability to move more than just the stars opened the dome to clearer explanations of daily motion, the seasons, and other non-observable concepts. Taken together, this divided astronomy research into two eras: the analog era and the digital era.

Research following the digital evolution also benefited from what he calls “paradigm wars,” a time roughly between 1980 and 2000 that saw less insistence on quantitative studies and the acceptance of qualitative and mixed methods research, especially in astronomy education research.

Slater also has championed the use of grey literature while conducting research in astronomy, arguing that these and dissertations undergo as much, if not more, review as papers appearing in refereed journals. In “Undiscovered Value of Grey Astronomy Education Research Results,” Slater notes that “Grey literature is the scholarly work that has

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2 Grey Literature: “That which is produced on all levels of government, academics, business and industry in print and electronic formats, but which is not controlled by commercial publishers.” www.greylit.org/about
5 ibid, p 15

This paper is intended to be a companion to the IPS White Paper titled “The Value of Education in the Planetarium” written by Jeanne Bishop.
been done and presented at conferences or exhaustively written up in dissertations, but never formally published in refereed journals. He provided an example of the best-known example of grey literature: Philip Sadler's *A Private Universe.*

“Many authors publishing reviews of research rarely include graduate theses and dissertations, despite the fact that most have been more thoroughly reviewed by a larger number of scholars—those four, five, or six scholars who sit on graduate review committees—than those two or three who review manuscripts for journals.”

Other changes Slater points out include a switch from live presentations by an astronomy educator with the analog projector to pre-recorded programs, and a change of focus from star and constellation identification to cutting-edge research and explaining high-interest concepts (black holes, for example). Other factors impacting change: the slowdown in the US economy starting in 2008, the push to adopt national education standards, and growing diversity among students.

Some notable conclusions from Research on Teaching Astronomy in the Planetarium:

“Taken together, there are tremendous forces shaping the way planetariums serve as a critical component of the larger US education portfolio. As a result, the future research questions pursued by planetarium education researchers will evolve as well.” (page 25)

“Moreover, planetarium education researchers will have to engage in shedding the one-size fits all education approach and find innovative ways to individualize the planetarium learning experience.” (page 25)

“What we now have come to better appreciate is that the planetarium in and of itself in isolation is not a magical silver-bullet for solving all of astronomy education’s challenges for improving learning and attitudes. Instead, planetarium education programs need to use the same educational theory-driven, research-confirmed best practices in science education to help enhance learners’ cognition and affect. The planetarium is unarguably able to capture attendees’ innate interest, but planetarium education research confirms that lasting change requires purposeful educational decisions in order to be relevant and effective.” (page 123)

What do researchers need?

In “A Community Discussion about Sharing and Publishing Space Science Education Research and Evaluation,” Buxner et al reported that a Special Interest Group at the Astronomical Society of the Pacific’s 2011 annual meeting expressed several specific concerns, including

1. The lack of a central place to publish and to read studies specifically in space science education.
2. The increasing need for a place to share evaluation results related to space science programs.
3. The need to make available a synthesis of research for non-education experts who work in space science education and public outreach.
4. The lack of access to relevant articles for individuals without institutional subscriptions.

At that point in time, concern 1 was being helped by *Astronomy Education Review* (AER), which provided the central place to publish. Unfortunately it operated only from October 2001 until December 2013. The *Journal of Astronomy & Earth Science Education* (JAESA) debuted a year later as an online, free-access publication under the editorship of Slater. It now fills the need for a central place to publish.

Concerns 2 and 3 are outside of the scope of this paper, but concern 4 is now being answered by iSTAR, the International Studies of Astronomy Education Research Database, which launched in 2017. It is an international collaboration of astronomy education researchers who maintain and continually populate a growing database that can be searched in an almost endless combination. In addition, it has collected hard-to-find theses and other grey literature and made them freely available for download by anyone doing research, a boon to those without access to institutional subscriptions (with the exception of some journal articles held by copyright behind paywalls, for which abstracts are available).

The iSTAR project is led by Dr. Stephanie J. Slater, director of the International CAPER Center for Astronomy & Physics Education Research, in collaboration with Australia’s Michael T. Fitzgerald and graduate student Saeed Salimpour of Edith Cowen University’s Institute for Education Research, Brazil’s Paulo S. Bretones of the International Astronomical Union’s Working Group on Astronomy Education, among many others, along with JAESA’s Slater and University of Wyoming Ph.D. candidate Tatge.

Thanks to iSTAR, doing a literature search about planetarium efficacy suddenly became much easier and yielded more results, primarily because the database includes access to master’s and doctoral theses not normally available and also shares research from grey literature.

Results of my iSTAR research: Highlights of the papers I chose to look at further

A doctoral dissertation titled *The Role of the Planetarium in Students’ Attitudes, Learning, and Thinking About Astronomical Concepts* by William R. Thornburgh, 2017 was the most exciting find. Dr. Thornburgh, now a postdoc at the University of Louisville, examined “… the role of the planetarium on students while learning astronomy. The main goals of this study were to evaluate changes in students’ attitudes towards astronomy, whether students learned and retained more knowledge due to planetarium-enriched instruction, and how the planetarium helped students think about astronomical concepts.”

His results: “… the immersive environment and unique capabilities of a digital planetarium positively influenced students’ attitudes, learning, retention, and thinking.” In addition, he clearly outlines the contributions of his research for planetariums, informal science education researchers, and schools. Because I consider his section on contributions to planetariums and planetarium educators to be so important, I am including the entire statement (page 126):

The first contribution of this study would be to planetariums and the education...
to improve their conceptions of size and distance from naïve and conflicting knowledge to a more scientific understanding after their visit. The paper argues that a combination of related, themed experiences related to spatial scale can account for the improvement, and recommends that these and even more innovative activities should be explicitly promoted at science centres and in out-of-classroom activities.

Cumhur Turk and Huseyin Kalkan in Turkey wrote in 2014 “The Effect of Planetariums on Teaching Specific Astronomy Concepts” with the goal of determining students’ knowledge levels on certain astronomy concepts and the effect of the planetarium environment on teaching. They found “The study results showed that teaching astronomical concepts in a planetarium environment was more effective than in a classroom environment. The study also revealed that students in the planetarium-assisted group were more successful in comprehending subjects that require 3D thinking, a reference system, changing the time and observation of periodic motion than those in control group.”

What do planetarians need?
The paper that I personally gained the most knowledge from was “Elementary Student Knowledge Gains in the Digital Portable Planetarium” by Laura D. Carsten-Conner, et al. In addition to positive results, specifically “Our results suggest that the portable planetarium may be a useful strategy in supporting learners as they struggle with reconciling observed patterns with underlying, non-observable motions of the Earth, and with visualizing concepts such as the speed of planetary orbits relative to their position with respect to the sun,” the paper was the only one I found that included a detailed description of the planetarium program itself.

The authors described the setting (a 6-meter dome), the projection system (a digital STARLAB), and the software (Starry Night). The program was interactive and 25 minutes long. A detailed description of the program provided the major points, the sequence it was presented, and the reasoning for the order of topic. Other research papers describe using the dome in presenting a general topic or in analyzing a specific program, but not the actual presentation itself. For example, teaching seasons is described in “Using a Digital Planetarium for Teaching Seasons to Undergraduates,” but the paper did not describe how the topic was presented under the dome. Another example, “Comparison of Student Learning About Space in Immersive and Computer Environments” looks specifically at one program, We Choose Space, and how presenting the program in a dome and on a computer affected retention.

Drilling down to the basics of the presentation, in my opinion, is the best help for most planetarian presenters.

Shannon Schmoll, in her doctoral dissertation “A Comparison of the Effectiveness of Two Instructional Techniques in a Planetarium Setting,” does not study planetarium efficiency.
cacy as much as she does two teaching method frameworks. She does, however, conclude that students need adequate preparation and classroom support to get the most from their informal education experience. In suggesting revisions to the SMILES (School-Museum Integrated Learning Experiences in Science) framework, one of the two she studies, she says:\textsuperscript{26}

These revisions included addressing choice and control normally seen in museum settings in the classroom. preparing students for language in addition to concepts seen while on a field trip by providing teachers with a script or list of vocabulary to be addressed in context, have students collect data from the show and explicitly use it with scientific practices in the classroom afterward to support multiple exposures to ideas and help them avoid using authority of facts gathered at the planetarium as a sole means of justifying answers, model specifically those scientific practices in the classroom, and address a single overarching topic in planetarium show[s] or delineate changes between topics to avoid confusing students.

The points noted in this sentence are all usable suggestions that planetarians can take advantage of, especially the need to address a single topic and, if more than one topic is included, to clearly let the students know when a topic change is taking place.

Planetarians need to contribute

Despite often being forgotten in planetarium education research, we under-the-dome planetarians have made many contributions to the field and continue to do so at each of our conferences. We do this by giving papers, which are then collected in conference proceedings. Until just recently, conference proceedings were not considered as appropriate sites for research because of the lack of peer review.

Returning to Slater and Tatge’s Research on Teaching Astronomy in the Planetarium:\textsuperscript{27} (page 11)

...Due to the surprising lack of empirical research reports in scholarly peer-reviewed journals related to planetarium education research, much of the research is found within grey literature (Slater 2015). Additionally, one of the journals central to planetarium education research, the Planetarian, publishes both peer-reviewed and grey literature mixed together without a clear distinction between the two.\textsuperscript{28} In order for a work to qualify as “peer-reviewed,” reports reviewed required an abstract, a listed accepted/published date, and one or more sections considers a methodology, literature review, or program evaluation with empirical results. For a research report to be classified as “grey literature,” it needs to fulfill one or all of the following criteria: no abstract, no bibliographic citations, a conference proceeding, poster, or presentation. Since a large portion of publications relating to planetarium education research usually describe the subject in a general manner, they were categorized within the program/curriculum report or description domain as long as they were not considered formal reviews of the literature. Also classified within this category were any works that described a new activity or planetarium. Even though the adjective “empirical” means something based on or verifiable by observation or experience rather than theory or pure logic, in educational research empirical research relies not only on the observable, but also on the measurable. This translates to methodologies: quantitative, qualitative/interpretive, and mixed-methods.\textsuperscript{29}

The subset of people who work under the dome who are able to conduct empirical research at the peer review level, especially within the requirement listed above, is fairly small; most (but not certainly all) of their names have been mentioned in this paper or in the endnotes. This leaves a large number of people making daily observations that are valuable to their peers, some of whom then share their observations, best practices, novel ideas, and other insights at conferences and in planetarium affiliate newsletters.

Here are research resources just waiting to be mined for data to share. There is Planetarian, of course, but also IPS conference proceedings and affiliate proceedings from around the world. Our resources are primarily grey literature, and iSTAR is willing to accept our contributions. As it states on the iSTAR website: “We challenge all communities of astronomy education researchers to use the iSTAR database to develop and extend collaborations; inform policy, funding and educational decisions; and share in the voice, perspective and experience of astronomy education research. Please join us by uploading any and all works related to astronomy education research!”\textsuperscript{30}

Sources ready to be data mined

Our job is to scour our publications for papers that deserve to be shared with wider audiences, instead of being hidden on our websites or shelves. Perhaps seek an astronomy education researcher from within your ranks to assist in deciding the suitability of the wider dissemination. Use the “iSTAR Database Document Categorization Scheme” that appears on page 12 of Slater’s article in the December 2017 Planetarian, or on pages 8-11 in the Astronomy Education Research in the Planetarium book.

Although the upload section of the iSTAR database website might appear daunting, do not let it stop you. The categories most applicable to planetarium grey literature are fairly clear, and you do not need to fill in every line:

- Document source: grey literature
- Type of resource: curriculum or program evaluation, curriculum description or report, position paper or editorial, and historical
- Empirical methodology: applies only to empirical studies
- Learning environment: informal
- Research setting: nearly all of the settings listed, with the possible exception of research facility
- Study participants: all apply
- Construct: your decision, but probably general teaching strategies and perhaps nature of science
- Scientific content focus area: all apply
- Demographic focus: all apply
- The final two categories, language of publication and location study conducted, are self explanatory.

Summary

There is a tremendous amount of valuable information in the planetarium community’s conference proceedings. Although it might not be possible for planetarians to perform empirical research, we certainly can add to the literature to help astronomy education researchers by taking advantage of the iSTAR Database.

\textsuperscript{26} Ibid, abstract.

\textsuperscript{27} This lack of distinction has changed over the past several years to make it clear which articles are reviewed. - Ed.

\textsuperscript{28} Slater-Tatage (2017) p 12.

\textsuperscript{29} istardb.org/information.html

\textsuperscript{30} istardb.org/information.html

\textsuperscript{15}
Greetings to the IPS community from Edmonton! We have dug out from a long, cold winter, and now we’re enthusiastically preparing for the IPS2020 conference, the 25 bienniel, coming up June 18-25, 2020.

We’re a year out and the planning is coming along well. For the first time, the IPS conference will feature a two-day Fulldome Film Fest, plus a one-day LIPS pre-conference workshop and a one-day IMERSA pre-conference event.

Edmonton is the capital city of the western Canadian province of Alberta and is a city defined by all four seasons. The northern summer is an ideal time to visit. The days are warm and long, the weather is glorious, and there is an amazing range of things to do, see, and participate in, both within the conference setting and in the wider community.

The city is also one of the most multicultural in the world, home to people representing just about every facet of human heritage one could imagine.

Edmonton famously is the location of Canada’s first public planetarium, the Queen Elizabeth II Planetarium (QEP), which opened in September 1960. Its first director was none other than long-time IPS member Ian McLennan. The year 2020 will mark the 60th anniversary of the QEP and of the introduction of the planetarium experience to Canada.

Alberta is known as Big Sky Country for its wide-open spaces and its big open skies. It’s where the big sky meets an infinite horizon, so the theme of the conference will be Big Sky—Think Big, Dream Big!

Let’s talk expanding horizons
What are the big opportunities for planetariums in the 21st century? We want discussions on how we will expand the horizons for 21st-century planetariums by looking beyond pre-rendered fulldome shows to ways in which we explore the possibilities of science visualization, artistic theatre, live science, and how this content is blended together with new planetarium technologies.

Since this is the IPS members’ conference, our planning process involves as many IPS members as are willing to provide meaningful input. Sessions will give delegates an opportunity to learn, socialize, share, and get to know each other. Other new partner organizations, such as LIPS and IMERSA, will be part of the IPS 2020 Conference program, providing you with a comprehensive conference experience.

Before and after the conference, there will be many possibilities to visit other scientific and educational institutions, as well as local and provincial tourism destinations.

Edmonton has Western Canada’s newest and largest museum, the Royal Alberta Museum. We are also home to the Art Gallery of Alberta, the scenic North Saskatchewan River valley, and the majestic Alberta Legislature building and grounds. Fort McMurray has a well-designed oil sands interpretative facility, and TELUS Spark is located in Calgary, just a short three-hour drive south of Edmonton. The world-famous Calgary Stampede starts its two-week run on July 3, 2020.

Between Edmonton and Calgary, there are a variety of wonderful regional museums, including the Royal Tyrell Museum of Palaeontology in Drumheller, just west of Edmonton, in the heart of the Canadian Rockies. Jasper National Park boasts the second largest dark-sky preserve in the world. The Skywalk and the Columbia Icefields are just a short drive south of Jasper along scenic highway 93. A post-conference tour is planned for the Jasper area and the Columbia Icefield. Check the IPS 2020 website as details of this trip become available to book for this special post-conference tour.

A brand new dome theatre
There are many details to look after, but the most important and exciting item requiring an update is the state of our dome theatre. It’s brand new, top to bottom, and it’s a beauty. The Margaret Zeidler Star Theatre (MZST), the science centre’s original planetarium, was state-of-the-art in 1984, but by 2014 it needed attention. We made renovating the dome a priority and spent several years raising the significant

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funds required to make it state-of-the-art once again. We closed the MZST in early September 2017, and spent the next eleven months rebuilding it.

Everything in the 33-year old planetarium came out. We stripped it right back to concrete and steel. The first step was rebuilding the entrance to make it wider and more accommodating. That entailed some structural steelwork and the pouring of plenty of new concrete. We completely redesigned the entrance experience, from the stairs that get you to the entrance, to the foyer, now rechristened the Imaginarium. The Imaginarium features a 10 by 3 metre wall with an interactive projected universe. Built around motion-sensing Kinect sensors, visitors interact with the projected imagery on the wall to create and control objects, simulating the creation of stars and black holes, with the occasional gravity wave added in for extra effect.

Upon entry into the Zeidler Dome itself, one might be struck with how much it looks like the original MZST. The basic layout and furnishings remain in the roughly the same configuration, but everything is new.

Astro-Tec supplied the new Ulteria seam 23-metre dome and Sky-Skan, Inc. created the world's first 10K dome projection system, providing over 10,000 pixels along each meridian.

We'll be honest—we don't have 10K pre-rendered content yet, but we're working on it for IPS2020. Nevertheless, 8K pre-rendered content and Sky-Skan's Dark Matter output at 10K just pops off the beautifully-crafted dome. The dome image is created by 12 SONY VPL-GTZ280 4K laser phosphor projectors that are managed through through the Digital Sky/Dark Matter system. It provides a crystal clear, sharp, immersive image of anything projected on the dome.

One thing you need to keep in mind about our dome is that is a classic level spring line dome orientation. Planetariums are so typically tilted these days that the classic non-tilted dome feels like a bit of a throwback. But we love our dome. It creates an evocative space that allows us to create many different moods. It is a wonderful space for speakers, concerts, fulldome shows, and tours of the universe.

We have 200 Sonate fixed reclining seats, from the Norwegian company Skeie, arranged concentrically around a central, circular stage. One quadrant of the dome has fixed seats on the perimeter only. The rest of this quadrant is the “beanbag section,” where visitors can elect to lie back completely horizontally to take in the show. The beanbags are incredibly popular.

In addition to the fulldome digital projection system, the Zeidler Dome is also equipped with a laser system provided by Laser Fantasy using the Pango-lin Beyond software. It includes five 2.5 W laser projectors, plus hazers for the aerial beam effects.

Audio is produced by 17 JBL main speakers distributed throughout the dome, along with two JBL subwoofers.

The facility was reborn as the Zeidler Dome and re-opened for the public on August 3, 2018. The new Zeidler Dome is a fitting showpiece for IPS2020 and we will be thrilled to share it with the world.

Renovated galleries

The dome has not been the only part of the science centre receiving attention. We have completely renovated three new galleries, with plans to renovate three more once we have completed the IPS2020 conference.

We also have an impressive giant screen theatre powered by an IMAX GT 3D laser projection system. It is proving to be a big success with our audience, and the digital projection technology gives us all sorts of flexibility in how we choose to use the space.

We have much to do in the next 12 months, but we are thrilled with the foundation we have prepared in order to host the world at the 25th IPS conference at IPS2020.

Fulldome showcase

The Fulldome Film Showcase will run June 18-19, and the IPS2020 conference will run June 22 to 25.

(Continues on next page)
Martin George
Chair, IPS Election Committee
martin.george3@hotmail.com

In accordance with the IPS Vision 2020 initiative, IPS is now calling for nominations for board members. Nominations must be received by 1 August 2019.

For many years, IPS governance has taken the form of the IPS Council, made up of the five officers and one representative from each of the IPS Affiliates. The last council meeting under that structure will be in Reykjavik, Iceland, 22-23 June 2019.

The new structure will include the officers as before, but the remaining board will be made up of elected members from around the world, on a “continental zone” basis. The zones are defined as Africa, Asia, North America, Latin America (including South America, Central America and the Caribbean), Oceania, and Europe (including Russia).

Zones with 49 or fewer IPS members will have one board member; zones with 50 to 499 IPS members will have two board members; and zones with more than 500 IPS members will have three board members.

For the 2019 elections, therefore, North America other than Brazil, you may make a nomination individually.

Nominations must be made to Martin George, chair of the IPS Election Committee, using the email address. I will be present at the IPS Council meeting in Reykjavik on 22-23 June and will be happy to answer any enquiries from affiliates about the process. Alternatively, any IPS member can email me at the abovementioned address at any time.

All Board Members will be elected in 2019. Regions represented by two members will have a 3-year term and a 2-year term (based on the number of votes). Regions with one member will be randomly assigned a 2- or 3-year term. This will ensure that future elections will be staggered so that not all board members end their terms at the same time.

Guidelines

To assist you in considering the most appropriate people to nominate, IPS has adopted, within its Standing Rules, the following guidelines for the responsibilities of board members:

1. Active involvement in IPS issues;
2. Maintaining contact with the IPS Officers, Affiliates and IPS members within their respective zones, and other Board Members;
3. Representing, at Board level, IPS members and Affiliates within their respective zones, by canvassing them to gather comments and suggestions about IPS issues;
4. Promoting IPS within their respective zones;
5. Where reasonable, attending affiliate meetings within their respective zones either personally or electronically via an internet connection;
6. Participating in the development of initiatives within the continent or continent.

Voting starts in October

When voting takes place beginning in October, all IPS members within a continental zone will vote to choose board members. The board member (or members, in the case of a continental zone electing more than one member) with the highest number of votes will be elected. Instructions on how to vote will be announced at the time of the election.

The opening of voting will be announced on the IPS website and through a bulletin message. Since it is expected that IPS Board Members will attend the Biennial Conference anyway there is no provision for reimbursement of transportation and lodging expenses. However, since the IPS Board Meeting customarily occurs two days prior to the start of the conference, it is expected that Board Members must arrive two days early, therefore Board Members may submit for 100% reimbursement of two nights’ lodging. (The extent of the reimbursement will depend on the funds available as determined by the Treasurer and the Finance Committee.)

In the non-conference years, IPS Officers and other Board Members may submit for 100% reimbursement of travel expenses to attend and return from the Board Meeting, and their room expenses for the time that the IPS Board is meeting. It is important to note that the extent of reimbursement is not guaranteed. It will be determined by the Treasurer and the Finance Committee and will depend on available funds, in addition to the submission being considered reasonable.

We urge you to consider the IPS members who would best serve your continental zone on the IPS Board, and contact them to determine whether they would accept a nomination.
COSMOS ODYSSEY

Our Quest to Discover the Universe

www.kwonochul.com/cosmosodyssey
contact: threestar@metaspace.co.kr
I left my small town, Bagé, on April 1, taking a bus to Porto Alegre and some flights to São Paulo, Miami, Denver, and finally arrived at Casper on April 3. During two weeks I learnt a lot about working in the planetarium. I spent some days in Casper and Laramie, but my host Michele Wistisen also arranged a visit to Denver on my way back home.

During this time, I was thinking about what I would write for *Planetarian*. So, I split this text in two: my planetarium experience and my personal experience. I hope both parts will encourage the readers to apply to the next edition of A Week in United States.

I have been working with a portable planetarium for 6 years and with a fixed dome for less than 2 years, so, I’m pretty new in this business. This trip to the U.S. was a wonderful experience to learn about how people do their work and I strongly recommend it to anybody interested in acquiring more knowledge about planetariums.

In Casper, I met Michele, Rod Kennedy and all the Casper Planetarium staff. I loved to work with Michele! Knowing the way she works with students producing their own shows was really amazing. They do a great job and I truly believe we’ll incorporate some of these ideas in the Unipampa’s Planetarium. We work with university students and Michele works with students from public schools. It was great to see this and we are certainly thinking about how we can implement that in Brazil.

**Learning from the children**

However, the most interesting things I learnt in Casper took place when Michele and I were sharing lessons we do for young kids from preschool up to 10 years-old. We both have some concerns about how can we make astronomy closer to kids: how effective are our activities and how can we implement them with so short a time that schools dedicate to the planetarium visit. I loved seeing the activities she uses about moon phases and building constellations on the floor using little toys, but the work with shadows was the best. We also discussed how best to use social media to engage our public by talking about the planetarium and astronomy.

During the time in Casper, I visited some schools, including a special Science Mountain School, where I developed an activity that I learnt in the Space Awareness Program and which is originally from London Museum, called The Mystery Boxes. That’s an activ-
ity I really like and can be used to talk about Science. (Here you can find a link about how to build them: https://studylib.net/doc/18347626/mystery-boxes—science-museum.

Watch out for snowballs!

It was quite an interesting experience to go up in the mountains during snowfall (remember that we don't have snow in Brazil), driving through roads we couldn't see and the temperature at -10°C! I just would like to give some advice to those who wish to visit Michele during the spring (yes, it snows in Wyoming during the spring): be careful, she will throw some snowballs at you, and you will lose your shoes in the mud trying to see some moose!

In the Casper Dome, I presented the show *Brazilian Indigenous Skies*, their constellations and relations to nature. Remembering that this is the International Year of Indigenous Languages, I talked about Jaceí, Guirá-Nhandu and Tuya'í, as well as how they are related to nature, fishing, seasons, and rains. We had a full house that included some young kids, which was great.

I also presented this show in Laramie, and changing from a school district planetarium to a planetarium at the University of Wyoming was also a great experience. My planetarium is also inside a university, but the work we do is much closer to what Michele does in Casper and so it was a good compliment to my first visit.

I also had the opportunity to meet Paul Taylor, an Australian storyteller, and learn about the aboriginal sky. It is amazing how cultures separated by thousands of miles can get together through the sky.

In Laramie, I had the opportunity to work with grad and undergrad students, which was great, since I could share a bit more about my work and tell them how we do work in Brazil.

I had a great time in both places, where I learnt a lot and met incredible people. Everybody was so kind, driving me to different cities, into the mountains and to curious restaurants and making me feel like home. I can surely tell that I had an incredible work and life experience.

As I gave some advice to those who wish to visit Casper, here I give you some advice about visiting Laramie: they live at 7,200 feet up the mountain. I found out about that while I was...

(Continues on next page)
Finally, Michele also arranged a meeting with Dan Neafus at Gates Planetarium at the Denver Museum of Nature and Science. The visit made my journey a complete experience because I got the chance to see a completely different kind of work being done inside a public science museum.

On my way back home I was able to stop in Los Angeles and, of course, during the few hours I had there I visited the Griffith Observatory (unfortunately, this time as a simple tourist).

It was a wonderful experience from which I learnt a lot and that I’ll keep in mind while trying to implement some of the ideas and techniques back home. However, meeting people, sharing cultures and making our world smaller is always the best experience.

When I arrived, Michele hosted me at her house, where I met her husband, Cordell, and their grandchildren, Duncan and Summer. We had some family meetings, dinners, and anniversaries. They drove me to Jackson Hole to show me the Tetons, moose, elk, coyotes, and mountain goats. More than that, they let me get inside their family, learning about their way of life and their culture. Special thanks to Duncan and Summer for their recipes for strawberry croissants and smoothies.

In Laramie, I met a great guy too. Jordan is a PhD student who is doing a great job in the planetarium. He showed me the university and he taught me how to operate the planetarium system.

He also kindly drove me to Denver, where we spent a wonderful afternoon with Dan Neafus, another great man who showed us everything about the museum and the planetarium, including the backstage. I can’t name everybody I met during these two weeks, but I’m sure these three people, Michele, Jordan, and Dan, can spread my thanks to all the people involved.

About the Week in the United States program

If you want to have a great collaborative experience, you should apply to host a planetarium colleague from another country. This experience exceeds any planetarium conference I’ve been to. Through hosting, you are able to share and glean ideas that you may not have time to at a conference. When you host, it really is a two-way sharing opportunity.

This year the Casper Planetarium had the opportunity to host Dr. Guilhereme Marrango-hello from Brazil. We chose to host him because we were interested in his presentation about the indigenous stories of the southern skies.

Guilhereme not only brought his stories, he also shared his culture with us. The staff of the Casper Planetarium appreciated hearing how Guilhereme teaches in the dome and in the classroom. Beyond the educational exchange, we will be adopting his ideas about promoting our planetarium.

I enjoyed sharing American and Wyoming culture with him. He now has experience with Apple pie a la mode, snow in April, buffaloes, and the Tenzi dice game.

My text does not begin to describe what a wonderful opportunity it is. When you host, you learn and share on multiple levels. But beyond that, my staff, teachers from my district, my family and many others now consider Guilhereme as their friend and colleague.

—Michele Wistisen

It was great having Guilhereme visit us here at the University of Wyoming! It was a very unique opportunity to have someone from another planetarium, let alone someone from another country, see what we do here and learn what they do at their planetarium.

We learned a lot from Guilhereme—not just little individual things, but also big picture ideas to make our planetarium better at educating and entertaining its patrons. I really hope Guilhereme learned at least one thing from us because we definitely learned a lot from him!

It was also wonderful for us to be able to host Guilhereme’s Brazilian Indigenous Constellations shows so that the citizens of Laramie could experience it. A number of junior high school groups also got to see his show, where they definitely learned about a culture they would never hear about otherwise.

—Jordan Turner

Let IPS help you celebrate the Apollo anniversary

IPS wants to help members promote and market their events surrounding the 50th Anniversary of the landing on the moon of Apollo 11 (July 20, 1969), plus provide you with materials to remember the subsequent Apollo moon landings.

We came across two wonderful video series that focus on the people who worked to send humans to the moon. They were being produced for the Space Coast region of Florida, but because the landing of Apollo 11 truly united all people of the world, we felt this work should be shared with a much larger audience.

How to use them?

• As video shorts prior to your planetarium program.
• In kiosks or monitors outside of the dome.
• In emails to your members.
• On your websites to encourage attendance for your programs and events.

The videos are courtesy of FLORIDA TODAY, the official newspaper of the Space Coast and a part of the USA TODAY network. Its People of Apollo series is short videos that look at some of the 400,000 people who helped make the moon landing possible, plus a 45-minute documentary with the same name. Trench Media, a media team committed to uncovering high-tech stories that affect society, also is based on the Space Coast. It is producing 50/50 Lunar Legends, short videos of the epic journey to space and those on Earth who lived it.

IPS members are able to download all of the videos. Non-members may download two videos, but must become IPS members to access them all. Go to www.ips-planetarium.org/page/ApolloPeople for complete details.

1923-2023

A number of activities are planned for the upcoming Centennial of the planetarium. These activities should have visual continuity, all using the same logo. IPS is seeking ideas for a “Centennial Of The Planetarium” logo. We ask for your submissions by August 31, 2019; technical details are listed at www.ips-planetarium.org/page/centennialtaskforce.

—Björn Voss, for the IPS Centennial Committee
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Passport to the Universe was developed by the American Museum of Natural History, New York (amnh.org) in collaboration with the National Aeronautics and Space Administration (NASA). Major support for new version provided by California Academy of Sciences, San Francisco.
Academy Style:
An Institutional Approach to Fulldome Storytelling

Scene from Life: A Cosmic Story
All images © California Academy of Sciences
“Respect for the audience member is the central focus of our work, especially respect for the cognitive load required to watch, enjoy, and understand fulldome content.”

Ryan Wyatt
Senior Director of Morrison Planetarium
California Academy of Sciences
San Francisco, California USA
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Abstract
The California Academy of Sciences in San Francisco has produced six award-winning fulldome shows since reopening Morrison Planetarium in 2008. In developing these shows and other content, the production team has defined an “Academy Style” of fulldome filmmaking with some specific design principles, including: starting at the human scale, maintaining camera motion and continuity whenever possible, using science data whenever possible (scientifically-informed artwork when not), and focusing on human- and audience-centered content. Indeed, respect for the audience member is the central focus of our work, especially respect for the cognitive load required to watch, enjoy, and understand fulldome content.

Since reopening the historic Morrison Planetarium in 2008, the California Academy of Sciences in San Francisco has produced six award-winning fulldome shows. These productions share certain features in common, comprising an intentional design strategy that we believe has proven effective in communicating complex science stories in the fulldome medium.

I think of us as having developed what I have nicknamed the “Academy Style,” a conservative but effective approach toward fulldome filmmaking. Previously, I have written about the “narrative journey,” which is a framework for thinking of the dome as a space in which storytelling is coupled with traveling, a voyage through a 3D environment with an articulate and knowledgeable tour guide (Wyatt 2005, 2010).

This, in turn, builds on ideas expressed by Academy-Award-winning filmmaker Ben Shedd, who has written, regarding giant-screen films (Shedd 1989), “In accounting for the sensation of movement, the filmic experience has moved from passive, from being held in a frame, to active, to becoming the engulfing reality with the audience present within the filmic events. In frameless film the audience becomes the main character in the film.” I see Academy Style as growing out of these fundamental considerations.

Furthermore, as Ka Chun Yu, Dan Neafus, and I have written about in previous issues of Planetarian, there are many ways to think about how we guide viewer attention in the dome (Yu et al 2016, 2017). This discussion of style is not unrelated to that set of ideas, but it builds on them to make certain assumptions about how we create content that maximizes an audience’s ability to follow a narrative and to learn from our films.

The elements of style
Academy Style leverages four core values:
- Creating human- and audience-centered content,
- Starting shows at a human scale,
- Maintaining camera motion and continuity, and
- Using data (or at the very least, deeply-informed artwork) whenever possible.

This basically adds up to treating the audience member with respect—respecting their comfort, their intellect, and their cognitive load.

I should note that I recommend this as a recipe for science storytelling in the dome, for fulldome films that intend to inspire and educate. It doesn’t necessarily apply to artwork or to content with the intent to startle, to provoke, or to discombobulate. However, if you want to stimulate an audience while respecting their cognitive load in following a story (and perhaps even absorbing some information), I think it’s hard to go wrong following these principles.

I also don’t see these as hard and fast rules, but more like guidelines, or as I described them above, values. We have broken some of the “rules” in our shows before, and as I’ll describe at the end of the article, we fully intend to shatter some of them in our next few productions.

A further caveat about this article is that I don’t explicitly address music and sound effects as much as I could. In part, this reflects my own bias, but I also think that our strategies around sound design don’t differ much from thoughtful sound design for any film, immersive or otherwise. Music and effects provide context, strike emotional chords, and enhance the sense of continuity between shots. So we try to use sound design to reinforce the values I outline below, but I only call attention to a few examples—an underestimate both in terms of the amount of effort we invest in sound and in the effect it has on the final experience.

Let’s elaborate
Without further ado, I’d like to elaborate on these ideas and give examples from the Academy’s six original, award-winning productions: Fragile Planet (2008), Life: A Cosmic Story (2010), Earthquake: Evidence of a Restless Planet (2012), Habitat Earth (2015), Incoming! (2016), and Expedition Reef (2018).

(Continues on next page)
Create human- and audience-centered content

First off, we tell stories that connect to the human experience. This can sometimes prove challenging with astronomy, but when the Academy has addressed astronomical topics, we have tended to steer toward stories that people relate to more readily—our place in the universe, the origins and future of life, the potential for life elsewhere. Because we work at an institution actively engaged in research in the life sciences, many of our shows address Earth- and life-centered topics—earthquakes, ecosystems, and coral reefs. But in every case, we actively seek out ways to thread human experiences into our shows.

For example, when we set out to teach audiences about earthquakes, we knew that we needed to recreate the 1906 San Francisco earthquake (Figure 1a). We chose to do this because, as an institution based in that city, we knew that our audiences expected it. (As it turns out, modern seismology was born out of research into the causes of the 1906 earthquake, so there are solid didactic reasons to mention the event, too.) But the choice was made also because we could use the visceral and dramatic experience of the immersive recreation of the event to draw people into the scientific story.

Later in Earthquake, we visit San Francisco landmarks—City Hall and the Ferry Building—that are familiar to both locals and many tourists. We conclude the show with a direct connection to human safety and well-being.

When we reveal the magnitude of the destruction in the wake of the Chelyabinsk meteor impact in Incoming!, we overlay maps of New York City, the San Francisco Bay Area, and the Tokyo metropolitan area (Figure 1b). We chose potentially familiar areas with distinctive coastlines (turns out landlocked cities don’t provide good geographic reference at that scale) to help make the content more relatable.

In more subtle ways, we also knit humans into the visuals (a challenging prospect, since depicting people on the dome comes with many caveats). At the end of Life: A Cosmic Story, we reveal an abstract DNA strand with images of life¹ that is intended to represent the fact that all life on Earth is connected through a shared genetic heritage. Photos of humans appear among photos of tigers, fish, insects, plants, and so forth (Figure 1c and cover image). This gently underscores how humanity is integrated into Earth’s living systems.

In Expedition Reef, we integrate video of visitors to the aquarium into the opening shot of the show (a bit more on that below). We also subtly include a few people fishing in a scene pulling out from the location of our virtual reef at Devil’s Point in the Philippines (Figure 1d)—if you listen closely, you can even hear them conversing in Tagalog! And we use popup images of humans and human impacts specific to the locations we are “flying over” at those points in the show, overlaid on the dome environment. This often coincides with the use of data visualization to provide a literal human face to otherwise abstract data.

Start at human scale

One can actually think of this as a corollary to the first idea. In order to set the stage for audiences to enter the fulldome story, we situate them in a familiar (or at least potentially familiar and identifiable) human-scaled environment. From there, we can increasingly and continuously shift into less familiar places as we tell our story.

For the original version of Fragile Planet

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¹ The locations of the pentagons and hexagons on which we show images of life on Earth are actually derived from the structure of a DNA molecule. The molecules in guanine and adenine take the shape of linked hexagons and pentagons, while cytosine and thymine form hexagons. The visualization of DNA at the end of Life: A Cosmic Story eliminates the individual molecules and simply uses these basic shapes to communicate the structure of DNA.
(the version that plays in Morrison Planetarium, not the distribution version), we begin the show inside the theater in which people are sitting, dissolve away the dome surface to reveal the exhibits in the adjacent area, then lift off through the Academy's living roof (Figure 2a). This situates the audience exactly where they are, watching the show, and allows us to begin a journey through increasingly unfamiliar spaces to regional and global scales on Earth, and on to interplanetary, interstellar, and intergalactic scales in the universe.

For Life: A Cosmic Story, the opening shot is of a redwood forest, fading in over the sounds of birds, insects, and wind (Figure 2b), pretty much the view you would have if you were standing in Muir Woods a few dozen kilometers north of San Francisco. We then shrink the perspective continuously to examine the interior of a leaf on one of those redwoods. More on that below.

For Earthquake: Evidence of a Restless Planet, the show opens on McClures Beach (Figure 2c), another site within easy driving distance of San Francisco but also a reasonable stand in for a generic beach. That location allows us the opportunity to use the ocean as a metaphor for the passage of time. More specifically, it allows us to examine the different time scales in the scene—from the lapping of waves over a period of seconds to the setting of the sun over several minutes, from the accumulation of sand over a period of thousands of years to the shifting of tectonic plates over the period of millions of years.

In just a few moments, with an establishing shot of a familiar locale, we connect to a core theme of the show, namely “telescoping time” from personal to historical to geological time. Then we rocket to an aerial perspective to see the northern California coastline deformed by tectonic forces.

For Habitat Earth, we begin with an industrial soundscape of engines and electronic bleats over black. We fade up inside a shipping yard (Figure 2d), watching semis deliver shipping containers to vessels destined for intercontinental trips across the ocean. A few computer-generated people (seen from a distance) inhabit the scene to provide scale, but the intent is to feel somewhat jarring, but not alien—or natural.

Many of us inhabit human-built environments for the majority of our days, so we elected to begin our show in a somewhat unsettling and uncomfortable space that nonetheless exists on the boundaries of our lived experiences. We then lift off from near ground level to an aerial perspective, revealing the natural environment in which the built environment exists.

For Incoming!, we start with a lizard peeking over a rock in the Arizona desert (Figure 2e), pulling back to see a hummingbird, cacti, and desert hares. We then follow a (Continues on next page)
hawk flying over the nearby Barringer Crater, before launching to a satellite view of Earth, highlighting the locations of other impact craters in North America.

Finally, for Expedition Reef, we fade up on the interior of an aquarium display of a tropical reef, with a young visitor pressed up against the acrylic in awe (Figure 2f). We break the barrier subtly at first, with a few fishes that appear to swim out of the water into mid air. Then we traverse the boundary between air and water, pivoting the camera as the aquarium environment fades away to reveal the Philippine coral reef where we introduce the myriad creatures that inhabit the ecosystem.

Each of these opening shots represents what we believe is a thoughtful response to the question of how to help audiences enter a story—both as a “physical” virtual entry point and also as a metaphorical opportunity to set the conceptual stage for the story we want to tell. As the starting point of our “narrative journey,” the opening shot needs to set up where we’re taking the audience, both in terms of the virtual voyage and in terms of the story.

**Maintain camera motion and continuity**

When I talk to people about our shows, this attribute probably receives the most attention. For the most part, in the Academy’s productions, the virtual camera never stops moving through our computer-generated environments. And on the two occasions when we have used physical cameras—for the “shake table” scene in Earthquake and the terrestrial forest scene in Habitat Earth—we have designed the shots to maintain motion throughout.

Furthermore, cuts occur rarely, with scenes going on in some cases for several minutes (or in the case of Fragile Planet, for the entire length of the show). It’s not just showing off! There are several good reasons why we choose to maintain camera motion and continuity. First and foremost, maintaining camera motion increases the sense of immersion, reinforcing a sense of dimensionality by providing depth cues for foreground, midground, and background objects. Without relying on stereoscopic tomfoolery in the dome, we can make audiences feel situated in a space by giving them parallax cues for a three-dimensional environment. Because a dome also engages people’s peripheral vision, this can be a powerful effect—for good or ill, in that individuals prone to motion sickness might feel a little too engaged by these techniques.

Avoiding cuts further supports immersion by allowing audiences to reside in a virtual environment for an extended period of time. When cutting from one immersive environment to another, the audience is effectively instantly transported from one place to another—potentially accompanied by a shift in scale—and it takes time for the human brain to make sense of such a dislocation. We can design the transitions in such a way to soften the blow, however; particularly for novice fulldome viewers, cuts can be very distracting and disorienting. So in our planetarium shows, we have avoided cuts as much as possible.

I believe that continuity also offers didactic benefits, allowing an immersive journey between locations and scales that provides valuable context to the viewer.

From my perspective, the quintessential 21st-century planetarium experience is a flight through a continuous, virtual assembly of nested astronomical datasets—from Earth to the solar system, through the nearest stars, out to the scale of a modeled Milky Way galaxy, and beyond, to the large scale structure of the universe and the cosmic microwave background. I’ve described this kind of “tour of the Universe” previously as well as the benefits accrued from contextualizing astronomical discoveries in three-dimensional space (Wyatt 2005).

A more modest transition in increasing

**Figure 3a–c.** Stills from Earthquake showing the continuous translation in size from (a) the human-scaled street view of 1906 San Francisco to (b) the regional perspective of how fires spread in the wake of the earthquake, overlaid on a diagrammatic view of the city, and (c) the global view of Earth’s crust, mantle, and core, with surface shaking seen in red.
Changes

In the planetarium world, change is the constant. That is, nothing stays the same forever. New innovations, new ideas, aging equipment, and even aging people(I) trigger changes. And at GOTO, we embrace change as the way we move forward.

Kurashiki Science Center Renovation

In Kurashiki Japan, GOTO has recently replaced a GOTO HELIOS star projector from the 1990’s with a new GOTO CHIRON III projector (special color for Kurashiki), and synchronized it with a 4K Virtuarium X fulldome system and 10K video panorama in a HYBRID configuration! This change brings a whole new range of presentation possibilities. Now operators of live programs can use the CHIRON III to show the most realistic and beautiful night skies as seen from earth, or can use GOTO’s Virtuarium X fulldome system to fly through the cosmos, or use both systems together to offer a complete, immersive sky visualization system.

THEATER 360 Upgrade

GOTO was proud to produce the Earthvision 360 degree theater for the international Expo 2005 in Aichi Japan. Going farther than fulldome, this was the first full SPHERE installation, with video images flying and moving all around - above and below - for the first time ever. After the Expo, the 11 meter sphere was moved to Japan’s National Museum of Nature and Science in Tokyo and is called Theater 360. It amazed throngs of visitors daily for over a decade, and in March 2019 received a total make-over using new, higher resolution video projectors and an improved Virtuarium X system. With those changes, it now plunges children and adults into the oceans, out into space, and even backward and forward in time in exciting, totally immersive adventures!

A Retirement and a New Face

And finally, two more big changes have happened. For the past 19 years Ken Miller has acted as GOTO INC’s liaison to the western world. But in May he retired to a life of fun, family, and travel. Ken says, “It has been a true honor and pleasure to represent GOTO to the planetarium world. In retirement, I’m now looking forward to visiting the cities, countries, and planetariums I’ve come to know, and reconnecting with so many friends. I hope I’ll see you all again soon!” Ken has now passed the GOTO liaison torch to Mark Webb, formerly of Adler Planetarium, who will carry it into the future, introducing new products and listening for ways that GOTO can continue to change and improve.

Are you ready for a change? Talk to GOTO.
scale (at least in terms of numbers of orders of magnitude), from street-level 1906 San Francisco to planet-wide tectonic plate boundaries, takes place near the beginning of Earthquake. This seamless transition starts with the visceral experience of an earthquake on the ground (Figure 3a); as we pull out to a view of San Francisco, data overlays show the damage inflicted to the city by fire and the regional effects of surface shaking (Figure 3b); broadening our perspective, we then follow the penetration of seismic energy underground where it reveals our global representation of Earth's core, mantle, and crust (Figure 3c). This sequence thus visually and conceptually situates an isolated seismic event in the context of the planetary-scale system that caused it.

In Life: A Cosmic Story, as previously noted, we begin in a redwood forest, but we then “dive” through the stoma of a leaf, revealing its inner structure, down to the scale of molecules engaged in photosynthesis (Wyatt et al. 2012). Aside from situating the audience at a human scale, this scene inverts the usual powers of ten of increasing scales to traverse twelve orders of magnitude in decreasing scale, down to the internal structure of a chloroplast (Figure 4a, b, c).

In each of these examples, visual continuity reinforces conceptual linkages. **Use science data**

This final value or guideline is categorically different from the preceding ones. Whereas everything I’ve described above relates to the intrinsic qualities of the fulldome medium, the motivation to rely on science data for visualization-based representations of natural phenomena has more to do with our institutional imperatives to communicate authentic science. That said, I think use of data often accrues additional aesthetic benefits, adding to the realism and persuasiveness of our productions.

As a 166-year-old scientific research and educational institution, the California Academy of Sciences has a stated commitment to “explore, explain, and sustain life,” with a strong emphasis on presenting authentic science specimens and data. This commitment to authenticity is both central to our institutional identity and of critical importance to our audiences, who have grown to expect scientific rigor from our productions. As a result, I firmly believe that our shows offer a level of engagement that we couldn’t attain by relying on artwork to describe scientific discoveries.

For example, in Incoming!, we wanted describe the evolution of solar system dynamics from planetesimal formation to the scattering of small-scale objects during the migration of the giant planets billions of years ago. To do this, we relied on simulations from multiple researchers. In particular, the visualization of data from Mike Brown and Konstantin Batygin (of Planet 9 fame) showed how Kuiper Belt Objects either got “kicked out” of the solar system or settled into higher-inclination orbits. The resulting animation2 has what I can only describe as a surprising weirdness that no one really expected—and Brown himself said he saw things in the visualization that he hadn’t seen before.

In Habitat Earth, we present the migration routes of ospreys and turkey vultures based on tracking data, coupled with net primary productivity data that shows the seasonal metabolism of plants that drives the migration (Figure 5). This not only allowed us to create derivative educational products that encourage students to explore patterns in the data, but I believe that it resulted in a more aesthetically engaging sequence than we would have developed with, say, diagrammatic elements such as arrows.

The examples above conform to typical examples of data visualization—ingesting tables of numbers gathered by scientists or generated by simulations. But we often use computer graphics to situate our audiences in photorealistic renderings of real places (typically in lieu of capturing fulldome video), so we rely heavily on photogrammetry, LIDAR, and remote sensing data to construct virtual locations.

In Earthquake, for example, we reconstruct McClures Beach (described above) using photogrammetry of the granitic cliff that faces the Pacific Ocean, and similar data formed the foundation for the opening shot of Incoming! at Barringer Crater. We even perform virtual taxidermy in Habitat Earth to recreate a3

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[2] See youtu.be/yXq1iJHumA for a video that includes an HD version of this simulations, starting around 2:11.

AVI PRESENTS

LASERS LIVE!

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In Iceland, extremes are just a way of life

Perlan opens the country’s first planetarium

By Sharon Shanks
Planetarian Editor
Planetarians are accustomed to explaining and visualizing extreme worlds under our domes.

Exoplanets, nothing like Earth, orbiting nearby stars.

Io, with its sulfurous volcanoes.

Triton, with its methane lakes.

The cold and hot extremes of Mercury, and the simply hot, punishing surface of Venus.

There is a place much closer to home where extremes are, simply, a way of life, where molten lava from deep underground meets a surface of ice.

This, of course, is Iceland. For many of us it is a place we have never visited, so in our eyes it is as mystical and mysterious as the surface of Mars.

But for the people who live there, it is simply home.
Pride in their country of geologic extremes—in their glaciers, thermal vents, fantastic cliffs, and waterfalls—is the focus of the Perlan Museum, the most visible landmark in capital city Reykjavík, which recently installed the first planetarium on this island nation.

The Perland (the pearl in English) was the brainchild of Óskar Rúnar Hararson and Gunnar Gunnarsson, who had “a dream to build the biggest exhibition in Iceland, where both locals and tourist could experience the wonders of Icelandic nature,” says Margrét Th. Jónsdóttir, Perlan managing director.

She shares some of the building’s history: “Perlan was designed by architect Ingimundur Sveinsson and opened to the public on 21 June 1991. The building is composed of an immense glass dome that sits on six hot water tanks. The dome is supported by a colossal steel frame, which serves as a gigantic radiator for the building. In the winter when it is cold, hot water runs through the frame, while cold water is used in the summertime.”

But long before the dome, this site atop the Öskjuhlíð held a single hot water tank built in 1939. The height allowed the tank to supply water anywhere in Reykjavík. Five more tanks were built over the next two decades. They were demolished and replaced in the 1980. The tanks each hold up to four million liters of geothermal hot water.

The first transformation

The first transformation came in 1991 when the tanks, already arranged in a circle, became the base for Perlan. The project placed a dome atop the tanks, giving the structure its resemblance to a pearl. The dome held a restaurant, and was circled by an observation deck.

“Perlan is one of the landmark buildings in Reykjavík but didn’t have a suitable role for many years, only the observation deck and a fine dining restaurant,” Jónsdóttir says. “In 2017 we opened the first phase of our nature exhibition, Wonders of Iceland, and today we are operating the biggest museum in Iceland. Today we are using two of the six tanks, one has an ice cave and a glacier exhibit and the other one has the planetarium.”

The remaining four are still holding geothermal hot water for the city. When the time came in 2015 to make the transformation, Perlan chose Jeff Bowen of Bowen Technovation to do the job. Bowen, headquartered in Indianapolis, was project manager for three phases of the extensive exhibits and the planetarium. He selected and assembled the teams for exhibit design, fabrication, installation, and programming, and was system designer for the exhibits and the planetarium (see sidebar for the details).

It was decided that the signature planetarium program would focus, of course, on the country. Titled Lost in Time: Wonders of Iceland and written by Bowen associate and planetarium consultant Phil Groce, the show revolves around the topics of fire, ice, and water.

Groce remembered: “Jeff Bowen and I had worked together many times on planetarium projects and decades ago, he hired me to write the script for the show Moon Witch. So, when he told me about the Perlan project and asked if I would write the opening show, I jumped at the chance. I don’t know if you have been to Iceland, but the whole country, with its rugged coastline, active volcanoes and glaciers, as well as some of the world’s most picturesque waterfalls, is just one big movie set.”

A script by committee

After touring and getting a feel for the country, Groce met with the Perlan’s board of directors and scientific advisors. “This was a script done by committee. Each member had a different view of what the show should represent and that proved to be the greatest challenge.”

Groce wrote the script treatment before he left Iceland, and “that is when the hard work started, mostly for Jeff, who served as executive producer.”

The show was to be 12 minutes long and serve as an introduction to the exhibits at Perlan and the natural wonders of Iceland. It was to serve primarily tourists, and yet give local visitors a different view of their country. “I didn’t want to write just a travelogue and 12 minutes was hardly enough time to dig into the science behind auroras and volcanoes. The exhibits at Perlan provide that information. I wanted to convey a personal and romantic view of Iceland.”

And that proved to be problematic, Groce said, because “Icelanders are not used to showing their feelings about their country. Early on, I wanted to use a romantic quote from Jules Verne that perfectly expressed my impression of the country and the impression of anyone who visits for the first time. The committee got hung up on the fact that Verne had never visited Iceland. Verne based his descriptions for Journey to the Center of the Earth on the diary of a sea captain who visited Iceland many times. Jeff fought to protect my view of Iceland as described in the script and the show’s title, Lost in Time, came from the Verne quote.”

The show script presented another challenge, because much of the material had never been photographed before in fulldome. “Jeff and the photographic/visualization team integrated original fulldome photography with existing flat-screen video and computer animations.” Unlike most planetarium productions, more than half was original fulldome live-action photography.

“One of my favorite things about the show is how it ‘breathes.’ There are lots of moments without narration and the dome is filled with sound and stunning imagery,” Groce noted. “To be honest, I have yet to see the show on the Perlan dome. I heard from friends who attended the grand opening that they loved the show and the script, which is proof that a successful show needs not just a good writer, but a brave producer who trusts his instincts.”

The show was produced in both Icelandic and English.

A beautiful place to visit

Everyone who visited Iceland as part of the project were enthralled with its beauty. Dale Lewis, vice president of dome supplier Astro-Projections, said, because “Icelanders are not used to showing their feelings about their country. Early on, I wanted to use a romantic quote from Jules Verne that perfectly expressed my impression of the country and the impression of anyone who visits for the first time. The committee got hung up on the fact that Verne had never visited Iceland. Verne based his descriptions for Journey to the Center of the Earth on the diary of a sea captain who visited Iceland many times. Jeff fought to protect my view of Iceland as described in the script and the show’s title, Lost in Time, came from the Verne quote.”

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(Continues on next page)
Tech Manufacturing, said “Iceland is a beautiful country with so much to see, especially if you like to enjoy nature, and hiking. So yes, we thoroughly enjoyed working there. The people are very friendly, hospitable, and the team we had working alongside us were great as well.”

As Lewis notes, “every project has its challenges.” In the case of the dome, “We did have one issue where one of their men fell onto the back of the dome while performing maintenance, ruining one of our panels about a month after we finished the dome. We had to fly our guy out next day to replace the panel.”

Another perspective comes from Ben Metzger, principal of Xibitz in Grand Rapids, Michigan.

“Working with the Perlan team was a fantastic experience. Xibitz is a unique hybrid; able to both build and prove out designs, and a challenge like this really let us flex our muscles. Our biggest test/obstacle was the distance we had to deal with because everything was built in our facility in Grand Rapids, Michigan, then shipped across the Atlantic. But because of our people and the team we worked with, we were able to achieve excellent results.”

There are always favorite parts to every job, and Metzger said for Xibitz, “our favorite part was witnessing the transformation of the unique space into an engaging and welcoming place. It truly highlights the dedication and talent of our team.”

Xibitz is a custom fabricator of branded environments. “We partner with world-class designers and architects to produce and install projects globally. Xibitz specializes in one-of-a-kind experiential spaces for the corporate, higher education, sports, museum, and healthcare markets by serving our clients as strategic partners; by providing value that uses innovation and creativity to help them achieve their goals,” Metzger said.

Robin Sip of Mirage3D, which developed the rig and methods to film native 8K live action for the dome, also faced his share of challenges as he pushed the envelope of full-dome production. You can read about some of his challenges in IMERSIVE News on page 46.

A complete “Wonders” experience

The dream for the biggest exhibition in Iceland, now called The Wonders of Iceland, is a complete experience that includes the planetarium. The focus is on Icelandic nature, glaciers, geysers, and volcanos. To share these wonders, one of the first exhibits to open is an Ice Cave, an ambitious project that resulted in a 100-meter-long display built with more than 350 tons of snow from Iceland’s Blue Mountains.

“The diameter of the cylinder containing it (the Ice Cave) is 23m,” Project Manager Jeff Bowen said. The snow is compressed through its own weight and the freezing temperatures, kept that way through a massive patented freezing system. “A 12-channel sound system plays an actual 12-channel recording we took inside real ice caves...dripping water, running water, cracks, etc. As you walk through, there is also lighting buried in the ice to simulate the ice-filtered lighting you see in real ice caves. In a few places you see moulins, which are vertical ‘chimneys,’ and small objects buried in the wall, such as you would see in real glaciers.”

The Ice Cave exists to the Glacier exhibition, which, next to the planetarium, is the second most popular attraction, Bowen noted. “It features a 4M high, 30m wide video panorama that run all the way to the floor. Visitors stand at any of 12 positions and wave at the wall to trigger nature events and text description. BT designed and installed 12 Kinects sensors, which are processed thru computer server to trigger events in real time. Six projectors with custom lenses project the panorama. There is an 8.3 interactive audio system.”

Bowen noted that the content was produced “by a whiz-bang Icelandic company, Gagarin.”

In addition to other standard interactives and looping videos, Bowen added that “One cool thing is there are two 2M-diameter glass-covered holes in the floor where our animator, Brien Barr, used animation to create scientifically-accurate animations of Icelandic whales. These had to be approved by Icelandic marine biologists and it was lot of work. We could not use file footage because there is none looking down on top of whales. When you stand on the glass they swim under you and swim between the two holes.”

Because bird watching and bird photo tours are popular in Iceland, Perlan decided to include its own Latrabjarg Cliff (10m high) with lifelike birds. Latrabjarg, located in northwest Iceland, is one of Europe’s biggest bird cliffs.1

“The goal of Wonders of Iceland is to bring visitors closer to nature and educate them about the future of our planet,” Jónsdóttir said. Their primary audiences are composed of tourists, but they also get school groups every morning during weekdays.

Jónsdóttir noted that the interest in astronomy is probably similar to that in other countries, but, because the planetarium at Perlan is the first (and only) facility of its kind in Iceland, “the planetarium has huge potential to be an educational center for the science of astronomy. Today we are not using the dome only for astronomy, we are particularly focusing on Icelandic nature.”

The dome’s next program is called Áróra, which the museum calls “the first ever 8K northern lights planetarium show.” It is a “beautiful story about the northern lights, combining science and art, to create a unique experience. It’s a journey, through the unique landscape of Iceland, to observe northern lights as you’ve never seen them,” according to the Perlan website.

You can get a taste of Perlan by going to https://perlan.is/.

1 You can learn more about it at https://www.westfjords.is/en/what-to-see-and-do/places/nature/latrabjarg
Project details

Planetarium
- 15m Astro-tec Ulteria 10-degree tilt dome, 148 panels on 4 courses, 5 fixed access ladders for maintenance; the first Ulteria seam dome in Europe
- 150 Irwin seats
- Evans & Sutherland 8K Digistar 6 projection system
- Six Digital Projection Insight 4K lasers projectors
- Bowen Technovation’s AstroFXAudio 7.1 audio system, AstroFXCommander theater control system, and AstroFXPresenter and alternate language system for Icelandic or English.

Elsewhere in the museum
- Exhibit fabricator: Xibitz in Grand Rapids, Michigan
- Exhibit design team: Lord Cultural, Toronto, Ontario, Canada; Xibitz; Bowen Technovation

The timeline
05.24.15
Bowen Technovation contacted by Iceland project team owners. New museum will include planetarium and exhibits about natural features in Iceland.
05.26.15
Bowen and Iceland teams explore possible buildings. Bowen is asked to assemble a turnkey design-build team for the project. Bowen selects Xibitz as the fabricator for the exhibits. Bowen creates a request for proposals for exhibit design.
11.09.15
Bowen and Xibitz add Lord Cultural (Toronto) to the design team.
06.01.17
Phase I opens with Ice Cave, glacier exhibits, 36m-long interactive video wall projection.
06.01.18
Phase II opens with various exhibits for volcanos, sea life forms, land life forms.
12.01.18
Planetarium opens with signature show production Lost in Time: Wonders of Iceland produced by Bowen Productions.

The people of the museum
- Gunnar Gunnarsson, CEO
- Óskar Rúnar Harðarson, cofounder and financier. The person who came up with the idea.
- Agnes Gunnarsdóttir, the first CEO and very influential in getting the project through Phase 1.
- Margrét Th. Jónsdóttir, Perlan managing director

The people who put it all together:
- Jeff Bowen, Bowen Technovation, Indianapolis, Indiana; project manager for 3 phases of extensive exhibits and planetarium. Selected and assembled team for exhibit design, fabrication, installation and programming; director and producer of the 8K planetarium show; system designer for the exhibits and planetarium designer.
- Phil Groce, script author, researcher for planetarium show and some exhibits
- Robin Sipp, Mirage 3D, developed rig and methods for shooting first native 8K live action for our dome
- Dale Lewis, Astro-Tec, provided new Ulteria 15m dome
- Matt Mascheri, Dome3D, all dome animations
- Ben Metzger, Xibitz, exhibit fabricator and installation company, prime contractor for all the exhibits

And the people to be thanked
- Ragnar Th. Sigurðsson, most famous photographer in Iceland; served as location guide. Used his incredible work in the pans and all skies.
- Ragnhildur Gisladottir, music composer and singer for 7.1 soundtrack.
Looking back from the year 2019: 
Fiftieth anniversary memories of Apollo 11

In 1963 I was very unhappy with my job. I was working for a well-known computer manufacturer, and had been told I would work in Manhattan, enabling me to continue my grad school career. But on my sixth day on a job that I economically needed I was told I would be in Poughkeepsie, New York, too far for my classes. I let everyone know how unhappy I was, and a friend passed my name along to Jerry Cook, an engineer at Grumman Aircraft who was recruiting people to work on a contract that they had recently received to build the Lunar Excursion Module, intended as the spacecraft to carry the first people to the moon.

Cook phoned me, and asked if it was correct that I had an educational background in astronomy. I explained it was the graduate program I hoped to complete, and my undergraduate degree was in astronomy and German. His next question asked if I would be interested in working on the Apollo Project. I considered the idea for perhaps as long as a nanosecond and replied, “I can afford an arm and both legs to work on it.” He laughed and said “I guess you're interested.”

Landing that dream job
After an interview in Bethpage, Grumman's headquarters, I was called back for a session with their security office. I filled out a form of four 8x14 pages, two columns each page, listing organizations they wanted to know if I or any family member was now or had been in the past a member.

The bottom of the last page asked the same for any organization not listed that preached or advocated the violent overthrow of “the government,” with threats of civil and criminal penalties for lies or omissions. I dutifully wrote in that I had relatives who had indeed acted to violently overthrow the government, including firing on the King's troops in April 1775 as they marched towards Bunker Hill.

This disturbed the head of security, who asked me to delete it “because it would cause trouble.” I asked if it would cause him trouble. He said no, and added, “It's on your head, dammit, go ahead.”

I got the job despite my subversive great grandfathers and was assigned to a group called “LEM Dynamics,” later changed to “LM Dynamics” when NASA decided “Excursion” sounded too frivolous. The Dynamics group included about 40 men (this was 1963, after all) and three secretaries, one of whom claimed to have worked as a Playboy Bunny. I was the only one with an astronomy background. The rest included a couple of draftsmen, computer programmers, a mathematician, and a variety of engineers. The boss, Ross Fleissig, had been a long-time member and sometimes officer in the American Rocket Society.

Two early incidents stick on my mind. One fellow had plotted on ordinary graph paper the altitude of the initial planned Earth orbit of the Apollo spacecraft and was surprised it was not a flat line. I explained about elliptical orbits and how they transfer onto graph paper.

The second incident had a number of engineers come complaining to me as the only local representative of the astronomical community that the moon's distance was not known to an accuracy of better than one mile. My response was that if the spacecraft was going 240,000 miles, having one mile make a difference meant their tolerances were too tight.

Secrets, finally revealed
What about those secrets the security office had so diligently protected? The Saturn 5 launch rocket had quite a few secrets, but it was being designed and built in California by North American Rockwell, and I never got near it or its secrets.

Two secrets I did get close to were the planned date for the first manned landing and communications frequencies. The original date of May 1967 was lost due to the Apollo 1 fire. The radio frequencies NASA would use for communications with the astronauts were secret because if published, it was feared every person on Earth with a ham

(Continues on page 92)
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More than 4.5 billion years ago, a wandering nascent Jupiter moved through the debris left over from a star's birth and basically wreaked havoc. Before being pulled back to the outer reaches of the new neighborhood, the planet disrupted the orbits of the still-developing inner planets.

Millions of years later, two of those young inner planets would collide, a seemingly mundane event that had monumental consequences for both planetesimals and the life that would one day evolve on the larger of the two.

Birth of Planet Earth, the latest show from Spitz Creative Media and the fourth collaboration between Spitz, the National Center for Supercomputing Applications (NCSA), and Thomas Lucas Productions, travels through more than one hundred million years of our planet's history to explore the origins of life on Earth.

Again drawing upon big data, research from two investigators at the Southwest Research Institute became supercomputer visualizations to give a better understanding of why, in our search of the universe for exoplanets we have yet to find one that shares the same size, tilt, orbit, and distance from its sun as the Earth—necessary attributes that all contributed to the evolution of life on our planet.

The “grand track”

Using hydrodynamic simulations, which the NCSA's Advanced Visualization Laboratory (AVL) visualized for the film, Dr. Kevin Walsh of the Southwest Research Institute and his collaborators showed that through a concept known as the “grand tack” (named after the sailing term for the action a boat takes as it turns its bow into the wind), Jupiter moved toward the inner solar system, disrupting the orbits of the developing inner planets. It eventually returned to the outer solar system, drawn by the gravity of another developing giant, Saturn.

During the grand tack, Jupiter's gravitational pull caused a number of the inner planets to be ejected from the solar system, while others collided and broke apart. These effects reduced the mass of the inner solar system, ensuring that smaller planets would survive and dominate.

The collision with Theia

Millions of years later, two surviving planets would cross paths—the young Earth and a neighboring proto-planet known as Theia. As the smaller Theia slammed into the Earth, it exploded into an atmosphere of vaporized rock hotter than the surface of the sun. What debris did not fall back to earth orbited the planet for as long as a century, gradually accumulating into the moon. Theia's remains mixed with Earth and became part of the Earth-Moon system.
Dr. Donna Cox of the AVL shares: “Dr. Robin Canup of the Southwest Research Institute computed the astrophysics for this crucial moment in the formation of the Earth-moon system. Her numerical model generates numbers that describe the physical dynamism of the collision that formed the moon. The AVL transformed Dr. Canup’s numerical data into a dynamic, stunning visualization of this seminal event.”

According to Dr. Canup, the formulation of oxygen molecules found in moon rocks brought back by the Apollo missions is identical to that found in rocks on Earth. This correlation does not exist with meteorites that have impacted Earth, granting credence to the concept that the moon and Earth have a shared genesis.

The collision also tilted Earth on its axis at 23.4 degrees, which is responsible for our modern seasonal changes as the Earth revolves around the sun.

Visualizing the scientific data

Located at the University of Illinois at Urbana-Champaign, the AVL, under Cox’s direction, is known for taking computational data and redefining it into high-resolution, cinematic-quality visuals for public consumption. As Lucas describes it, “The visualization of science through supercomputing resources provides a level of detail and dynamism that’s ideally suited for full-dome presentation.”

According to Cox: “One of the reasons that Birth of Planet Earth is unique is because of the production-quality data visualizations developed by the Advanced Visualization Lab at the National Center for Supercomputing Applications. Our AVL team worked iteratively with teams of scientific researchers to transform billions of numbers from computational data into stunning visual scenes for the Birth of Planet Earth.”

As a filmmaker, Lucas said he always looks for the core idea on which to base the story. In the case Birth of Planet Earth, he found that core in an AVL visualization that he had heard about for years, a flight through primitive bacteria. Once he saw the animation in person, he began to understand its meaning: “The animation of the primitive bacteria shows an energy path of a photon hitting a cell, converting into another form of energy. It was photosynthesis in its most primitive form. Photosynthesis produced oxygen, and oxygen changed the composition of our planet. Life is what turned this planet from a rocky, toxic outpost to Earth as we know it now.”

(Continues on page 71)
A shopping district in the heart of Tokyo seems like an odd place to find a state-of-the-art planetarium, but it is the perfect home for a fusion of stars and entertainment, a blend of education and cutting-edge technology. Welcome to KONICA MINOLTA PLANETARIA TOKYO, a planetarium theater complex that pushes the envelope of the universe to encompass all tastes.

Opened in Yurakucho, the center of Tokyo, in December 2018, the planetarium uses space that was once a movie theater on the ninth floor of Yurakucho Mullion, the iconic building near Yurakucho Station that is filled with shops, entertainment, and offices. For pop culture fans, the building also was “demolished” by Godzilla in the 1985 movie The Return of Godzilla.

It is the third theater managed by Konica Minolta Planetarium, the only planetarium manufacturer that operates directly managed theaters.

The planetarium has two dome theaters, a virtual reality attraction, a café, and a gallery shop.

By Sakura Okoshi and Hiroyuki Kamano
Konica Minolta Planetarium Co., Ltd.
Tokyo, Japan
sakura.okoshi@konicaminolta.com

The stars come out to play in Yurakucho

A montage of the sights and experiences at the KONICA MINOLTA PLANETARIA TOKYO. All images courtesy Konica Minolta Planetarium.
New challenges offered in DOME 1

For Dome 1, we challenge ourselves to develop new kinds of planetarium performances, such as a new style of show programming that combines a musical starry night talk, live music and a bar-style planetarium.

As the opening work of DOME 1, “Dream, Wish Upon A Star” is now on stage. Projected images and the performance by the young actor are synchronized in the program. The actor provides a commentary on the starry sky while performing along with many songs. The actor conveys the story with acting and dance performances, commentary on the constellations and the universe is seen in each season.

This program offers visitors a new and unconventional dome experience compared to typical planetarium shows. Actors take turns starring in each show with their interpretation of the starry skies, as well as stories and live performances, as the story proceeds with the actor’s “Dream” telling. The story progresses according to the season, and it is a show which is definitely enjoyed by people who like to see a musical. Since the actor changes the show each time, a completely new type of program can be enjoyed every time you see it.

Eat and drink inside planetarium!

“Please do not refrain from eating and drinking. Please enjoy eating and drinking.” We allow the audience to eat and drink in the DOME1 theater. Until now, there have been many customer requests for dome space that allows eating and drinking. DOME 1 has been considered and planned as the theater where eating and drinking is permitted, a feature since the design phase. In a general planetarium theater, eating and drinking is quite difficult because it usually always involves a risk of spilling.

In DOME 1, there are movable seats and the covers of the seats are vinyl leather. Even if someone spills food and the covers become dirty, these materials make cleaning the mess very easy. Likewise, floor surface does not use a general carpet, instead, using the flooring material for sports facilities which were introduced recently at gymnasiums. Besides the merit that it is strong against dirt, it is also suitable for content for which you enjoy standing, due to its elastic nature. For these reasons, it is an environment that is perfectly suited for multipurpose dome space.

There are cafe and shop next to the dome, both with the concept of Outer Space. “Cafe Planetaria” provides photogenic food and drinks including alcohol with the concept of “Taste the Space” aligned with the planetarium’s atmosphere.

An interview with Chief Theater Manager Yusuke Kawanago

Q: Which programming is popular?

In addition to the two planetarium theaters, there is a variety of content, such as a virtual reality attraction, a cafe, and a shop. It is a place where you can enjoy not just one program, but several. The experience is so enjoyable that guests may not even realize they’ve spent so much time here. In addition to a variety of planetarium shows, we also offer a bar-style planetarium on Friday night and live music on weekends. Our hope is that customers who have never visited a planetarium before will come and enjoy this unique experience again and again.

Q: Which programming is popular?

The opening shows of DOME2 are in collaboration with Japanese popular artists Dreams Come True and the famous musician well-known for the Ghibli movies, Joe Hisaishi, are very popular. And many customers who have never experienced VR will enjoy VirtuaLink for the first time, since it is within the planetarium facility. In addition, a doughnut in the motif of the galaxy is popular at the cafe and a necklace is attracting attention at the shop.

(Continues on page 51)
Imagine life in a world where there are

Media dystopia in 360°:
A prize-winning short film

Jasmin Meziou
Student Assistant
Mediendom-Center for Culture and Science Communication
University of Applied Sciences
Kiel, Germany

The project started in early 2018 as a class given by Eduard Thomas, the director of the Mediendom, Kiel’s planetarium, which is also part of the University of Applied Sciences in Kiel.

The twelve students participating in Thomas’ class called “How real is the future?” discussed many topics concerning our digital future and were asked to develop a concept for an immersive short film or application in fulldome or VR about this topic.

Dealing with questions about their future, the students came across the things that seem to affect their lives the most: the use of smartphones (or other smart devices in their home) and, of course, social media.

“I would never leave the house without my phone. However, smart speakers or home assistants like Alexa really scare me. I don’t want to be monitored but I know I couldn’t be part of society without using my phone constantly,” said Mira Haack, one of the four students who developed the concept of HoloSense—All Eyes On You, which was ultimately chosen for production. The project was a cooperation with the art foundation of HSH (Hamburg Commercial Bank) Nordbank, which sponsored the production of the film in fulldome and VR.

About the film
Data protection: the topic that seems to become more and more present in our world as time passes. However, most will coldly wave aside its importance by saying they have nothing to hide, thinking that nothing they share online could ever be harmful to them.

Whether it’s posting family pictures on Facebook, using Google Maps as a navigation system or wearing a fitness-tracker to measure your heart rate, using the internet has become almost natural to us. Sharing data may bring benefits, and it also has often become necessary for us to do everyday tasks and engage with other people in today’s society as a result, but what are the risks of it?

In order to give a glimpse of what could happen in just a couple of decades if we continue to gladly share our personal information online, we developed the concept for the short film HoloSense, where secrets are a thing of the past.

In the production, humans wear smart contact lenses that augment their reality at all times and allow the government to monitor the population’s every move. The short film shows a day of Sam Cooper’s life in this dystopian future, when everyone knows everything about each other simply by looking at one another.

The HoloSense-lenses allow the person to view a kind of “public Facebook” interface that automatically shows up when looking at someone. It reveals information about personal interests, recent activities, health status, their bank account, and much more.

After learning about the advantages of the smart lenses in everyday life, we quickly realize that the dark side of this system is bigger than we think and that an obligatory public “Facebook” could cause more harm than good.

An impressive first-person experience

The concept of HoloSense was chosen for production because it was considered the most up-to-date topic and would give an

Stills from HoloSense—All Eyes on You. Above: Film poster, designed by Michel Magens.
The students of Holosense. Group photo by Sven Wied

interesting and emotional insight about our possible digital future. We thought that it would be interesting to have the viewer literally see through the eyes of the protagonist to provide the feeling of really being inside this world where it’s impossible to be anonymous or to keep secrets from anyone. That’s why the film is produced in the first person perspective and is therefore well suited for the dome—viewers can look around and discover new perspectives if they decide to watch the film again.

In addition to the dome version, we also wanted it to be available in virtual reality, which offers an even more immersive experience because the viewer can also see the “bottom part” of the 360° film when looking down and can really experience it first-hand.

This way, the topic of data protection finally becomes more real to us. The immersive fulldome experience opens up a new view on the topic by taking the viewer on a short trip to the possible future and showing that the world of Holosense might be a lot closer than we want to realize.

However, the film doesn’t berate or sternly give advice on what to do—it simply wants to raise awareness about the value of our privacy and that it’s not yet too late to change our mindset about it.

Holosense–All Eyes On You premiered in September of 2018 in the Mediendom in Kiel and has since been shown at last year’s Digi-star User’s Group conference in Salt Lake City and received an “Excellence Award” at the IFSV Dome Fest 2019 in Tokyo.

Credit goes to the entire class, which also includes Karim Aloulou, Cora Braun, Mats Rasmus Claessen, Mira Haack, Antonia Hauschild, Marie Sophie Kristen, Nico Kuhn, Alexandra Metz, Sebastian Scholz, Phillip Black, and Sophie Marie Yasmin Schweitzer, under the direction of Prof. Isabella Beyer and Eduard Thomas. The film was produced by Northdocks.

The film is available for free for fulldome and virtual reality. For more information, please visit www.alleyesonyou.de or, if you’re interested in receiving the latest version of the film for your planetarium, contact jasmin.meziou@mediendom.fh-kiel.de.
Dome media has changed a lot in the 21st century. Planetarians of a certain era were trained to create slides as the main way to “paint” the dome. Occasionally we’d get to run a 16-mm movie as part of a presentation. Of course, many of us were familiar with video production, but it was initially of limited use in the dome.

When video projectors became available, they took the place of the film projector, but we could still only paint part of the dome with footage, usually in the “sweet spot” front and center on the dome. For example, in 1997 I co-produced (with Mark C. Petersen) a show called SkyQuest that featured footage shot “on location.” It tells the story of a young woman growing up dreaming of being a space explorer. Later on, we see her as an adult woman operating her observatory.

The client, the Einstein Planetarium at the Smithsonian National Air and Space Museum, had a new video projector and wanted to make use of it, projecting onto the “sweet spot.” The rest of the show was not video, but more typical of a slide show at the time, with all skies and panoramas. This was produced a few years before the first fulldome video showed up on the scene.

Today, immersive video for the dome is ubiquitous. Live-action fulldome shooting continues to intrigue producers who want to harness its power to tell stories on the dome. The first such film done entirely in live-action was R+J, produced in 2004 by LivinGlobe. This interpretation of “Romeo and Juliet” for the dome was shot in the Canary Islands using a troupe of Shakespearean performers. Today, actors are becoming more commonplace in domed shows.

With the advent of such films, a whole new cinematic language is arising that takes the special properties of the dome into account. (Note that I’m referring here to works created specifically for the dome, not giant-screen transfers, which began life as non-dome content.)

**Live-action at the Summit**

At the recent IMERSA Summit, we heard from several producers who incorporated live-action into their recent fulldome works, including Robin Sip of Mirage3D. He is probably one of the most prolific of those working with live action these days. His last few films have used actors in front of green screens, and for his most recent production, Mars 1001, Robin used specially-built sets in his green screen studio and cast actors in the key roles rather than create animated characters.

“I think we are doing the audience a favor with presenting real actors instead of photorealistic CG (computer graphics) representations of actors, which we tried doing in the early days of fulldome,” he said. “The actors’ facial expressions add so much to how the audience feels and relates to what is happening. When we place the actors in a set, for them there is no difference to a normal flat screen film set except for the fact that we have to film in multiple directions, and actions of the actors in the same scene are often recorded at different times and then combined together into one scene.”

For the production, they had to get very creative to simulate conditions on a Mars-bound ship. “In one set, the Mars Transfer Vehicle, we suspended actors from the ceiling to simulate Mars gravity on board. So, we left the ceiling out which was later added in CG,” said Robin. “The fact that the sets were not partial sets but complete 360° sets really helped the actors. They loved it when they saw the sets for the first time. It immediately generated a great vibe among them as they took many selfies. This atmosphere lasted the entire three long days of shooting with them.”

More recently, Robin and his team faced major challenges doing immersive shots for the show Lost in Time produced by Bowen Technovation for the Perlan Planetarium in Reykjavik, Iceland. (See the article on page 32 for more information about this new installation.)

“First of all we never tried out the technique of shooting around the nodal point of the camera outside before,” he said. “We took a risk in Iceland as the end customer had demanded the absolute highest resolution possible. So, we decided to work with a 360° canvas of 16K x 8K, just as we had developed for Mars 1001. That technique worked fine inside our own studio where conditions during the shoot never changed, but outside the conditions change during a 30-minute shoot in all directions. Luckily, Iceland was kind to us during the shoot, although it demanded a lot of post work and we had to mask little problems, like birds flying in and out of the field of view.”
During the IMERSA Summit, Robin shared the difficulty of doing aerial shoots in Iceland. “These were a major challenge. Shooting with a fisheye was the better option for the moving camera shots,” he said. The team grappled with trying to find a way to shoot from a drone or a helicopter and ultimately hired a heavy lift drone operator for short sections of flight. For the helicopter shoot at a much more remote location, Robin purchased a helicopter nose mount, and made a deal with a local helicopter pilot that if he would mount it on his helicopter he could keep it. “We then proceeded to put a gimbal which was not meant for aerial shots but could handle speeds up to 75 mph on the nose mount, and put our camera on that.”

The team flew to the Vatnajokull glacier, landed beside it and then mounted the camera, only to find out that shaking was still a problem. On the next trip, they made adjustments and got better results.

Full dome exoplanet exploration

For the fulldome show EXO, astronomer Sébastien Gauthier of the Rio Tinto Alcan Planetarium in Montréal and his crew shot scenes in various places to give a sense of what life on Earth is like and what life might be like elsewhere. EXO is a 30-minute show with some 20 minutes of live action and 10 minutes of CG material. The crew traveled the world to get their scenes, from locales across Canada to the U.S. and Ethiopia. They also engaged a separate crew to do specific shots in Japan and the U.S.

Sébastien described the challenges they met, including the need to rig up new equipment and try new ways of shooting. “I use a constellation of equipment depending on the requirements of the shot,” he said. “Some equipment is for time lapses, other is for ‘close ups’ at 180° of field of view. In my vision of fulldome filming, it is important to vary the field of view to play with the shot value, in other words, not only locate the camera to tell the story but also adjust the framing by selecting the right field of view for the shot. Most of the time I will film in 213° of field of view (360° x 213°) and I can go up to 235° of field of view. So, from this point of view, 180° is almost a close up!”

Looking in on works in progress

At least two productions “in progress” are making significant use of live-action shooting for the dome. One is a show about the Event Horizon Telescope, the globe-spanning array of radio telescopes whose data were used to create the first image of a black hole. For that project, which is being produced by Robin Sip, the crew has spent time in the Atacama Desert in Chile at the ALMA array. They have been working at very high altitudes, which, as Robin pointed out, was “filming in 8K fulldome in the Atacama Desert, a remarkable place, going from very hot to freezing.”

The idea behind all this live-action shooting is to take audiences to places they’ve never gone before—which is, of course, what planetarium theaters have done for decades. But, in this era of immersive video, live-action filming allows the producers to make scenes much more “real” and in the moment.

IMERSA Board member Ryan Wyatt is the senior director of Morrison Planetarium at the California Academy of Sciences in San Francisco, and his team is heavily involved in a live-action shoot of their own. This one also involves filming at ALMA as well as at other observatories and in Santiago. The Academy team, too, is facing high-altitude challenges as they use their expertise to set the scene for their new NSF-funded show, called Big Astronomy.

I asked Ryan and his team to describe their experience, and why they are going to such lengths to shoot “on location” for fulldome. For them, it’s still a new way of doing shows.

Director of photography Ken Ackerman described it as a process of discovery. “Sending a film crew to Chile is an expensive proposition, so we began with a scouting trip to the locations we knew we wanted to include in the show,” he said. “Our show is about astronomy in Chile. The live action footage focuses on the large telescope operations, and the people who work on those telescopes,” he said.

From that preliminary work, the team began to build the story and planned return trips to shoot the actual immersive footage for the show. The team is working on a mix of live shots as well as “action” shots. “In the end, we have a mix of scenic shots, action shots of either the telescopes moving or opening, and people at work,” said Ken. “When we started working on this project, we thought about all the fulldome video footage we have seen in the past and noticed that much of it is static shots on a tripod. When we create a CG fulldome show, since we are building the environments, we are free to fly the camera through that scene however we choose and indeed that is one of the important techniques that we rely on to give our shows an immersive and exciting feel to them.”

(For more on how the Academy team has historically designed their shows, see Ryan’s article on page 24 of this issue.)

Because of the immersive nature of the dome, the live-action shots aren’t always “action” in the normal sense of the word. For this new show, the producers have had to change their way of thinking about such scenes. “Compared to flat screen video, we capture longer shots,” Ryan. “This is in support of fewer, more languorous, and more cautious edits in our shows.”

The result should be a natural way of seeing a scene for the audience, a sense of “being there” that cannot be achieved with less-immersive videos. “Composition is always tricky when shooting for fulldome,” said Ken. “Since we don’t have the luxury of a frame, nor the ability to zoom—it takes some creativity. The different ways of moving the camera help keep the shots feeling dynamic, but are most effective when you have good parallax. So you want to have some foreground object, some midground structure, and some distant structure, for the best effect. This often means that we would set up the camera underneath over-hanging structures, or close to mechanical equipment so that we would get a lot of nice parallax through the shot. One other thing that I’ve noticed is that the pure ‘location’ or ‘scenic’ shots are somewhat interesting, but I find them far more interesting when there are people in the shot.”

As it has been for Robin Sip’s shoots in Iceland and Chile, weather presented a challenge for the San Francisco team. “We have been planning for many night-sky time-lapses of the stars, and then when we are on-location in one of the driest places on the planet the sky is full of clouds,” said Ken. “Overcast skies can just ruin what would be an otherwise beautiful shot. They make everything feel flat and low-contrast.”

Timing is always a battle, too. The team planned many “magic hour” shots at observatories, a time when all the conditions line up just right.

(Continues on next page)
and the view is breathtaking. It turns out the magic is fleeting. “That gives you a very small window of time for optimal lighting conditions, sometimes as little as 15 minutes,” Ackerman pointed out. “There were times when we would get all the equipment set up in one location, and then look behind us and see that the lighting was spectacular nearby, and then we would hustle to change our whole configuration, only to then lose that light. It’s kind of ridiculous and hilarious and fun but upsetting all at the same time.”

In addition, the team wanted to shoot a scene with a group of school children. According to Mike Schmitt, the Academy’s visual effects supervisor and camera operator/technical director for the show, the scene was at least as complex as any of the others they did.

“In Santiago we had only one scene to shoot, which took place at the Planetario de Santiago. There, we shot video of more than 200 school kids entering the planetarium building from their school buses, and a scene of the large group sitting in the planetarium asking astronomy related questions during a Q&A led by the show’s narrator, Prof. Bárbara Rojas Ayala,” he said. “Our process involved a lot of planning but also a great deal of improvisation. When possible, we would scout the location first, decide which scenes to shoot, choose what rig and camera setups to use and then rehearse each shot. The planetarium shoot gave us this luxury, because we were able to visit the location multiple times and practice with our equipment before the day of the shoot. This was really important since we had to be ready when the kids showed up!”

There are no on-camera interviews in the show itself. However, the team did capture flat screen video interviews for the show. “The people we filmed in fulldome never spoke to the camera,” said Mike. “Instead, we chose what ‘action’ to film based on their previous on-camera interviews done last October. Ultimately, the voiceover from those interviews will play over the fulldome scenes we shot at ALMA, with Celia and Alfredo describing what they do while watching scenes of them doing it.”

**Equipment Is key**

Just as the language of fulldome requires careful thought, shooting an immersive experience for the planetarium requires equipment equal to the task. For EXO, Sebastian Gauthier and his team used a wide array of cameras and lenses for task-specific shots. They included a rig of five DSLR Nikon D7100 with 10.5mm lenses providing up to 360° x 220° for time lapses, Nikon D810 and D850 with Sigma 8mm and Nikon 8-15mm for 180° time lapses, a RED 8K Helium with Entaniya Lens MFT 250 3.0mm and 3.6mm for Live 30fps up to 235° of FOV, a Panasonic GHS in 6K mode with Entaniya Lens MFT 250 3.0mm and 3.6mm for Live 30fps up to 235° of FOV, a no parallax custom rig with a Panasonic GHS and Olympus 8mm lens for stitched live action up to 220° of FOV for sharp and high resolution footage, a Sony a7S II and a7R II, Zeiss Axio microscope, Zeiss stereo macroscope Discovery, and Nikon Eclipse E200 for microscopic shots of plankton, and a GH5 on a 1.6m telescope to capture a live shot of the star Vega.

For his work on the current Event Horizon show, and on some previous projects, Robin Sip prefers to use the RED Weapon Helium camera, with different lenses depending on the shot. “We use a motion-controlled camera rig which can repeat its movements precisely,” he said. “The technical difficulty is that there is no camera yet that can capture an 8K dome master frame in one go. That would require a camera with a vertical sensor resolution of 8K, that does not exist. But we still wanted to achieve that.”

The San Francisco team has been using a Sony Venice 6K Full Frame camera with an 8mm Canon Fisheye lens attached via a MetaBones adapter. “On our most recent shoot, we have taken this a step further using a newly released Extender for the Sony Venice that basically allows you to detach the lens and camera sensor from the bulk of the camera body,” Ken said. “Shooting for fulldome is always challenging because of the huge field of view, which makes it hard to keep equipment and lights out of the frame. It also makes shooting outside challenging because often the sky can just wash-out the entire dome. The Sony Venice has been great because we can shoot in the Sony RAW format which gives us a very large gamut of image data, so we can make lots of adjustments in post.”

The Venice camera was outfitted with the Canon 8-15mm lens as were the other Sony cameras the team used. They deployed three Sony a7R III cameras to shoot simultaneous scenes, mostly of the night sky at ALMA. They also used a motion control system on rails and a non-Bluetooth single axis motion control head to use at the ALMA high site where Bluetooth and Wi-Fi are not allowed.

Ultimately the show will be a mix of live-action shots at ALMA, Gemini Observatory, Cerro Tololo International Observatory, and even the Planetario de Santiago—as well as CG geography and astronomy shots. The end result will give audiences a “first-hand” feel for the locations the team visited, the people they met, and the astronomical research happening in Chile.

Far from being an exotic way to bring locales and people to the dome, today live-action is becoming an accepted technique in fulldome shows. As more producers embrace it, audiences will be exposed to new ways of looking at everything from our own planet to the wider universe.

**IMERSA and IPS**

For the first time in a decade, IMERSA will be meeting again at an IPS conference. For those planning to attend the conference in Edmonton, there’ll be an IMERSA Day on July 18, 2020, just after the fulldome festival and the day before the conference starts in earnest. IMERSA board is planning a slate of activities, including keynote speakers and panels. The joint meeting marks the first time the two organizations have
Q: What is the vision for the facility?
We truly value hospitality and focus on it as much as possible, so that customers will want to spend their precious time here. Throughout the facility we have designed completely original experiences, including various touch points that will remind each visitor of their own unique experience and create memories that will last a lifetime.

For example, we have an interactive feature in the lobby. It is the realization of the idea that you can make a wish when a shooting star actually shoots across the sky. You simply fill in your wish with a smartphone app. When a meteor is observed by the Meteor Broadcaster, you will see your wish projected on the wall screen.

Q: How many visitors have you had so far?
The opening was a great success during the holiday season. 100,000+ customers have visited in the first 3 months. We have 3,000 customers a day on the weekend. We would also like to further explore how to attract more customers on weekdays.

Q: What are the age ranges of visitors?
We see a wide range of visitors, from age 10 up to people in their 60s. We are seeing more couples than family groups here, compared with our other two direct management theaters, Manten and Tenku, where we have more family group visitors. It is a feature of this area in Yurakucho. We see a lot of young couples, but also welcome many couples in their 50s and 60s.

Q: How about overseas visitors?
At the moment, the show programs in DOME2 and VirtualLink are multilingual. Currently, foreign visitors comprise only a small attendance percentage, but we would enjoy having more overseas customers in the future.

Q: How do you want to grow this facility?
We would like for our PLANETARIA TOKYO to be a place where customers will return time after time. We would like to continue to expand into a wide range of new offerings in the pursuit of the new value of the planetarium.

You can find out more about the planetarium at https://planetarium.konicaminolta.jp/planetariatokyo/foreigner/.

(PLANETARIA TOKYO, continued from page 43)
This spring I attended a workshop on technology integration. It was very interesting to see how they “integrated” the best ideas from different educational partnerships to present a much more unified collection of ideas. This synthesis of best practices is also basic enough to be applied to technology integration in grades K-12 and in a variety of content areas. An idea that was presented in the opening slides was “you have to pre-teach technology in your classes so you can later have expectations of high rigor and depth of knowledge from the students.”

The presenters took the 4 C’s from the Partnership for 21st Century Skills1 and combined them with digital citizenship ideas from the International Society of Technology in Education” (ISTE 2007 & 2016)2 and CommonSense Media.3

The result is:
- Communication
- Creativity
- Critical Thinking
- Collaboration
- Digital Citizenship

**Communication**

In many ways, this is the lynchpin skill for the others. It is the one that takes an assignment from being a “show me” to a “tell me.” For example, a student can show a picture of the moon and make a caption for where the Apollo missions landed, or they can tell me about the Apollo mission landing sites by annotating an image of the moon with landing locations and labels.

Key things to look for in adding the C of communication to the technology lessons you are doing include multimedia presentations, digital storytelling, infographics, and simulations.

**Creativity**

This best practice is the one that nurtures the student’s originality, and can be channelled back to a reflective question for the teacher. Are you providing the student the opportunity to choose? If all the students are doing the same type of assignment and they didn’t get to choose the method of representation, then your assignment is only providing the most basic integration of technology. The basic level is good for learning the equipment or technique, but when you are looking for depth of knowledge it is better to allow the students to make their own path.

**Critical Thinking**

This skill set is one that I would teach in parallel with communication. Critical thinking isn’t just developing a plan and conducting research, but also how to manage projects/time, solving problems, using the appropriate tools, and making informed decisions using the best available resources. Here are some examples of ways you can integrate critical thinking into your lessons:
- In depth questioning and inquiry based learning
- Real world scenarios focused on problem based learning
- Identify strategies to meet goals
- Collect information, data, and graphics that best represent data
- Synthesize and analyze multiple sources of information to form conclusions, solve problems, or understand complex systems.

**Collaboration**

I have to remember not to break out in song to “Ice Ice Baby” when talking about this topic, even though “stop, collaborate and listen” is one of the best lines for introducing collaboration to students.

Technology and collaboration let students broaden perspectives, increase empathy, and promote teamwork. The key to this working is establishing a safe learning environment where students feel comfortable connecting with learners from a variety of backgrounds and cultures and examine issues from multiple viewpoints.

In my planetarium I taught a lesson where I had the students answer these questions to themselves before posting a comment: “Is it needed? Is it necessary? Is it true? Does it improve upon the silence?” The idea was, for example, if on a forum someone had already posted a comment, then before you added a comment that you ask yourself the questions and then decide if it was better to just “like” the comment than to post or add another version.

Our social studies teachers were very good at teaching the difference between first, second, and third person accounts of events and we used that to hone our answers to “Is it true?” Improving the silence was the only way I could add wait time to a student’s responses. I wanted them to think about their answers for a moment before commenting, because once it was online it was there for all to see.

**Digital Citizenship**

For this best practice, how does your lesson allow students to learn the skills to recognize the rights, responsibilities, and opportunities of an interconnected digital world? As experienced technology users, the students will need a little more structure to help them act in ways that are safe, legal, ethical, and self-aware while using technology. Are they actively cultivating a positive digital identity and reputation? I like to remind students of the permanence of their actions online by showing them the first email they ever sent. They also need to foster a culture of respect for intellectual property (both theirs and others).

As I said in the opening, I liked that these five best practices did a great job of covering the key tenets of technology integration. It also reminds us that using technology during instruction isn’t an instant fix, but a series of skills that have to be taught.

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1 www.battelleforkids.org/networks/p21/frameworks-resources
2 www.iste.org/learn/digital-citizenship
3 www.commonsense.org/education/digital-citizenship
4 The lyrics to this 1990 Vanilla Ice song include “All right stop/Collaborate and listen.” If you don’t remember the song, you might recall the furor over its liberal borrowing of the first chords of “Under Pressure” by Queen. This is definitely an example of poor digital citizenship. www.youtube.com/watch?v=rog8ou-ZepE
Apollo Anniversary Lesson

I’ve been getting ready for presentations this summer celebrating the Apollo 11 Anniversary with a school-friendly model of the trip from the Earth to the moon.

If you ask a student how far the moon is away from the Earth, you will get a wide variety of answers, some qualitative (“the full moon looks huge in the sky so it is close by”) and some quantitative (“it is really hard to get to the moon, it must be a million miles away”).

Looking at images available to the public, like this image of a flight path from the NASA archives, you can see the confusion. The Earth and moon are in scale to size with each other, but not to their orbital distance. It gives the impression that the moon is a lot closer than it actually is.

Most of the schools I’m visiting this summer have football fields that can temporarily be used to make the model. Using the goal posts as the anchor helps set the scale. For this model, the approximate 240,000-mile (384,400-km) distance from Earth to the moon is the field’s 360-ft span from goal post to goal post. On that scale, Earth is 12 ft (3.7 m) across and the moon is about 3.25 ft (1 m).

Because I use a portable planetarium, I didn’t want to also transport an inflatable ball that was 12 ft across, so I took a look at the goal posts for help in devising an alternative. The width of a standard high school goal post is 23 ft 4 in (approximately 7.1 m), and that got me thinking of banners.

Talking to a local print shop I found that a 15 ft vinyl banner with reinforced grommets in the top was pretty reasonably priced. When I met with the designer we had fun going through their collection of high resolution images that could be used to make our giant Earth. With the banner only being 4 ft wide we focused on the equatorial region of the Earth. With the scaled size of the moon, the entire 3.25 ft image fit on its banner. The designer also noted that we would want to change the spacing of the grommets so there wasn’t one located exactly in the center because some goal posts have a brace there that would make it difficult to attach to.

To make attaching and detaching easier I went with hook and loop straps. As an added bonus I had them add the ISS’s silhouette 3.6 inches off the widest part of the Earth on each side. The station is out of scale with the rest because it would be too small to be easily seen, so the silhouette is 0.375 inches tall. I felt making this part out of scale was acceptable because it was a silhouette and not an actual picture of the station.

Below is the data table I created to help when I met with the banner company.

<table>
<thead>
<tr>
<th>Object</th>
<th>Actual sizes (km)</th>
<th>Scaled size (ft)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Earth diameter</td>
<td>12,756</td>
<td>12</td>
</tr>
<tr>
<td>Moon diameter</td>
<td>3,476</td>
<td>3.25</td>
</tr>
<tr>
<td>Earth to moon distance</td>
<td>384,400</td>
<td>360</td>
</tr>
</tbody>
</table>

For the students to interact with the model, I drew some Apollo models on cardstock to put on tongue depressor handles to let anyone “travel” to the moon if they want to (running from goalpost to goalpost). This is also a good time for the rest of the group to talk some moon trivia and facts.

I intentionally avoided any labeling of the banners specifically for the 50th anniversary of the Apollo 11 landing so that I can use it next year for any of my groups learning about the moon.

My prototype banners were made on butcher paper, and if you cannot afford the vinyl banners this is an alternative. While the paper worked for a couple of hours, it was very susceptible to damage from the wind. If you choose to make banners out of paper, I would suggest laminating them.

Jack L. Northrup is an American Midwestern astronomy educator who loves the dark skies from living in a flyover state.

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PARTYcles

#038 - June '19

Alex Cherman

Uh... Are you OK, Mr. Electron?

Yeah... You don’t look particularly particular.

I feel sick, like I’m in a ship or something...

You definately look wavy...

What do you mean... WAVY?

You... uhm... look like a wave...

Holy DeBroglie!

I think I got a case of DUALITY!

Probably caught it from that photon you ran away with a while ago...
The Shadow Knows

Patty Seaton, our current IPS executive secretary and an active member of the IPS Education Committee, is known for her creative programs. Last summer in Toulouse she engaged participants at one of our Education Committee sessions in poetry writing. She has given papers on her very popular Harry Potter program, and she is continuously working to prepare activity-based planetarium programs that meet education standards.

Patty has done a great job of problem-solving in order to present her innovative program about shadows cast by the sun at different seasons. Here she describes how she was able to get lights for shadows in her presentation of “The Shadow Knows.” Normally this is one aspect of understanding seasons and the sun's path that we cannot present in the planetarium, but Patty found a way to do it. I hope that many planetariums can benefit from her work. - Jeanne Bishop

When you are working with 40-year-old equipment, you need to be innovative when it comes to teaching current science standards. For example, how do you meet the Next Generation Science Standards (NGSS) 5th grade Performance Expectation (PE) 5-ESS1-2: Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows? You can show a video. You can do some online representations. You can go outside and physically mark the changes in shadows during the day. However, what if you want to observe the changes over a year?

Who knows what innovation lurks in the hearts of planetarians? Challenge accepted: I decided we were actually going to create a shadow experience right in our planetarium. Fortunately, we have a lot of room behind our 55-foot (16.8 m) dome, and more than 25 years ago our planetarium director, Fred Stutz, had already marked out the paths of the sun for the equinoxes and the solstices, using a series of lights to sequentially mark the hours of daylight.

With Fred gone, I pondered how to create the effect I wanted. I am no electronics expert. While brainstorming with colleagues, a great suggestion was made: why not use remote controls that work with no electronics expert. While brainstorming with colleagues, a great suggestion was made: why not use remote controls that work with no electronics expert. While brainstorming with colleagues, a great suggestion was made: why not use remote controls that work with no electronics expert. While brainstorming with colleagues, a great suggestion was made: why not use remote controls that work with no electronics expert. While brainstorming with colleagues, a great suggestion was made: why not use remote controls that work with no electronics expert. While brainstorming with colleagues, a great suggestion was made: why not use remote controls that work with no electronics expert. While brainstorming with colleagues, a great suggestion was made: why not use remote controls that work with...
shadow. I hope to test the same activity using a small stage that will fit in the open area in the front of our theater to see if more students will be able to observe the shadows from their seats.

I created the diagram model along with the students using an overhead projector (hey, I still use slide projectors; don’t judge! If the technology works, use it!). Fig. 3 shows the results. (Note that students are provided with a list of abbreviations.)

Another challenge is that I’m not standing in the right position to get the precisely correct shadows. For this reason, we do not measure the angles or the length of the shadows; we just draw their positions relative to each other. By the time we have completed the activity, the students can verbally provide evidence using their models to support a claim that the shadows inform us of time of day and the time of year. Students even figure out my challenge: how do I tell the equinoxes apart? They eventually figure out that you have to know the direction of the shadow in the days and weeks before the equinox in order to determine if it is spring or autumn.

This program was well received in its pilot year of running. Each time I ran it, I could not help but be proud of the way we solved this puzzle of how to best demonstrate shadows in a planetarium setting. It would be a crime not to share it with the rest of the planetarium community.

Fig. 2: The mid-morning, noon, and mid-afternoon lights along one of the sun paths. While the picture shows all three on at the same time, we operate them one at a time during the lesson. The lights work beautifully to cast shadows that are fairly realistic. (Right) Fig. 3: The diagram model.
Dear fellow planetarians

Below you will find descriptions of many new exciting planetarium shows (wouldn’t you just love to see some of them?), news on upcoming conferences, and information on domes being built and refurbished across the planet. As for events, the 50th anniversary of the first steps on the moon naturally plays an important role worldwide.

For this section I’m indebted to contributions from Björn Voss, Aase R. Jacobsen, Loris Ramponi, Milène Windling, Alexis Delivorias, Andrew Kerr, Bart Benjamin, and John Hare.

Let’s start the tour around the world in Central Europe.

Society of German Speaking Planetaria
Baden-Württemberg. The experimenta science center and its Science Dome in the southern German city of Heilbronn, near Stuttgart, re-opened its doors on 31 March after extensive construction of a new building. Located on an island within the Neckar river in Heilbronn, the experimenta is now Germany’s largest science center with 25,000 square meters of attractions, including 275 interactive experiments, nine school labs, a “maker space,” and a rooftop observatory.

A core attraction is the Science Dome, a partially subterranean 21.5-meter dome with a 700 square meter tilted dome projection screen, a Universarium star projector, 8K 3D-capable dome projection, as well as generous lighting and laser show systems. A world first among dome theaters is an auditorium that can be rotated by 180 degrees, turning the entire audience of 150 persons away from the projection dome and towards a full-sized, fully equipped theater stage. This stage hosts several live science shows daily, as well as theater, music, cultural events, and entertainment in the evenings. It is equipped with a water curtain for front and rear projection, and features a large high voltage show installation.

The Science Dome is open daily, with a mix of fulldome, stage, and mixed formats across the STEM fields, tailored for different age and interest groups, in Germany’s 3rd most ethnically-diverse city. Its team of 20 is led by Kenan Bromann (area lead technology and Science Dome), astrophysicist Dr. Kai Noeske (department head Science Dome), and

GDP. Top left, the new experimenta science center in Heidelberg. At left, the Science Dome at experimenta rotates towards its dome screen (left), and towards its theatre stage (right). Images courtesy of experimenta Heilbronn.
Above: In this triptych, one of the new projectors in its mount is being lifted into position. Cutouts had been made into the existing projection gallery to accommodate the new projectors. In the center, first light with the new projectors, before the installation of masks and before digital blending. At right, during the opening ceremony, the first publicly shown image by the new projection system was a short excerpt of the show *The Planets*, followed by the German premiere of *EXO: Are We Alone?*. Photos courtesy of LWL/Voss/Steinweg.
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.

North Rhine-Westphalia. The Münster Planetarium has re-opened with a new True8k projection system. On 12 April, the planetarium in the western German city of Münster re-opened after a 5-week installation of a new fulldome projection system. The new system employs a setup of 10 Sony laser phosphor 4k projectors, delivering an image with a resolution of more than 8k pixels, at high brightness and high contrast.

In Münster, this setup was indeed chosen mainly for its high brightness, contrast and intensity of color. Due to limitations of the building, the projectors could not be positioned as they normally would in order to project directly onto the dome. Instead, they had to be installed looking straight up with each projecting via a mirror. This unusual setup, however, did not cause any noticeable degradation of the image.

The first presentation with the new projection system was also at the same time the premiere of the new German version of planetarium Montréal’s show EXO: Are We Alone?

Berlin. On 28 March, the show Birth of Planet Earth, created by Spitz Creative Media, had its world premiere at Planetarium Berlin. After a welcome address by planetarium director Tim Florian Horn, an introductory lecture was given by geologist Dr. Oliver Bens from Geoforschungszentrum Potsdam. Then, the audience was immersed in the impressive imagery showing the formation of our home planet.

Afterwards, Brad Thompson from Spitz Creative Media and Kalina Borkiewicz from the NCSA Advanced Visualization Lab gave exciting insight into the production process of the program. (See more about Birth of Planet Earth on page 40.)

Nordic Planetarium Association

The Steno Museum in Aarhus, Denmark has had a rare visit from space: a Soyuz capsule that was the one that took the Danish astronaut Andreas Mogensen up to ISS in 2015. The capsule has been on display from November 2018 until May 2019, and is now back at the Technical Museum in Elsinore.

Several thousand people saw it during its stay in Aarhus, and many also attended the weekend talks about life on ISS and other special events in association with the exhibit. In addition, Andreas Mogensen came by and was reunited with his capsule for a day, and he gave a very inspiring talk about his trip to ISS. Young people were invited to ask him questions and meet him.

The capsule was a very nice supplement to the astronomy education programs in the planetarium and the museum has experienced a big interest by both school classes, young people, and the general public.

The Next NPA meeting will be in Sandness, Norway in September and everyone is invited. Registrations are now open so please, visit the conference website: www.jaermuseet.no/npaconference.

Italian Association of Planetaria

Nicola Bonomo is the winner of the Planit prize 2019 with a tribute to the 50th anniversary of Apollo 11. Moon 2019 is the title of the video, produced by 3D in collaboration with Mark Rutherford School, which was presented during the national meeting of Italian planetariums in April in Cagliari.

The video shows a significant improvement compared to the productions that have participated in this competition to date. The contents and the narrative structure are well balanced, and the soundtrack enriches the video of an effective emotional component, which is functional to the involvement of the public. The Saturn V launch scene is particularly sophisticated. The prize for the winner is 500 €. The next competition will be held in 2020.
On the day of the event, more than five hundred visitors enjoyed the Bureau for Information Technology of the City of Rijeka and StepRi. organized a lecture on the City of the Future, in collaboration with the theme was Museums: Innovations and Digital Future. In this respect, it participated in the Night of Museums national cultural event, whose main European/Mediterranean Planetarium Association was surprised to find performing works by Mozart in the Church of Saint Cristo. Chrysta shared his observations of student, Castelli shared his observations of (1578). Castelli was a teacher in Rome and observer Benedetto Castelli, born in Brescia, discovered the phases of Mercury. After exploring Brescia, Chrysta happened across an orchestra performing works by Mozart in the Church of Saint Cristo. Chrysta was surprised to find a rare reflection sundial under a ceiling in the cloister of the monastery after the concert. She admired the sundial for its beauty and innovative way of telling time in an age before modern technology. Later, she stopped to see the Piazza delle Loggia clock tower in the city of Brescia. Having visited Piazza San Marco of Venice a few years ago, she was excited to see the similarities between the astronomical clock of the lagoon city and the one located in Piazza della Loggia. During her stay in Perugia, there was an art exhibition that displayed paintings depicting bubbles. One of the paintings, Newton discovers the refraction of light, comes from a Brescia art museum. In Italy, it is quite easy to find connections between art and science. The two weeks traveling and teaching in Italy will likely inspire Chrysta to share all that she has learned with her audience at the Liberty Science Center.

Chrysta Ghent (Jennifer Chalsty Planetarium, Jersey City, New Jersey, USA) was the 2019 winner of the An Experience in Italy for an American Planetarium Operator program. Students and the public from the cities of Perugia, Spoleto, Assisi, Brescia, Lumezzane, and Gorizia participated in conferences and lessons that involved Chrysta as lecturer.

Chrysta taught about the solar system, the moon, Native American star stories, and Italian astronomers (including not only the famous Galileo Galilei, but also Giovanni Battista Zupi, who discovered the phases of Mercury).

During a visit to the popular observatory called Specola Cidnea in the center of Brescia, Chrysta found an inscription displayed in remembrance of the Italian observer Benedetto Castelli, born in Brescia (1578). Castelli was a teacher in Rome and at the University of Pisa (after Galileo). As a student, Castelli shared his observations of the Venus phases with Galileo.

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European/Mediterranean Planetarium Association

Croatia. This past January, the Rijeka Astronomical Centre participated in the Night of Museums national cultural event, whose main theme was Museums: Innovations and Digital Future. In this respect, it organized a lecture on the City of the Future, in collaboration with the Bureau for Information Technology of the City of Rijeka and StepRi. On the day of the event, more than five hundred visitors enjoyed the evening shows and films screened at the Rijeka digital planetarium, as well as the lecture itself, a workshop on microscopes and an exhibition of children’s drawings.

The Rijeka Astronomical Centre also introduced on its Facebook Fan page the 100 Minutes of Astronomy event, in which more than 5,000 followers had the opportunity to ask questions related to Astronomy.

In February, the Centre’s digital planetarium celebrated Valentine’s Day with the show Romance Under the Stars, focusing on the Ancient Greek myth of Perseus and Andromeda, an adventurous love story that is also a great opportunity to introduce the audience to these two great constellations. The demand for tickets was so high that an additional show was organized for the same day, and four shows in total were seen by almost two hundred visitors.

In March, on the occasion of International Day of Planetariums, celebrated at the Rijeka Astronomical Centre since 2010, there was a special program on 9 March that included an educational quiz and a storytelling for children, in collaboration with the Portić Association for Promoting the Wellbeing of Children.

Another interesting event was a wind trio concert under the planetarium dome lit by Hubble telescope images by orchestral members of the Croatian National Theatre Ivan Zajc, a theatre, opera, and ballet house located in Rijeka. At the time of writing, the Rijeka Astronomical Centre is making preparations for Dark Sky Week, and has scheduled its participation to the national Science Festival.

Greece. The Eugenides Planetarium in Athens finished its latest production titled Mars: The Red Planet, a show scheduled to premiere this coming October, and is currently embarking on a new production related to the history of our planet.

On Thursday 14 March, the Hellenic Space Agency (HSA) honored Dionysios “Dennis” Simopoulos, past director of the Eugenides Planetarium for 40 years, for his selfless and invaluable contribution to the dissemination of astronomy and space science in Greece. Keynote (Continues on page 60)
BIRTH OF PLANET EARTH

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speakers included Christodoulos Protopapas, president of HSA; Manolis Plionis, president of the National Observatory of Athens and cosmology professor at the Aristotle University of Thessaloniki; and Nikos Pappas, minister of Digital Policy, Telecommunications and Media.

On Tuesday 19 March 2019, on the occasion of the spring equinox, the Eugenides Planetarium scheduled free screenings of The Future in Space, a show highlighting the future of space exploration, including the construction of bases on the moon and Mars and the possibility of interstellar travel, that was introduced to the audience by Manos Kitsolas, director of the Eugenides Planetarium.

Society of French Speaking Planetaria

For the 50th anniversary of the Apollo 11 mission, the APLF acquired an 8-minute fulldome movie on this historic mission produced by Phoenix Production. This small movie traces the history of the mission and its scientific and technical issues. Wishing to boost its network, the association offered the movie free to all its members.

The dynamics of French language planetariums are also reflected in new planetarium projects and projection/simulation system renewal projects. They are exceptionally numerous at the moment (ongoing projects are marked on the map above).

Pacific Planetarium Association

The William M. Thomas Planetarium at Bakersfield College (Bakersfield, California) replaced their older Spitz SciDome 1K system with a new Spitz SciDome 4K system that uses laser projection instead of the normal lamps in October 2018. Nick Strobel said: “What a difference having 16X the number of pixels displayed on the dome! Much sharper images and the system is also much brighter than the old system.” He also noted that porting the old shows over was easy to do.

A 3-day workshop (11-13 March) was held at Lawrence Hall of Science (LHS) for a dozen or so Digitalis Nightshade users. Alan Gould included demonstrations of Nightshade software using the Lawrence Hall of Science Planetarium’s Digitarium Lambda projection system in its 30-foot dome. Using workstations provided by workshop leaders Karrie Berglund and Kyle Doane, the participants made scripts and designed augmented lessons with html-based interfaces. Overall it was a very valuable experience. A bonus to the workshop was seeing the latest technique at Lawrence Hall of Science for audience members to read and write in the planetarium: LED-lit clipboards designed and built by John Erickson, the LHS planetarium director.

The National Space Club (NSC) has awarded the 2019 Space Educator, Lifetime Achievement Award to Dr. Andrew Fraknoi, astronomy professor at the Fromm Institute for Lifelong Learning at the University of San Francisco (USF). Fraknoi is the first astronomy educator to receive the prize.

The award was presented at the NSC’s 62nd Annual Robert Goddard Memorial Dinner on 22 March in Washington DC, in the company of 2,000 aerospace industry, exploration, and education leaders. The prestigious award generally recognizes secondary school teachers active in teaching space science, but is occasionally given to individuals in the wider world for a lifetime of contributions to space or space-science education.

The award citation lauds Fraknoi for: “his career as an award-winning astronomy educator, innovator, author, and key link communicating our expanding knowledge of the universe.” It adds, “His books, textbooks, virtual curriculum, public activities, and interaction with students and audiences numbering in the thousands have inspired and engaged the American public in the exploration of space.”

Over the last few years, Fraknoi has served as the lead author of Astronomy, a free, open-source introductory textbook, published by the non-profit OpenStax Project at Rice University, supported by the Hewlett, Gates and other foundations. The book is now in use in over 500 universities, colleges, and schools in the U.S., saving millions of dollars of textbook costs for students.

In 1992, the International Astronomical Union named asteroid 4859 Fraknoi to honor his contributions to the public understanding of science.

Retired as chair of the Astronomy Department at Foothill College in Los Altos, Fraknoi previously served for 14 years as the executive director of the Astronomical Society of the Pacific.

Great Lakes Planetarium Association

Illinois. In March, Chicago’s Adler Planetarium hosted Annette S. Lee, director of the St. Cloud State University Planetarium, for a talk on
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indigenous Native American stories of the stars and constellations. In December, Adler experimented with a concept called Adler Book Club, which paired three Adler astronomers with three local sci-fi authors for a series of one-to-one conversations. In January, upwards of 1,800 people braved single-digit temperatures in an attempt to observe the total lunar eclipse. Although clouded out, guests enjoyed moon-related activities instead.

The William M. Staerkel Planetarium at Parkland College in Champaign hosted their James B. Kaler Science Lecture in April, which addressed advances in artificial intelligence. Later that month, they hosted an all-day session of the Artemis Bridge Simulator. Work continues on new school programs for Champaign schools’ 5th grades, as well as programming to address new Girl Scout badges and assisting their local forest preserve district to acquire Dark Sky Park status.

Peoria’s Dome Planetarium hosted four sold out Romance Under the Stars events for Valentine’s Day, their best year ever! This spring, they host their 20th annual Interplanetary 5K race through their Community Solar System Scale model, as well as a Space Explorers Day Camp in the dome. They are also working on creating a live show to celebrate the 50th anniversary of Apollo 11.

Indiana. The Brown Planetarium at Ball State University (Muncie) recently hosted a special family month, with planetarium shows, hands-on activities, and balloon rockets. The planetarium and BSU astronomers hosted a very unique family session of public telescope events in March and April. What made them unique was that the telescopes were located at dark observing locations in Arizona, South America, and the Canary Islands!

Michigan. On 12 April, Kalamazoo Valley Museum Planetarium participated with Michigan State University’s Science Festival for State Wide Astronomy Night (SWAN). The activities included a live session under the dome that discussed how a family can interact with the night sky using the unaided eye or simple observing tools. Former KVM planetarium coordinator Eric Schreur also presented “Photographing the Night Sky.”

The Longway Planetarium (Flint) has two big projects. The first was their first full dome feature production on forces that presents Newton’s laws of motion to a third-grade audience. The other project is a fulldome vignette for the 50th anniversary of the lunar landing coming later this year.

The new University of Michigan Museum of Natural History (Ann Arbor) is now open! More than 2,000 school children were booked for their dome in the month following the 14 April public opening of the dome, museum store, Forum Theater, and some exhibits. Opening will conclude in November with three more galleries.

The Grand Rapids Public Museum’s Roger B. Chaffee Planetarium has enjoyed high attendance during snowflake break and the return of Concerts Under the Stars. In February, GRPM hosted “Roger That!”, an annual collaboration with Grand Valley State University that celebrates space travel and honors Roger B. Chaffee.

After many renovations to its inside and the exterior, the Hurst Planetarium at the Ella Sharp Museum in Jackson hosted a successful “re-launch party” in January, as well as a well-attended lunar eclipse viewing party on 21 January.

The Abrams Planetarium (East Lansing) has begun celebrating the 50th anniversary of the moon landing with very local connections. In 1969, East Lansing artist Alixandra Summit painted three works commemorating the big event. Now her paintings are on display on their blacklight gallery. The staff is also about to roll out a telescope borrowing program, partnering with the Capital Area District Library’s Library of Things.

The Delta College Planetarium in Bay City is continuing its recent upgrade to Digistar 6 by creating new custom content for special live programs. These include presentations on the Apollo 8 anniversary, (Continues on page 68)
Data to Dome
Science & Data Visualization Task Force

WWT Planetarium Project is a winner

Guest Columnist
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Recently, the Foundation for the Development of Science and Technology Museums in China (FDSTMC) announced the winners of the 2018 Science and Technology Museum Development Award. The project “WWT Planetarium based on the big data of Virtual Observatory,” submitted by the Chinese Virtual Observatory (China-VO) team, won the Nomination Award. This award means the WWT Planetarium project was officially accepted by the science and technology museum community in China.

The WWT Planetarium system has already been launched in a number of cities in China, including Beijing, Shanghai, Guangzhou, Chongqing, Shijiazhuang, Wuhan, and Zunyi. It has also been widely recognized in the astronomical education community, especially in primary and secondary schools.

What is WWT?
WorldWide Telescope (WWT) is a scientific data visualization platform. It was first designed as a tool for astrophysical data exploration and discovery in the era of large and disparate data. Acting as a virtual sky, WWT allows users to explore all-sky surveys across the electromagnetic spectrum, and to overlay data from telescopes and observatories across the globe.

With WWT, massive real data can be used for not only professional astronomical research, but also education and public outreach.

WWT was first developed by Microsoft Research and is now run by the American Astronomical Society (AAS). You can learn more at http://worldwidetelescope.org/home.

The unique contextual narrative layer of the WWT sets it apart from other astronomical data visualization systems. Users can record or view recorded paths through the virtual environments and add narration, text, and imagery. These are called “tours.” With this feature users are able to use real research data to create their own stories and share them with others. That means the user can write their own astronomical story script, insert images they like and use their own voice or music for background. When applied to education and public outreach, it is a promising tool for illustrating many advanced STEAM concepts.

In February 2017, China-VO published a teaching instruction book for teachers who wanted to start an astronomy class in primary school. With the book and the supporting tours, the WWT platform can be used as a tool for astronomical education.

Some teachers in China have already done this. In May 2018, Ms. Wan Wanghui organized an open astronomy class in Wuhan Museum of Science and Technology. Teacher Lin Yifei from Xiamen Wuyuan No.2 Middle School uses WWT in their physics classes, something that was welcomed by their students.

And why WWT planetarium?
Based on the AAS-WWT platform and additional features developed by China-VO team, WWT Planetarium provides an astronomy education environment that is perfect for astronomical education and public outreach in China. WWT Planetarium is perfect for school and small science and technology museums wishing to organize interactive astronomy classes. With the book and the supporting tours published by China-VO in 2017, WWT Planetarium can be used as a special classroom for astronomical education.

The large dome-shaped projection screen of planetarium always will be the best fit for astronomy shows because it can provide great experiences similar to looking at real starry sky. But building large planetariums is too expensive for many small science museums.

On the other hand, the WWT platform can be easily used on any computer. Teachers and students may use it to create tours in regular computer classroom or home. Some of the student created tours were very impressive, creative, and complete, which fully satisfied the requirements to be shown in the planetarium. When the tours are actually presented in WWT Planetarium, the students who create them can feel great encouragement to continue their astronomy study.

The FDSTMC’s award not only means the WWT Planetarium is recognized in China, but also a success for the IAU Data Driven Astronomy Education and Public Outreach effort. Currently the China-VO team is working on building up an astronomical education ecosystem in China based on WWT platform and will keep pushing forward the boundary of the WWT Planetarium and other instances of astronomical data applications in education and public outreach fields.
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About being biased

I have to remind myself time and again that I am biased. It doesn’t matter how many times I said yes, I can understand other people’s perspective, it still takes constant mental effort to switch sides.

When I arrived in New Zealand, I looked at Orion. Actually, no. I hung on Orion as if my stellar life depended on it. It did in a way because everything was upside down and Orion was the only thing I recognised. From it, I reconstructed the other stellar patterns and created new ones. So when I’m explaining the sky to visitors from the Northern Hemisphere I start with Orion, a logical choice—if Orion is in the sky at that time.

I also start with the ecliptic and what is on it, day and night. Then we look for the Milky Way and by following its beautiful trail, inside it, somewhere opposite the ecliptic, is the Southern Cross. That’s what makes sense to me.

So here I am a couple weeks ago, getting feedback about a stargazing course that I am teaching here at the planetarium when someone—none other than my boss—said “Why don’t you start with the Southern Cross? It makes sense to me,” he said. “It’s very easy to find.” Yet here I was, thinking that Southern Cross was the grand finale.

This story continues in the box.

Needing to be bi-hemispherical

In summertime, New Zealand’s population doubles (the touristic heuristic) and that is reflected in the visitor numbers at the planetarium. It’s always almost 50/50 that both hemispheres are represented in the audience. So opening by asking people from which hemisphere they are is very important because, it goes without saying, there are always two conversations to be held, two interpretations of the same sky. This is not to mention that many people are confused about things being upside down and ask if the sun rises from the west. It doesn’t, but it goes through the northern sky.

Māori starlore: this time of the year is the New Year

We are gearing here to observe the Māori New Year, Matariki. It won’t be until the end of June, but there is already a great buzz about it. Everyone is booking their end of year functions and Space Place is very popular. The end of June is also, for many businesses, the end of the fiscal year (including ours), so it does feel like the New Year, especially because it is now wintertime here, and in some places it even snows. The perks of having a tilted planet!

Matariki is one of the names that Māori give to the Pleiades. In this instance they mark the heliacal rising of the sun after the winter solstice and the new year. The name means the eye of the ariki (the chief). It might not look like an eye in the northern hemisphere, where the Pleiades are inverted, but if you observe it upside down it does. More than that, when it reappears in the sky it rises before the sun, like a harbinger, the eye of Ra, the eye of the chief.

For a few years after I arrived here I was convinced that this is the only translation of the Pleiades and called it as such at all times. However, as I learned more about the Māori starlore, I realised that the Pleiades fits into many sky constructs; depending on when it is observed makes it parts of different asterisms in combination with other stars.
It turns out that Māori have instances when they look at the sky as a whole rather than piece by piece, which is what we do with our constellations-asterisms. For instance, for me Scorpions will always be Scorpions, doesn’t matter when I look at it.

But it is the fishhook of Maui that drags the Milky Way from the sky in winter months, when the asterism climbs to the zenith. The same stars are then part of Te Waka (the canoe) O (of) Tamarereti around November, when the Milky Way surrounds the horizon; Scorpions is the prow and Orion is the stern of the waka. Then around March, Scorpions is Manaia ki te Rangi, the guardian of the heavens rising from the western horizon.

The Pleiades are well used

We barely have different names for our asterisms across cultures. For instance, nearly everyone calls Scorpions the scorpion. Perhaps the Pleiades have the most names: M45, the Pleiades, Subaru, the Seven Sisters, the Hen and Chicken. Yet the Māori have places for them in three snapshots of the skies. In June, before sunrise, they are the Eye of the Arikia; in November, when they are on the eastern horizon in the evening, they are the feathers that adorn the canoe of Tamarereti; and later on in the year, around March when they are on the western horizon in the evening, they are Te Tawhiti, the shining ones.

This probably was my biggest unlearning experience ever; the night sky of Aotearoa (the Māori name of New Zealand). Unlearning is a real technique they teach when you are an analyst in order to prevent bias. You need to un-learn the information you previously held so than you can see everything with fresh eyes. Try that in real life!

Māori is also an oral culture and I came across information from conversations rather than books so it was quite a journey to get the puzzle together.

The sun here is called by the Māori Tamanui Te Ra, a name bearing resemblance to Ra, the Egyptian Sun god. He has two wives, Hine Raumati, marked by Antares (or Rehua in Māori) and Hine Takuruu (marked by Takuruu, the Māori name for Sirius), which he takes turns visiting at the solstices.

Matariki (the eye of the chief) is observed around the winter solstice, as the cluster is back in the morning sky mid-June and the exact date of the occurrence is linked to the phases of the moon. Being an oral culture, the Māori has many variations and interpretations that vary from tribe to tribe of exactly which phase. The Māori calendar is called Maramataka and is based on the moon, the name meaning literally “the turning of the moon.” Each of the 30 nights of Maramataka has a name and the phases of the moon inform the activities that are happening each day.

Regardless if everyone agrees or not when exactly the New Year should occur, this year in Wellington we will have fireworks to mark the event, which is something I very much look forward to.

Nga Mihi o te Tau Hou (Happy New Year) from Aotearoa.

(Academy Style, continued from page 30)

So while the Academy is committed to using data ripe for visualization goes far beyond the typical astronomical datasets.

When we introduce shows in Morrison Planetarium, our presenters emphasize the authenticity of the science and the use of visualizations. By taking time to articulate this in advance of the audiences seeing our productions, we set the stage for people to be attentive to the science in the images as well as in the narration. The visuals and the verbal content explicitly reinforce one another.

In an internal evaluation of Habitat Earth that specifically asked visitors about their expectations around the authenticity of data used in the show, the vast majority responded that they would expect our content to leverage real data. Furthermore, the perceived authenticity of the data made the show more compelling.

So while the Academy is committed to using data-based visualizations as a foundation for our storytelling for reasons that spring from our institutional values, I think our productions benefit aesthetically from the use of data—and our audiences seem to appreciate—and to expect—the added effort taken to present authentic science.

Closing thoughts

In this article, I have tried to articulate the values that have informed choices in our productions. But as I noted above, this represents a fairly conservative approach to full-dome filmmaking. We have gently bent or broken some of these “rules” in our existing catalog of shows, and we plan to take a more divergent approach to future productions.

When we have broken the rules, we have done so consciously and in service of the story and the clarity of our messages. We elected not to use data, for example, when we illustrated the passage of time using spinning starfields in Incoming! because depicting more realistic stellar motion created an incomprehensible visual mess. We have also used cuts judiciously—for example, a “zoom” into the full moon at the end of Incoming! that helps underscore a poetic rumination at the end of the show.

For our upcoming NSF-funded Big Astronomy show about Chile’s great observatories, we will make extensive use of live-captured video. This forces us to make use of more frequent cuts and transitions, and although we’ll use a fixed camera for some shots, we have tried very hard to maintain camera motion for as much of the show as possible. (You can read more about the details of our team’s experience with camera technology in this issue’s IMERSA Matters column on page 46, and we will be releasing a white paper on our learnings in a forthcoming issue of Planetarian.)

And our show about the coevolution of life and our planet, set to open at the Academy in September 2020? That may or may not begin at a human scale...

Rules are made to be broken, after all. And recognizing the reasons for the rules, the rationale for the choices we’ve made in our productions up to this point, allows us to make judicious decisions about when to reconsider those choices in future productions. I certainly hope that articulating the thinking behind our “Academy Style” can help other fulldome filmmakers consider choices they make in their productions.

Thanks

Many thanks to the team at the California Academy of Sciences who reviewed and commented on the draft of this article—including Ken Ackerman, Elizabeth Babcock, Jeroen Lapré, Akemi Mease, Molly Michelson, Ethan Scardina, Mike Schmitt, Dan Tell, and Aaron White.

References

observational astronomy techniques, and the northern lights.

Ohio. Last November, astronaut Mike Fincke visited the Yahn Planetarium at Penn State Behrend for the fourth time in his career. Mike gave a presentation in a nearby lecture hall titled “Space Exploration: The I.S.S., Moon and Mars.”

The Ward Beecher Planetarium at Youngstown State University had a phenomenal weekend at the end of January with their “Rock the Dome Weekend.” They used SkySkan’s Milkdrop program in Digital Sky 2 to present 14 shows.

The Vandalia-Butler Planetarium at Smith Middle School follows the 50th anniversary of Apollo 11 with programs about Projects Mercury and Gemini, lunar mysteries, and *The Loneliest Men in the Universe*, a program that celebrated Michael Collins and his fellow command module pilots who orbited the moon alone while their colleagues were on the surface.

The Bowling Green State University Planetarium held a successful observatory open house for the lunar eclipse on 20 January. BGSU mourns the passing of long-time narrator Dr. Lois Cheney, emerita from BGSU’s theater department, who narrated more than a dozen planetarium shows over the years.

**Wisconsin/Minnesota.** The Barlow Planetarium at University of Wisconsin-Fox Valley just completed their seasonal four months of laser shows, with near capacity crowds.

The Bell Museum’s (Falcon Heights, Minnesota) Year of Apollo to celebrate the 50th anniversary of Apollo II is underway. The first event was a weekend-long Space Fest that concluded with the January total lunar eclipse, where the Bell Museum saw over 4,000 visitors, 1,300 for the frigid lunar eclipse alone.

The Forestview Planetarium (Baxter, Minnesota) saw the installation of a Digistar 6 system in late November of 2018. A single projector system that was originally installed in 2004 was replaced with a two-projector system. The planetarium is in year two of hosting school visits from 22 school districts that surround Brainerd, thanks to funding from Sourcewell.

The Manfred Olson Planetarium at University of Wisconsin-Milwaukee finished *Birth of the Universe* with record attendance of 900+ people at the end of February. In January, they hired a part-time marketing coordinator, who is now helping them publicize the planetarium on campus and the community. In spring, they began a new production titled *Arabian Nights* to celebrate Arabian contributions to astronomy and learn more about Arabic culture.

**Southeastern Planetarium Association**

Conference announcements dominate the news from SEPA this time. SEPA 2020 will be held in Fort Pierce, Florida. Jon Bell, director of the Hallstrom Planetarium at Indian River State College in Fort Pierce, is pleased to host the 2020 conference. The planetarium features a 40-foot, 12-degree tilted dome, 74 seats, and is equipped with both opto-mechanical and fulldome digital projection. Conference dates and details will be furnished later. SEPA will return to Kingsport, Tennessee in 2021 for its 50th anniversary conference. The facilities at Bays Mountain Park include a recently renovated planetarium situated in a 3,550-acre nature preserve. Planetarium Director Adam Thanz emphasizes that this is the third SEPA conference to be held at Bays Mountain. He has promised to show delegates why this is so.

Tentative plans for 2023 include a U.S. national conference to be hosted by the Sudekum Planetarium in Nashville, Tennessee. Further information, as it becomes available, will be posted on the SEPA website.

For any and all information regarding SEPA please visit the website sepadomes.org and or contact the IPS representative John Hare at johnhare@earthlink.net.
This close to the surface, details matter. Overlaps, crimps, folds, and exposed rivets will affect your image. Perfect projection is only possible on a perfectly uniform surface. NanoSeam™ has no irregularities in the surface. None. It’s why the most prestigious venues choose Spitz domes - including The Adler, The Hayden, and our partners like IMAX, Disney, Universal Studios, and Seaworld.
Big things happening in the LIPS world!

It’s perhaps not a huge thing, but I’m still excited about it: We have a new logo for LIPS. The original LIPS logo was designed and created for LIPS 2011 by Rob Spearman, Digitalis’s president. At that time, we had no idea if LIPS would take place ever again, so the original logo was always meant to be temporary: it would disappear if LIPS never happened again or be replaced by something more professional if LIPS did continue.

We ended up keeping the original logo much longer than expected, partly because of time constraints and partly because we wanted to find the right designer for a new logo. This year we finally found both the time and the talent.

Over the past year Digitalis has been working with a very skilled graphic designer on some of our commercial projects. We asked that designer to create some logo ideas for LIPS, highlighting that LIPS is astronomy-related and about live programs. She came up with three possibilities, and I selected the one shown here. I’m pleased with her design, and I hope the entire LIPS community is, too!

LIPS 2019 shaping up nicely

Now on to the bigger things: By the time this column is published, LIPS 2019 will be only two months away. As always, LIPS is shaping up to be a fun and valuable conference, and I am eagerly anticipating it.

As a reminder, our host this year is Cradle of Aviation Museum (COAM) and its JetBlue Sky Theater Planetarium in Garden City, New York. LIPS 2019 will take place 14-16 August, with an optional add-on Data to Dome workshop on August 13.

More information about LIPS 2019—including registration, if space is still available—is available on the LIPS website, LIPSymposium.org.

This will be the second all-day Data to Dome workshop before a LIPS, and we will be applying what we learned from the first to make this second one even better. I’m including an image showing some of the 2018 groups hard at work preparing their presentations. My thanks to Mark SubbaRao for his willingness to fit leading this Data to Dome workshop into his hectic schedule!

The JetBlue Sky Theater Planetarium is a 24-m tilted dome that seats 300 people. We have set a cap of 60 people for LIPS 2019, so that means that we will have many extra seats in the planetarium during LIPS sessions. We are planning to use some of those extra seats at sessions for audience members to participate in programs led by LIPS attendees. After these presentations, the entire LIPS group will be invited to give feedback on the program: what went well, what could be improved, etc.

I’m particularly excited about observing Data to Dome-focused presentations. Presenting current science to the public is very different from presenting it to an audience of planetarians. I am interested to see how the audiences react, what questions they ask, how our presenters explain concepts, etc.

The JetBlue Sky Theater Planetarium is one of the largest domes to host a LIPS; the only larger host dome was the Morrison Planetarium at the California Academy of Sciences, our LIPS 2015 host. As my own planetarium teaching experience is in much smaller domes, I am curious to see how live, interactive programs with a public audience feel in such a large dome. The largest dome I taught in was the Willard Smith Planetarium at Pacific Science Center (the LIPS 2018 host), which is a non-tilted dome, 8.2m in diameter, with concentric bench seating for 40.

Kerri Kiker of COAM has done presentations at previous LIPS about audience activities they use in the JetBlue Sky Theater. I’m sure that seeing activities and programs in this dome will be beneficial and thought-provoking for all LIPS 2019 attendees. I will write about that after LIPS 2019.

More Mini LIPS Coming

In addition to the main LIPS, there are plans for several other LIPS-style events. By the time you read this, there will have been a Mini LIPS held just before the SEPA-MAPS conference in June at the South Carolina State Museum in Columbia. I will write about that day in my next LIP Service column.

GLIPSA 2019 is in planning for October (exact date to be determined, but likely 23 October). If you’re trying to figure out what the letters in GLIPSA stand for, don’t bother: GLIPSA is a LIPS and GLPA smushed (Continues on next page)
LIPS is becoming global

I have also had requests from other countries about holding LIPS. Mexico has expressed interest in holding a LIPS, likely in early 2020. Plans are also underway in Japan to hold a LIPS there, and Kaoru Kimura has asked me to attend. Kaoru is one of LIPS's strongest supporters, and she regularly presents at LIPS. I have never been to Japan, and LIPS would be an excellent reason to visit!

As plans firm up for the IPS 2020 Mini LIPS, I will be sure to give updates on the LIPS Facebook page and the LIPS Google Group. For now, pencil in the IPS 2020 Mini LIPS in your calendars for 21 June. You won't want to miss it! See this end of the column for information on the Facebook page and Google Group.

LIPS Facebook group: Search for “Live Interactive Planetarium Symposium.”

Kalina Borkiewicz from the National Center of Supercomputing Applications presents during the grand opening of Birth of Planet Earth at Stiftung Planetarium. Photos courtesy Spitz, Inc.

Animation problem solvers

Mike Bruno of Spitz Creative Media recalls the early days of the collaboration: “We first worked with Donna Cox’s team at NCSA’s Advanced Visualization Lab on Black Holes: the Other Side of Infinity, the 2006 Denver Museum of Nature & Science production. NCSA was contracted to produce the majority of the visuals for this show. Tom Lucas, the writer/director, hired Spitz to create a special-effects shot of several kayakers plunging into a waterfall, as an analogy for falling into a black hole. In the process, we all got to know each other and later (2012) co-produced Dynamic Earth: Exploring Earth’s Climate Engine. It has been booked in around 200 domes and translated into numerous languages.”

The third collaboration was for Solar Superstorms. The collaboration had its origins in a Public Broadcasting Service/Nova documentary about black holes that producer/director Lucas was working on with Donna Cox and her group at the AVL. “Mike Bruno at Spitz persuaded us that the story would really come alive and gain wide exposure in a giant screen fulldome version,” Lucas noted.

For Birth of Planet Earth, animation duties were split between Spitz and the AVL. “The Spitz Creative team,” says Lucas, “is steeped in visual effects and high-end animation production.” Lucas would construct the film as a back-and-forth between Spitz Creative’s dramatic and realistic animations and the simulations of the Advanced Visualization Lab, creating a visual dialogue between the two.

(LIPS, continued from page 41)

Making science accessible

Birth of Planet Earth provides audiences with an array of important scientific concepts presented in an easy to understand and enjoyable format. According to Spitz’s Bruno, “We’ve done extensive testing with school groups, teachers and general public audiences in several locations. Birth of Planet Earth seems to resonate well with grade 6 and older, though even younger kids love the visuals, especially the Theia-Earth impact sequence.

“Our museum partner is the Tellus Science Museum in Georgia. David Dundee (planetarium director) and his team are producing the teacher guide and STEM curriculum resources. They are terrific collaborators and have tremendous experience with outreach education, and expert at creating materials that help teachers and students maximize their planetarium field trip experience.”

Narrated by Richard Dormer (Beric Dondarrion on the hit HBO series Game of Thrones), the 24-minute show is being distributed internationally in a number of languages. “We are just starting to roll it out and were really delighted to see it premiere in Berlin,”2 says Bruno. ☮

(LIPS, continued from page 41)

Lucas would use the advent of photosynthesis as the conclusion to his fulldome show. The buildup beckons audiences to ask a single question: “Did the Earth have to turn out this way, or was it somehow a fluke?”

(LIPS, continued from page 41)

together. GLIPSA is the acronym for the Great Lakes Planetarium Association, if you’re unfamiliar with it. GLIPSA 2019 will be the seventh GLIPSA, with the first taking place in 2013 in Peoria, Illinois. Stay tuned for more information about GLIPSA 2019 as plans start to shape up.

I was asked to organize a Mini LIPS for IPS 2020, which will be the first LIPS at an IPS conference. You hopefully know that IPS 2020 will be hosted by TELUS World of Science Edmonton in Edmonton, Alberta, Canada, 18-25 June.

The IPS 2020 Mini LIPS is still quite far in the future, but early plans are coming together well. My thanks to the people who have graciously agreed to be on the IPS 2020 Mini LIPS committee (alphabetically by last name): Keith Davis, Alan Gould, Ian McLennan, and Mark Webb. And, of course, my thanks to our hosts for their past, present, and future assistance with the planning.

As plans firm up for the IPS 2020 Mini LIPS, I will be sure to give updates on the LIPS Facebook page and the LIPS Google Group. For now, pencil in the IPS 2020 Mini LIPS in your calendars for 21 June. You won’t want to miss it! See this end of the column for information on the Facebook page and Google Group.

Freshers to the LIPS scene include Kaoru Kimura of the University of Tokyo in Japan. She has asked me to organize a Mini LIPS there for 2020, and Kaoru has asked me to attend. Kaoru is one of LIPS’s strongest supporters, and she regularly presents at LIPS. I have never been to Japan, and LIPS would be an excellent reason to visit!

In short, there are many opportunities to participate in LIPS-style events. It is gratifying to see our movement gathering so much steam, and I know it will continue to grow stronger. Although I am the person whose name appears at the top of this column, there are countless people who contribute to the direction of LIPS, and there is room for more. I hope to see you at one or more LIPS events in the near future!

To stay informed of LIPS events, there are two main options: LIPS Facebook group: Search for “Live Interactive Planetarium Symposium,” and then send a request to join. It is a closed group, but I try to approve requests very quickly. As always, I invite you to send feedback directly to me: karrie@DigitalisEducation.com.
Digital audio update

International standardized digital audio methods, software, and hardware have changed greatly since I last wrote about this subject. Because most of you want to run 5.1, 7.1, or even more channels of surround sound, we will focus today on those channel counts.

SPDIF, optical ADAT, Dante, AES3, Cobra Net, AVB, Blu-Link ... how to choose?

It is now all about “networked” audio over ethernet (AoIP), just like lighting control (Artnet), and video (AVoverIP).

Modern planetarium and exhibit digital audio is typically generated right in the video server and output over ethernet, skipping the sound card altogether. In some cases, the analog audio from media players, microphones, and Blu-ray players is captured by little converters and then routed through network switches.

There are many advantages of using this method. Later we will dig into many of these, but in summary networked audio allows any channel to be routed to any destination and changed as needed at any time. While this is very important for school and convention center meeting rooms and exhibit areas, we in the exhibit and dome theater benefit from the wide acceptance of this approach.

Here are the latest terms and technologies you need to know about as you select your new dome projection and audio packages.

What is old?

Digital audio over coax and optical SPDIF (Sony/Philips Digital Interface) and ADAT (Alesis Digital Audio Tape) optical have now been pretty much relegated to consumer home use. A few recording studios still use ADAT optical for recording gear and one planetarium projection manufacturer still supports this.

AES3 is still one of the most common high-quality broadcast level formats, but is beginning to disappear in the world of installations. The cabling is larger and more expensive than CAT cables and two channels are carried on one pair of wires, so it takes a great amount of wire for very many channels.

AES hardware is typically expensive.

Cobra Net was the gold standard for CAT6 networked audio, but you will see below it has quickly been supplanted by other formats. CobraNet installations are expensive due to licensing and are subject to higher latency, which causes delays in lip sync and live monitoring.

AVB (AudioVideoBridging) overcame many of the issues with CobraNet when standardized in 2010. AVB has a comparatively small number of major manufacturers on board. The hardware and network switches are proprietary and expensive.

HARMAN Pro (Crown, Soundcraft, BSS, JBL, DBX) has its own digital audio network for point to point digital audio distribution. It runs on low cost CAT cable, is super reliable, cost effective, and latency free.

What is new?

The most common new technology worldwide is known by several names, but they all run on the Audio Engineering Society AES67, formalized in 2013. Any manufacturer can develop its own AES67-conforming hardware and software and, in most cases, it might be interchangeable between manufacturers. Where AES67 is an interoperability standard, any brand name can add proprietary functionality to their hardware and software.

Some of the brand names are, in order of popularity, Dante, Livewire, Q-LAN, and Ravenna. Nearly all digital audio systems now use the AES67, approach which has mostly replaced CobraNet for networked audio in new systems.

Why has Dante replaced others?

First, it is a new universal format and has rapidly become the standard. Most of the major manufacturers now have hardware and software to support this, and most are called “Dante-enabled.” Even the competing formats AVB and Blu-link have converters to receive/send Dante. In addition:

- The network switches are generic and low cost. Almost any gigabit switch will do.
- Any channels of source audio can be routed to any outputs in control software, which means no more plugging wires or patch cables in and out. You can run up to 64 bi-directional channels of audio at 24/48K or 24/96K resolution; 24/48K is where most planetarium show producers top out.
- The format is noise free, buzz free, and incredibly reliable with no ground loops.
- Small size CAT6 and CAT5e cabling are used, which reduces conduit/wireway sizes. This cabling is also much less costly than shielded audio cable.
- There are hundreds of manufacturers making all manner of Dante-enabled devices.
- Some of the audio engines for computers are totally software based, so there are no sound cards needed.
- Dante mic input plates and converters for Blu-ray, DVD, CD, tablets, phones, and any other type of audio source can be input onto the network.
- Computer audio output is all digital over USB (2-8 channels) or NIC, so the poor quality noisy audio card and interference from computer power supplies are eliminated.
- You can go Dante all the way from the server output and console mixer, through the audio processor, through the switches, and directly to the amplifiers—all digitally with CAT 6 cable.
What is the topography?

Figure 2 is a typical networked audio diagram for planetarium with 7.1 surround sound and two lobby exhibits. Figure 3 shows a typical Dante channel configuration in the Dante Controller software for a 5.1 theater with a console mixer.

Notes and precautions.

Although it is possible to run networked audio on shared lighting, control, and data networks, it is well understood in pro audio ranks that you should run network audio on its own network.

The same is true for Artnet lighting control. You can convert every audio signal in your system to networked packets, but you may not want to. It is still good to have some analog redundancy in case of network switch or other failure. Keeping analog mic inputs and an analog output from your operator’s console wired direct to analog inputs on the audio processor will always make a CD and mic available for live talks.

As usual, feel free to contact me at jeffb@bowentechnovation.com if you want me to suggest some additional reading material.

Reader question.

Can you edge blend and geometry correct new solid state laser projectors?

Answer: Absolutely. Most all-dome digital systems and exhibit panorama systems use only these new projectors.

(4074) Sharkov = 1981 UNTL. Discovered 1981 October 22 by N. S. Chernykh at the Crimean Astrophysical Observatory. Named in honor of Viktor Ivanovich Sharkov (b. 1933), an experimental astrophysicist known for his laboratory simulation of the physical phenomena in icy cometary nuclei. A staff member of the Ioffe Physical and Technical Institute in St. Petersburg for many years, he has been director of the St. Petersburg Planetarium since 1993.

Close encounters of the Sagan kind

Note: My three times that I had personal interaction with Carl Sagan: at Cornell University, at IPS ’76 in Boulder, Colorado, and at the National Air and Space Museum the “Comet Halley” Symposium...

One of the interesting aspects of working in a planetarium is the opportunity to meet all variety of famous personalities: from astronomers to astronauts to politicians and then some. Not only can such personal encounters stimulate our own interest, but their stories can be used to also do the same for those who visit our facilities.

One such person that many of us may have had the chance to meet was astronomer and science popularizer Carl Sagan, who was just starting to make a public name for himself in the early 1970s when some of us were getting started under the dome. I was fortunate enough to have had three such encounters with him and these are their accounts.

In the summer of 1973 and fresh from completing my freshman year of college, I was contacted by my former high school Earth Science teacher to find out if I wanted to drive with him and another teacher I knew down to Cornell University in Ithaca, New York.

They had scheduled a get together with planetary scientist Dr Joe Veverka, who at the time was working on preparations for the Viking 1 and 2 missions to Mars. It sounded like a fun and interesting trip, so I readily agreed. I don’t know if any of us had hoped that we would run into Carl Sagan while we were there, but I was so convinced of its improbability that I did not bring along my copy of Sagan’s first popular science book, The Cosmic Connection, with me.

The influence of Cosmic Connection

This was a book that had a great influence on how I thought about both communicating astronomy as well as its interdisciplinary relationship with other sciences, such as biology and paleontology. Its change in my mindset also led me to write my first produced planetarium show in 1977—Nous Sommes du Soleil (We Are One in the Sun), about different ways of looking at astronomy through other sciences and what their connections could lead to—while I was still a graduate student at Michigan State University’s Abrams Planetarium.

It was a nice summer’s day when we arrived at Cornell and Dr. Veverka gave us the “cook’s tour” of the planetary sciences spaces in their building. One of the things that I will never forget was an experiment to test the roughness of Martian surfaces that might be observed by the two Viking orbiters circling overhead while the two landers performed their experiments on the ground.

Two thin half-circle arched tracks of aluminum ran side by side over the top of a large platform sitting on a table top. Riding on the two tracks was a camera whose reflectance readings were displayed on a monitor. By varying the angle of the camera along the track relative to the platform, they could get different readings based on the sun’s angle (simulated by a bright light source) and how it appeared when it bounced off of materials placed on the platform. These, in turn, would give some understanding of the coarseness of the surface material observed.

Believe it or not, but the day we went through the lab, they were testing the reflectance of breakfast cereal corn flakes to see how that type of surface material coarseness would look to the orbiting cameras. Just goes to show you that great science can come from the simplest and most unexpected of things.

Done with our visit, Veverka was walking us down a long hallway to the door when who should we see striding toward us but none other than Carl Sagan, dressed casually in button down-collar shirt and slacks. Veverka stopped him and introduced us (with me regretting leaving my book at home). He was glad to hear that all three of us visitors had liked The Cosmic Connection and then he went his way and we continued on ours to the parking lot outside.
Keep in mind that this first encounter of the Sagan kind was long before his many other books, the original *Cosmos* television series or the results from the planetary missions where he participated as part of the imaging teams. But it was still a huge personal rush and one of many special career memories.

**An encounter at IPS**

My second close encounter of the Sagan kind was at the IPS '76 meeting hosted by the then recently-opened Fiske Planetarium at the University of Colorado in Boulder. If I remember right—Mark and Caroline Petersen would know better than I since they were both associated with the Fiske at the time and it's where I first met them—Carl Sagan was the keynote speaker at the meeting.

This time I was going to be better prepared as I had been to the college bookstore and had bought his *Intelligent Life in the Universe*, co-written with Soviet astrophysicist I. S. Shklovskii. After his talk and Q&A session were over, Sagan stuck around and answered one-on-one questions and signed books. While he signed mine, I asked him if he would say hello to Joe Veverka for me, which, in hindsight, would have been impossible since he did not know my name, nor did he seem to remember me from that brief encounter in the hallway at Cornell (and really, why should he?).

Without slowing his signing, he challenged me by replying, “Oh, how do you know Dr. Veverka?” Being unfamiliar with Sagan’s more direct questioning style that we would see develop over the years, especially considering issues of science, I was somewhat taken aback and realized that I had tried to get a little too familiar based on an hour or two of contact. I quickly explained the summer of 1973 visit to the planetary sciences lab at Cornell, but again, not even a glimmer of recognition. Unimpressed, Sagan went on signing books and I left with a life lesson learned.

**On the third**

By October 1985, I was the program resource manager at the Smithsonian’s Albert Einstein Sky Theater (formerly the Albert Einstein Spacearium and later the Albert Einstein Planetarium, as it is known today) and was responsible for organizing a symposium in conjunction with our soon-opening show, *Comet Quest*, which—as you may have already guessed—was about Comet Halley, then making its latest pass in our skies through late spring 1986.

I had been very fortunate to get funding from M&M Mars (the candy people) as well as attracting some interesting speakers, such as the only American working with the Soviets and their two Vega spacecraft, the only American working with the Japanese Suisei (or was it the Sakigake?) probe, and one of the Americans working with the Europeans and their close-encountering Giotto that was going to get a flyby view of Halley’s nucleus from inside the comet’s coma.

I still needed a keynote speaker to kick off the whole thing and Carl Sagan readily came to mind. His *Comet* book with Ann Druyan had not come out yet, but he had talked about Halley’s current return enough that he would be a popular, colorful, and very informative speaker. Little did we know just how popular a speaker he would turn out to be.

Negotiations for having him appear at the National Air and Space Museum for the event had to be handled through The Planetary Society, of which Sagan had been one of three founding members. Knowing what I did afterward, I suspect the Society was also using it as a way to make them more widely known.

The person in charge of the arrangements from their side was Louis Friedman, their executive director. For some reason or other, he always reminded me of comedian Gary Shandling, except that he was super serious all the time and not the least bit funny.

Every time it felt like we were finalizing everything he would come back—keep in mind that this was long before e-mails and texting—with another condition that had to be met for Carl to appear. One that I still remember as perhaps being a little “over the top” was that he had to be escorted to and from the speaker’s platform—in our 450-seat then-named Samuel P. Langley IMAX® Theater—by an armed guard. In nearly 13 years at the Museum, I cannot recall any other time when such an arrangement had to be made for such a speaker. Not once for famous aviators, astronauts, artists, historians, or scientists. That in and of itself was not going to be a problem since all of our guards at the Smithsonian carried service revolvers, so it wasn’t like we would have to hire anyone special, but it did seem excessive and we had never had a problem before. But, we had to agree.

As in all such instances of having a well-known symposium speaker, there was a nice dinner in the Museum Director’s Conference Room up on the staff office level, though I remember very little of it as I, being the arranger, was mentally preoccupied with details, though I’m sure it was as fine as similar such meals in the past. It certainly was a collegial meal.

One small problem did present itself during dinner: there were far more people trying to attend the event than the Langley IMAX® Theater could accommodate: way more. One of the museum’s audio-visual technicians informed me of this and we quickly got permission to open up the planetarium so that people could sit in there and at least listen to Sagan’s talk. That took care of another 250. We might as well have tried to contain a bathtub full of water with a small paper cup, as the building was packed.

Then an AV tech hit on a great solution. If you’ve never been inside the National Air and Space Museum, the downtown building (there’s also another branch now out by Dulles Airport in Virginia) is made up of four giant stone cubes with glass spacer sections in between three of... (Continues on page 80)
Catching up: from the internet and in person

Susan Button and I had a great time at IPS regional conferences: we made it to MAPS and GLPA in 2018. Now we are gearing up for 2019 MAPS/SEPA and GLPA conferences, where we will see all our portable and stationary dome friends and learn all kinds of tricks of the trade! Credit: Dan Goins

(Editor’s note: Tom Button has been a familiar and always friendly face at conferences for as long as I have been an IPS member.)

Astronomy for Thinkers

We have added an update to the Portable Planetarium Resource page on the IPS website (www.ips-planetarium.org/page/portableresources). John Krieger notified us of his newly-configured website, “Astronomy for Thinkers-Resources for Active-Minded Astronomy Education.” John is a science teacher and on this site he provides some interesting articles and some free teaching aids that he has developed over the years.

One of the articles that might be of special interest to you is called “A Digital Home Planetarium: How to make a home planetarium using cardboard, a mirror, and a digital projector.” www.astronomyforthinkers.com/articles/digital-home-planetarium/

Free Astronomy Textbook

Andrew Fraknoi, emeritus chair of the Astronomy Department at Foothill College in California, announced, “Some 200,000 students (and more than 500 instructors) around the U.S. and the world have now used the free, introductory, open-source textbook Astronomy, published by the national, non-profit OpenStax project at Rice University.” The book can be read or downloaded in a number of different formats, including on-line, PDF, iBooks, Kindle, etc. at openstax.org/details/astronomy.

“This book is part of a program, supported by several large foundations, to make high-quality, peer-reviewed, introductory textbooks in all fields available to students without charge, and thus reduce the mounting costs of a college education.” In addition to Fraknoi, the senior authors are David Morrison at the NASA Ames Research Center, and Sidney Wolff, National Optical Astronomy Observatory. About 70 astronomers participated in the production and vetting of the book, and 24 more are contributing authors.

“The book is accompanied by an Open Education Resource Hub, where free ancillary materials by the authors and by your colleagues are shared. More than 25 different resources are already available, including a subject listing of free short videos for Astro 101, a listing of free lab manuals and lab activities, resources for teaching more about the contribution of women to astronomy, a detailed primer for new instructors, a guide to using the free Stellarium software, and much more. Just go to the Instructor Resources Tab at the above website.”

Resource Guides for Astronomy, Education

Fraknoi also is fond of resource guides of all types. He said “One of my special interests is producing astronomy resource guides to help educators, astronomy students, and the interested public figure out the best books, articles, and websites for researching a particular topic in space science or astronomy education.”

On his website Exploring the Universe with Andrew Fraknoi (www.fraknoi.com/), he has links to take you to some of the resource guides he has recently updated or compiled. If you find them useful or have suggestions for them, please let him know.

The full collection of resource guides can be found at www.fraknoi.com/resource-guides-on-astronomy-education/. Currently there are nine guides provided as both word documents and PDFs:

- Women in Astronomy: Their Accomplishments and Challenges
- Web Resources for Debunking Astronomical Pseudo-science
- Sources of Astronomical Images
- Free Lab Exercises for Introductory Astronomy Courses
- Copyright-free Images of all the Objects in the Messier Catalog
- Pluto, the Kuiper Belt, and Planet Nine
- Plays (and some Films) about Astronomers
- Light Pollution (and Radio Interference)
- An Annotated Catalog of Music Inspired by Astronomy

He writes that the last one is his newest and it is an annotated guide that lists over 250 pieces of music inspired by serious astronomy, including both classical and popular music examples. YouTube links are given for the vast majority, so you (or your students) can listen to them without expense.

Among the musical pieces included are:

- a Hubble Space Telescope cantata,
- eight rock songs about black holes with reasonable science,
- a supernova piano sonata,
- a musical exploration of the Messier catalog of nebulae, clusters, and galaxies,
- a moving song about Stephen Hawking.

(Susanne 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.)
SciDome includes an ever-growing library of educational applications, all designed to teach STEAM subjects in fulldome. Explore Earth and deep space, tour the human body, interact with 3D physics, stream 4K video to the dome, easily show and explore Unity models, and much more. Powerful teaching apps, and Spitz SciDome IQ projection systems, deliver the ideal solution for dome education.
Apollo 8: The Thrilling Story of the First Mission to the Moon
Jeffrey Kluger, Henry Holt and Company, New York, 2017
Reviewed by Francine Jackson, University of Rhode Island, Providence, Rhode Island, USA

It has been 50 years since the age of lunar travel began, and many of us who were alive at that time recall the thrill of the first men who actually flew there, orbited our neighbor 10 times (and becoming the first men in history to actually view the far side), and safely return exactly on time. This incredible feat assured the world that a trip to the moon no longer was science fiction. It was real.

But we are talking about events from a half a century ago, and, quite honestly, some of us who were alive at that time might not have been as aware of the journey as we should have, and there are a lot of people born after this event who do not know the story behind it.

Enter Jeffrey Kluger. His account of this historic venture has the reader virtually both on the space craft with the three astronauts and in the mission control center, monitoring every momentous second of this mission.

The author begins this book with the life of Commander Frank Borman and his rise through astronaut training and his successful two-week Gemini endurance trip, where he was first teamed with Jim Lovell. Borman, Lovell, and newbie Bill Anders became the crew of Apollo 8, launched on December 21, 1968.

They originally were scheduled for the 9th flight, but were bumped up to become the first to travel to, and orbit, the moon.

In addition to Apollo 8, the author goes through the history of NASA, from its early NACA (National Advisory Committee for Aeronautics) days to its mission of assuring that President John F. Kennedy’s words to land on the moon by the end of the decade were fulfilled.

Kluger’s sympathetic wording of the Apollo 1 disaster and the step-by-step reason why the three crew members of Apollo 7 never flew again are clearly documented, and through the book we understand how both missions were devastating in their own rights.

Because Kluger also wrote Lost Moon: The Perilous Voyage of Apollo 13, he was already very involved in the history of space travel and knew many of the people who were part of the Apollo 8 mission. This history led to participants being very receptive to giving the author any information he required to make this book well worth your time.

If you do remember the days of Apollo 8, or even if you weren’t born when it happened, you will be taken back to the days of the early Apollo program, and be well ready to celebrate the anniversary of what may well be considered the most important mission in the history of mankind.

18 Miles: The Epic Drama of Our Atmosphere and Its Weather
Christopher Dewdney, ECW Press, 2018
Reviewed by Francine Jackson

We all take breathing for granted. The atmosphere is just another part of our daily lives that is just there for us. But, when looked at very closely, it really deserves more attention than it normally gets. It takes the help of author Dewdney to allow us to sit back and appreciate it so much more.

First of all, he reminds us how small the atmosphere is: If we shrink Earth to the size of a basketball, the atmosphere would become the thickness of food wrap. And yet this thin layer, in addition to being vital for our continued life, is the scene of sometimes unimaginable weather occurrences.

The author recalls that in his teens, he became so fascinated by weather that he bought a home weather station from his Edmund Scientific catalog. It was then, upon its arrival, that his fascination became an obsession. The author revels in discussing the many ways that weather can take shape and change with no warning.

He speaks of a trip where he stopped during a snowstorm to catch a connecting bus that never came and how he had to survive until two snowmobilers found him buried in the snow.

He accounts how one person was once able to look straight up into the funnel of a tornado, and introduces us to the various steps in the makings of a hurricane and the formation of rain, sleet, and snow. Dewdney even has a chapter on how weather changed history, from thousands of years ago to the middle of the 20th century.

Without even reading the small biography of the author, the reader can easily tell that Christopher Dewdney is a poet; in fact, he has written 11 books of it, in addition to several nonfiction works. 18 Miles is completely readable, and, hopefully, gives the reader a new respect for the atmosphere that blankets our planet and keeps us so comfortably alive.

1 For a quick read about Apollo 7 and why head colds are not good during space-flight, go to https://en.wikipedia.org/wiki/Apollo_7

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.
On the Future: Prospects For Humanity
Martin Rees, Princeton University Press, 2018
Reviewed by Bruce L. Dietrich, Wyoming, Pennsylvania, USA

Astronomer Royal Martin Rees is a past master of Trinity College and director of the Institute of Astronomy at Cambridge University. As a member of the UK’s House of Lords and former president of the Royal Society, he remains very involved in international science and the thoughtful evaluation of modern technology.

Some 15 years ago Planetarian printed my review of his book Our Cosmic Habitat, including the words “This is a fine book for anyone with either a scientific or metaphysical interest in the cosmos.” The thin book now in my hand, On the Future: Prospects for Humanity, also engenders a very positive introduction, but also with a thoughtfully solemn aura.

This little gem is divided into four beautifully-crafted chapters providing broad perspective, personal anecdotes, some seldom-mined historical background, strong scientific emphasis, and hope: Deep in the Anthropocene, Humanity’s Future on Earth, Humanity in a Cosmic Perspective, and The Limits and Future of Science.

Rees suggests that our increasing population, with its increasing material expectations and supported by the abundant use of energy, will increase the Earth’s ecological stress beyond sustainable limits. Perhaps “sustainable intensification” will provide a pass, but if the benefits of innovation are to be spread world-wide, there will need to be lifestyle changes for all of us.

The text is powerful and the end notes, compelling. Until we can actually repurpose other worlds to serve as our home, humanity’s path is clear.

Our species has both the ability to visualize the Earth’s geological and biological future and increasingly to influence them. Will we make the correct choices in a timely way? Rees implores us to think globally, rationally, and long term, “empowered by twenty-first century technology, but guided by values that science alone can’t provide.”

Sun and Moon: A Story of Astronomy, Photography, and Cartography
Mark Holborn, 2019, Phaidon Press in association with the Royal Observatory Greenwich and the Royal Astronomical Society
Reviewed by April Whitt, Fernbank Science Center, Atlanta, Georgia, USA

“I make this book not as a scientist nor a historian of science. I am neither. I am a narrator. My arena is a place where images are arranged. I put them in an order and in so doing, I construct a narrative.”

Author Mark Holborn begins this beautiful book with those words. As planetarians, we arrange images, construct narrative, and order information for our audiences. This large (30x31 cm/nearly 12-inch square) volume follows images of the sun and moon, from Galileo’s 1609 ink wash drawings of lunar phases to the Sloan Digital Sky Survey’s 3-dimensional map of galaxies within two billion light years from Earth.

The whole book is arranged chronologically. It begins with the Knowth Passage Tomb in County Meath, Ireland, constructed 3000 BCE. The astronomical ceiling of the Tomb of Senenmut in Thebes, Upper Egypt was painted around 1460 BCE. A lacquered wooden chest from Suizhou in China’s Hubei province shows a sky map from 433 BCE.

The Antikythera mechanism, a bronze planetarium/computer/complex scientific instrument was built in Greece 150-100 BCE. Dr. Xenophon Moussas spoke about the device at the IPS conference in Alexandria, Egypt, in 2010, and Holborn’s book contains an image of a 2017 expanded model of all the features.

Today we can employ instruments to accurately measure the positions of the sun and moon. Scientists in the past have laid out stone circles (Stonehenge) and built huge brass-and-bronze celestial globes (Beijing Ancient Observatory in the 1670s).

And the intertwining of science and society winds throughout the book. Arab cultures used knowledge of the night sky, particularly in the Bedouin tradition, for navigation in a desert region. Time and direction are important in the Islamic faith for finding the direction of Mecca and confirming sunrise and set times, particularly during the month of Ramadan.

In societies dependent on agriculture, knowing when the Nile would flood, when game animals were ready for hunting, the correct times for planting, or when a harvest moon lengthened crop gathering time are all vital just for survival. Later, observatories were built to assist maritime navigation. Knowledge really is power.

In the early eighteenth century, the Rajput prince Jai Singh II began building the city of Jaipur. In the center of the construction, surrounded by a protective wall, is Jantar Mantar, the Jaipur observatory. His observatory wove together Hindu tradition with astronomical references in ancient Vedic texts, and Persian and Arabic influences in Islamic astronomy. Demonstrating his knowledge would make an alliance with the court of the emperor and establish political stability.

The Jaipur observatory’s massive stone devices measure the declination of the sun, the ascension of any celestial object, and the passage of time accurate to a few seconds. All this was done before telescopes with lenses or mirrors.

Magnifying rock crystal lenses from 750 BCE have been found in present-day Iraq and in Knossos in Crete. How they were used and how much the users understood about light can only be guessed today. But when Galileo drew his images of moon phases and Newton experimented with a reflecting telescope, they were part of the great scientific progress of the late seventeenth century.

Lenses in telescopes allowed observation of the large and far away. Microscopes aided advances in medicine and natural history. One fascinating section of this book is full of the details.

Once telescopes were used to observe the face of the moon, mapping that satellite began in earnest. Cartography relies on accurate measurements, and mapping our own planet required some way to compute longitude. Sailors could easily determine latitude by timing when the sun was at noonday height, but longitude was “dead reckoning” for decades. Dava Sobel’s book Longitude is an excellent source for that particular story of “injustice, deceit, ambition, rivalry and the usual base instincts.”

Quadrants and sextants gave way to John Harrison’s portable clocks, which allowed accurate calculation of longitude. Cartography bloomed with maps of the outlines of continents in correct relation to each other. Maritime trade became safer (and more profitable). Captain Cook left on voyages of exploration (and transit observing).

The third section of Sun and Moon details “Selenographia” with images of the instruments used to observe the moon, mechanical (Continues on page 80)
Portable Planetarium Presentations

Lauren Ard writes, “I made it to the big time! The Grand Canyon hired me to participate in their centennial celebration. I’ll be giving planetarium shows all day long on May 31. The planetarium shows are free with your national park admission! "I’ll be doing planetarium shows at the Grand Canyon visitor’s center. Portable Planetarium Presentations is a small business in Tucson, Arizona. Our goal is to make astronomy education an interactive, exciting experience for everyone involved!” Contact Lauren at laurenaeard@gmail.com, and you can follow her on Facebook.

Explicit/Implicit Memory

I keep trying to get a deeper grasp of what my husband, Tom, is going through and, to that end, I have been reading a book called Alzheimer’s Disease and Dementia, What Everyone Needs to Know by Steven R. Sabat. Having just finished a chapter on explicit and implicit memory, it occurs to me that this is good information for planetarians too!

First let me define explicit memories. These are the memories we develop through conscious learning. This is the kind of memory that helps us learn some facts presented in planetarium programs, like the characteristics of planets, constellations, and star names etc. Many people remark that they do not remember many facts from a one-time visit, but they remember developing a life-long love for astronomy/science after just one visit. This brings us to implicit memory: the ones people make unconsciously. We planetarians should always be conscious of the unconscious memories that are being made.

If planetarium shows are remarkable enough, without any effort our visitors will take away positive memories that can last a lifetime. Not only must our presentation be an excellent visual and auditory experience, it needs to be unique, possibly through creating cognitive dissonance and then problem solving, and through personal contact with a human guide (a talented presenter).

Planetariums in general are unique spaces where sights and sounds are different than a theatre. Portable planetariums, in particular, provide a small intimate environment, which is perfect for personal interaction and intense auditory and visual experiences. In these small environments every presentation can be different from the others because the presenter can direct the experience to accommodate each group’s needs and interests.

Visitors can sense that it is a special presentation for their group; they develop a strong personal relationship to the presenter, the other participants, and the content; this expands the strong positive (or negative) implicit memories that can be created.

Now let’s go back to people who suffer memory loss or dysfunction. This is a group with special needs and we can address those needs with the same courtesy, respect, and sensitivity that we show to all of our visitors.

They may not be able to make new explicit memories, but they can make new implicit memories. We can give them the opportunity to make these pleasurable memories and add to the quality of their lives. This can be a new area of research and may be appropriate for people in the early and midlevel stages of dementia and Alzheimer’s.

Another example to explore and learn from is sensory-friendly films. Some movie theaters are providing safe and accepting environments where the lights are turned up a little and the sound is turned down a little. Read more at www.autism-society.org/get-involved/other-ways-to-get-involved/sensory-friendly-films/.

There is not enough room in this review to describe the final man in space images as they should be described. The iconic images of Earth from Apollo missions, the Voyager mission golden record, the Hubble Space Telescope images, galaxies, planets, and the Powers of Ten sequence by the Eames brothers—all are worth the price of purchase.

My only quibble is the book’s font size. I understand that it’s necessary to fit all the information in, but my aging eyes had to take it in over several weeks. This is a unique presentation of astronomical history and art, and I highly recommend it.
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E&S welcomes the newest member to our team

Estelle Pacalon - Show Distribution and Sales Manager

“I’m excited to begin this international adventure with Evans & Sutherland. Thanks to its expertise and long history, E&S has always been a reference point for innovation within the industry. They are the largest producer of fulldome shows and I’m looking forward to distributing their extensive library.”
Final master plan approval workshop

A best option or hybrid option was the direction established in your previous preliminary brainstorming workshop. To prepare for the final workshop, this best option should be analyzed and refined by your architects or engineers, based on your input.

As a planetarian, your role will be to make sure you understand the plans and drawings, and how spaces will operate and flow for your programs: shows, teaching, presentations, events, or whatever functions you may offer. Ideally, the best option plans should be sent in advance to all the workshop participants so they have adequate time to review and digest the master plan. You should also compare the best option against your master plan checklist, and communicate your evaluation to the whole team in advance as well.

The format for the final workshop should be similar to that of the preliminary workshop. In this final workshop, the team should review the drawings, identify any tweaks that the architect or engineer should make, and approve the revised plan. You should also review the budget and schedule to make sure everything is still on track with funding and timeframe your leaders and stakeholders approved during the design brief.

To complete the master plan, your design professionals will then refine the plans to incorporate any tweaks for use by the design team going forward. You may also choose to have the team produce presentation-quality color plans, and perhaps 3-dimensional renderings or physical models, since these are effective tools for fundraising and public communications.

Outside-in

If you have difficulty understanding drawings and plans, a great way to visualize what your master plan will look like in the future is to use other planetariums as a reference. Images or photos from the web or from our own IPS resources and providers (https://www.ips-planetarium.org/page/resources), or from your own personal experiences, can help communicate your ideas to the team.

Trees, sun and stars ... and water

Outside outside space. Out where there are noises in the woods. Out where your eyes hurt when you walk out of the dome. Out where you can see the Milky Way, hopefully. Out where Ken Brandt needed a canoe to get to the Robeson Planetarium, after his saga of hurricane floodings recounted in last quarter’s installment. Outside the planetarium building is this quarter’s Planetarian subject, the second and concluding section on Master Planning.

Are you slightly curious about how to actually create a master plan? It’s simple. Just balance the outside-in and inside-out forces, just like in particle physics. In the second master plan workshop described below, your team will find a consensus solution, first working with the outside “givers”: environment, context, neighborhood, and adjacent land uses, streets, and utilities which surround your site.

“Elements” are the land areas, building functions, and spaces which must then fit inside the site boundaries. A simple problem: balancing in three dimensions. To continue to illustrate how to create this balance, again using the Robeson as our hypothetical case study, below we will return with Ken Brandt to explore the possibilities for rebuilding on the existing site of the old unsalvageable planetarium.

One last thing before I forget, you also have to balance your master plan in the fourth dimension. The master plan should consider long-range phases for growth, and what your planetarium will be like in 50 years, like the Robeson. Chief Seattle¹ said think forward seven generations. Still curious? Dr. Brandt will grab his scope and look into the future. Just like in astrophysics.

¹ An American Suquamish and Duwamish chief for whom the city of Seattle, Washington, is named. See en.wikipedia.org/wiki/Chief_Seattle
If you have difficulty understanding outside-in, here are several photos of planetariums which relate well outside to their environment and surroundings. Outside forces are called “givens,” since typically your planetarium project has to work within what has been given to you in the way of views, access, or adjacent buildings. Often planetariums are part of another larger new building such as a museum, science center, or a school as well. Even if your project is a retrofit or renovation of an existing building, a master plan is still an essential tool for guiding your planetarium into the future.

The Adler is well-known both for its programs and cool location on the shores of Lake Michigan. The water, parks, and adjacent museums provide a great context for the stand-alone planetarium and museum, with the Chicago skyline as a spectacular backdrop.

In an earlier article, we noted that the glass walls of the Hayden in New York City visually connect the planetarium to the plazas and streets of the urban fabric, and its transparency creates excitement and interest to attract visitors.

Familiar to planetarians, the Beijing Planetarium, host of IPS 2014, also uses curved glass walls to showcase their several planetarium and theater venues inside and create a fabulous backdrop for the plaza in front, while respecting the outside space around the original historical building, the first planetarium in Asia.

Like the Hayden and Beijing, the Niebo Kopernika Planetarium in Warsaw (also familiar as host of IPS 2016) is part of a larger science museum building, but is pulled out as a separate structure, creating unique relationships within its context adjacent to the river, park, and trail. Did you know there is a major highway and parking garage hiding underground, under the green parks along the river next to the Kopernika?

The NorrköpingsVisualiseringscenter in Sweden is also part of a larger complex of historic buildings and warehouses, but it was limited to only a small visible element on the outside to hint about the visualization center and planetarium inside. However, the planetarium creates its own dramatic identity by connecting to the outside with inside views to and from the river and walkways.

The Casper Planetarium may also be familiar to planetarians, since Casper was on the totality centerline of the 21 August 2017 solar eclipse. Casper is much more similar to the Robeson; it is stand-alone, medium-size, hides the parking in back, and connects well to the street for visibility with an inviting entrance. With a welcoming scale, natural materials, and a setting amongst the grass and trees, Casper appeals to visitors and schoolkids with its own magic!

**Inside-out**

The Robeson space requirements, or “elements,” were defined during the design brief, the previous step in the design process, in the schedule of accommodation. To easily comprehend the quantities, the visual schedule of accommodation shown here comprehensively illustrates all the space elements at the same scale. This is all the stuff that has to fit inside the site.

**Big rocks first**

Although at Robeson we don’t yet know the precise site dimensions, we have made a reasonable estimate of the size, and at first impression this may appear to be a challenge. It might look like that science problem in which you are asked to put 1-litre containers of water, sand, and pebbles, and several big rocks, into a 3-litre container. The solution is the same in master planning: the big rocks first. Start with the best position for the dome, then proceed with the smaller and more flexible elements. Big rocks first is even more important if you have an urban site with a large audience size and a small land parcel; your master plan should be a vertical multiple-story solution, starting with the ground floor.

In master planning for the early 21st century, auto parking will take up a lot of your precious land area, but it is flexible and can be subdivided into smaller elements and perhaps woven into the landscape. By the end of this century, we hopefully will have other, better means of transportation: bikes, cycles, public transit, on-demand, self-drive, portals, whatever. And then, what used to be a parking lot, will be torn up and turned into paradise.

(Continues on next page)
Back from the future

Speaking of the late 21st century, we have to go meet Ken when he comes back from the future with his research for the master plan phasing. Ken said at the Robeson sesquicentennial in 2119, a grand opening was held for the new Aquadome and Fluorite Teaching Lab.

Start with the maximum you could ever want on the site, even in your wildest dreams. Next, add a reserve part of the land as TBH, to be held, as a place for future generations to build their dreams too. Finally, work backwards from that distant future to a nearer and more knowable future, and ensure that phase one will work for your initial programs, budget, and schedule on opening day.

An Even-keeled Option

What then does a well-balanced master plan look like? A carpenter would look for things to be on the level, a veteran sailor would look to be steady, even-keeled. For the Robeson, as a replacement project on an existing site, the new plan will look a lot like the existing plan. The roads and trees will be the same. Like the sequential additions to the old building, a new Robeson could be built in multiple phases, with a TBH area held for future unknowns, future generations. The TBH area could be used in the short-term for open space, or to allow for additional parking, if needed.

The dome will be the most visible element on the site, and will provide a visual landmark to guide visitors to the site. School buses should have a separate circulation route, with safe sheltered pathways to the building. Good quality connections should be provided for all means of transportation: sidewalks, especially to the public transportation stop, and bike paths and bike racks. Convenient accessible and priority parking should be linked to the entry.

Support and service areas should be hidden from view as much as possible, and consider landscaping or screening to block unwanted views to adjacent land uses. Connections should also be made to the forest and old schoolhouse, both of which could offer additional learning venues at the site.

Consider providing many learning space options on this campus, which could allow a class to spend an entire day at the Robeson: multiple planetarium shows, exhibits, classrooms for traditional and alternative instruction formats, and labs for hands-on experimenting and maker space teamwork.

Include brown-bag lunch space, primarily outdoors, with indoor flex space for bad weather. The existing Robeson site worked well for almost 50 years and has many good features. Reuse of the site would allow other school district lands to be allocated to traditional classrooms. Take advantage of the natural beauty of the site and forest; it can provide a balanced backdrop or the building. An even-keel.

In next Planetarian installment

When are we finally going to get to the building design? For those of you who have followed the process from design brief through master planning, you can be confident that in next quarter's next step, Concept Design, your evolving design will work well for your programs in your new planetarium, and it will be feasible to build a good quality building within the approved budget and schedule.

For those of you who said, “skip this preliminary stuff, let’s just jump into design,” ok, good luck. You can still get a great building and cool planetarium by skipping the preliminary steps, but you will be following the “back-to-the-drawing-board” process.

As mentioned before, this is not a good idea. You may have many more iterations of plans, spend three to four times as much on design fees, delay the schedule, and have a lot of frustrated folks. Note that the month or two spent up front preparing for design is a small fraction of the 2- to 4-year timeframe to complete construction.

There is a direct relationship between the value of decision-making and project cost. As shown in the value diagram below, the decisions made in the early stages of the project are the most valuable, since the cost to make changes is very low in the design brief and master plan steps, only the cost of meetings and revising analysis and sketches. When you get into construction, and the concrete starts pouring, the cost to make changes skyrockets. Think twice about skipping steps in the process.

The sequence of upcoming Planetarian articles will continue to follow the sequence of a typical design and construction process, as previous articles have. In Concept and Schematic Design, the next steps, complexity increases, and the design will progressively become more detailed. From time to time, we will add articles that complement the design sequence, and dig deeper into specific more complex subjects, such as accessibility, dome-support structure, air conditioning, and fire sprinklers. And most importantly, in Outside Space, we want to be ahead-of-the-curve, so new technologies will be explored even if they might still be in that virtual vapor visualization stage.
Design Concepts

As is our usual custom, here are some additional concepts for master planning design ideas, again using the Robeson Planetarium's existing location as our case study. Please use the concepts in any way to help your project. And if you have cool ideas or images, please send them to us to share with all the IPS community. The whole set of diagrams are posted on the IPS website here: www.ips-planetarium.org/page/2017DesignGuide.

In master planning, the position of the sun is most critical to designing a building that responds to natural light and is energy-efficient. The solar “dome” diagram used in building design looks towards the northeast for Robeson, and shows the path of the sun across the sky, by hour, by day, by season, projected on a portion of a hemisphere placed on the ground.

This audience of planetarians should be able to understand this diagram, where the red line indicates the equinoxes, and is representative of the path the sun would follow on a single day. The outside edges of the yellow band are the solstices, and indicate the extremities of the sun’s annual path. The sun path diagram shows how the 3-D dome is projected on the ground, in plan, in 2 dimensions, in Robeson.

Other significant master planning forces or “givens” which should be considered, to be illustrated in future Planetarian installments, include: air quality, topography, soils, and regulations from public codes and ordinances. In our case study of a hypothetical Robeson replacement, the building will be one story and the site is relatively flat, so we can continue to work in master planning in plan view only, in 2 dimensions. The existing site geometry is still to be confirmed, as well as the soil conditions and utilities, and of course what solutions can be engineered to control storm water.

You can apply these concepts to your specific planetarium site geometry, environment, and latitude and longitude. Your team of professionals can easily merge your concepts into their digital design and construction models common in the industry today.

In many cultures throughout history, the sun and star positions were critical to their survival, and were reflected in ancient architecture and city planning (more on that in future concepts too). Many planetariums not only mark the four cardinal points inside their domes, but both the dome and building are oriented to those four points.

But why stop there? Planetarians want to be able show where we are in the universe! For designing a plain-old building, good-old Sol is the primary outside force. But a science-hungry teenage girl, in Robeson County, may want to know where to look in the sky for Sagittarius, and a more precise number than 40,000km, from 34.6275844°N, -79.05954838° W, to V4647 Sgr. And see where we will be in the future universe!
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How do you easily transport a telescope on a tripod mount through a normal-sized house door?

This sounds like a riddle, or possibly a joke, but it’s a question that has taken many years of consideration. The answer sounds easy. Get something like a wheeled tripod holder.

- It turns out that it is more complicated than that. I had a few requirements that were not addressed with a commercial mount. They were:
  - It had to be easy to make.
  - It had to hold the weight of the equipment with no flexure.
  - It had to use hardware that was robust and not allow the tray to wobble on its feet.
  - It needed to be able to go over doorway thresholds.
  - It needed a tray surface with side walls to hold and contain eyepieces, accessories, etc.
  - It needed to allow the weight of the telescope and mount travel through the tripod legs and, as best as possible, direct that weight straight down to the ground. I.e., not have a foot that makes contact to the ground and be separated from where the tripod makes contact with the tray.
  - It had to have large, wooden feet to spread out the load, to absorb some vibrations, and to provide friction. And,
  - It had to fit through the door!

You might think that these points would be considered with a commercial mount, but they are not. My ideal concept was to have casters attach to the telescope tripod directly, but this was quite complex and I wanted to keep the project simple. It would also not allow for a nice tray.

My final design was a compromise to keep all the features I wanted to the best I could create and keep the construction easy. I think the one thing that came close to not working was the size of the tray. Because of the size of my tripod footprint (a Losmandy folding HD tripod with the legs fully retracted), the tray ended up being j-u-s-t small enough to fit through the door. The other non-perfect aspect was that you have to manually spin the two nuts for each foot, which can be tedious. Otherwise, it works as planned! I can leave the entire scope, mount, tripod, and accessories all set and ready in our office.

My process for setting up is easy
1. Roll out the scope.
2. Align the tripod to north (as best as I can) using a compass. One of the tripod legs should be pointed north. (Note: make sure you are compensating for magnetic declination!)
3. If I’m traveling, set the latitude.
4. The mount I use is a Losmandy G-11. It has bubble levels built in aligned to N-S and E-W. I lower the front foot, which is aligned with north, until level. Since you’re raising the tray to get the casters off the ground, the lower nut is now acting as a screw lever to do this. To make it effortless, I use a very large wrench as an extended arm.
5. I lower the back two feet to the ground and lower the proper one more to level the mount.
6. I snug all the upper nuts. This tightens the whole assembly and makes everything rigid.
7. Observe!

Points to note
The small, loose, wooden triangular piece holds the tripod leg down for transport so it won’t pop out going over a threshold. It also clamps the tripod down when observing. It is removable on purpose if I need to remove the tripod. The small spacers on either side of the tripod leg keep the leg from shifting back and forth.

Amazingly, if I only roughly point the scope to north, have the correct latitude, and level the tripod, I am very close to polar alignment. For visual observing, this is usually fine. Even at ~250X, a planet will stay in the field of view for 15-30 minutes without adjustments!

Construction
As stated before, I wanted to keep it simple. The base is made from a ¾” sheet of plywood cut in a triangle. The mitered corners were done at the end of the project after the side rails and the loose piece of wood were cut and assembled. The miter cut was done to all the pieces at the same time with a miter saw.

I wanted the wooden feet to be as close to the tripod feet as possible. But, in order for the bolt that holds the feet to be accessible, it pushed the wooden feet out just a touch. The large wooden feet allow for the scope’s weight to be directed back under the tripod feet and to spread
out the load at the same time.
The caster's mounting plate is partially under the tripod feet, allowing the scope weight to also travel down to the ground. Unfortunately, the caster is inside the footprint of the tripod. Having it outside would have made the transport more secure, especially going over a door's threshold.
The loose wooden piece holds the tripod from popping out. Rolling on the deck is very smooth and easy. I also made the wooden feet out of pressure-treated decking material as it could be in contact with wet ground.
Milling the feet was a small challenge. I wanted thickness to the feet, partially for stability, but also to accommodate the nuts and lock washers. This meant using a Forstner's bit that was large enough to allow the body of a large, 1 ⅛ inch socket to tighten the nuts. The bit was 1.5 inch in diameter. (A Forstner bit is a drill bit for wood that cuts a flat bottom. In order for the nuts to fit, I used jam nuts, which are about half the height of a regular nut.)
The wheels are 5-inch non-marring rubber casters. The larger size allows for the tray to clear the door's threshold and for smoother rolling. Be aware that when the wooden foot is raised all the way, it only allows for about 2.5 inches of clearance.
I used locking casters because that is what was available. It is not necessary, though nice if it is needed.
The trim for the side rails is ⅜ x 1.5 inch. This is enough to hold large objects from rolling off, while not making the large, threaded rod longer to allow for the feet to drop and level the tray. The trim is attached with only five screws that come up from below the plywood sheet. An additional screw is attached from the side at the ends to join the trim together. I’ve already mentioned the small shims to keep the tripod legs from shifting side to side. The tray ended up being large enough to easily hold the eyepiece bag you see in the photo along with battery and wrench.
The final cost of the project, to me, was about U.S. $75, but I already had all the wood. I think the whole project could be done for about $100. To keep the cost down and to find such large hardware, I visited a local builder's hardware store that sells, essentially, by the pound.
I hope this is a project you can do to make your observing easier. I know it has helped me. If you have any questions, please ask.☆
A Different Point of View

As we continue into the look back at the “2009 International Year Of Astronomy” (and it doesn’t look like we’re doing another one anytime soon), I kind of wonder what was the need for it in the first place. The general consensus some 10 years ago was to get people out and look up at the real sky by attending star parties and the like. The heck with that, I want people to come to my planetarium shows, or worst case scenario, come to a combo of planetarium show and then live viewing. As we look forward to the 100th year of the planetarium, we might just get the horse properly before the cart and place the dome room first in the minds of the general public.

Since I have no idea how well my first little ditty on the planetarium went over with readers of my March column, I will force upon you another of the spectacular arias from the (rock) Opera “Beyond The Sixth Magnitude” (Copyright Gareron Music, used with permission).

“Ode to The Star Party vs. The Planetarium”
You could go outside but it's not the same, for those of us who play the planetarium game.
You set up a tripod and then a scope, and once set up you begin to hope.
That some people will come on by, and enjoy what your looking at up in the sky.
It took some research and a bunch of cash, for you to join in this observing bash.
The people who come begin to scatter, before looking up but it doesn’t matter.
The clouds come in and cover the sky, and you begin to wonder why oh why.
The temperature plummet and you begin to fear, about that storm that appears so near.
So you hurry and stumble to pack up your gear, and wonder why you ever came out here.
You could have entered the dome and sat right down, in a room that's truly environmentally sound.
So you dim the lights and what do you get, a sky so bright, it’s hard to forget.
So how do you get the best of both worlds, it's not a choice between swine and pearls.
Just have an observatory very near by, and have your choice of both kinds of sky.

This (and the opening overture last issue) are part of a larger collection of works from dedicated amateur planetarians who don’t have much other to offer for the 100th year celebration of the invention other than perhaps a new ditty for every issue before the magic year of 2023. Thank goodness this is not a monthly publication as I don’t think I could come out with that many fantastic poems/songs. Anyway, on to more usual things.

Keith’s captured quips, chapter seven
“Next time I would like to see Star Wars” (I wonder how many viewers think of a planetarium as a movie theater now.)
“Thank you for keeping us up at 2 o’clock in the morning.”
“I’m going to try and drag my parents there...”
“...I was in Reno a while ago and went to the planetarium to watch a show but we were ten minutes late.”
“The star projector was huge compared to my next door neighbor’s one.” (No, he doesn’t live next door to Lonnie Hammargren, former Nevada attorney general who did buy the Fleishmann Planetarium’s original star projector when we upgraded. Maybe his neighbor has a telescope?) (Perhaps his neighbor has a Spitz Jr.-Ron)

Ten years ago
June 2009: This marks the “International Year Of Astronomy 2009” (you can believe that was 10 years ago).
The front cover offers an actor portraying Galileo, live under the dome. Funded nationally in Canada, each planetarium would receive a script, fulldome background visuals, and a sound track with narration and music. Each individual planetarium would provide a live actor to play the part of Galileo and interact with the backgrounds and prerecorded track.

I must say I really like this idea. The problem I’m sure is the added expense for the live actor to be available for each presentation would become prohibitive, but just think of the impact on the audience.
Every time I see the name Ray Worthy, I am saddened at the loss of this most generous man. It seems that 10 years ago he gave up the production of his portable dome as his eyesight was failing, and rather then make an inferior product he would make none at all. Alas, integrity seldom found anymore.
But that is just this man’s opinion. And isn’t that what it all boils down too, our own opinion on what is good or not good? A new column started by Steve Case in the previous issue, “Planetarium Show Reviews,” evidently generated some feedback and the addition of multiple viewpoints.
Now being opinionated can be deadly because as you stick your neck out, someone, somewhere, is sharpening an ax. Luckily I’m just this old opinionated eccentric weirdo that reports on things that happened at least a decade ago, so I can be easily dismissed, but Steve actually requested “points of rebuttal.” Now how can this old Chicago boy not walk through that open door?
“Planetarium shows are not movies” and he thinks we all agree on this. The question is it doesn’t matter what we agree on, it’s what the audience thinks that really counts, and I’ve read enough comments that a fair number in our audiences think we are indeed big movie houses. (If it looks like a duck and swims like a duck, then it is a duck.) And this comes right down to the long list of credits at the end of the production. I can certainly agree with him on this point, because when
the credits roll the “movie” is over and people tend to stand and leave. Again the duck thing.

Now I personally don’t think the fellow who holds the producers limousine door open necessarily deserves a screen credit, but I’m not the guy holding the door, am I. No one cares either, which is why people start to leave as soon as the credits start. Now I am old enough to remember when the credits ran at the beginning of a film and it just ended with “The End.” Perhaps this is what’s needed for planetarium shows so that the live portion can jump right in after the movie part.

“Please decide whether or not to use metric units.” Well, Mr. Jefferson just didn’t push hard enough and we’re stuck! Even today, most people just don’t understand (and don’t want to learn) a new numbering system. If they don’t understand, they check out and don’t stay engaged.

“If you can’t create a good graphic, use a photograph.” Now we need a copyright lawyer. Even if a NASA picture is available to us as free, I don’t think you can use it for resale in another project. Keep it under our ownership even if it’s a stick figure of the Milky Way. (How many are now thinking this is a really cheap movie with bad special effects.)

With apologies to Steve Case, I will get off my soapbox now, but remember, you opened the door, even if it was a decade ago. And for those of you pondering what the heck I’m babbling on about, check out page 50 of the June 2009 issue.

Ed Lance, in his “The Planetarium: A Transitional Animal” article, mentions the dome as being a great place to pick up your video game controller and drive a moon buggy through an obstacle course, playing against another visitor. Would it still be called a planetarium, or would it be a digital playhouse?

Twenty-five years ago

June 1994: “A Sky Promoter’s Ten Commandments” conducted by Jon U. Bell begins our quarter-century look back:

1. Do Not Promote Esoteric Sky Events.
2. Delete this phrase from your vocabulary: “Once in a lifetime.”
3. Do not undercut other planetarians needlessly.
4. Do not try to “scoop” the competition.
5. Do not promote astronomically high meteor counts.
6. Keep all information dispensed to the media and the public as accurate as possible.
7. Don’t invent your own names or theories.
8. Make allowances for bad seeing conditions.
9. Know your viewing region.
10. Avoid any endorsement opportunities.

Richard McColman explains how he built a “warpspeed effect” projector out of a surplus overhead projector. He only spent $10, not the three million that Chicago wanted for theirs’. Now this is my speed, and I might try to make this.

From “Scriptorium,” Alan Davenport presented James Manning’s “Voyages.” This well-written script bounces from the exploration of Earth to the exploration of space. Humans will always explore, be it on sailing ships or space ships, because it is part of our nature, and this script will keep the audience totally enthralled.

An example: “We have always climbed the hill, and crossed the ocean. And it was just inevitable, when the last earthly sea was crossed, that we would turn at last to the greatest ocean of all...it stretches away from the shores of our little Earth for ten thousand million million miles and more. We name it ‘space’; it is the largest ocean we shall ever know.”

I don’t know about you guys, but that is great writing to me.

Forty-five years ago

June 1974: In a Letter to the Editor, Thomas Wm. Hamilton reported on his visits to Munich and Paris and the planetariums therein. In Munich, he found the planetarium show lasted about 20 minutes and the same show ran for a full year. He compared this with the planetarium in Paris, which had programs that changed with the seasons and rotated daily.

Music in the planetarium, the topic in an article in June 1973, spurred several others to share their thoughts on this subject area. The submissions by Tim Clark from the Strasenburgh Planetarium (Rochester, New York), Dwight Gruber from the Oregon Museum of Science and Industry (Portland), R. John Steiffer from Thomas Johnson Junior High School (Lanham, Maryland), and G. Henry Sultner from the Dallastown Pennsylvania Area School District, prove that picking music is in the ear of the beholder. Basically if you like a particular kind of music, you will use it no matter what others think.

For me, good music is virtually anything that doesn’t require a drum set. (A timpani is not part of a drum set, in my humble opinion.) Yeah, I like classical music, and I like movie soundtracks partly because that is where classical music went to. What is interesting is this old music is new again because most of the younger set has never heard any of it. So now my old music is new again. Just watch out for those movie soundtracks.

When I go from a light polluted sky to a dark sky view I use a cut from the soundtrack to Disney’s The Lion King (animated version 1994) where Mufasa appears to his son in the clouds. One younger visitor recognized it immediately...bummer. I will replace it—heck no, I like it and so it will stay.

2 If you’ve forgotten this political faux pas (and the people at the Adler Planetarium certainly have not), check out this response by Astronomer Phil Plait at www.huffpost.com/entry/why-does-john-mccain-hate_b_133178.
radio would jam the airwaves trying to talk to them.

I found the engineers, lacking a proper education, had invented their own vocabulary. I heard constant reference to something called the “central angle,” and after a couple weeks finally asked for an explanation. One of the engineers put on his most gracious face and deigned to explain. With seconds I said “You mean the true anomaly!” I had to explain to him (and some evedroppping engineers) that astronomers had been dealing with this since Kepler's day over 300 years earlier. I wound up giving a brief impromptu class to bring them up to date on ordinary terminology, but they did invent one pair of new terms: pericynthion and apocynthion. The closest and furthest points in an orbit around the moon, based on an ancient Greek name for the moon goddess.

My main job for the three years on Apollo was determining a back up technique for lunar orbit rendezvous, radar accuracy requirements for the on-board radars during the return of the LM from the moon to the orbiting CSM (Command and Supply Module), fuel usage for the RCS (reaction control system), and a few other minor issues. Calculations were mostly done on an IBM 7094 computer, only recently upgraded from a 709. Materials were sent to a central computer room and came back the next day. A small IBM 1620 sat near us and was available all the time, but it could not handle six degree of freedom problems.

By the time the first landing took place, I was working at Viewlex, writing canned shows for their Apollo model planetarium. For the landing I bought my first television and held a three-day party, attracting a couple dozen friends, one of whom brought his own TV, so we were always tuned to two different networks, switching if one dared carry a commercial.

My only disappointment was that the broadcast from space was not interrupted by an alien voice announcing we had qualified for junior membership in the Galactic Federation.

Shasta Visions caters to the spherical

For people inclined toward the spherical, there’s a shop located at the base of Mount Shasta in Northern California that has exactly what you crave.

It’s called Shasta Visions, and has been designing and producing marbles, globes, and spherical gifts since 1987. If your gift shop is looking for products to stock for the Apollo anniversaries this year and coming up, Shasta Vision sells wholesale as well as to individuals through its website at https://marblesglobesgifts.com/ They market through fine gift stores, museums, planetariums, catalogs, theme parks, and more. Shasta Visions globes are made in the USA.

Its vision and mission, according to its website, “is to inspire caring for the world by creating beautiful products that express love, build awareness, and communicate peace.”

New books: India’s Planetariums, universe’s spring

Dr. Jayanta Sthanapati has authored the book History of Planetariums in India: 1954-2018, a comprehensive historical and technical account. It is an academic endeavour by Sthanapati, an eminent researcher in the history of science, who was director of National Level Science Museums in India for more than a decade and retired as the deputy director-general of the National Council of Science Museums, India.

The self-published ebook is available from a variety of stores; you can learn more at https://books2read.com/u/4AJYZN. It is the second volume of a series of books on History of Science Museums and Planetariums in India, also by Sthanapati, and is the outcome of a project completed under the sponsorship of the Indian National Commission for History of Science of the Indian National Science Academy.

According to the publicist, “We believe it to be only of its kind available in the literature. The book will be a perfect link between formal and informal astronomy education for teachers, students and interested readers.”

From India, we will go to Greece, where Dionisis Simopoulos, retired director of the Eugenides Planetarium in Athens, also has written a new book titled The Spring of the Universe: The first steps and its evolution. The soft cover book was released in 2018 by Metaichmo Press; ISBN 9786180316483. The book is available only in Greek.

Add Figment Effects to your toolbox

Every fulldome producer has a toolbox of programs, scripts, and tricks to make their lives easier. Figment Effects Shop needs to be there among the screwdrivers, custom effects, Photoshop, and Blender. Founded in 2013 as Full Dome Stock Footage, the company says its goal “is to make available our easy to use software integration technologies that enable maximum workflow efficiency for fulldome content creators.”

Each month Figment Effects Shop releases a new toolset and/or
Hermann B. W. Mucke
March 1, 1935 – March 12, 2019

Former head of the Vienna (Austria) Planetarium, Hermann Mucke passed away on March 12, 2019 at the age of 85.

A significant promoter of amateur astronomy in German-speaking Europe, he studied physics at the Vienna University of Technology but under the influence of his teacher and mentor Oswald Thomas he soon took up the challenge of adult education in astronomy.

In 1964 he was made head of the new Vienna city planetarium and made it an internationally-reputed institution during his directorship. From 1971 onward Mucke was also the scientific director of the Urania educational observatory.

On occasion of his retirement from both positions in 2000, the asteroid 7074 Muckea was named in his honor. In the months preceding the solar eclipse of August 11, 1999, the media referred to him as Mister Sonne ("Mr. Sun").

Mucke’s most significant scientific achievements were in celestial mechanics and in historical astronomy. He collaborated with Jean Meeus to compile a catalog of solar eclipses, and later another catalog of lunar eclipses. For a considerable time he was particularly concerned with comets, and published a catalog of comet orbital elements.

Although technically in retirement, Mucke continued to embark on new projects. Taking up a concept of his teacher Thomas, he designed and established a public celestial observation post with various multimedia enhancements (the Sternengarten) close to the Wotruba Churchat the Georgenberg, a hilltop in Liesing on the Southwestern outskirts of Vienna. He continued to manage the Astronomical Bureau and to edit the Sternenbote, a monthly scientific periodical for German-speaking amateur astronomers which Mucke had founded in 1957. Source: Wikipedia, https://en.wikipedia.org/wiki/Hermann_Mucke_(astronomer)

Screeshot of flat screen tutorial

tutorial for free in order to improve fulldome content production workflows around the world. Newly-released is a tutorial on how to convert fulldome masters to flat screen 16:9 video, useful if you need to share clips or previews on social media, YouTube, and/or Vimeo. You can check it out at https://youtu.be/lxcnnyBDCYA.

To pay the bills, Figment Effects Shop creates fulldome content, provides visual effects for planetariums, domes, feature films, commercials, and special venue projects. Go to http://figmenteffects.com for full details; you can check out the free tutorials at http://figmenteffects.com/fulldome.html.

IPS “ambassador” to South America still on the job

Bryant González Vásquez, the backpacking astronomer who is visiting planetariums throughout South America, reported recently from Paraguay, where he will visit the only fixed planetarium in the country, located in San Cosme y Damián. “Recently I was in a school promoting the visit to planetariums and using information given by you and the IPS organization, talking about the history of planetariums and different planetariums around the world. I am now in Coronel Oviedo, university students have a planetarium construction project. Our visit was really productive for them.”

Bryant is traveling with Pablo Urrea, another traveler, photographer, and designer.

They recently visited Huaráz, a small city in Peru “but with very big attractions, many foreigners and nationals visit this place to go to its mountains and lagoons, valleys and stone forests that surround it. It is a destination for all backpackers and travelers, but also for any amateur astronomer and astrophotographer because the conditions of their skies away from the big cities offers an extraordinary quality.”

You can follow the trip at mochilersastronom.wixsite.com/travel and mochilaastronomica.blogspot.com.co.
Dale Etheridge
November 10, 1941-April 19, 2019

Dr. Dale Etheridge, 78, retired director of the College of Southern Nevada Planetarium, died April 19, 2019. A founding member of the Pacific Planetarium Society and one of its original directors, Dale helped set up the Western Alliance Conference and was a fellow of the International Planetarium Society.

Born November 10, 1941, in Long Beach California, he was raised in San Pedro, California, and graduated from Millikan High School in 1960. He earned a bachelor’s degree in astronomy from the University of Southern California in 1964.

During college, Dale’s interest in science became focused on astronomy, and he also discovered that his greatest satisfaction came from sharing his knowledge of the universe with others in a way they could understand. His greatest joy was in seeing people’s eyes light up when they understood how complex things really worked. In college he also began working at Griffith Observatory and eventually served as curator of exhibits from 1971-72. There he found his real professional home in the planetarium. Dale earned his master’s in science education from California State University-Los Angeles in 1966 and his doctorate in science education from UCLA in 1976.

After graduation he briefly worked as director and astronomy professor at Mount San Antonio Community College. During that tenure he was recruited by what was then Clark County Community College in Las Vegas to build their planetarium.

Dale served as planetarium director and professor of astronomy at what is now the College of Southern Nevada from 1976 until he retired in 2014. During those years his focus in the planetarium was on public understanding of science. He was active in both regional and international astronomical societies, where he served as an officer and board member many times.

At CSN he received a number of outstanding faculty and service awards. In 2011 he had the distinction of receiving the Regents’ Outstanding Teaching Faculty Award for the entire University and Community College System of Nevada. He also was instrumental in introducing the use of computer technology into the classroom as a teaching tool. He built the first online astronomy classes at CSN almost 20 years ago and even after retiring he continued to teach online as an emeritus faculty member right up through Fall 2018, when he was very ill.

He is survived by his wife, the former Carolyn Collins; a daughter, Cheryl and step-daughter Vicki, and two grandchildren.

Dale Etheridge liked to embrace the latest technology while respecting historical convention. To Dale, the planetarium was not just where he worked but a tool for showing the universe to everyone.

In science we sometimes pay so much attention to the numbers and results, we miss why it matters. Dale brought the beauty of science and astronomy to thousands of students and CSN Planetarium visitors. I have seen Dale spend hours explaining to a student/future astronomer the scientific method or the difference between demonstrations and experiments. My friend and boss of over 30 years is a true example of what it means to be an educator and planetarian.

—Robert Pippin

Frances Decibus
April 21, 2019

Frances Decibus, retired planetarium director for the Old Bridge, New Jersey schools, passed away April 21, 2018 at home. Born in 1930, she resided in Perth Amboy, New Jersey, before moving to Metuchen more than 30 years ago. She was a teacher and planetarium director for the Old Bridge Board of Education for 43 years, retiring in 1999.

She is survived by nieces and nephews. Visitation was held at the Gosselin Funeral Home in Edison, New Jersey.

Peter Runge
May 30, 1950-January 22, 2019

Peter Runge, presenter at Menke Planetarium in Glücksburg, Fördestraße 37, died on January 22, 2019.

His passing was shared by Evans & Sutherland, who noted that he designed the logo for the Digistar Users Group and was a brilliant presenter.

Menke Planetarium, once privately owned by the Menke family, became part of the University of Flensburg in 1995.

“Not just beautiful, though--the stars are like the trees in the forest, alive and breathing. And they’re watching me.”
— Haruki Murakami
Kafka on the Shore
Planetarians’ Calendar of Events

2019 - International Year of the Periodic Table

3-5 June. Japan Planetarium Association (JPA), Annual Conference, Fukuoka City Science Museum, Japan. Contact: Sumito Hirota, hirota@e23.jp; general@planetarium.jp; https://planetarium.jp (Japanese only. Other languages are not available.)

4-8 June. Conference of Southeastern Planetarium Association (SEPA) and Middle Atlantic Planetarium Society (MAPS), Blue Cross Blue Shield Planetarium, South Carolina State Museum, Columbia, South Carolina, USA. www.sepadomes.org

5-7 June. IPS Fulldome Festival Brno, Brno Observatory and Planetarium, Kravi hora 2, Brno, Czech Republic. The festival is supported by the International Planetarium Society. Contact: Jiri Dusek, director@hvezdarna.cz; www.fulldomefestivalbrno.com

6-8 June. European Network Science Centres & Museums (ECSITE), 2019 Annual Conference, 30th edition, Experimentarium, Copenhagen, Denmark. www.ecsite.eu


http://www.21.planetariums.ru/_en/index.html. Contact Andrey Lobanov and Ekaterina Tikhomirova: lobanov@planetariums.ru; en_tihomirova@mail.ru

22-23 June. International Planetarium Society Council Meeting, Perlan Planetarium, Reykjavík, Iceland. www.perlan.is


20 July. 50th anniversary of the Apollo 11 landing on the moon.

23 July- 1 August. Spitz Summer Institute. Spitz, Inc. Chadds Ford, Pennsylvania, USA. Dome-based education using the SciDome planetarium; courses cover astronomy and earth science presentation, curriculum, program creation. Contact jtowne@spitzinc.com or see www.spitzinc.com/Institute

31 July - 3 August. Western Alliance Conference meets at the University of Nebraska-Omaha Mallory Kountze Planetarium in Omaha, Nebraska. The conference website is now live and accepting reservations as well as papers at https://www.rollingbluffsplanetarium.com/western-alliance-conference-2019. For additional information visit https://www.facebook.com/events/1956848214363185/

31 July. Deadline for the applicants of “A Week in Italy for an American Planetarium Operator” in collaboration with IPS Portable Planetarium Committee. www.ips-planetarium.org/page/italy

14-16 August. 2019 Live Interactive Planetarium Symposium, Cradle of Aviation in Garden City, New York, USA. Contact Karrie Berglund <karrie@digitaliseducation.com> or see www.lipsymposium.com


6-8 September. NPA meeting, Nordic and Baltic Planetarium Association, Vitenfabrikkene, Sandnes, Norway. Conference language is English. Contact: Sven Gundersen, Sven.Gundersen@jaermuseet.no; NPA president Aase Roland Jacobsen, aase.jacobsen@slau.dk. www.jaermuseet.no/vitenfabrikkene/en www.facebook.com/

Compiled by Loris Ramponi - osservatorio@serafinozani.it

2020 - International Year of Plant Health

8 March. International Day of Planetariums, public initiatives between 7 and 8 March. https://www.ips-planetarium.org/page/IDP

26 March. Deadline of PlanIt Prize for an original video production, organized each year by Italian Association of Planetaria (PlanIt), Italy. The prize is open to everyone. First prize 500 euro. www.ips-planetarium.org/?page=WeekinUS

31 December. Deadline for the contest “A week in United States.” For information and application requirements go to: www.ips-planetarium.org/?page=WeekinUS

For corrections and new information for the Calendar of Events, please send a message to Loris Ramponi at osservatorio@serafinozani.it. More details about several of these upcoming events is included in the International News column in this issue. The most up-to-date information also is available online in the IPS Calendar of Events at www.ips-planetarium.org
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.

Last Light

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Some odds and ends (heavy on the odds)

During a discussion about adding color to the Middle Atlantic Planetarium Society’s logo, Talia Sepersky mentioned that television went with color, what? Fifty years ago?

President Kevin Williams replied, “So this color thing might be catching on?”

To which Talia answered, “I’m just saying—which part of The Wizard of Oz did you like better?”

Kyle Doane (educational specialist with Digitalis Education Solutions) offers a definition: Planetarian: An astrophysicist with early elementary teaching experience who minored in theater, computer programming, film making, and public relations.

Dave Hostetter (planetarium curator at the Lafayette Science Museum) shared some observations from his planetarium programs:

February was an interesting month for kids in the planetarium. Early on, a boy came to the console after a program to ask some questions and see our meteorites. He looked really familiar but I couldn’t place him.

Then I realized that he looked like Alfred E. Neuman2.

Last weekend another kid came to the console tightly gripping his plastic stegosaurus fossil, and he was the spitting image of Young Sheldon3.

In the very next program, before the lights even came down a 4-year-old girl pointed to my name tag and asked, “What’s that?”

“My name tag.”

“Why do you wear it?”

“So people know I work at the museum.”

“Do you have to wear it?”

“Yes.”

“Who makes you wear it?”

“The Boss.”

And then, squinting fiercely and voice dropping a notch, “What’s his name?”

I warned the director the next day that he might get a call from an outraged 4-year-old Libertarian-in-training.

And today, in a 5th grade school program about the planets, there was a girl who was absolutely enchanted, amazed, and joyous about everything she saw, with many oohs and aahs, all enhanced by the fact that she was Cyndi Lauper’s’ mini-me. Girls just wanna have science.

And Georgia goes to the nationals!

One of the best parts about teaching in the planetarium, I think, are the opportunities to work with incredible young people. A mentor for a group of middle school students contacted Fernbank Science Center last October to ask about a LEGO Robotics “In Orbit” program. One of the requirements for the team was to meet with an astronomer and ask about orbiting space stations and habitats on Mars.

Half a dozen young women brought their space station model and we talked about life support systems, their design for the layout of their station, travel time to Mars, and human requirements for the journey to Mars.

A few months later, an e-mail message from their mentor said that of the hundreds of teams competing in Georgia, theirs was one of nine chosen to go to the national competition, and could they use Fernbank’s logo on their competition banner. The answer, of course, was Yes!

Even better, another message in late April announced, “I am pleased to inform you that the TechnoWizards won an award at the First World Championship for ‘outstanding project research.’ Much gratitude to you!”

What a privilege to work with such great young people. We are blessed.

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1 The classic 1939 American movie begins in black and white and switches to color after Dorothy’s house lands in Oz.
2 en.wikipedia.org/wiki/Alfred_E._Neuman
3 www.cbs.com/shows/young-sheldon/
4 cyndilauper.com/
Meet the New Star Projector of the Digital Age
Simple, Compact, Powerful

MEGASTAR-Neo

- Requires minimum space, best for integration with digital planetariums.
- One million stars, 16 individual bright stars, over 170 deep space objects.
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- Lightweight, can be carried by one person.

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